

(12) 특허협력조약에 의하여 공개된 국제출원

(19) 세계지식재산권기구
국제사무국

(43) 국제공개일

2023년 12월 14일 (14.12.2023)



WIPO | PCT



(10) 국제공개번호

WO 2023/239189 A1

(51) 국제특허분류:

C07D 413/14 (2006.01)

H10K 50/11 (2023.01)

H10K 85/60 (2023.01)

NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(21) 국제출원번호:

PCT/KR2023/007897

(22) 국제출원일:

2023년 6월 9일 (09.06.2023)

(25) 출원언어:

한국어

(26) 공개언어:

한국어

(30) 우선권정보:

10-2022-0070344 2022년 6월 9일 (09.06.2022) KR

10-2023-0073696 2023년 6월 8일 (08.06.2023) KR

(71) 출원인: 주식회사 엘지화학 (LG CHEM, LTD.) [KR/KR]; 07336 서울특별시 영등포구 여의대로 128, Seoul (KR).

(84) 지정국 (별도의 표시가 없는 한, 가능한 모든 종류의

역내 권리의 보호를 위하여): ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, SD, SL, ST, SZ, TZ, UG, ZM, ZW), 유라시아 (AM, AZ, BY, KG, KZ, RU, TJ, TM), 유럽 (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

공개:

— 국제조사보고서와 함께 (조약 제21조(3))

(72) 발명자: 이정하 (LEE, Jung-ha); 34122 대전광역시 유성구 문지로 188 LG화학 기술연구원, Daejeon (KR). 이동훈 (LEE, Dong Hoon); 34122 대전광역시 유성구 문지로 188 LG화학 기술연구원, Daejeon (KR). 서상덕 (SUH, Sang Duk); 34122 대전광역시 유성구 문지로 188 LG화학 기술연구원, Daejeon (KR). 김영석 (KIM, Young Seok); 34122 대전광역시 유성구 문지로 188 LG화학 기술연구원, Daejeon (KR). 김동희 (KIM, Donghee); 34122 대전광역시 유성구 문지로 188 LG화학 기술연구원, Daejeon (KR). 오중석 (OH, Joongsuk); 34122 대전광역시 유성구 문지로 188 LG화학 기술연구원, Daejeon (KR). 오민택 (OH, Mintack); 34122 대전광역시 유성구 문지로 188 LG화학 기술연구원, Daejeon (KR).

(74) 대리인: 유미특허법인 (YOU ME PATENT AND LAW FIRM); 06134 서울특별시 강남구 테헤란로 115, Seoul (KR).

(81) 지정국 (별도의 표시가 없는 한, 가능한 모든 종류의 국내 권리의 보호를 위하여): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MU, MW, MX, MY, MZ, NA, NG, NI, NO,

(54) Title: NOVEL COMPOUND AND ORGANIC LIGHT EMITTING DEVICE USING SAME

(54) 발명의 명칭: 신규한 화합물 및 이를 이용한 유기 발광 소자

4
3
2
1

(57) Abstract: The present invention provides a novel compound and an organic light emitting device using same.

(57) 요약서: 본 발명은 신규한 화합물 및 이를 이용한 유기발광 소자를 제공한다.



WO 2023/239189 A1

명세서

발명의 명칭: 신규한 화합물 및 이를 이용한 유기 발광 소자 기술분야

[1] 관련 출원(들)과의 상호 인용

[2] 본 출원은 2022년 6월 9일자 한국 특허 출원 제10-2022-0070344호 및 2023년 6월 8일자 한국 특허 출원 제10-2023-0073696호에 기초한 우선권의 이익을 주장하며, 해당 한국 특허 출원들의 문헌에 개시된 모든 내용은 본 명세서의 일부로서 포함된다.

[3]

[4] 본 발명은 신규한 화합물 및 이를 포함하는 유기 발광 소자에 관한 것이다.

[5]

배경기술

[6] 일반적으로 유기 발광 현상이란 유기 물질을 이용하여 전기에너지를 빛에너지로 전환시켜주는 현상을 말한다. 유기 발광 현상을 이용하는 유기 발광 소자는 넓은 시야각, 우수한 콘트라스트, 빠른 응답 시간을 가지며, 휘도, 구동 전압 및 응답 속도 특성이 우수하여 많은 연구가 진행되고 있다.

[7]

[8] 유기 발광 소자는 일반적으로 양극과 음극 및 상기 양극과 음극 사이에 유기물층을 포함하는 구조를 가진다. 상기 유기물층은 유기 발광 소자의 효율과 안정성을 높이기 위하여 각기 다른 물질로 구성된 다층의 구조로 이루어진 경우가 많으며, 예컨대 정공주입층, 정공수송층, 발광층, 전자수송층, 전자주입층 등으로 이루어질 수 있다. 이러한 유기 발광 소자의 구조에서 두 전극 사이에 전압을 걸어주게 되면 양극에서는 정공이, 음극에서는 전자가 유기물층에 주입되게 되고, 주입된 정공과 전자가 만났을 때 엑시톤(exciton)이 형성되며, 이 엑시톤이 다시 바닥상태로 떨어질 때 빛이 나게 된다.

[9]

[10] 상기와 같은 유기 발광 소자에 사용되는 유기물에 대하여 새로운 재료의 개발이 지속적으로 요구되고 있다.

[11]

[12] [선행기술문헌]

[13] [특허문헌]

[14] (특허문헌 0001) 한국특허 공개번호 제10-2000-0051826호

[15]

발명의 상세한 설명

기술적 과제

[16] 본 발명은 신규한 화합물 및 이를 포함하는 유기 발광 소자에 관한 것이다.

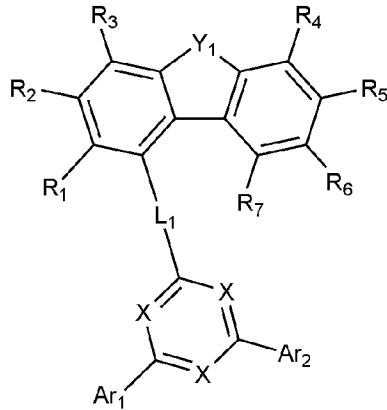
[17]

과제 해결 수단

[18] 본 발명은 하기 화학식 1로 표시되는 화합물을 제공한다:

[19] [화학식 1]

[20]



[21] 상기 화학식 1에서,

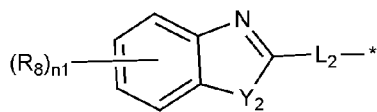
[22] Y_1 은 O 또는 S이고,[23] R_1 내지 R_7 은 서로 동일하거나 상이하고, 각각 독립적으로 수소, 중수소, 또는 치환 또는 비치환된 C_{6-60} 아릴이고,[24] L_1 은 단일 결합이거나, 또는 중수소로 치환 또는 비치환된 페닐렌 또는 나프틸렌이고,

[25] X는 각각 독립적으로 N, CH, 또는 CD이되, X 중 둘 이상은 N이고,

[26] Ar_1 및 Ar_2 중 하나는 하기 화학식 2 또는 화학식 3으로 표시되는 치환기이고, Ar_1 및 Ar_2 중 나머지는 중수소로 치환 또는 비치환된 페닐 또는 나프틸이고,

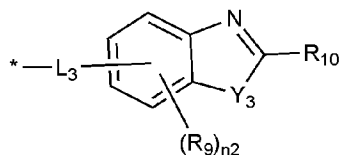
[27] [화학식 2]

[28]



[29] [화학식 3]

[30]



[31] 상기 화학식 2 및 화학식 3에서,

[32] Y_2 및 Y_3 은 각각 독립적으로 O 또는 S이고,[33] L_2 및 L_3 은 각각 독립적으로 단일 결합이거나, 또는 중수소로 치환 또는 비치환된 페닐렌 또는 나프틸렌이고,[34] R_8 , R_9 , 및 R_{10} 은 각각 독립적으로 수소, 중수소, 또는 중수소로 치환 또는 비치환된 페닐 또는 나프틸이고,[35] $n1$ 은 1 내지 4의 정수이고,

- [36] n_2 는 1 내지 3의 정수이고,
 [37] 단, R_1 내지 R_{10} , L_1 내지 L_3 , 및 Ar_1 내지 Ar_2 중 적어도 하나 이상은 중수소이거나 중수소로 치환된 것이다.

[38]

- [39] 또한, 본 발명은 제1 전극; 상기 제1 전극과 대향하여 구비된 제2 전극; 및 상기 제1 전극과 상기 제2 전극 사이에 구비된 1층 이상의 유기물층을 포함하는 유기 발광 소자로서, 상기 유기물층 중 1층 이상은 상기 화학식 1로 표시되는 화합물을 포함하는 것인, 유기 발광 소자를 제공한다.

[40]

발명의 효과

- [41] 상술한 화학식 1로 표시되는 화합물은 유기 발광 소자의 유기물 층의 재료로서 사용될 수 있으며, 유기 발광 소자에서 효율의 향상, 낮은 구동전압 및/또는 수명 특성을 향상시킬 수 있다. 특히, 상술한 화학식 1로 표시되는 화합물은 정공주입, 정공수송, 정공주입 및 수송, 발광, 전자수송, 또는 전자주입 재료로 사용될 수 있다.

[42]

도면의 간단한 설명

- [43] 도 1은 기판(1), 양극(2), 발광층(3), 음극(4)으로 이루어진 유기 발광 소자의 예를 도시한 것이다.

[44]

- [45] 도 2는 기판 (1), 양극(2), 정공주입층(5), 정공수송층(6), 전자저지층(7), 발광층 (3), 정공저지층(8), 전자 주입 및 수송층(9) 및 음극(4)로 이루어진 유기 발광 소자의 예를 도시한 것이다.

[46]

발명의 실시를 위한 형태

- [47] 이하, 본 발명의 이해를 돕기 위하여 보다 상세히 설명한다.

[48]

- [49] 본 명세서에서,  또는 는 다른 치환기에 연결되는 결합을 의미한다.

[50]

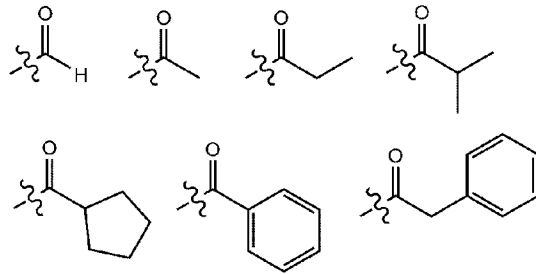
- [51] 본 명세서에서 "치환 또는 비치환된"이라는 용어는 중수소; 할로젠기; 니트릴기; 니트로기; 히드록시기; 카보닐기; 에스테르기; 이미드기; 아미노기; 포스핀옥사이드기; 알콕시기; 아릴옥시기; 알킬티옥시기; 아릴티옥시기; 알킬술폰시기; 아릴술폰시기; 실릴기; 붕소기; 알킬기; 사이클로알킬기; 알케닐기; 아릴기; 아르알킬기; 아르알케닐기; 알킬아릴기; 알킬아민기; 아랄킬아민기; 헤테로아릴아민기; 아릴아민기; 아릴포스핀기; 또는 N, O 및 S 원자 중 1개 이상을 포함하는 헤테로고리기로 이루어진 군에서 선택된 1개 이상의 치환기로 치환 또는 비치환된

거나, 상기 예시된 치환기 중 2 이상의 치환기가 연결된 치환 또는 비치환된 것을 의미한다. 예컨대, "2 이상의 치환기가 연결된 치환기"는 비페닐기일 수 있다. 즉, 비페닐기는 아릴기일 수도 있고, 2개의 페닐기가 연결된 치환기로 해석될 수 있다.

[52]

[53] 본 명세서에서 카보닐기의 탄소수는 특별히 한정되지 않으나, 탄소수 1 내지 40인 것이 바람직하다. 구체적으로 하기와 같은 구조의 화합물이 될 수 있으나, 이에 한정되는 것은 아니다.

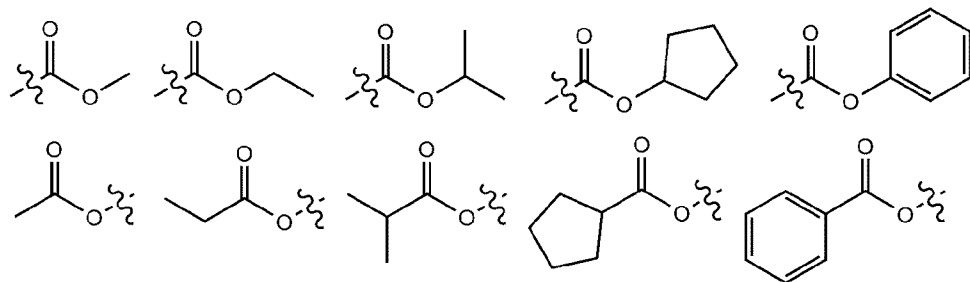
[54]



[55]

[56] 본 명세서에 있어서, 에스테르기는 에스테르기의 산소가 탄소수 1 내지 25의 직쇄, 분지쇄 또는 고리쇄 알킬기 또는 탄소수 6 내지 25의 아릴기로 치환될 수 있다. 구체적으로, 하기 구조식의 화합물이 될 수 있으나, 이에 한정되는 것은 아니다.

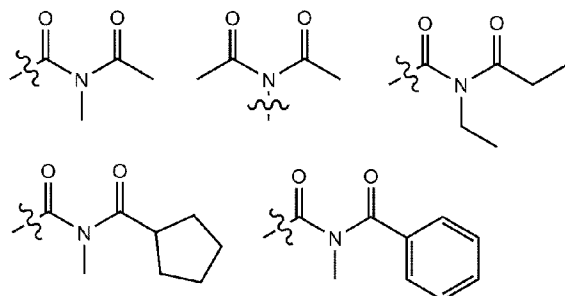
[57]



[58]

[59] 본 명세서에 있어서, 이미드기의 탄소수는 특별히 한정되지 않으나, 탄소수 1 내지 25인 것이 바람직하다. 구체적으로 하기와 같은 구조의 화합물이 될 수 있으나, 이에 한정되는 것은 아니다.

[60]



[61]

- [62] 본 명세서에 있어서, 실릴기는 구체적으로 트리메틸실릴기, 트리에틸실릴기, t-부틸디메틸실릴기, 비닐디메틸실릴기, 프로필디메틸실릴기, 트리페닐실릴기, 디페닐실릴기, 페닐실릴기 등이 있으나 이에 한정되지 않는다.
- [63]
- [64] 본 명세서에 있어서, 붕소기는 구체적으로 트리메틸붕소기, 트리에틸붕소기, t-부틸디메틸붕소기, 트리페닐붕소기, 페닐붕소기 등이 있으나 이에 한정되지 않는다.
- [65]
- [66] 본 명세서에 있어서, 할로젠기의 예로는 불소, 염소, 브롬 또는 요오드가 있다.
- [67]
- [68] 본 명세서에 있어서, 상기 알킬기는 직쇄 또는 분지쇄일 수 있고, 탄소수는 특별히 한정되지 않으나 1 내지 40인 것이 바람직하다. 일 실시상태에 따르면, 상기 알킬기의 탄소수는 1 내지 20이다. 또 하나의 실시상태에 따르면, 상기 알킬기의 탄소수는 1 내지 10이다. 또 하나의 실시상태에 따르면, 상기 알킬기의 탄소수는 1 내지 6이다. 알킬기의 구체적인 예로는 메틸, 에틸, 프로필, n-프로필, 이소프로필, 부틸, n-부틸, 이소부틸, tert-부틸, sec-부틸, 1-메틸-부틸, 1-에틸-부틸, 펜틸, n-펜틸, 이소펜틸, 네오펜틸, tert-펜틸, 헥실, n-헥실, 1-메틸펜틸, 2-메틸펜틸, 4-메틸-2-펜틸, 3,3-디메틸부틸, 2-에틸부틸, 헵틸, n-헵틸, 1-메틸헵틸, 사이클로헵틸 메틸, 사이클로헵틸메틸, 옥틸, n-옥틸, tert-옥틸, 1-메틸헵틸, 2-에틸헵틸, 2-프로필헵틸, n-노닐, 2,2-디메틸헵틸, 1-에틸-프로필, 1,1-디메틸-프로필, 이소헵틸, 2-메틸헵틸, 4-메틸헵틸, 5-메틸헵틸 등이 있으나, 이들에 한정되지 않는다.
- [69]
- [70] 본 명세서에 있어서, 상기 알케닐기는 직쇄 또는 분지쇄일 수 있고, 탄소수는 특별히 한정되지 않으나, 2 내지 40인 것이 바람직하다. 일 실시상태에 따르면, 상기 알케닐기의 탄소수는 2 내지 20이다. 또 하나의 실시상태에 따르면, 상기 알케닐기의 탄소수는 2 내지 10이다. 또 하나의 실시상태에 따르면, 상기 알케닐기의 탄소수는 2 내지 6이다. 구체적인 예로는 비닐, 1-프로페닐, 이소프로페닐, 1-부테닐, 2-부테닐, 3-부테닐, 1-펜테닐, 2-펜테닐, 3-펜테닐, 3-메틸-1-부테닐, 1,3-부타디에닐, 알릴, 1-페닐비닐-1-일, 2-페닐비닐-1-일, 2,2-디페닐비닐-1-일, 2-페닐-2-(나프틸-1-일)비닐-1-일, 2,2-비스(디페닐-1-일)비닐-1-일, 스틸베닐기, 스티레닐기 등이 있으나 이들에 한정되지 않는다.
- [71]
- [72] 본 명세서에 있어서, 사이클로알킬기는 특별히 한정되지 않으나, 탄소수 3 내지 60인 것이 바람직하며, 일 실시상태에 따르면, 상기 사이클로알킬기의 탄소수는 3 내지 30이다. 또 하나의 실시상태에 따르면, 상기 사이클로알킬기의 탄소수는 3 내지 20이다. 또 하나의 실시상태에 따르면, 상기 사이클로알킬기의 탄소수는 3 내지 6이다. 구체적으로 사이클로프로필, 사이클로부틸, 사이클로펜틸, 3-메틸사이클로펜틸, 2,3-디메틸사이클로펜틸, 사이클로헥실, 3-메틸사이클로헥실, 4-

메틸사이클로헥실, 2,3-디메틸사이클로헥실, 3,4,5-트리메틸사이클로헥실, 4-tert-부틸사이클로헥실, 사이클로헥틸, 사이클로옥틸 등이 있으나, 이에 한정되지 않는다.

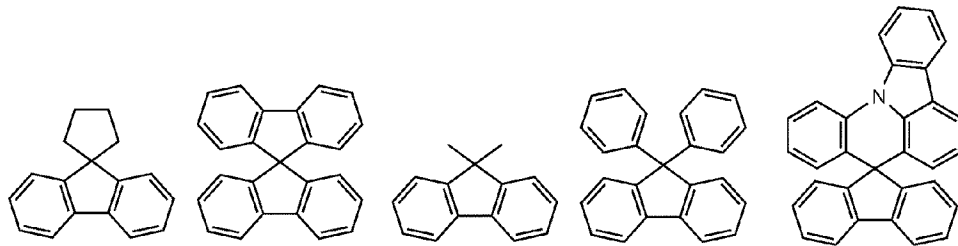
[73]

[74] 본 명세서에 있어서, 아릴기는 특별히 한정되지 않으나 탄소수 6 내지 60인 것이 바람직하며, 단환식 아릴기 또는 다환식 아릴기일 수 있다. 일 실시상태에 따르면, 상기 아릴기의 탄소수는 6 내지 30이다. 일 실시상태에 따르면, 상기 아릴기의 탄소수는 6 내지 20이다. 상기 아릴기가 단환식 아릴기로는 페닐기, 바이페닐기, 터페닐기 등이 될 수 있으나, 이에 한정되는 것은 아니다. 상기 다환식 아릴기로는 나프틸기, 안트라세닐기, 페난트릴기, 파이레닐기, 페릴레닐기, 크라이세닐기, 플루오레닐기 등이 될 수 있으나, 이에 한정되는 것은 아니다.

[75]

[76] 본 명세서에 있어서, 플루오레닐기는 치환될 수 있고, 치환기 2개가 서로 결합하여 스피로 구조를 형성할 수 있다. 상기 플루오레닐기가 치환되는 경우,

등이 될 수



있다. 다만, 이에 한정되는 것은 아니다.

[77]

[78] 본 명세서에 있어서, 헤테로고리기는 이종 원소로 O, N, Si 및 S 중 1개 이상을 포함하는 헤테로고리기로, 탄소수는 특별히 한정되지 않으나, 탄소수 2 내지 60인 것이 바람직하다. 헤테로고리기의 예로는 티오펜기, 퓨란기, 피롤기, 이미다졸기, 티아졸기, 옥사졸기, 옥사디아졸기, 트리아졸기, 피리딘기, 비피리딘기, 피리미딘기, 트리아진기, 아크리딘기, 피리다진기, 피라지닐기, 퀴놀리닐기, 퀴나졸린기, 퀴녹살리닐기, 프탈라지닐기, 피리도 피리미디닐기, 피리도 피라지닐기, 피라지노 피라지닐기, 이소퀴놀린기, 인돌기, 카바졸기, 벤조옥사졸기, 벤조이미다졸기, 벤조티아졸기, 벤조카바졸기, 벤조티오펜기, 디벤조티오펜기, 벤조퓨라닐기, 페난트롤린기(phenanthroline), 이소옥사졸릴기, 티아디아졸릴기, 페노티아지닐기 및 디벤조퓨라닐기 등이 있으나, 이들에만 한정되는 것은 아니다.

[79]

[80] 본 명세서에 있어서, 아르알킬기, 아르알케닐기, 알킬아릴기, 아릴아민기 중의 아릴기는 전술한 아릴기의 예시와 같다. 본 명세서에 있어서, 아르알킬기, 알킬아릴기, 알킬아민기 중 알킬기는 전술한 알킬기의 예시와 같다. 본 명세서에 있어서, 헤테로아릴아민 중 헤테로아릴은 전술한 헤테로고리기에 관한 설명이 적용될 수 있다. 본 명세서에 있어서, 아르알케닐기 중 알케닐기는 전술한 알케닐

기의 예시와 같다. 본 명세서에 있어서, 아릴렌은 2가기인 것을 제외하고는 전술한 아릴기에 관한 설명이 적용될 수 있다. 본 명세서에 있어서, 헤테로아릴렌은 2가기인 것을 제외하고는 전술한 헤테로고리기에 관한 설명이 적용될 수 있다. 본 명세서에 있어서, 탄화수소 고리는 1가기가 아니고, 2개의 치환기가 결합하여 형성한 것을 제외하고는 전술한 아릴기 또는 사이클로알킬기에 관한 설명이 적용될 수 있다. 본 명세서에 있어서, 헤테로고리는 1가기가 아니고, 2개의 치환기가 결합하여 형성한 것을 제외하고는 전술한 헤테로고리기에 관한 설명이 적용될 수 있다.

[81]

[82] 본 명세서에 있어서, "중수소화된 또는 중수소로 치환된"이라는 의미는 화합물, 2가의 연결기 또는 1가의 치환기 내 치환 가능한 수소 중 적어도 하나가 중수소로 치환됨을 의미한다.

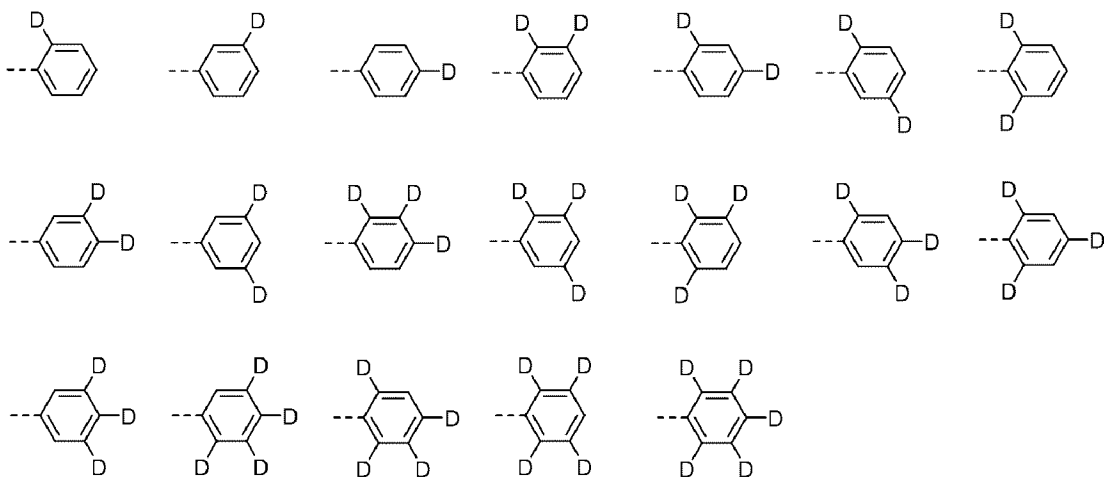
[83]

[84] 또한, "비치환되거나 또는 중수소로 치환된" 또는 "중수소로 치환 또는 비치환된"이라는 의미는 "비치환되거나 또는 치환 가능한 수소 중 1개 내지 최대 개수가 중수소로 치환된"을 의미한다. 일례로, "비치환되거나 또는 중수소로 치환된 페난트릴"이라는 용어는 페난트릴 구조 내 중수소로 치환 가능한 수소의 최대 개수가 9개라는 점 고려할 때, "비치환되거나 또는 1개 내지 9개의 중수소로 치환된 페난트릴"이라는 의미로 이해될 수 있다.

[85]

[86] 또한, "중수소화된 구조"라는 의미는 적어도 하나의 수소가 중수소로 치환된 모든 구조의 화합물, 2가의 연결기 또는 1가의 치환기를 포괄하는 것을 의미한다. 일례로, 페닐의 중수소화된 구조는 하기와 같이 페닐기 내 치환가능한 적어도 하나의 수소가 중수소로 치환된 모든 구조의 1가의 치환기들을 일컫는 것으로 이해될 수 있다.

[87]



[88]

[89] 또한, 화합물의 "중수소 치환율" 또는 "중수소화도"는 화합물 내 존재할 수 있는 수소의 총 개수(화합물 내 중수소로 치환 가능한 수소의 개수 및 치환된 중수소의 개수의 총 합)에 대한 치환된 중수소의 개수의 비율을 백분율로 계산한 것을 의미한다. 따라서 화합물의 "중수소 치환율" 또는 "중수소화도"가 "K%"라고 함은, 화합물 내 중수소로 치환 가능한 수소 중 K%가 중수소로 치환된 것을 의미한다.

[90]

[91] 이 때, 상기 "중수소 치환율" 또는 "중수소화도"는 MALDI-TOF MS(Matrix-Assisted Laser Desorption/Ionization Time-of-Flight Mass Spectrometer), 핵자기 공명 분광법(^1H NMR), TLC/MS(Thin-Layer Chromatography/Mass Spectrometry), 또는 GC/MS(Gas Chromatography/Mass Spectrometry) 등을 이용하여 통상적으로 알려진 방법에 따라 측정할 수 있다. 보다 구체적으로, MALDI-TOF MS를 이용하는 경우 상기 "중수소 치환율" 또는 "중수소화도"는 MALDI-TOF MS 분석을 통해 화합물 내에 치환된 중수소 개수를 구한 다음, 화합물 내 존재할 수 있는 수소의 총 개수 대비 치환된 중수소의 개수의 비율을 백분율로 계산하여 구할 수 있다.

[92]

[93] 본 발명은 상기 화학식 1로 표시되는 화합물을 제공한다.

[94]

[95] 구체적으로, 상기 화학식 1로 표시되는 화합물은 디벤조퓨란 또는 디벤조티오펜의 모핵 구조 중 특정 위치에, 특정 구조의 N 함유 헤테로 고리가 치환된 둘 이상의 N을 포함하는 벤젠 고리가 결합된 화합물로, 상기 화합물의 치환기 중 적어도 하나 이상이 중수소이거나, 혹은 중수소로 치환된 것을 특징으로 한다. 특히, 상기 화합물은 치환기가 경수소인 화합물에 비하여, 장수명 특성을 가지고 있으며, 이에 따라 유기 발광 소자의 발광층에 효과적으로 적용할 수 있다.

[96]

[97] 구체적으로, 상기 화학식 1에서,

[98] Y_1 은 O 또는 S이고,

[99] R_1 내지 R_7 은 서로 동일하거나 상이하고, 각각 독립적으로 수소, 중수소, 또는 치환 또는 비치환된 C_{6-60} 아릴이고,

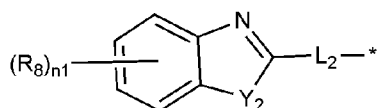
[100] L_1 은 단일 결합이거나, 또는 중수소로 치환 또는 비치환된 페닐렌 또는 나프틸렌이고,

[101] X는 각각 독립적으로 N, CH, 또는 CD이되, X 중 둘 이상은 N이고,

[102] Ar_1 및 Ar_2 중 하나는 하기 화학식 2 또는 화학식 3으로 표시되는 치환기이고, Ar_1 및 Ar_2 중 나머지는 중수소로 치환 또는 비치환된 페닐 또는 나프틸이고,

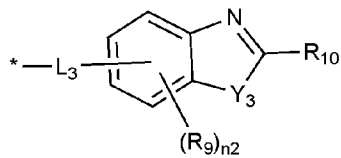
[103] [화학식 2]

[104]



[105] [화학식 3]

[106]



[107] 상기 화학식 2 및 화학식 3에서,

[108] Y₂ 및 Y₃은 각각 독립적으로 O 또는 S이고,

[109] L₂ 및 L₃은 각각 독립적으로 단일 결합이거나, 또는 중수소로 치환 또는 비치환된 페닐렌 또는 나프틸렌이고,

[110] R₈, R₉, 및 R₁₀은 각각 독립적으로 수소, 중수소, 또는 중수소로 치환 또는 비치환된 페닐 또는 나프틸이고,

[111] n₁은 1 내지 4의 정수이고,

[112] n₂는 1 내지 3의 정수이고,

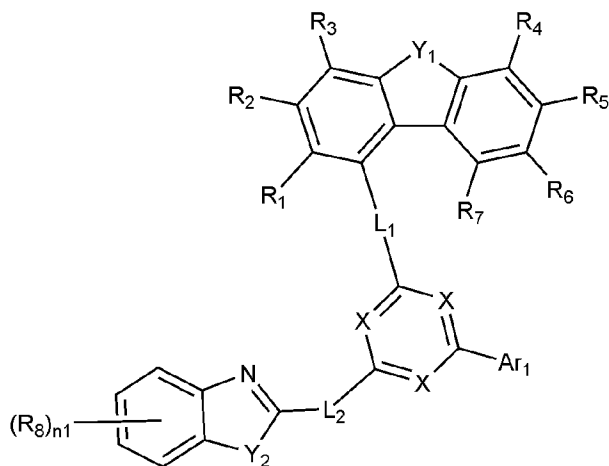
[113] 단, R₁ 내지 R₁₀, L₁ 내지 L₃, 및 Ar₁ 내지 Ar₂ 중 적어도 하나 이상은 중수소이거나 중수소로 치환된 것이다.

[114]

[115] 구체적으로, 상기 화학식 1은, Ar₂가 상기 화학식 2 또는 화학식 3인 바람직한 일례에 따라, 하기 화학식 1-1 또는 화학식 1-2로 표시된다:

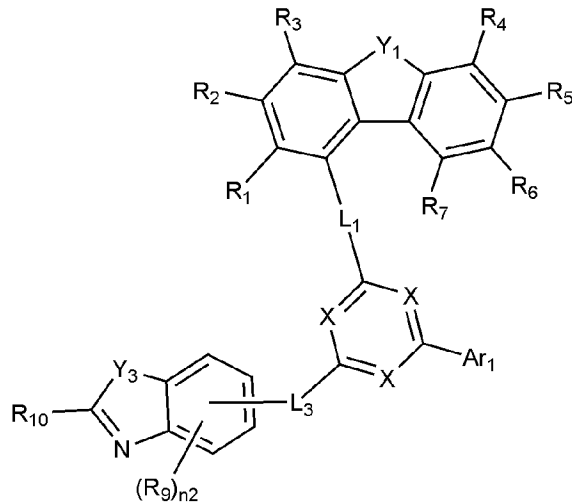
[116] [화학식 1-1]

[117]



[118] [화학식 1-2]

[119]



[120] 상기 화학식 1-1 및 1-2에서, Y_1 , Y_2 , Y_3 , X , Ar_1 , L_1 내지 L_3 , R_1 내지 R_{10} , n_1 , 및 n_2 는 상기 화학식 1에서 정의한 바와 같다.

[121]

[122] 구체적으로, 상기 화학식 1, 및 화학식 1-1 내지 1-2에서, Y_1 내지 Y_3 은 각각 O 또는 S이다.

[123]

[124] 또한, 상기 화학식 1, 및 화학식 1-1 내지 1-2에서, R_1 내지 R_7 은 각각 수소, 또는 중수소이거나, 또는 치환 또는 비치환된 C_{6-30} 아릴, C_{6-24} 아릴, C_{6-18} 아릴, 또는 C_{6-12} 아릴, 또는 C_{6-10} 아릴일 수 있다.

[125]

[126] 바람직하게는, R_1 내지 R_7 은 각각 수소, 중수소, 페닐, 또는 중수소 치환된 페닐일 수 있으며, 좀더 바람직하게는, R_1 내지 R_7 은 각각 수소, 중수소, 또는 페닐일 수 있다.

[127]

[128] 한편, R_1 내지 R_7 중 적어도 하나 이상이 중수소이고, R_1 내지 R_7 중 나머지는 수소일 수 있다. 바람직하게는, R_1 내지 R_7 중 적어도 3개 이상 또는 3개 내지 7개의 중수소이거나 중수소가 치환된 것일 수 있다. 좀더 구체적으로 R_1 내지 R_7 중 적어도 4개 이상 또는 4개 내지 6개의 중수소이거나 중수소가 치환된 것일 수 있다. 이때, R_1 내지 R_7 중 나머지는 수소이거나 중수소가 치환되지 않은 치환기일 수 있다. 또는, R_1 내지 R_7 은 모두가 중수소일 수 있다.

[129]

[130] 일례로, R_1 내지 R_6 중 적어도 하나 이상이 중수소이고, R_1 내지 R_6 중 나머지와 R_7 은 수소일 수 있다. 바람직하게는, R_1 내지 R_6 중 적어도 3개 이상 또는 3개 내지 6개의 중수소이거나 중수소가 치환된 것이고, R_1 내지 R_6 중 나머지와 R_7 은 수소일 수 있다. 좀더 구체적으로 R_1 내지 R_6 중 적어도 4개 이상 또는 4개 내지 6개의

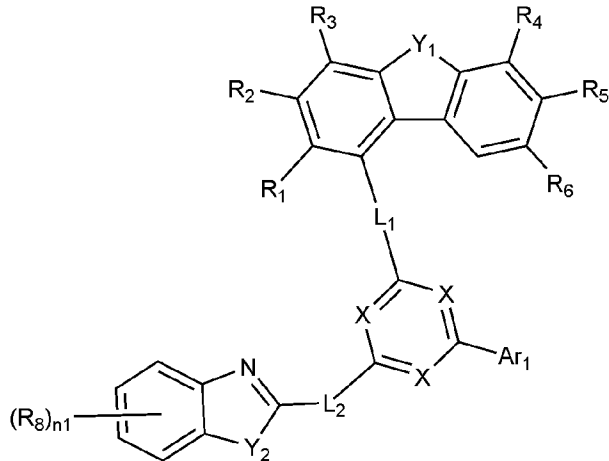
중수소이거나 중수소가 치환된 것이고, R_1 내지 R_6 중 나머지와 R_7 은 수소일 수 있다.

[131]

[132] 예컨대, 상기 화학식 1은, R_1 내지 R_7 의 바람직한 일례에 따라, 하기 화학식 1-3 또는 화학식 1-4로 표시된다:

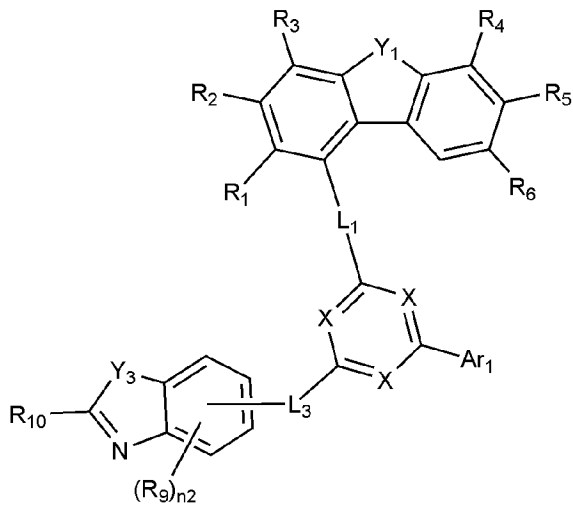
[133] [화학식 1-3]

[134]



[135] [화학식 1-4]

[136]



[137] 상기 화학식 1-3 및 1-4에서, Y_1 , Y_2 , Y_3 , X , Ar_1 , L_1 내지 L_3 , R_1 내지 R_6 , R_8 내지 R_{10} , n_1 , 및 n_2 는 상기 화학식 1에서 정의한 바와 같다.

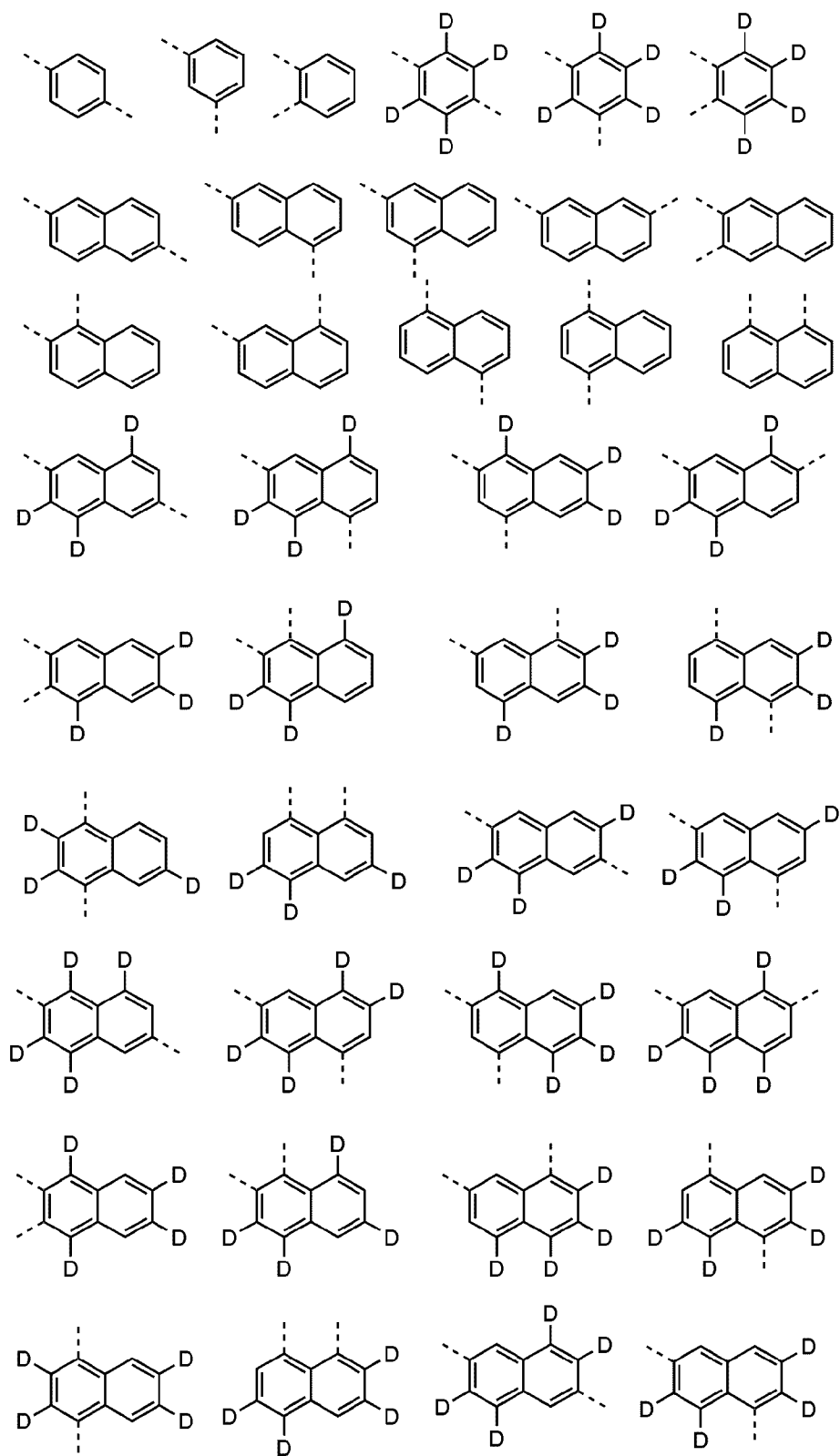
[138]

[139] 한편, 상기 화학식 1 및 화학식 1-1 내지 1-2에서, L_1 , L_2 , 및 L_3 는 각각 단일결합이거나; 또는 페닐렌, 중수소가 치환된 페닐렌, 나프틸렌, 또는 중수소가 치환된 나프틸렌일 수 있다.

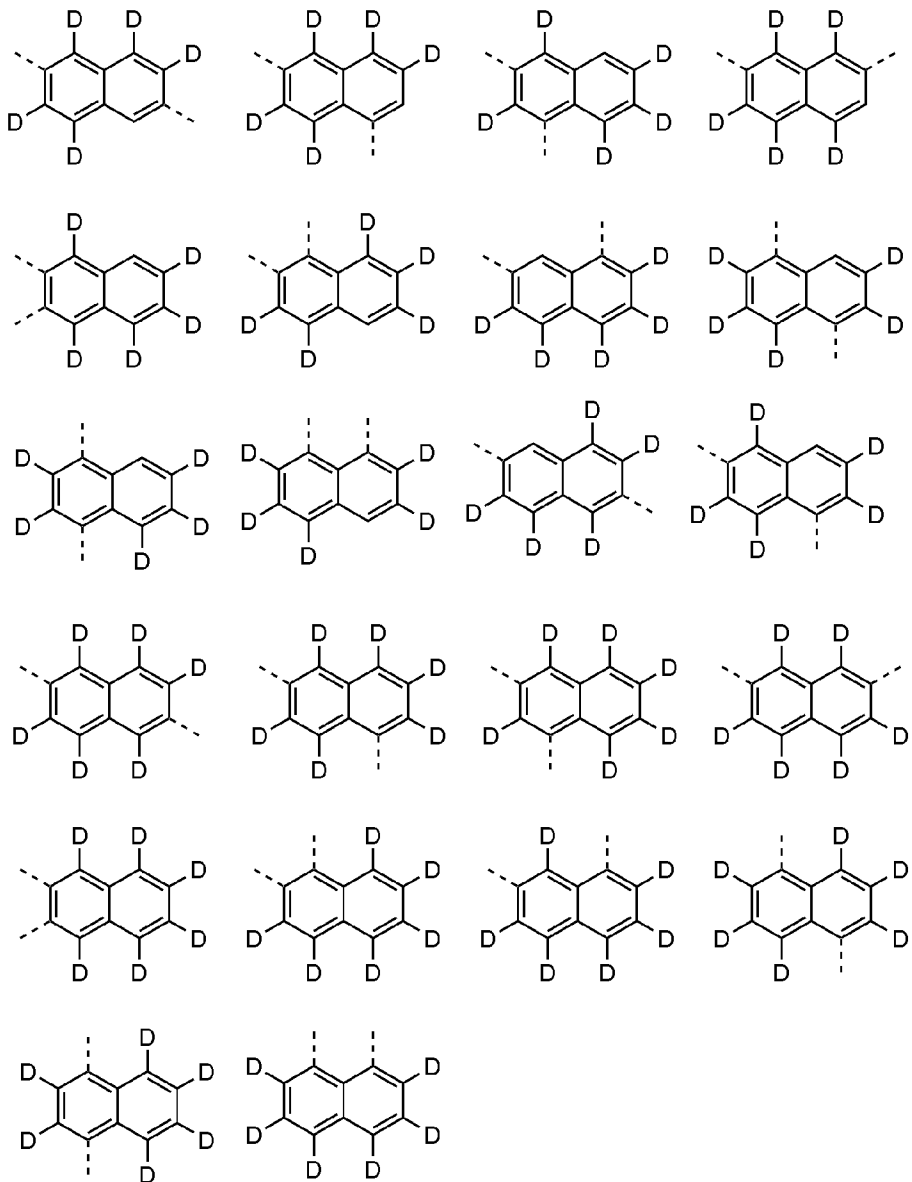
[140]

- [141] 일예로, L_1 , L_2 , 및 L_3 는 각각 단일결합이거나; 또는 페닐렌, 4개의 중수소가 치환된 페닐렌, 나프틸렌, 혹은 3개 이상 또는 3개 내지 6개의 중수소가 치환된 나프틸렌일 수 있다.
- [142]
- [143] 구체적으로, L_1 , L_2 , 및 L_3 는 각각 단일결합이거나, 또는 하기로 구성되는 군으로부터 선택되는 어느 하나일 수 있다.

[144]



[145]



[146]

[147] 바람직하게는, L_1 은 단일결합일 수 있다.

[148]

[149] 바람직하게는, L_2 및 L_3 는 각각 단일결합이거나; 또는 페닐렌, 4개의 중수소가 치환된 페닐렌, 나프틸렌, 혹은 3개 이상 또는 3개 내지 6개의 중수소가 치환된 나프틸렌일 수 있다.

[150]

[151] 그리고, 상기 화학식 1, 및 화학식 1-1 내지 1-2에서, X는 각각 N, CH, 또는 CD이 되, X 중 둘 이상은 N이다. 바람직하게는 X는 모두 N일 수 있다.

[152]

[153] 한편, 상기 화학식 1에서, Ar_1 및 Ar_2 중 하나는 상기 화학식 2 또는 화학식 3으로 표시되는 치환기이고, Ar_1 및 Ar_2 중 나머지는 중수소로 치환 또는 비치환된 페닐,

나프틸, 또는 비페닐이며, 바람직하게는 중수소로 치환 또는 비치환된 페닐, 또는 나프틸이다.

[154]

[155] 일례로, Ar_1 및 Ar_2 중 하나는 상기 화학식 2 또는 화학식 3으로 표시되는 치환기이고, Ar_1 및 Ar_2 중 나머지는 페닐, 5개의 중수소가 치환된 페닐, 나프틸, 혹은 4개 이상 또는 4개 내지 7개의 중수소가 치환된 나프틸일 수 있다.

[156]

[157] 구체적으로, 상기 화학식 1, 및 화학식 1-1 내지 1-2에서, Ar_1 또는 Ar_2 는 각각 하기로 구성되는 군으로부터 선택되는 어느 하나일 수 있다.

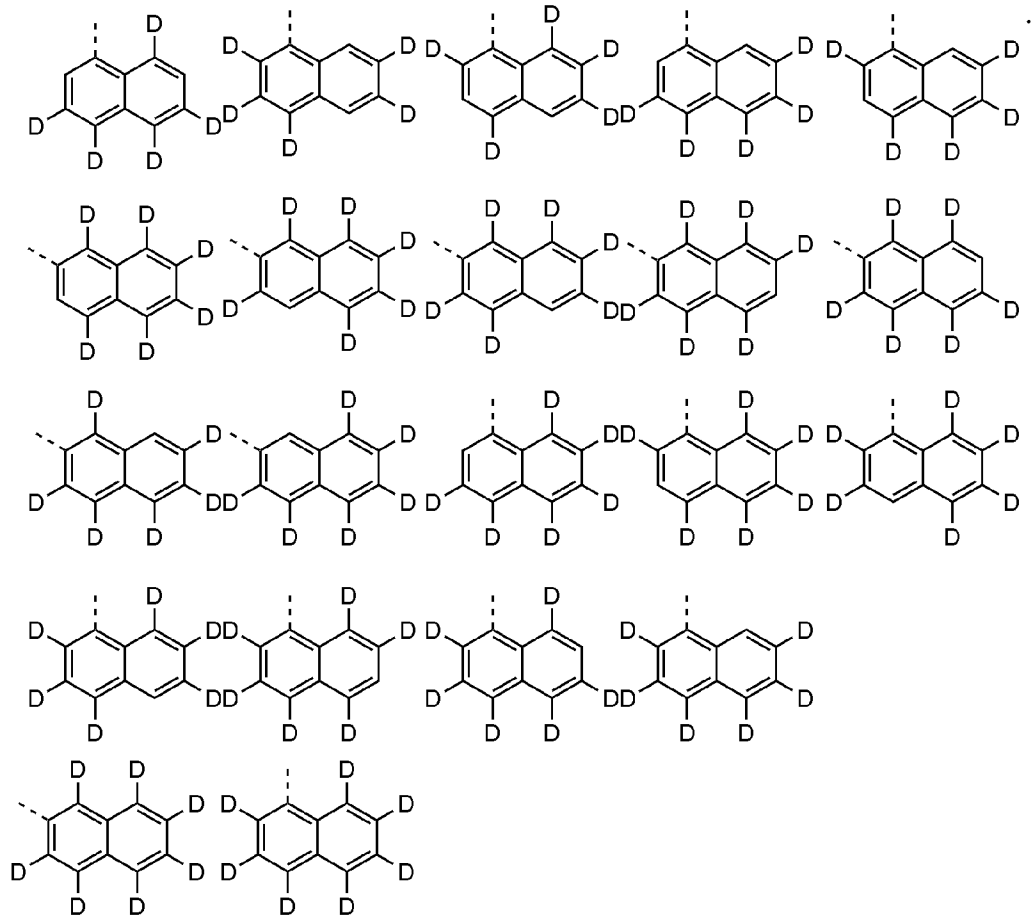
[158]

The figure displays a collection of chemical structures for deuterated aromatic compounds, arranged in a grid. The structures include:

- Monocyclic:** A single benzene ring with one deuterium (D) atom at the 1-position.
- Polycyclic:**
 - Naphthalene derivatives with deuterium atoms at various positions (1, 2, 3, 4, 5, 6, 7, 8).
 - Anthracene derivatives with deuterium atoms at various positions (1, 2, 3, 4, 5, 6, 7, 8, 9, 10).

The deuterium atoms are indicated by the letter 'D' at specific carbon positions on the rings. Some structures show multiple deuterium atoms, representing different isotopologues of the parent compounds.

[160]



[161]

[162] 한편, 상기 화학식 1, 및 화학식 1-1 내지 1-2에서, R_8 , R_9 , 및 R_{10} 은 각각 수소, 또는 중수소이거나, 또는 중수소로 치환 또는 비치환된 페닐 또는 나프틸이다.

[163]

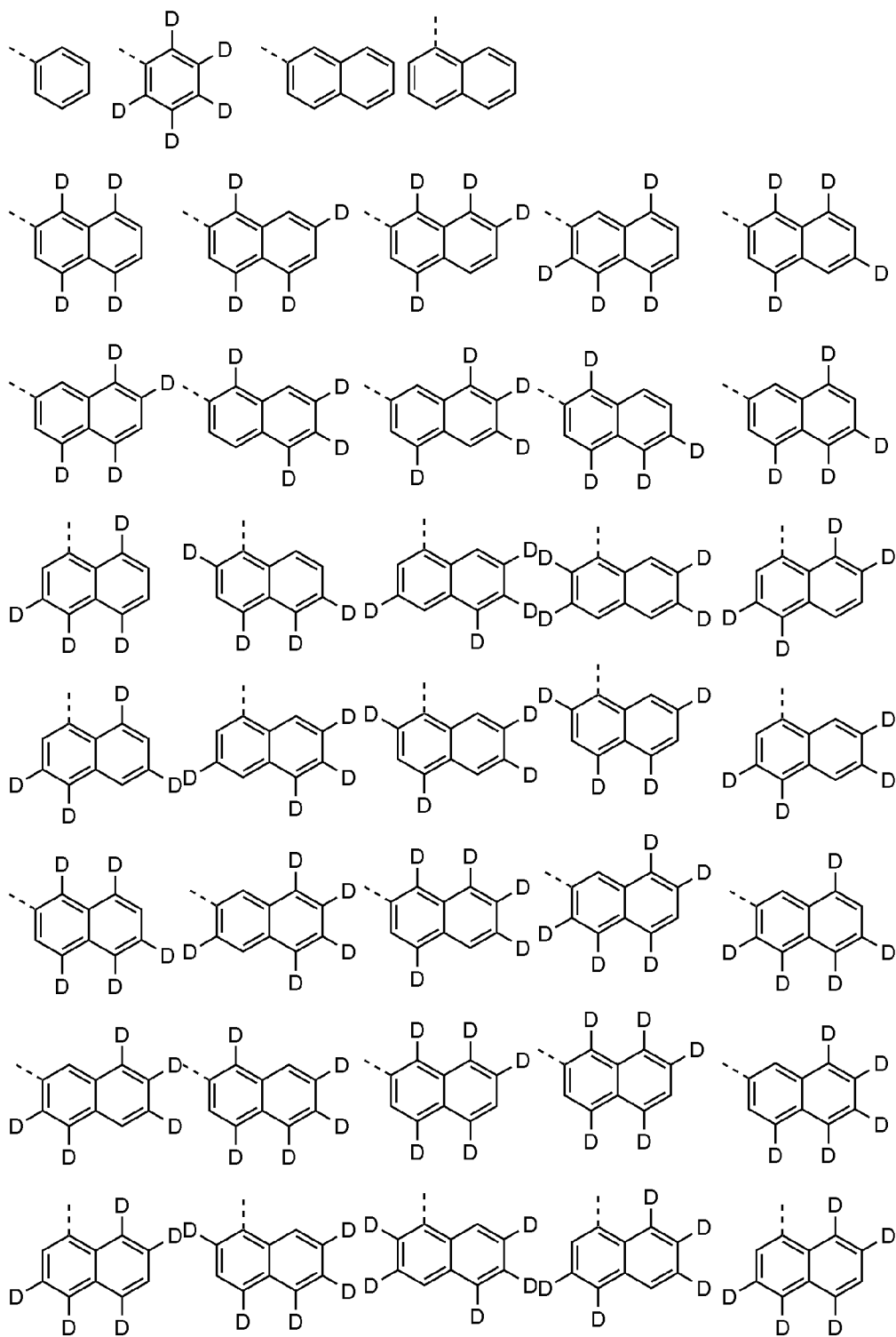
[164] 일례로, R_8 , R_9 , 및 R_{10} 은 각각 수소, 또는 중수소이거나, 또는 페닐, 5개의 중수소가 치환된 페닐, 나프틸, 혹은 4개 이상 또는 4개 내지 7개의 중수소가 치환된 나프틸일 수 있다.

[165]

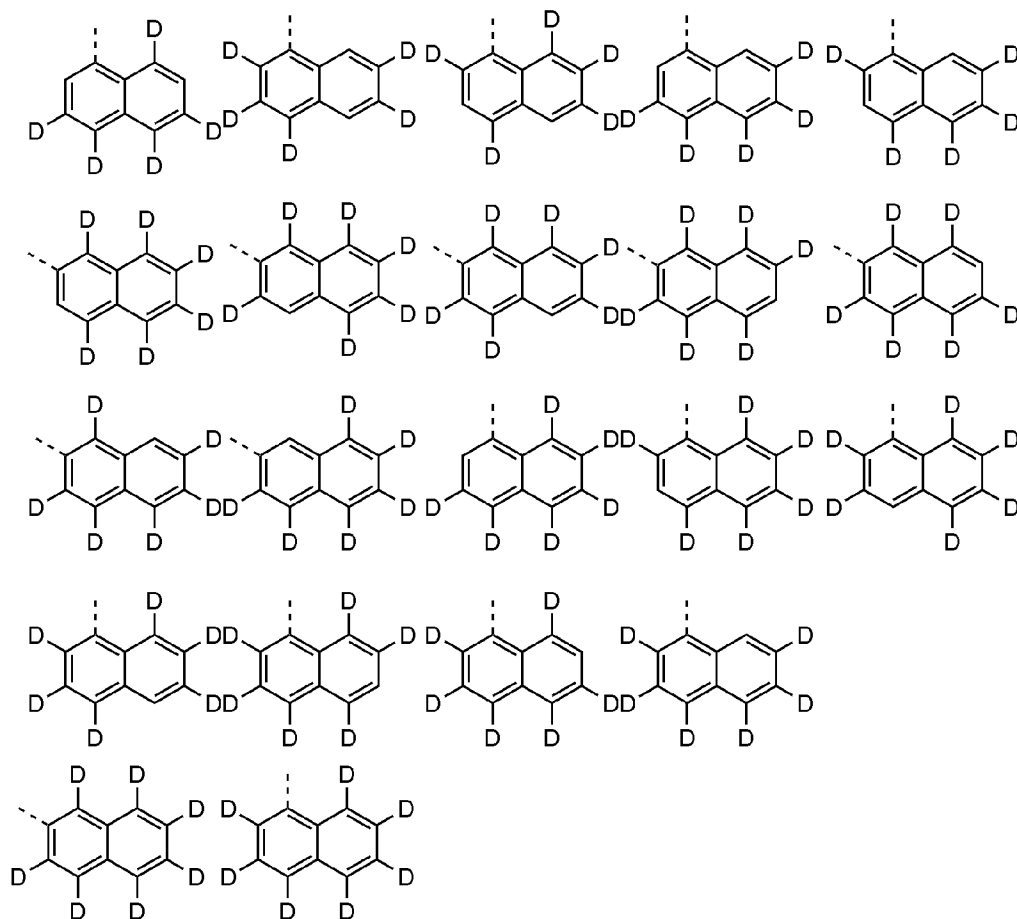
[166] 구체적으로, R_8 , R_9 , 및 R_{10} 은 각각 수소, 또는 중수소이거나, 또는 하기로 구성되는 군으로부터 선택되는 어느 하나일 수 있다.

[167]

[168]



[169]



[170]

[171] 또한, 상기 화학식 1, 및 화학식 1-1 내지 1-2에서, n_1 은 1 내지 4의 정수이고, n_2 는 1 내지 3의 정수이다. 일례로, n_1 및 n_2 은 모두 1일 수 있다.

[172]

[173] 한편, 상기 화학식 1, 및 화학식 1-1 내지 1-2에서, R_1 내지 R_{10} , L_1 내지 L_3 , 및 Ar_1 내지 Ar_2 중 적어도 하나 이상은 중수소이거나 중수소로 치환된 것이다.

[174]

[175] 구체적으로, R_1 내지 R_{10} 중 적어도 하나 이상은 중수소이거나, 또는 L_1 내지 L_3 중 적어도 하나 이상은 중수소로 치환된 페닐렌 또는 나프틸렌이거나, 또는 Ar_1 및 Ar_2 중 적어도 하나 이상은 중수소로 치환된 것일 수 있다. 바람직하게는, R_1 내지 R_7 중 적어도 하나 이상은 중수소로 치환된 것일 수 있다.

[176]

[177] 특히, 상기 화합물은 적어도 하나 이상의 중수소를 포함하는 것이다.

[178]

[179] 이때, 화합물의 중수소 치환율은 1% 내지 100%일 수 있다. 구체적으로는, 상기 화합물의 중수소 치환율은 5% 이상, 10% 이상, 20% 이상, 30% 이상, 40% 이상, 50% 이상, 60% 이상, 70% 이상, 75% 이상, 80% 이상, 또는 90% 이상이면서, 100% 이하일 수 있다.

[180]

[181] 또한, 상기 화합물은 중수소를 1개 내지 50개의 중수소를 포함할 수 있다. 보다 구체적으로는, 상기 화합물은 중수소를 포함하지 않거나, 또는 1개 이상, 2개 이상, 3개 이상, 4개 이상, 5개 이상, 6개 이상, 7개 이상, 8개 이상, 또는 9개 이상이면서, 50개 이하, 40개 이하, 35개 이하, 32개 이하, 30개 이하, 28개 이하, 26개 이하, 24개 이하, 22개 이하, 20개 이하, 18개 이하, 16개 이하, 14개 이하, 13개 이하, 12개 이하, 11개 이하, 또는 10개 이하의 중수소를 포함할 수 있다.

[182]

[183] 일례로, 상기 화학식 1로 표시되는 화합물은, 적어도 3개 이상 또는 3개 내지 7개의 중수소가 치환된 것일 수 있으며, 좀더 구체적으로는 적어도 4개 이상 또는 4개 내지 6개의 중수소가 치환된 것일 수 있다. 예컨대, R_1 내지 R_{10} , L_1 내지 L_3 , 및 Ar_1 내지 Ar_2 중 적어도 3개 이상 또는 3개 내지 7개가 중수소이거나, 또는 적어도 4개 이상 또는 4개 내지 6개가 중수소로 치환된 것일 수 있다. 바람직하게는, R_1 내지 R_7 중 적어도 3개 이상 또는 3개 내지 7개가 중수소이거나, 또는 적어도 4개 이상 또는 4개 내지 6개가 중수소로 치환된 것일 수 있다.

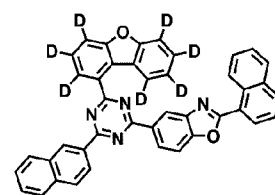
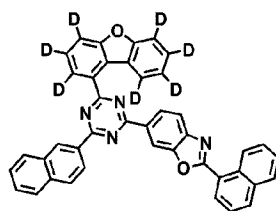
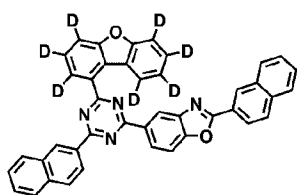
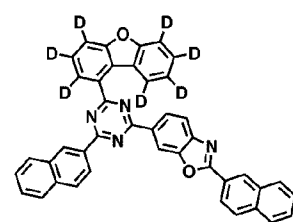
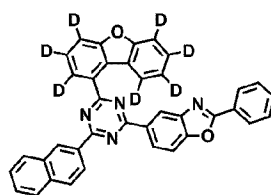
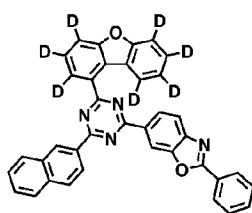
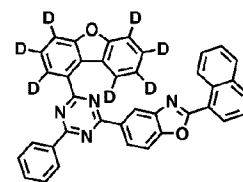
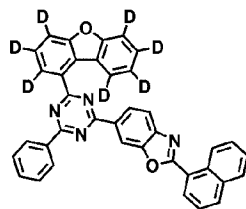
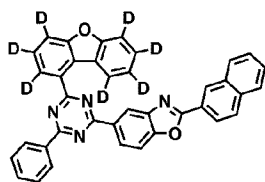
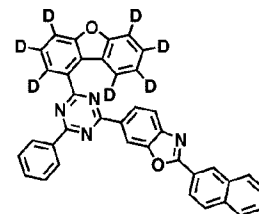
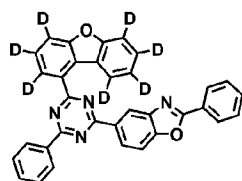
[184]

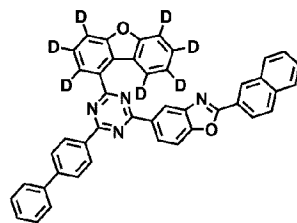
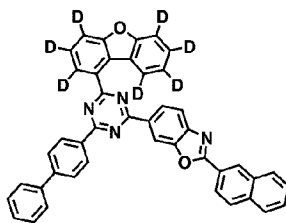
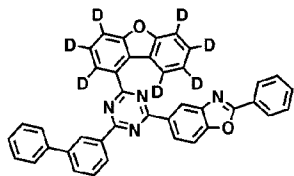
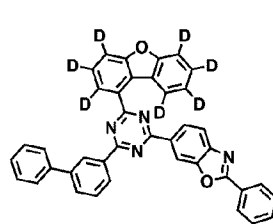
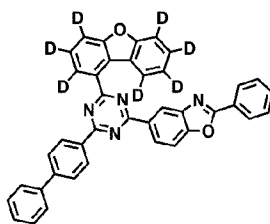
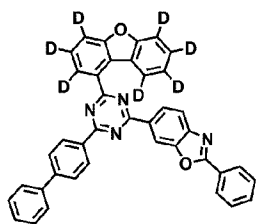
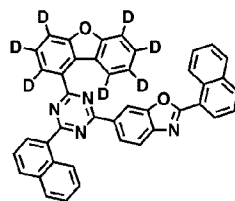
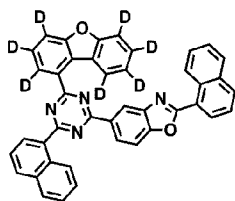
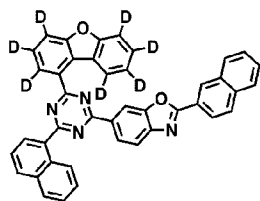
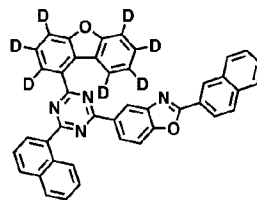
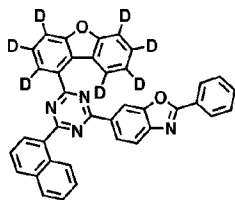
[185] 또한, 상기 화학식 1에 포함된 모든 수소는 중수소로 치환될 수 있다.

[186]

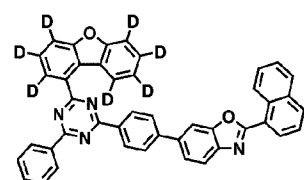
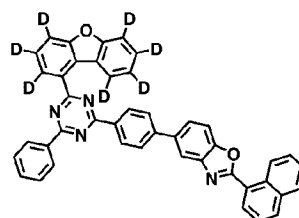
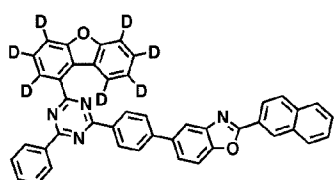
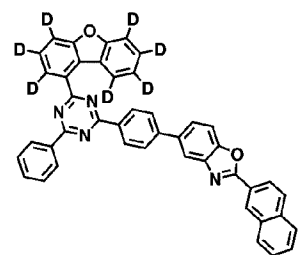
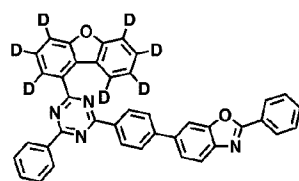
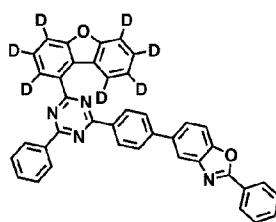
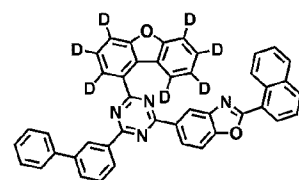
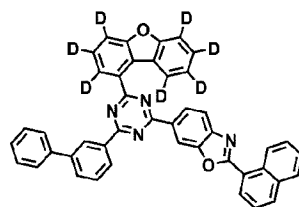
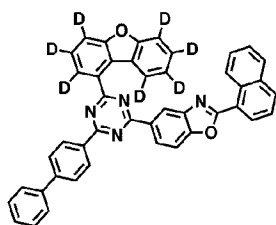
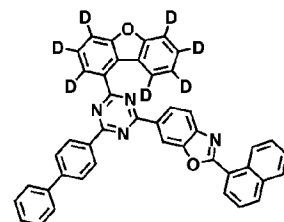
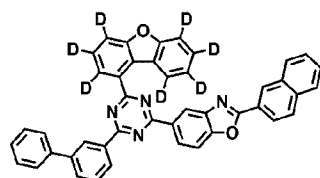
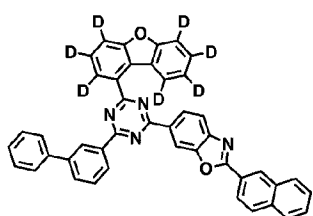
[187] 상기 화학식 1로 표시되는 화합물의 대표적인 예는 하기와 같다.

[188]

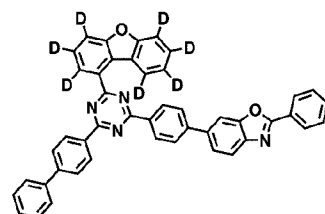
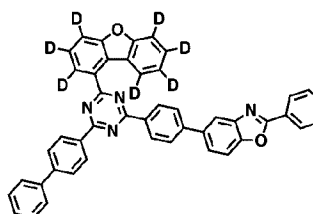
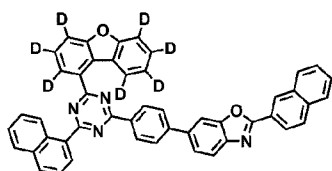
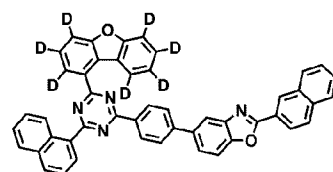
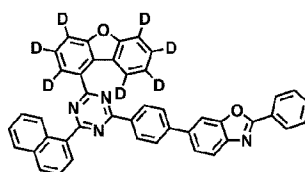
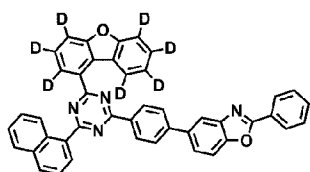
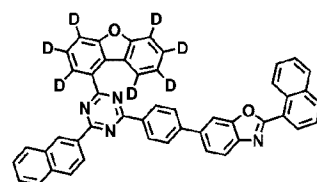
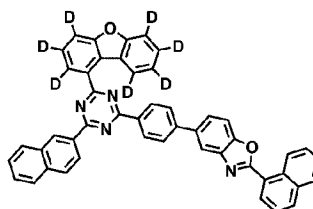
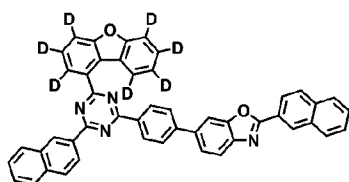
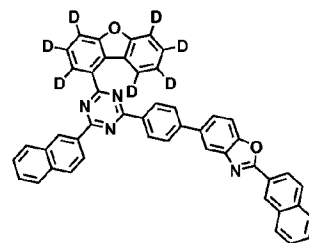
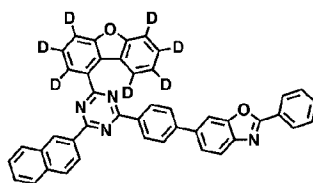
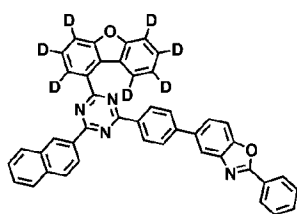




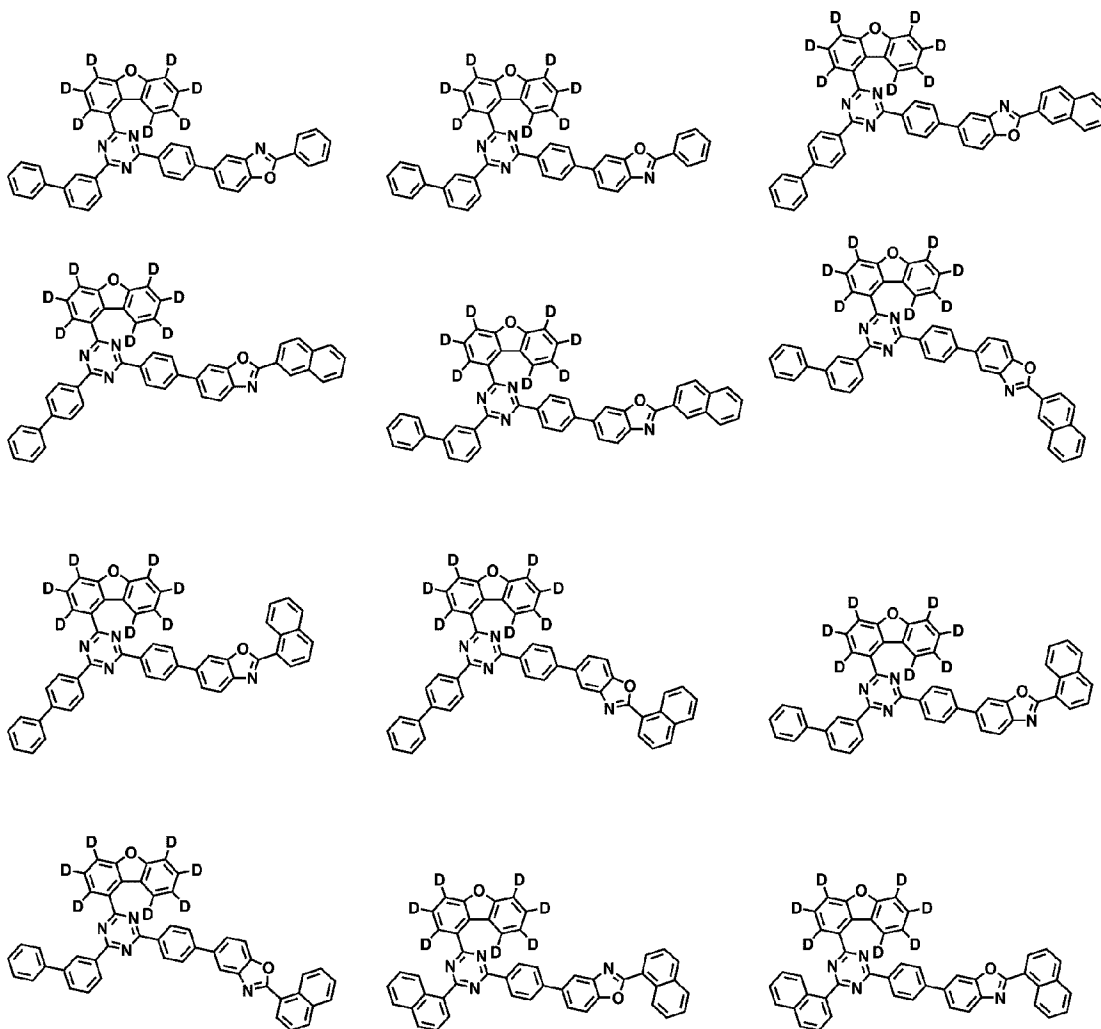
[191]



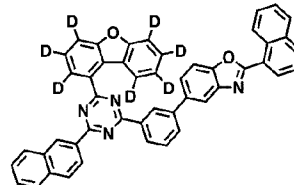
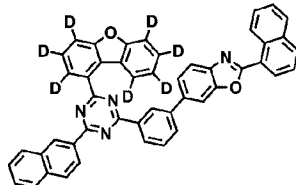
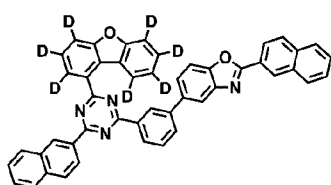
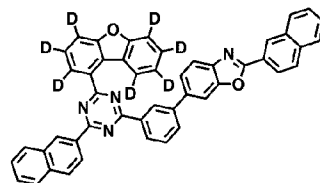
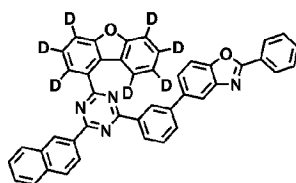
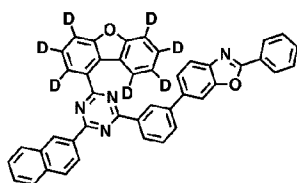
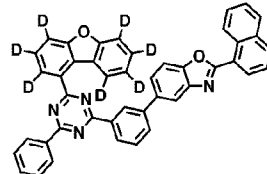
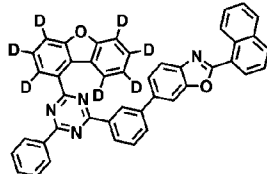
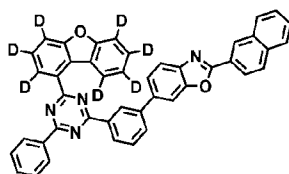
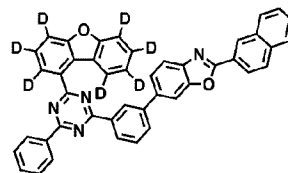
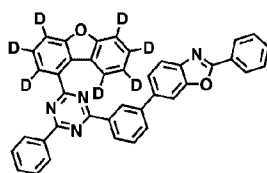
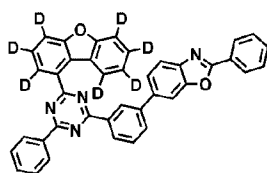
[192]



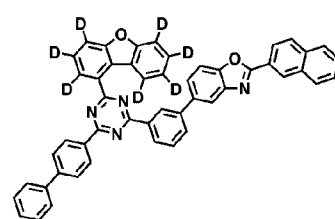
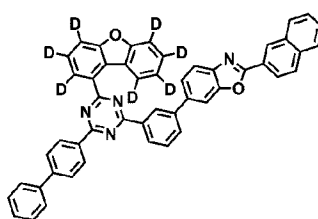
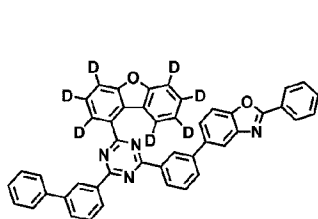
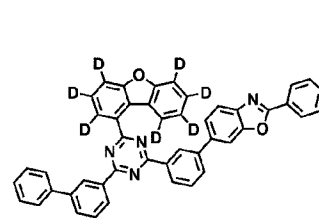
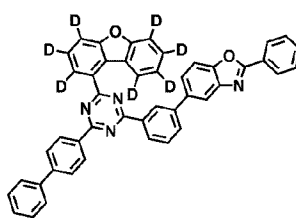
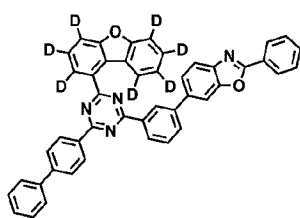
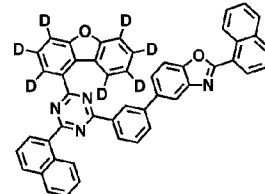
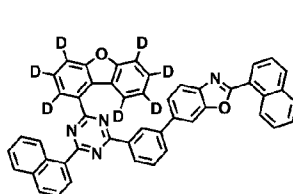
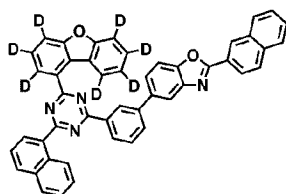
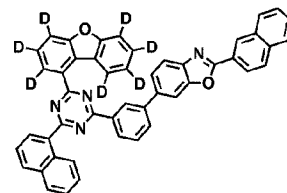
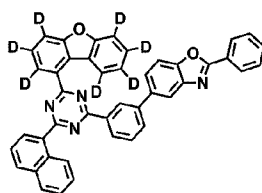
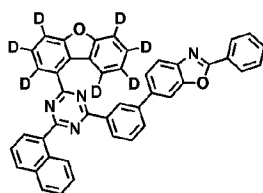
[193]



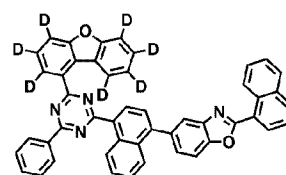
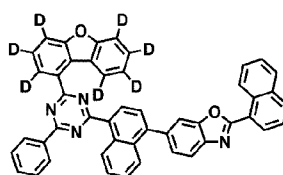
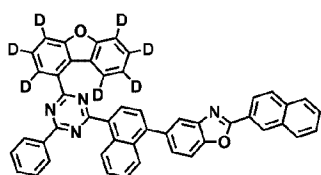
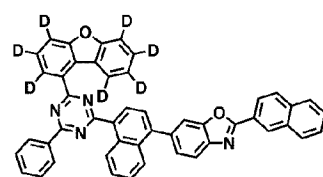
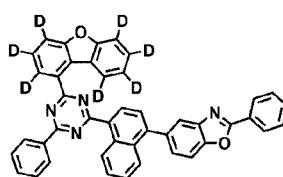
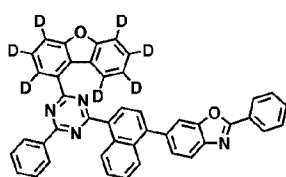
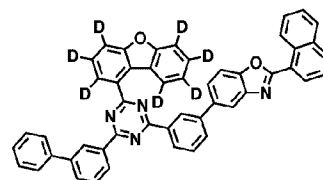
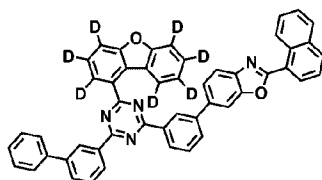
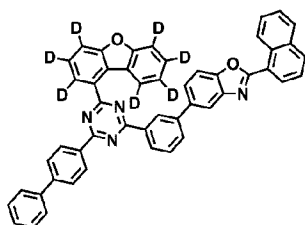
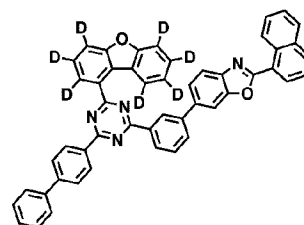
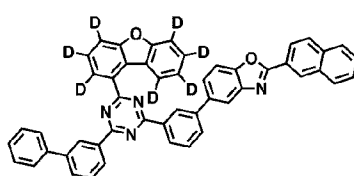
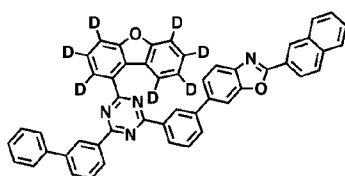
[194]



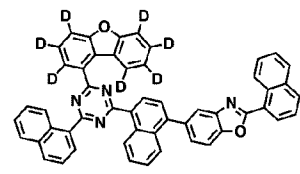
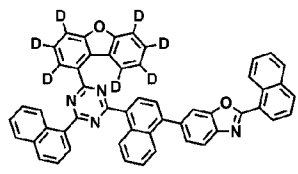
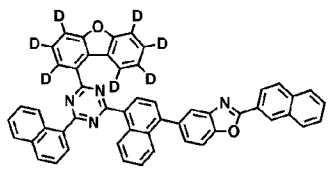
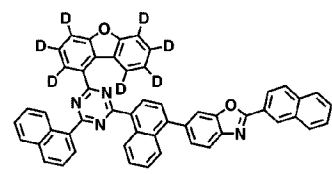
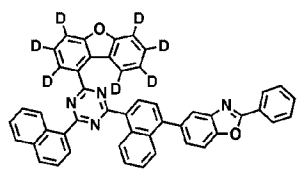
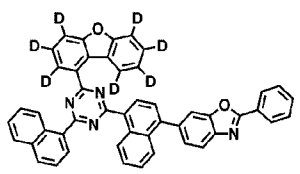
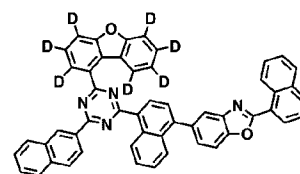
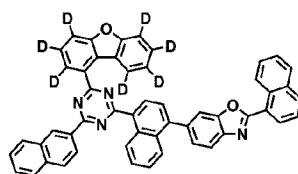
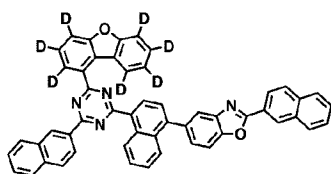
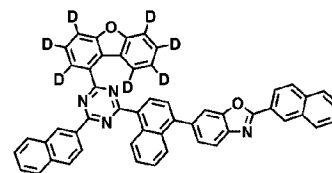
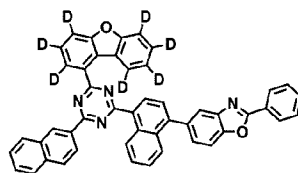
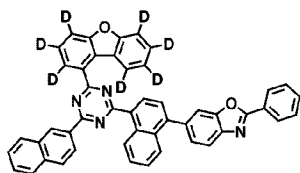
[195]



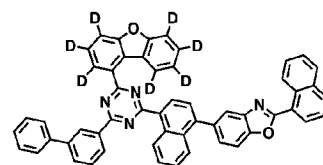
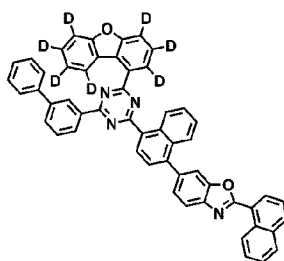
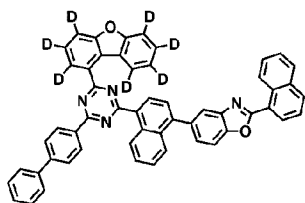
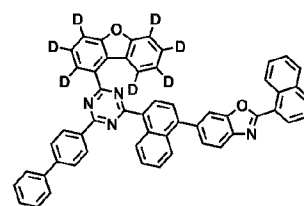
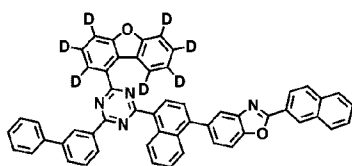
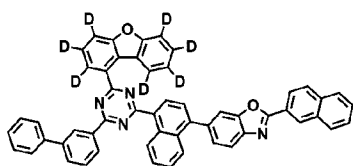
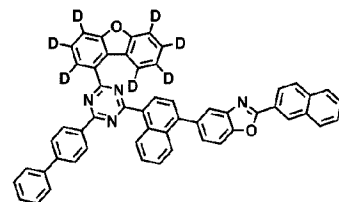
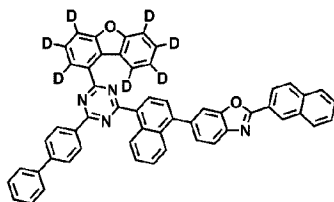
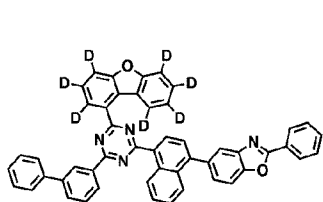
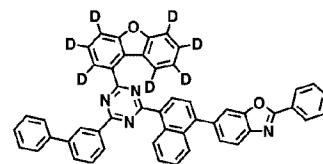
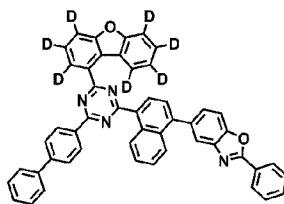
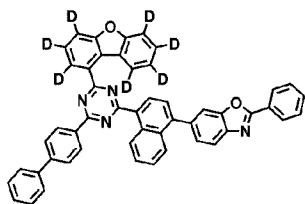
[196]

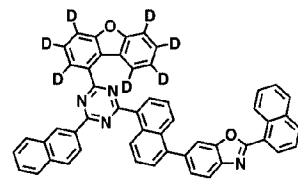
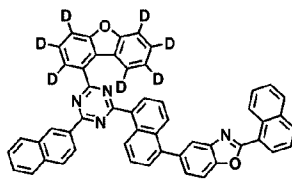
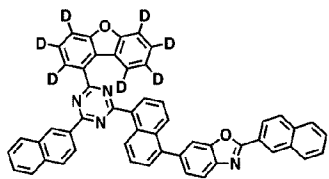
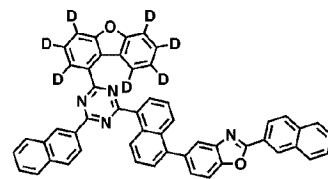
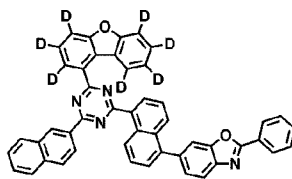
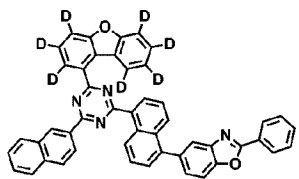
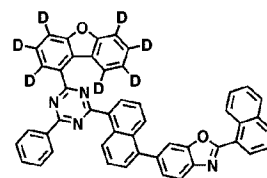
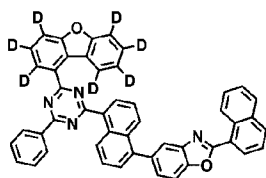
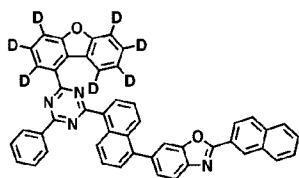
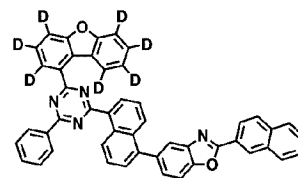
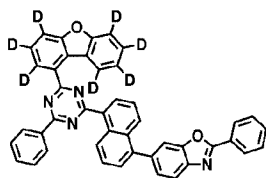


[197]

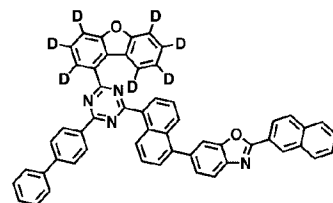
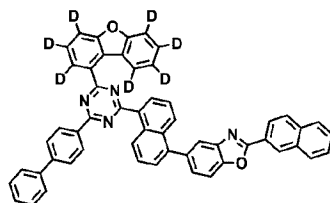
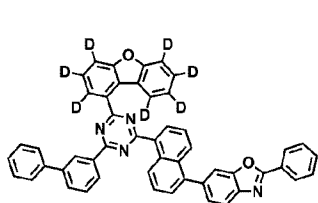
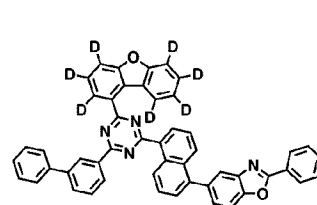
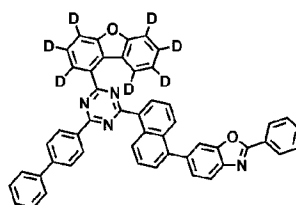
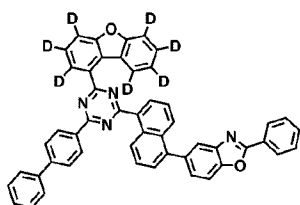
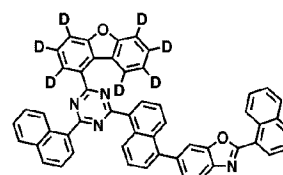
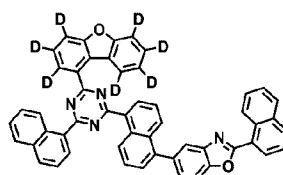
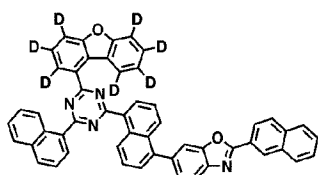
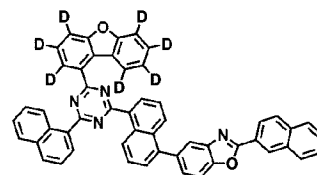
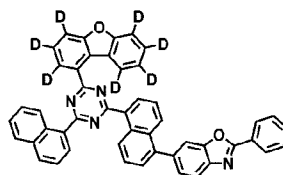
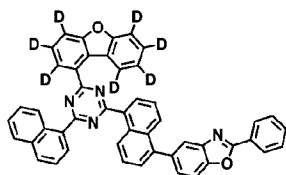


[198]

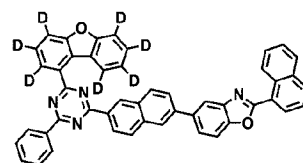
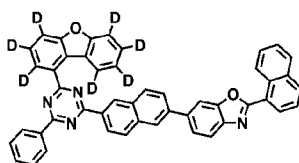
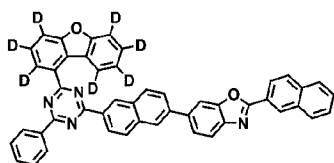
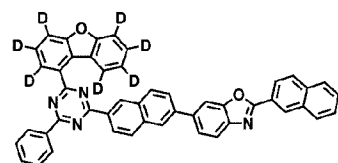
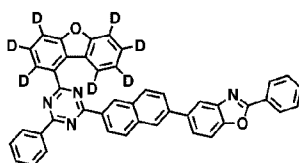
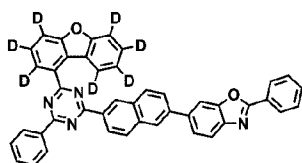
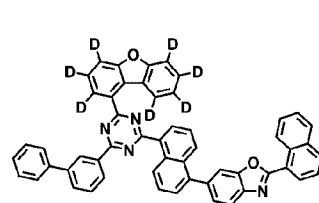
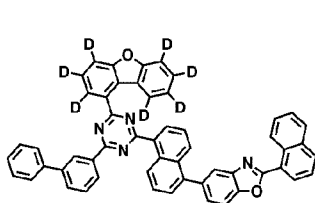
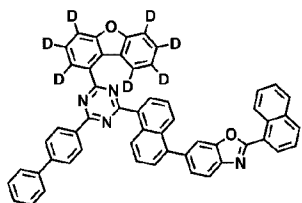
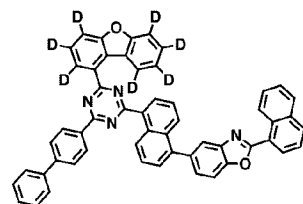
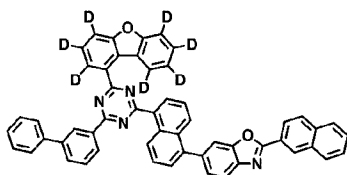
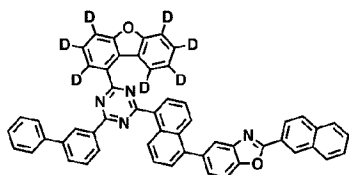




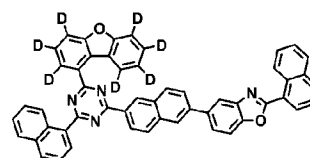
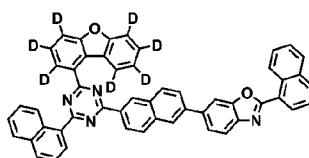
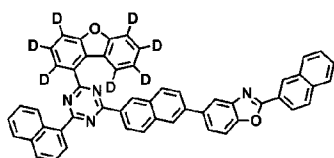
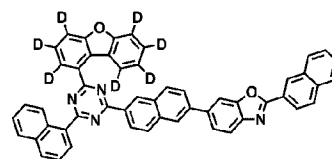
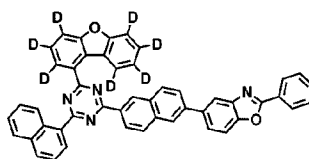
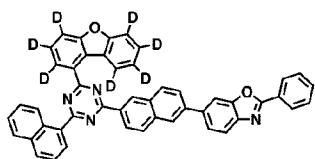
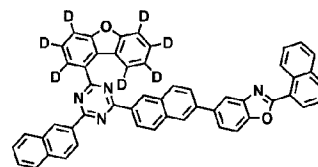
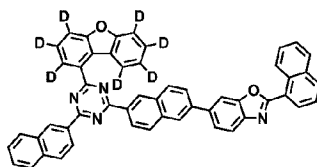
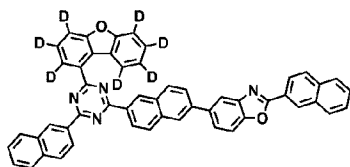
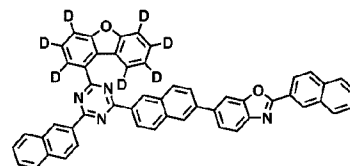
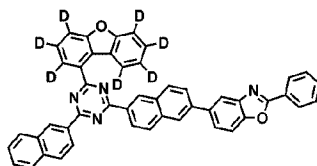
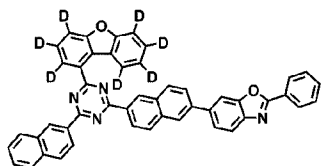
[200]

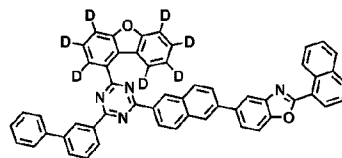
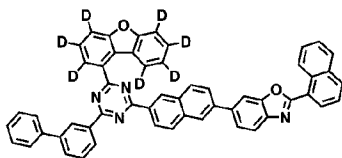
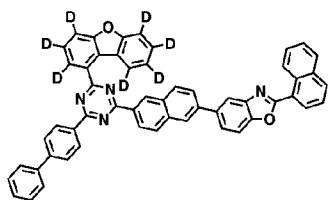
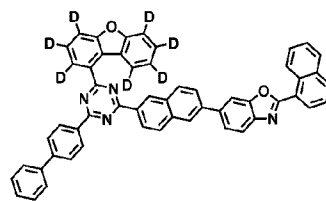
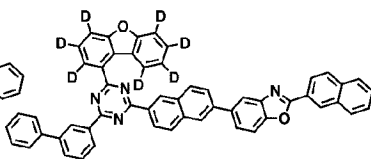
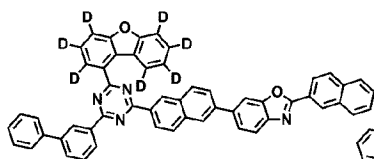
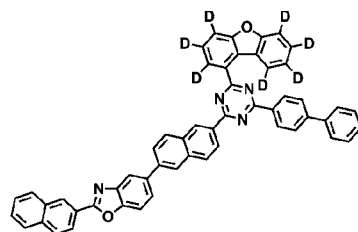
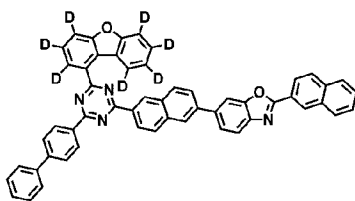
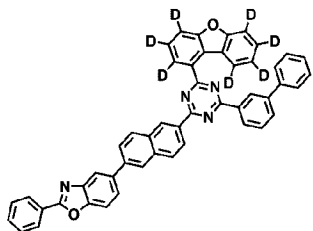
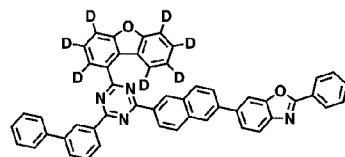
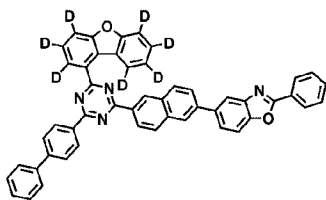


[201]

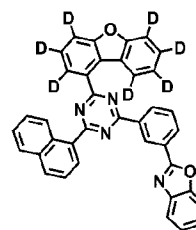
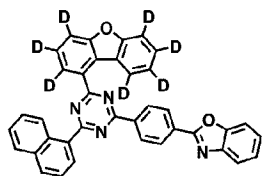
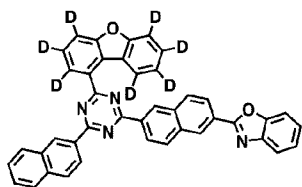
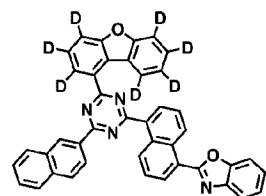
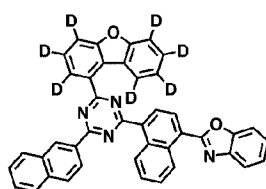
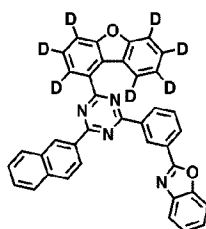
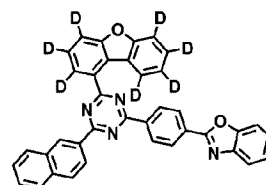
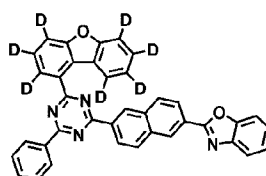
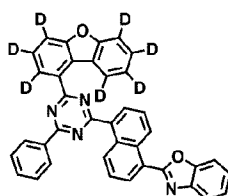
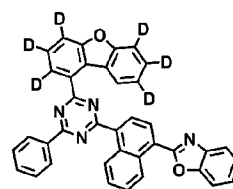
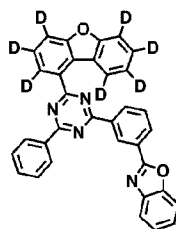
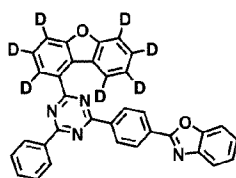


[202]

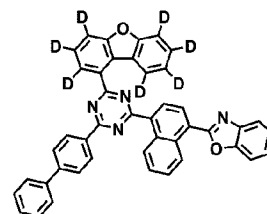
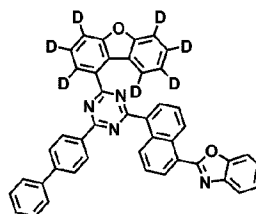
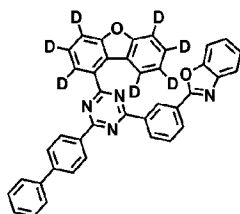
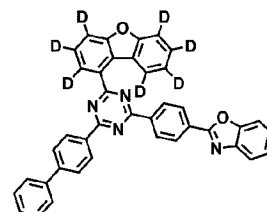
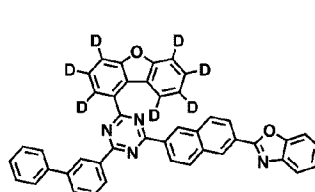
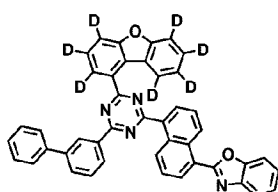
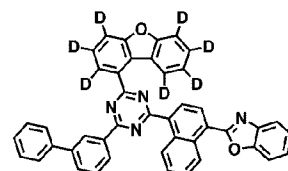
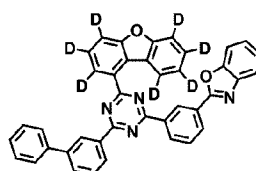
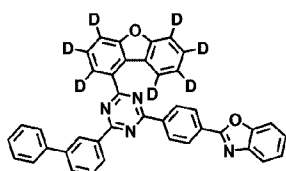
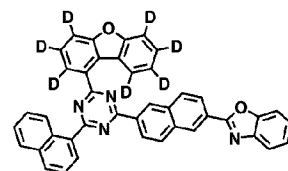
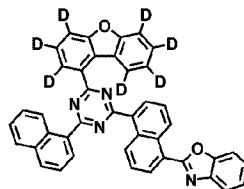
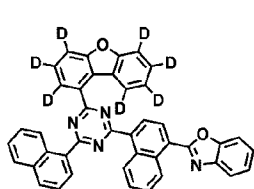




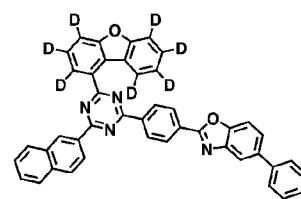
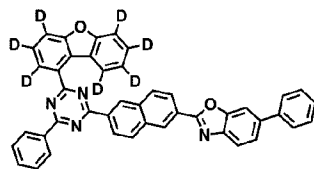
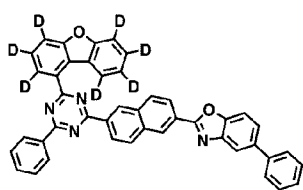
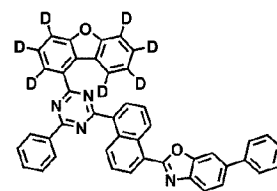
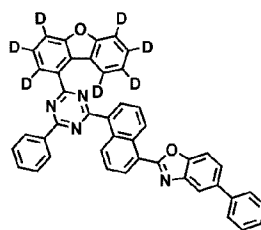
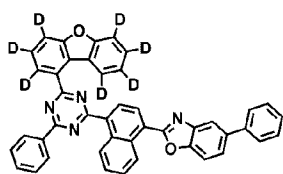
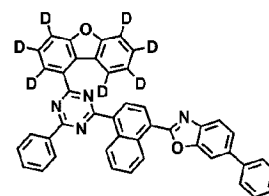
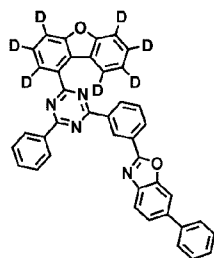
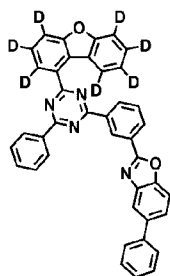
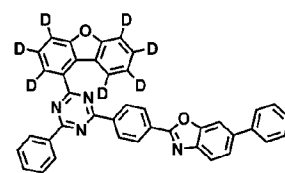
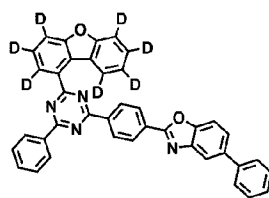
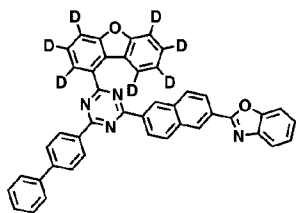
[204]



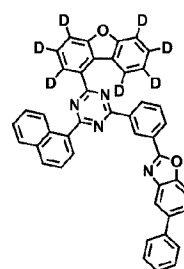
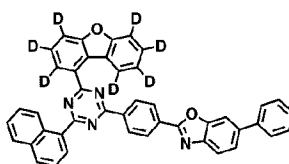
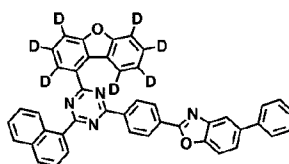
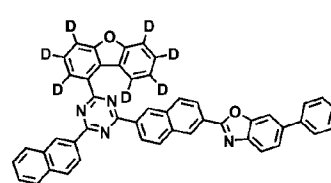
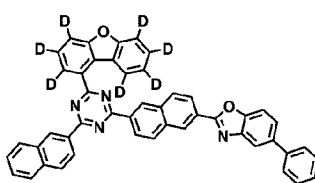
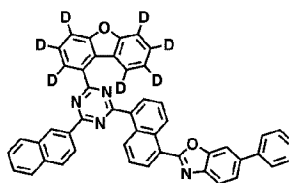
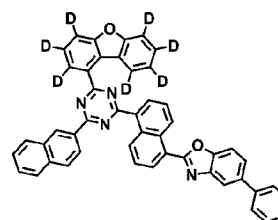
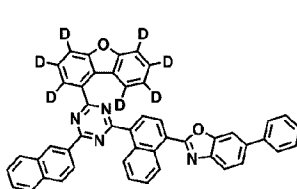
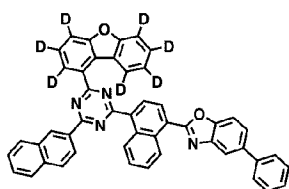
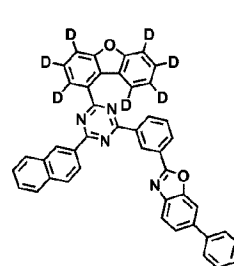
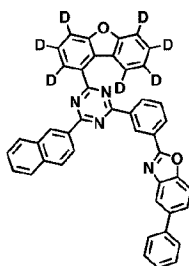
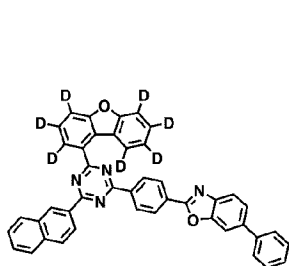
[205]



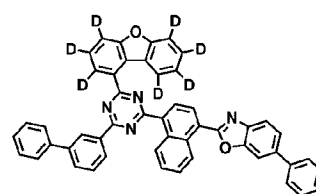
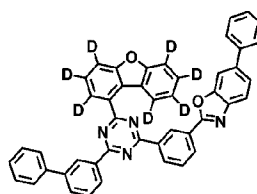
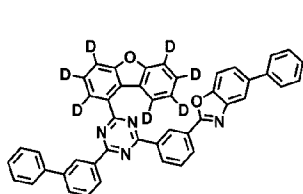
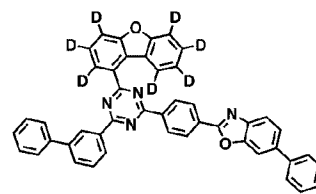
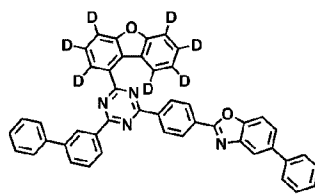
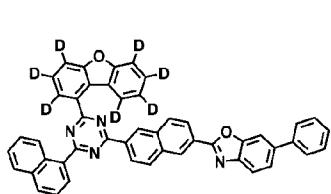
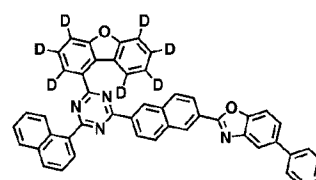
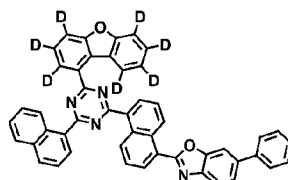
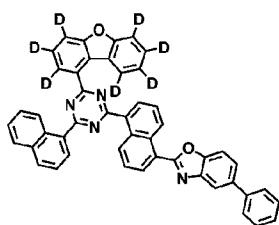
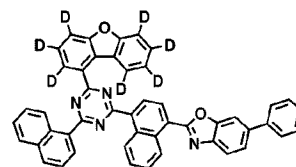
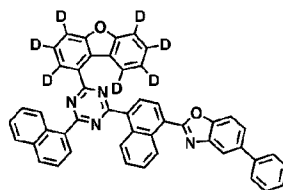
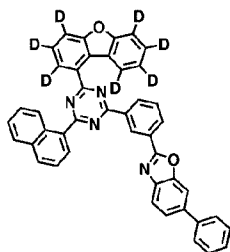
[206]



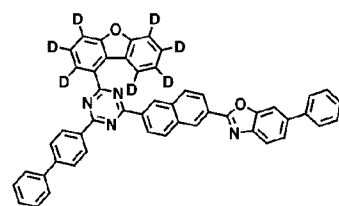
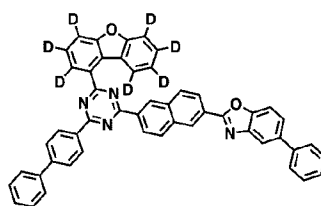
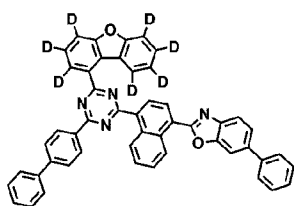
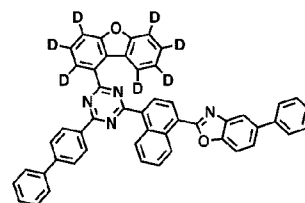
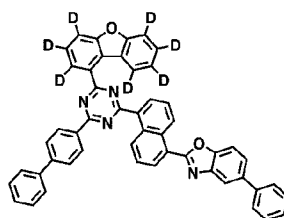
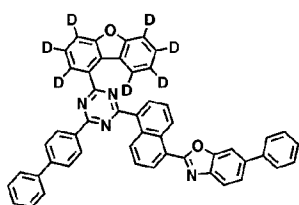
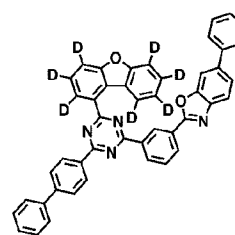
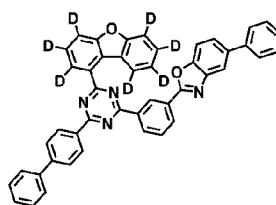
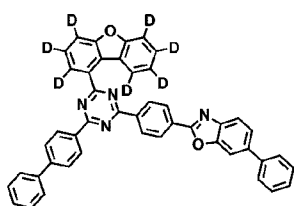
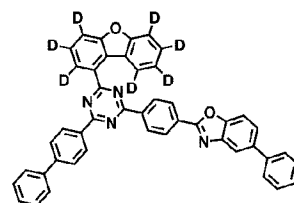
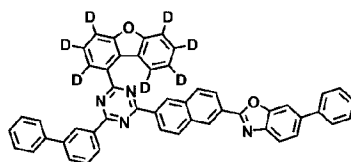
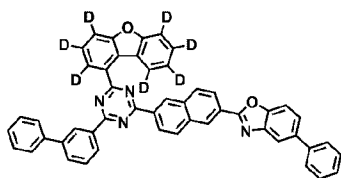
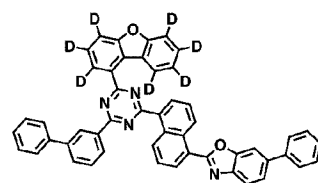
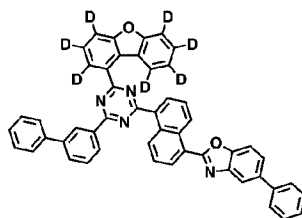
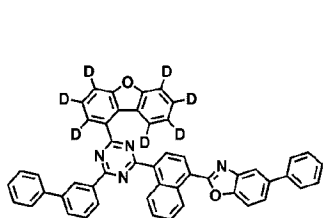
[207]



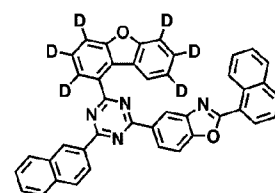
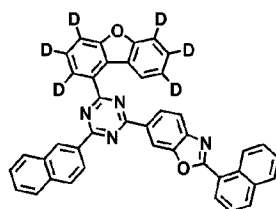
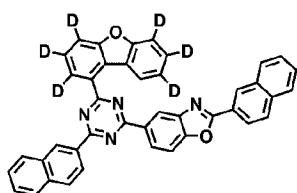
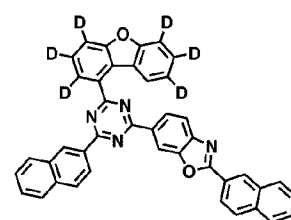
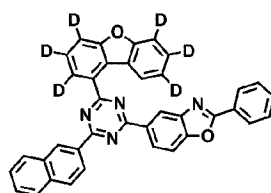
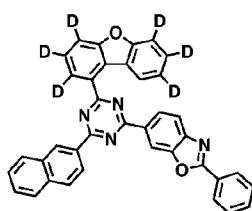
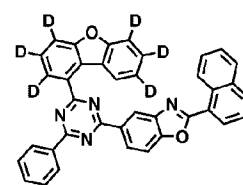
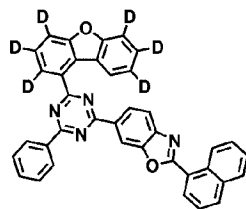
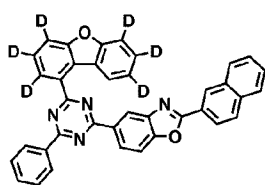
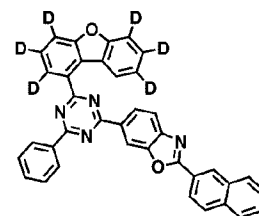
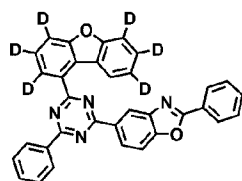
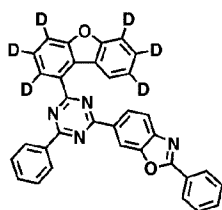
[208]



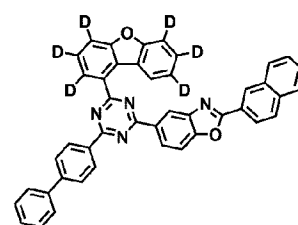
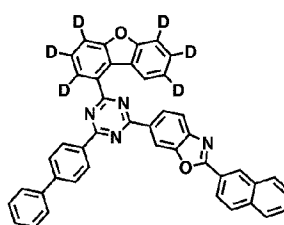
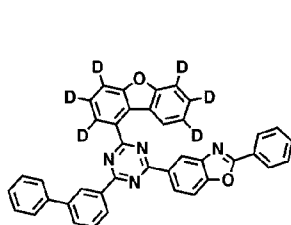
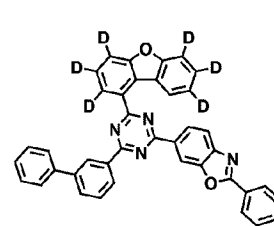
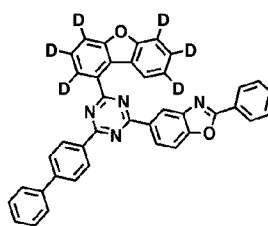
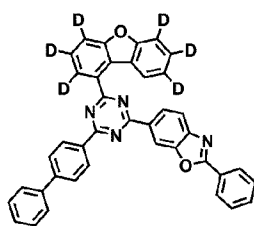
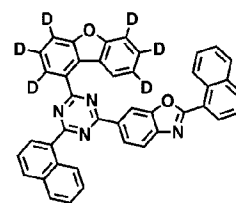
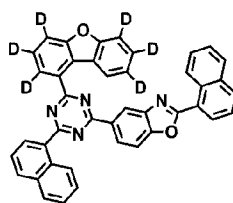
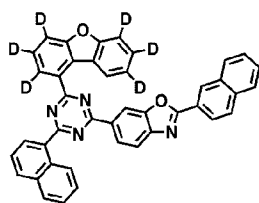
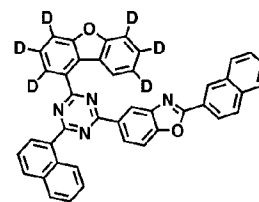
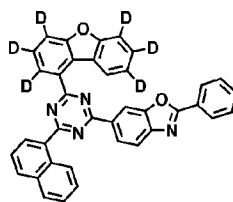
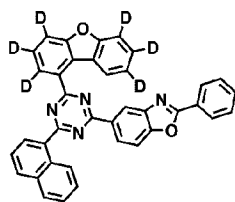
[209]



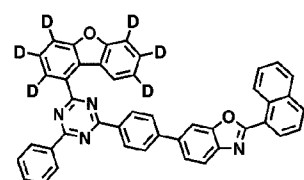
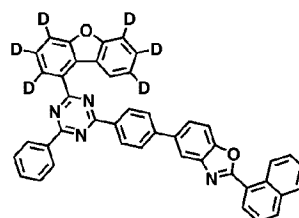
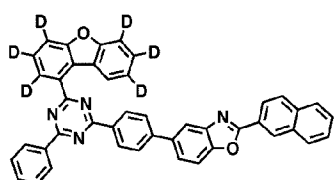
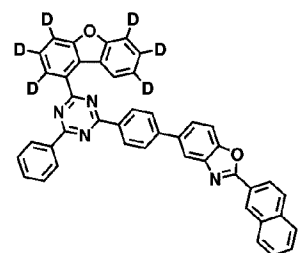
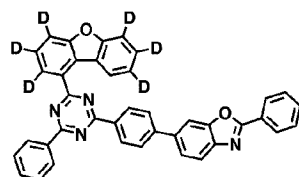
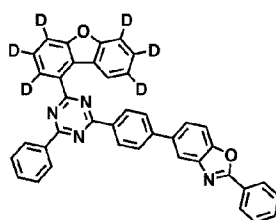
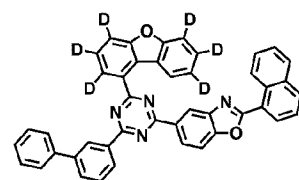
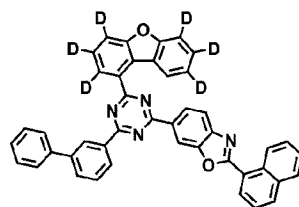
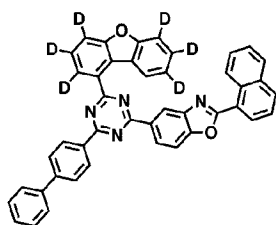
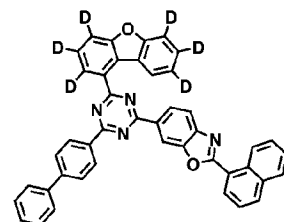
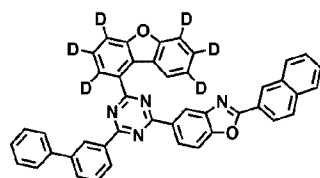
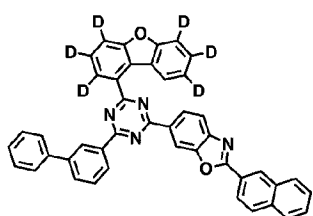
[210]



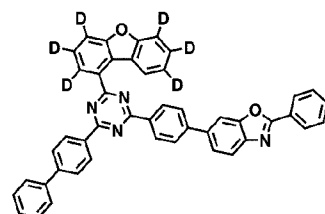
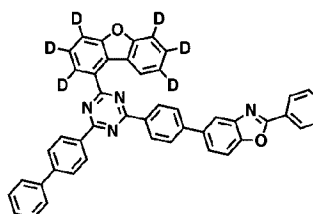
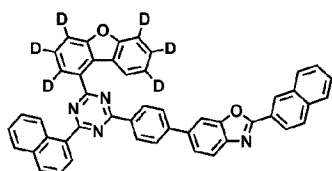
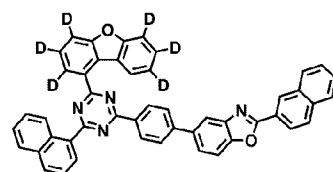
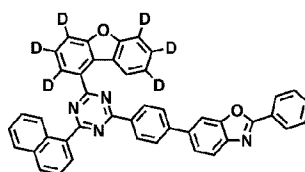
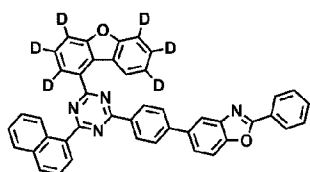
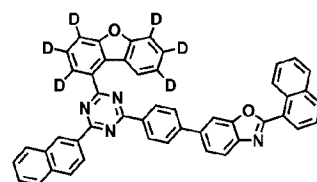
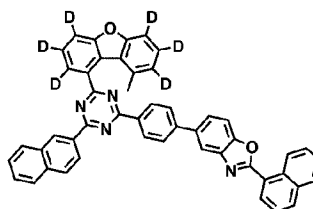
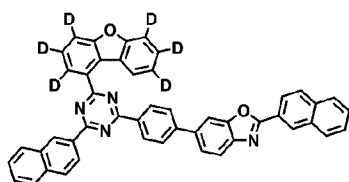
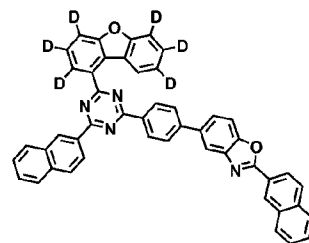
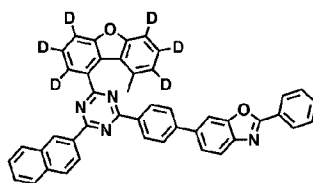
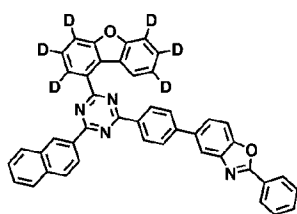
[211]



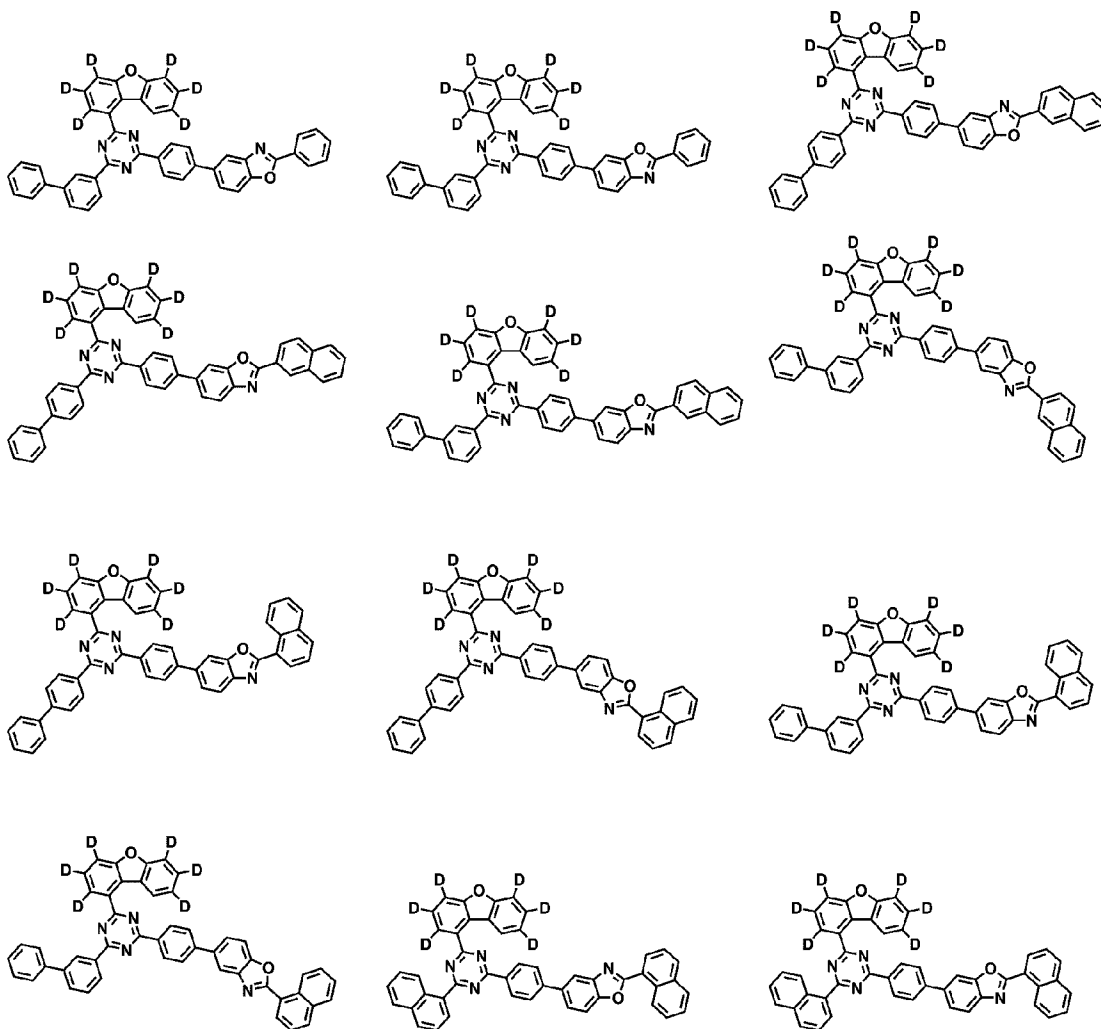
[212]



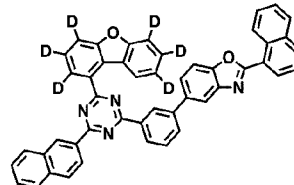
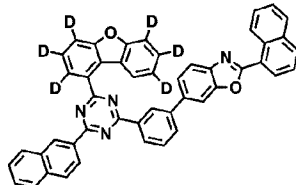
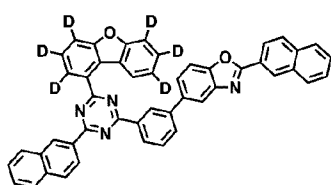
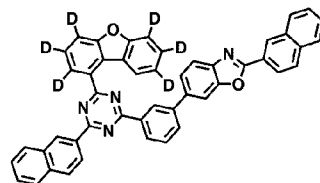
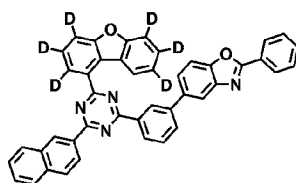
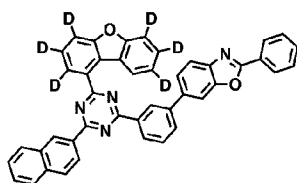
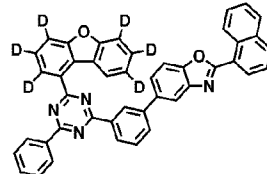
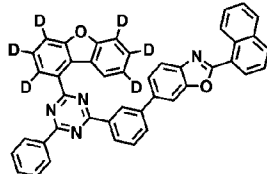
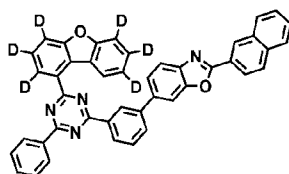
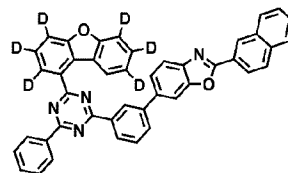
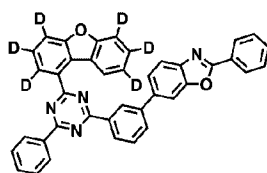
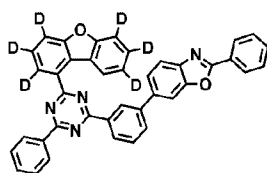
[213]



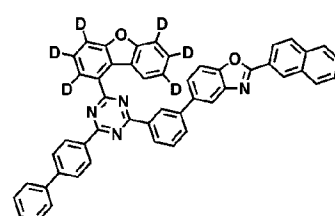
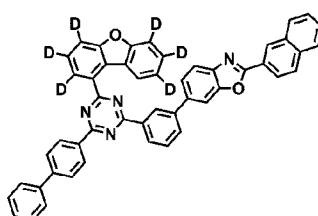
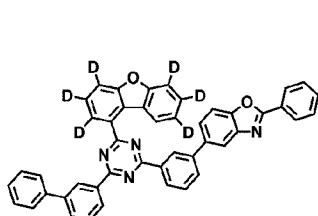
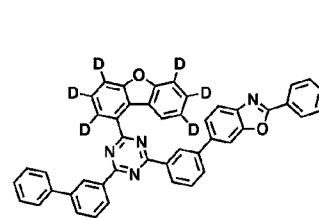
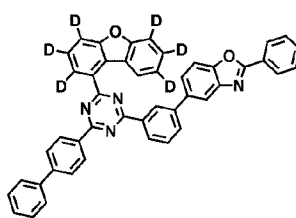
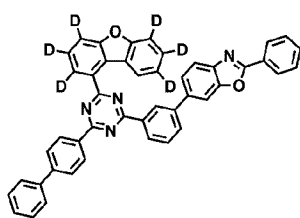
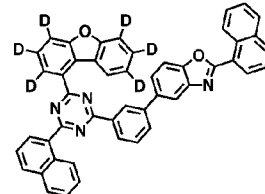
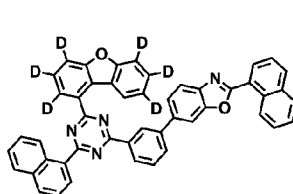
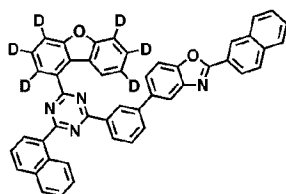
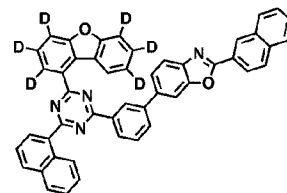
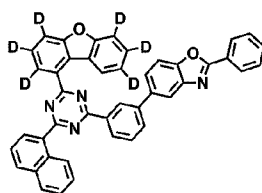
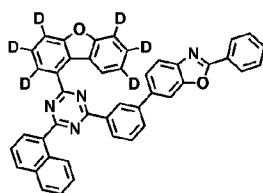
[214]



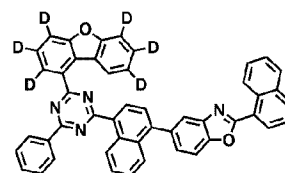
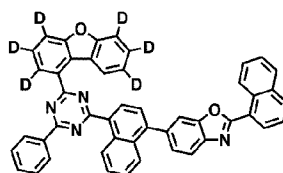
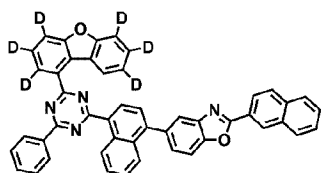
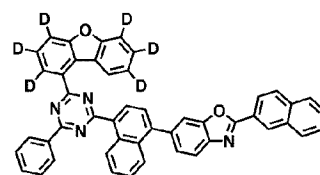
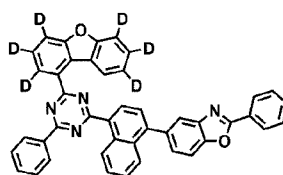
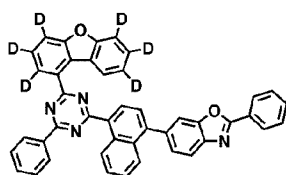
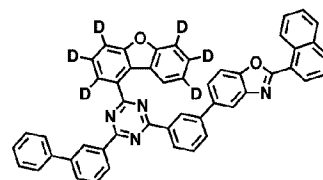
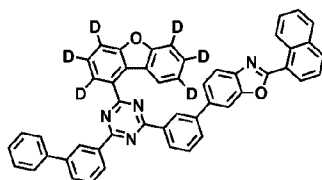
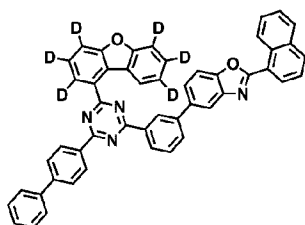
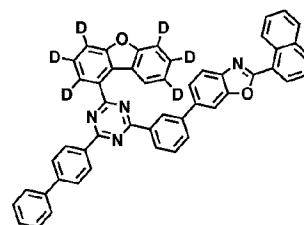
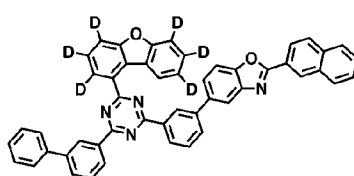
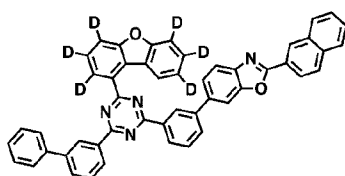
[215]



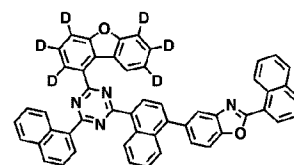
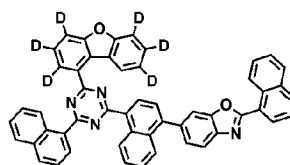
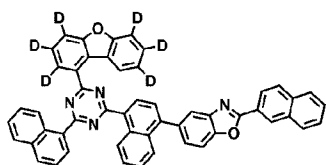
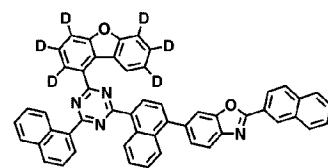
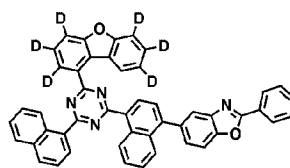
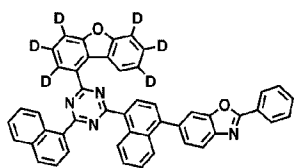
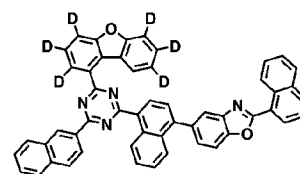
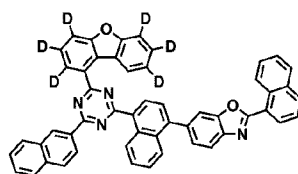
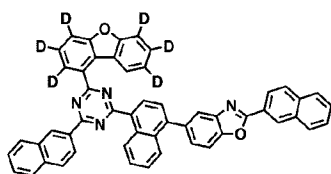
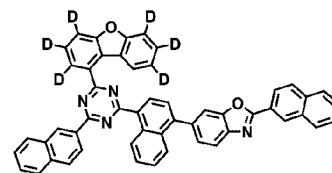
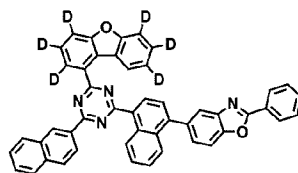
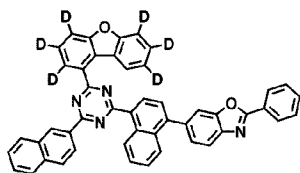
[216]



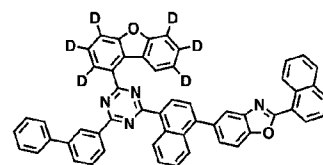
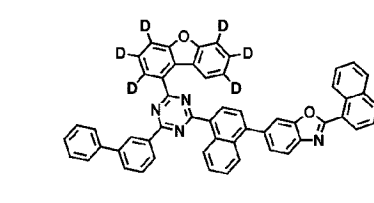
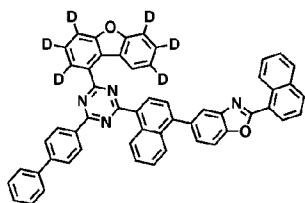
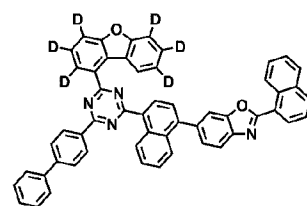
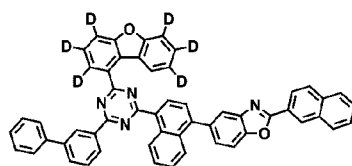
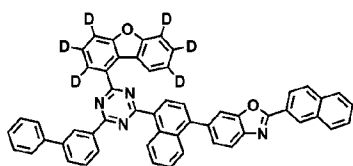
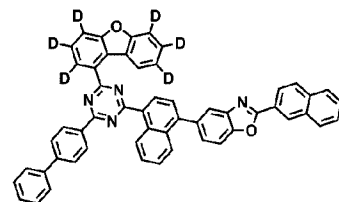
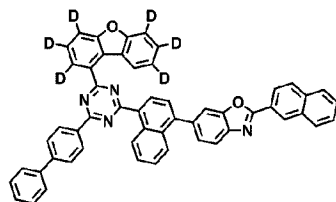
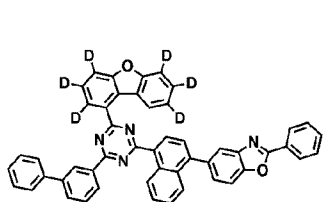
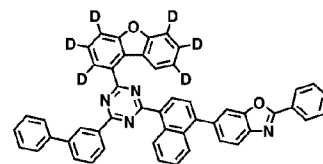
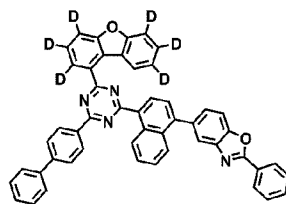
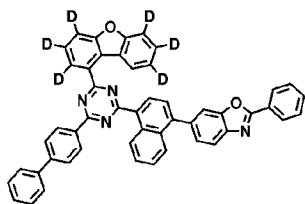
[217]



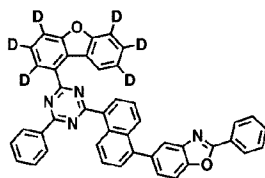
[218]



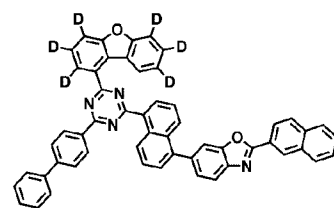
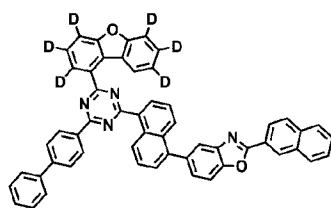
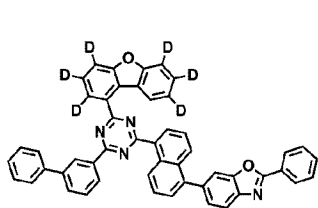
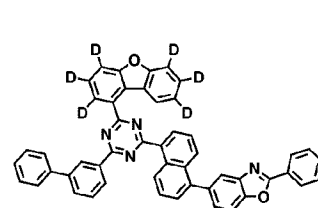
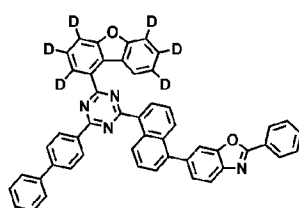
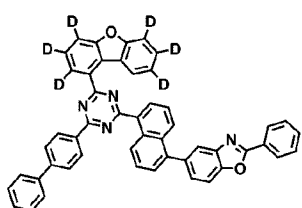
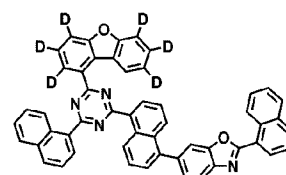
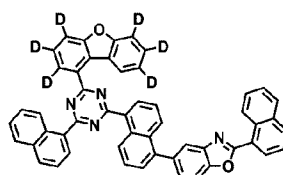
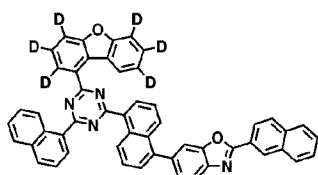
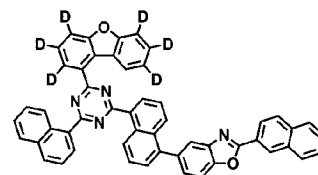
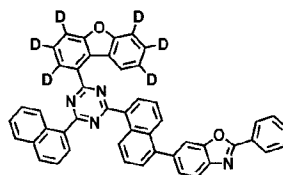
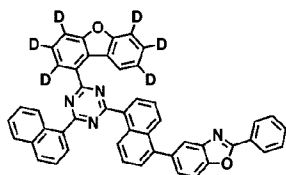
[219]



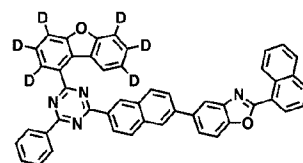
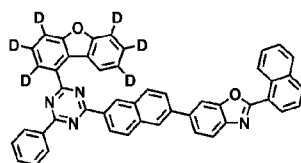
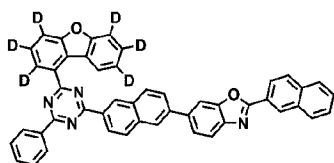
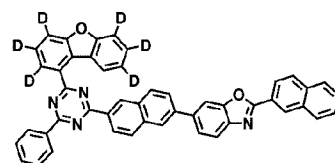
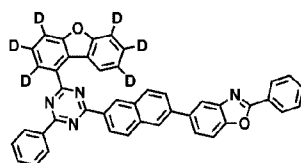
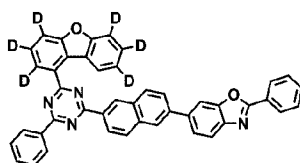
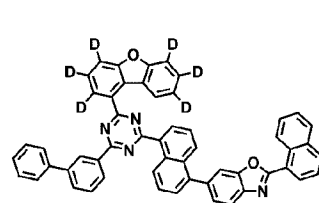
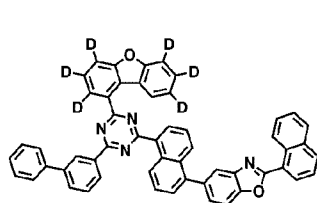
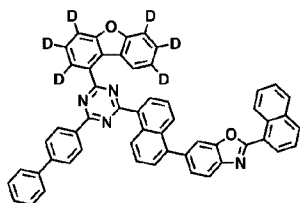
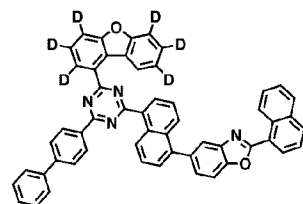
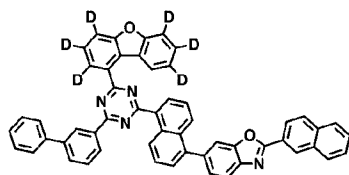
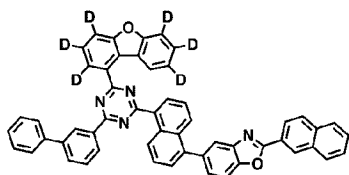
[220]



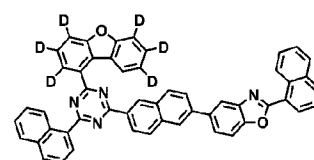
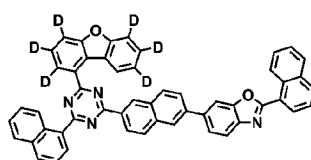
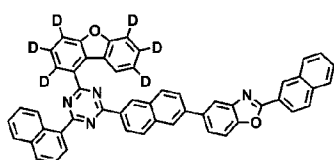
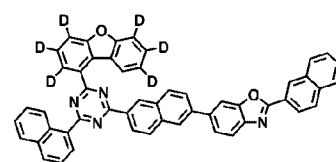
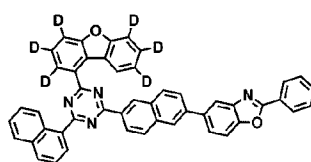
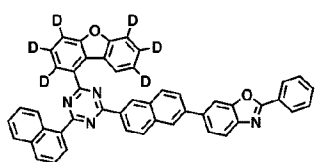
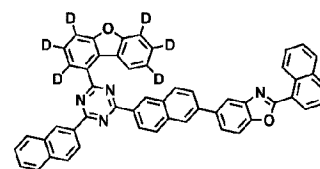
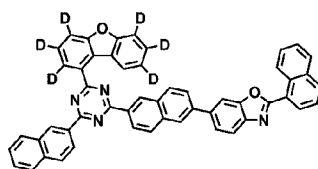
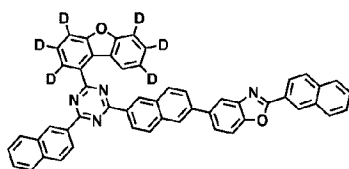
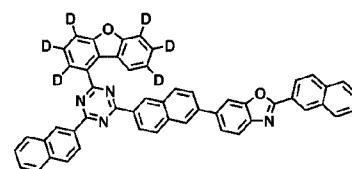
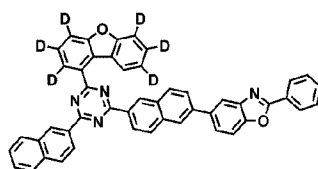
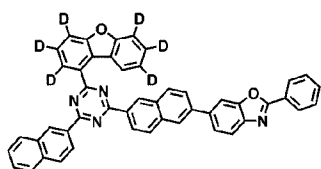
[221]



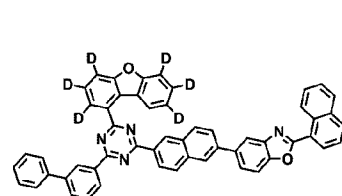
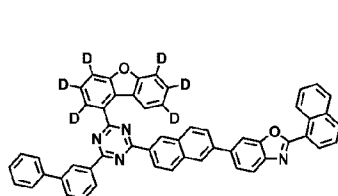
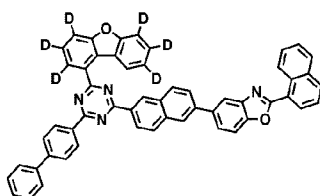
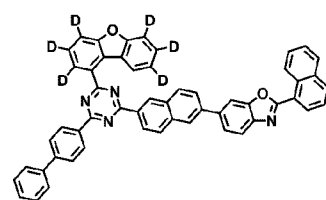
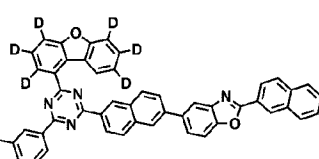
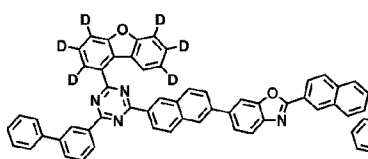
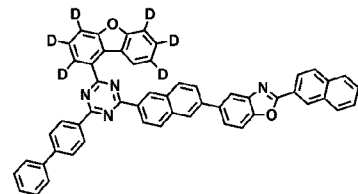
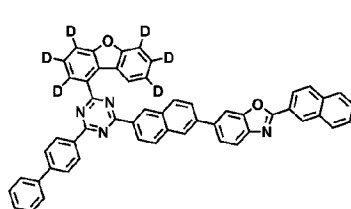
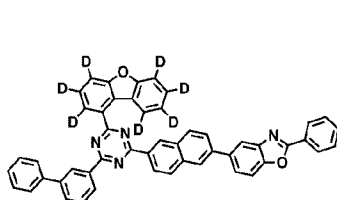
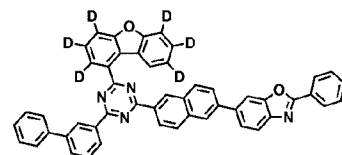
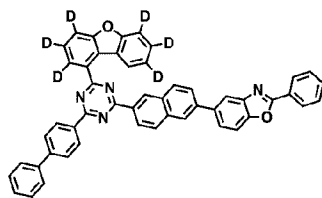
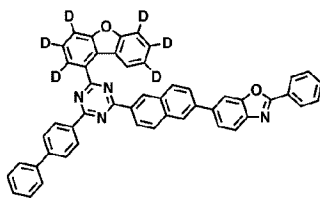
[222]



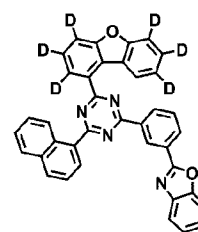
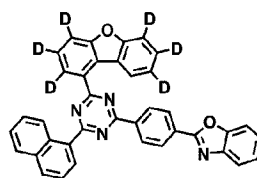
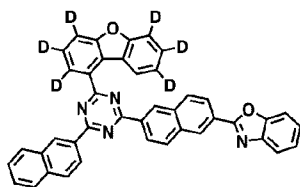
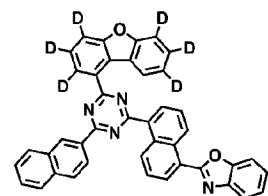
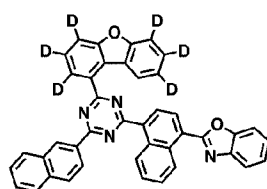
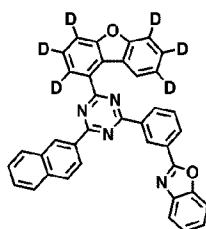
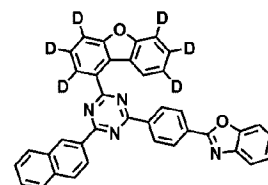
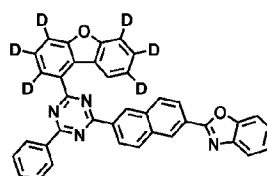
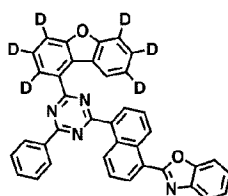
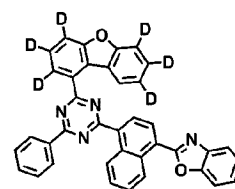
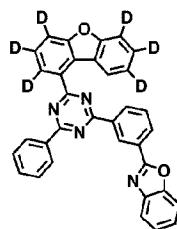
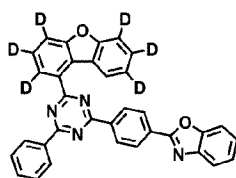
[223]



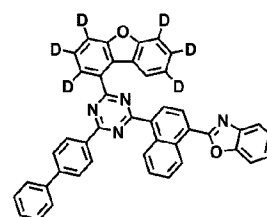
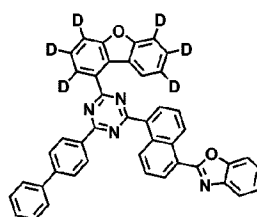
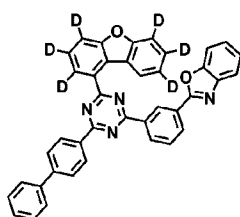
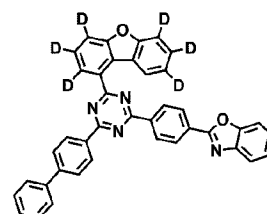
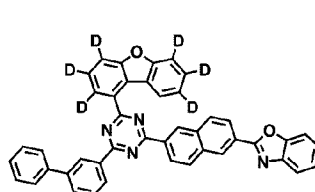
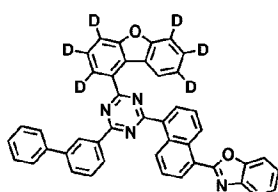
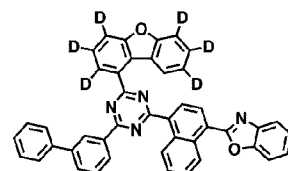
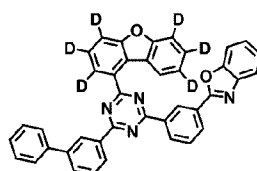
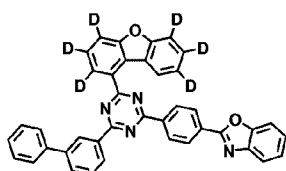
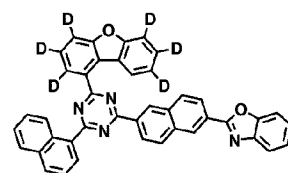
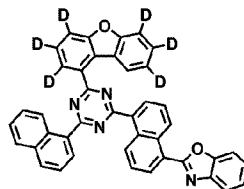
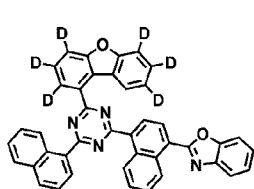
[224]



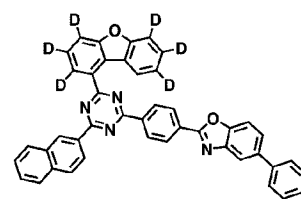
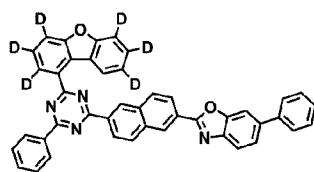
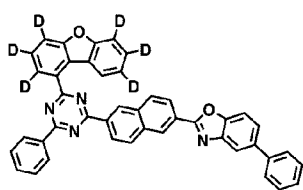
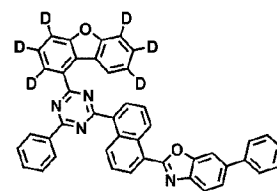
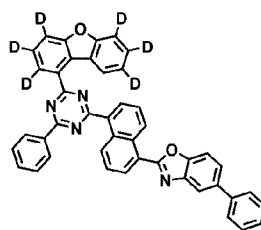
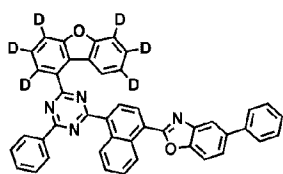
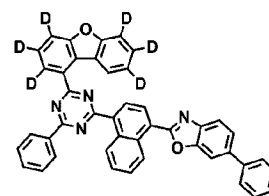
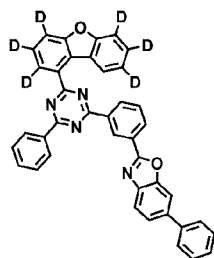
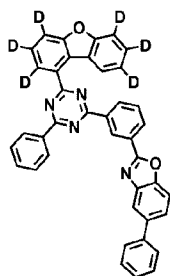
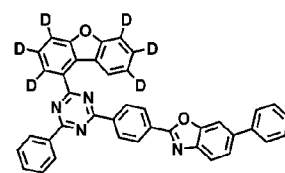
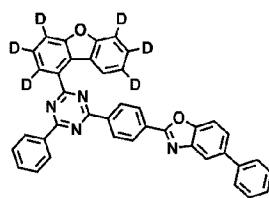
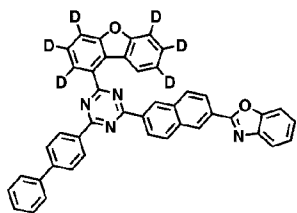
[225]



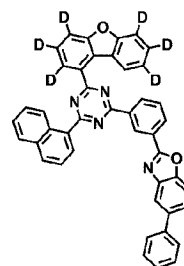
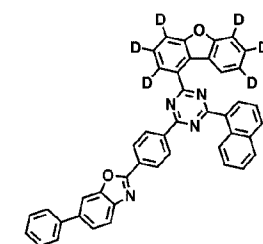
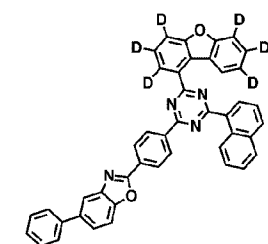
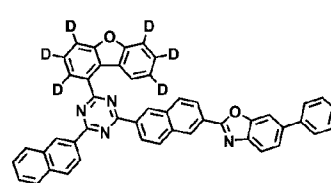
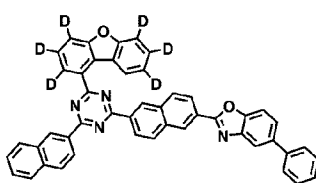
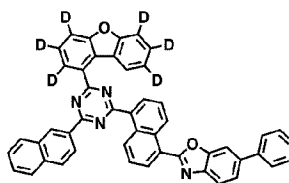
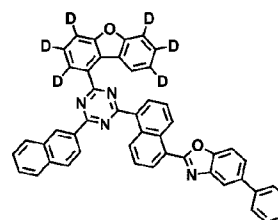
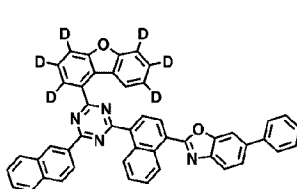
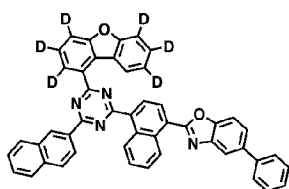
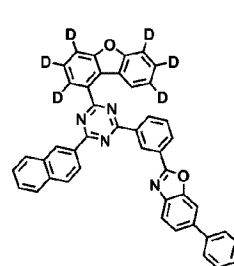
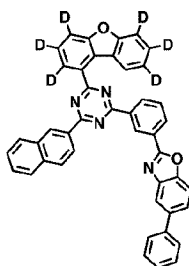
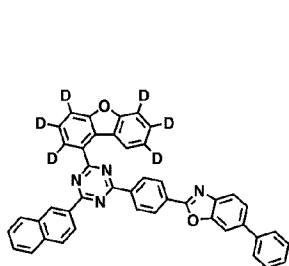
[226]



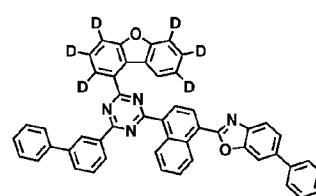
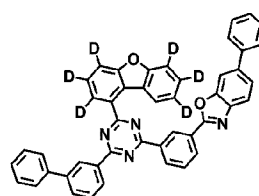
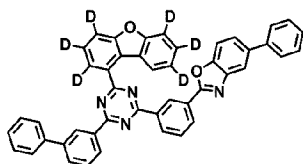
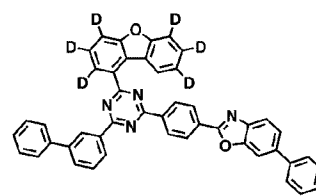
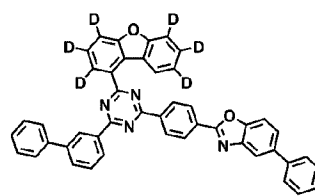
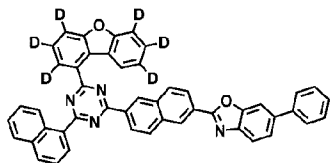
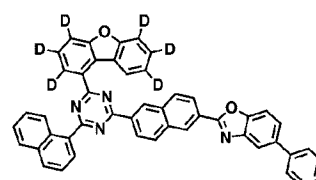
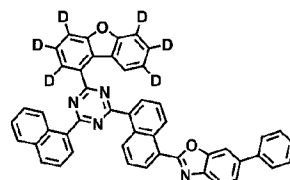
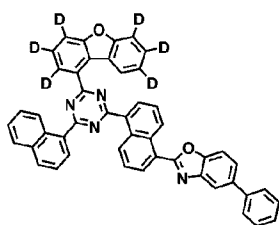
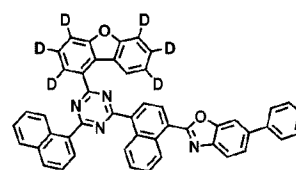
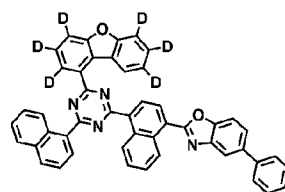
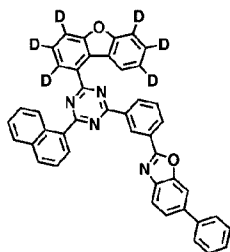
[227]



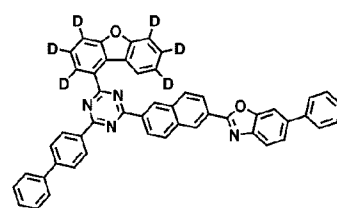
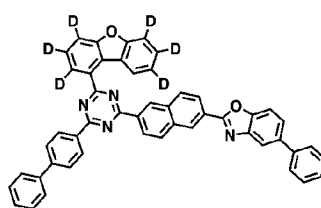
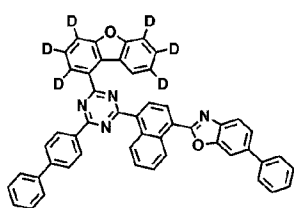
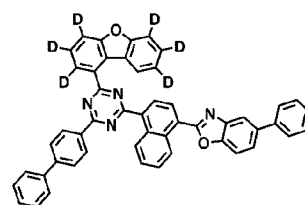
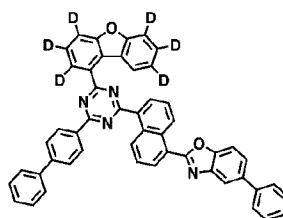
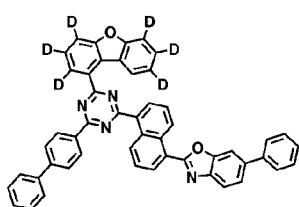
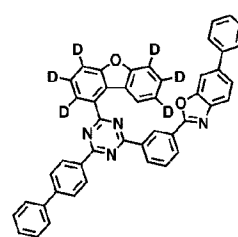
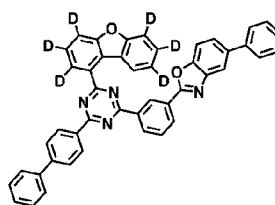
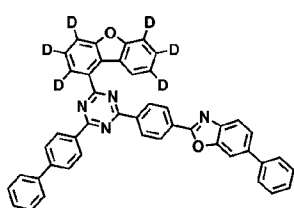
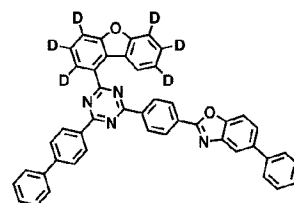
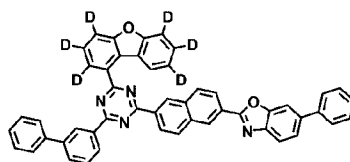
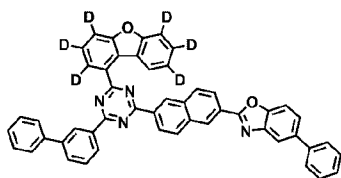
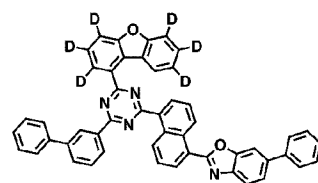
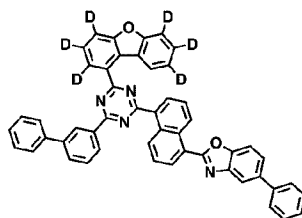
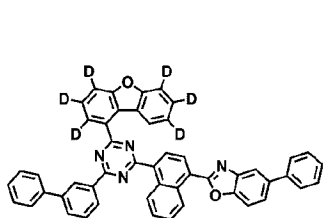
[228]



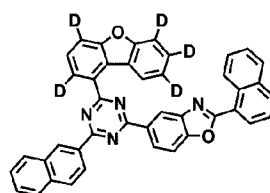
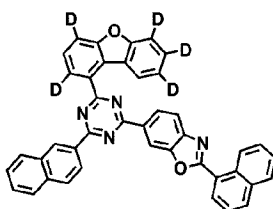
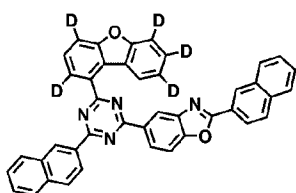
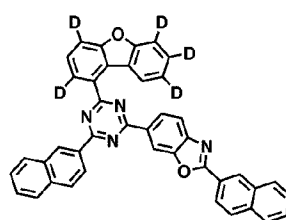
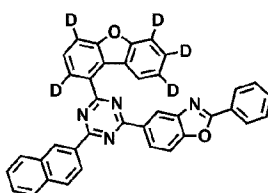
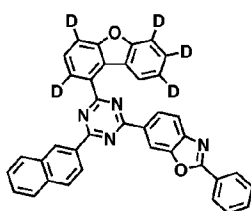
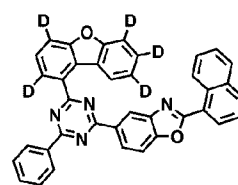
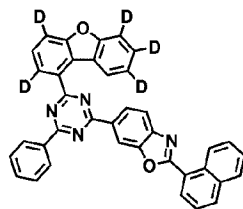
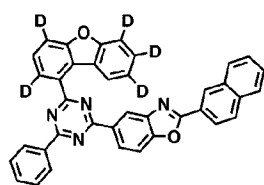
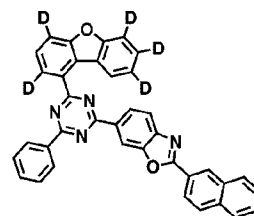
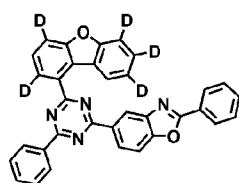
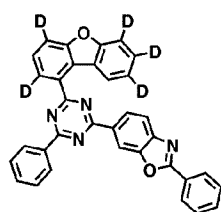
[229]



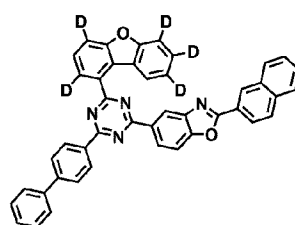
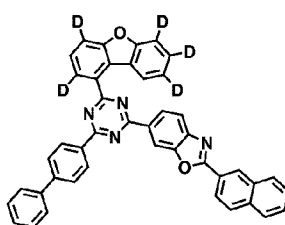
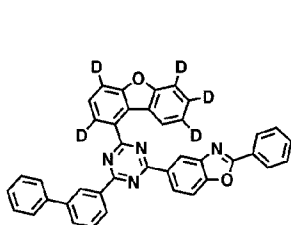
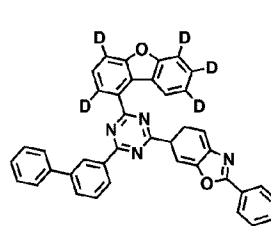
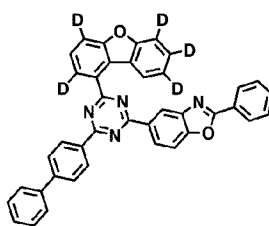
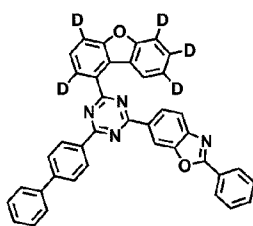
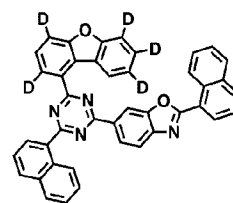
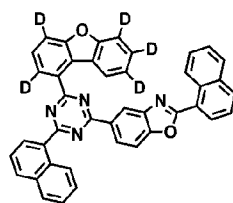
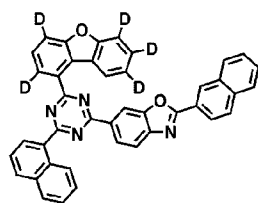
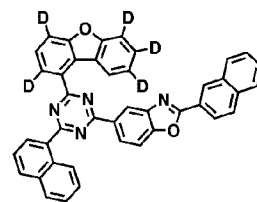
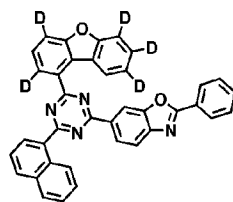
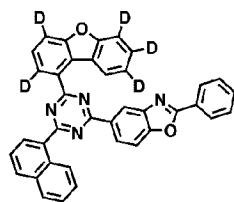
[230]



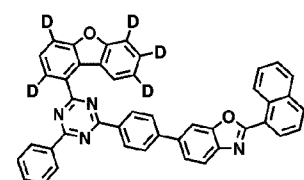
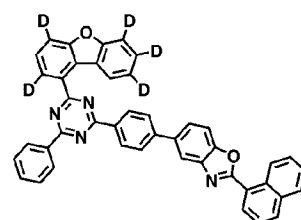
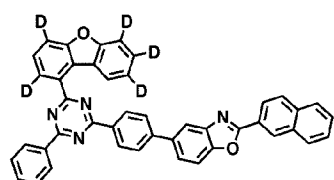
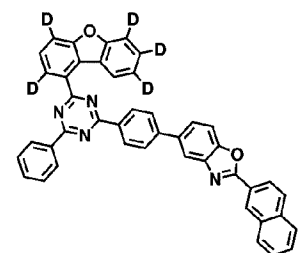
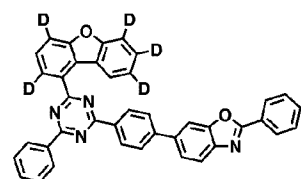
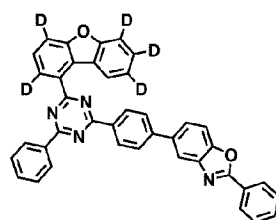
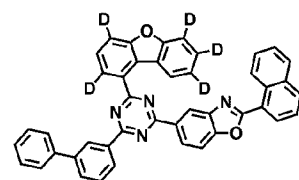
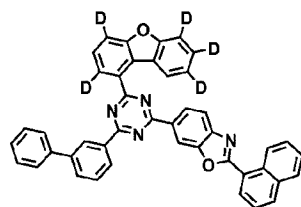
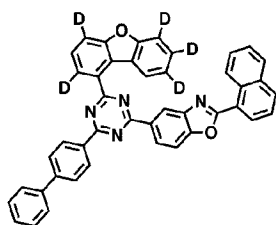
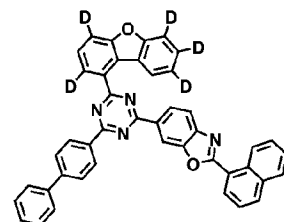
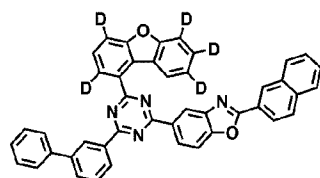
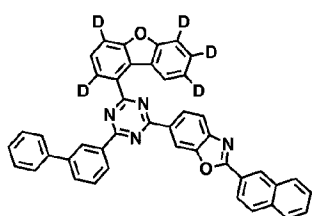
[231]



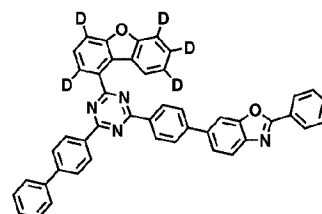
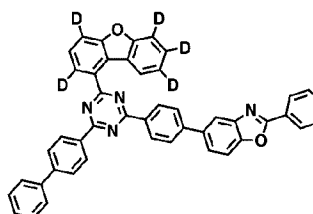
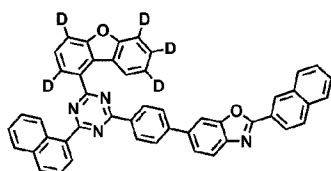
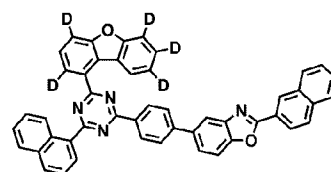
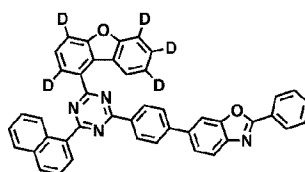
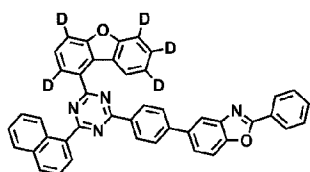
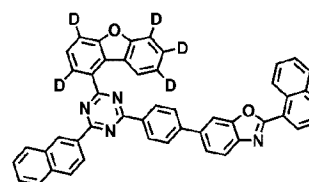
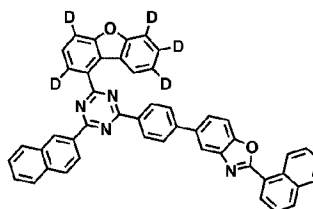
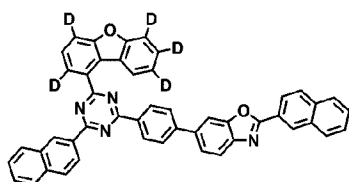
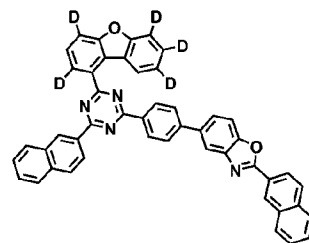
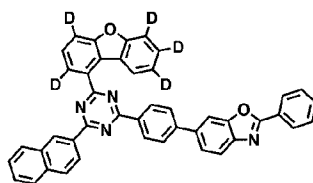
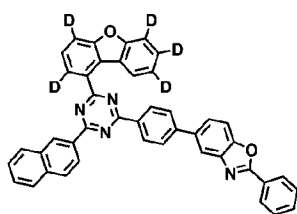
[232]



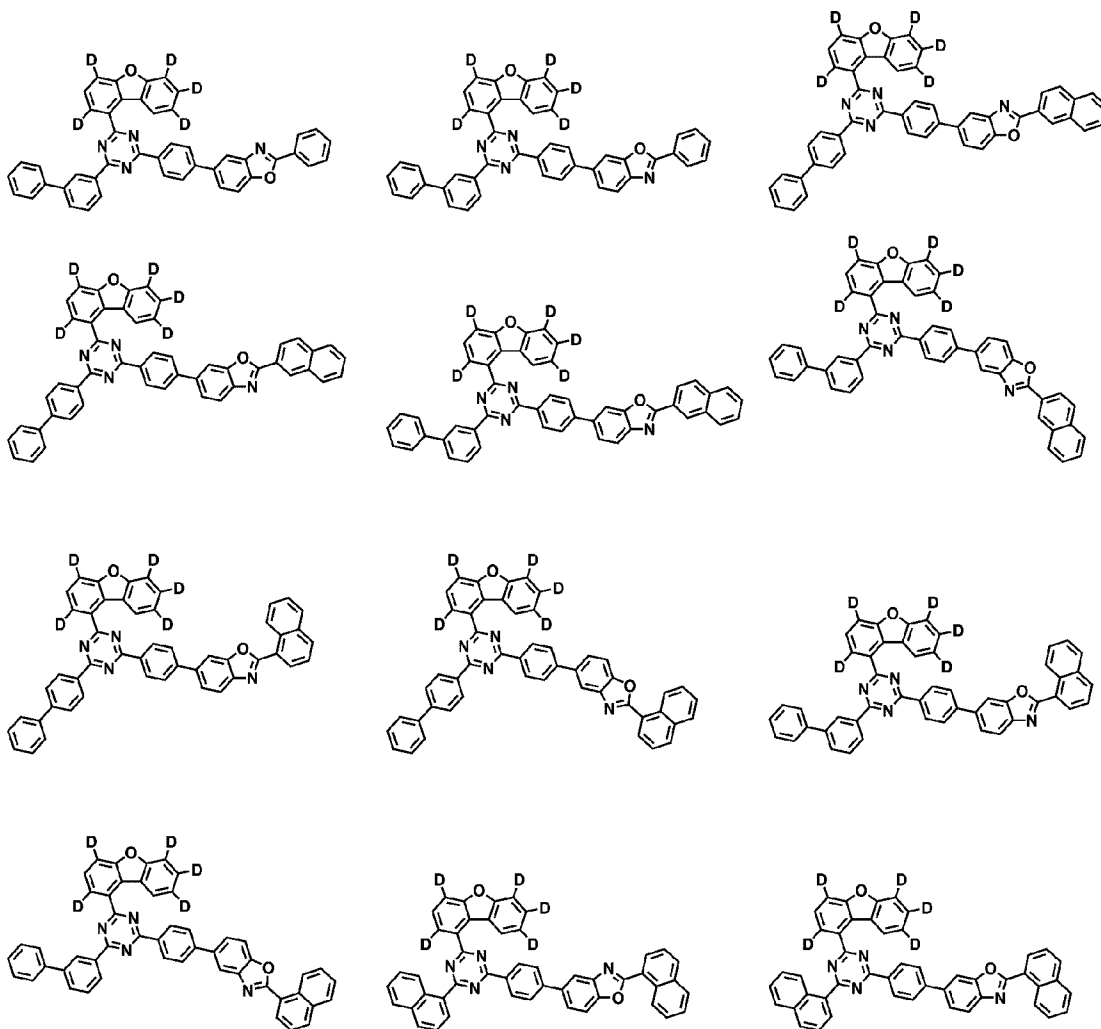
[233]



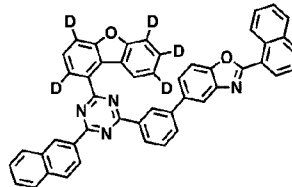
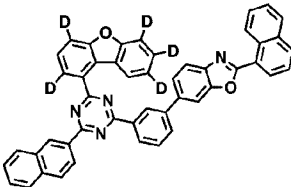
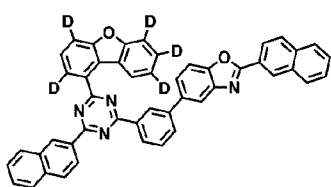
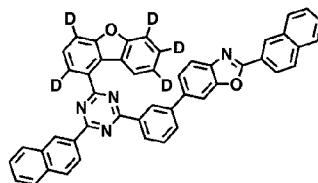
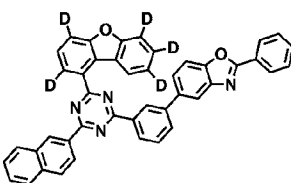
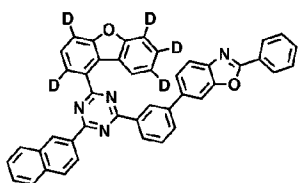
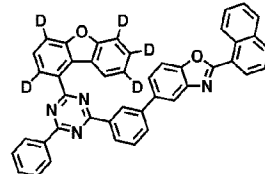
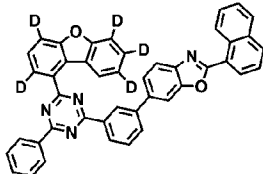
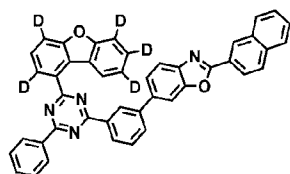
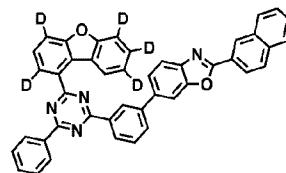
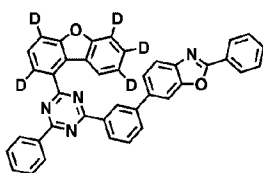
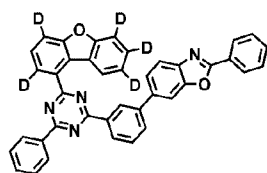
[234]



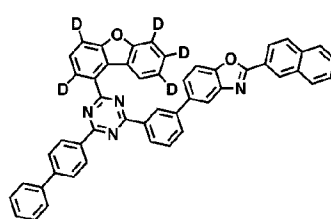
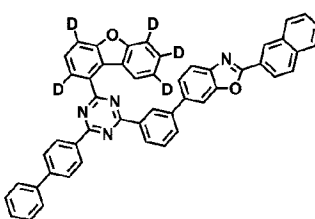
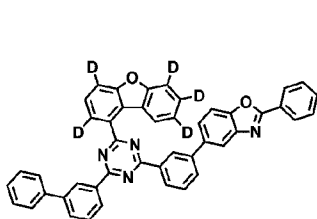
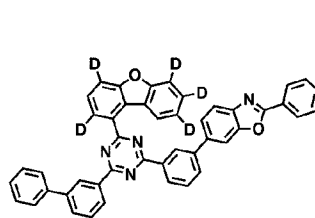
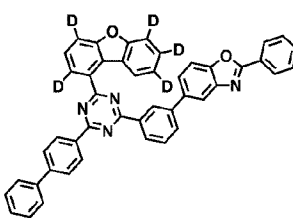
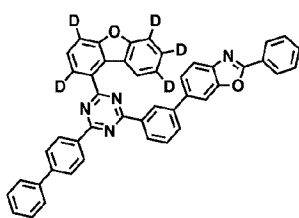
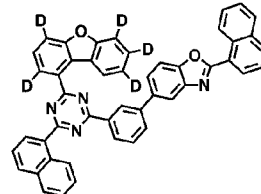
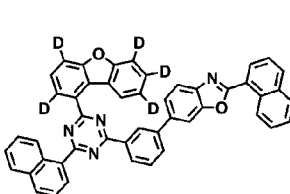
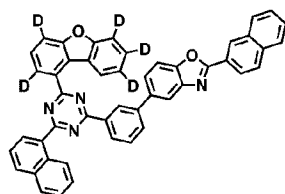
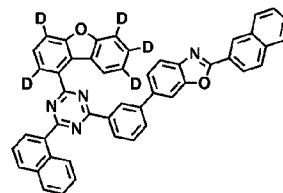
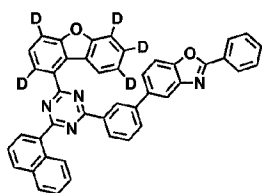
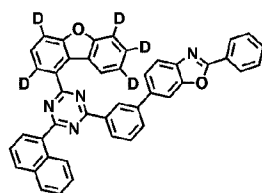
[235]



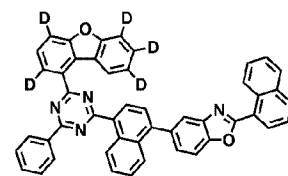
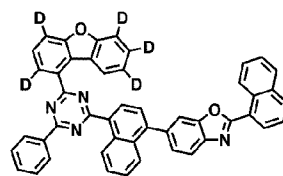
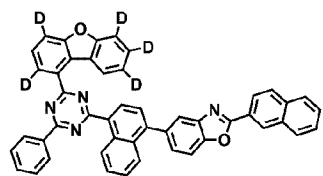
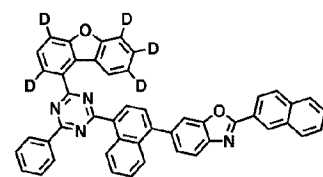
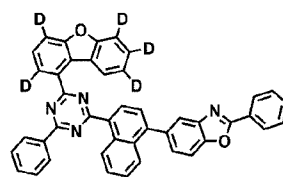
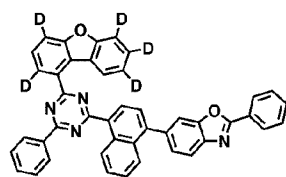
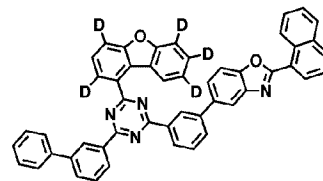
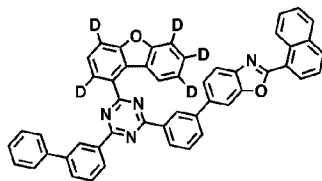
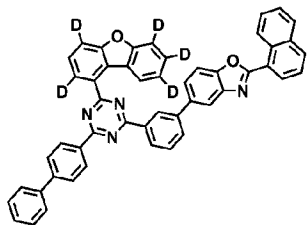
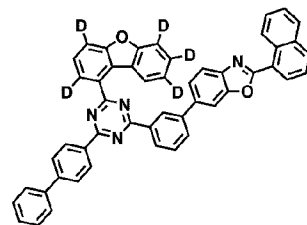
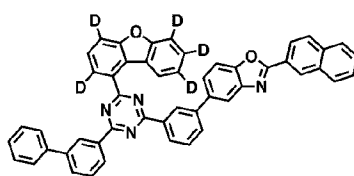
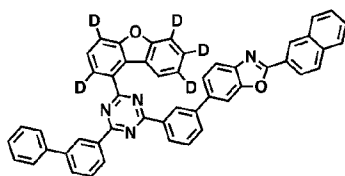
[236]

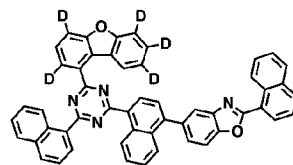
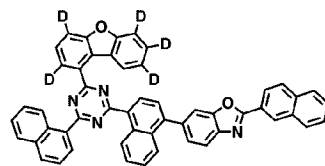
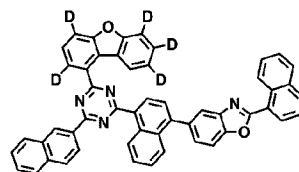


[237]

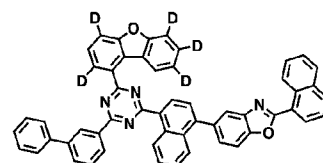
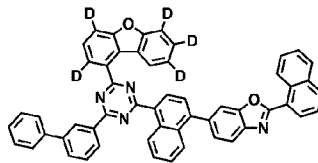
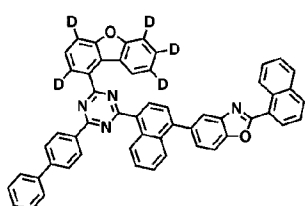
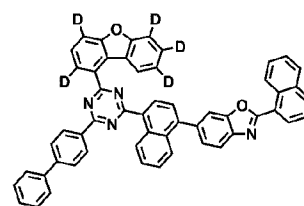
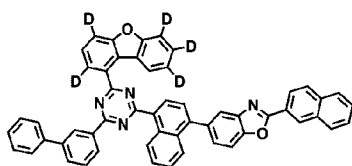
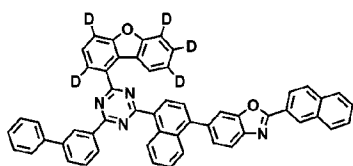
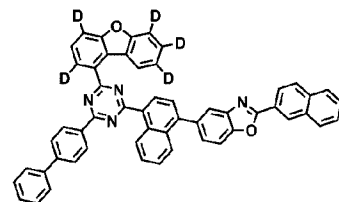
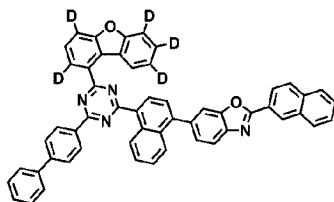
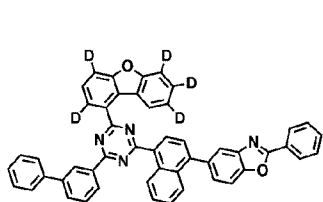
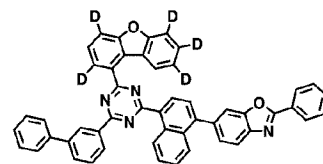
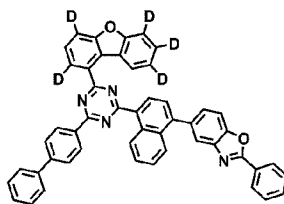
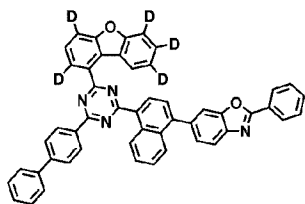


[238]

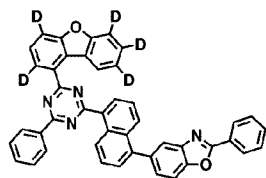




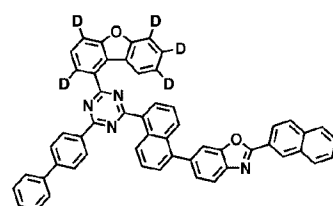
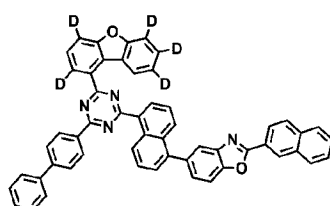
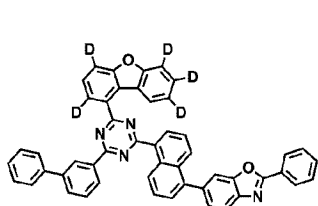
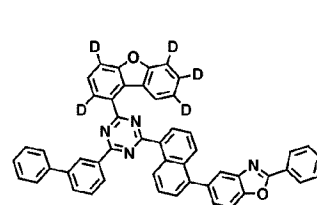
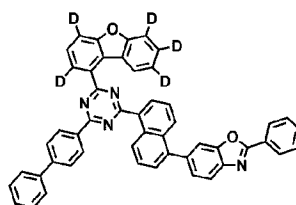
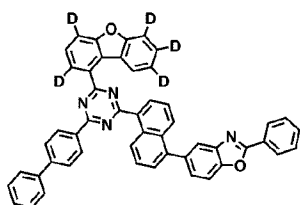
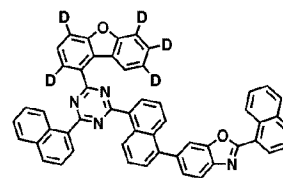
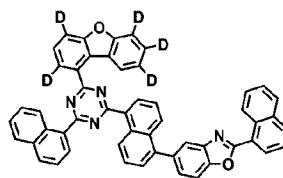
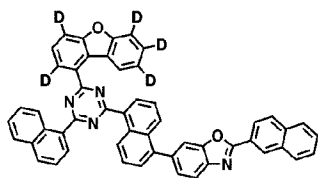
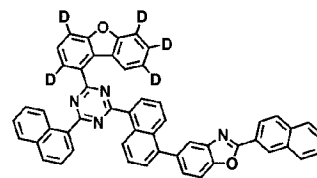
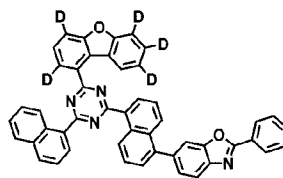
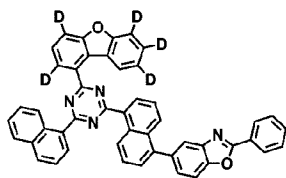
[240]



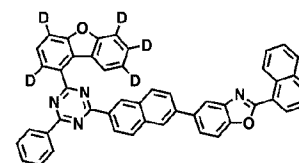
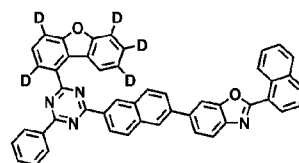
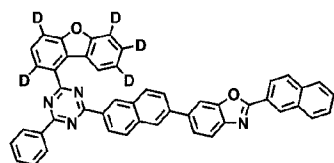
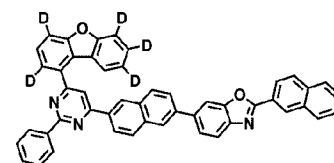
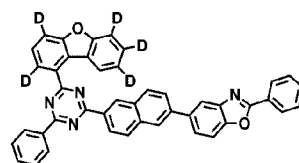
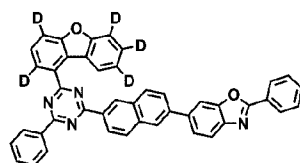
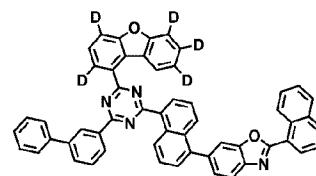
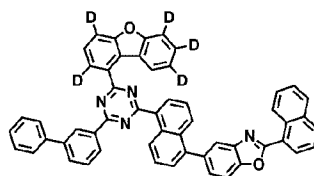
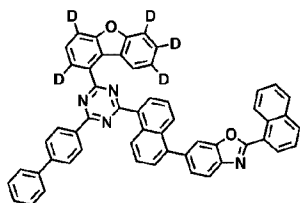
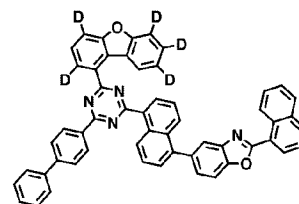
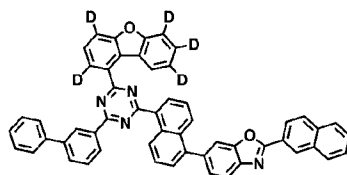
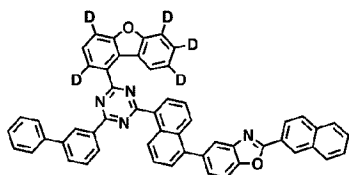
[241]



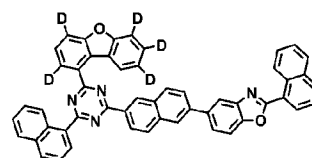
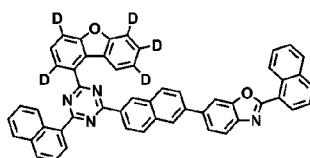
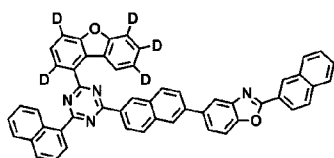
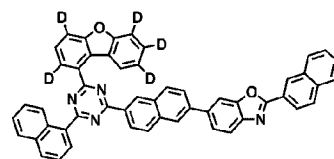
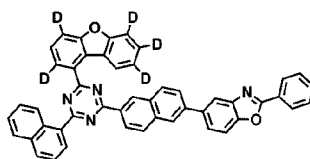
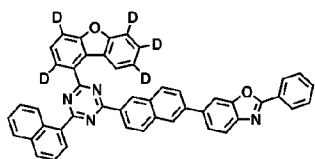
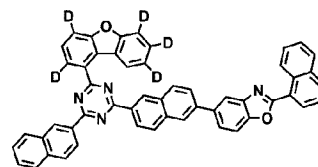
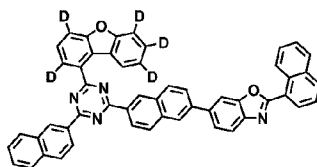
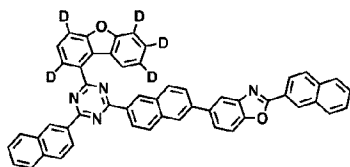
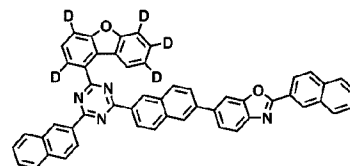
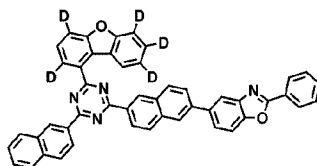
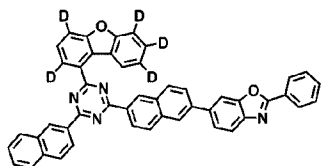
[242]



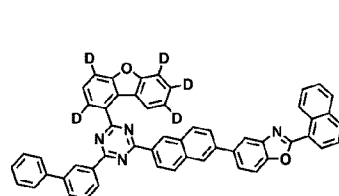
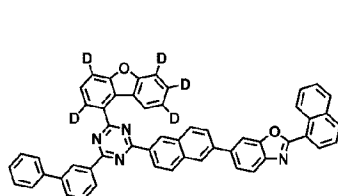
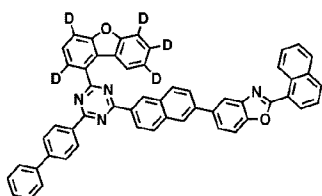
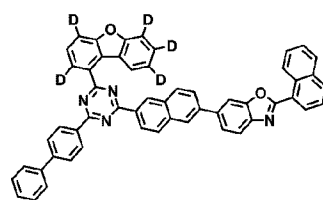
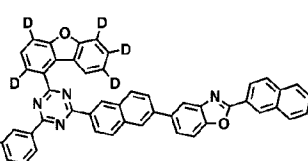
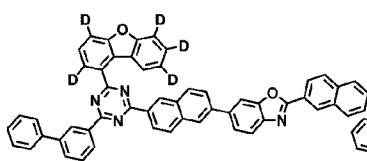
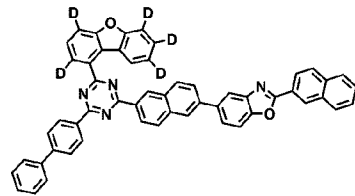
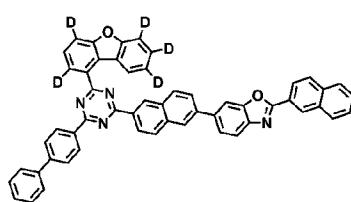
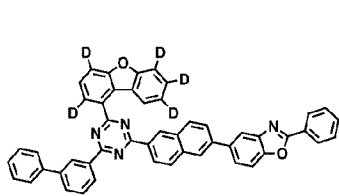
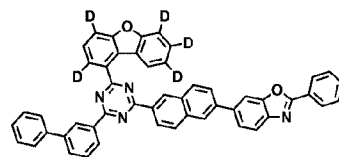
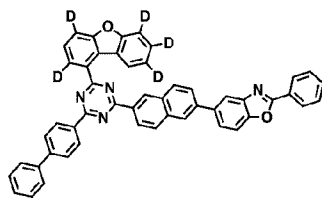
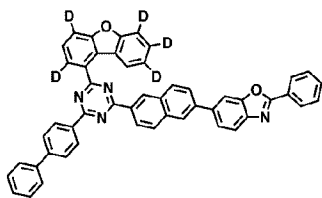
[243]



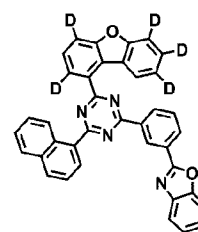
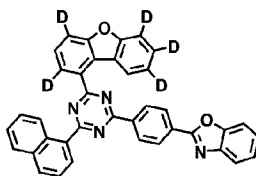
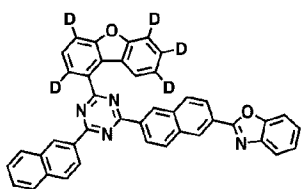
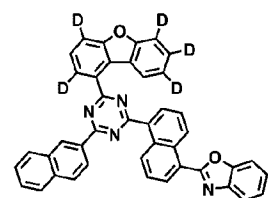
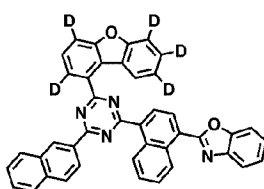
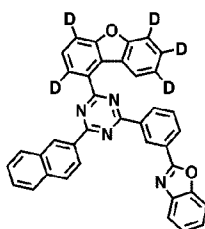
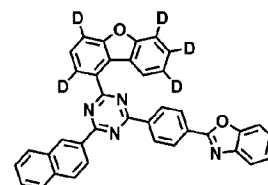
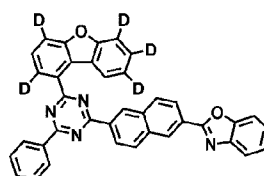
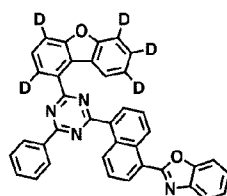
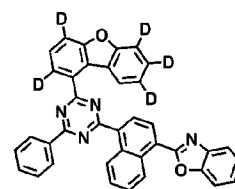
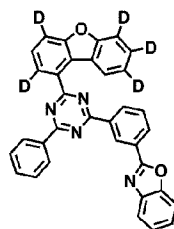
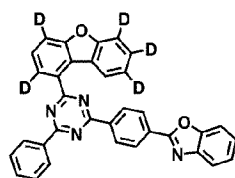
[244]



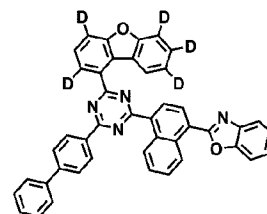
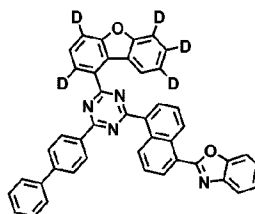
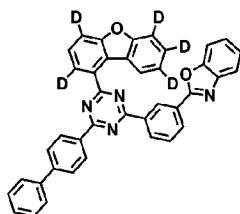
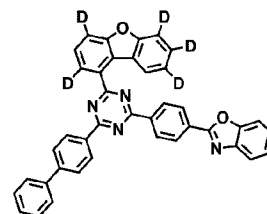
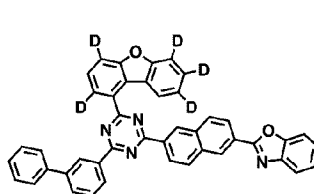
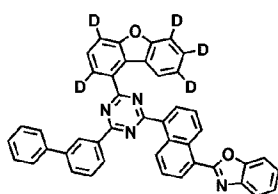
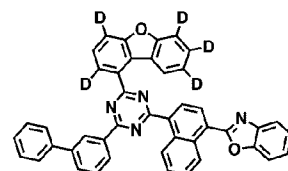
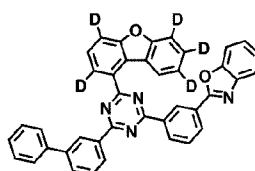
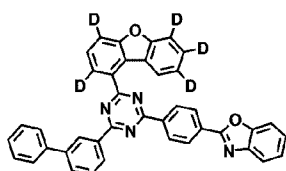
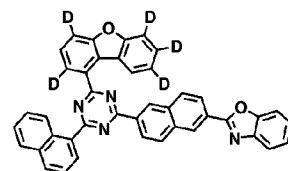
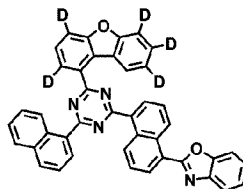
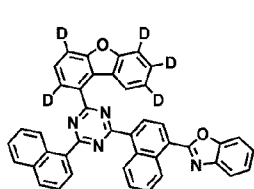
[245]



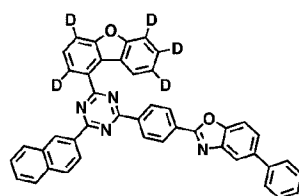
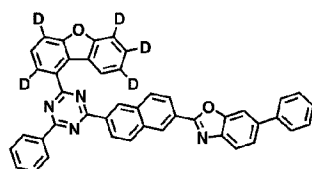
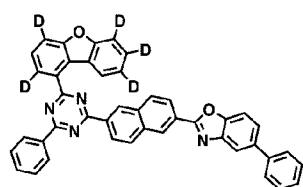
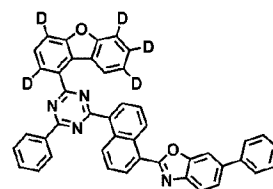
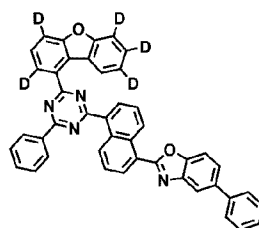
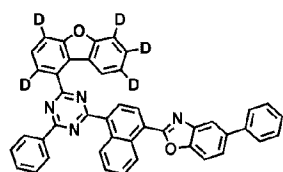
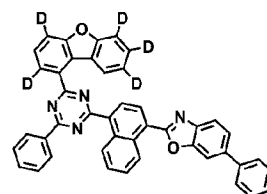
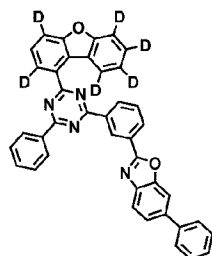
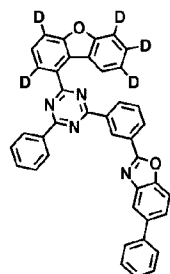
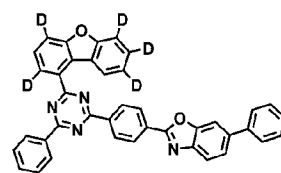
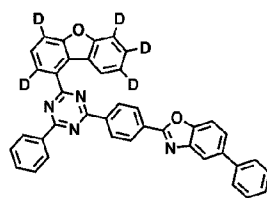
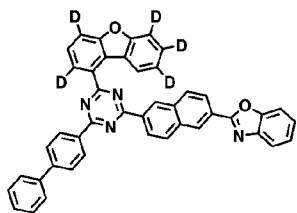
[246]



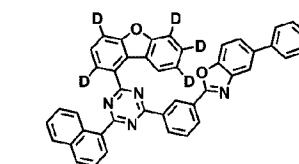
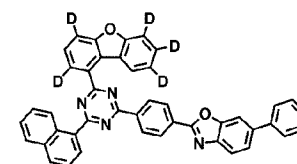
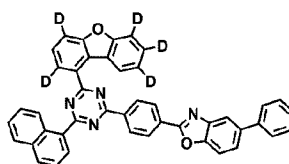
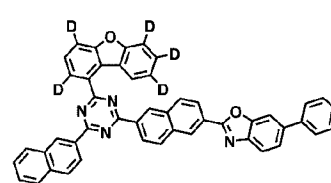
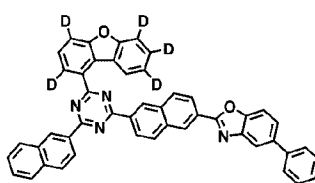
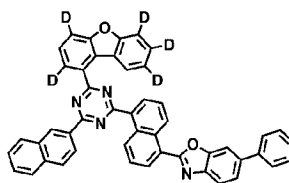
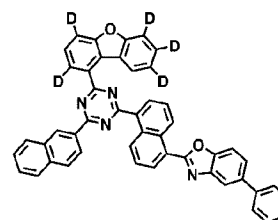
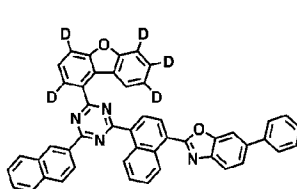
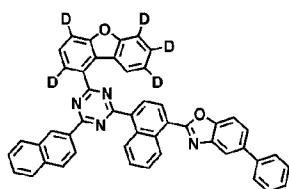
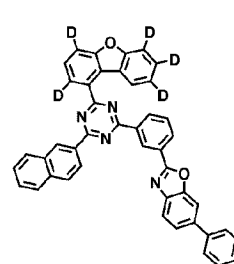
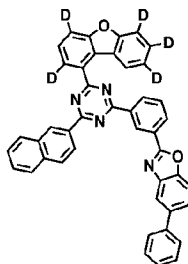
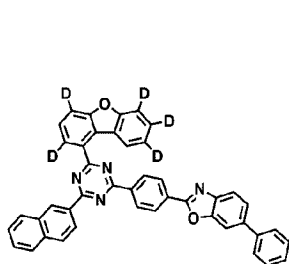
[247]



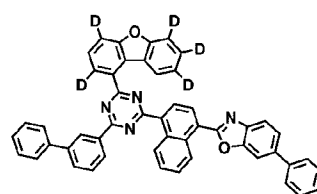
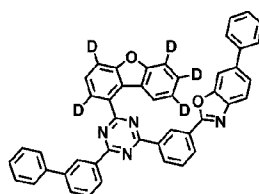
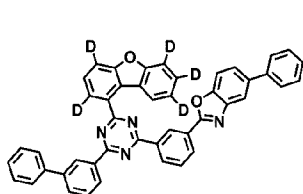
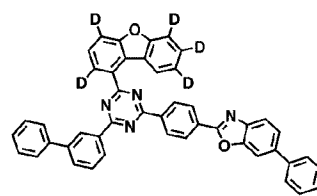
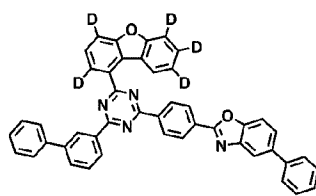
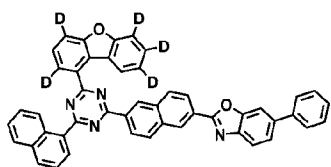
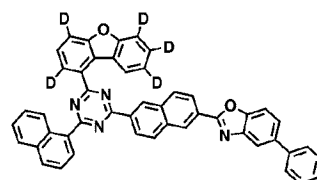
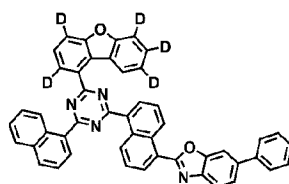
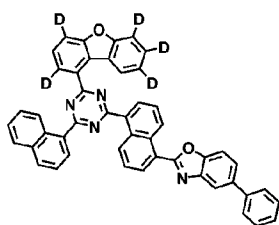
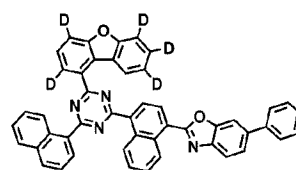
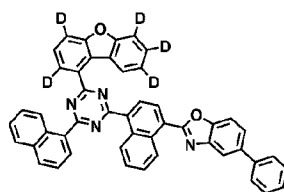
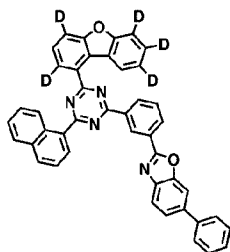
[248]



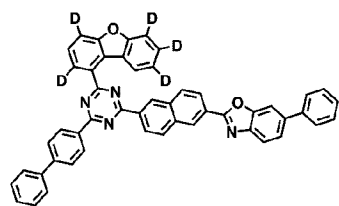
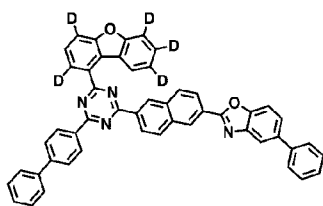
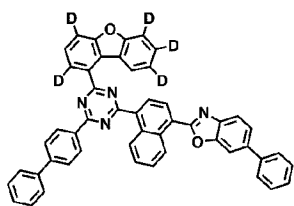
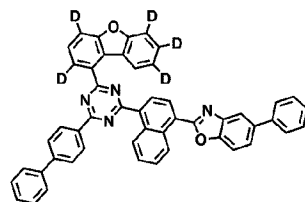
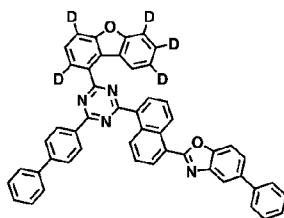
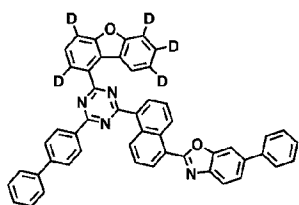
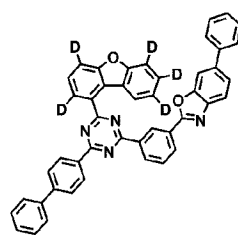
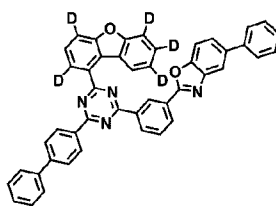
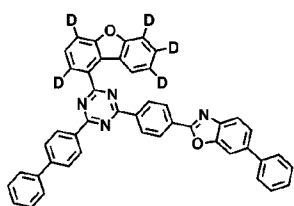
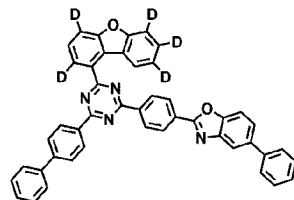
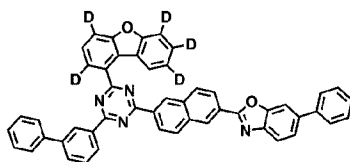
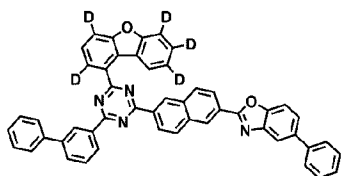
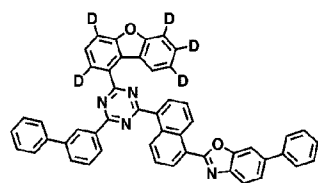
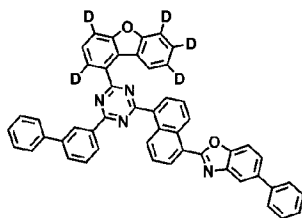
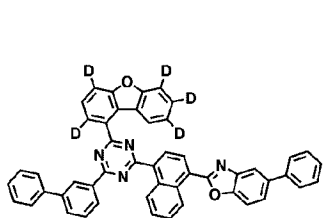
[249]



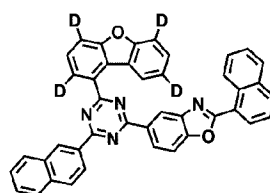
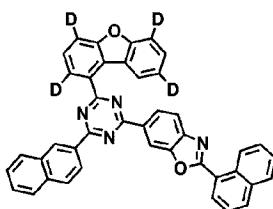
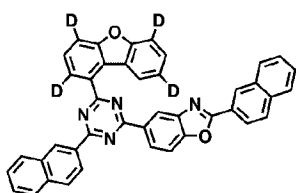
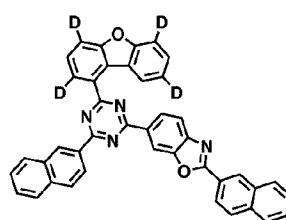
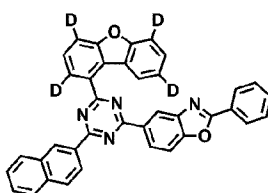
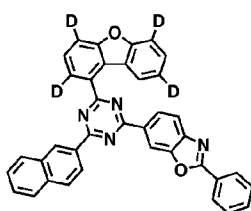
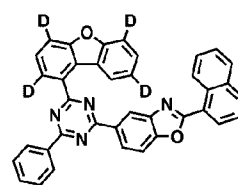
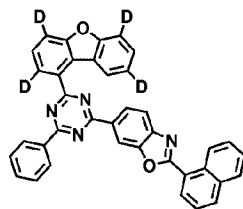
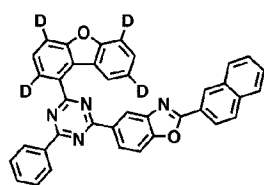
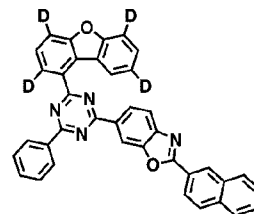
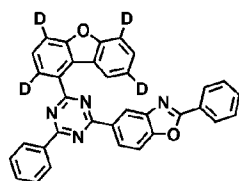
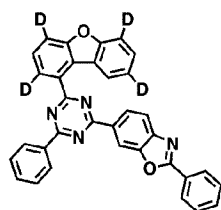
[250]



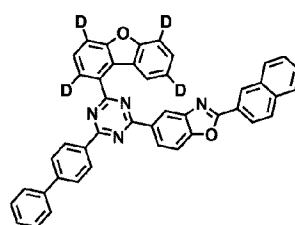
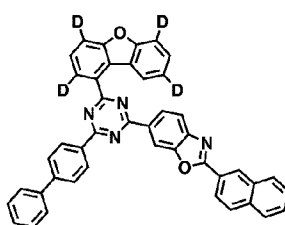
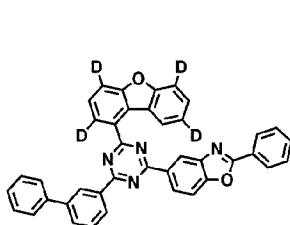
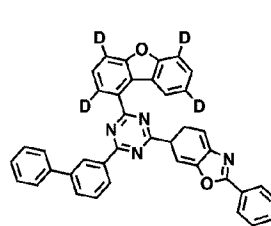
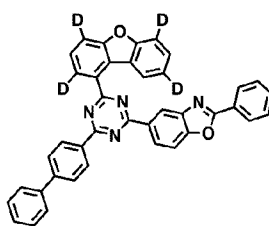
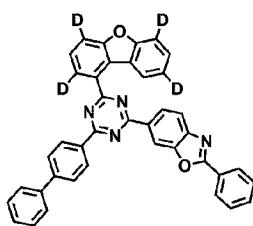
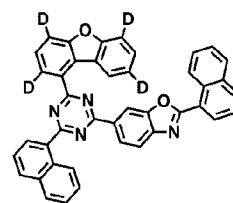
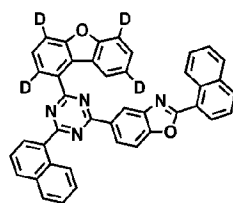
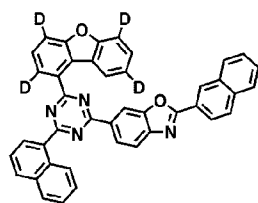
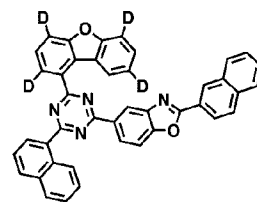
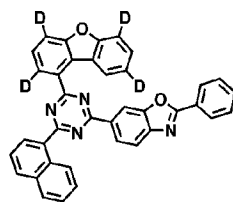
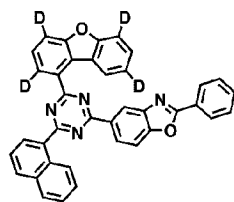
[251]



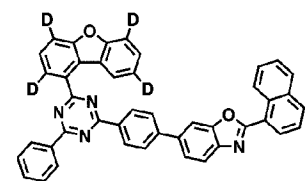
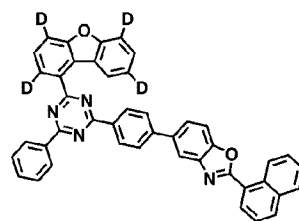
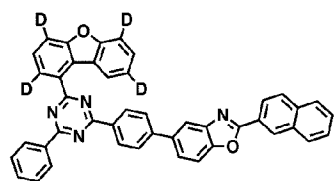
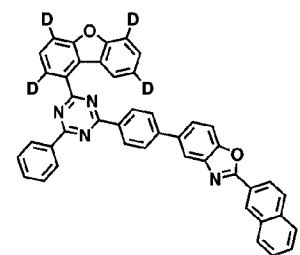
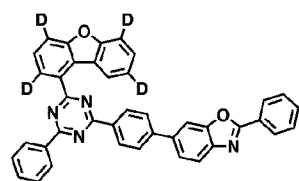
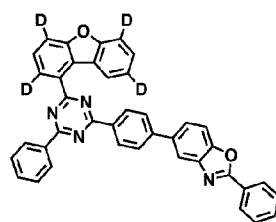
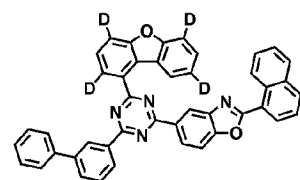
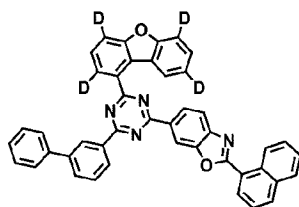
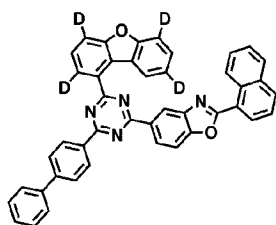
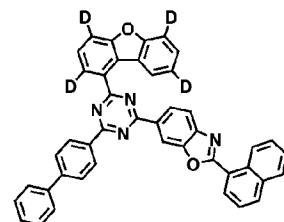
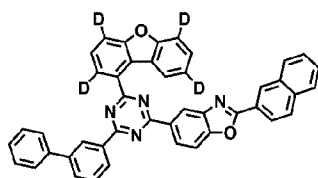
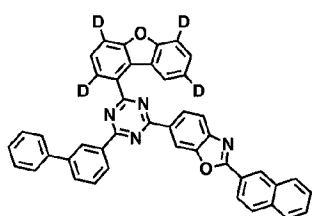
[252]



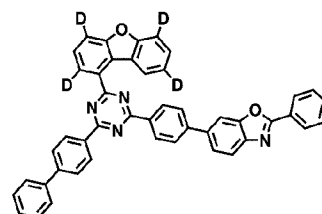
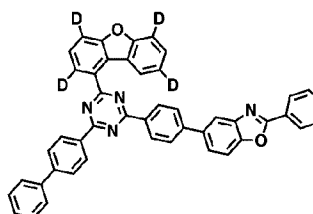
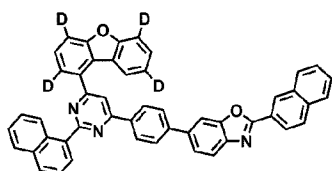
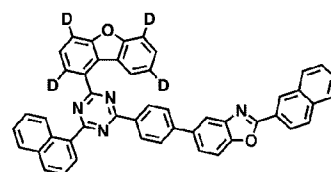
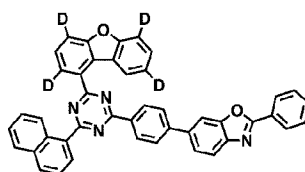
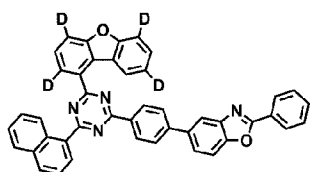
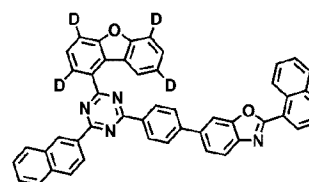
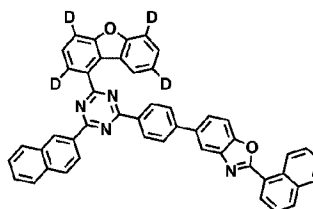
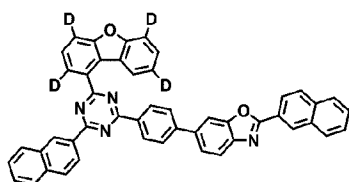
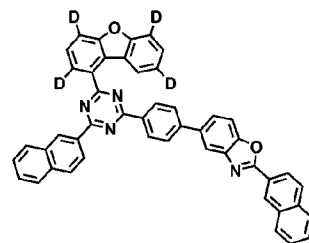
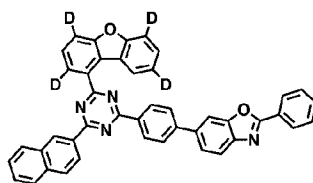
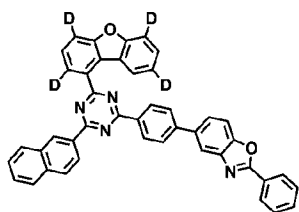
[253]



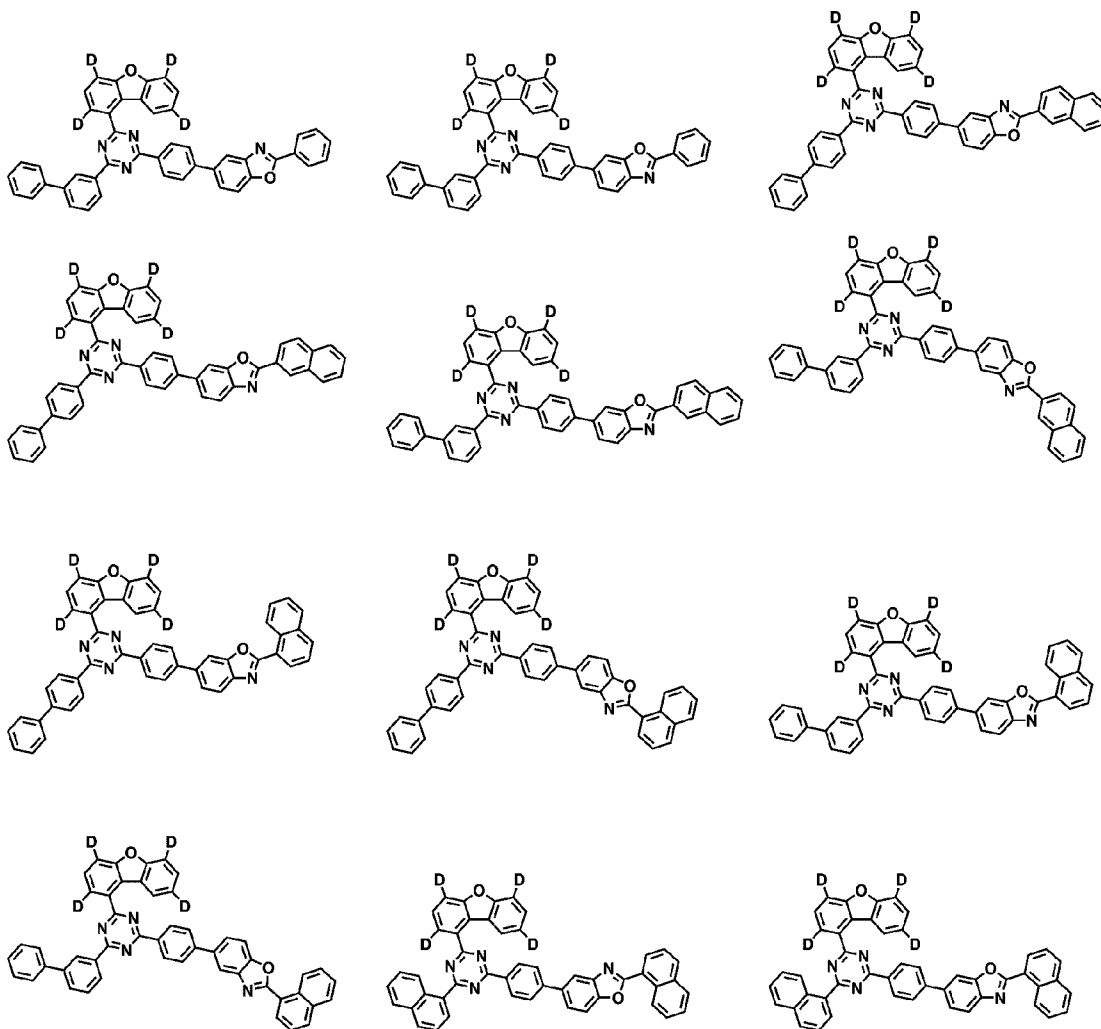
[254]



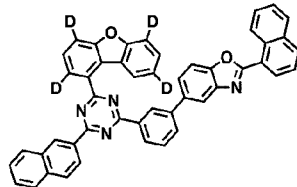
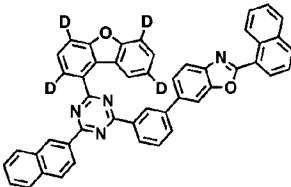
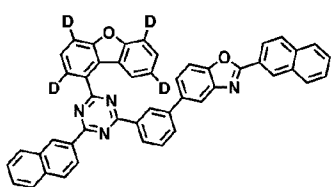
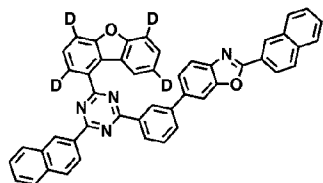
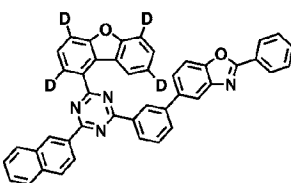
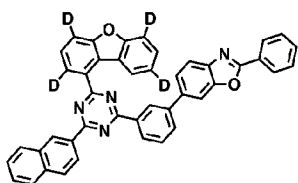
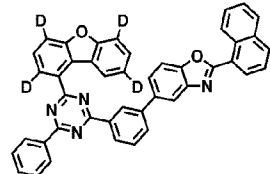
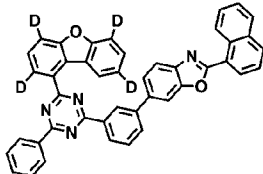
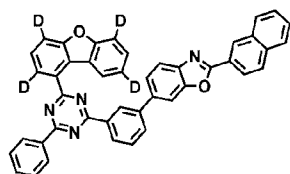
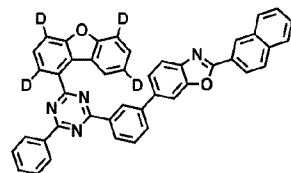
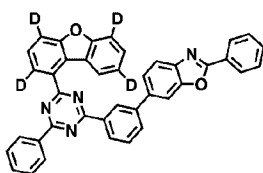
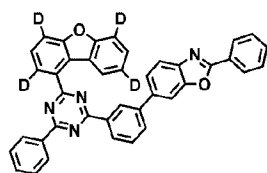
[255]



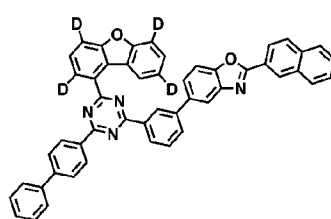
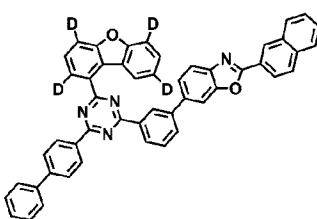
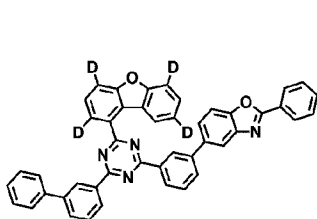
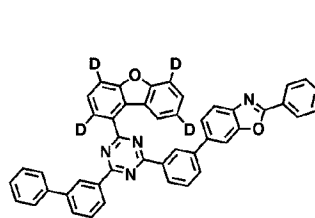
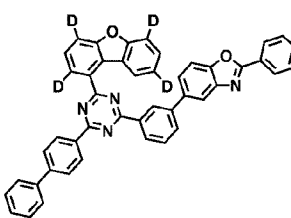
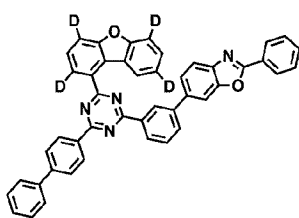
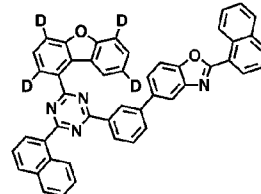
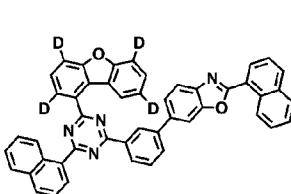
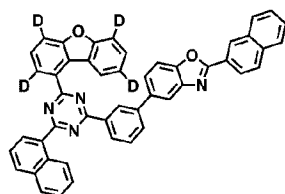
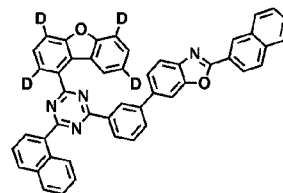
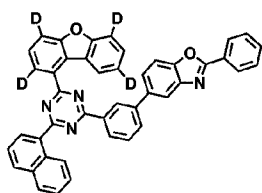
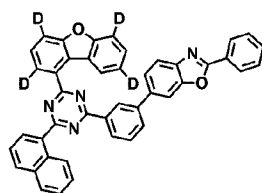
[256]

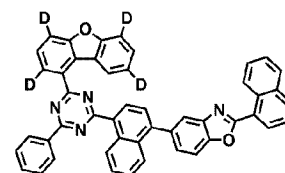
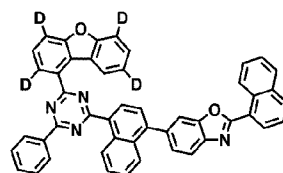
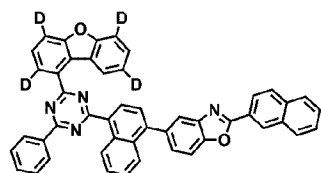
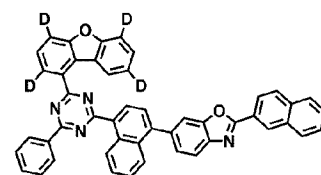
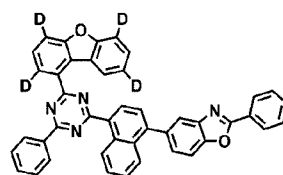
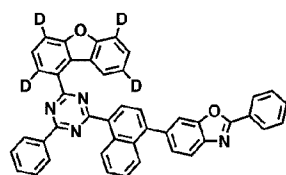
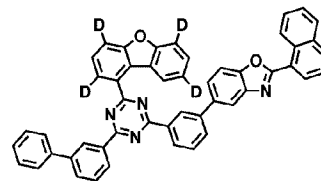
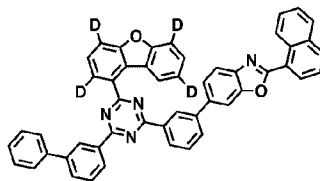
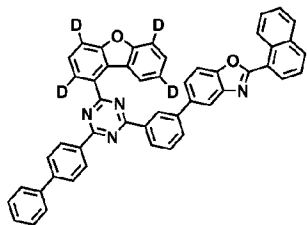
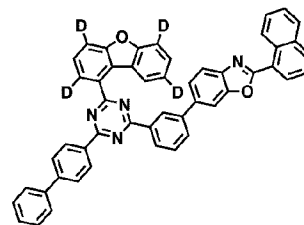
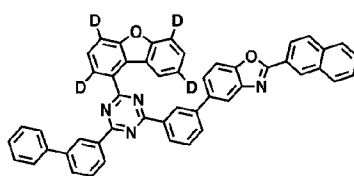


[257]

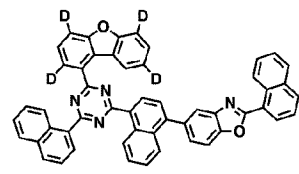
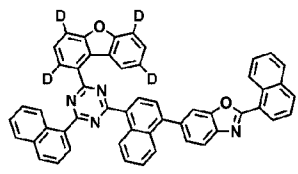
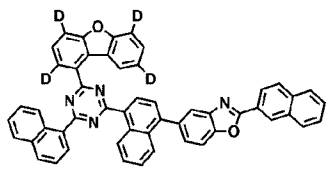
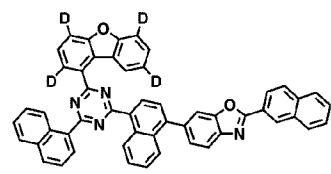
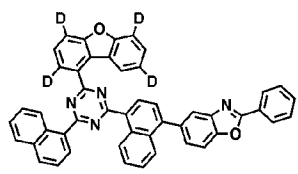
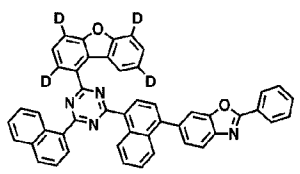
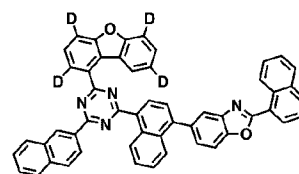
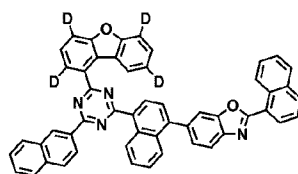
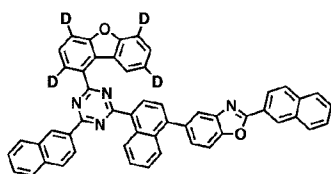
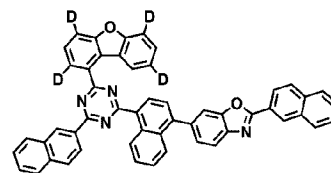
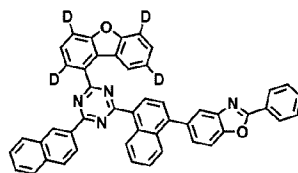
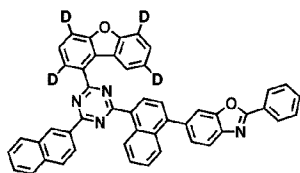


[258]

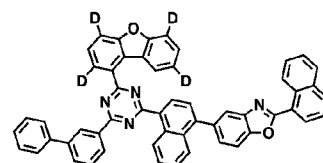
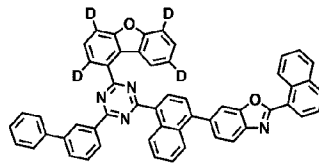
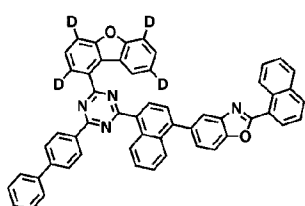
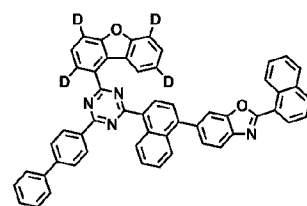
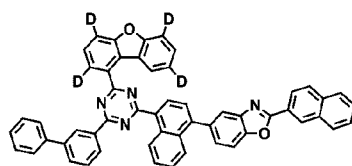
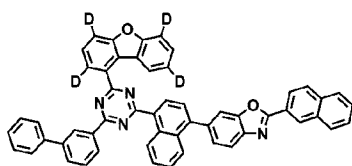
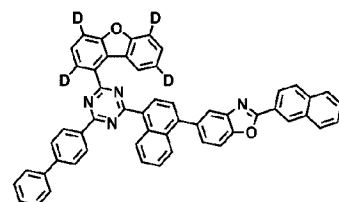
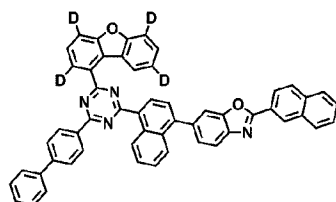
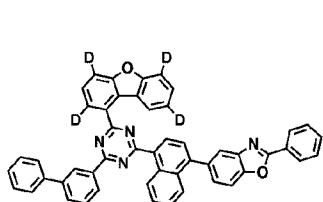
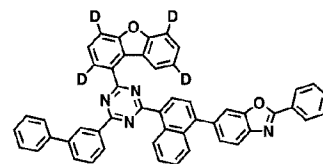
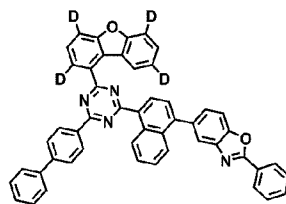
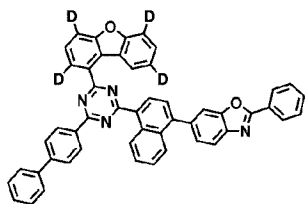




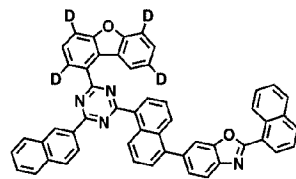
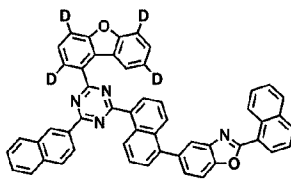
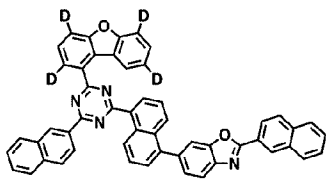
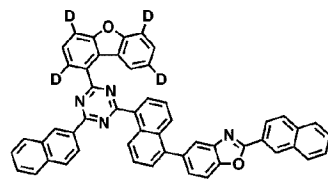
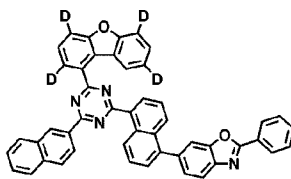
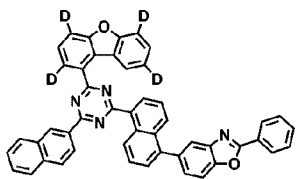
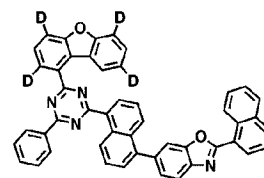
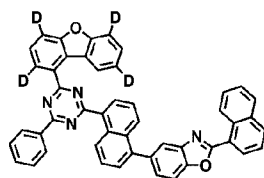
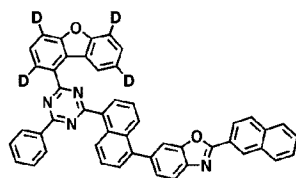
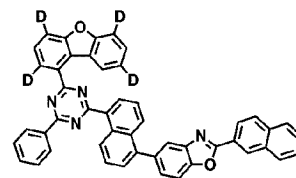
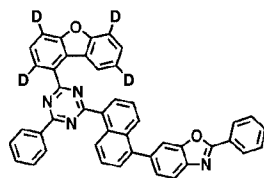
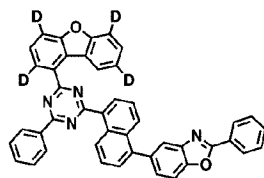
[260]



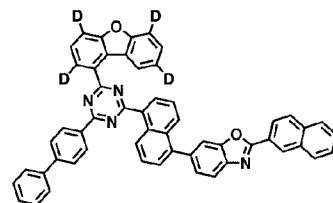
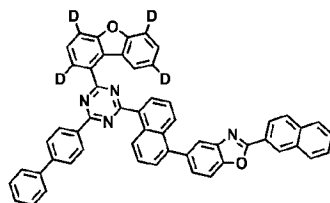
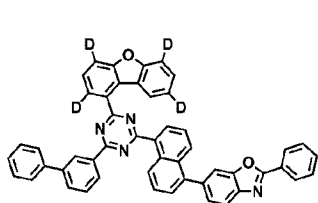
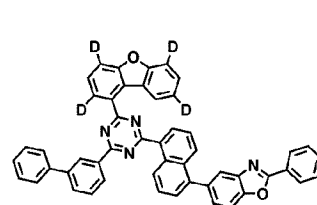
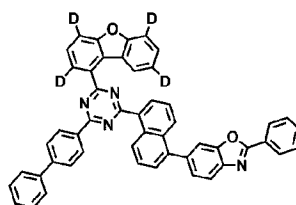
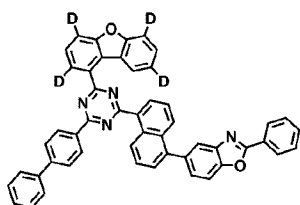
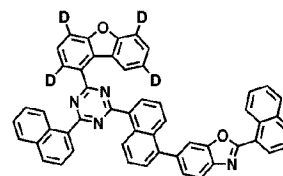
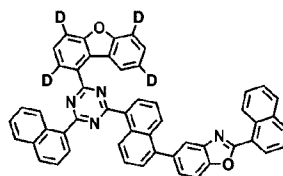
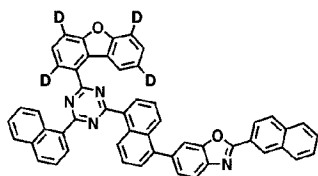
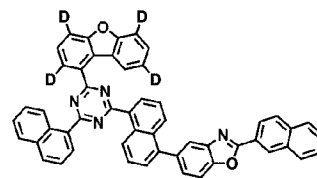
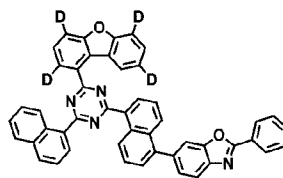
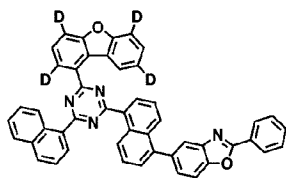
[261]



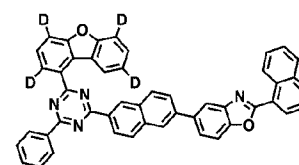
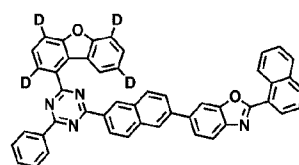
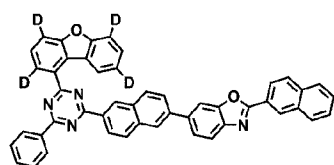
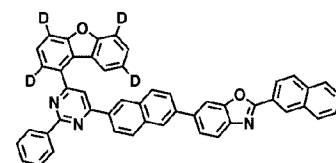
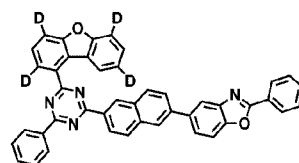
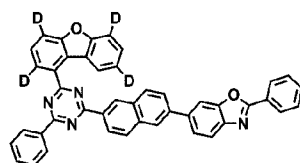
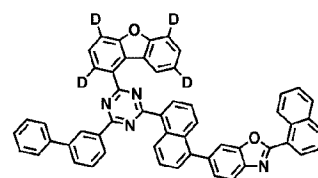
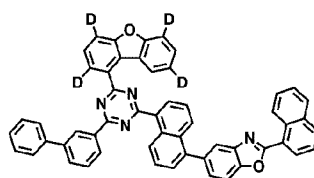
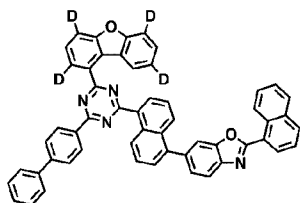
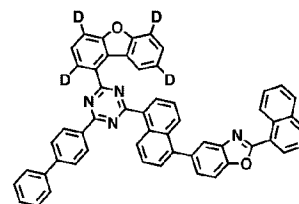
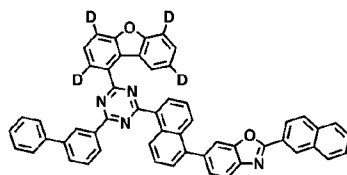
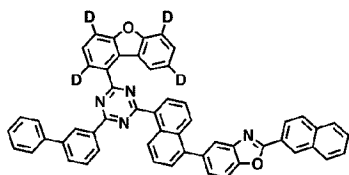
[262]



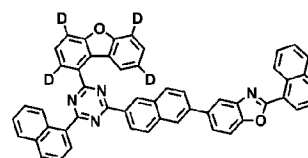
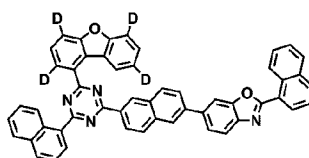
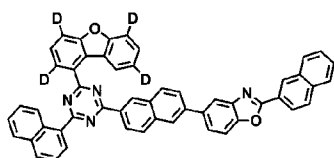
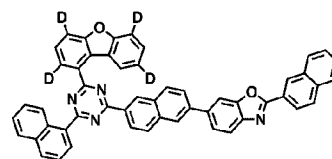
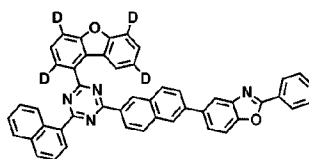
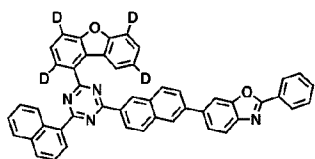
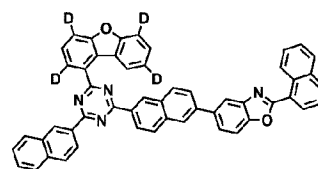
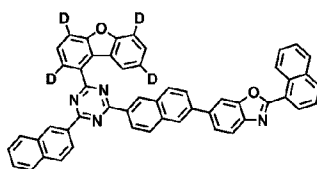
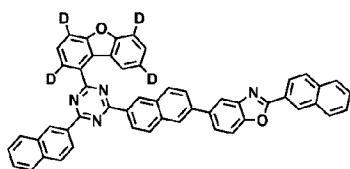
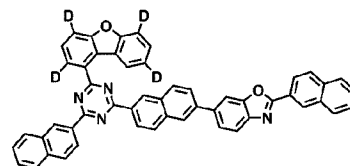
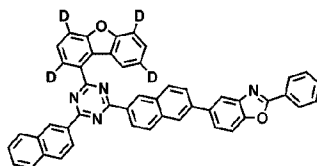
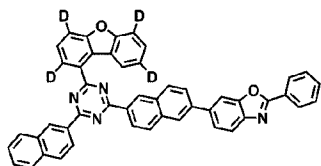
[263]



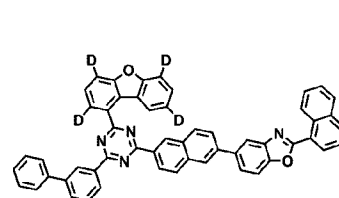
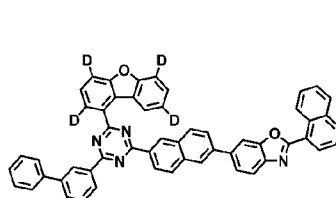
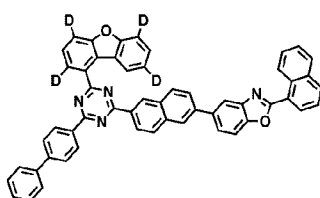
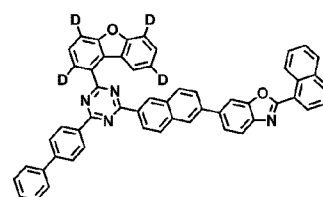
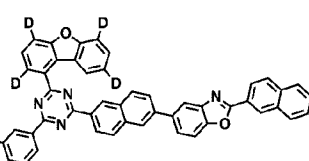
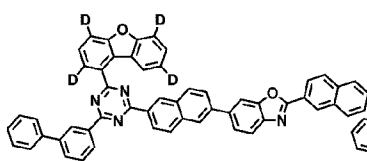
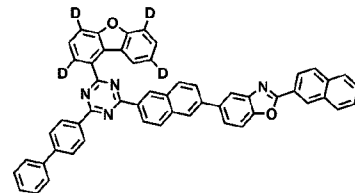
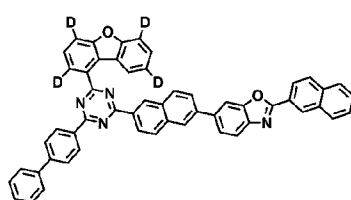
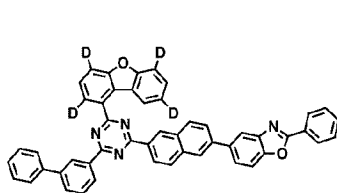
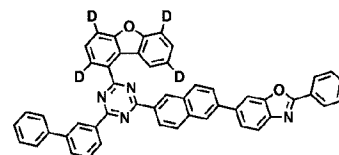
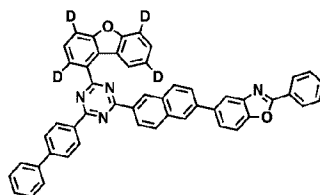
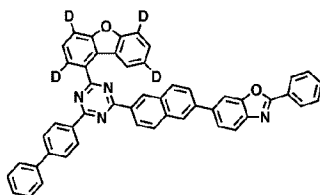
[264]



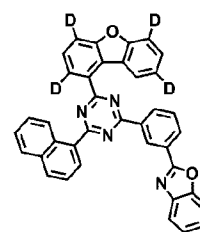
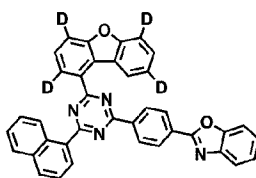
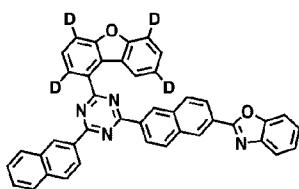
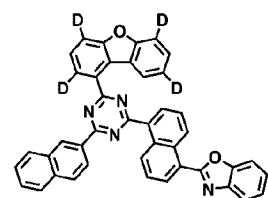
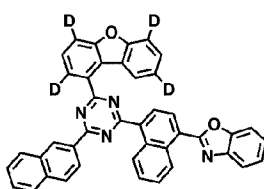
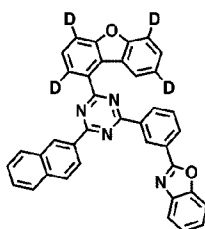
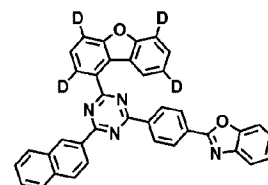
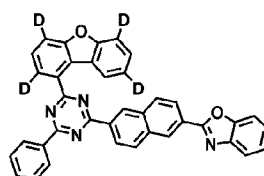
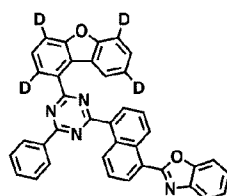
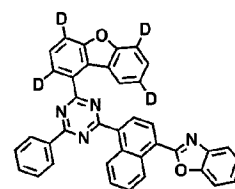
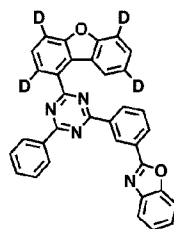
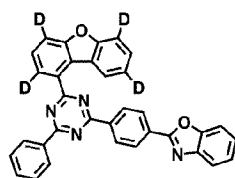
[265]



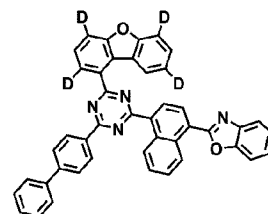
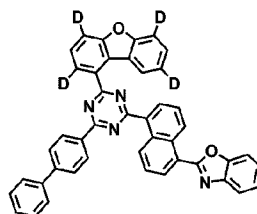
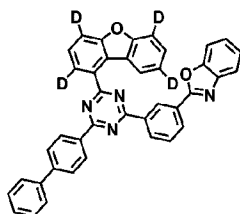
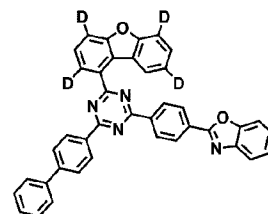
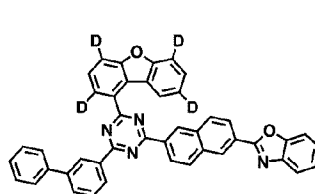
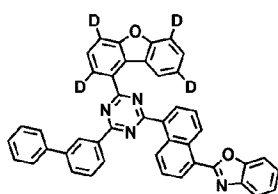
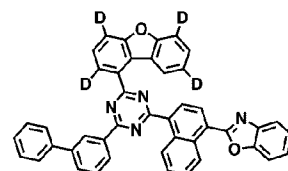
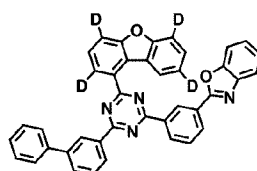
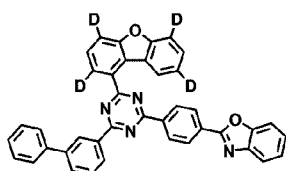
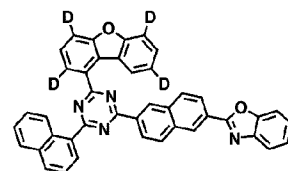
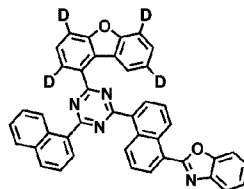
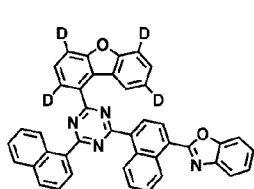
[266]



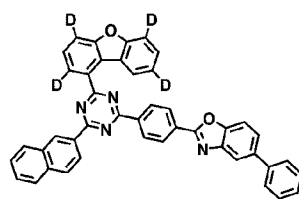
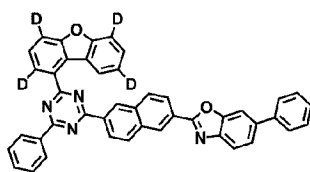
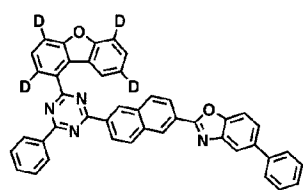
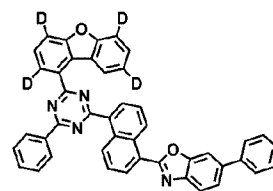
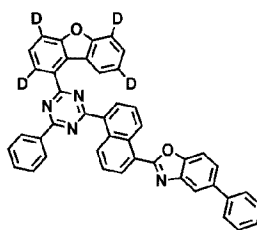
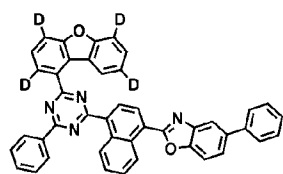
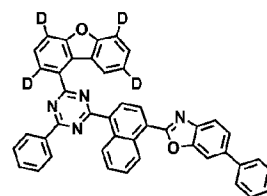
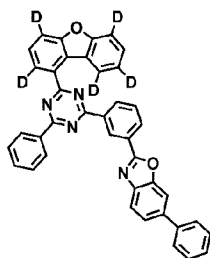
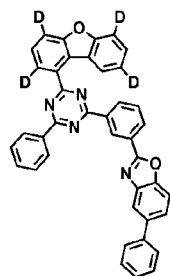
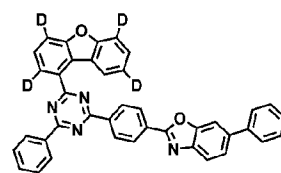
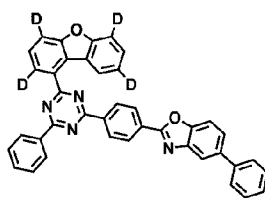
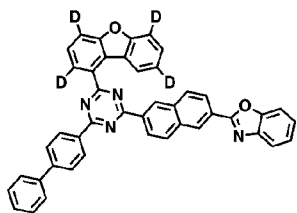
[267]



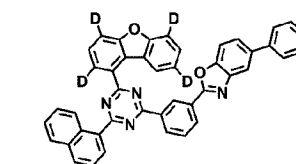
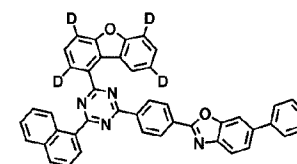
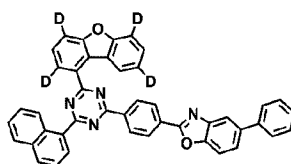
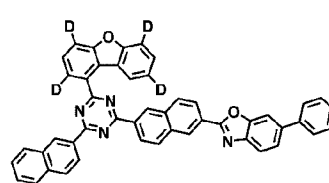
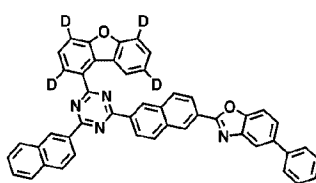
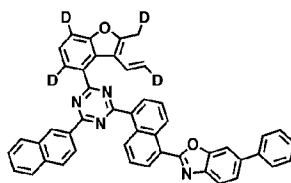
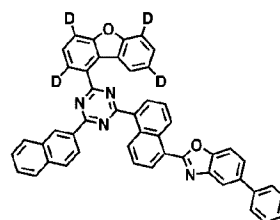
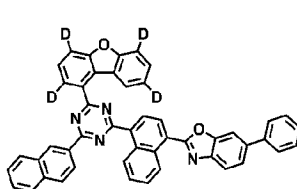
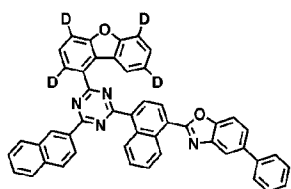
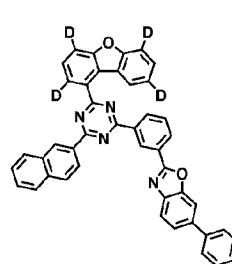
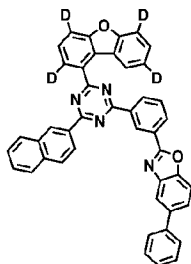
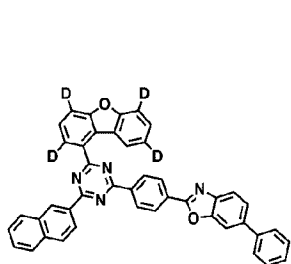
[268]



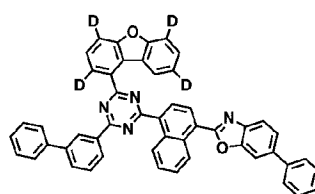
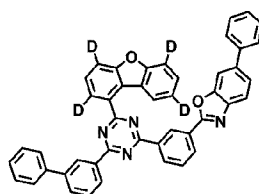
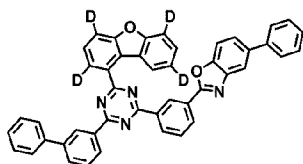
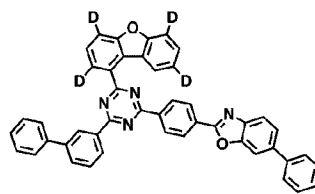
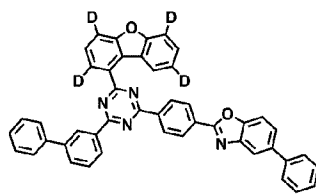
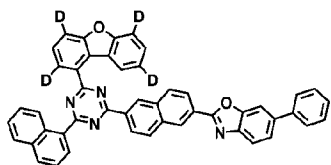
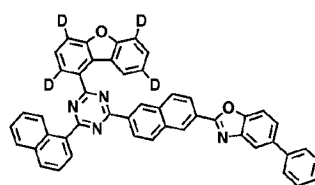
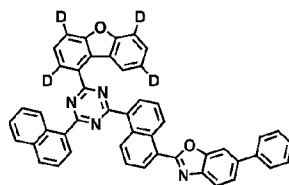
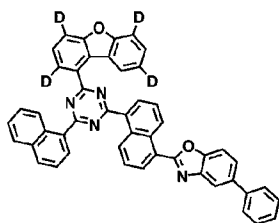
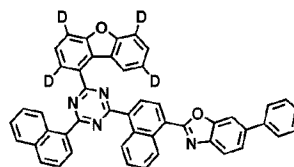
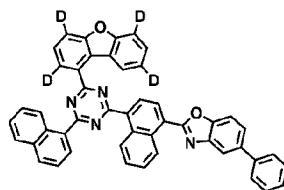
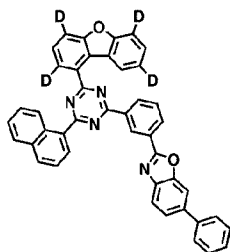
[269]



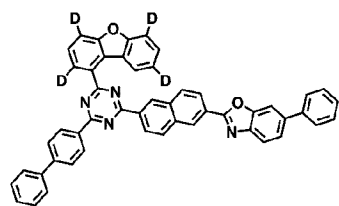
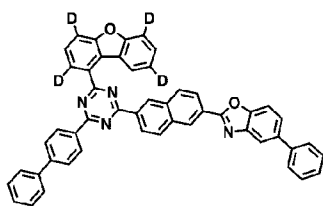
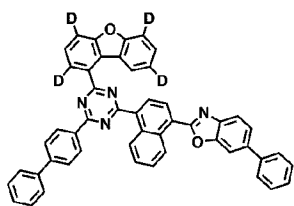
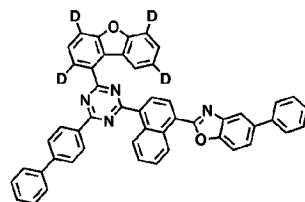
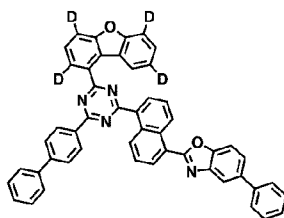
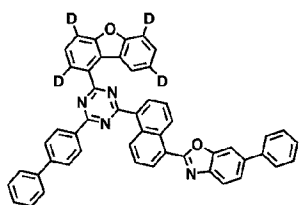
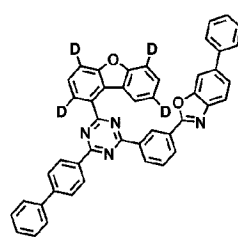
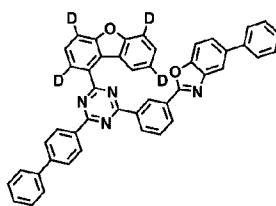
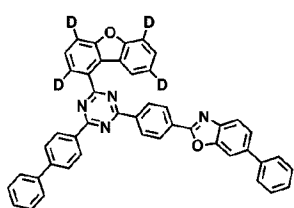
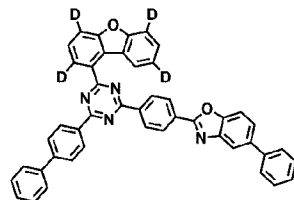
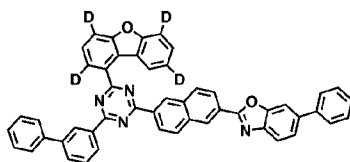
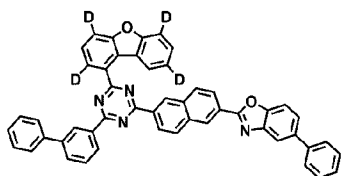
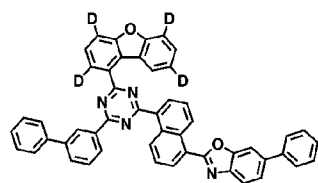
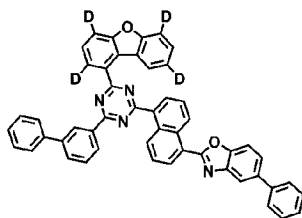
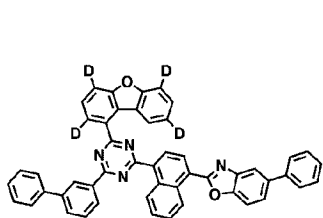
[270]



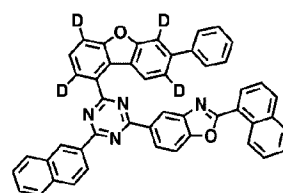
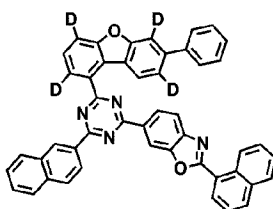
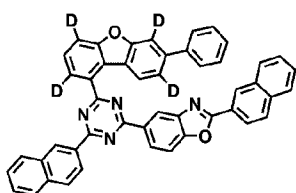
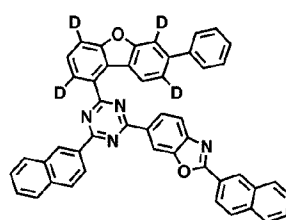
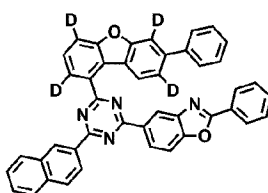
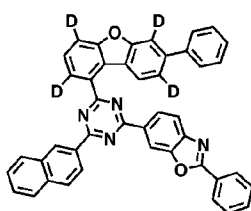
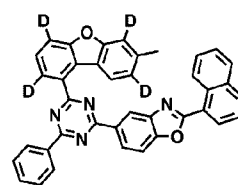
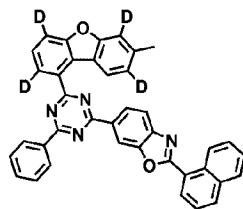
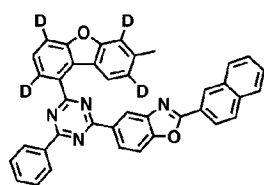
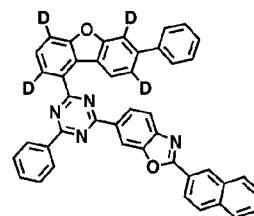
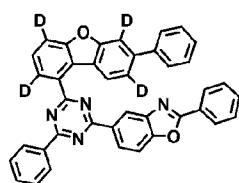
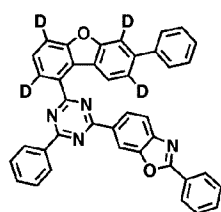
[271]



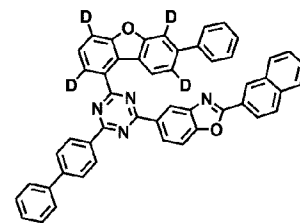
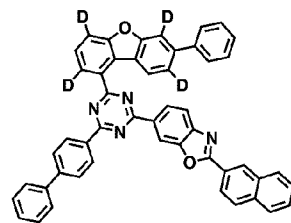
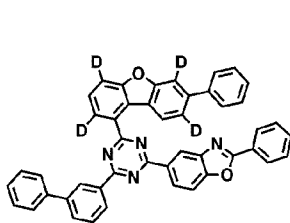
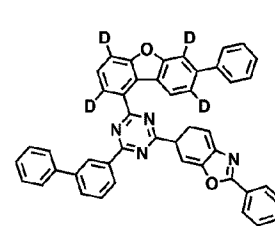
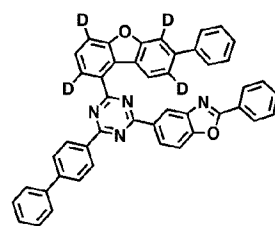
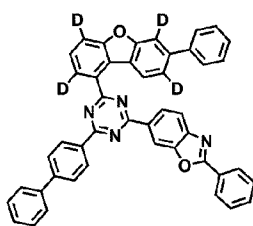
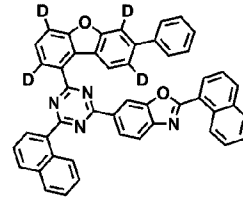
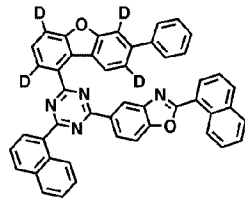
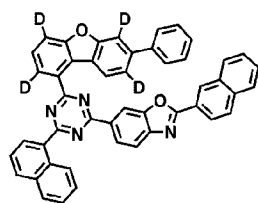
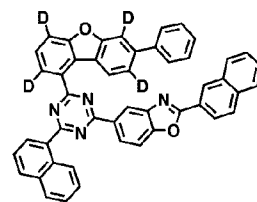
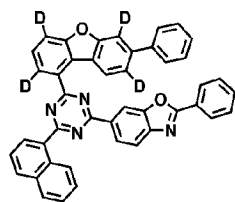
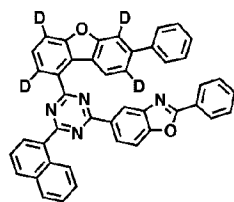
[272]



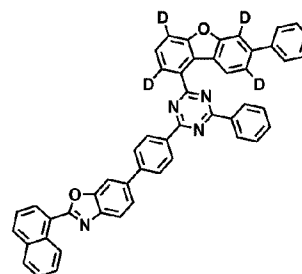
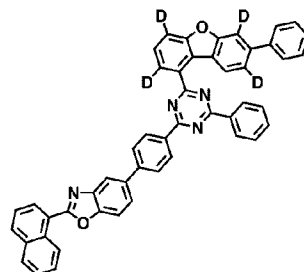
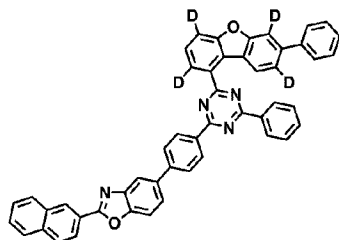
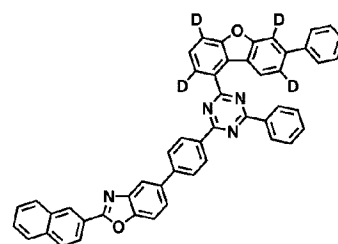
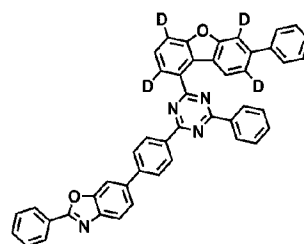
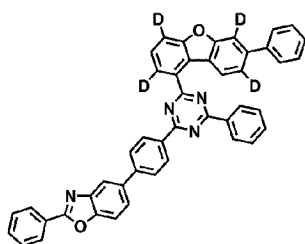
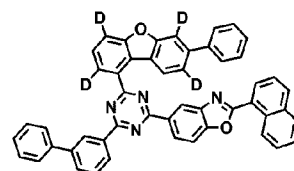
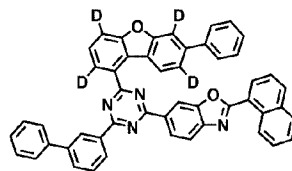
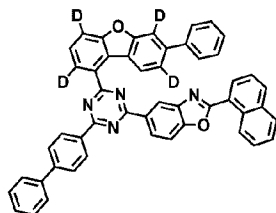
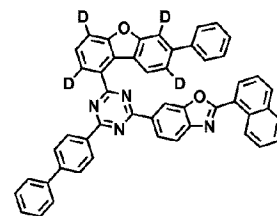
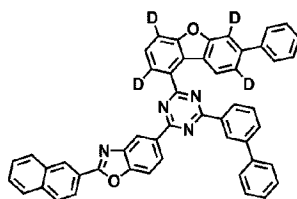
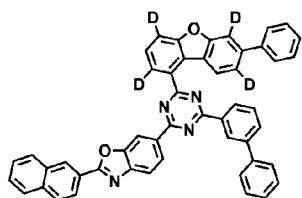
[273]



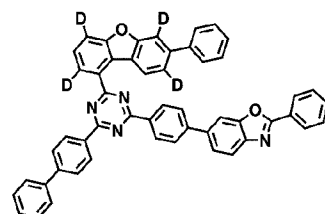
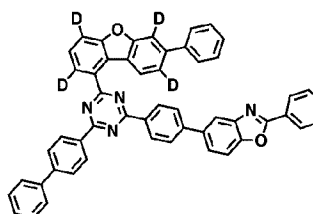
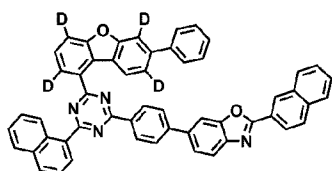
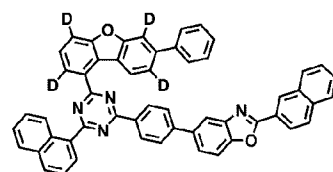
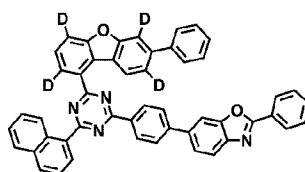
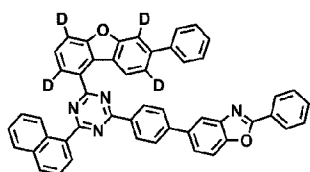
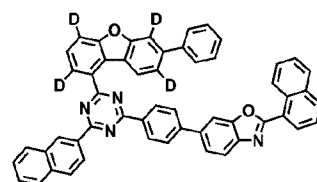
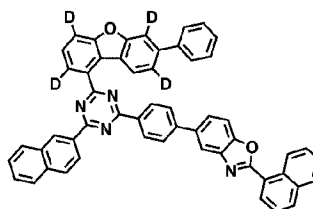
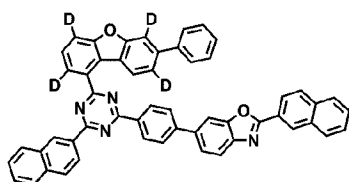
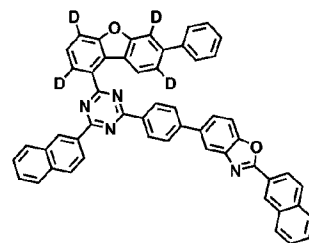
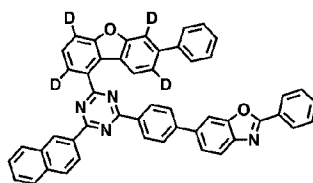
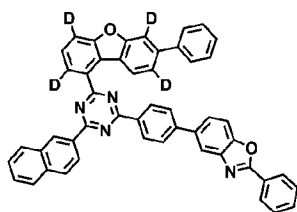
[274]



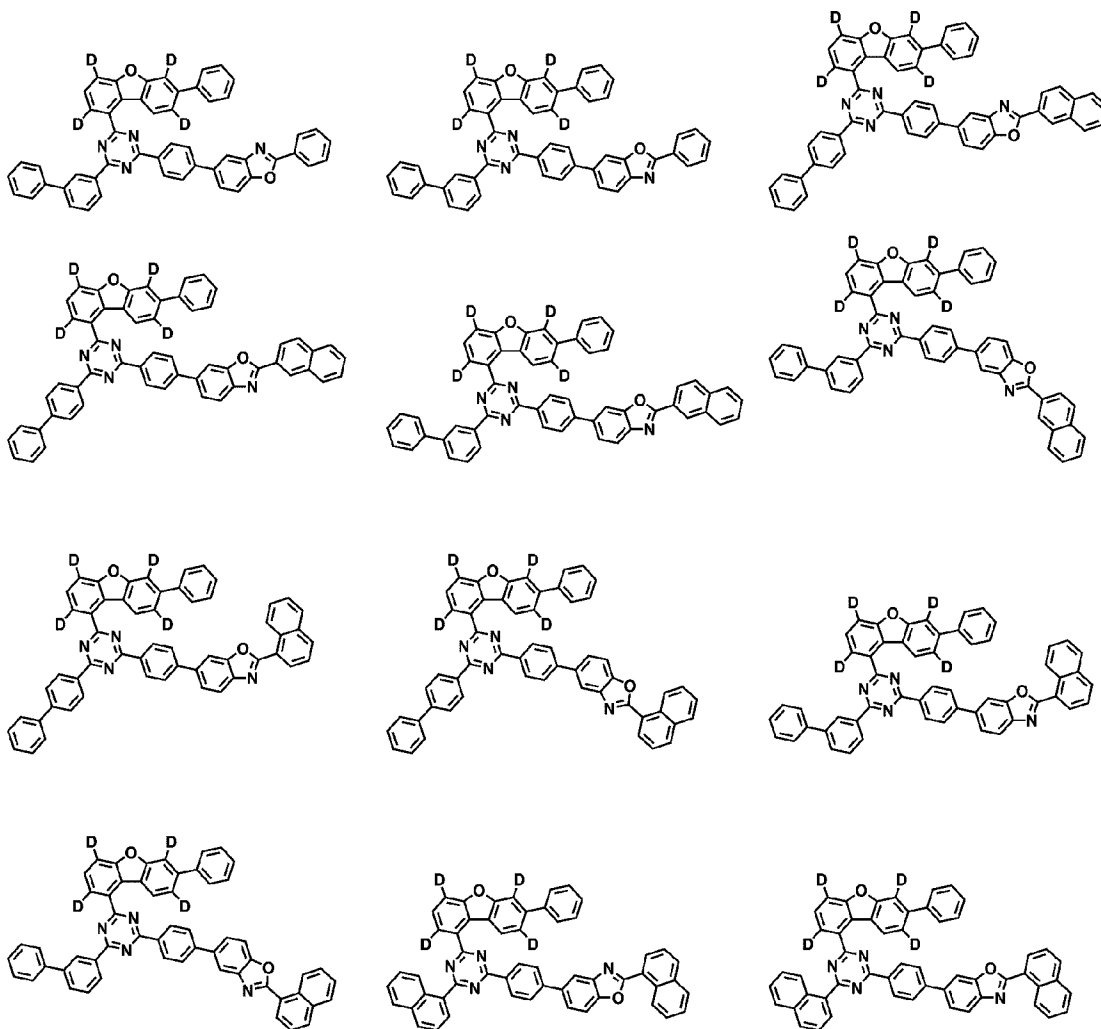
[275]

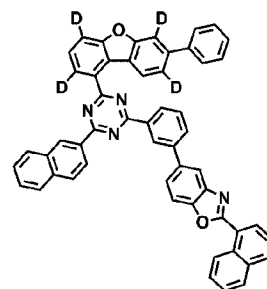
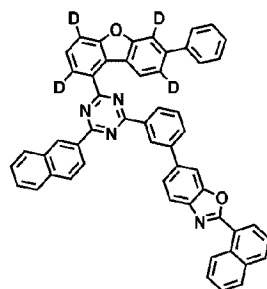
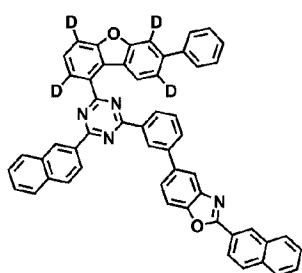
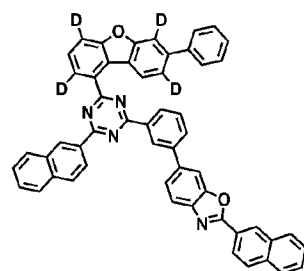
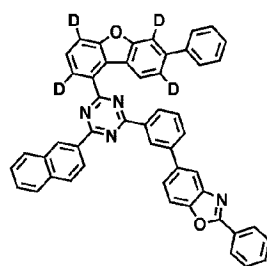
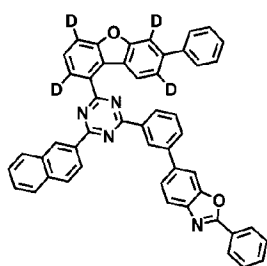
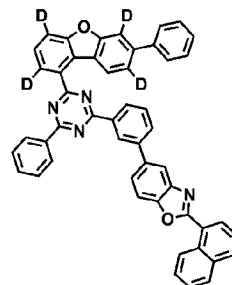
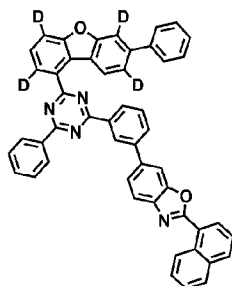
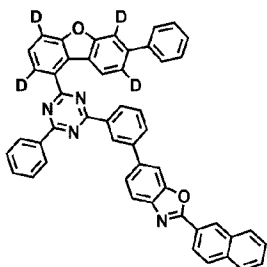
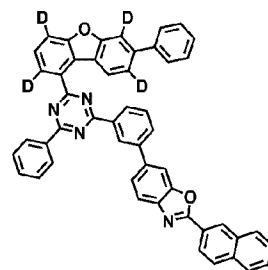
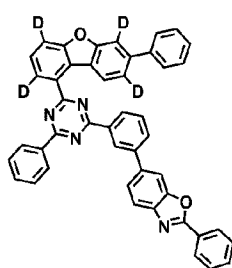


[276]

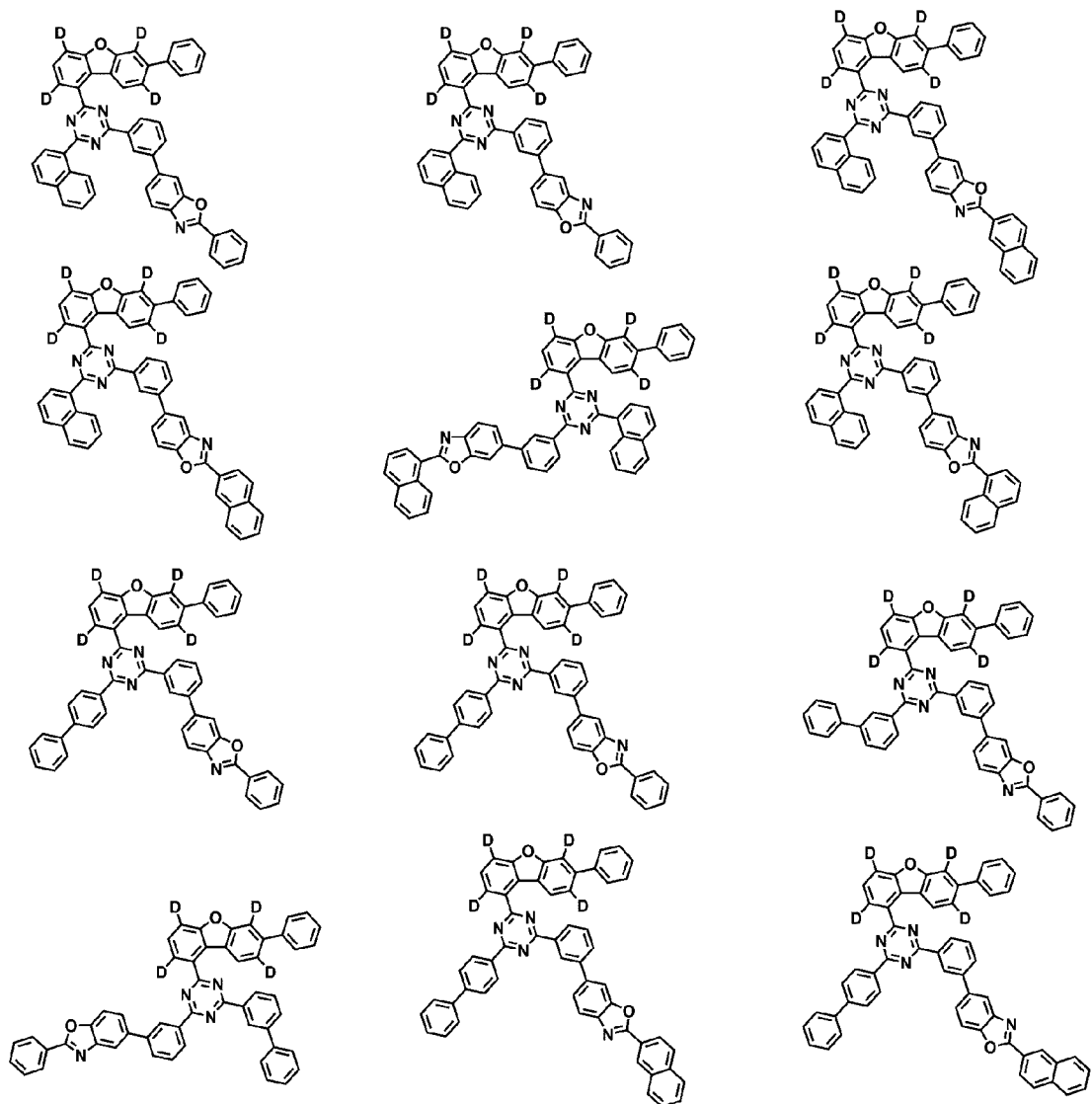


[277]

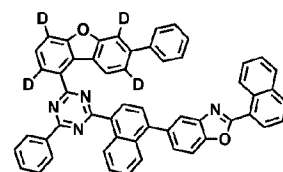
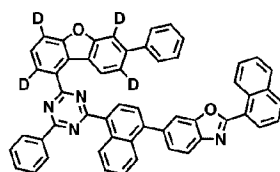
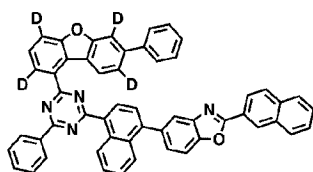
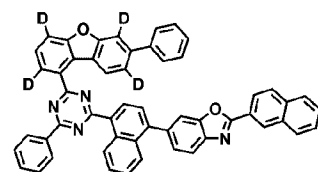
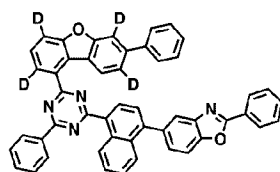
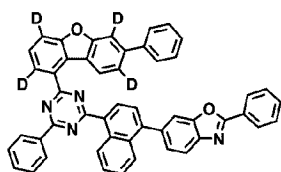
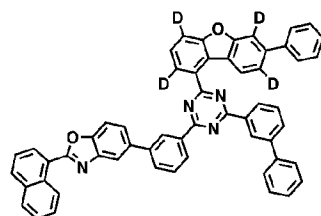
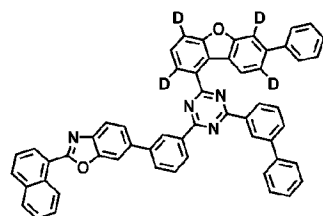
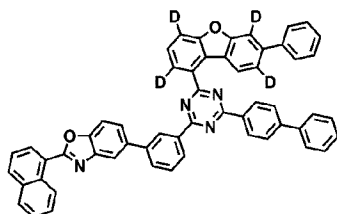
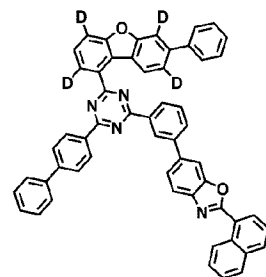
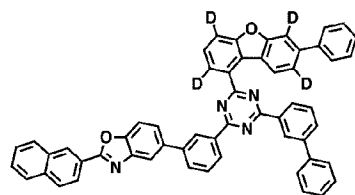
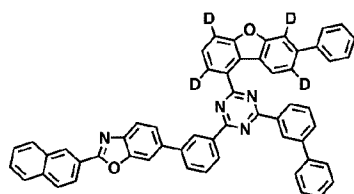




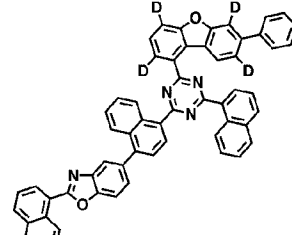
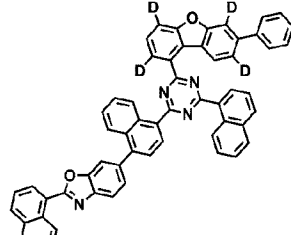
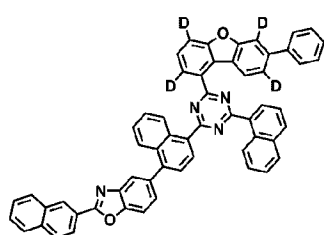
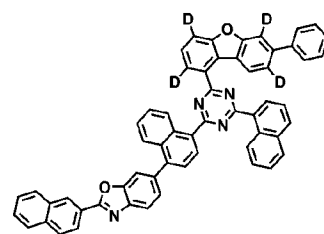
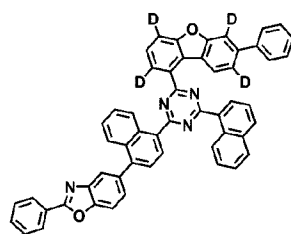
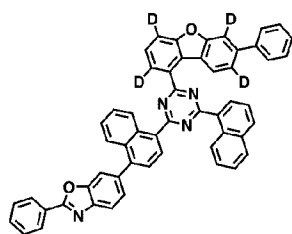
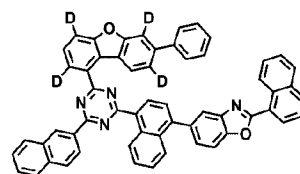
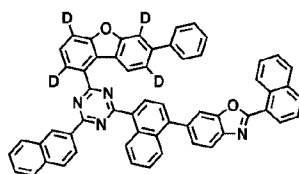
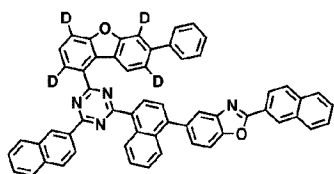
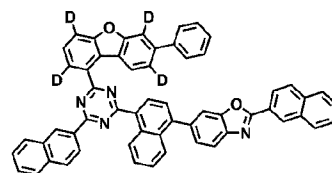
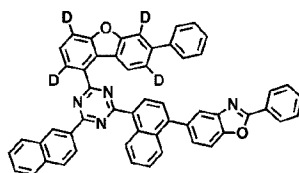
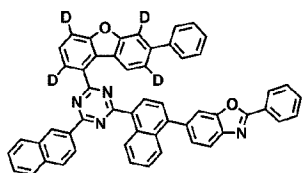
[279]



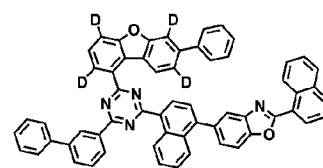
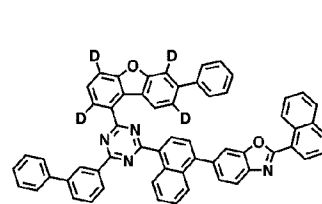
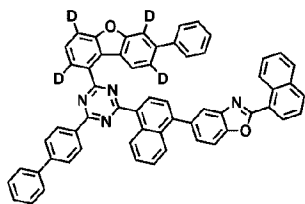
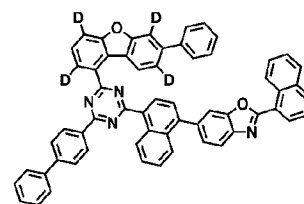
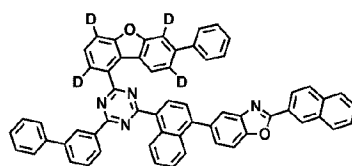
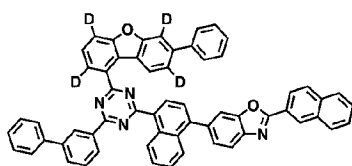
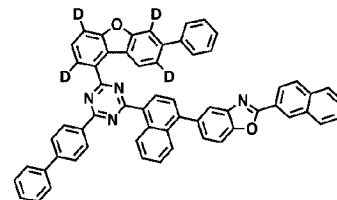
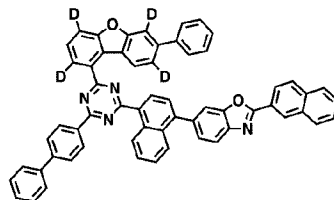
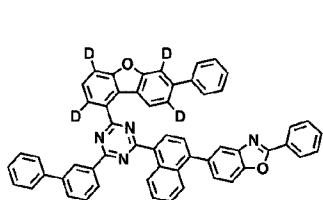
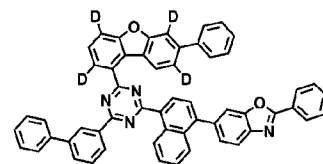
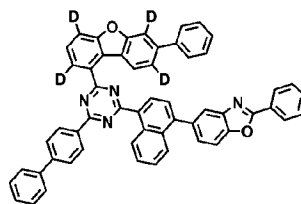
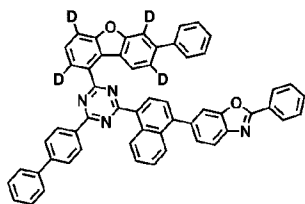
[280]



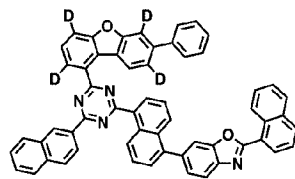
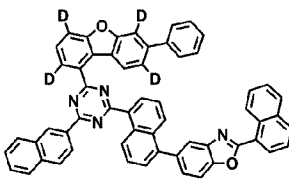
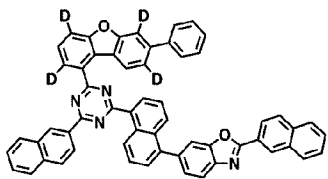
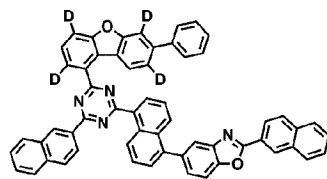
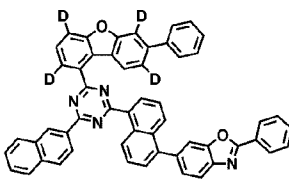
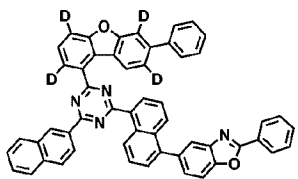
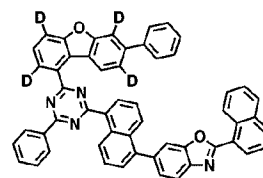
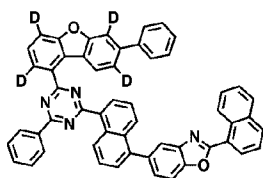
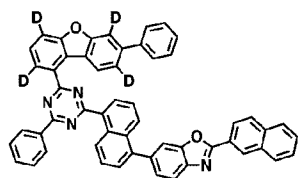
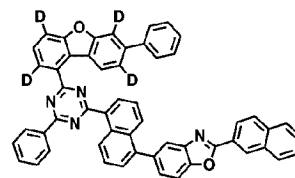
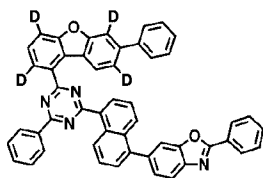
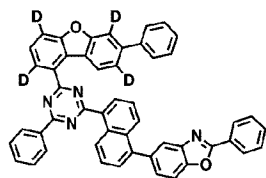
[281]



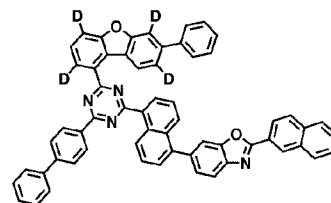
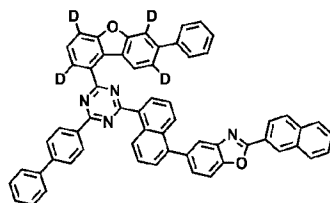
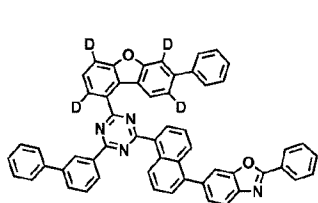
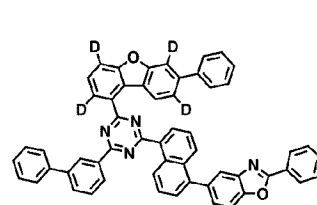
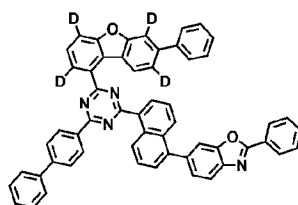
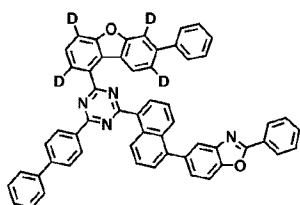
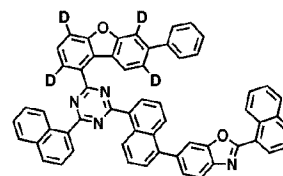
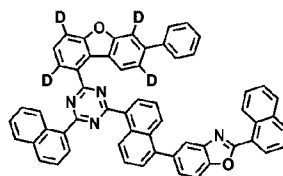
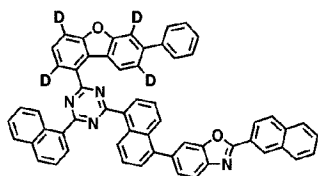
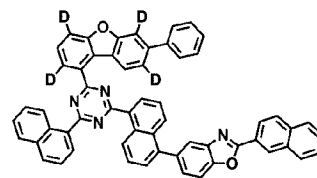
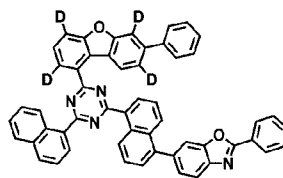
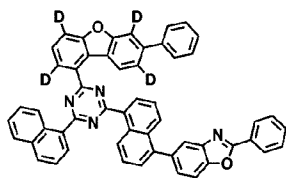
[282]

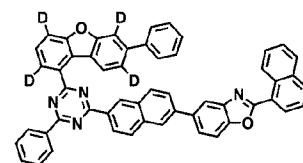
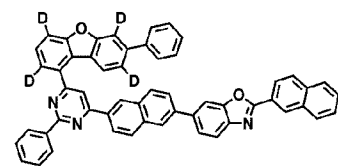
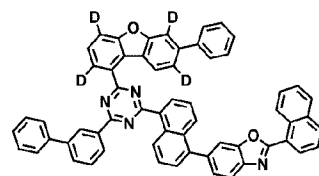


[283]

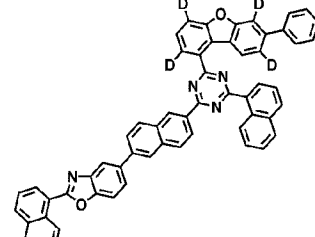
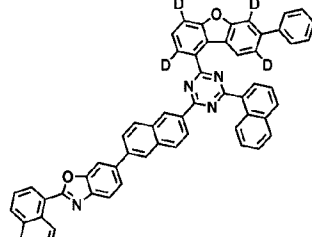
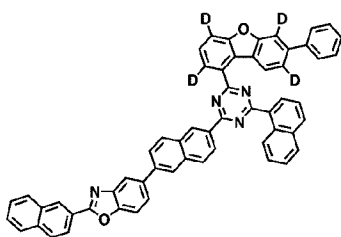
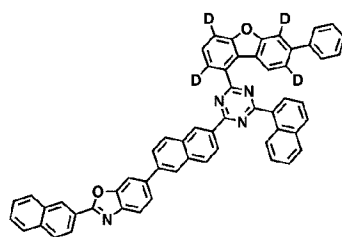
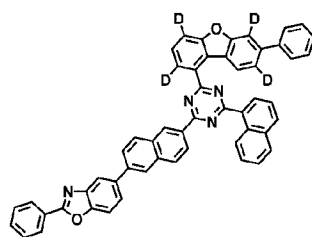
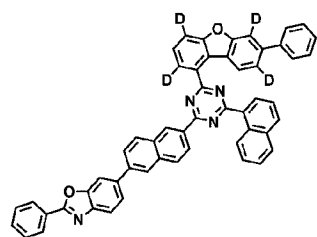
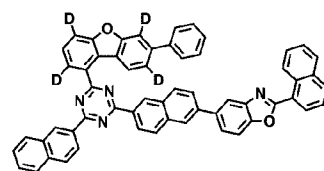
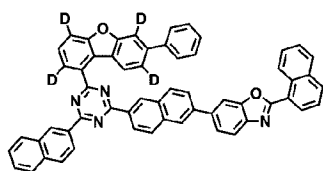
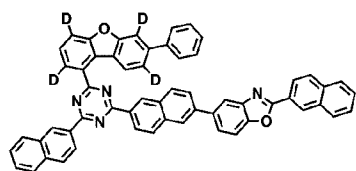
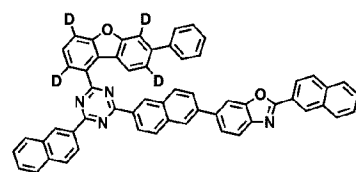
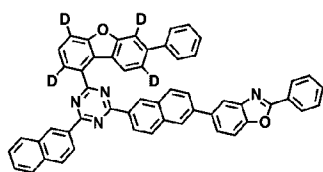
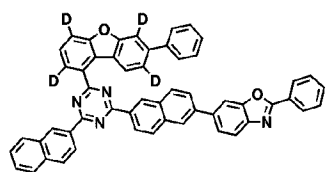


[284]

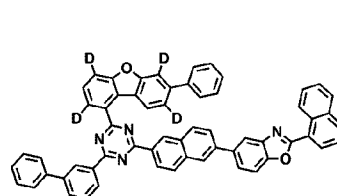
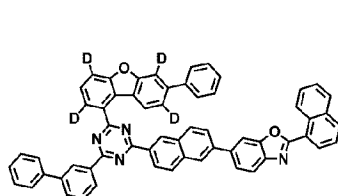
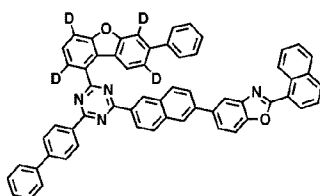
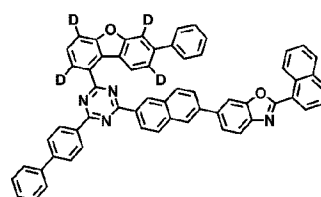
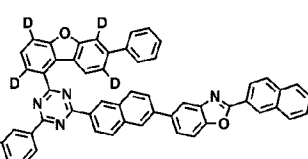
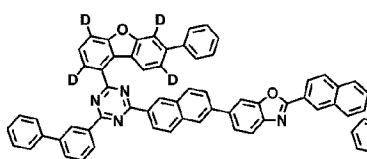
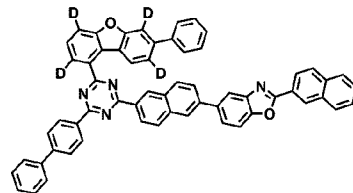
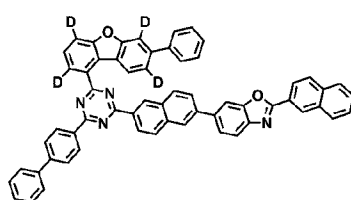
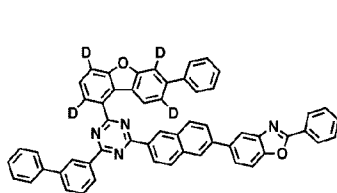
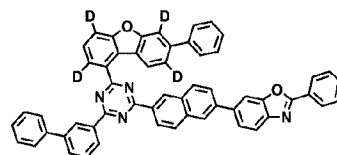
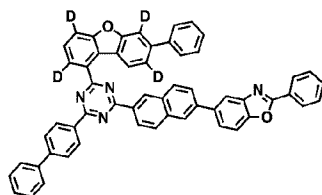
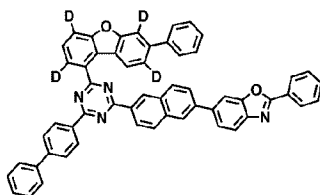




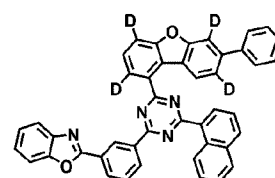
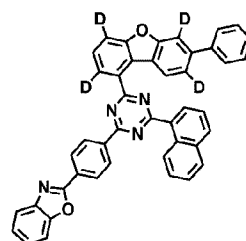
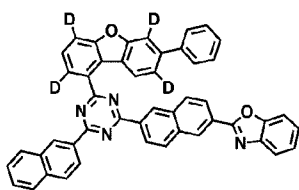
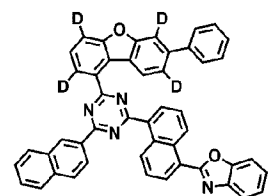
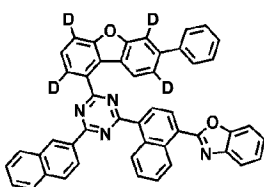
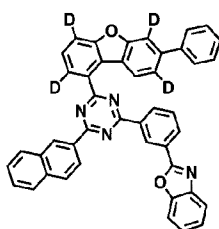
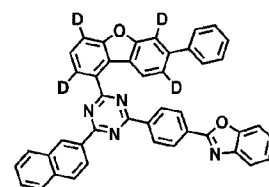
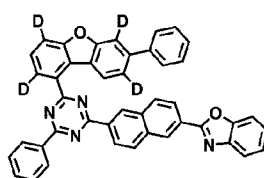
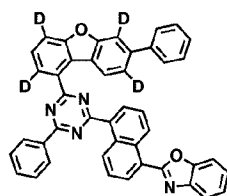
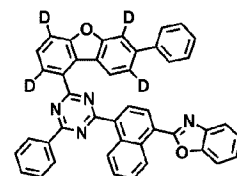
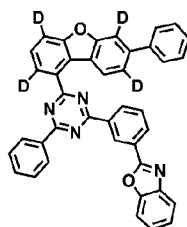
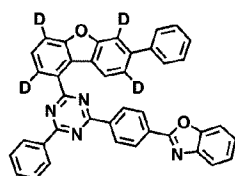
[286]



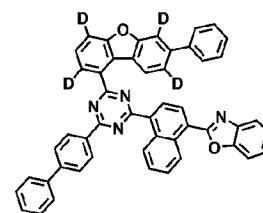
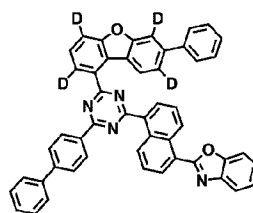
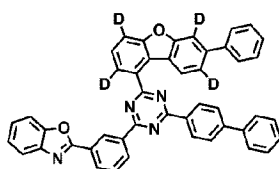
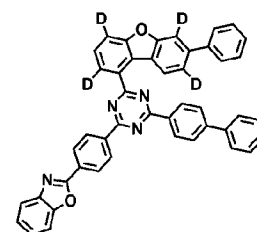
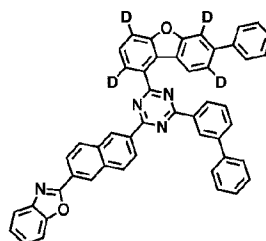
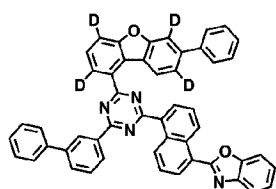
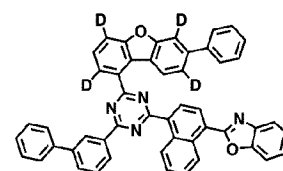
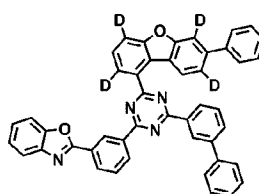
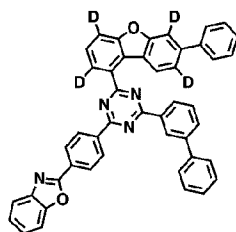
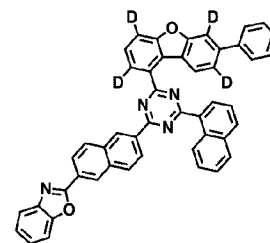
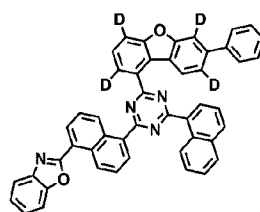
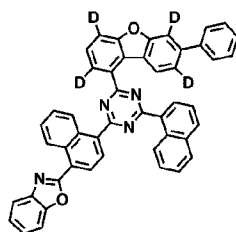
[287]



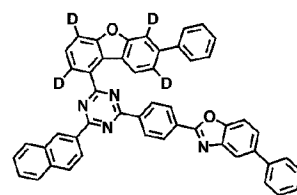
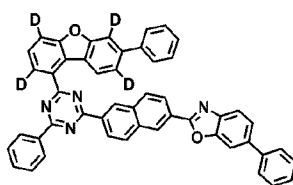
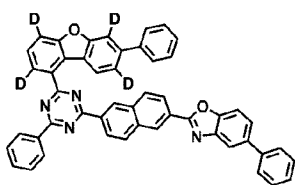
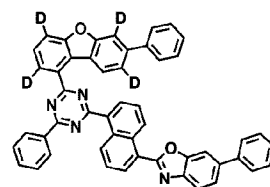
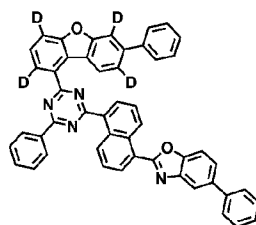
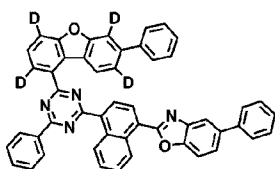
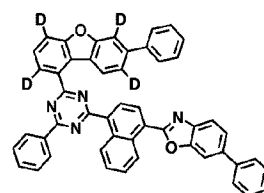
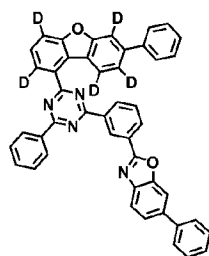
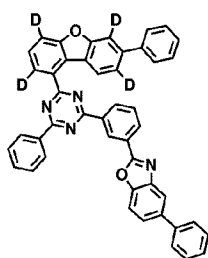
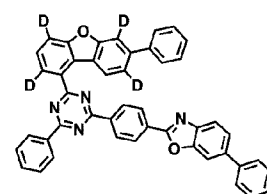
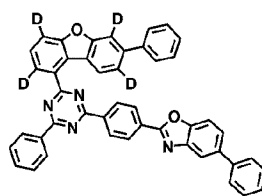
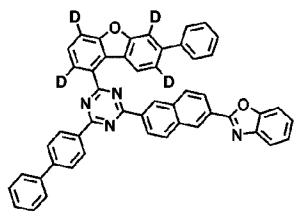
[288]



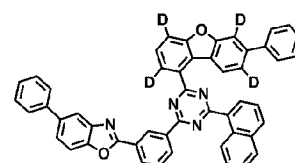
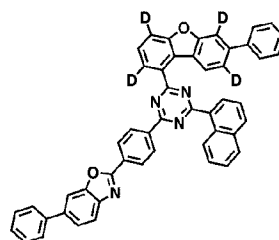
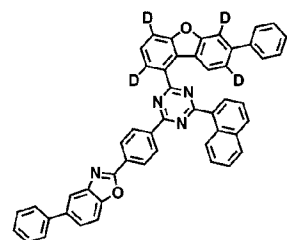
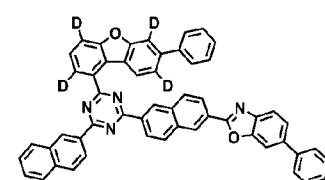
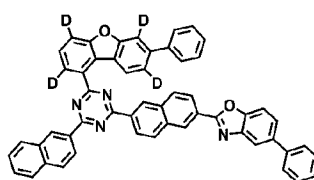
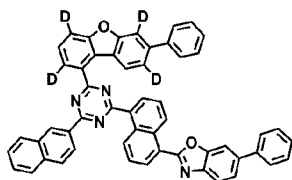
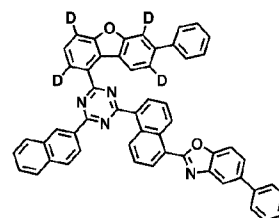
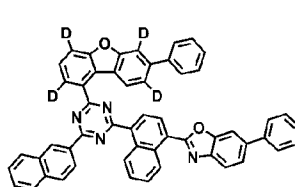
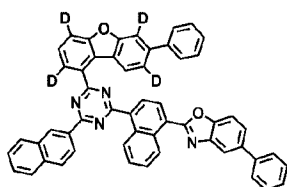
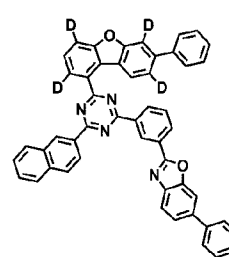
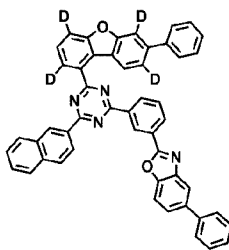
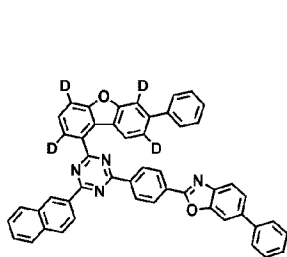
[289]



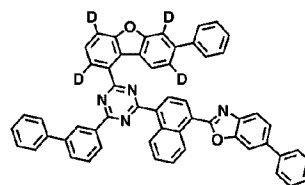
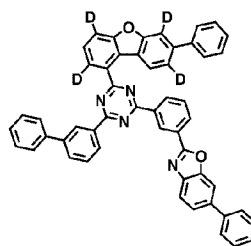
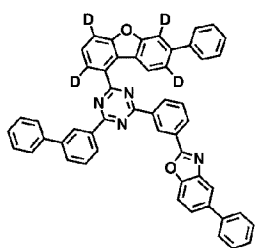
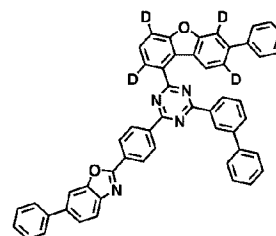
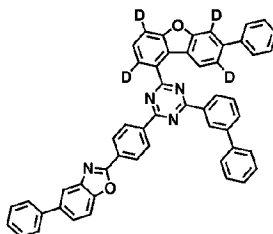
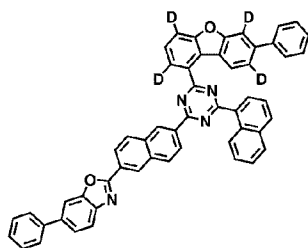
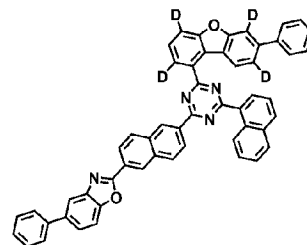
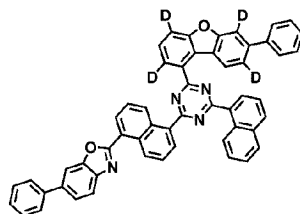
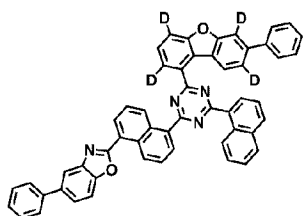
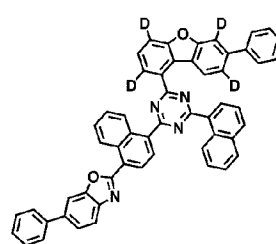
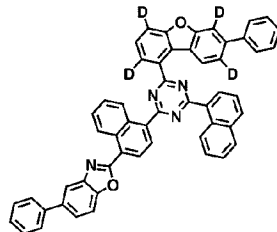
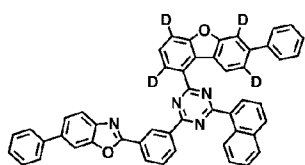
[290]



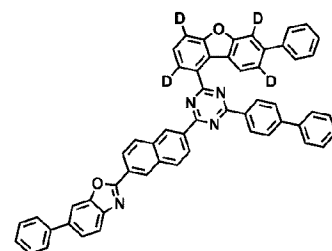
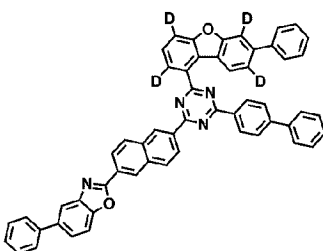
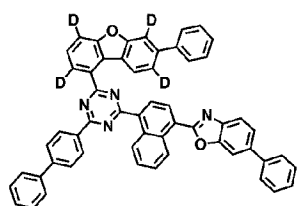
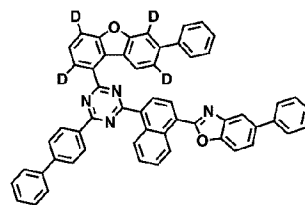
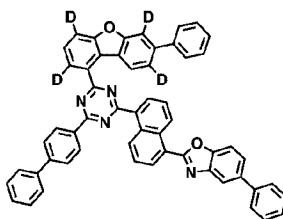
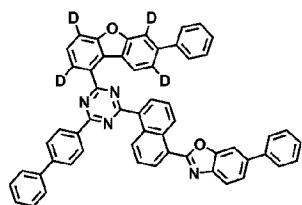
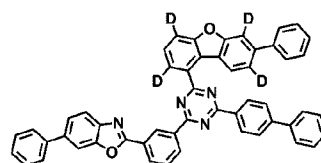
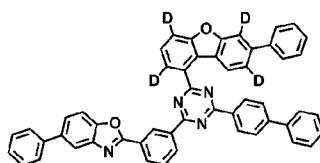
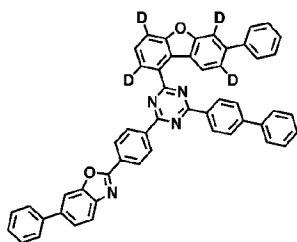
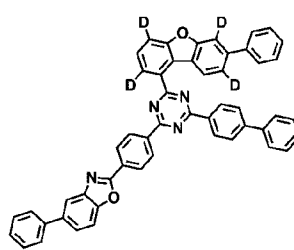
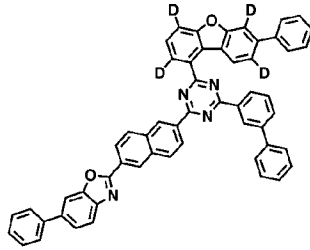
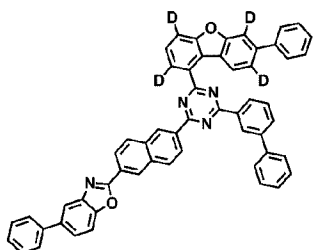
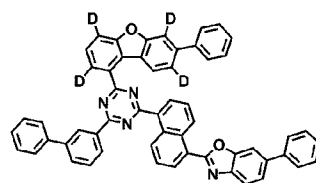
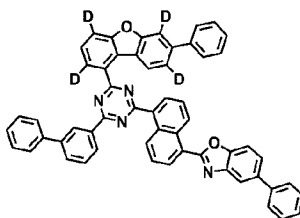
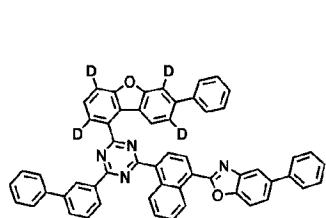
[291]



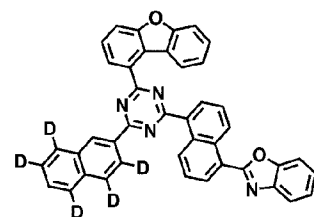
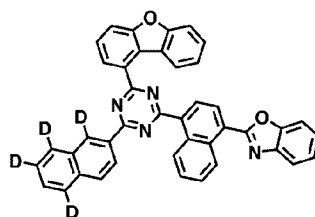
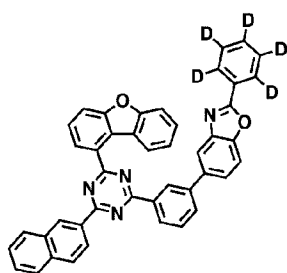
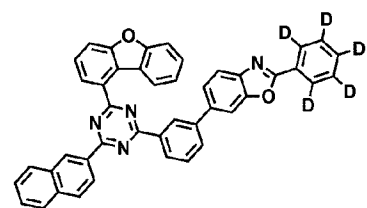
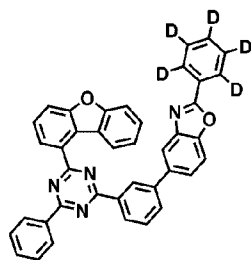
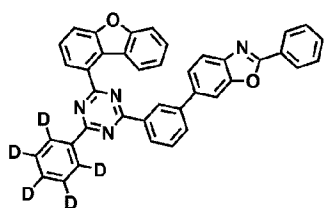
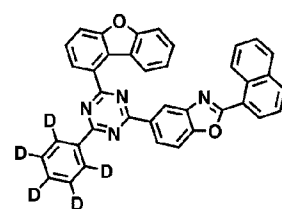
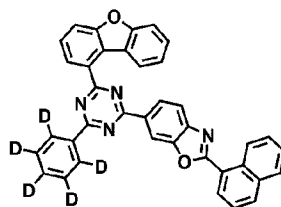
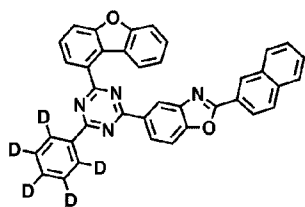
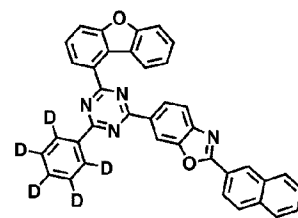
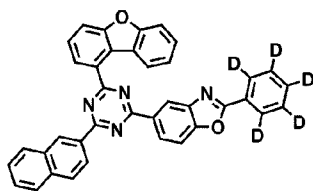
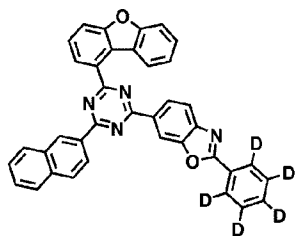
[292]



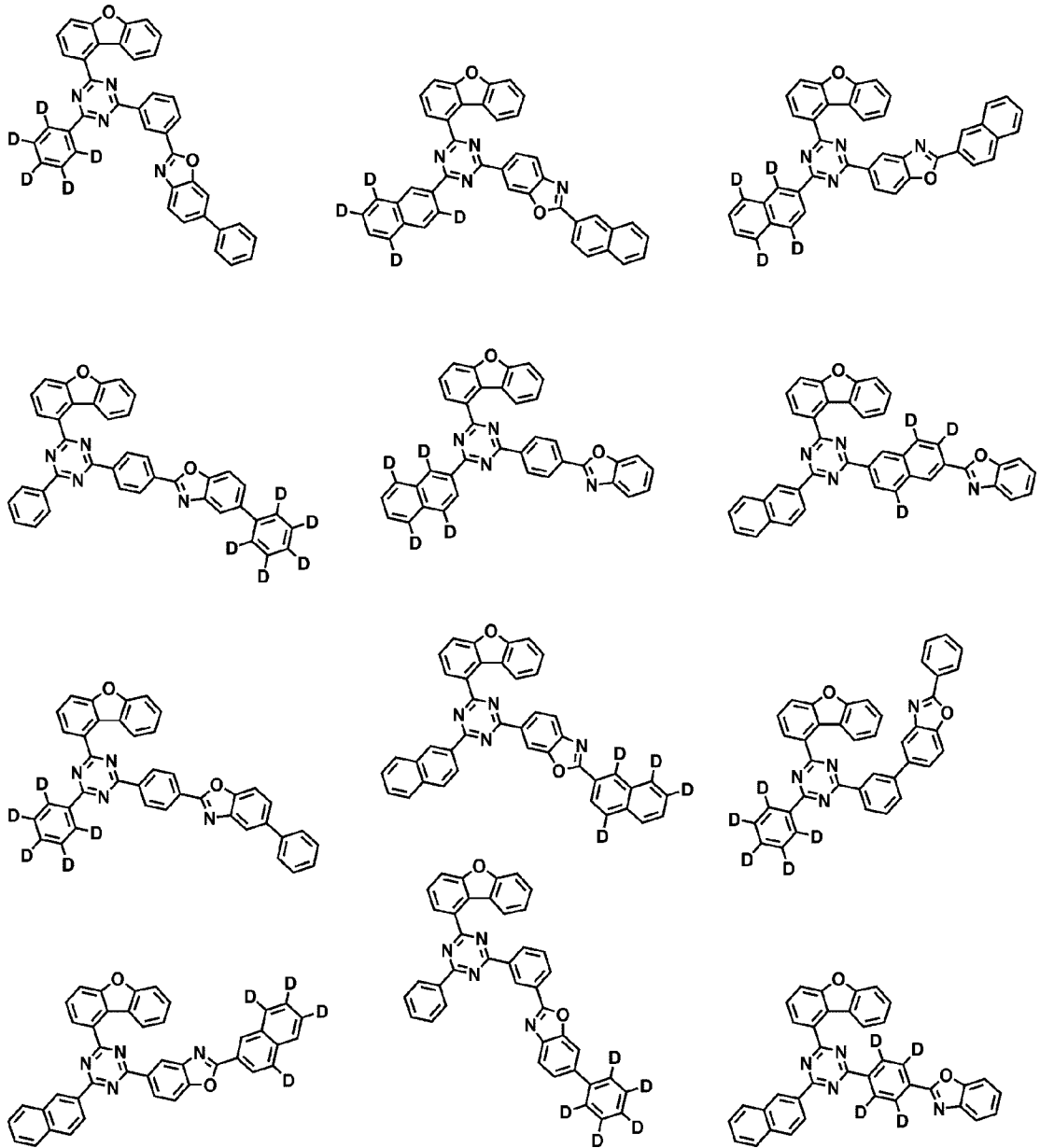
[293]



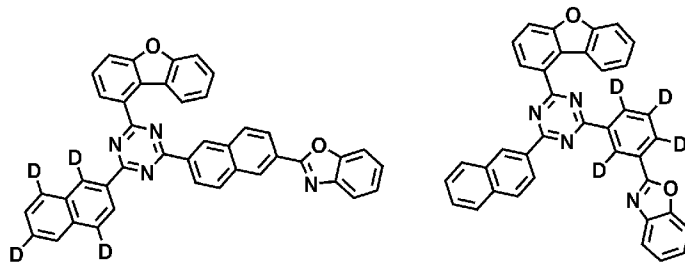
[294]



[295]



[296]



[297]

[298]

한편, 본 발명은 상기 화학식 1로 표시되는 화합물을 포함하는 유기 발광 소자를 제공한다. 일례로, 본 발명은 제1 전극; 상기 제1 전극과 대향하여 구비된 제2 전극; 및 상기 제1 전극과 상기 제2 전극 사이에 구비된 1층 이상의 유기물 층을 포함하는 유기 발광 소자로서, 상기 유기물층 중 1층 이상은 상기 화학식 1로 표시되는 화합물을 포함하는, 유기 발광 소자를 제공한다.

[299]

[300] 본 발명의 유기 발광 소자의 유기물 층은 단층 구조로 이루어질 수도 있으나, 2층 이상의 유기물층이 적층된 다층 구조로 이루어질 수 있다. 예컨대, 본 발명의 유기 발광 소자는 유기물 층으로서 정공주입층, 정공수송층, 전자저지층, 발광층, 정공저지층, 전자수송층, 전자주입층 등을 포함하는 구조를 가질 수 있다. 그러나 유기 발광 소자의 구조는 이에 한정되지 않고 더 적은 수의 유기층을 포함할 수 있다.

[301]

[302] 또한, 상기 유기물 층은 정공주입층, 정공수송층, 또는 정공 주입과 수송을 동시에 하는 층을 포함할 수 있고, 상기 정공주입층, 정공수송층, 또는 정공 주입과 수송을 동시에 하는 층은 상기 화학식 1로 표시되는 화합물을 포함한다.

[303]

[304] 또한, 상기 유기물 층은 정공주입층, 정공수송층, 또는 정공 주입과 수송을 동시에 하는 층을 포함할 수 있고, 상기 정공주입층, 정공수송층, 또는 정공 주입과 수송을 동시에 하는 층은 상기 화학식 1로 표시되는 화합물을 포함한다.

[305]

[306] 또한, 상기 유기물 층은 전자저지층을 포함할 수 있고, 상기 전자저지층은 상기 화학식 1로 표시되는 화합물을 포함한다.

[307]

[308] 또한, 상기 유기물 층은 발광층을 포함할 수 있고, 상기 발광층은 상기 화학식 1로 표시되는 화합물을 포함한다.

[309]

[310] 또한, 상기 발광층은 도펀트 화합물을 더 포함한다.

[311]

[312] 또한, 상기 발광층은 화학식 1의 화합물과 도펀트를 포함한다.

[313]

[314] 일례로, 상기 발광층은 화학식 1의 화합물과 도펀트를 포함하고, 화학식 1의 화합물과 도펀트를 100:1 내지 1:1의 중량비로 포함한다.

[315]

[316] 또한, 상기 발광층은 화학식 1의 화합물과 도펀트를 포함하고, 화학식 1의 화합물과 도펀트를 100:1 내지 2:1, 또는 100:1 내지 5:1, 또는 100:1 내지 10:1, 또는 100:1 내지 20:1, 또는 100:1 내지 30:1의 중량비로 포함한다.

[317]

[318] 일례로, 상기 도펀트는 금속착체이다.

[319]

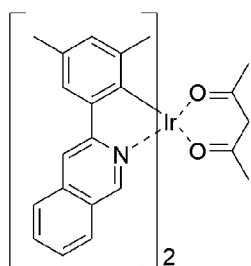
[320] 구체적으로, 상기 도펀트는 이리듐계 금속착체이다.

[321]

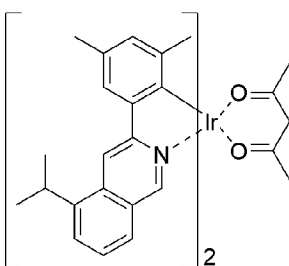
[322] 또한, 상기 유기물층은 발광층을 포함하고, 상기 발광층은 도펀트를 포함하고, 상기 도펀트 물질은 하기 구조식들 중에서 선택된다.

[323]

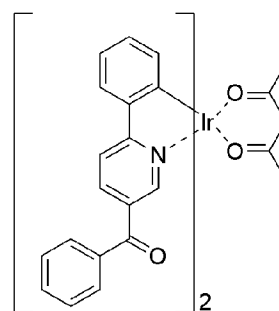
[324]



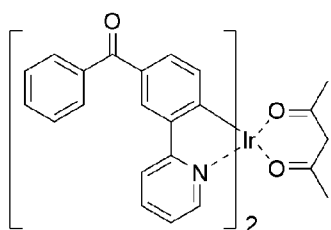
Dp-1



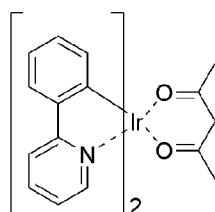
Dp-2



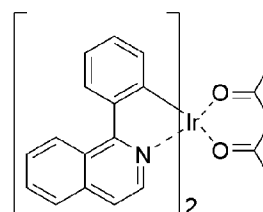
Dp-3



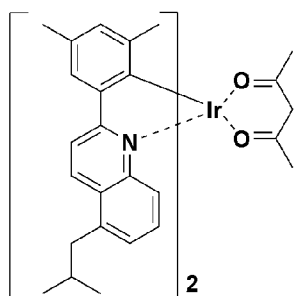
Dp-4



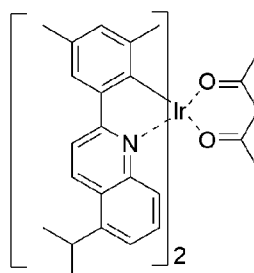
Dp-5



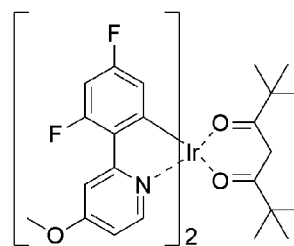
Dp-6



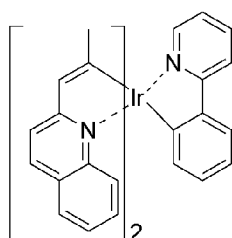
Dp-7



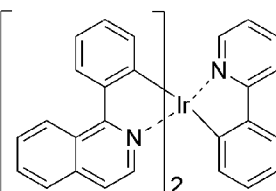
Dp-8



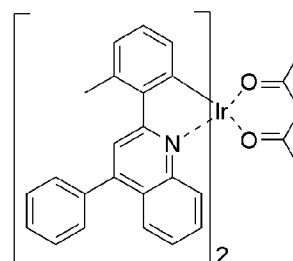
Dp-9



Dp-10

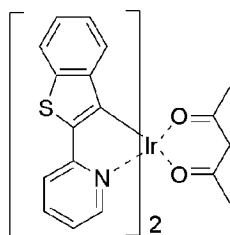
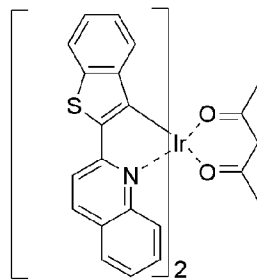
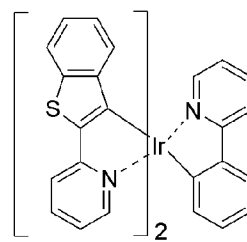
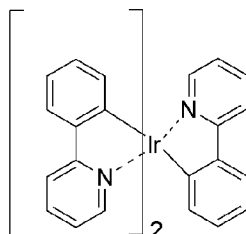
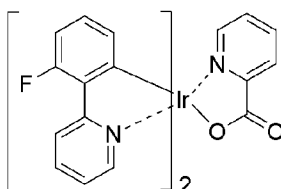
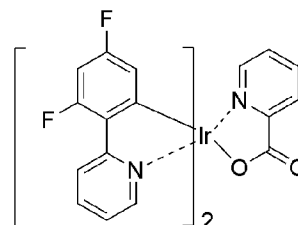
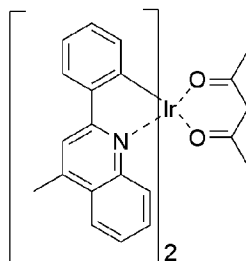
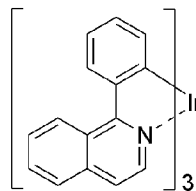
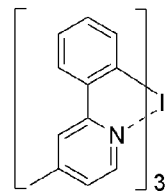
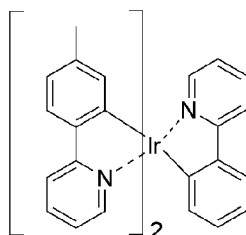
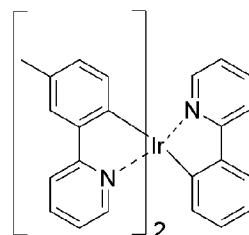
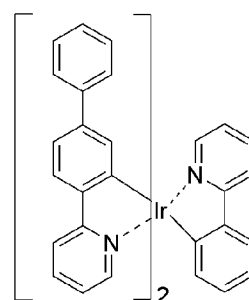


Dp-11

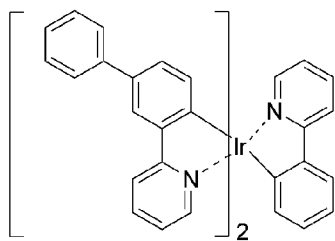
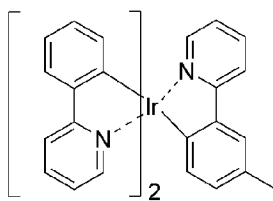
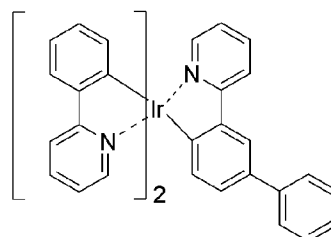
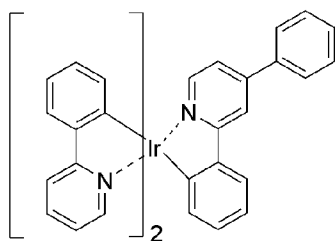
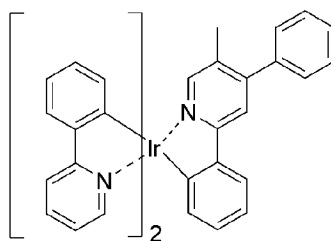
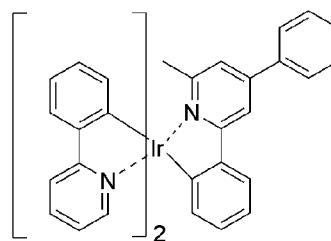
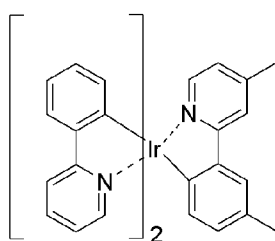
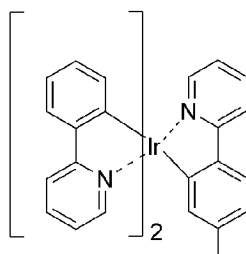
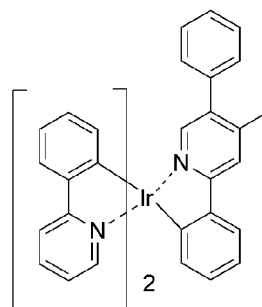
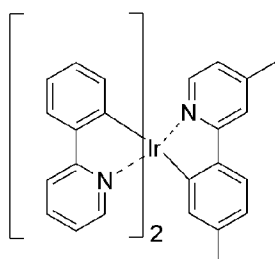
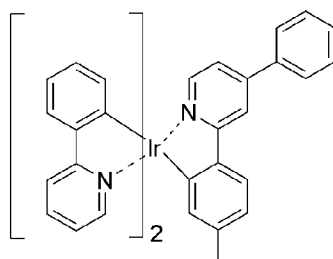
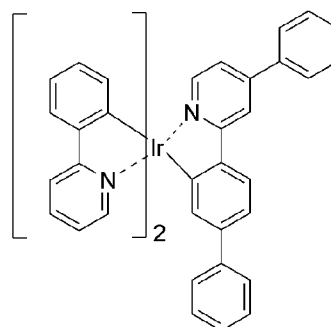


Dp-12

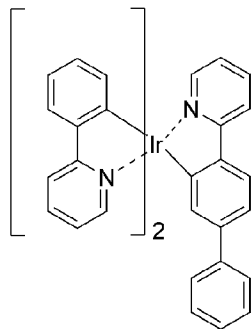
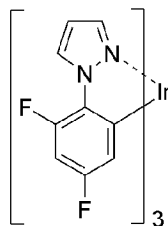
[325]

**Dp-13****Dp-14****Dp-15****Dp-16****Dp-17****Dp-18****Dp-19****Dp-20****Dp-21****Dp-22****Dp-23****Dp-24**

[326]

**Dp-25****Dp-26****Dp-27****Dp-28****Dp-29****Dp-30****Dp-31****Dp-32****Dp-33****Dp-34****Dp-35****Dp-36**

[327]

**Dp-37****Dp-38**

[328]

[329] 상기 명시된 구조는 도판트 화합물로 이에 한정하는 것은 아니다.

[330]

[331] 또한, 상기 유기물 층은 정공저지층을 포함할 수 있고, 상기 정공저지층은 상기 화학식 1로 표시되는 화합물을 포함한다.

[332]

[333] 또한, 상기 유기물 층은 전자수송층, 전자주입층, 또는 전자 주입과 수송을 동시에 하는 층을 포함할 수 있고, 상기 전자수송층, 전자주입층, 또는 전자 주입과 수송을 동시에 하는 층은 상기 화학식 1로 표시되는 화합물을 포함한다.

[334]

[335] 또한, 상기 유기물 층은 발광층 및 전자저지층을 포함하고, 상기 발광층 또는 전자저지층은 상기 화학식 1로 표시되는 화합물을 포함할 수 있다.

[336]

[337] 또한, 본 발명에 따른 유기 발광 소자는, 기판 상에 양극, 1층 이상의 유기물 층 및 음극이 순차적으로 적층된 구조(normal type)의 유기 발광 소자일 수 있다. 또한, 본 발명에 따른 유기 발광 소자는 기판 상에 음극, 1층 이상의 유기물 층 및 양극이 순차적으로 적층된 역방향 구조(inverted type)의 유기 발광 소자일 수 있다. 예컨대, 본 발명의 일실시예에 따른 유기 발광 소자의 구조는 도 1 및 2에 예시되어 있다.

[338]

[339] 도 1은 기판(1), 양극(2), 발광층(3), 음극(4)으로 이루어진 유기 발광 소자의 예를 도시한 것이다. 이와 같은 구조에 있어서, 상기 화학식 1로 표시되는 화합물은 상기 발광층에 포함될 수 있다.

[340]

[341] 도 2는 기판 (1), 양극(2), 정공주입층(5), 정공수송층(6), 전자저지층(7), 발광층 (3), 정공저지층(8), 전자 주입 및 수송층(9) 및 음극(4)로 이루어진 유기 발광 소자의 예를 도시한 것이다. 이와 같은 구조에 있어서, 상기 화학식 1로 표시되는 화합물은 상기 정공주입층, 정공수송층, 전자저지층, 발광층, 정공저지층, 및 전자 주입 및 수송층 중 1층 이상에 포함될 수 있다. 구체적으로, 상기 화학식 1로 표시

되는 화합물은 상기 발광층에 포함될 수 있으며, 예컨대, 발광층의 호스트 재료로 포함될 수 있다.

[342]

[343] 본 발명에 따른 유기 발광 소자는, 상기 유기물 층 중 1층 이상이 상기 화학식 1로 표시되는 화합물을 포함하는 것을 제외하고는 당 기술분야에 알려져 있는 재료와 방법으로 제조될 수 있다. 또한, 상기 유기 발광 소자가 복수개의 유기물층을 포함하는 경우, 상기 유기물층은 동일한 물질 또는 다른 물질로 형성될 수 있다.

[344]

[345] 예컨대, 본 발명에 따른 유기 발광 소자는 기판 상에 제1 전극, 유기물층 및 제2 전극을 순차적으로 적층시켜 제조할 수 있다. 이때, 스퍼터링법(sputtering)이나 전자빔 증발법(e-beam evaporation)과 같은 PVD(physical Vapor Deposition)방법을 이용하여, 기판 상에 금속 또는 전도성을 가지는 금속 산화물 또는 이들의 합금을 증착시켜 양극을 형성하고, 그 위에 정공 주입층, 정공 수송층, 전자저지층, 발광층, 정공저지층, 전자 수송층, 및 전자주입층 등을 포함하는 유기물 층을 형성한 후, 그 위에 음극으로 사용할 수 있는 물질을 증착시켜 제조할 수 있다. 이와 같은 방법 외에도, 기판 상에 음극 물질부터 유기물층, 양극 물질을 차례로 증착시켜 유기 발광 소자를 만들 수 있다.

[346]

[347] 또한, 상기 화학식 1로 표시되는 화합물은 유기 발광 소자의 제조시 진공 증착법 뿐만 아니라 용액 도포법에 의하여 유기물 층으로 형성될 수 있다. 특히, 상기 화학식 1로 표시되는 화합물은 용액 도포법에 사용되는 용매에 대한 용해도가 우수하여, 용액 도포법을 적용하기 용이하다. 여기서, 용액 도포법이라 함은 스핀 코팅, 딥코팅, 닥터 블레이딩, 잉크젯 프린팅, 스크린 프린팅, 스프레이법, 롤 코팅 등을 의미하지만, 이들만으로 한정되는 것은 아니다.

[348]

[349] 이에, 본 발명은 상기 화학식 1로 표시되는 화합물 및 용매를 포함하는 코팅 조성물을 제공한다.

[350]

[351] 상기 용매는 본 발명에 따른 화합물을 용해 또는 분산시킬 수 있는 용매이면 특별히 제한되지 않으며, 일례로 클로로포름, 염화메틸렌, 1,2-디클로로에탄, 1,1,2-트리클로로에탄, 클로로벤젠, o-디클로로벤젠 등의 염소계 용매; 테트라하이드로퓨란, 디옥산 등의 에테르계 용매; 톨루엔, 크실렌, 트리메틸벤젠, 메시틸렌 등의 방향족 탄화수소계 용매; 시클로헥산, 메틸시클로헥산, n-펜탄, n-헥산, n-헵탄, n-옥탄, n-노난, n-데칸 등의 지방족 탄화수소계 용매; 아세톤, 메틸에틸케톤, 시클로헥사논 등의 케톤계 용매; 아세트산에틸, 아세트산부틸, 에틸셀로솔브아세테이트 등의 에스테르계 용매; 에틸렌글리콜, 에틸렌글리콜모노부틸에테르, 에틸렌글리콜모노에틸에테르, 에틸렌글리콜모노메틸에테르, 디메톡시에탄, 프

로필렌글리콜, 디에톡시메탄, 트리에틸렌글리콜모노에틸에테르, 글리세린, 1,2-헥산디올 등의 다가 알코올 및 그의 유도체; 메탄올, 에탄올, 프로판올, 이소프로판올, 시클로헥산올 등의 알코올계 용매; 디메틸술폭사이드 등의 술폭사이드계 용매; 및 N-메틸-2-피롤리돈, N,N-디메틸포름아미드 등의 아미드계 용매; 부틸벤조에이트, 메틸-2-메톡시벤조에이트 등의 벤조에이트계 용매; 테트라린; 3-phenoxy-toluene 등의 용매를 들 수 있다. 또한, 상술한 용매를 1종 단독으로 사용하거나 2종 이상의 용매를 혼합하여 사용할 수 있다.

[352]

[353] 또한, 상기 코팅 조성물의 점도는 1 cP 내지 10 cP가 바람직하며, 상기의 범위에서 코팅이 용이하다. 또한, 상기 코팅 조성물 내 본 발명에 따른 화합물의 농도는 0.1 wt/v% 내지 20 wt/v%인 것이 바람직하다.

[354]

[355] 또한, 본 발명은 상술한 코팅 조성물을 사용하여 기능층을 형성하는 방법을 제공한다. 구체적으로, 상술한 본 발명에 따른 코팅 조성물을 용액 공정으로 코팅하는 단계; 및 상기 코팅된 코팅 조성물을 열처리하는 단계를 포함한다.

[356]

[357] 상기 열처리 단계에서 열처리 온도는 150 °C 내지 230 °C가 바람직하다. 또한, 상기 열처리 시간은 1 분 내지 3 시간이고, 보다 바람직하게는 10 분 내지 1 시간이다. 또한, 상기 열처리는 아르곤, 질소 등의 불활성 기체 분위기에서 수행하는 것이 바람직하다.

[358]

[359] 일례로, 상기 제1 전극은 양극이고, 상기 제2 전극은 음극이거나, 또는 상기 제1 전극은 음극이고, 상기 제2 전극은 양극이다.

[360]

[361] 상기 양극 물질로는 통상 유기물 층으로 정공 주입이 원활할 수 있도록 일함수가 큰 물질이 바람직하다. 상기 양극 물질의 구체적인 예로는 바나듐, 크롬, 구리, 아연, 금과 같은 금속 또는 이들의 합금; 아연 산화물, 인듐 산화물, 인듐주석 산화물(ITO), 인듐아연 산화물(IZO)과 같은 금속 산화물; ZnO:Al 또는 SnO₂:Sb와 같은 금속과 산화물의 조합; 폴리(3-메틸티오펜), 폴리[3,4-(에틸렌-1,2-디옥시)티오펜](PEDOT), 폴리피롤 및 폴리아닐린과 같은 전도성 고분자 등이 있으나, 이들에만 한정되는 것은 아니다.

[362]

[363] 상기 음극 물질로는 통상 유기물 층으로 전자 주입이 용이하도록 일함수가 작은 물질인 것이 바람직하다. 상기 음극 물질의 구체적인 예로는 마그네슘, 칼슘, 나트륨, 칼륨, 티타늄, 인듐, 이트륨, 리튬, 가돌리늄, 알루미늄, 은, 주석 및 납과 같은 금속 또는 이들의 합금; LiF/Al 또는 LiO₂/Al과 같은 다층 구조 물질 등이 있으나, 이들에만 한정되는 것은 아니다.

[364]

[365] 상기 정공주입층은 전극으로부터 정공을 주입하는 층으로, 정공 주입 물질로는 정공을 수송하는 능력을 가져 양극에서의 정공 주입효과, 발광층 또는 발광재료에 대하여 우수한 정공 주입 효과를 갖고, 발광층에서 생성된 여기자의 전자주입층 또는 전자주입재료에의 이동을 방지하며, 또한, 박막 형성 능력이 우수한 화합물이 바람직하다. 정공 주입 물질의 HOMO(highest occupied molecular orbital)가 양극 물질의 일함수와 주변 유기물 층의 HOMO 사이인 것이 바람직하다. 정공 주입 물질의 구체적인 예로는 금속 포피린(porphyrin), 올리고티오펜, 아릴아민 계열의 유기물, 헥사니트릴헥사아자트리페닐렌 계열의 유기물, 퀴나크리돈(quinacridone)계열의 유기물, 페릴렌(perylene) 계열의 유기물, 안트라퀴논 및 폴리아닐린과 폴리티오펜 계열의 전도성 고분자 등이 있으나, 이들에만 한정되는 것은 아니다.

[366]

[367] 상기 정공수송층은 정공주입층으로부터 정공을 수취하여 발광층까지 정공을 수송하는 층으로, 정공 수송 물질로 양극이나 정공 주입층으로부터 정공을 수송받아 발광층으로 옮겨줄 수 있는 물질로 정공에 대한 이동성이 큰 물질이 적합하다. 구체적인 예로는 아릴아민 계열의 유기물, 전도성 고분자, 및 공액 부분과 비공액 부분이 함께 있는 블록 공중합체 등이 있으나, 이들에만 한정되는 것은 아니다.

[368]

[369] 상기 발광 물질로는 정공 수송층과 전자 수송층으로부터 정공과 전자를 각각 수송받아 결합시킴으로써 가시광선 영역의 빛을 낼 수 있는 물질로서, 형광이나 인광에 대한 양자 효율이 좋은 물질이 바람직하다. 구체적인 예로 8-히드록시-퀴놀린 알루미늄 착물(Alq₃); 카바졸 계열 화합물; 이량체화 스티릴(dimerized styryl) 화합물; BAlq; 10-히드록시벤조 퀴놀린-금속 화합물; 벤조사졸, 벤즈티아졸 및 벤즈이미다졸 계열의 화합물; 폴리(p-페닐렌비닐렌)(PPV) 계열의 고분자; 스피로(spiro) 화합물; 폴리플루오렌, 루브렌 등이 있으나, 이들에만 한정되는 것은 아니다.

[370]

[371] 상기 발광층은 호스트 재료 및 도펀트 재료를 포함할 수 있다. 호스트 재료는 축합 방향족환 유도체 또는 헤테로환 함유 화합물 등이 있다. 구체적으로 축합 방향족환 유도체로는 안트라센 유도체, 피렌 유도체, 나프탈렌 유도체, 펜타센 유도체, 페난트렌 화합물, 플루오란텐 화합물 등이 있고, 헤테로환 함유 화합물로는 카바졸 유도체, 디벤조퓨란 유도체, 래더형 퓨란 화합물, 피리미딘 유도체 등이 있으나, 이에 한정되지 않는다. 바람직하게는, 상기 호스트 재료로서 본 발명에 따른 화합물을 사용한다.

[372]

[373] 도펀트 재료로는 방향족 아민 유도체, 스트릴아민 화합물, 붕소 착체, 플루오란텐 화합물, 금속 착체 등이 있다. 구체적으로 방향족 아민 유도체로는 치환 또는

비치환된 아릴아미노기를 갖는 축합 방향족환 유도체로서, 아릴아미노기를 갖는 피렌, 안트라센, 크리센, 페리플란텐 등이 있으며, 스티릴아민 화합물로는 치환 또는 비치환된 아릴아민에 적어도 1개의 아릴비닐기가 치환되어 있는 화합물로, 아릴기, 실릴기, 알킬기, 사이클로알킬기 및 아릴아미노기로 이루어진 군에서 1 또는 2 이상 선택되는 치환기가 치환 또는 비치환된다. 구체적으로 스티릴아민, 스티릴디아민, 스티릴트리아민, 스티릴테트라아민 등이 있으나, 이에 한정되지 않는다. 또한, 금속 착체로는 이리듐 착체, 백금 착체 등이 있으나, 이에 한정되지 않는다. 바람직하게는, 상기 도펀트 재료로서 이리듐계 금속 착체를 사용한다.

[374]

[375] 상기 발광층은 적색 발광층일 수 있으며, 본 발명에 따른 화합물을 호스트 재료로 사용할 경우, 전자와 정공에 대한 안정도가 높아지며, 호스트에서 적색 도펀트의 에너지 전달이 잘 이뤄지면서, 유기 발광 소자의 구동전압, 발광 효율 및 수명 특성을 향상시킬 수 있다.

[376]

[377] 상기 전자수송층은 전자주입층으로부터 전자를 수취하여 발광층까지 전자를 수송하는 층으로 전자 수송 물질로는 음극으로부터 전자를 잘 주입 받아 발광층으로 옮겨줄 수 있는 물질로서, 전자에 대한 이동성이 큰 물질이 적합하다. 구체적인 예로는 8-히드록시퀴놀린의 Al 착물; Alq_3 를 포함한 착물; 유기 라디칼 화합물; 히드록시플라본-금속 착물 등이 있으나, 이들에만 한정되는 것은 아니다. 전자 수송층은 종래기술에 따라 사용된 바와 같이 임의의 원하는 음극(cathode) 물질과 함께 사용할 수 있다. 특히, 적절한 음극(cathode) 물질의 예는 낮은 일함수를 가지고 알루미늄층 또는 실버층이 뒤따르는 통상적인 물질이다. 구체적으로 세슘, 바륨, 칼슘, 이테르븀 및 사마륨이고, 각 경우 알루미늄 층 또는 실버층이 뒤따른다.

[378]

[379] 상기 전자주입층은 전극으로부터 전자를 주입하는 층으로, 전자를 수송하는 능력을 갖고, 음극으로부터의 전자 주입 효과, 발광층 또는 발광 재료에 대하여 우수한 전자주입 효과를 가지며, 발광층에서 생성된 여기자의 정공주입층에의 이동을 방지하고, 또한, 박막형성능력이 우수한 화합물이 바람직하다. 구체적으로는 플루오레논, 안트라퀴노다임에탄, 다이페노퀴논, 티오피란 다이옥사이드, 옥사졸, 옥사다리아졸, 트리아졸, 이미다졸, 페릴렌테트라카복실산, 프레오레닐리덴 메탄, 안트론 등과 그들의 유도체, 금속 착체 화합물 및 질소 함유 5원환 유도체 등이 있으나, 이에 한정되지 않는다.

[380]

[381] 상기 금속 착체 화합물로서는 8-하이드록시퀴놀리나토 리튬, 비스(8-하이드록시퀴놀리나토)아연, 비스(8-하이드록시퀴놀리나토)구리, 비스(8-하이드록시퀴놀리나토)망간, 트리스(8-하이드록시퀴놀리나토)알루미늄, 트리스(2-메틸-8-하

이드록시퀴놀리나토)알루미늄, 트리스(8-하이드록시퀴놀리나토)갈륨, 비스(10-하이드록시벤조[h]퀴놀리나토)베릴륨, 비스(10-하이드록시벤조[h]퀴놀리나토)아연, 비스(2-메틸-8-퀴놀리나토)클로로갈륨, 비스(2-메틸-8-퀴놀리나토)(o-크레졸라토)갈륨, 비스(2-메틸-8-퀴놀리나토)(1-나프톨라토)알루미늄, 비스(2-메틸-8-퀴놀리나토)(2-나프톨라토)갈륨 등이 있으나, 이에 한정되지 않는다.

[382]

[383] 본 발명에 따른 유기 발광 소자는 배면 발광(bottom emission) 소자, 전면 발광(top emission) 소자, 또는 양면 발광 소자일 수 있으며, 특히 상대적으로 높은 발광 효율이 요구되는 배면 발광 소자일 수 있다.

[384]

[385] 또한, 본 발명에 따른 화합물은 유기 발광 소자 외에도 유기 태양 전지 또는 유기 트랜지스터에 포함될 수 있다.

[386]

[387] 상기 화학식 1로 표시되는 화합물 및 이를 포함하는 유기 발광 소자의 제조는 이하 실시예에서 구체적으로 설명한다. 그러나 하기 실시예는 본 발명을 예시하기 위한 것이며, 본 발명의 범위가 이들에 의하여 한정되는 것은 아니다.

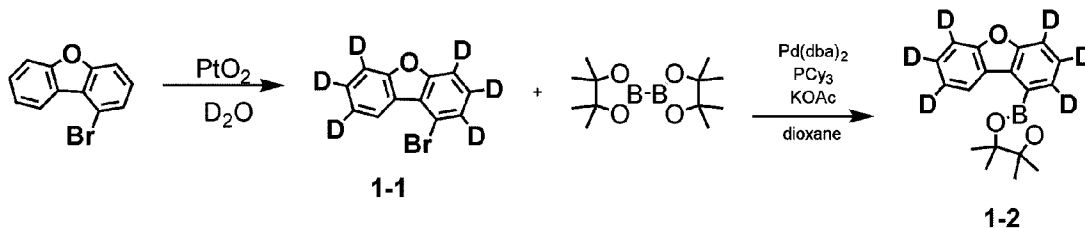
[388]

[389] [실시예]

[390] 제조예

[391] 제조예 1: 중간체 화합물 1-2의 제조

[392]



[393] 단계 1) 화합물 1-1의 제조

[394] 셰이커 튜브에 1-bromodibenzo[b,d]furan (20.0 g, 80.9 mmol), PtO₂ (5.5 g, 24.3 mmol), D₂O 405 mL를 넣은 후, 튜브를 밀봉하고 250 °C, 600 psi에서 12 시간 동안 가열하였다. 반응이 종료되면 클로로포름을 넣고 반응액을 분액 깔대기에 옮겨 추출하였다. 추출액을 무수황산마그네슘으로 건조, 농축하고 시료를 실리카 겔 컬럼 크로마토그래피로 정제하여 중간체 화합물 1-1을 제조하였다(13.5 g, 64%, MS: [M+H]⁺ = 253).

[395]

[396] 단계 2) 중간체 화합물 1-2의 제조

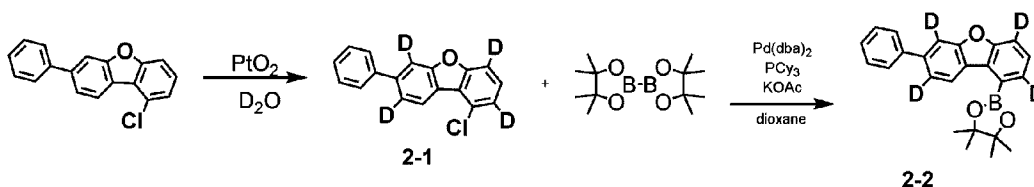
[397] 질소 분위기에서 상기 중간체 화합물 1-1 (13.5 g, 53.6 mmol)와 비스(피나콜라토)디보론 (16.3 g, 64.3 mmol)을 1,4-디옥산(Diox) 270 mL에 넣고 교반 및 환류하였다. 이 후 포타슘아세테이트 (15.4 g, 160.7 mmol)를 투입하고 충분히 교반한 후

팔라듐디벤질리덴아세톤팔라듐 (0.9 g, 1.6 mmol) 및 트리시클로헥실포스핀 (0.9 g, 3.2 mmol)을 투입하였다. 3 시간 반응 후 상온으로 식인 후 유기층을 필터처리하여 염을 제거한 후 걸러진 유기층을 증류하였다. 이를 다시 클로로포름 482 mL에 투입하여 녹이고, 물로 2회 세척 후에 유기층을 분리하여, 무수황산마그네슘을 넣고 교반한 후 여과하여 여액을 감압 증류하였다. 농축한 화합물을 클로로포름과 에탄올재결정을 통해 중간체 화합물 1-2을 제조하였다(12.5 g, 78%, MS: $[M+H]^+ = 301.2$).

[398]

[399] 제조예 2: 중간체 화합물 2-1의 제조

[400]



[401] 단계 1) 화합물 2-1의 제조

[402] 제조예 1의 단계 1)과 동일한 반응을 수행하되, 1-bromodibenzo[b,d]furan 대신에 1-chloro-7-phenyldibenzo[b,d]furan을 사용한 것을 제외하고, 제조예 1의 중간체 화합물 1-1의 제조와 동일한 방법으로 중간체 화합물 2-1를 제조하였다 (13.8 g, 수율 68%, MS: $[M+H]^+ = 283$).

[403]

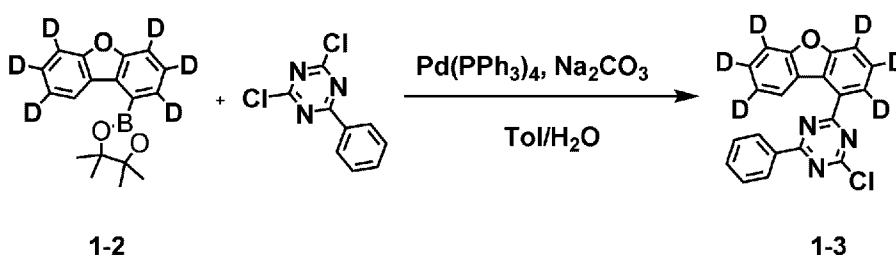
[404] 단계 2) 중간체 화합물 2-2의 제조

[405] 제조예 1의 단계 2)와 동일한 반응을 수행하되, 중간체 화합물 1-1 대신 상기 중간체 화합물 2-1를 사용한 것을 제외하고, 제조예 1의 중간체 화합물 1-2의 제조와 동일한 방법으로 중간체 화합물 2-2를 제조하였다 (16.1 g, 수율 88%, MS: $[M+H]^+ = 375$).

[406]

[407] 제조예 3: 중간체 화합물 1-3의 제조

[408]



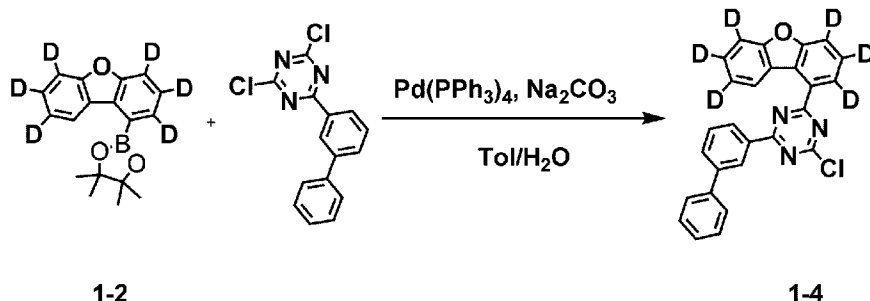
[409] 질소 분위기에서 중간체 화합물 1-2 (5 g, 16.7 mmol)와 2,4-dichloro-6-phenyl-1,3,5-triazine (3.7 g, 16.7 mmol)를 톨루엔 100 mL에 넣고 교반 및 환류하였다. 이후 소듐카보네이트 (5.3 g, 50 mmol)를 물 5 mL에 녹여 투입하고 충분히 교반한 후 테트라키스트리페닐-포스피노팔라듐 (0.6 g, 0.5 mmol)을 투입하였다. 3 시간 반응 후 상온으로 식인 후 유기층과 물층을 분리 후 유기층을 증류하였다. 이를

다시클로로포름 91 mL에 투입하여 녹이고, 물로 2회 세척 후에 유기층을 분리하여, 무수황산마그네슘을 넣고 교반한 후 여과하여 여액을 감압 증류하였다. 농축한 화합물을 클로로포름과 에탄올재결정을 통해 중간체 화합물 1-3을 제조하였다 (5.3 g, 87%, MS: $[M+H]^+ = 364.1$).

[410]

[411] 제조예 4: 중간체 화합물 1-4의 제조

[412]

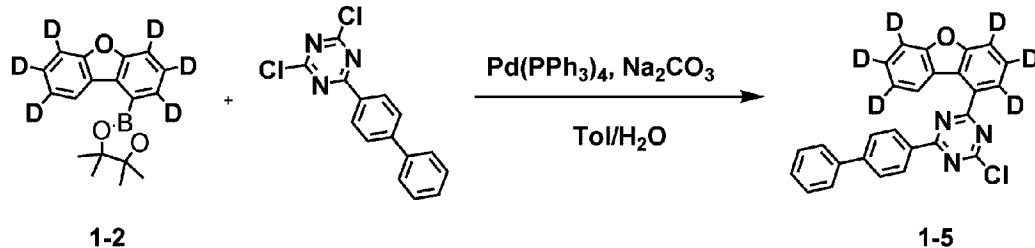


[413] 제조예 3과 동일한 반응을 수행하되, 2,4-dichloro-6-phenyl-1,3,5-triazine 대신에 2-([1,1'-biphenyl]-3-yl)-4,6-dichloro-1,3,5-triazine을 사용한 것을 제외하고, 제조예 3의 중간체 화합물 1-3의 제조와 동일한 방법으로 중간체 화합물 1-4를 제조하였다 (5.3 g, 수율 73%, MS: $[M+H]^+ = 440$).

[414]

[415] 제조예 5: 중간체 화합물 1-5의 제조

[416]

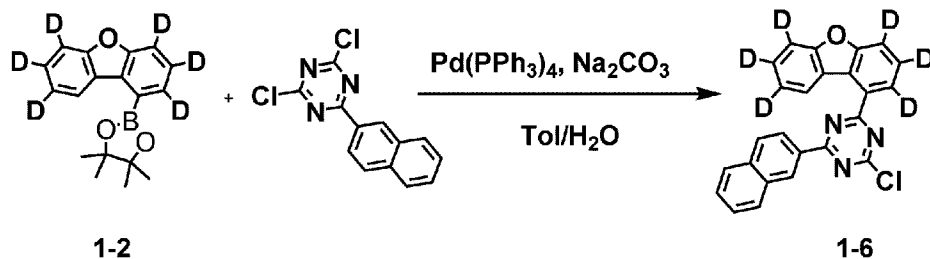


[417] 제조예 3과 동일한 반응을 수행하되, 2,4-dichloro-6-phenyl-1,3,5-triazine 대신 2-([1,1'-biphenyl]-4-yl)-4,6-dichloro-1,3,5-triazine을 사용한 것을 제외하고, 제조예 3의 중간체 화합물 1-3의 제조와 동일한 방법으로 중간체 화합물 1-5를 제조하였다 (5.8 g, 수율 80%, MS: $[M+H]^+ = 440$).

[418]

[419] 제조예 6: 중간체 화합물 1-6의 제조

[420]

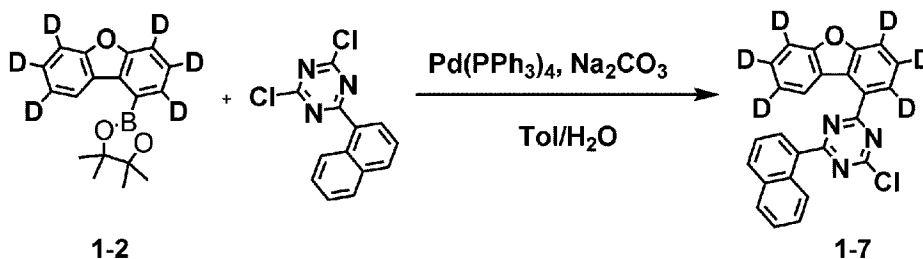


[421] 제조예 3과 동일한 반응을 수행하되, 2,4-dichloro-6-phenyl-1,3,5-triazine 대신 2,4-dichloro-6-(naphthalen-2-yl)-1,3,5-triazine을 사용한 것을 제외하고, 제조예 3의 중간체 화합물 1-3의 제조와 동일한 방법으로 중간체 화합물 1-6을 제조하였다 (5.0 g, 수율 73%, MS: $[M+H]^+ = 414$).

[422]

[423] 제조예 7: 중간체 화합물 1-7의 제조

[424]

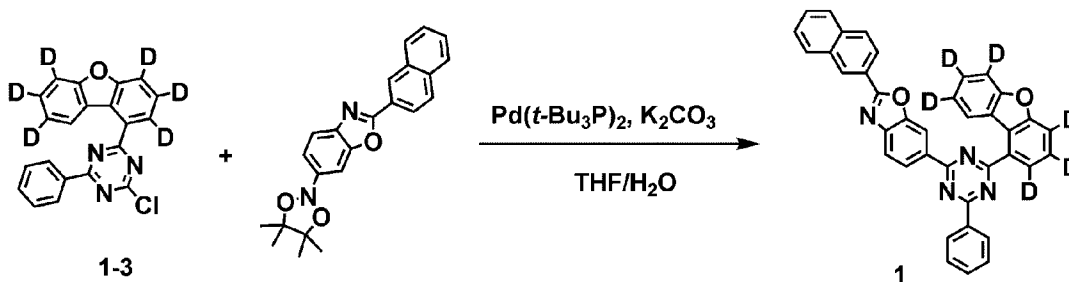


[425] 제조예 3과 동일한 반응을 수행하되, 2,4-dichloro-6-phenyl-1,3,5-triazine 대신 2,4-dichloro-6-(naphthalen-1-yl)-1,3,5-triazine을 사용한 것을 제외하고 제조예 3의 중간체 화합물 1-3의 제조와 동일한 방법으로 중간체 화합물 1-7을 제조하였다 (4.4 g, 수율 64%, MS: $[M+H]^+ = 414$).

[426]

[427] 합성예 1: 화합물 1의 제조

[428]

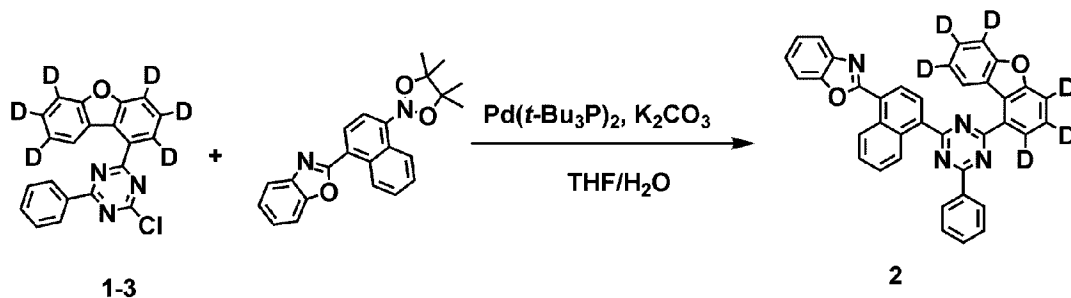


[429] 질소 분위기에서 중간체 화합물 1-3(5 g, 13.8 mmol)와 2-(naphthalen-2-yl)-6-(4,4,5,5-tetramethyl-1,3,2-dioxazolidin-2-yl)benzo[d]oxazole (5.2 g, 13.8 mmol)를 테트라하이드로퓨란 100 mL에 넣고 교반 및 환류하였다. 이 후 포타슘카보네이트 (5.7 g, 41.3 mmol)를 물 6 mL에 녹여 투입하고 충분히 교반한 후 비스(트리 터셔리-부틸포스핀)팔라듐 (0.1 g, 0.1 mmol)을 투입하였다. 3 시간 반응 후 상온으로 식인 후 생성된 고체를 여과하였다. 고체를 디클로로벤젠 355 mL에 투입하여 녹이고, 물로 2회 세척 후에 유기층을 분리하여, 무수황산마그네슘을 넣고 교반한 후 여과하여 여액을 감압 증류하였다. 농축한 화합물을 디클로로벤젠과 테트라하이드로퓨란재결정을 통해 화합물 1을 제조하였다 (5.1 g, 65%, MS: $[M+H]^+ = 573.2$).

[430]

[431] 합성예 2: 화합물 2의 제조

[432]

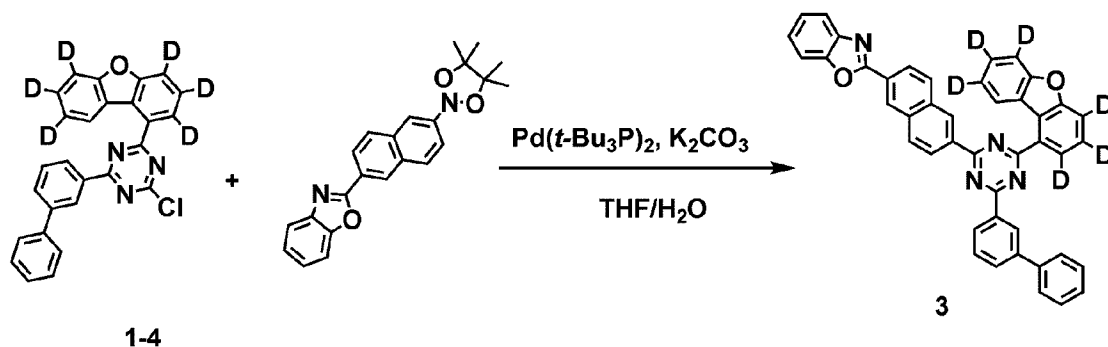


[433] 합성예 1과 동일한 반응을 수행하되, 2-(naphthalen-2-yl)-6-(4,4,5,5-tetramethyl-1,3,2-dioxazolidin-2-yl)benzo[d]oxazole 대신에 2-(4-(4,4,5,5-tetramethyl-1,3,2-dioxazolidin-2-yl)naphthalen-1-yl)benzo[d]oxazole 을 사용한 것을 제외하고, 합성예 1의 화합물 1의 제조와 동일한 방법으로 화합물 2를 제조하였다 (6.7 g, 수율 85%, MS:[M+H]⁺= 573).

[434]

[435] 합성예 3: 화합물 3의 제조

[436]

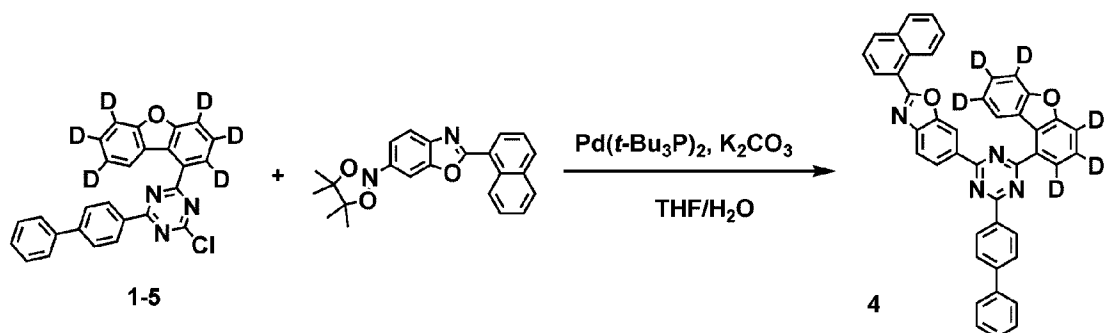


[437] 합성예 1과 동일한 반응을 수행하되, 중간체 화합물 1-3과 2-(naphthalen-2-yl)-6-(4,4,5,5-tetramethyl-1,3,2-dioxazolidin-2-yl)benzo[d]oxazole 대신에 중간체 화합물 1-4 와 2-(6-(4,4,5,5-tetramethyl-1,3,2-dioxazolidin-2-yl)naphthalen-2-yl)benzo[d]oxazole 을 사용한 것을 제외하고, 합성예 1의 화합물 1의 제조와 동일한 방법으로 화합물 3을 제조하였다 (5.3 g, 수율 71%, MS:[M+H]⁺= 649).

[438]

[439] 합성예 4: 화합물 4의 제조

[440]



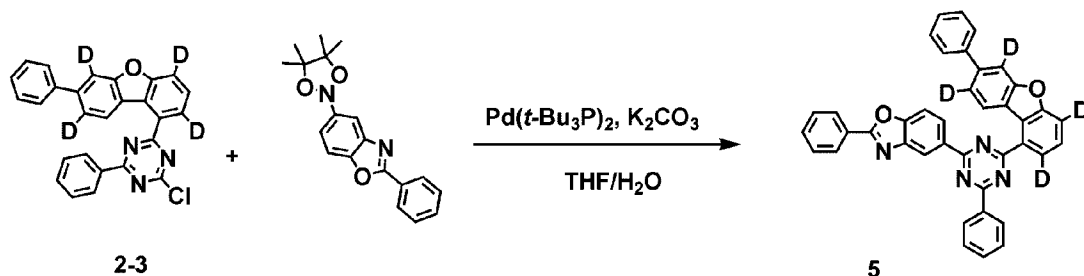
[441] 합성예 1과 동일한 반응을 수행하되, 중간체 화합물 1-3과 2-(naphthalen-2-yl)-6-(4,4,5,5-tetramethyl-1,3,2-dioxazolidin-2-yl)benzo[d]oxazole 대신에 중간체

화합물 1-5와 2-(naphthalen-1-yl)-6-(4,4,5,5-tetramethyl-1,3,2-dioxazolidin-2-yl)benzo[d]oxazole 을 사용한 것을 제외하고, 합성에 1의 화합물 1의 제조와 동일한 방법으로 화합물 4를 제조하였다 (5.1 g, 수율 69%, MS:[M+H]⁺= 649).

[442]

[443] 합성예 5: 화합물 5의 제조

[444]

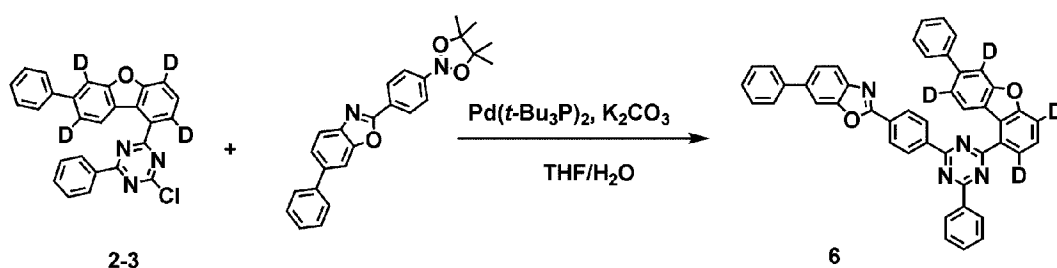


[445] 합성예 1과 동일한 반응을 수행하되, 중간체 화합물 1-3과 2-(naphthalen-2-yl)-6-(4,4,5,5-tetramethyl-1,3,2-dioxazolidin-2-yl)benzo[d]oxazole 대신에 중간체 화합물 2-3 과 2-phenyl-5-(4,4,5,5-tetramethyl-1,3,2-dioxazolidin-2-yl)benzo[d]oxazole 을 사용한 것을 제외하고, 합성에 1의 화합물 1의 제조와 동일한 방법으로 화합물 5를 제조하였다 (5.3 g, 수율 77%, MS:[M+H]⁺= 597).

[446]

[447] 합성예 6: 화합물 6의 제조

[448]

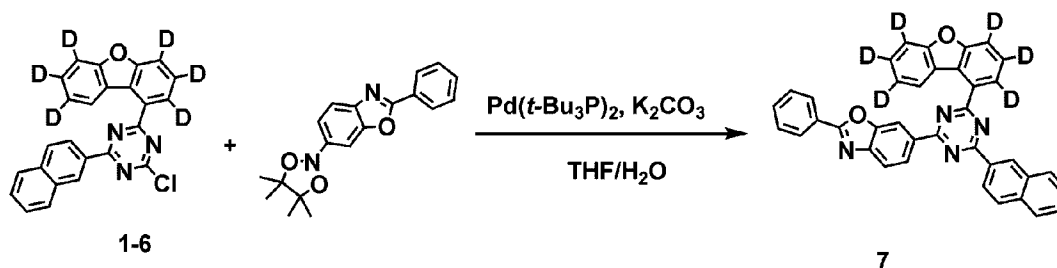


[449] 합성예 1과 동일한 반응을 수행하되, 중간체 화합물 1-3과 2-(naphthalen-2-yl)-6-(4,4,5,5-tetramethyl-1,3,2-dioxazolidin-2-yl)benzo[d]oxazole 대신에 중간체 화합물 2-3과 6-phenyl-2-(4-(4,4,5,5-tetramethyl-1,3,2-dioxazolidin-2-yl)phenyl)benzo[d]oxazole을 사용한 것을 제외하고, 합성에 1의 화합물 1의 제조와 동일한 방법으로 화합물 6을 제조하였다 (6.3 g, 수율 82%, MS:[M+H]⁺= 673).

[450]

[451] 합성예 7: 화합물 7의 제조

[452]

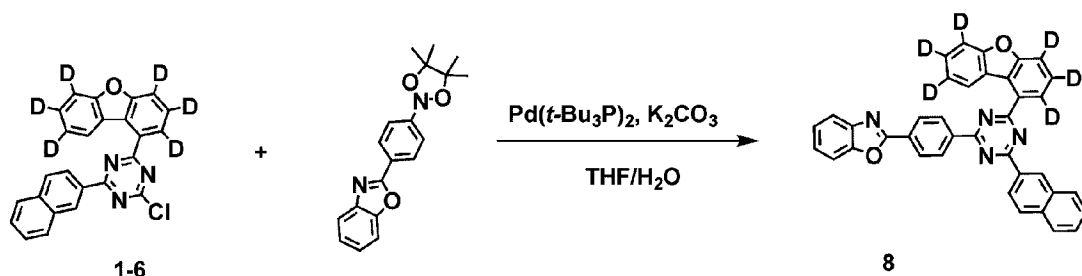


[453] 합성에 1과 동일한 반응을 수행하되, 중간체 화합물 1-3과 2-(naphthalen-2-yl)-6-(4,4,5,5-tetramethyl-1,3,2-dioxazolidin-2-yl)benzo[d]oxazole 대신에 중간체 화합물 1-6과 2-phenyl-6-(4,4,5,5-tetramethyl-1,3,2-dioxazolidin-2-yl)benzo[d]oxazole을 사용한 것을 제외하고, 합성에 1의 화합물 1의 제조와 동일한 방법으로 화합물 7을 제조하였다 (6.2 g, 수율 89%, MS:[M+H]⁺= 573).

[454]

[455] 합성예 8: 화합물 8의 제조

[456]

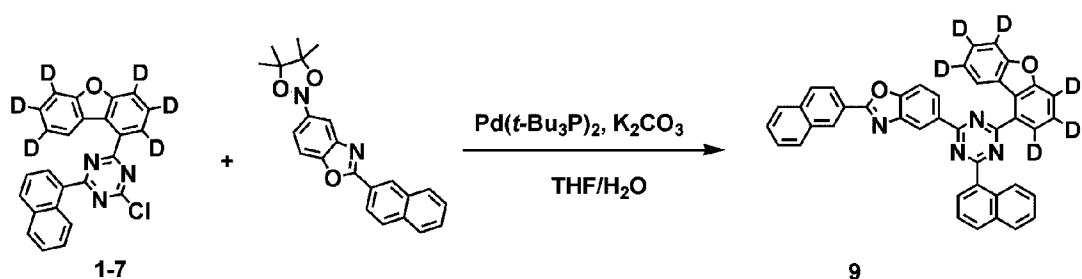


[457] 합성에 1과 동일한 반응을 수행하되, 중간체 화합물 1-3과 2-(naphthalen-2-yl)-6-(4,4,5,5-tetramethyl-1,3,2-dioxazolidin-2-yl)benzo[d]oxazole 대신에 중간체 화합물 1-6과 2-(4-(4,4,5,5-tetramethyl-1,3,2-dioxazolidin-2-yl)phenyl)benzo[d]oxazole을 사용한 것을 제외하고, 합성에 1의 화합물 1의 제조와 동일한 방법으로 화합물 8을 제조하였다 (5.1 g, 수율 74%, MS:[M+H]⁺= 573).

[458]

[459] 합성예 9: 화합물 9의 제조

[460]

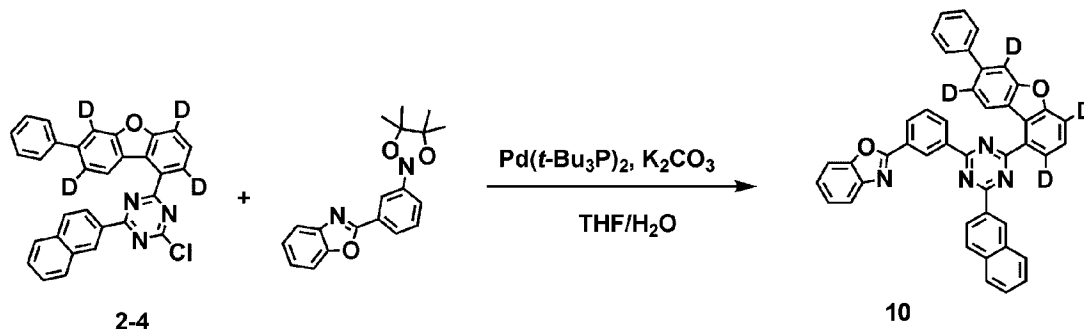


[461] 합성에 1과 동일한 반응을 수행하되, 중간체 화합물 1-3과 2-(naphthalen-2-yl)-6-(4,4,5,5-tetramethyl-1,3,2-dioxazolidin-2-yl)benzo[d]oxazole 대신에 중간체 화합물 1-7과 2-(naphthalen-2-yl)-5-(4,4,5,5-tetramethyl-1,3,2-dioxazolidin-2-yl)benzo[d]oxazole을 사용한 것을 제외하고, 합성에 1의 화합물 1의 제조와 동일한 방법으로 화합물 9를 제조하였다 (6.1 g, 수율 80%, MS:[M+H]⁺= 623).

[462]

[463] 합성예 10: 화합물 10의 제조

[464]



[465] 합성에 1과 동일한 반응을 수행하되, 중간체 화합물 1-3과 2-(naphthalen-2-yl)-6-(4,4,5,5-tetramethyl-1,3,2-dioxazolidin-2-yl)benzo[d]oxazole 대신에 중간체 화합물 2-4와 2-(3-(4,4,5,5-tetramethyl-1,3,2-dioxazolidin-2-yl)phenyl)benzo[d]oxazole을 사용한 것을 제외하고, 합성에 1의 화합물 1의 제조와 동일한 방법으로 화합물 10을 제조하였다 (4.4 g, 수율 66%, MS:[M+H]⁺ = 647).

[466]

[467] 실시예 1

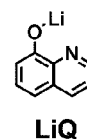
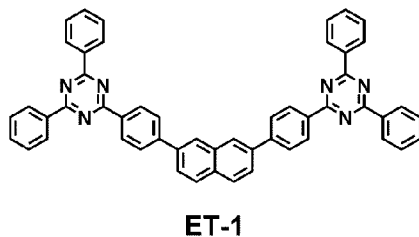
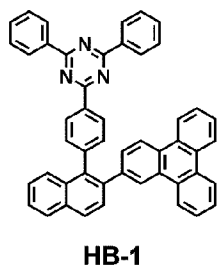
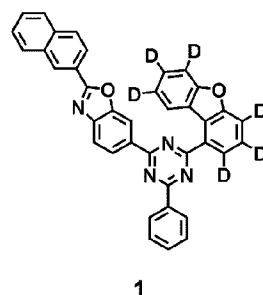
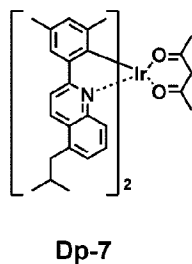
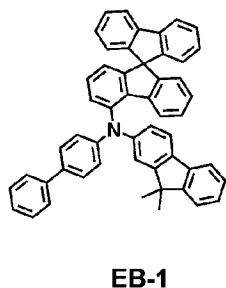
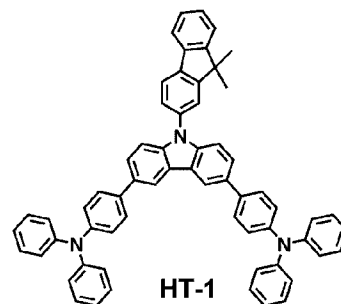
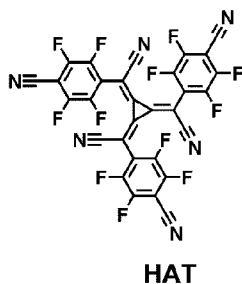
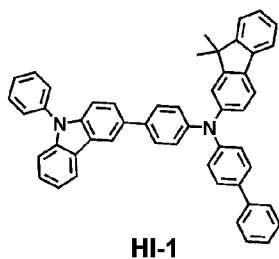
[468] ITO(indium tin oxide)가 1,000 옹스트롬(Å, angstrom)의 두께로 박막 코팅된 유리 기판을 세제를 녹인 증류수에 넣고 초음파로 세척하였다. 이때, 세제로는 피셔사(Fischer Co.) 제품을 사용하였으며, 증류수로는 밀러포어사(Millipore Co.) 제품의 필터(Filter)로 2차로 걸러진 증류수를 사용하였다. ITO를 30 분 동안 세척한 후 증류수로 2회 반복하여 초음파 세척을 10 분 동안 진행하였다. 증류수 세척이 끝난 후, 이소프로필알콜, 아세톤, 메탄올의 용제로 초음파 세척을 하고 건조시킨 후 플라즈마 세정기로 수송시켰다. 또한, 산소 플라즈마를 이용하여 상기 기판을 5 분 동안 세정한 후 진공 증착기로 기판을 수송시켰다.

[469]

[470] 이렇게 준비된 ITO 투명 전극 위에 정공주입층으로, 하기 화합물 HI-1를 11500 Å의 두께로 열 진공 증착하여 정공주입층을 형성하되, 하기 화합물 HAT을 1.5% 농도로 p-도핑 하였다. 상기 정공주입층 상에 하기 화합물 HT-1을 진공 증착하여 막 두께 800 Å의 정공수송층을 형성하였다. 이어서, 상기 정공수송층 위에 막 두께 150 Å으로 하기 화합물 EB-1을 진공 증착하여 전자저지층을 형성하였다. 이어서, 상기 전자저지층, 즉, EB-1 증착막 위에 하기 화합물 1 과 하기 화합물 Dp-7을 98:2의 중량비로 진공 증착하여 400 Å 두께의 적색 발광층을 형성하였다. 상기 발광층 위에 막 두께 30 Å으로 하기 화합물 HB-1을 진공 증착하여 정공저지층을 형성하였다. 이어서, 상기 정공저지층 위에 하기 ET-1 화합물과 하기 LiQ 화합물을 2:1의 중량비로 진공 증착하여 300 Å의 두께로 전자 주입 및 수송층을 형성하였다. 상기 전자 주입 및 수송층 위에 순차적으로 12 Å 두께로 리튬플로라이드(LiF)와 1,000Å 두께로 알루미늄을 증착하여 음극을 형성하였다.

[471]

[472]



[473]

[474] 상기의 과정에서 유기물의 증착 속도는 $0.4 \text{ \AA/sec}$ 내지 $0.7 \text{ \AA/sec}$ 를 유지하였고, 음극의 리튬플로라이드는 $0.3 \text{ \AA/sec}$, 알루미늄은 $2 \text{ \AA/sec}$ 의 증착 속도를 유지하였으며, 증착시 진공도는 $2 \times 10^{-7} \text{ torr}$ 내지 $5 \times 10^{-6} \text{ torr}$ 를 유지하여, 유기 발광 소자를 제작하였다

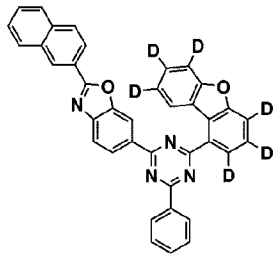
[475]

[476] 실시예 2 내지 10

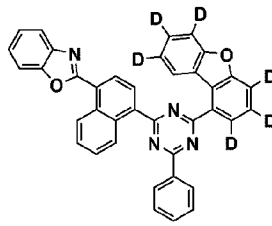
[477] 실시예 1의 유기 발광 소자에서 발광층 형성시 호스트로서 화합물 1 대신에, 하기 표 1에 기재된 화합물 2 내지 10을 각각 사용한 것을 제외하고는, 상기 실시예 1과 동일한 방법으로 유기 발광 소자를 제조하였다.

[478]

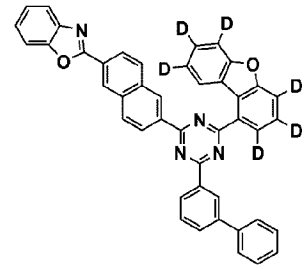
[479]



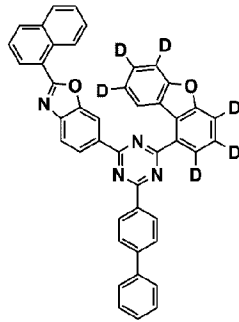
1



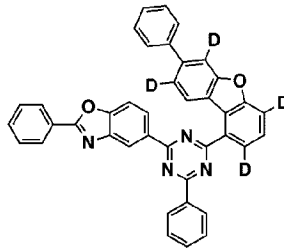
2



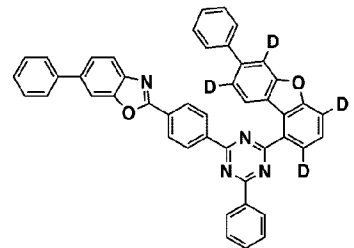
3



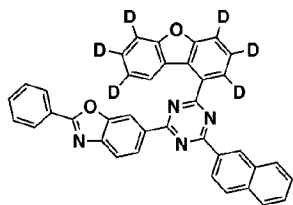
4



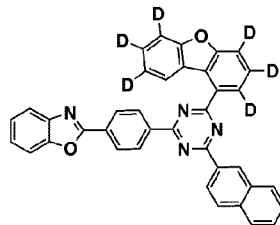
5



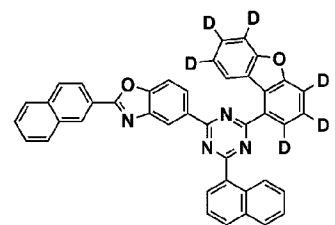
6



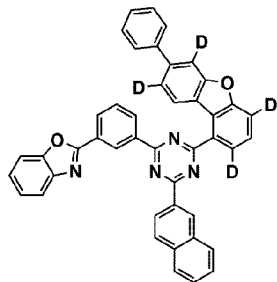
7



8



9



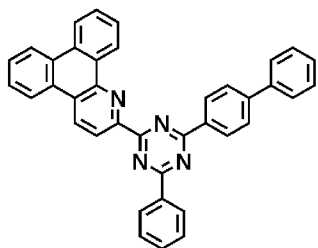
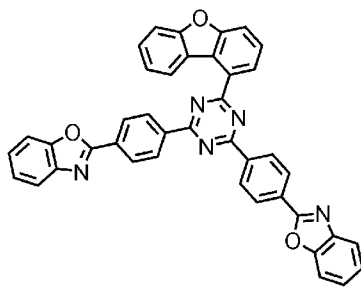
10

[480]

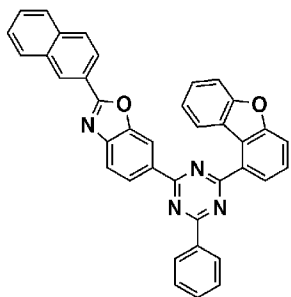
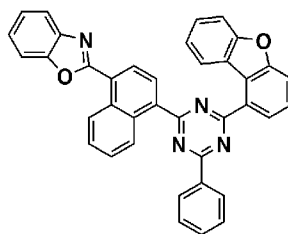
[481] **비교예 1 내지 4**

[482] 실시예 1의 유기 발광 소자에서 발광층 형성시 호스트로서 화합물 1 대신에, 하기 표 1에 기재된 화합물을 각각 사용한 것을 제외하고는, 상기 실시예 1과 동일한 방법으로 유기 발광 소자를 제조하였다. 하기 표 1에서 사용한 C1 내지 C4의 화합물은 아래와 같다.

[483]

**C1****C2**

[484]

**C3****C4**

[485]

[486] **[실험예]**

[487] 상기 실시예 및 비교예에서 제조한 유기 발광 소자에 대하여, 10 mA/cm²의 전류 밀도에서 구동 전압과 발광 효율을 측정하였으며, 50 mA/cm²의 전류 밀도에서 초기 휘도 대비 95%가 되는 시간(LT95)을 측정하였다. 그 결과를 하기 표 1에 나타냈다.

[488]

[489] **[표1]**

	발광층 호스트	전압(V) (@10mA/cm ²)	효율(Cd/A) (@10mA/cm ²)	수명(h) (LT ₉₅ at 5 0mA/cm ²)
실시예 1	화합물 1	4.25	25.01	177
실시예 2	화합물 2	4.28	23.05	180
실시예 3	화합물 3	4.30	24.37	179
실시예 4	화합물 4	4.41	23.98	186
실시예 5	화합물 5	4.31	24.33	172
실시예 6	화합물 6	4.39	24.25	181
실시예 7	화합물 7	4.24	24.20	176
실시예 8	화합물 8	4.22	23.98	175

실시예 9	화합물 9	4.35	24.87	181
실시예 10	화합물 10	4.33	23.99	179
비교예 1	화합물 C1	5.68	14.33	59
비교예 2	화합물 C2	4.90	20.5	69
비교예 3	화합물 C3	4.65	21.23	98
비교예 4	화합물 C4	4.71	22.31	76

[490]

[491] 상기 표 1의 결과로부터 화학식 1의 구조를 갖는 화합물들을 유기 전계 발광 소자의 발광층에 적용하였을 경우, 저전압, 고효율, 장수명의 특성을 갖는 소자를 얻을 수 있음을 확인하였다.

[492]

[493] 특히, 본 발명에 따른 화합물을 발광층의 호스트로 사용하여 제조된 유기 발광 소자의 경우에 비교예의 유기 발광 소자에 비하여 효율 및 수명 측면에서 더욱 우수한 성능을 나타내는 것을 알 수 있다.

[494]

[495] 상기와 같이, 본 발명의 화합물들이 비교예 화합물들에 비하여 치환기의 위치 및 치환기의 종류에 따라 효율 및 수명 측면에서 우수한 특성을 나타냄을 확인할 수 있었다.

[496]

[497] **[부호의 설명]**

[498] 1: 기관 2: 양극

[499] 3: 발광층 4: 음극

[500] 5: 정공주입층 6: 정공수송층

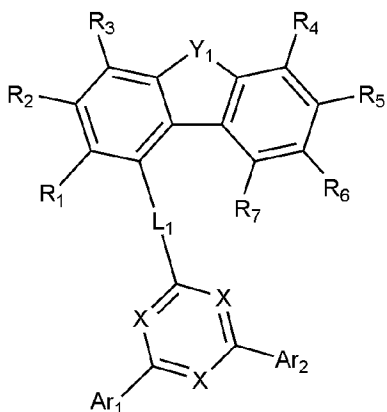
[501] 7: 전자저지층 8: 정공저지층

[502] 9: 전자 주입 및 수송층

청구범위

[청구항 1] 하기 화학식 1로 표시되는 화합물:

[화학식 1]



상기 화학식 1에서,

Y_1 은 O 또는 S이고,

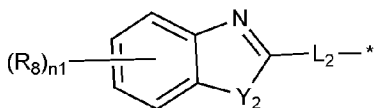
R_1 내지 R_7 은 서로 동일하거나 상이하고, 각각 독립적으로 수소, 중수소, 또는 치환 또는 비치환된 C_{6-60} 아릴이고,

L_1 은 단일 결합이거나, 또는 중수소로 치환 또는 비치환된 페닐렌 또는 나프틸렌이고,

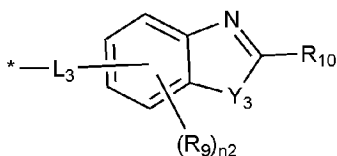
X는 각각 독립적으로 N, CH, 또는 CD이되, X 중 둘 이상은 N이고,

Ar_1 및 Ar_2 중 하나는 하기 화학식 2 또는 화학식 3으로 표시되는 치환기이고, Ar_1 및 Ar_2 중 나머지는 중수소로 치환 또는 비치환된 페닐 또는 나프틸이고,

[화학식 2]



[화학식 3]



상기 화학식 2 및 화학식 3에서,

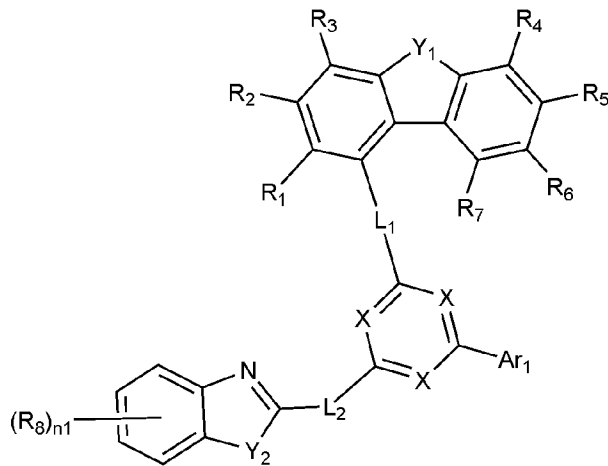
Y_2 및 Y_3 은 각각 독립적으로 O 또는 S이고,

L_2 및 L_3 은 각각 독립적으로 단일 결합이거나, 또는 중수소로 치환 또는 비치환된 페닐렌 또는 나프틸렌이고,

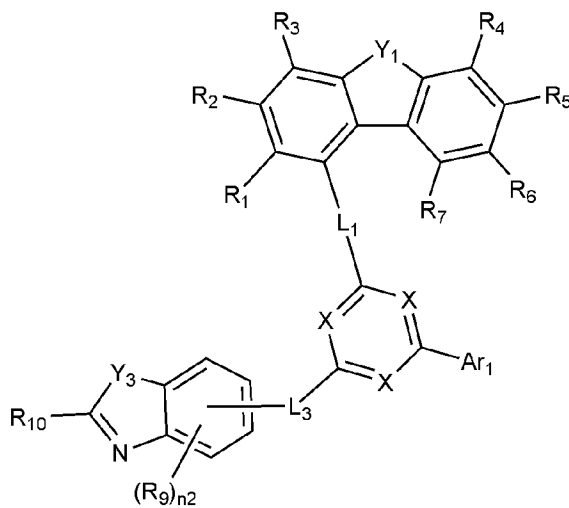
R_8 , R_9 , 및 R_{10} 은 각각 독립적으로 수소, 중수소, 또는 중수소로 치환 또는 비치환된 페닐 또는 나프틸이고,

n1은 1 내지 4의 정수이고,
 n2는 1 내지 3의 정수이고,
 단, R₁ 내지 R₁₀, L₁ 내지 L₃, 및 Ar₁ 내지 Ar₂ 중 적어도 하나 이상은 중수소
 이거나 중수소로 치환된 것이다.

[청구항 2] 제1항에 있어서,
 하기 화학식 1-1 또는 화학식 1-2로 표시되는,
 화합물:
 [화학식 1-1]



[화학식 1-2]



상기 화학식 1-1 및 1-2에서,
 Y₁, Y₂, Y₃, X, Ar₁, L₁ 내지 L₃, R₁ 내지 R₁₀, n1, 및 n2는 제1항에서 정의된 바
 와 같다.

[청구항 3] 제1항에 있어서,
 R₁ 내지 R₇은 각각 수소, 중수소, 페닐, 또는 중수소 치환된 페닐인,
 화합물.

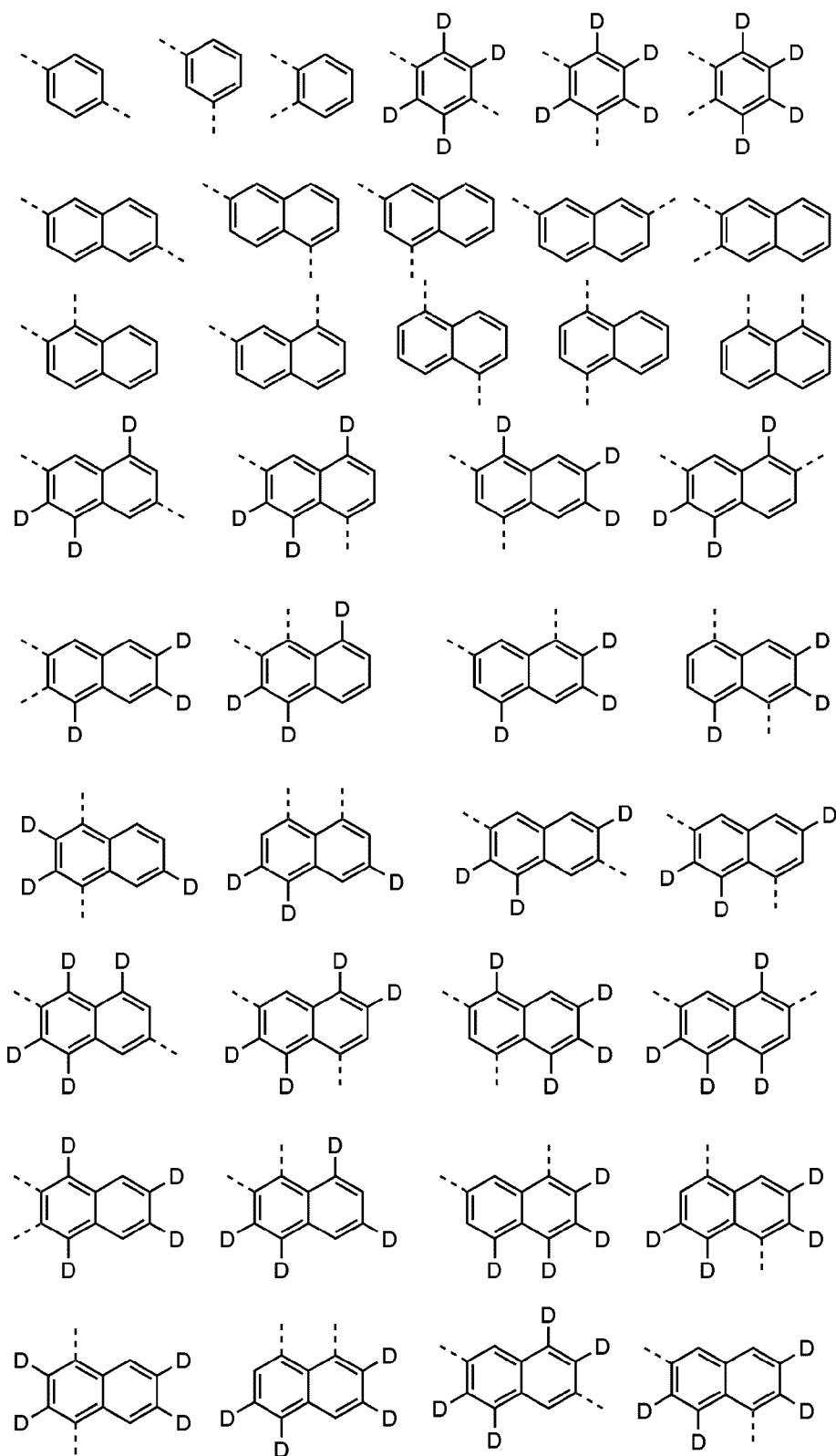
[청구항 4] 제1항에 있어서,

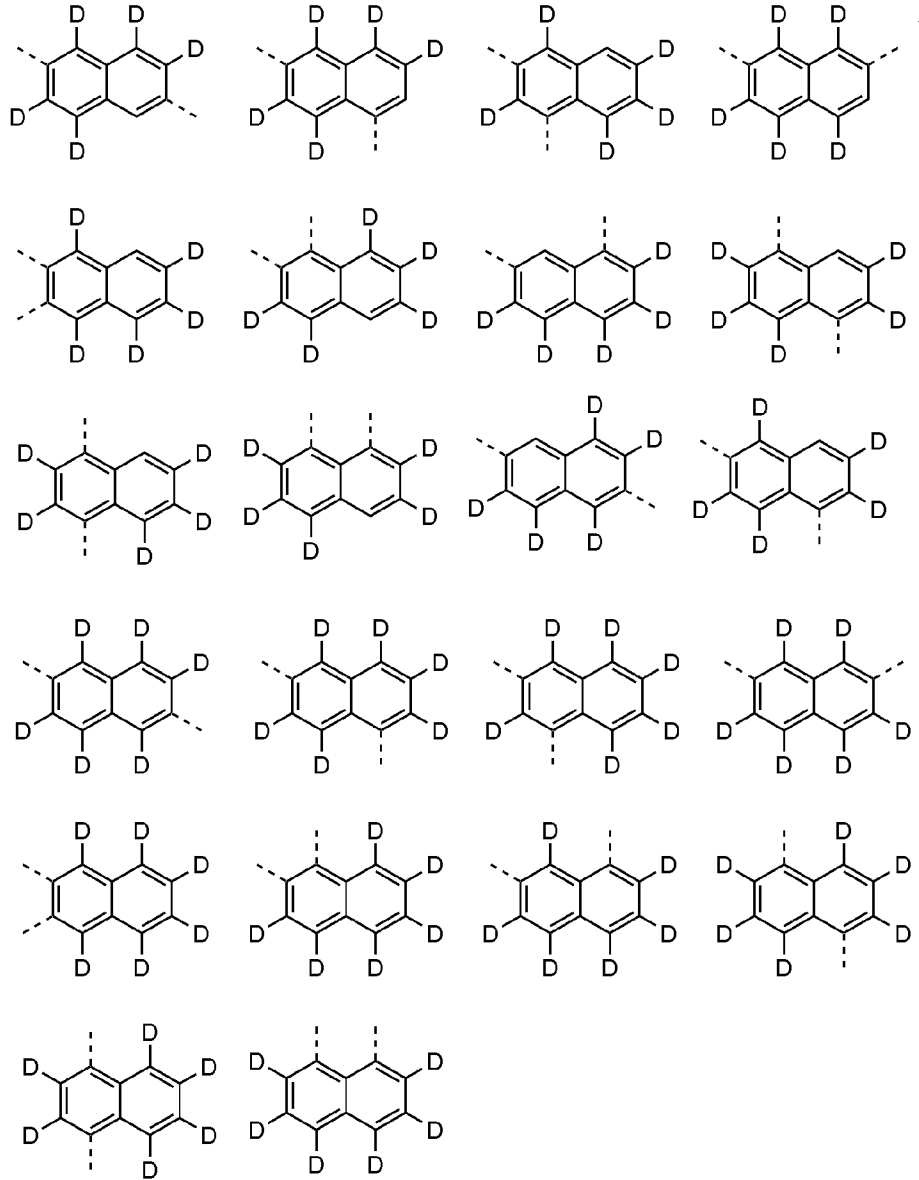
R_1 내지 R_7 중 적어도 하나 이상이 중수소인,
화합물.

[청구항 5] 제1항에 있어서,
 R_1 내지 R_7 중 적어도 4개 이상이 중수소인,
화합물.

[청구항 6] 제1항에 있어서,
 R_1 내지 R_7 중 4개 내지 7개가 중수소인,
화합물.

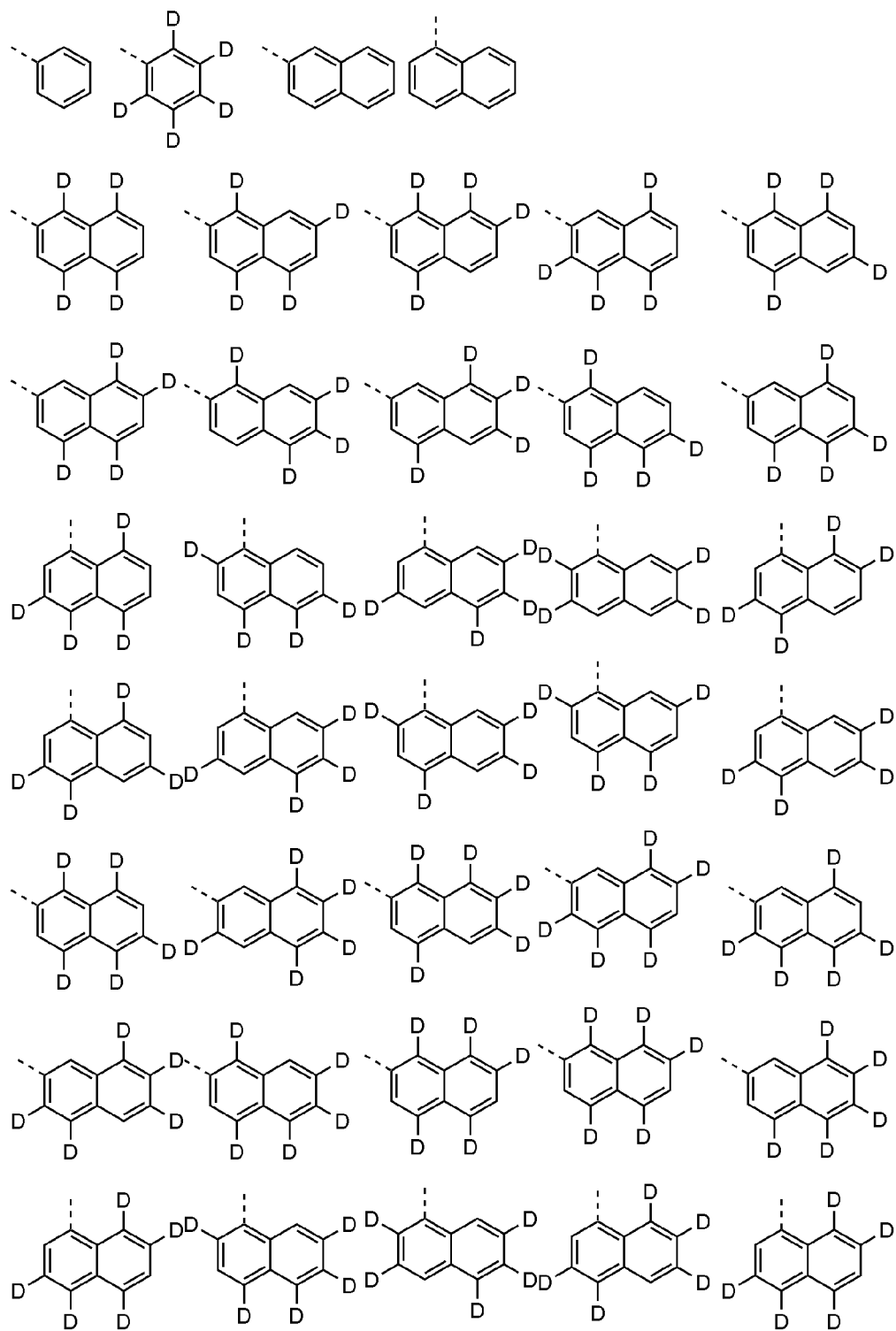
[청구항 7] 제1항에 있어서,
 L_1 , L_2 , 및 L_3 는 각각 단일결합; 또는 하기로 구성되는 군으로부터 선택되
는 어느 하나인,
화합물:

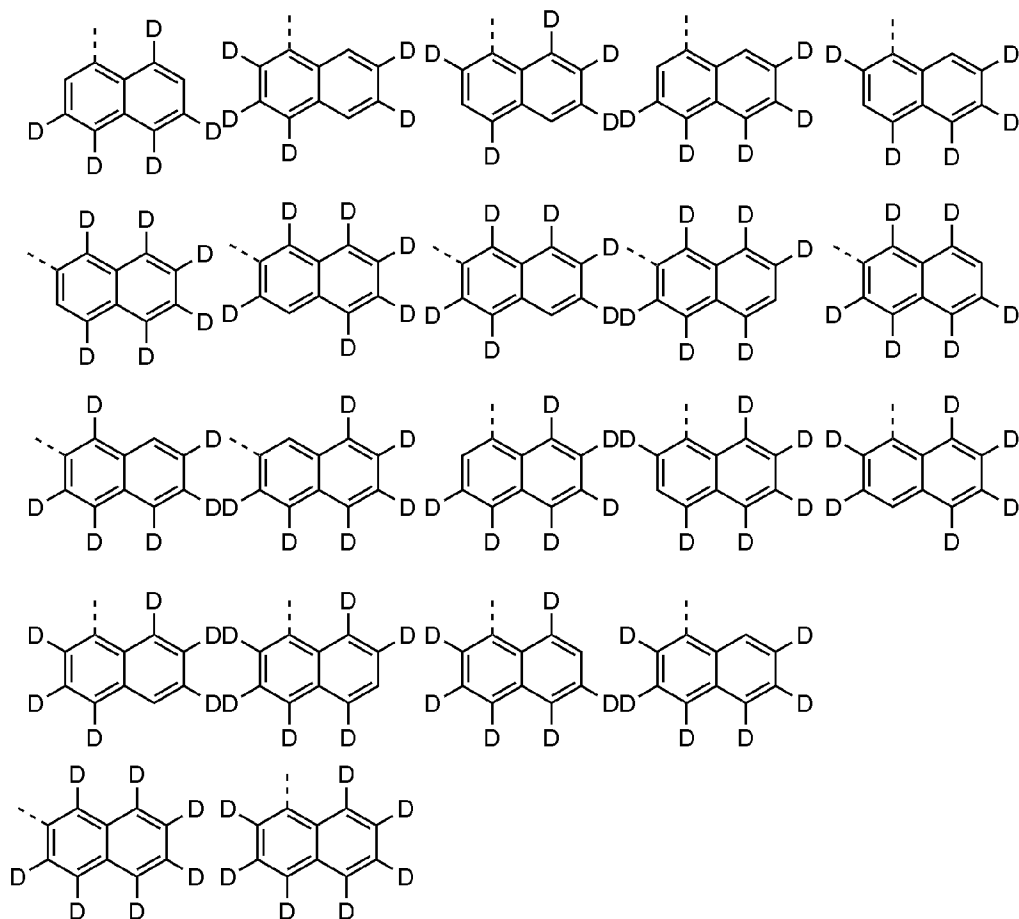




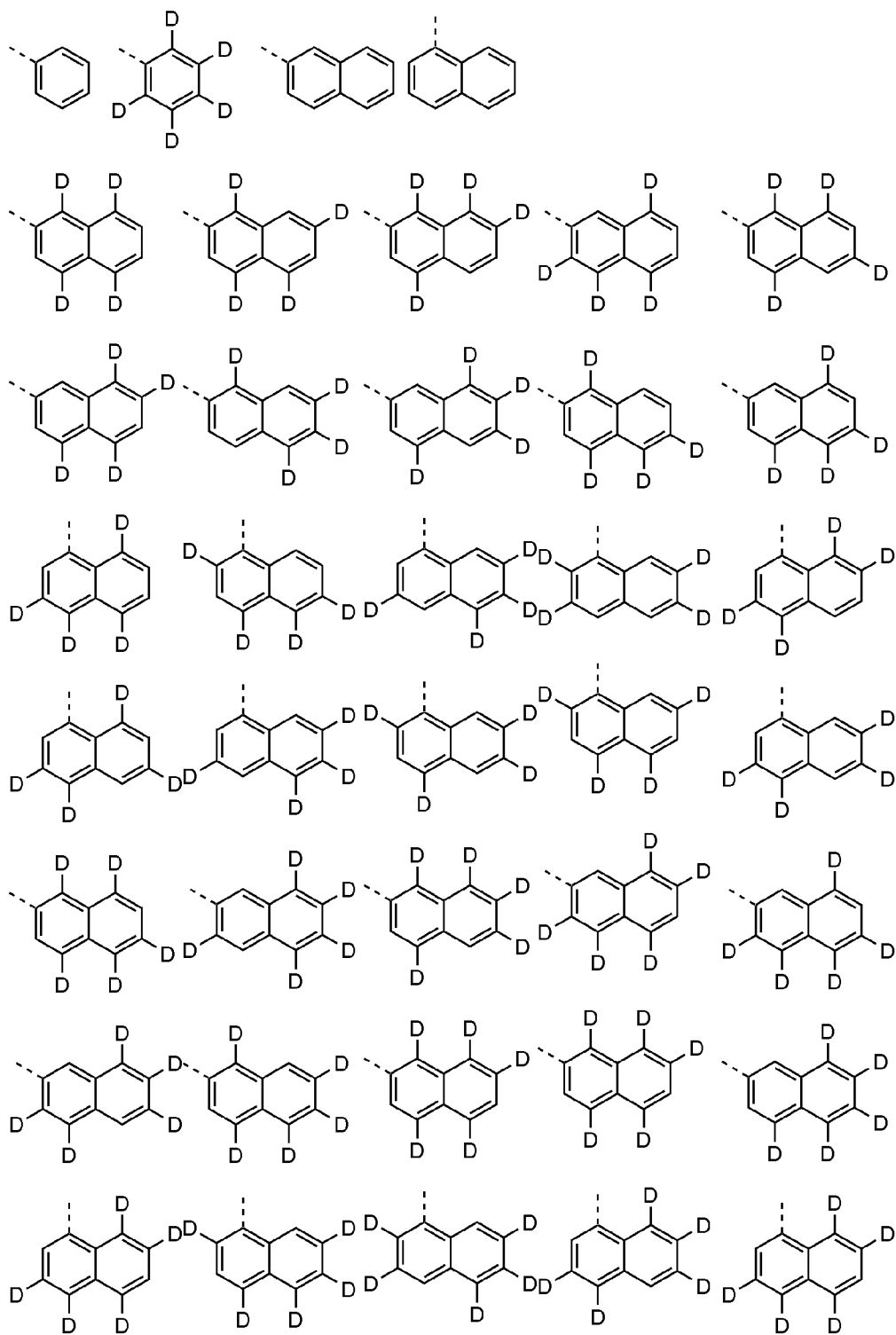
[청구항 8] 제1항에 있어서,
X는 모두 N인,
화합물.

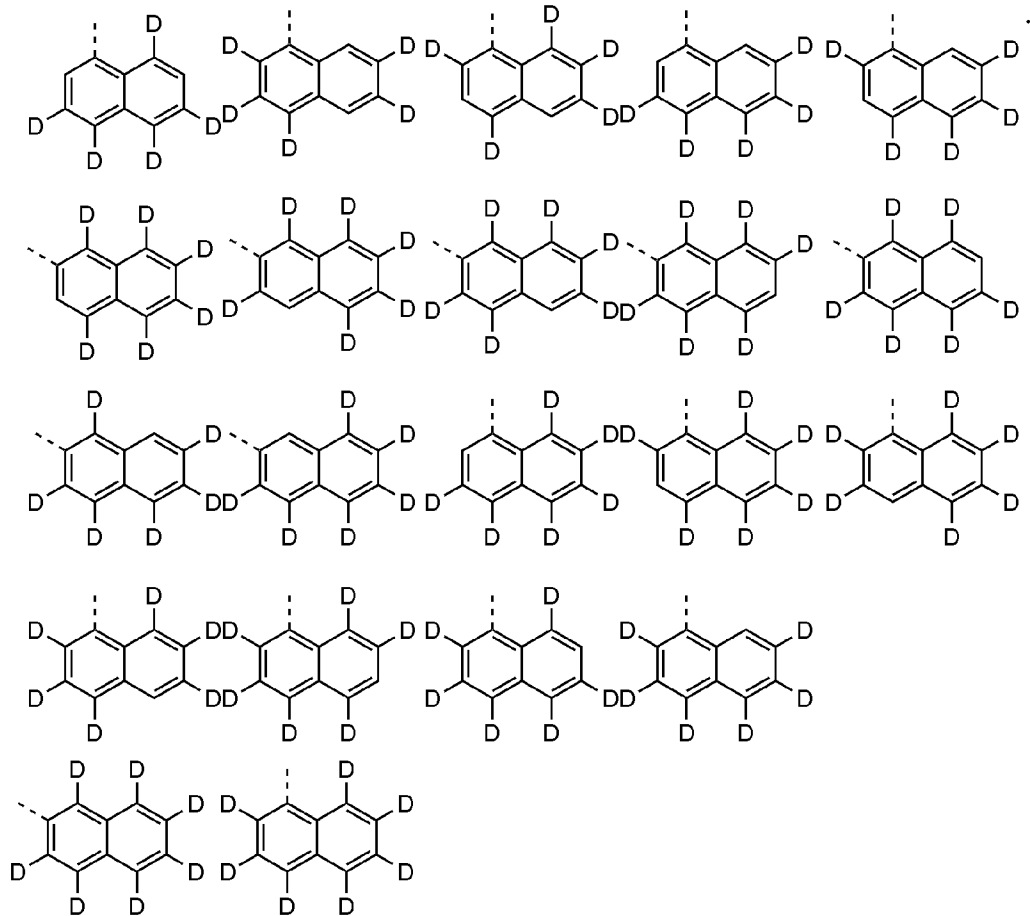
[청구항 9] 제1항에 있어서,
Ar₁ 및 Ar₂ 중 하나는 상기 화학식 2 또는 화학식 3으로 표시되는 치환기이
고, Ar₁ 및 Ar₂ 중 나머지는 하기로 구성되는 군으로부터 선택되는 어느 하
나인,
화합물:



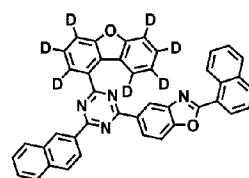
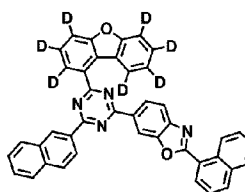
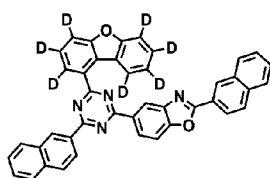
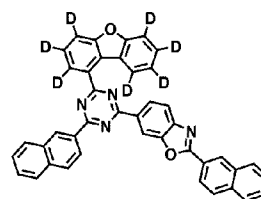
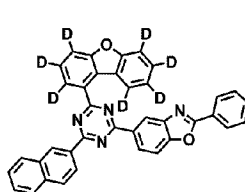
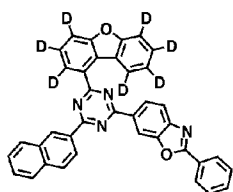
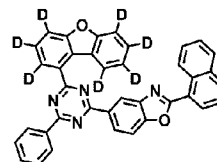
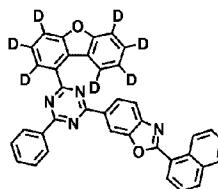
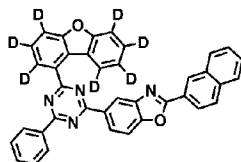
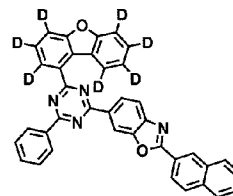
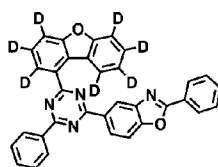
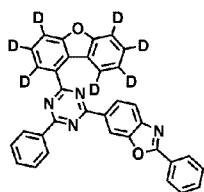


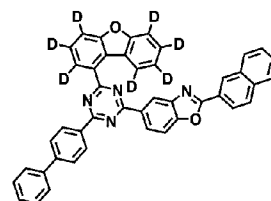
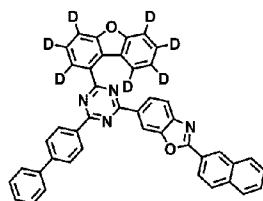
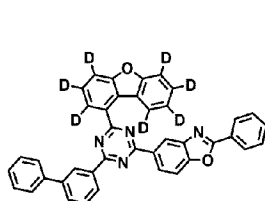
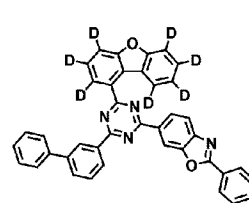
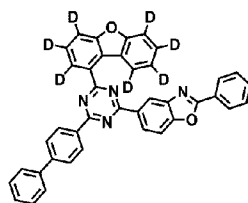
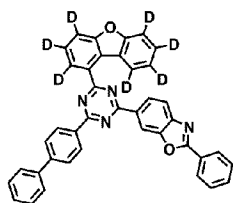
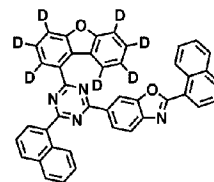
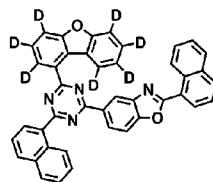
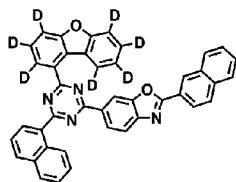
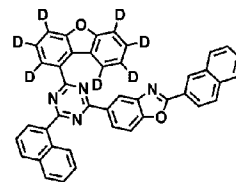
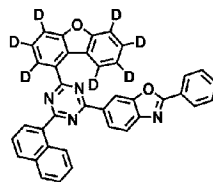
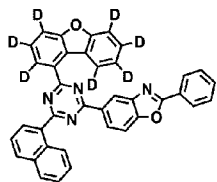
- [청구항 10] 제1항에 있어서,
 R_8 내지 R_{10} 은 각각 수소, 또는 중수소이거나, 또는 하기로 구성되는 군으로부터 선택되는 어느 하나인,
 화합물:

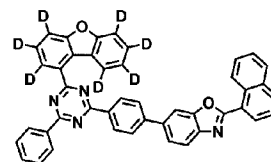
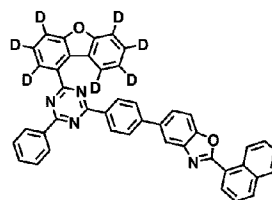
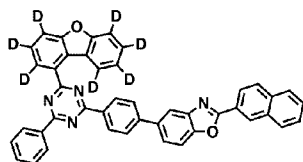
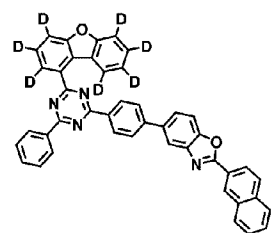
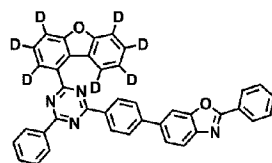
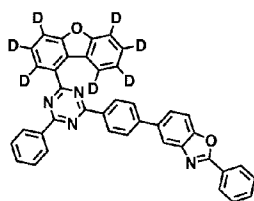
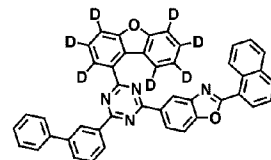
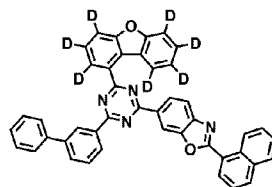
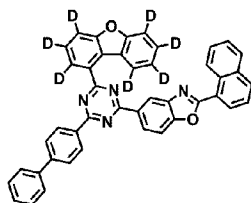
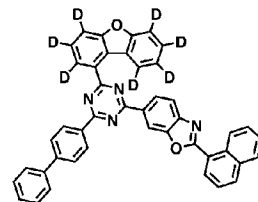
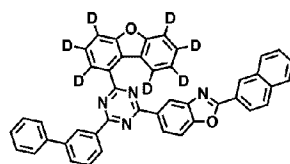
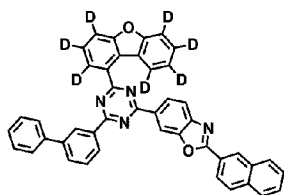


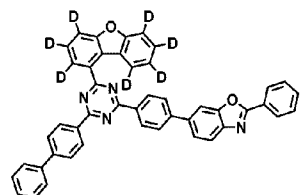
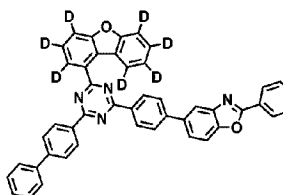
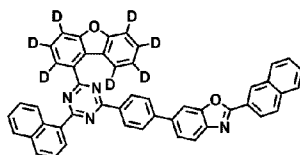
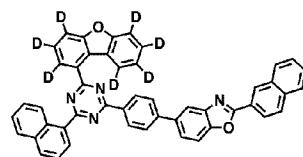
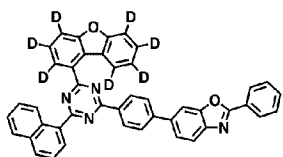
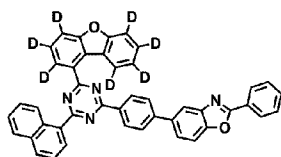
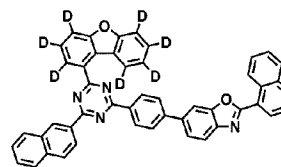
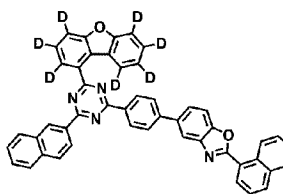
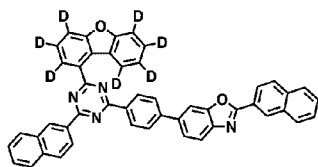
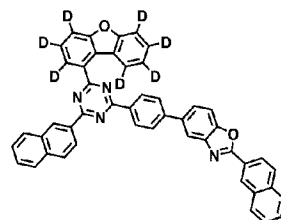
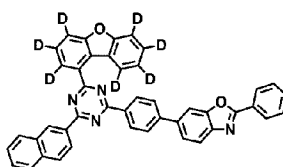
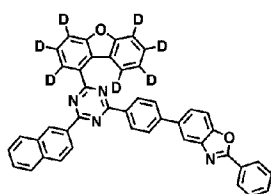


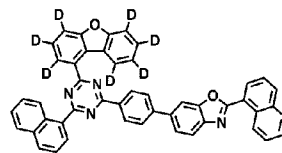
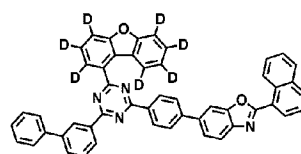
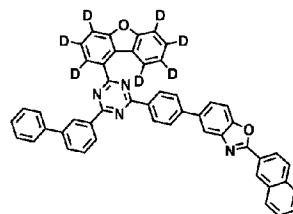
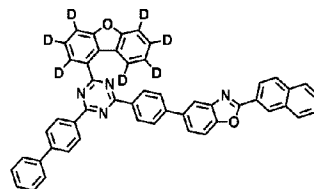
- [청구항 11] 제1항에 있어서,
상기 화학식 1로 표시되는 화합물은, 적어도 3개 이상의 중수소가 치환된
것인,
화합물.
- [청구항 12] 제1항에 있어서,
상기 화학식 1로 표시되는 화합물은, 3개 내지 7개의 중수소가 치환된 것
인,
화합물.
- [청구항 13] 제1항에 있어서,
상기 화학식 1로 표시되는 화합물은 하기로 구성되는 군으로부터 선택되
는 어느 하나인,
화합물:

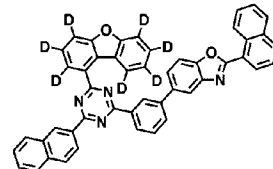
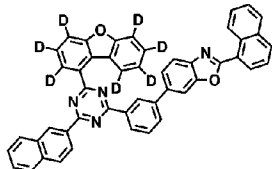
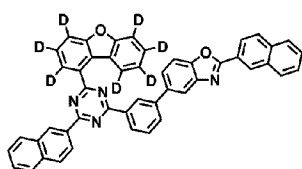
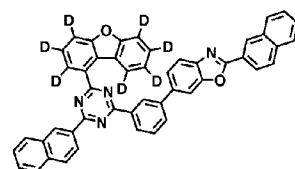
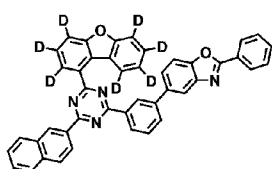
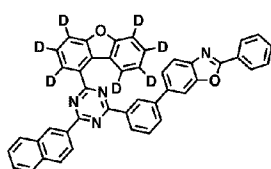
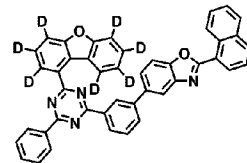
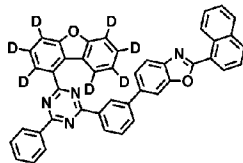
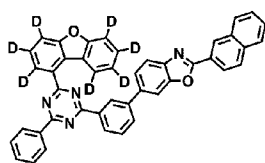
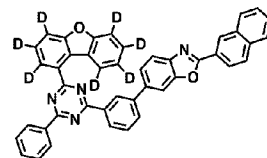
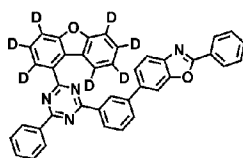
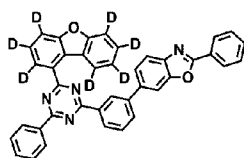


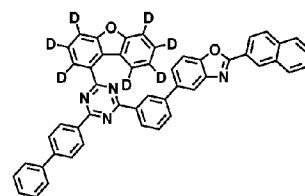
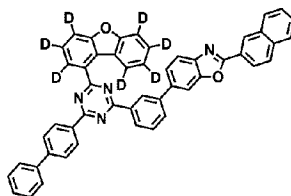
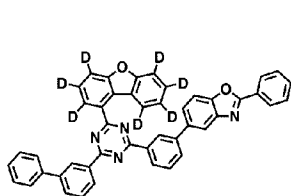
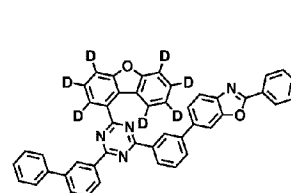
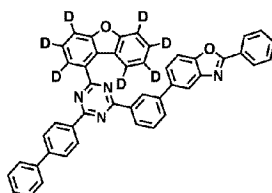
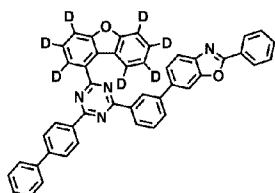
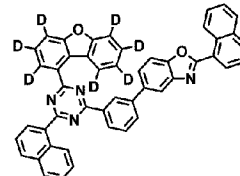
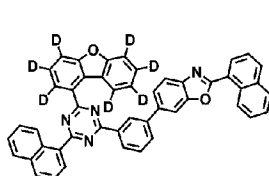
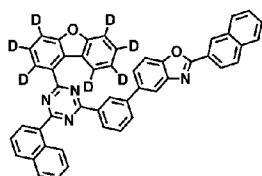
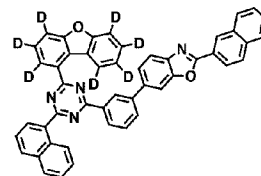
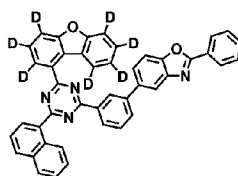
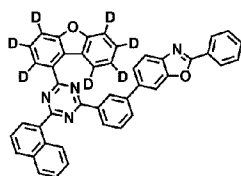


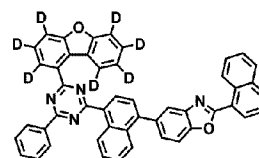
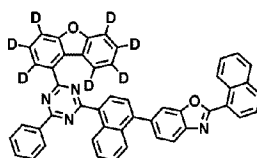
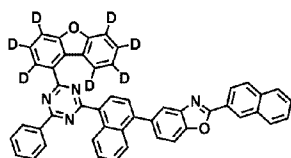
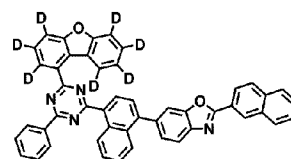
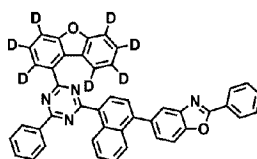
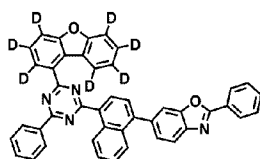
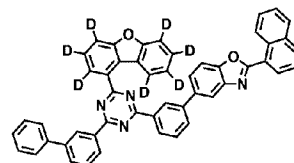
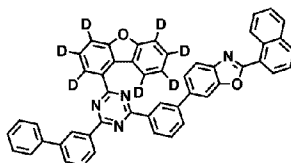
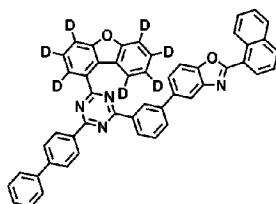
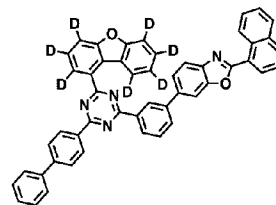
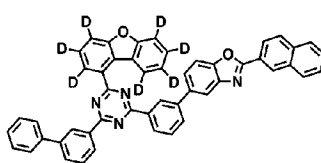
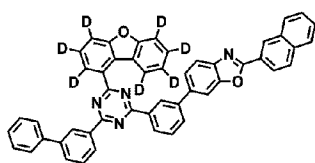


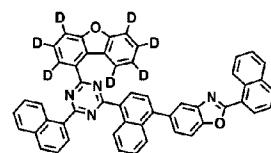
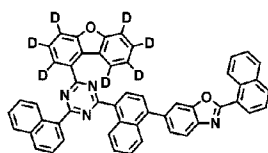
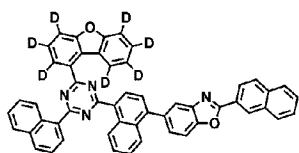
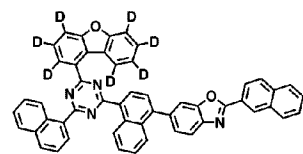
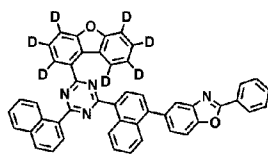
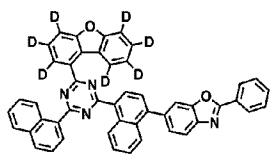
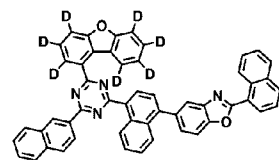
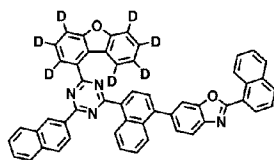
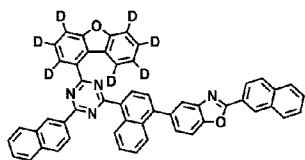
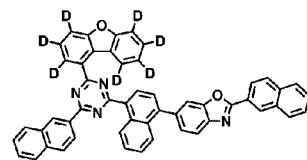
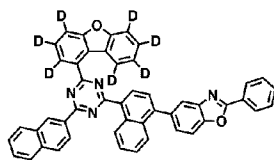
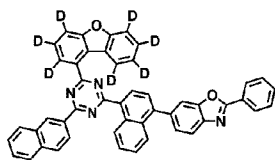


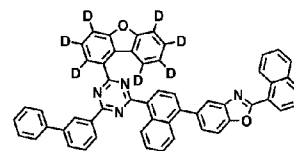
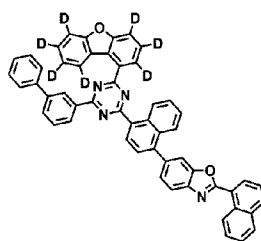
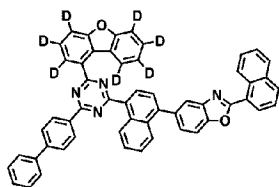
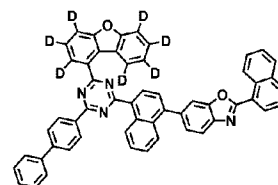
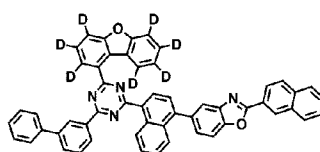
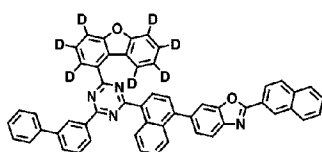
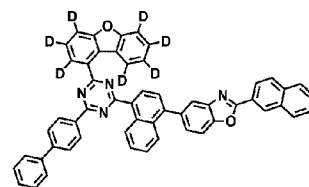
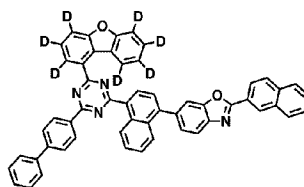
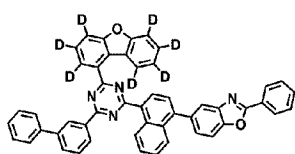
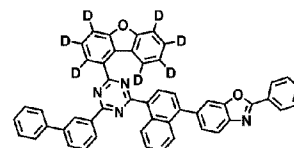
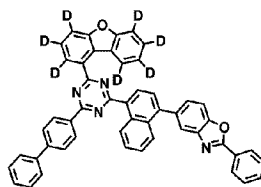
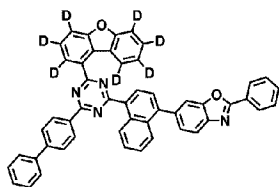


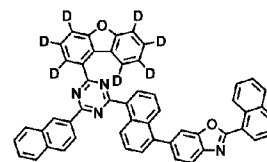
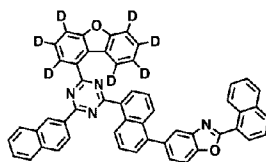
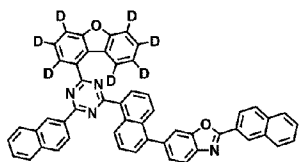
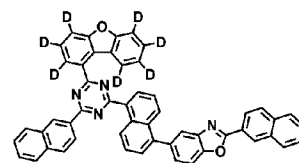
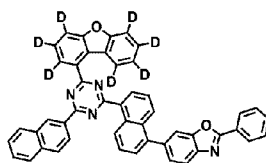
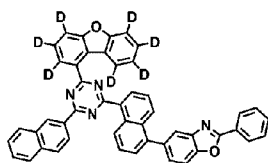
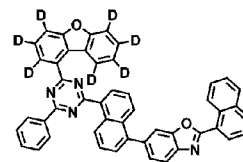
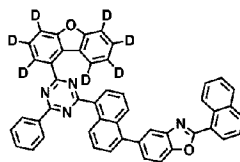
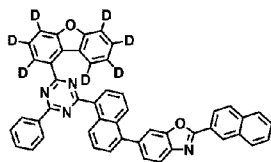
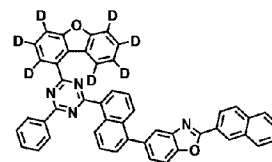
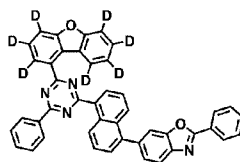
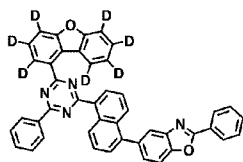


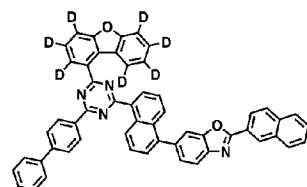
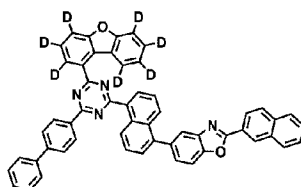
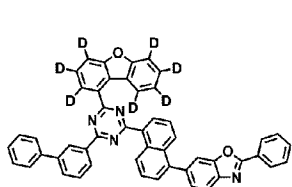
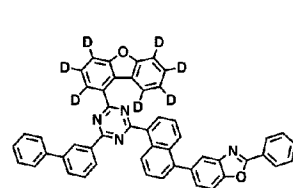
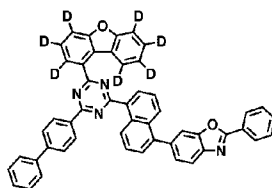
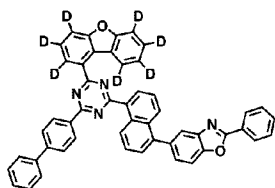
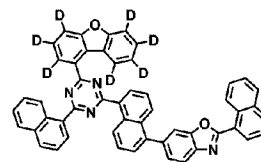
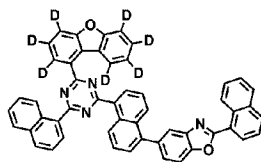
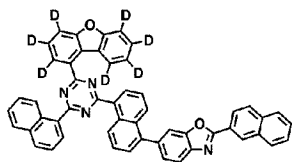
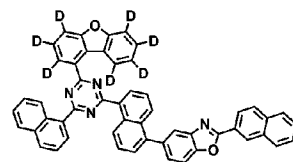
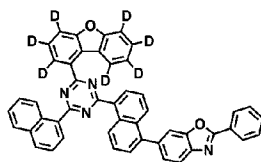
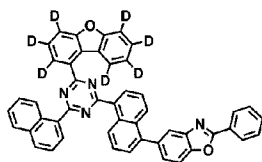


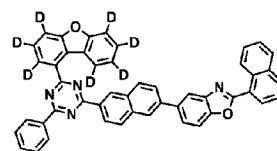
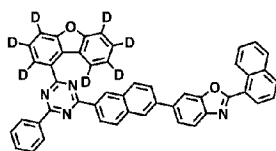
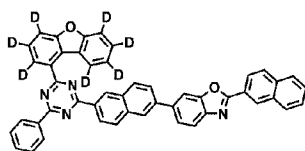
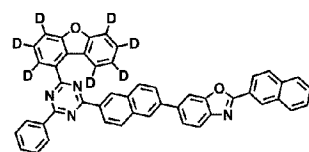
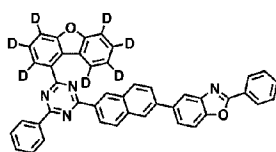
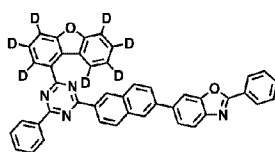
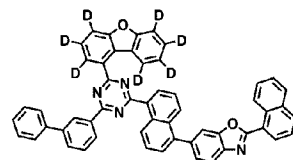
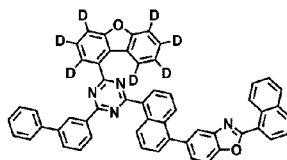
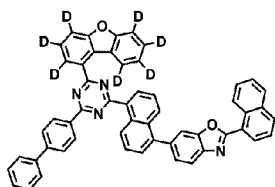
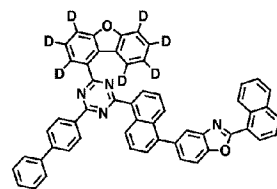
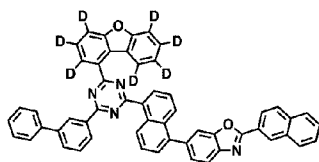
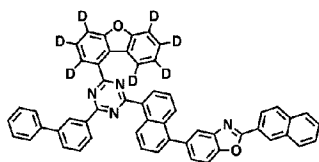


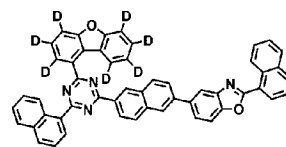
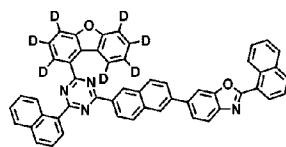
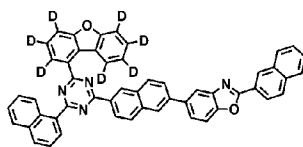
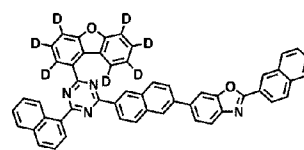
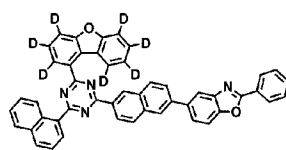
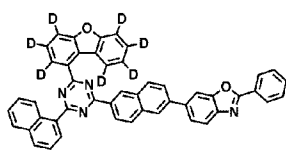
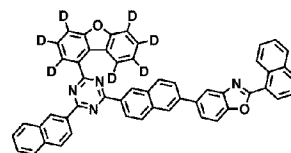
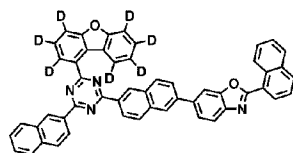
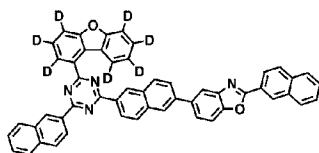
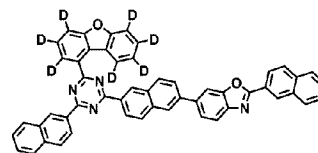
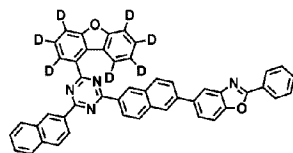
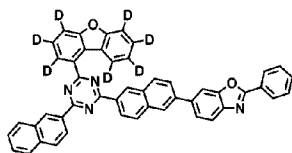


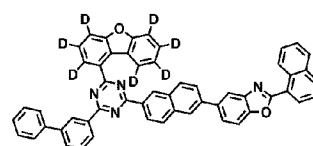
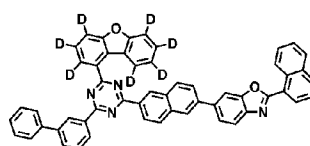
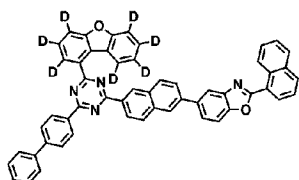
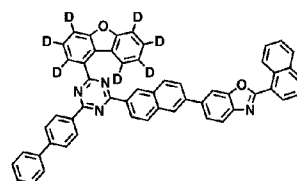
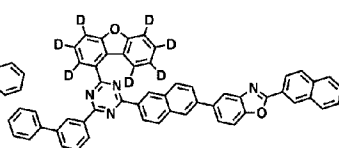
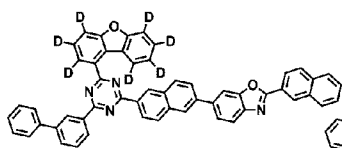
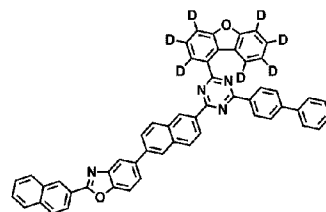
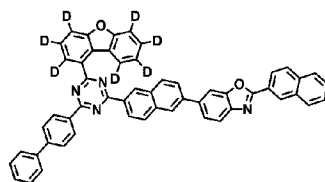
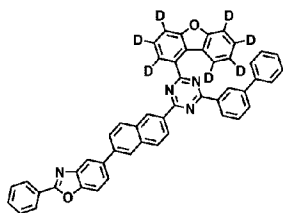
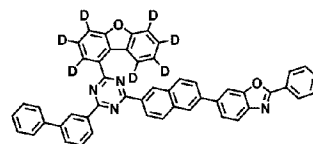
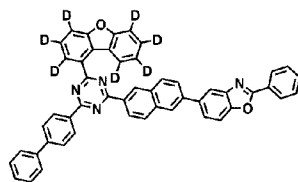
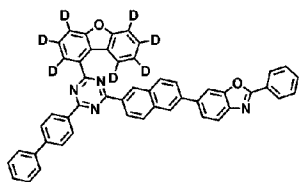


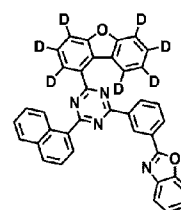
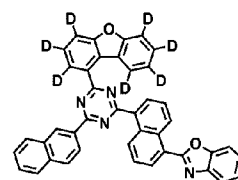
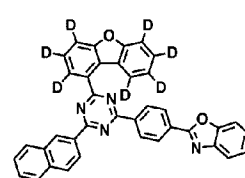
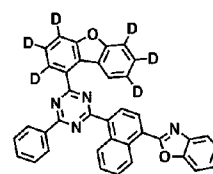


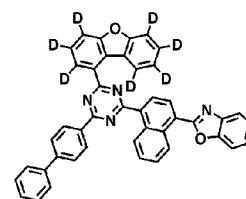
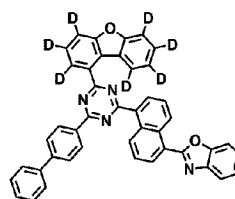
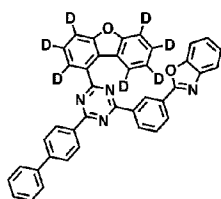
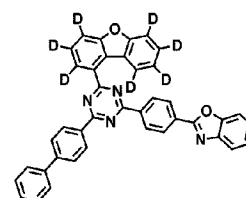
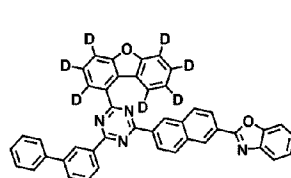
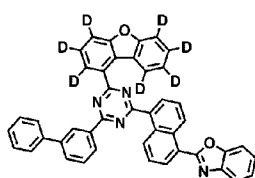
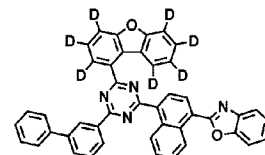
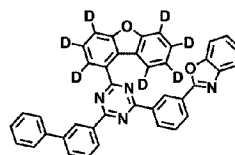
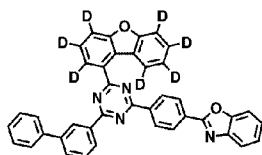
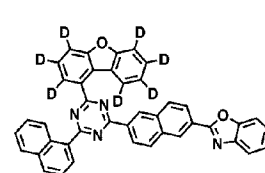
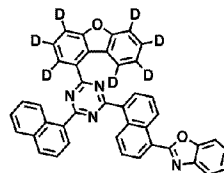
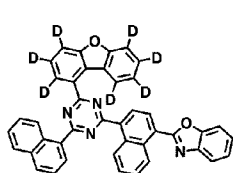


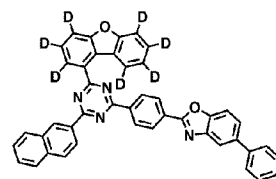
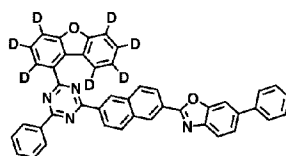
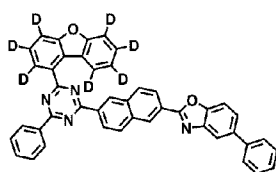
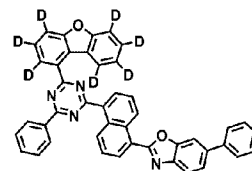
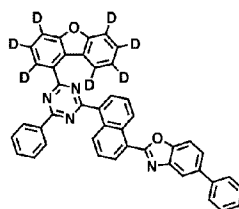
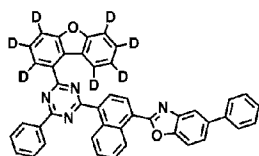
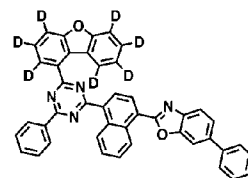
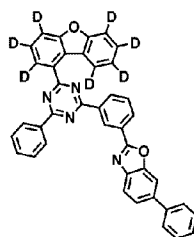
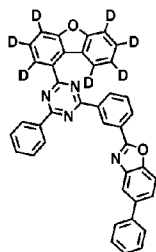
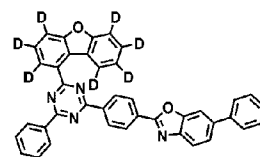
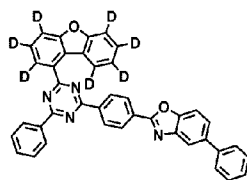
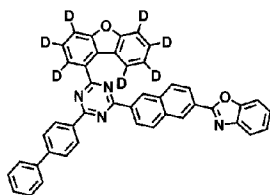


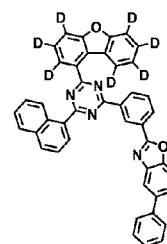
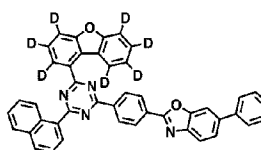
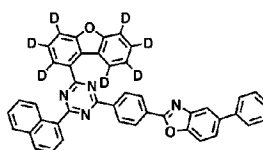
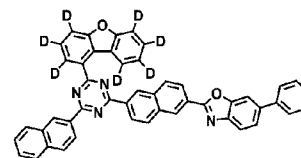
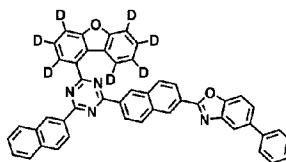
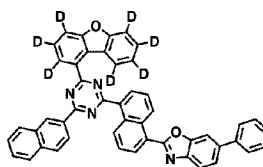
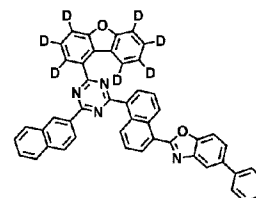
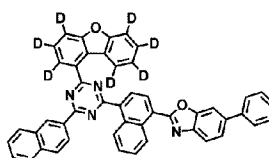
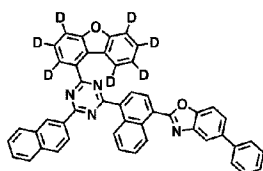
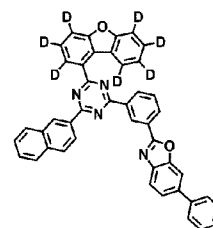
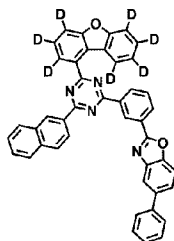
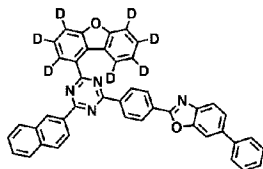


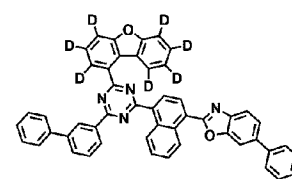
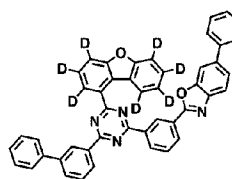
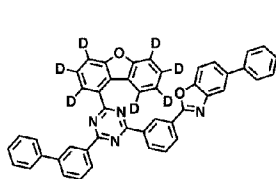
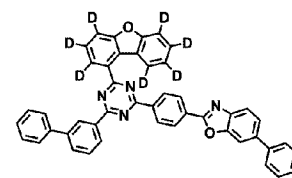
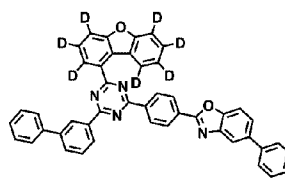
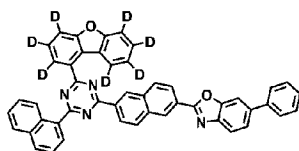
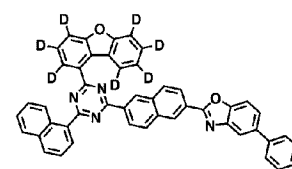
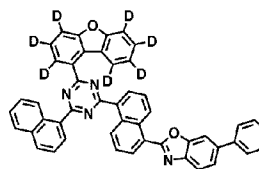
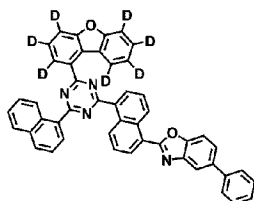
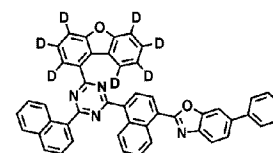
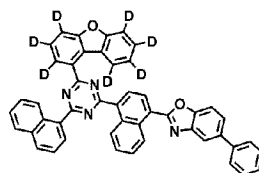
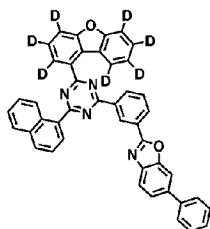


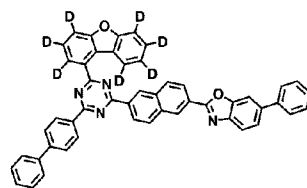
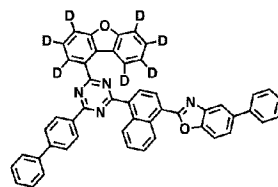
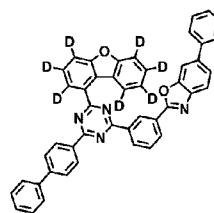
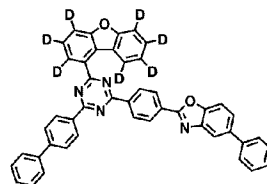
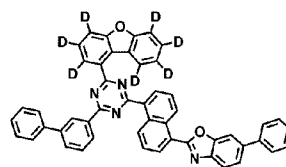


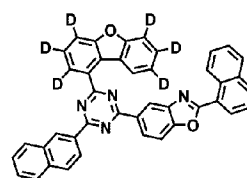
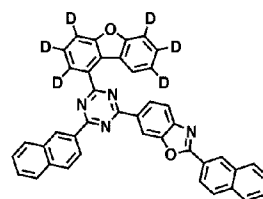
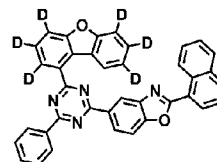
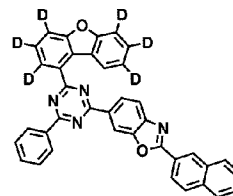


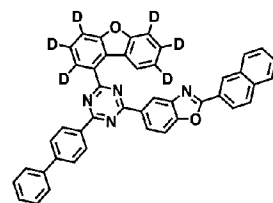
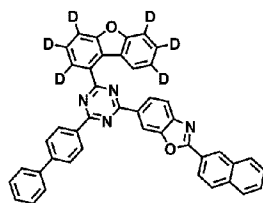
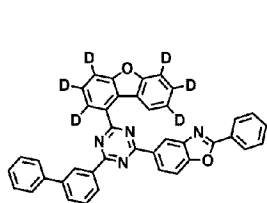
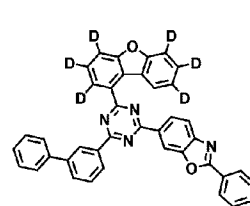
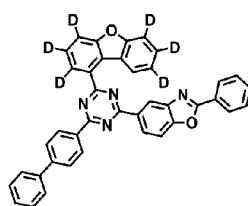
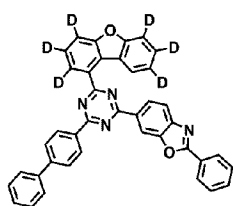
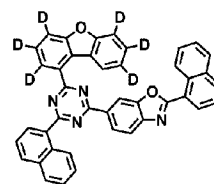
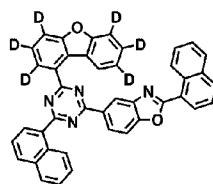
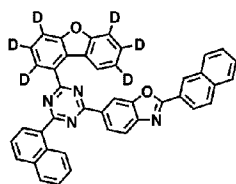
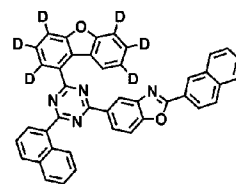
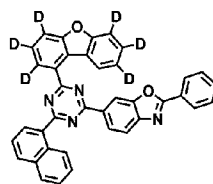
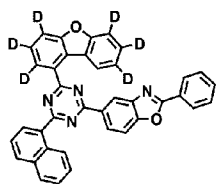


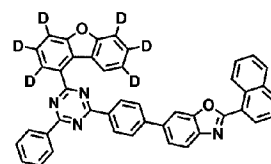
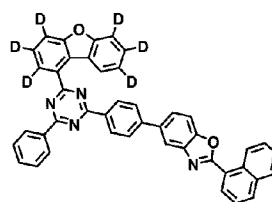
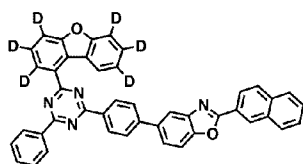
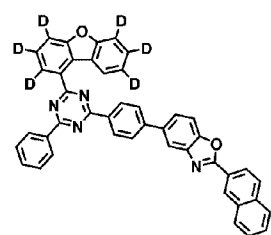
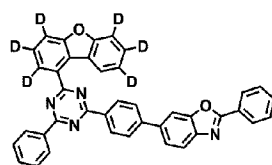
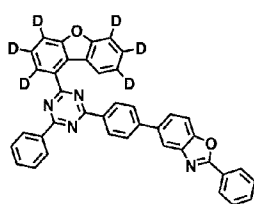
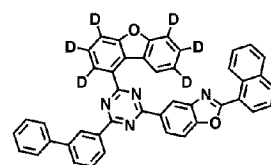
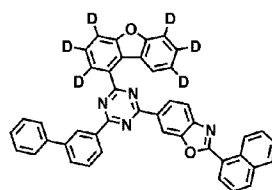
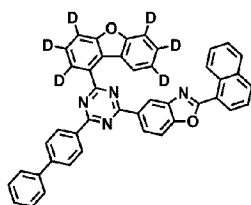
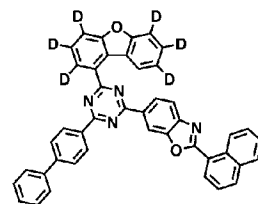
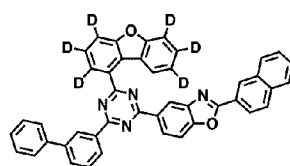
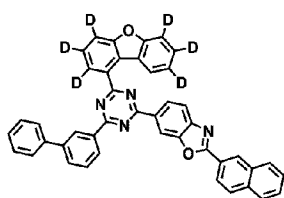


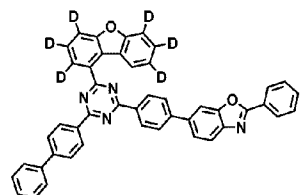
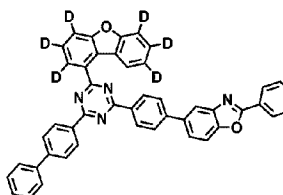
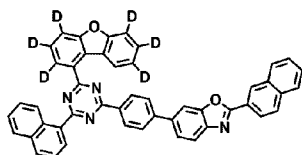
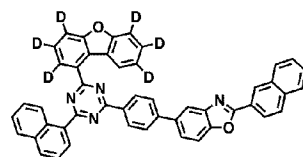
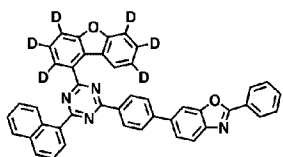
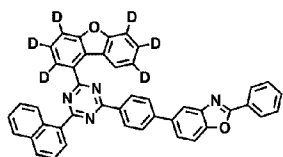
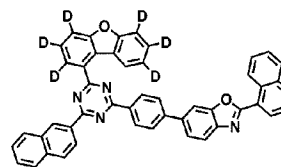
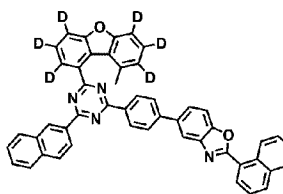
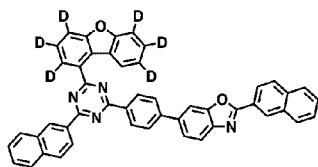
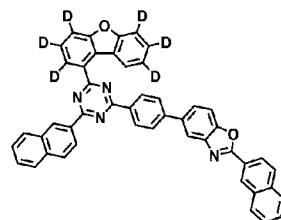
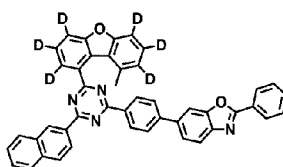
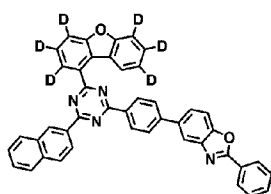


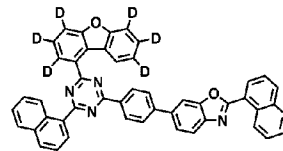
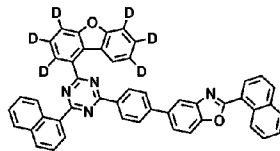
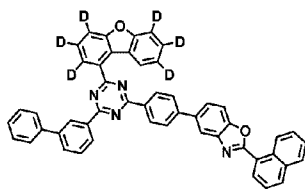
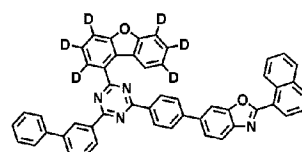
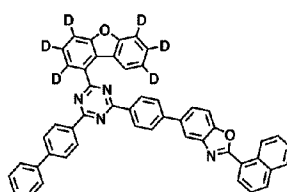
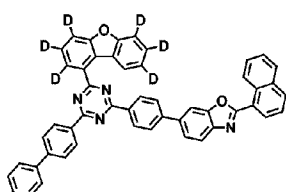
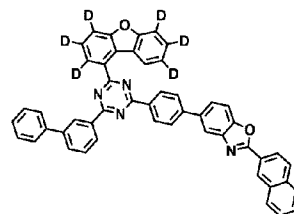
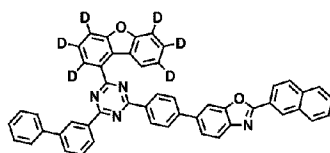
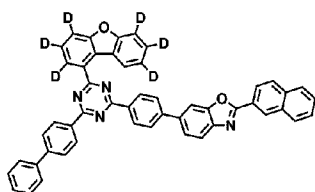
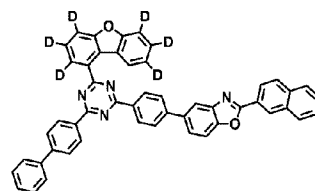
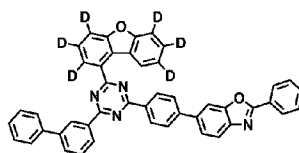
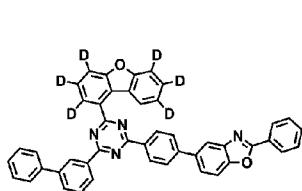


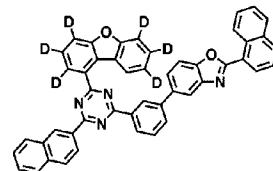
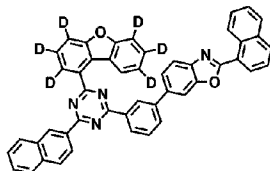
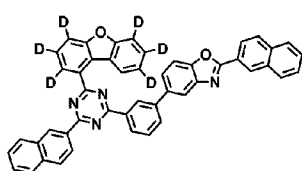
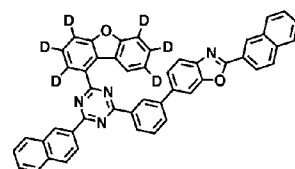
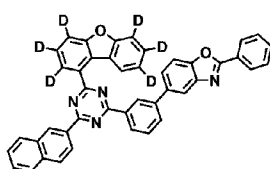
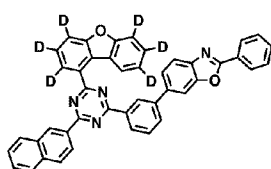
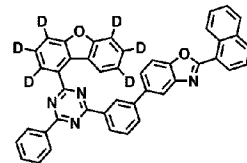
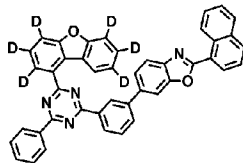
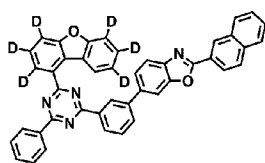
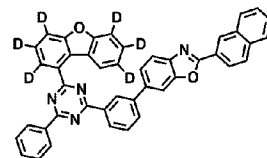
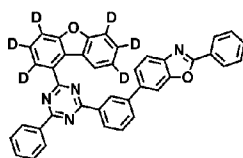
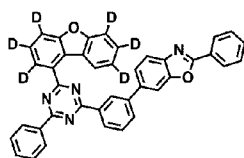


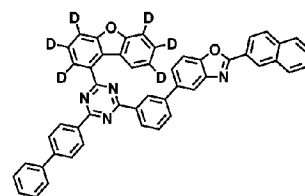
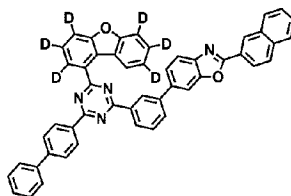
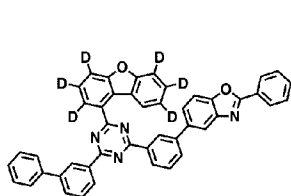
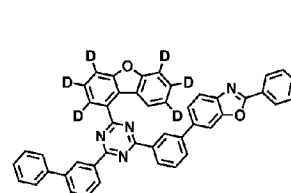
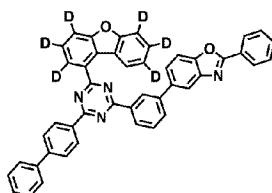
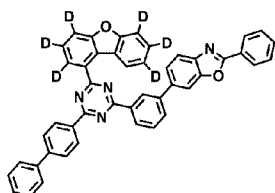
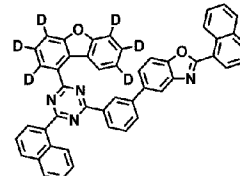
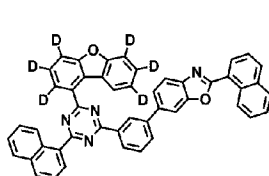
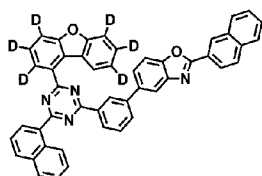
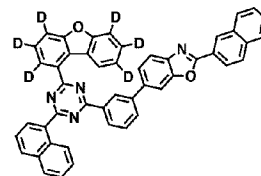
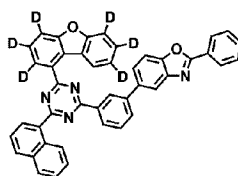
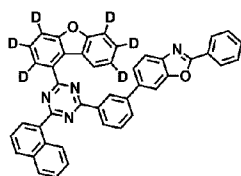


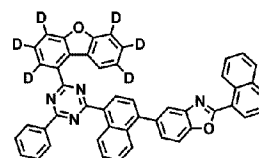
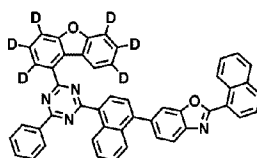
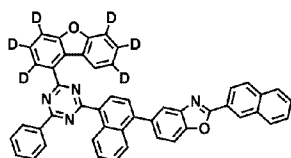
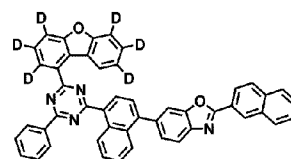
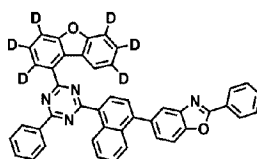
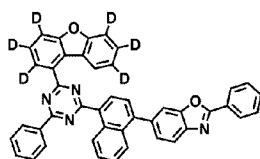
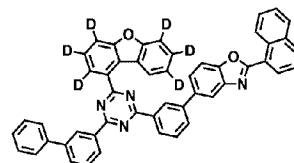
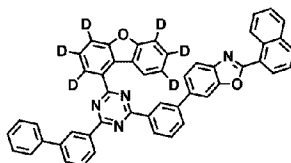
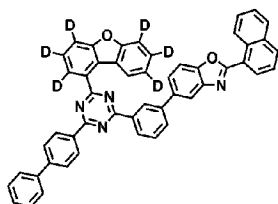
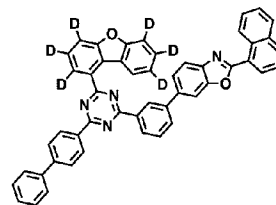
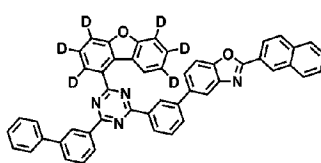
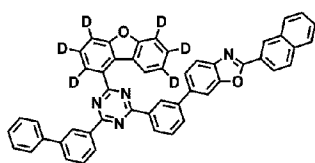


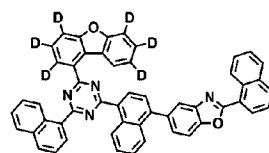
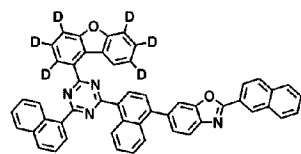
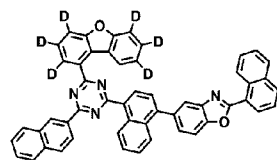
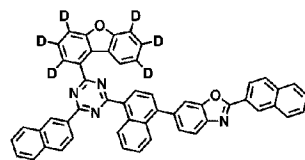


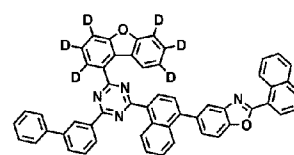
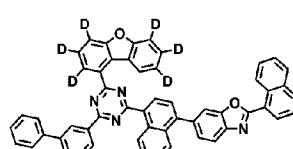
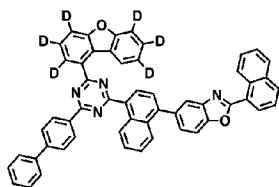
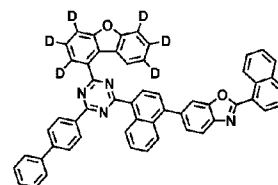
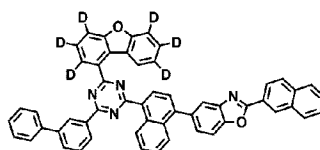
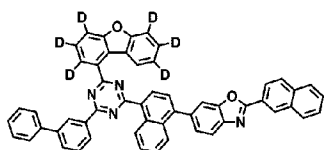
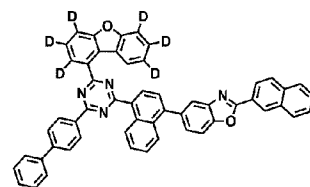
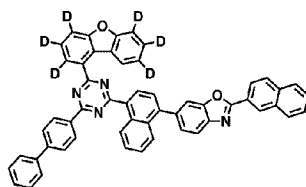
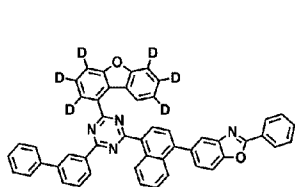
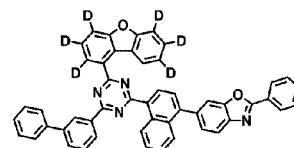
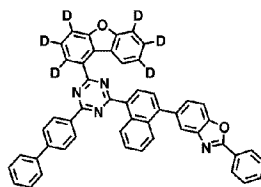
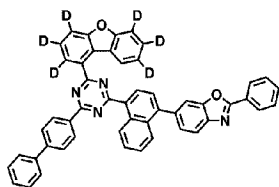


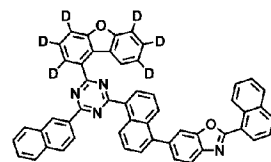
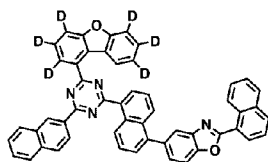
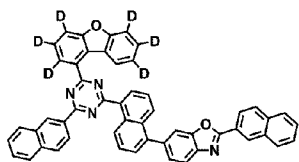
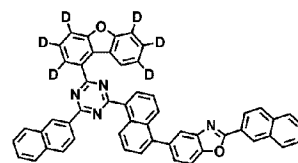
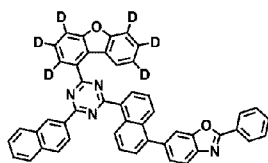
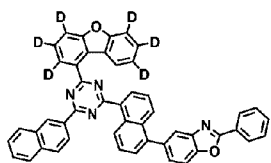
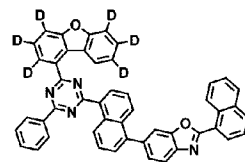
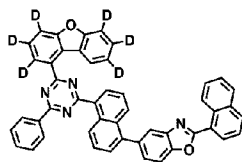
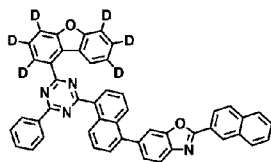
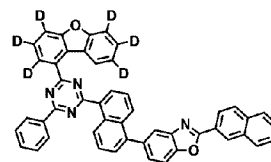
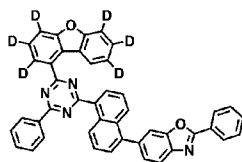
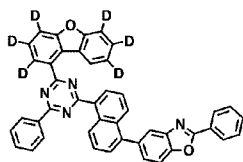


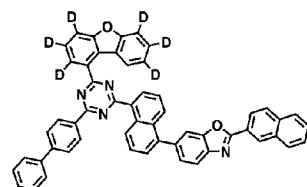
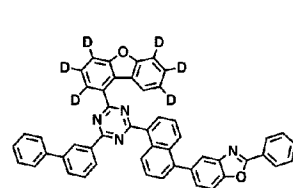
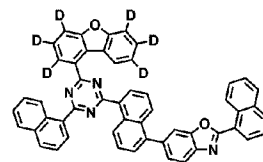
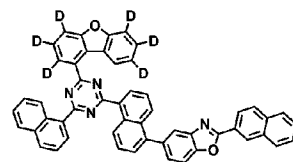


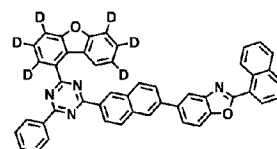
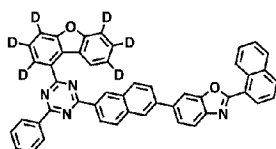
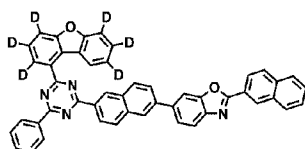
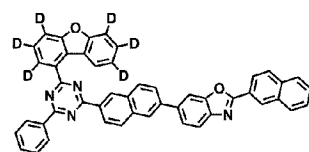
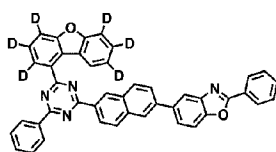
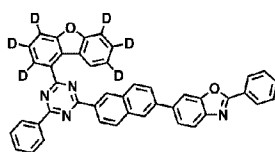
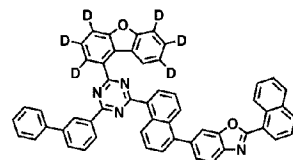
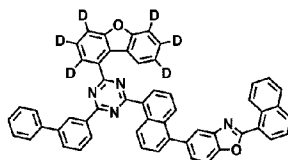
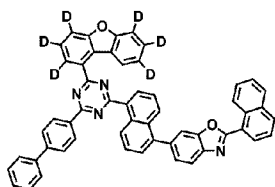
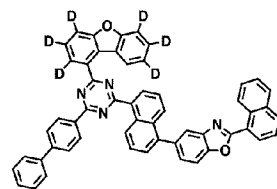
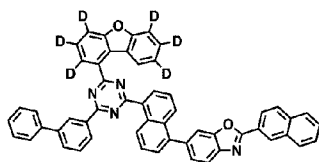
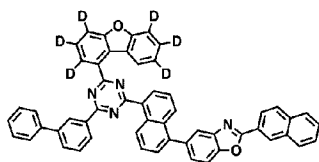


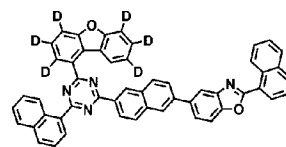
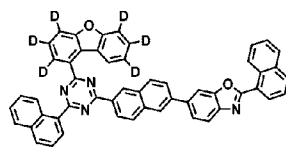
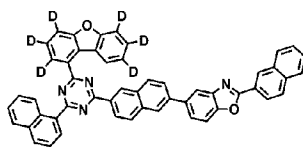
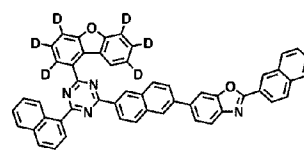
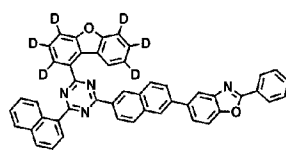
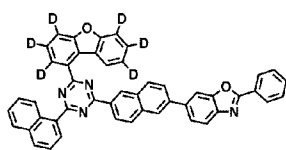
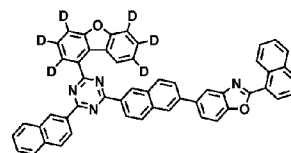
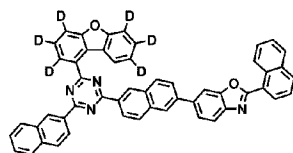
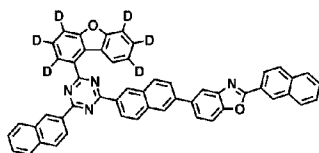
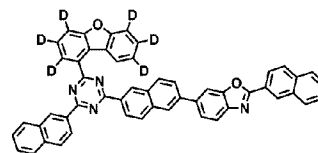
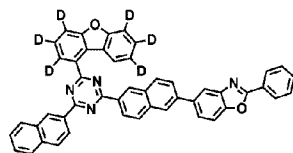
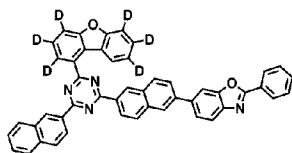


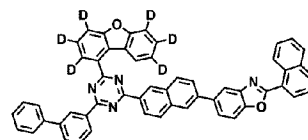
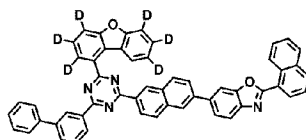
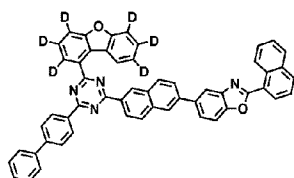
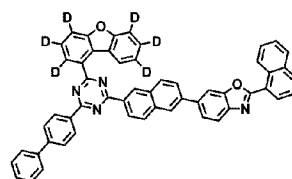
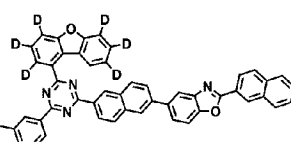
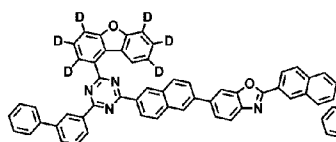
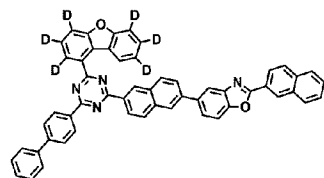
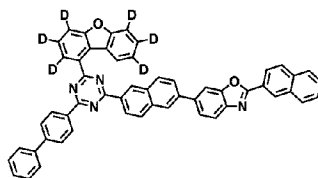
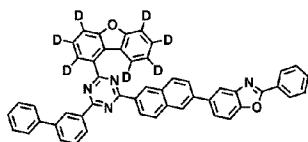
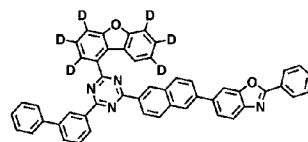
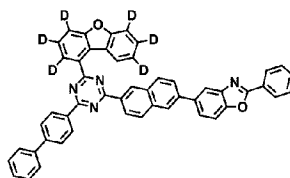
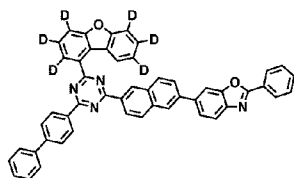


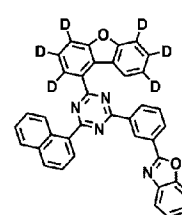
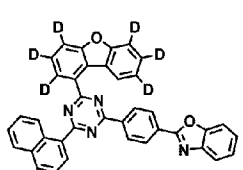
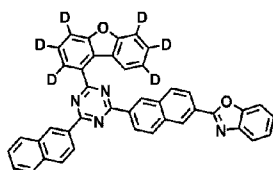
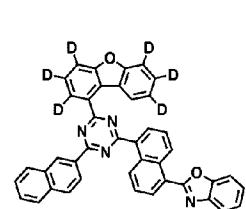
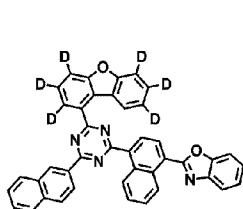
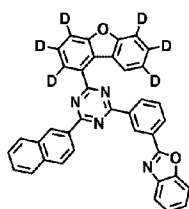
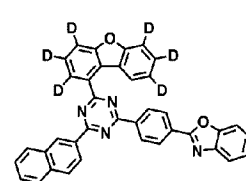
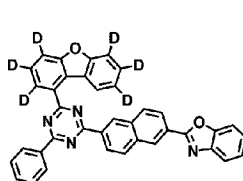
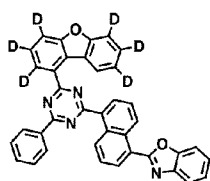
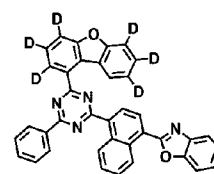
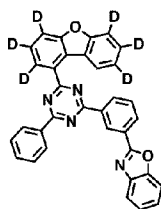
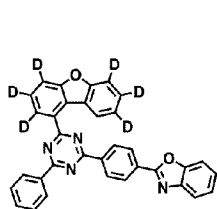


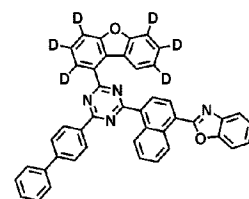
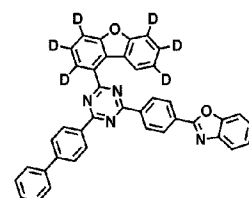
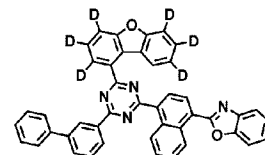
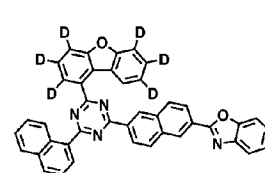


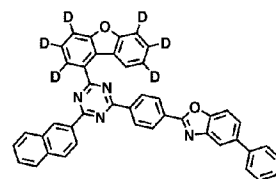
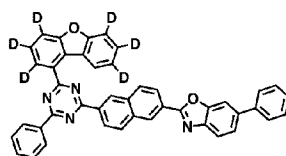
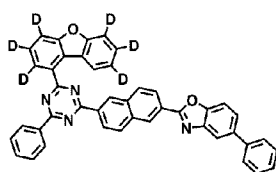
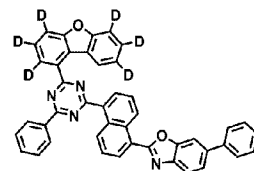
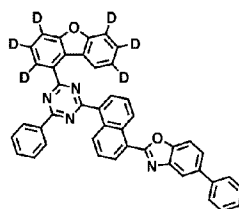
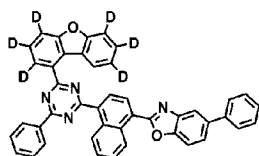
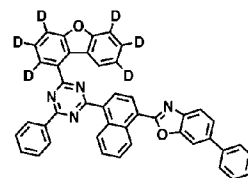
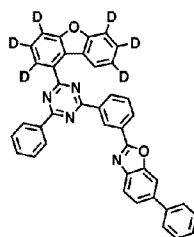
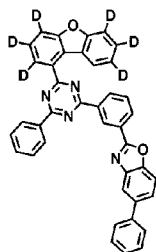
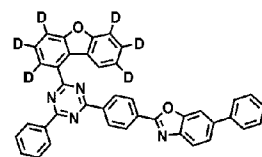
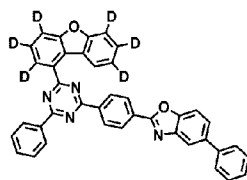
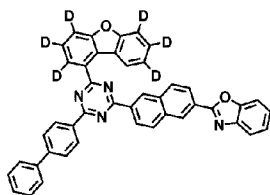


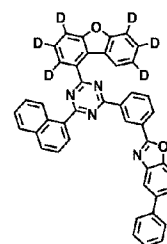
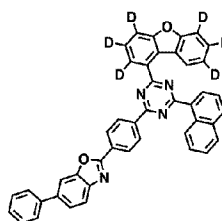
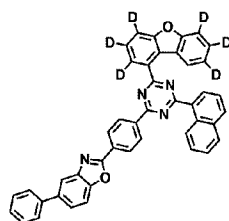
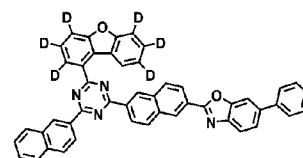
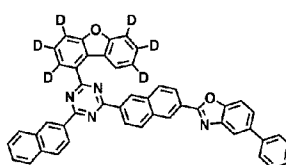
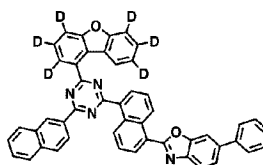
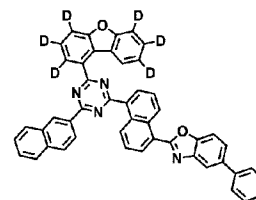
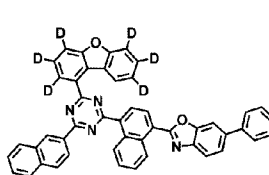
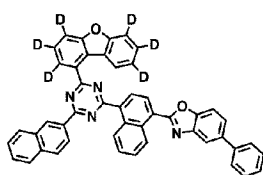
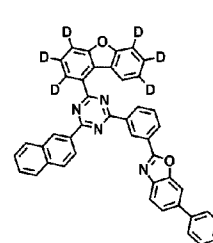
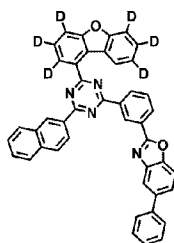
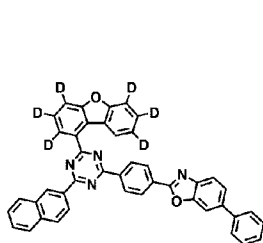


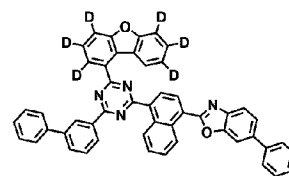
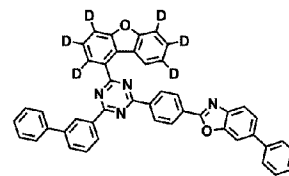
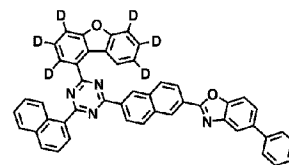
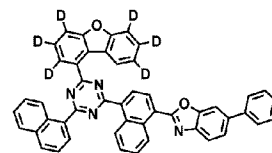


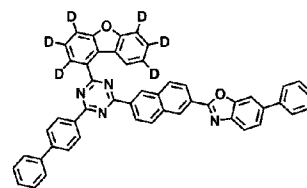
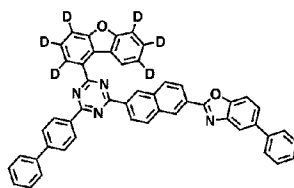
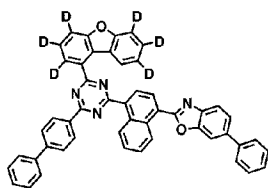
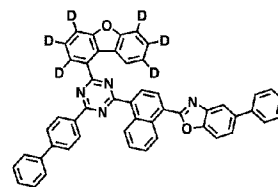
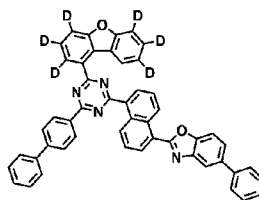
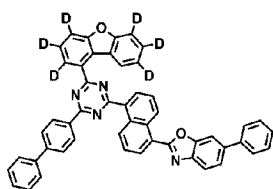
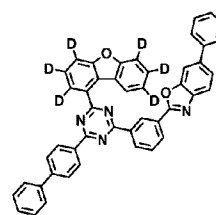
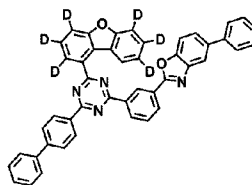
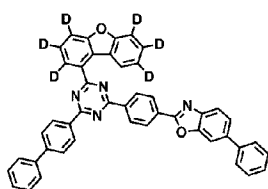
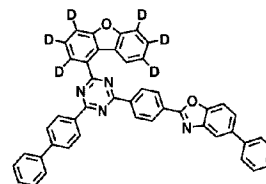
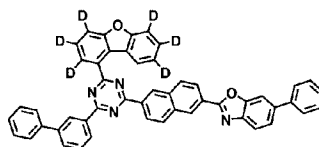
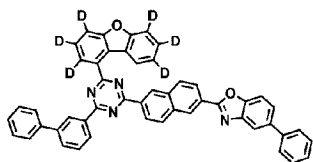
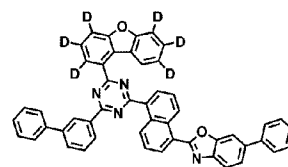
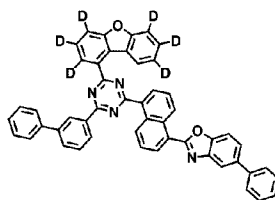
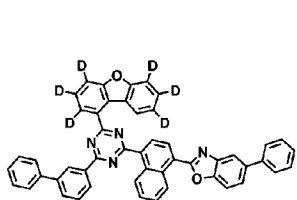


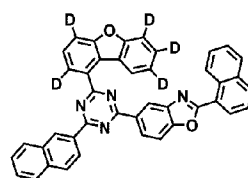
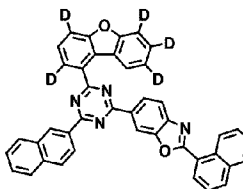
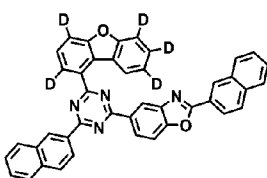
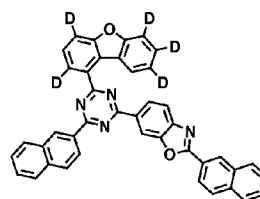
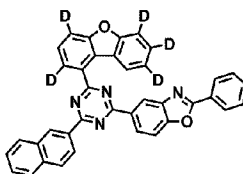
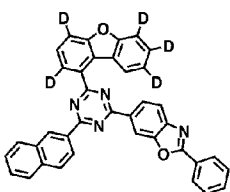
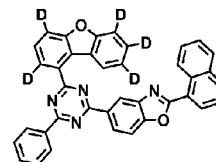
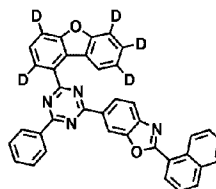
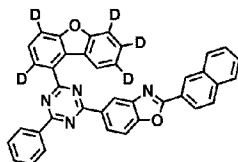
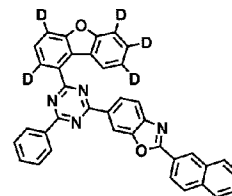
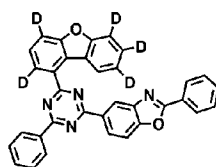
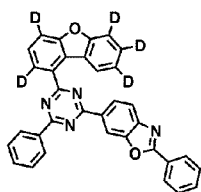


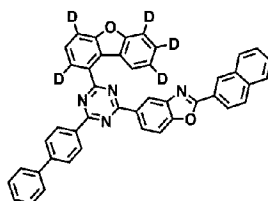
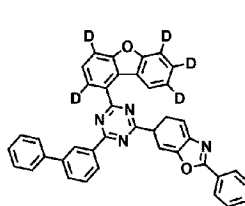
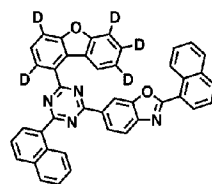
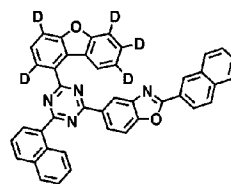


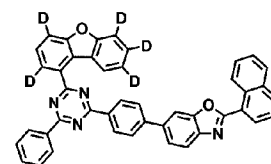
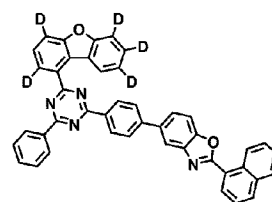
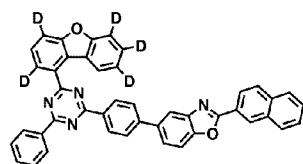
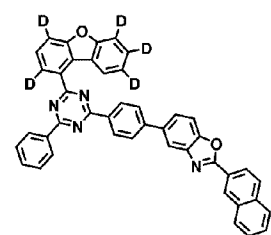
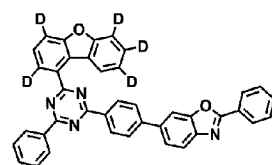
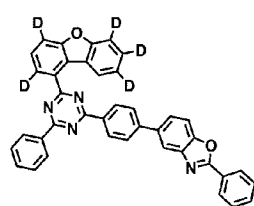
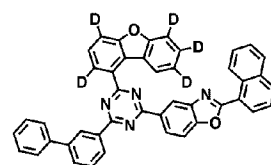
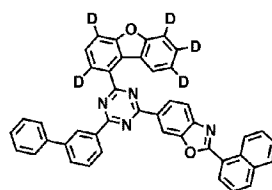
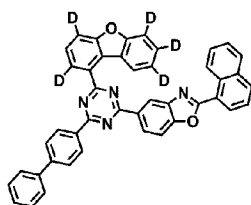
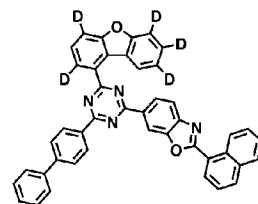
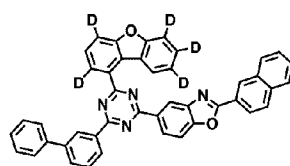
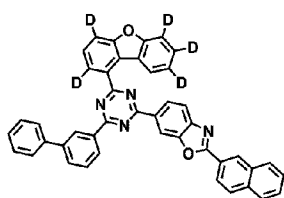


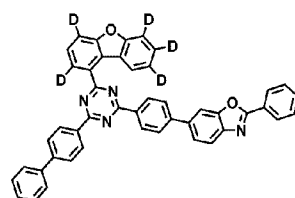
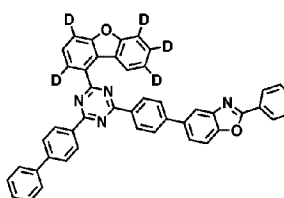
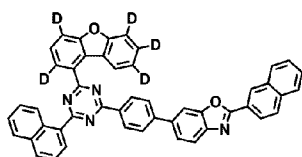
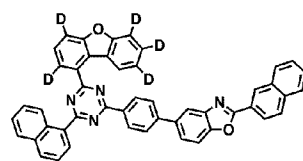
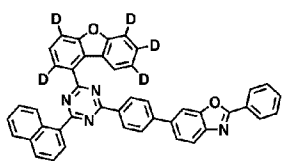
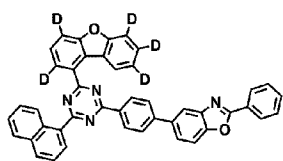
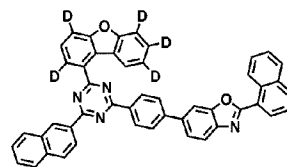
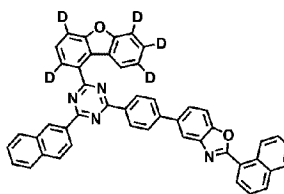
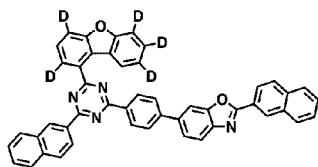
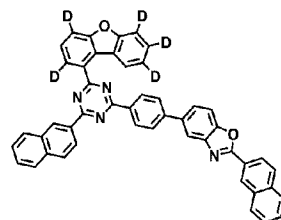
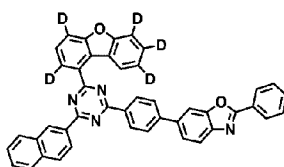
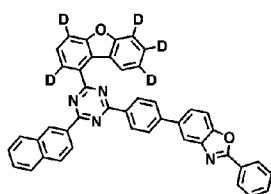


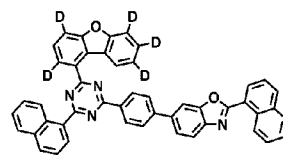
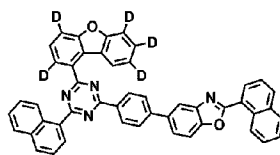
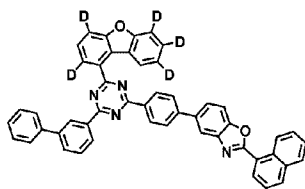
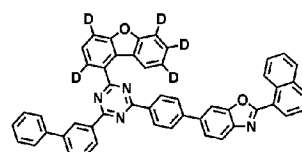
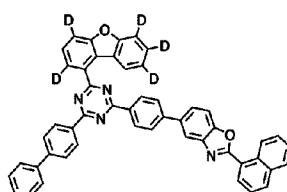
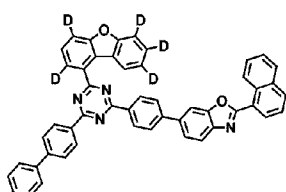
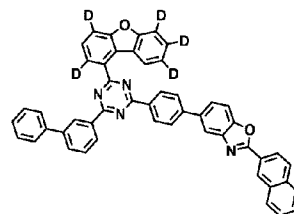
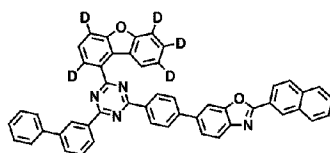
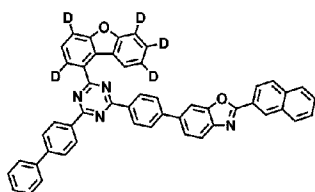
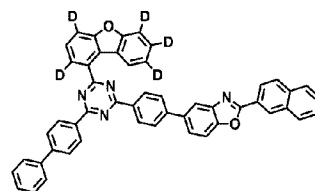
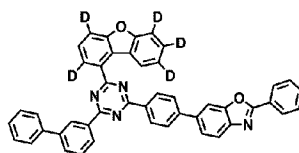
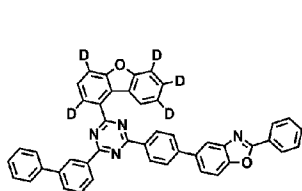


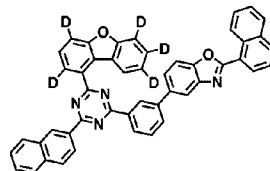
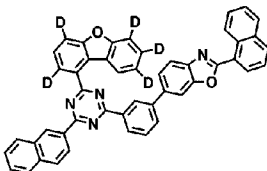
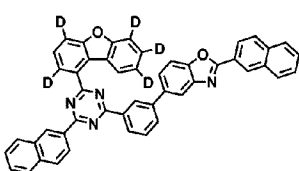
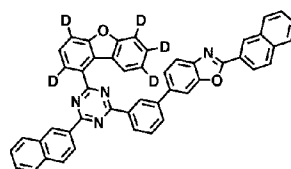
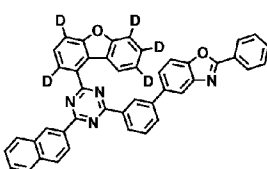
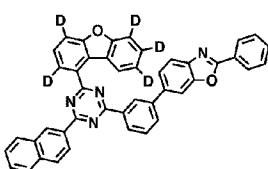
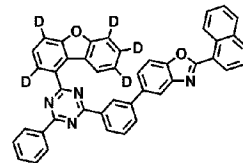
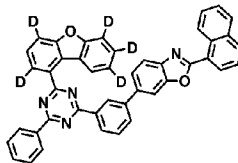
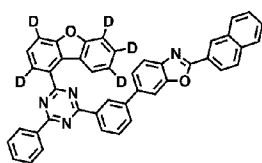
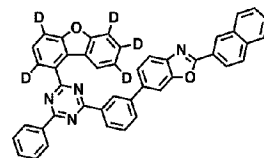
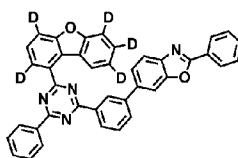
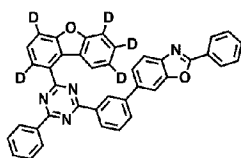


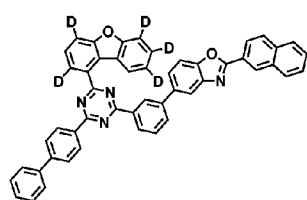
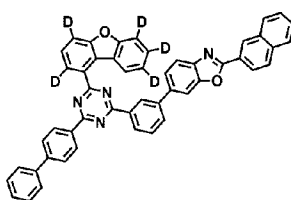
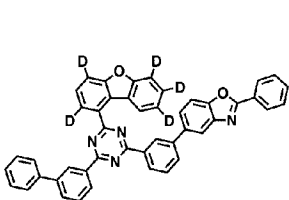
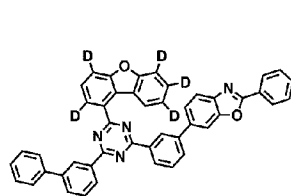
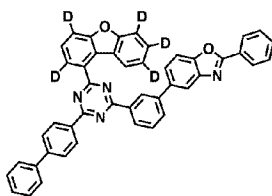
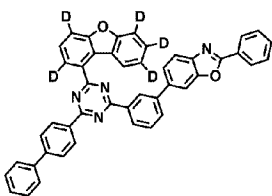
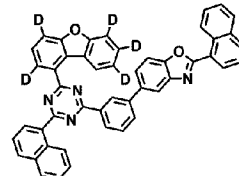
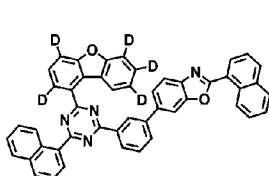
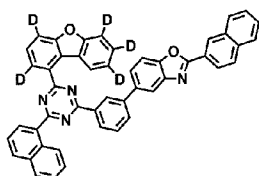
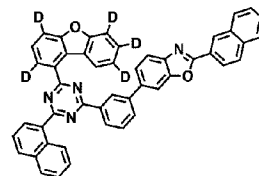
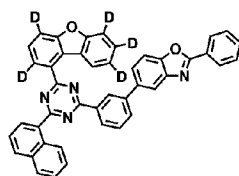
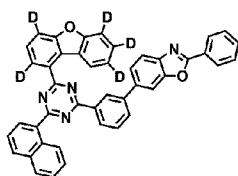


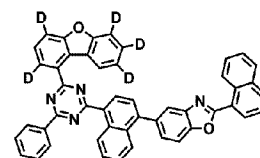
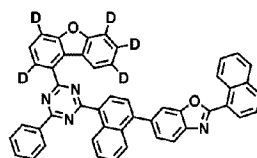
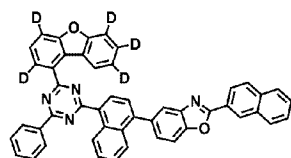
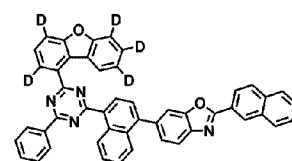
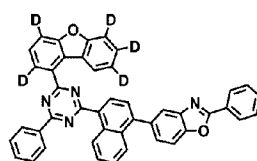
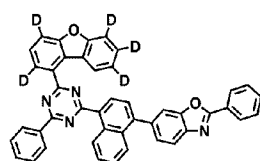
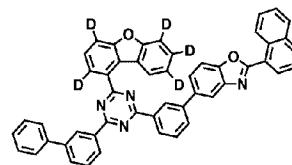
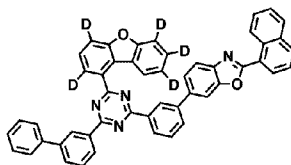
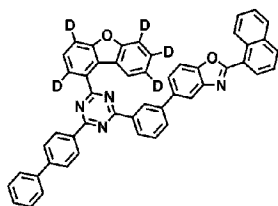
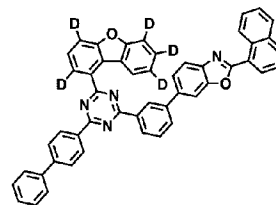
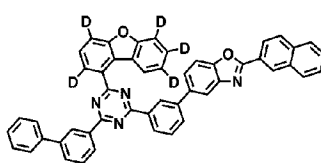
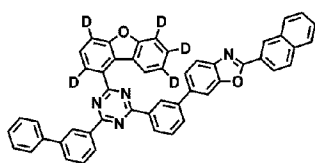


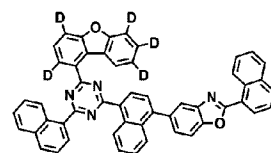
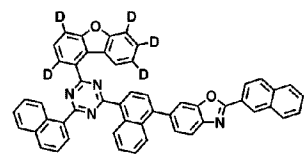
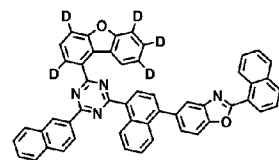
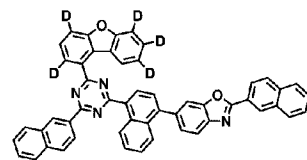


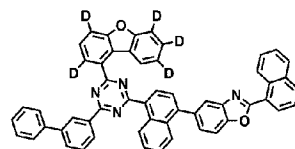
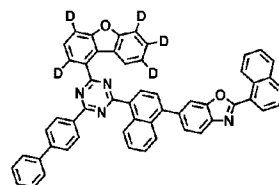
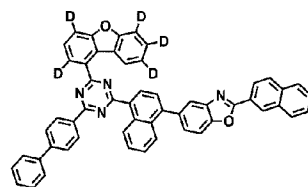
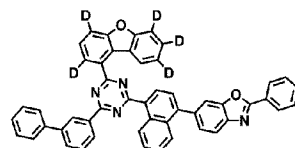


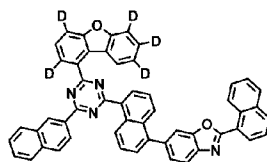
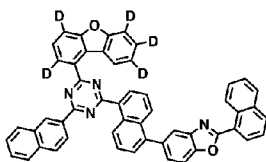
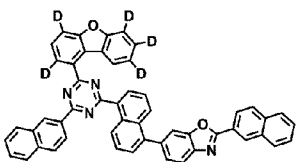
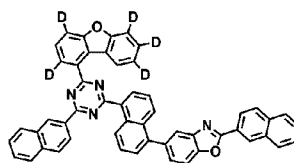
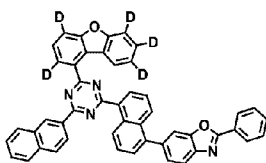
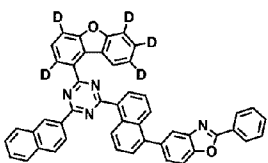
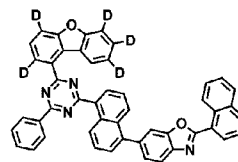
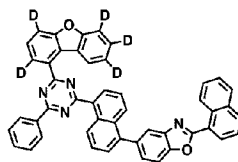
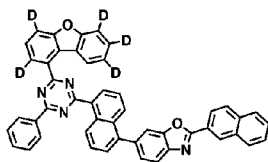
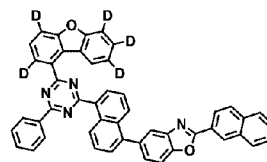
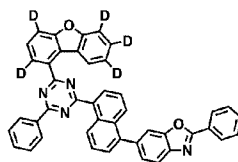
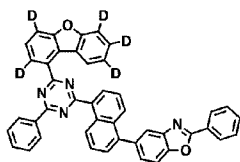


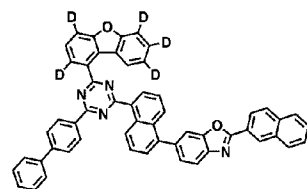
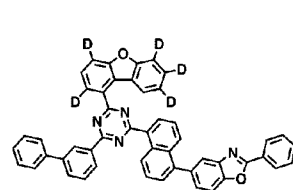
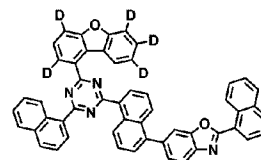
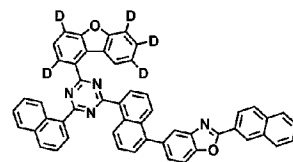


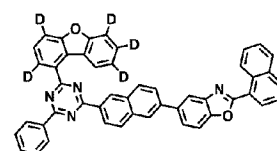
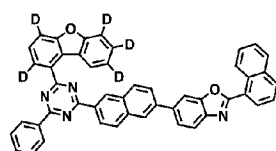
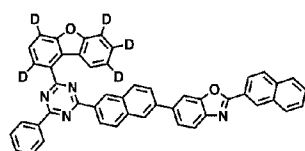
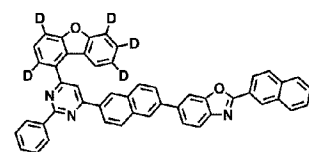
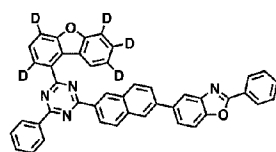
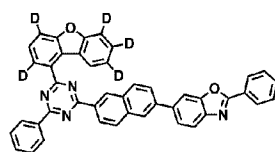
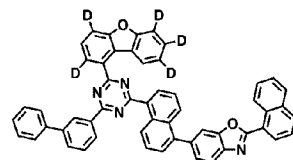
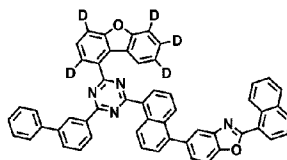
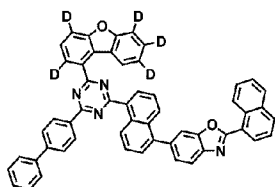
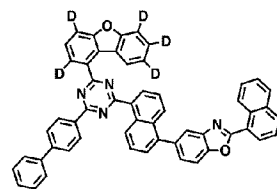
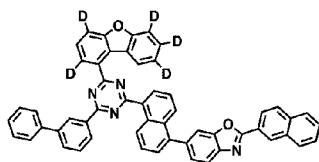
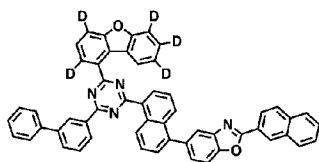


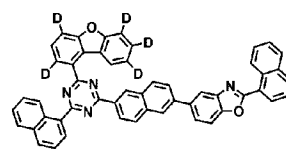
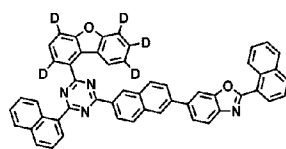
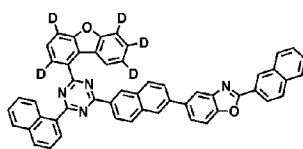
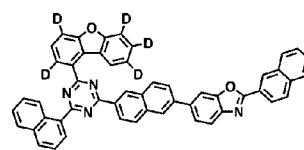
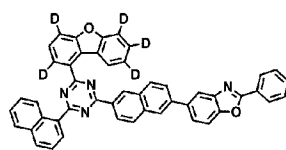
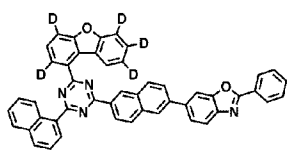
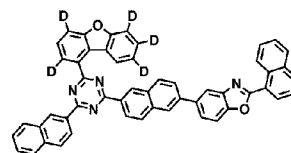
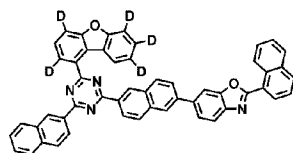
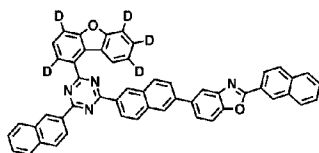
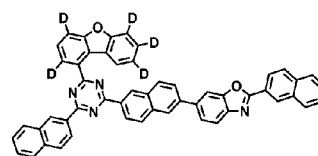
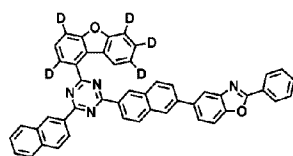
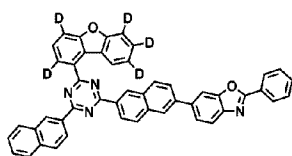


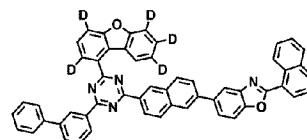
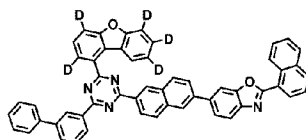
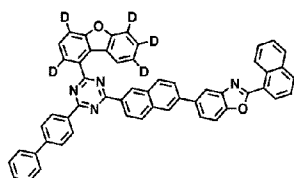
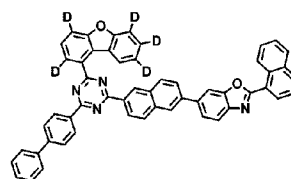
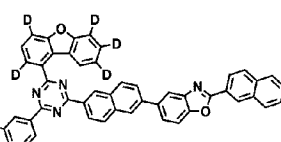
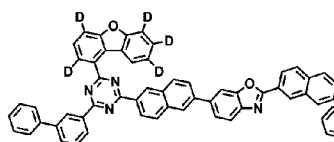
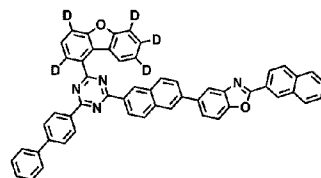
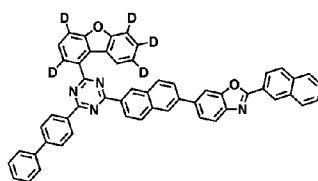
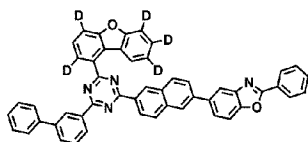
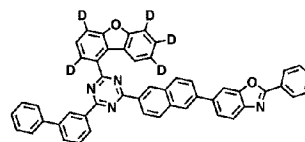
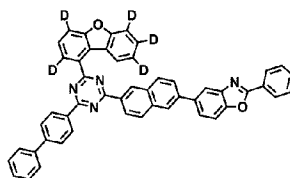
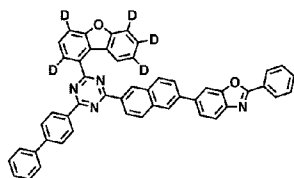


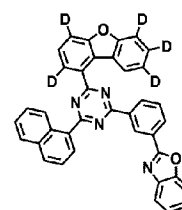
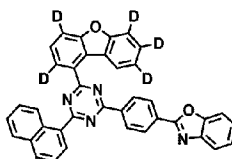
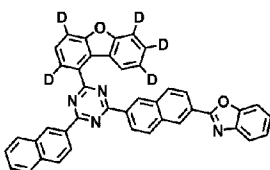
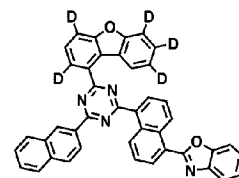
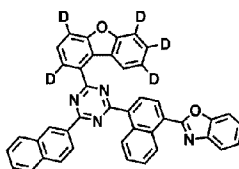
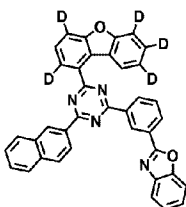
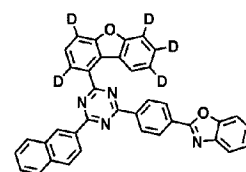
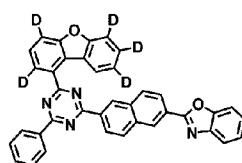
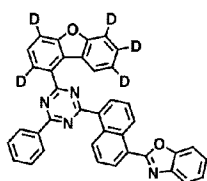
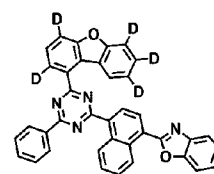
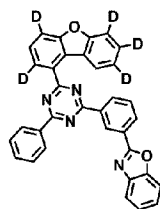
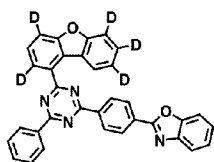


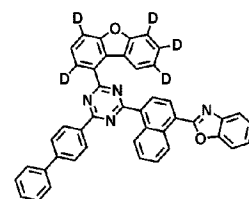
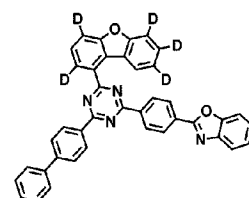
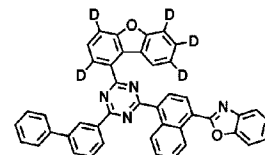
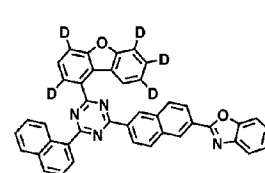


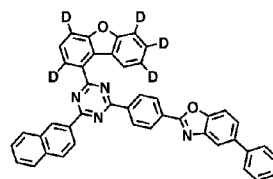
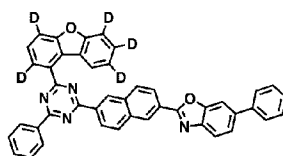
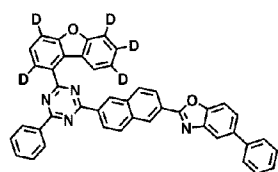
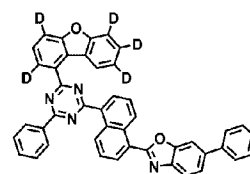
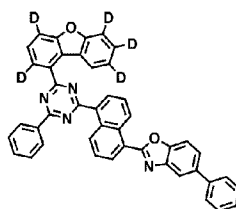
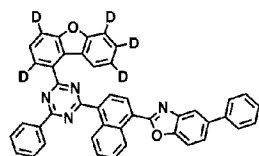
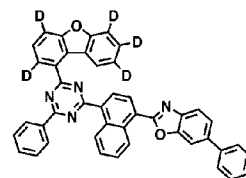
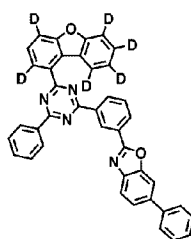
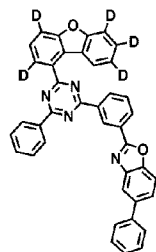
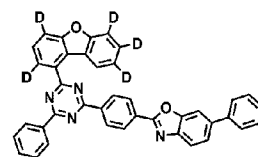
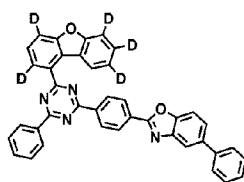
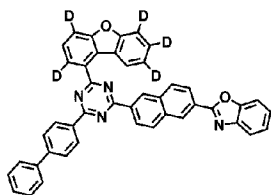


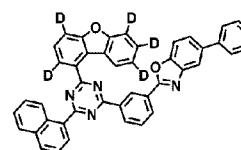
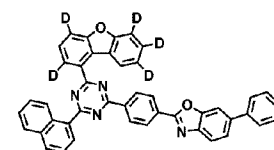
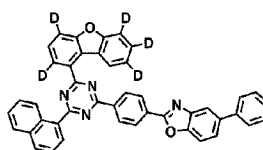
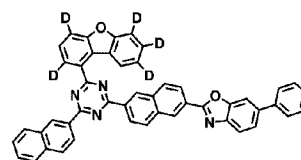
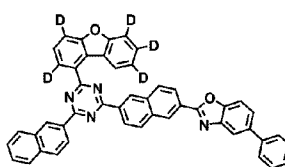
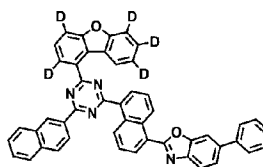
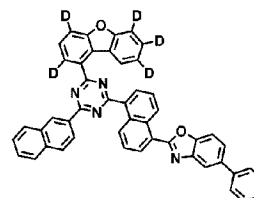
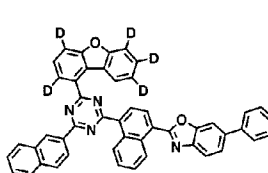
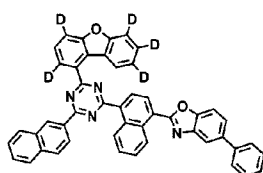
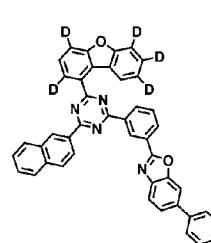
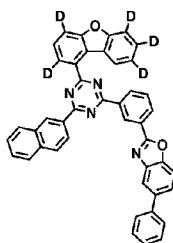
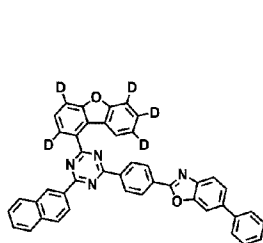


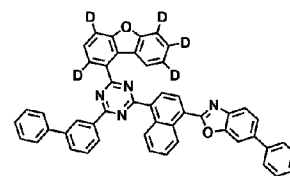
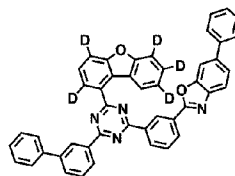
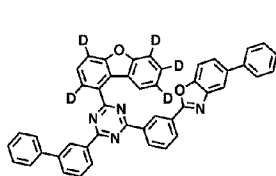
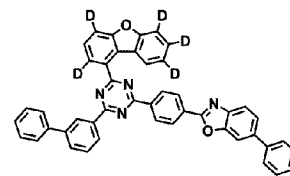
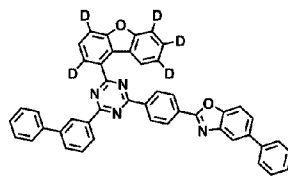
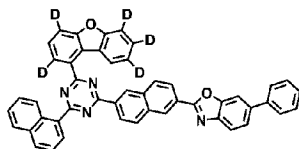
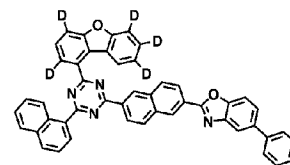
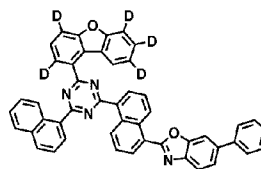
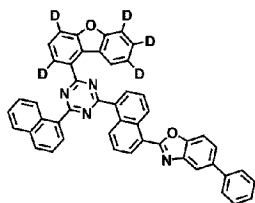
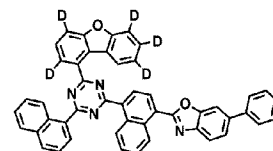
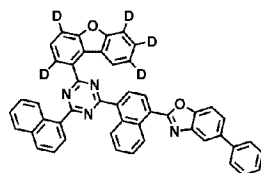
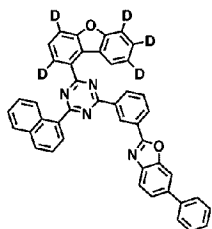


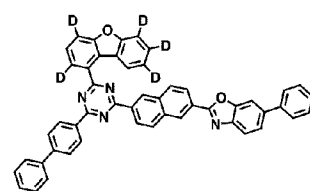
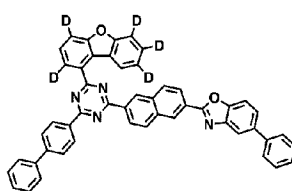
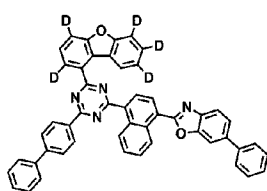
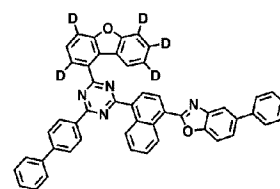
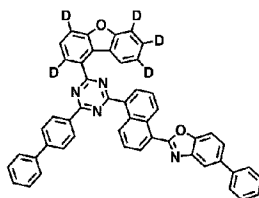
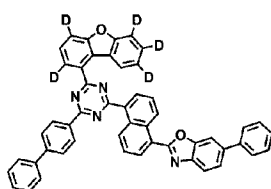
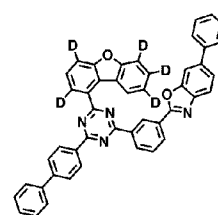
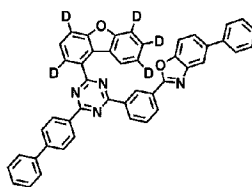
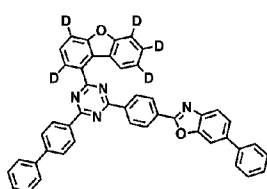
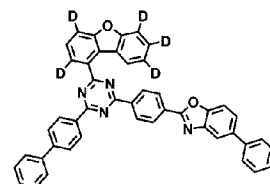
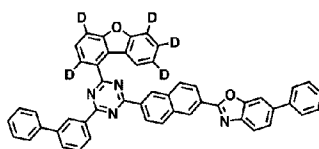
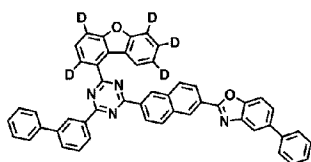
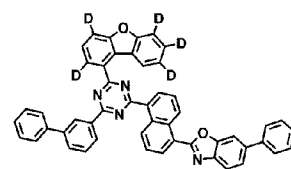
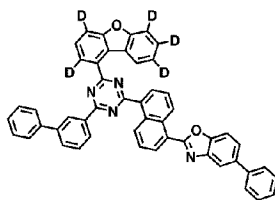
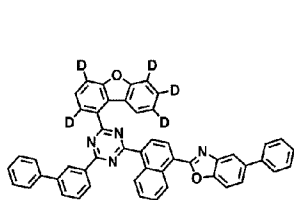


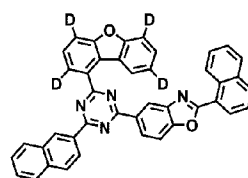
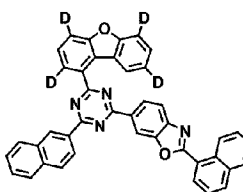
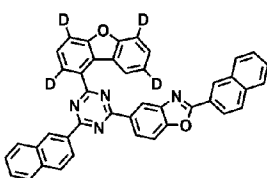
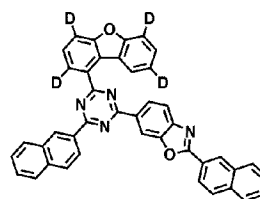
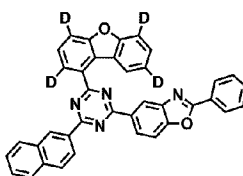
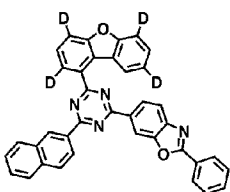
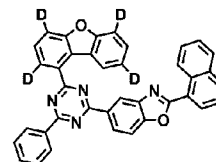
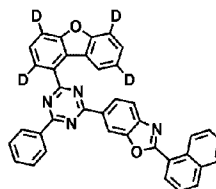
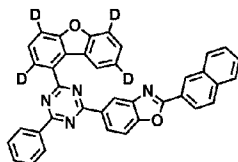
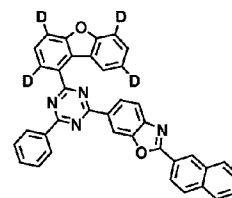
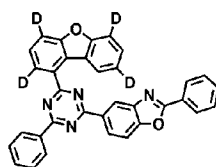
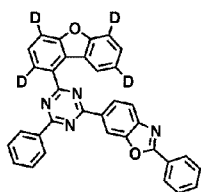


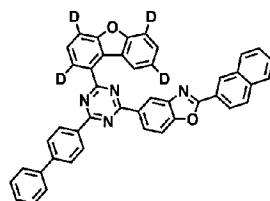
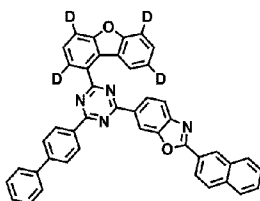
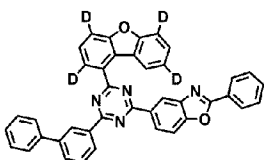
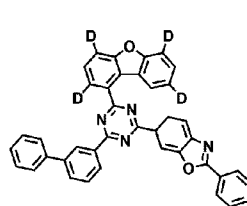
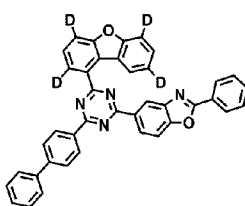
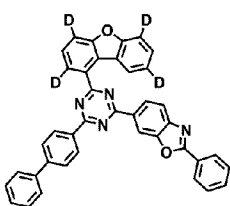
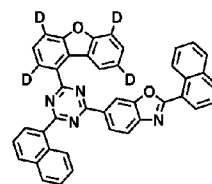
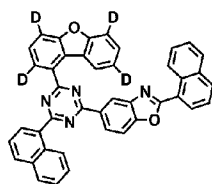
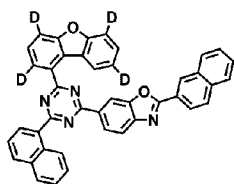
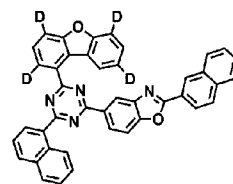
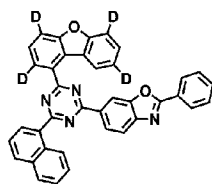
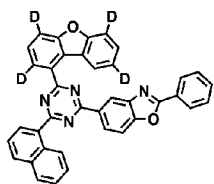


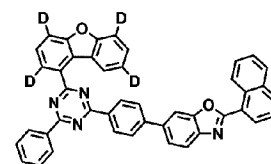
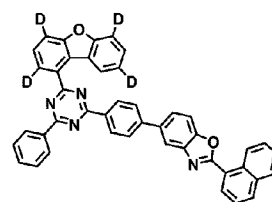
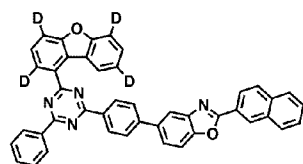
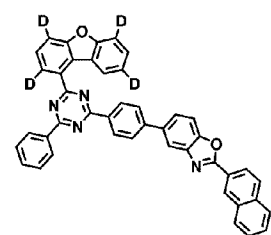
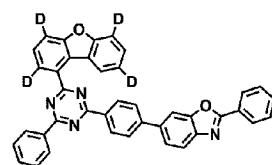
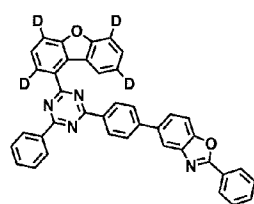
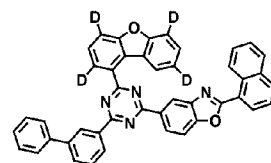
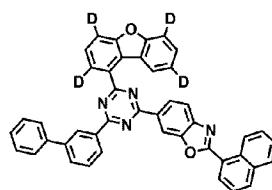
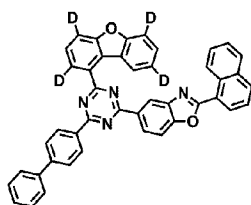
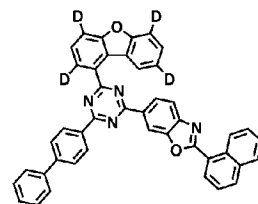
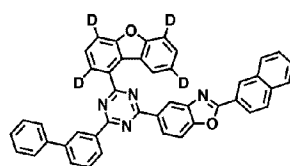
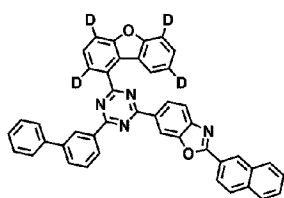


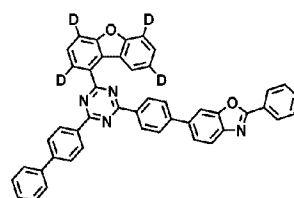
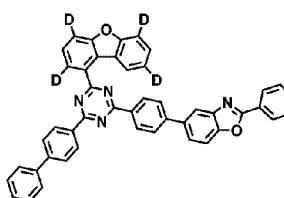
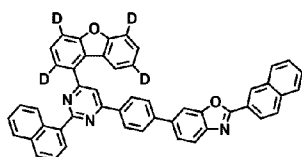
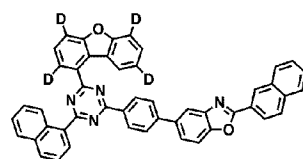
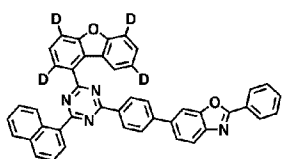
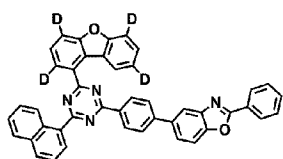
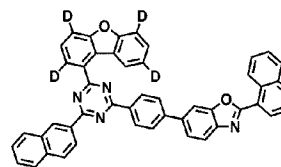
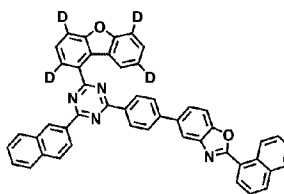
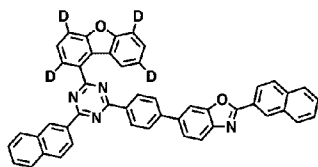
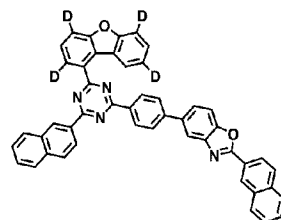
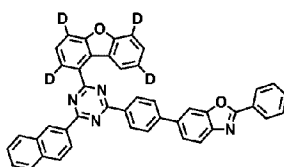
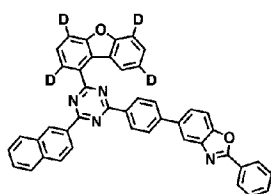


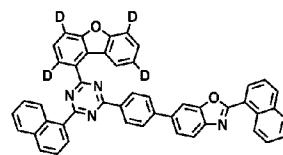
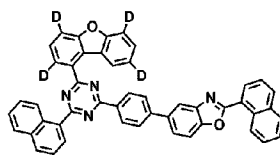
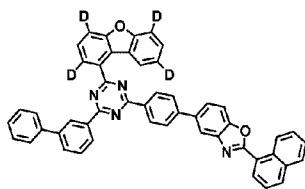
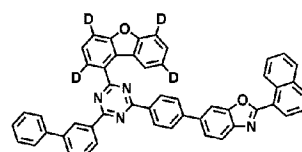
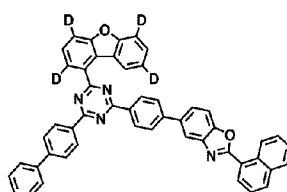
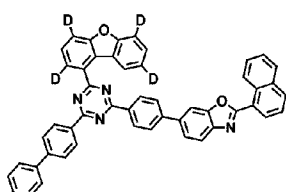
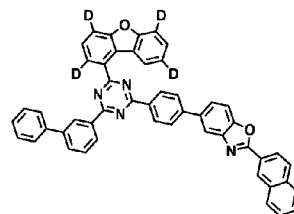
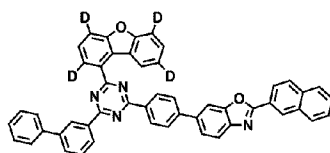
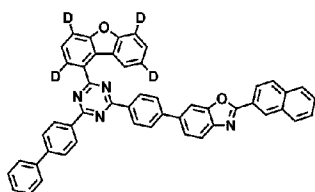
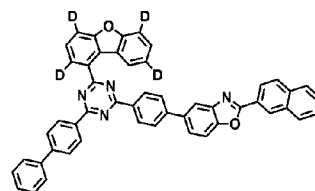
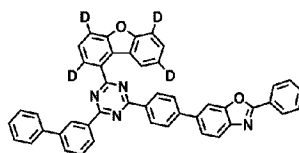
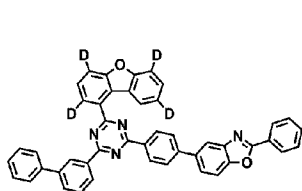


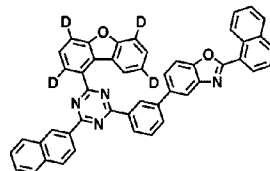
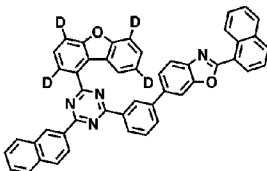
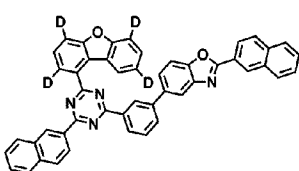
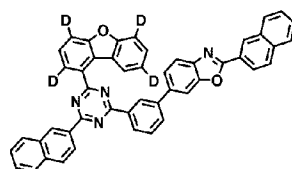
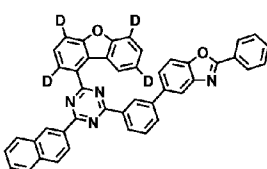
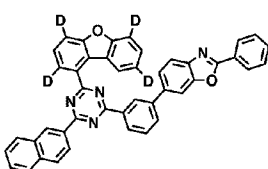
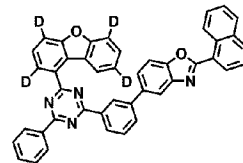
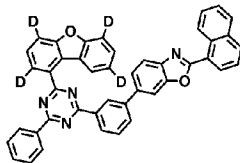
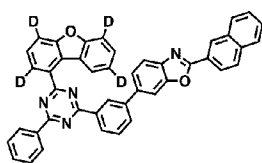
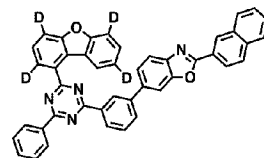
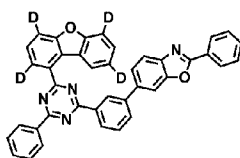
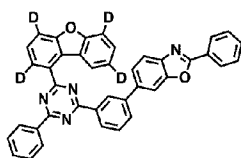


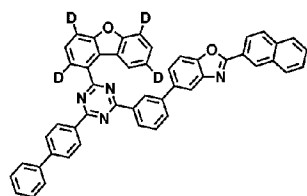
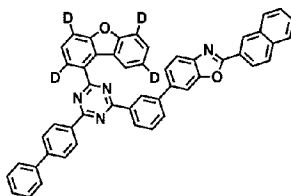
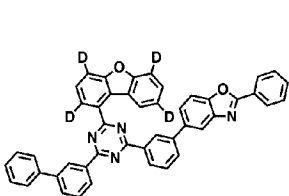
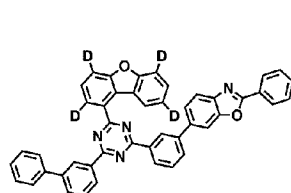
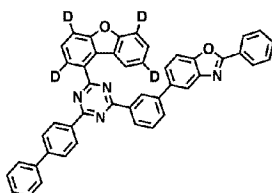
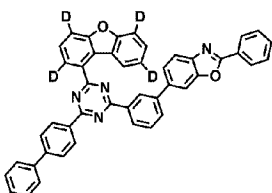
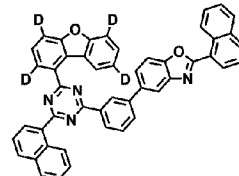
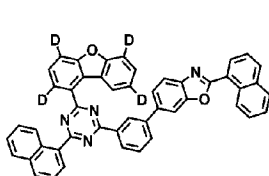
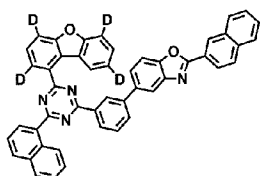
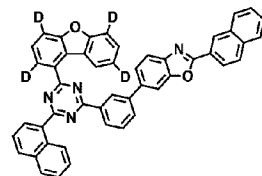
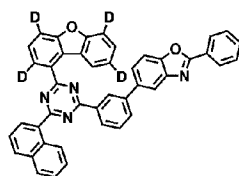
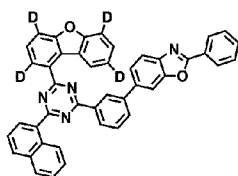


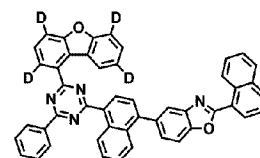
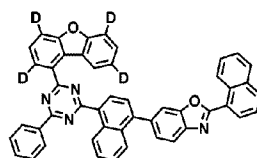
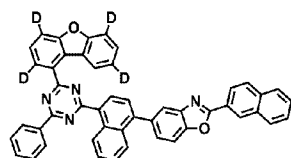
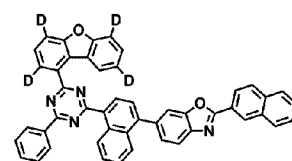
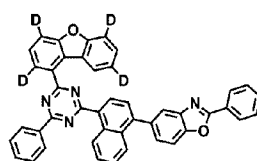
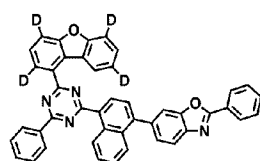
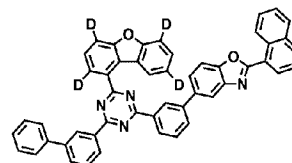
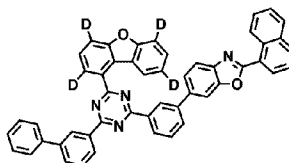
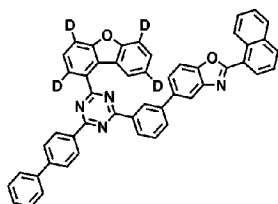
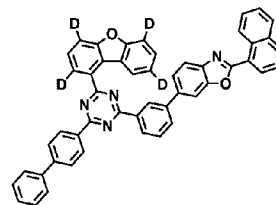
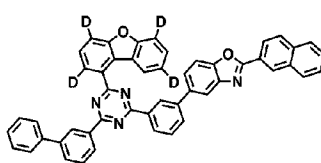
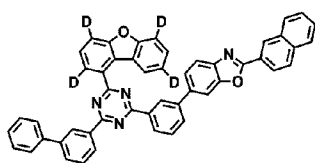


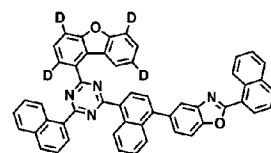
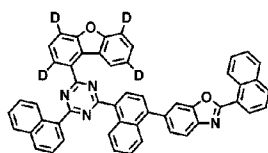
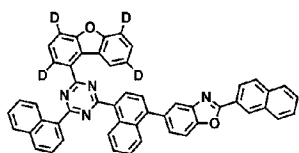
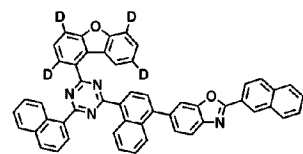
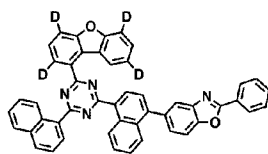
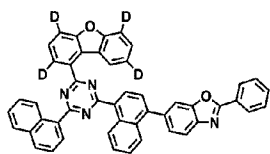
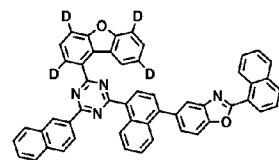
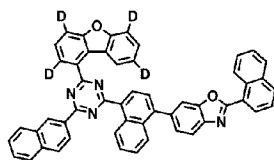
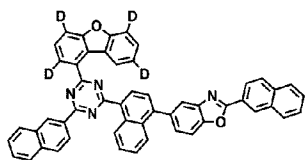
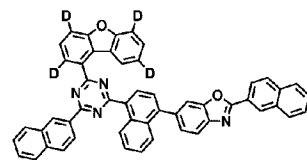
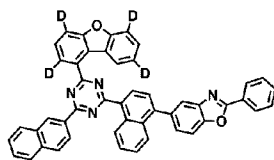
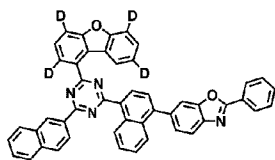


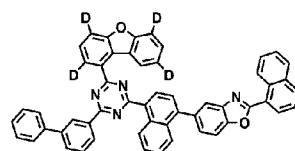
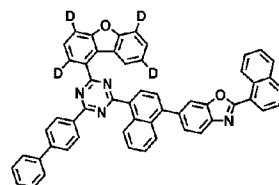
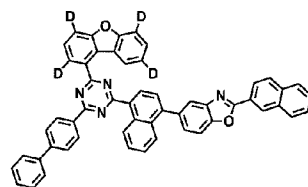
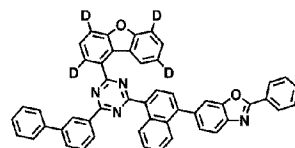


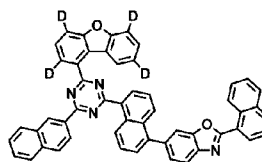
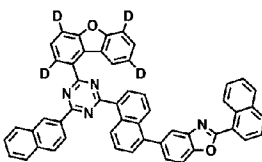
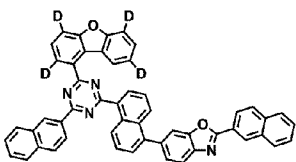
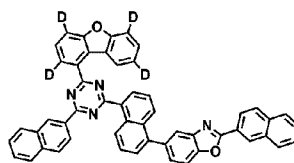
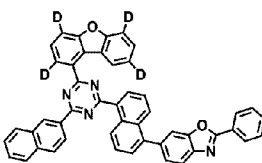
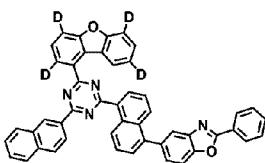
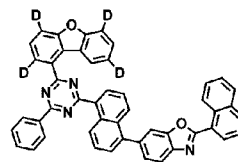
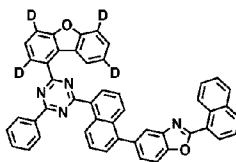
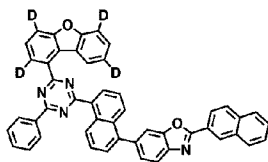
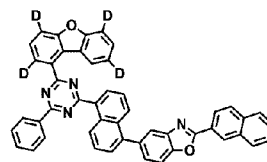
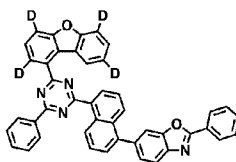
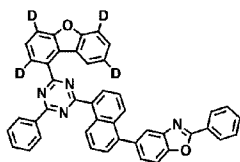


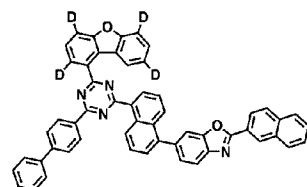
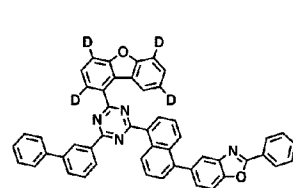
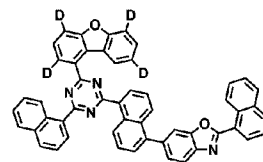
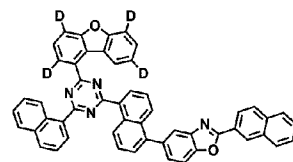


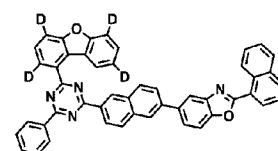
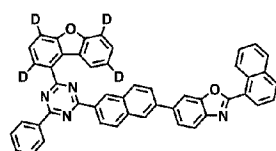
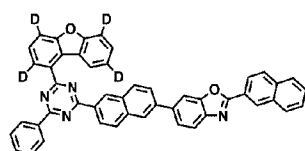
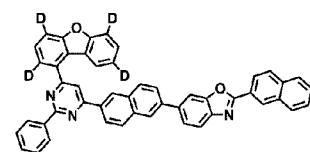
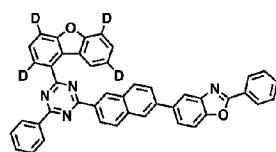
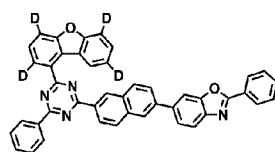
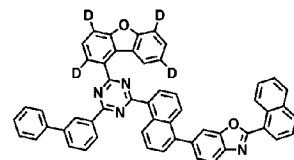
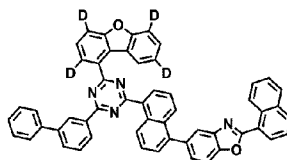
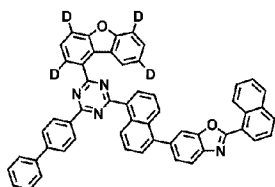
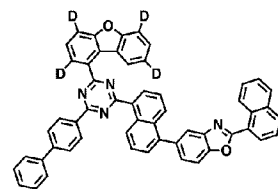
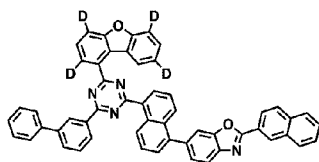
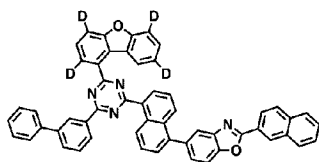


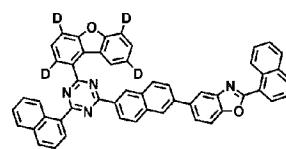
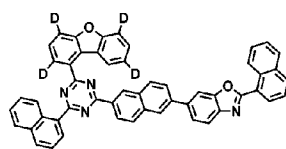
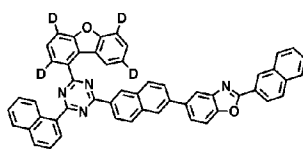
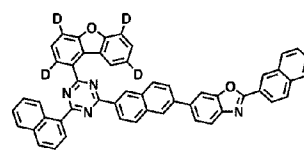
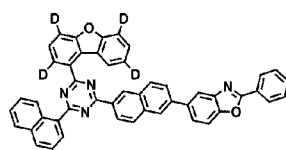
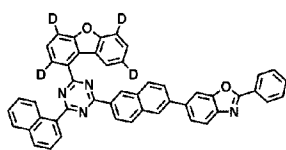
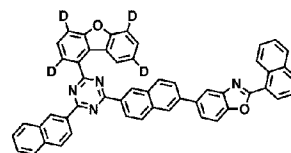
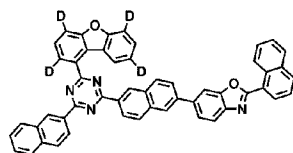
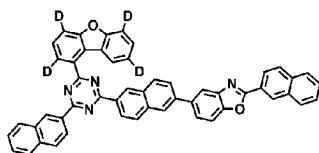
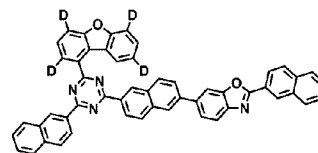
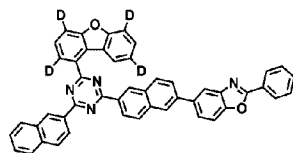
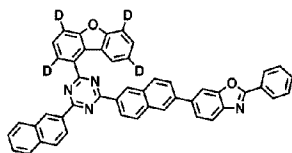


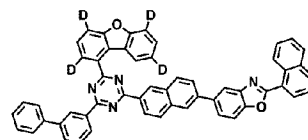
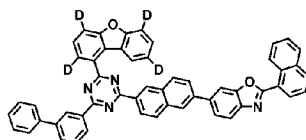
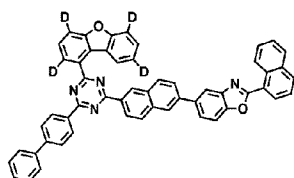
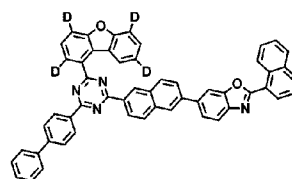
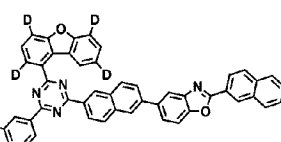
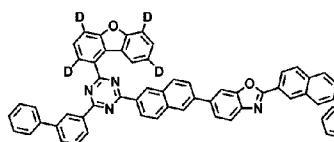
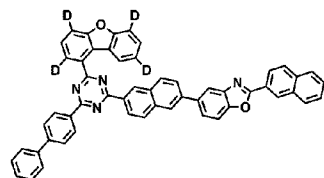
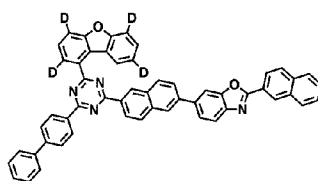
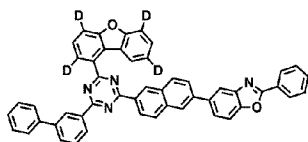
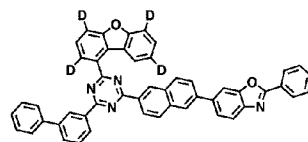
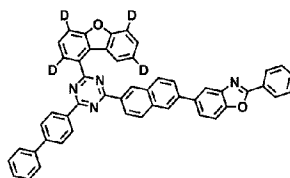
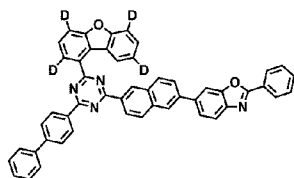


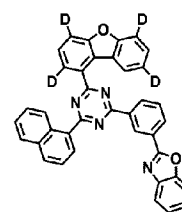
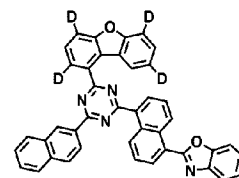
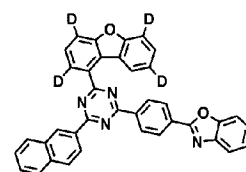
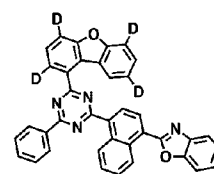


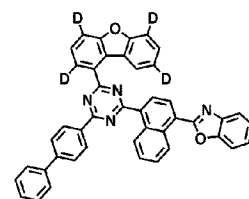
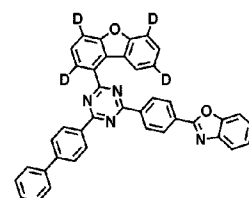
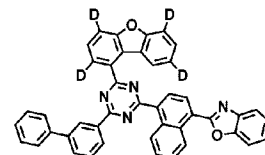
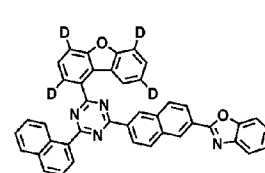


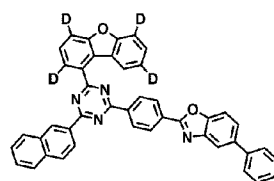
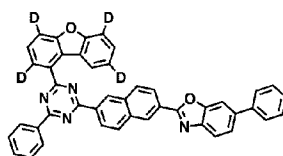
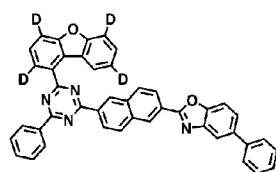
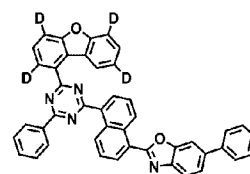
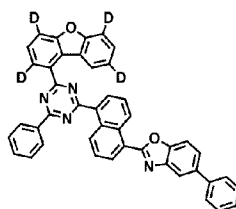
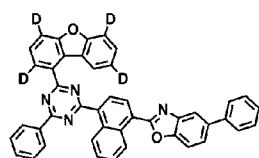
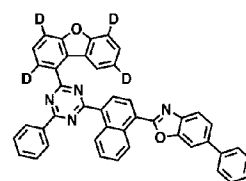
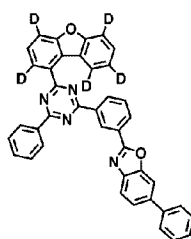
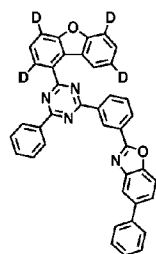
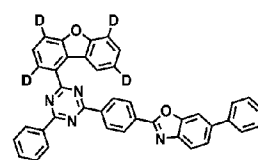
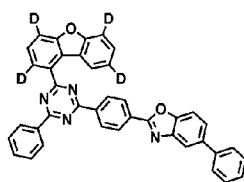
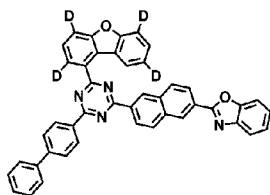


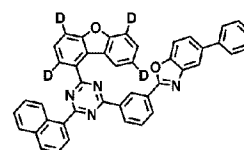
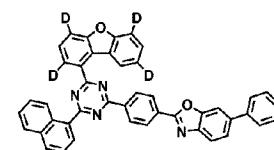
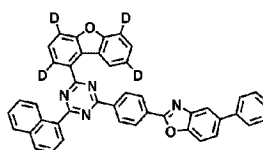
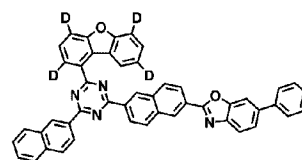
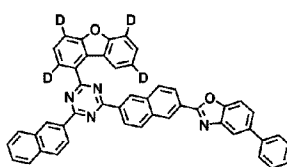
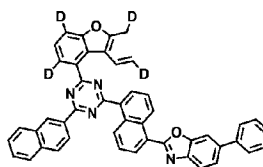
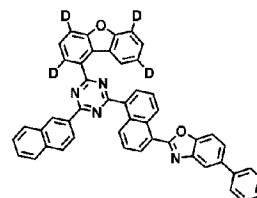
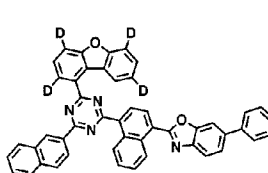
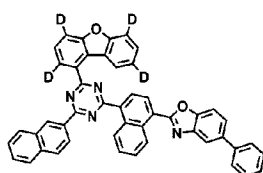
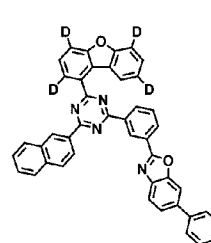
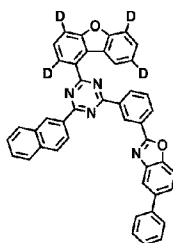
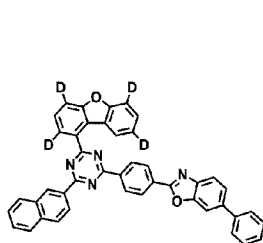


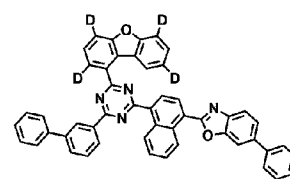
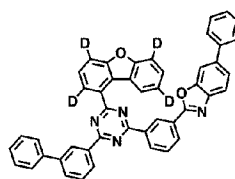
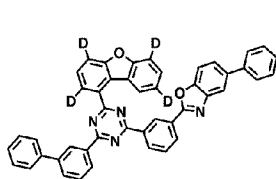
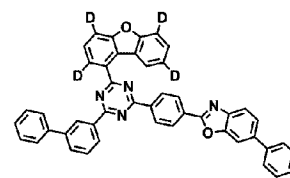
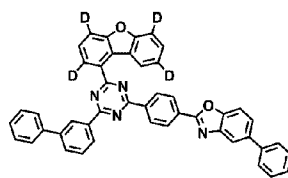
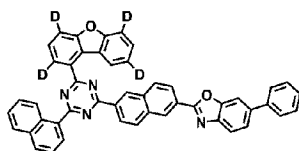
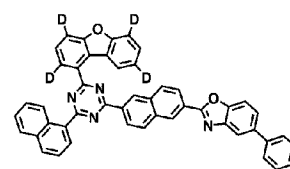
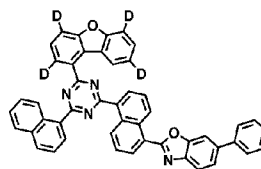
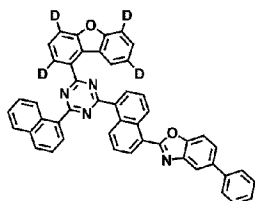
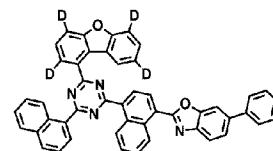
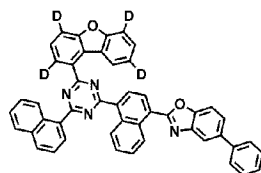
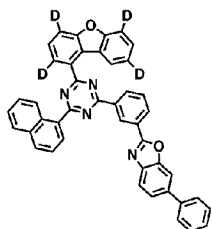


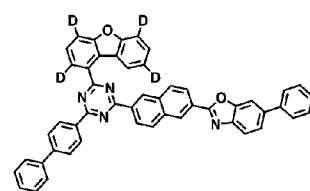
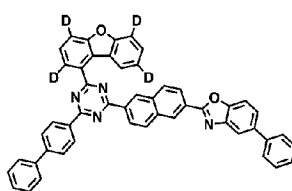
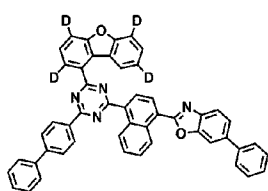
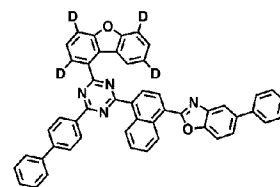
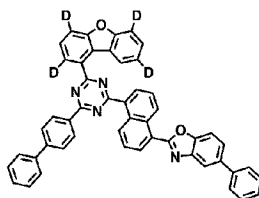
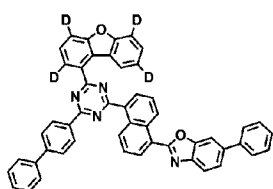
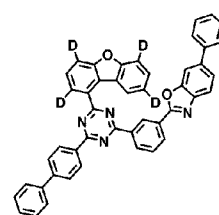
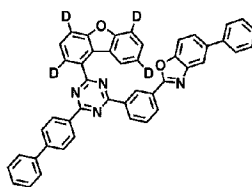
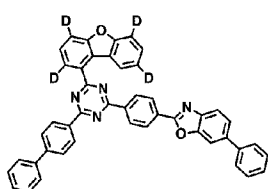
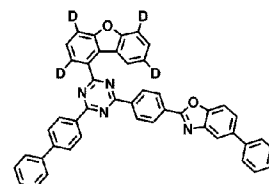
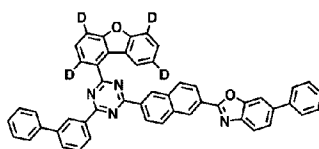
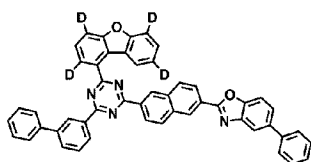
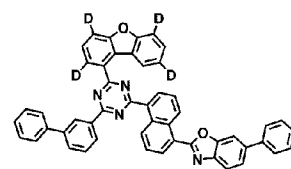
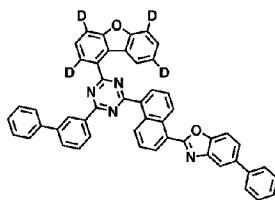
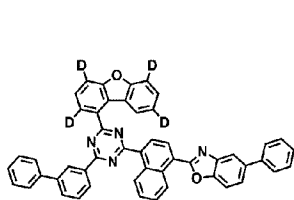


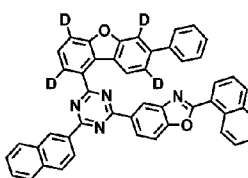
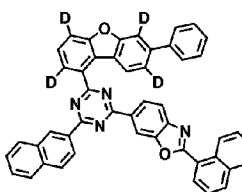
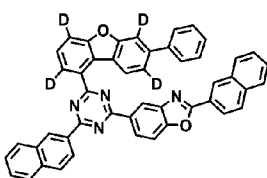
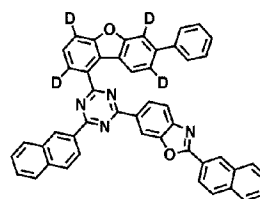
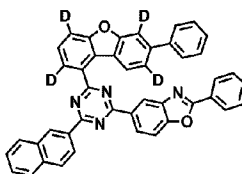
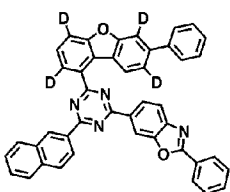
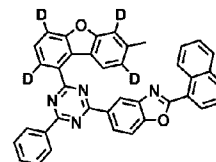
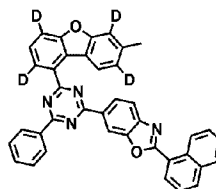
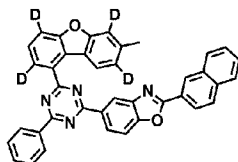
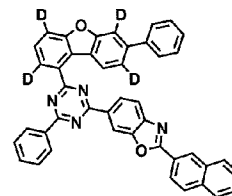
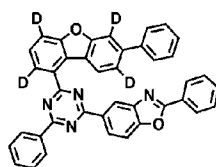
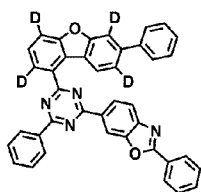


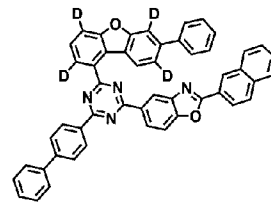
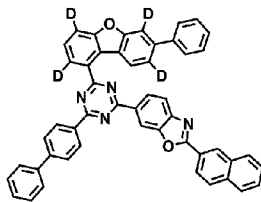
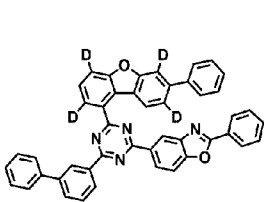
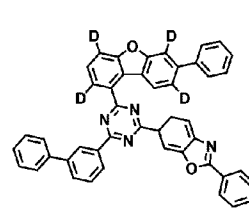
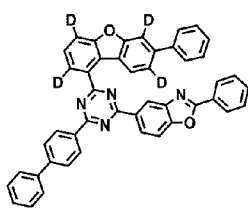
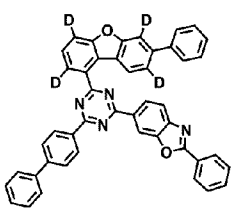
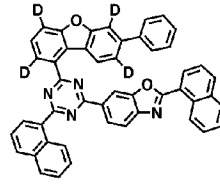
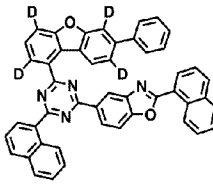
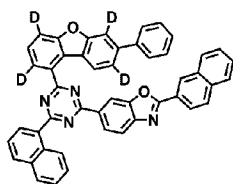
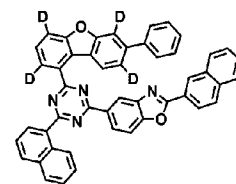
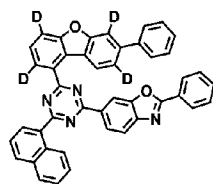
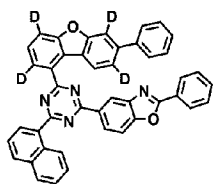


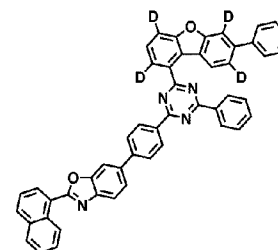
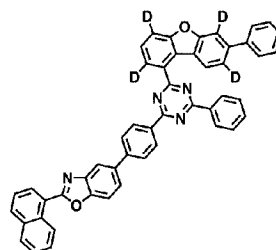
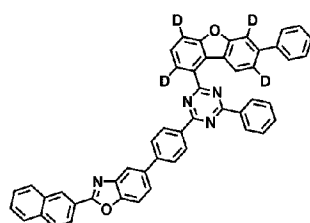
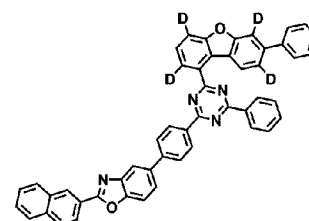
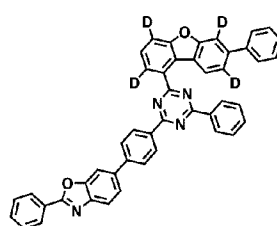
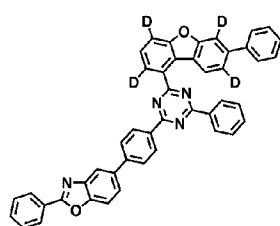
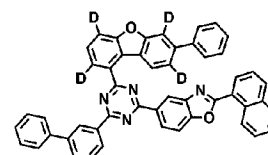
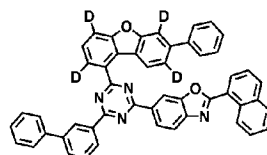
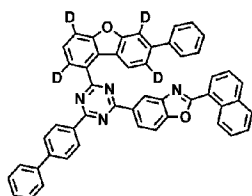
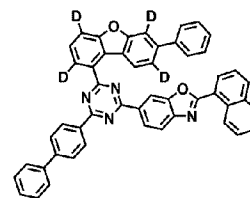
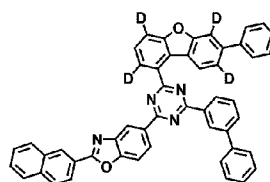
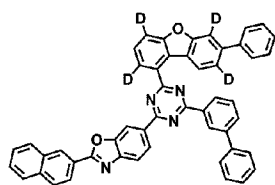


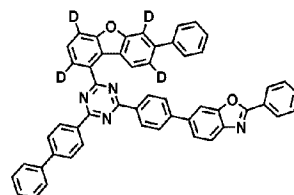
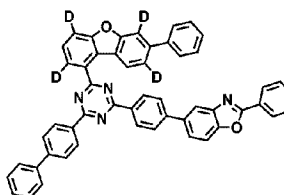
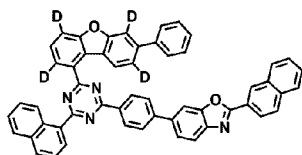
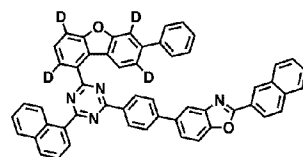
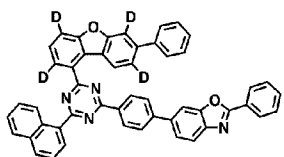
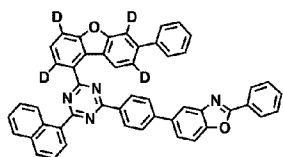
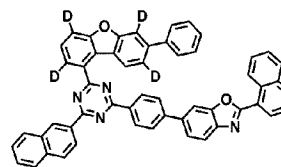
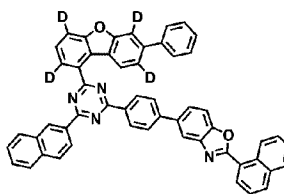
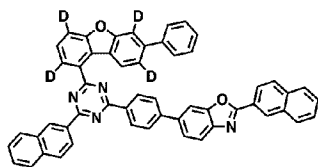
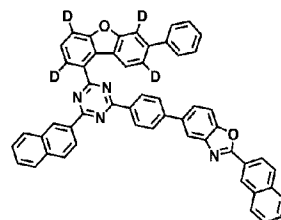
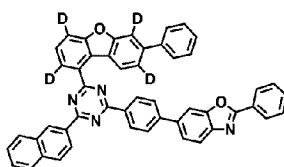
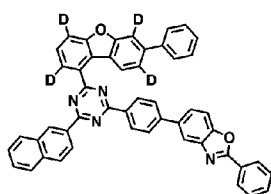


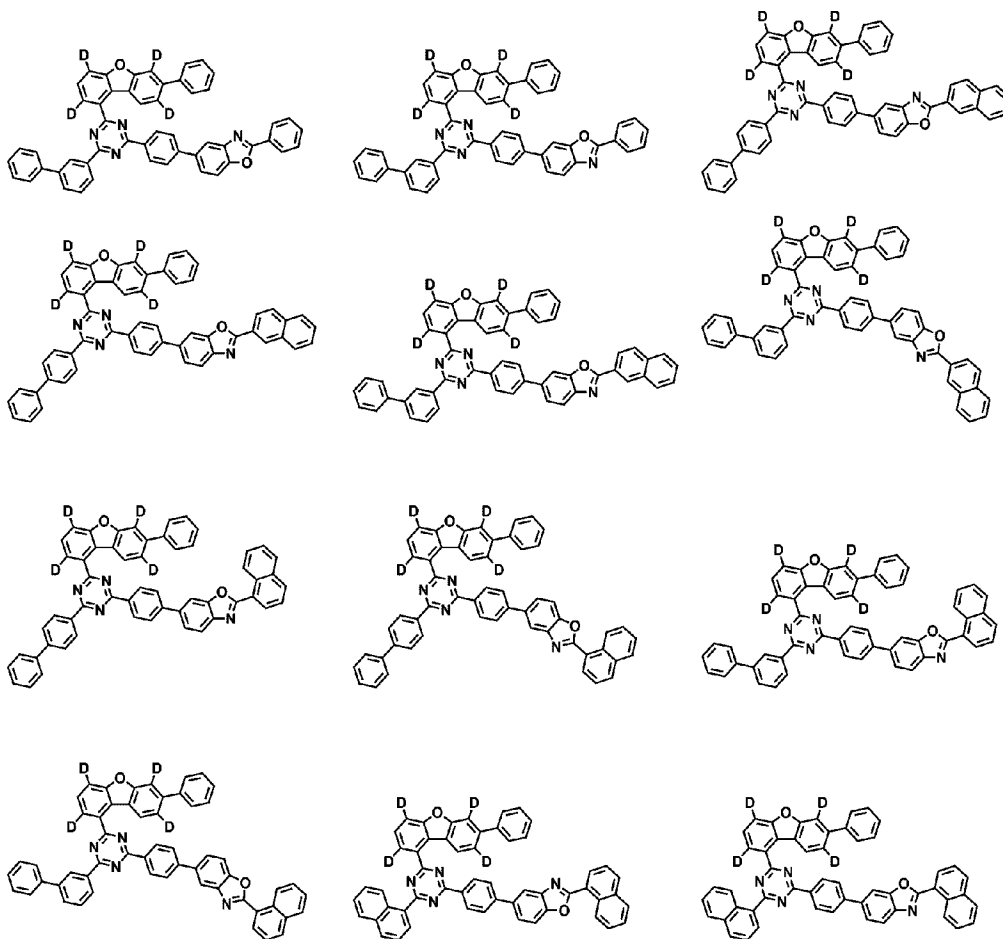


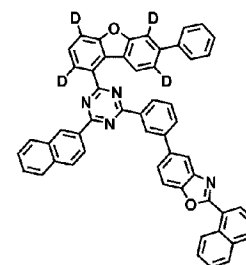
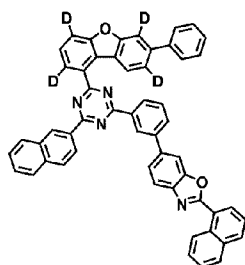
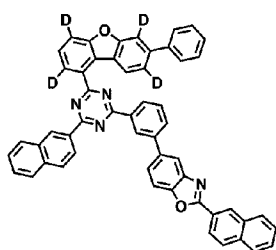
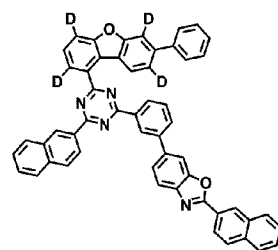
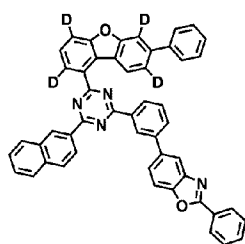
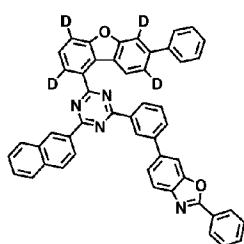
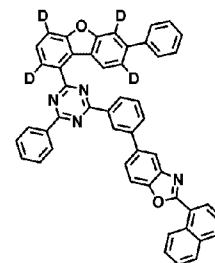
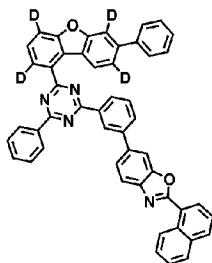
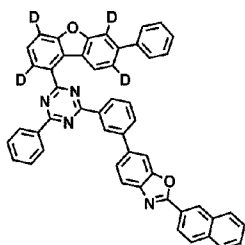
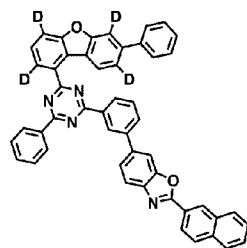
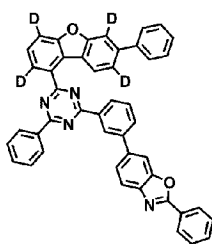
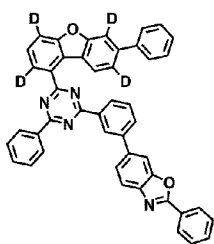


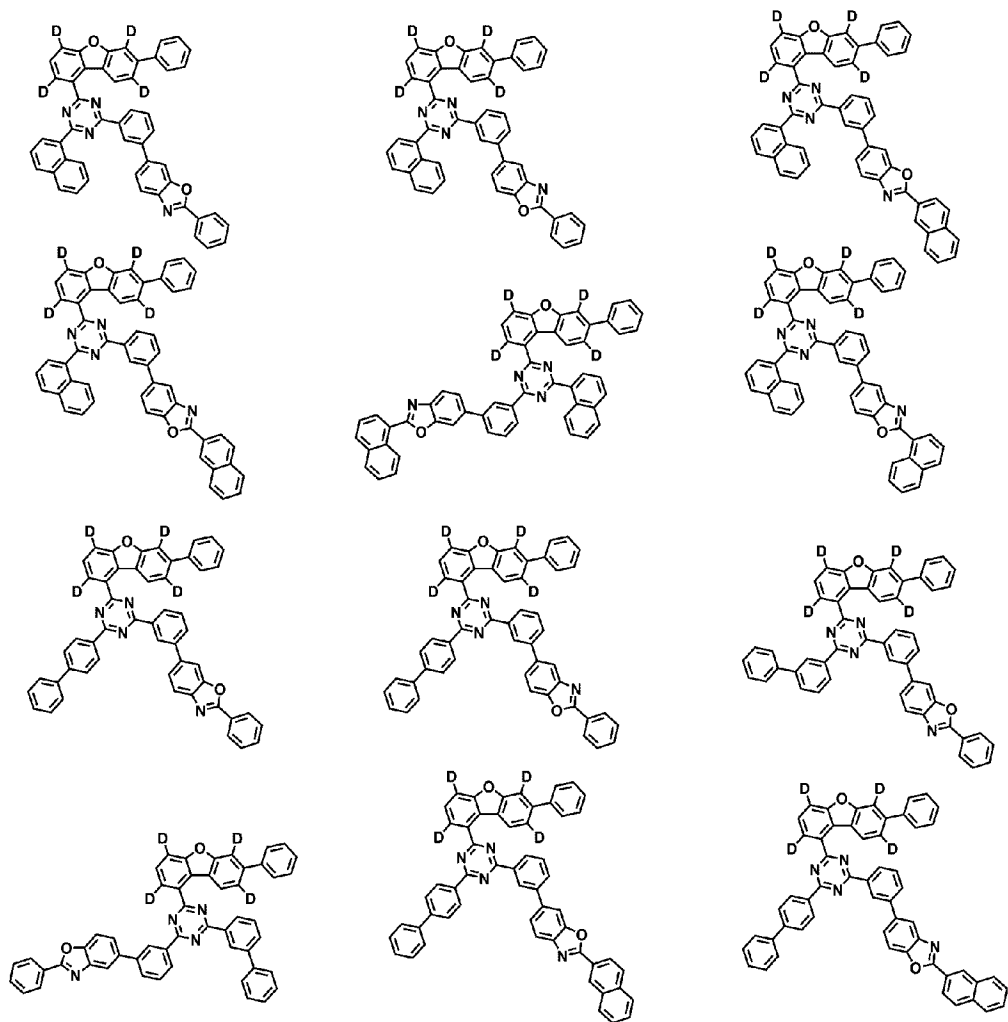


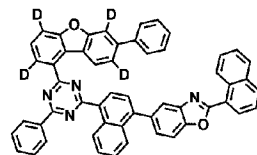
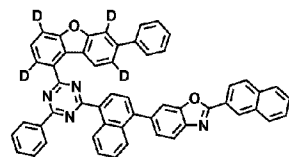
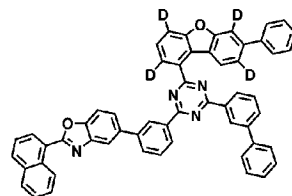
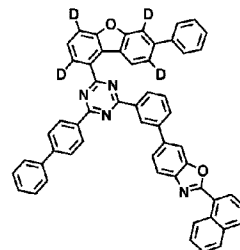


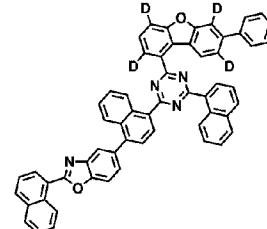
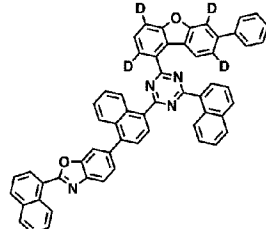
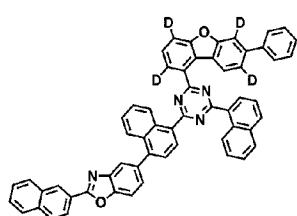
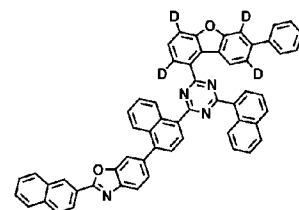
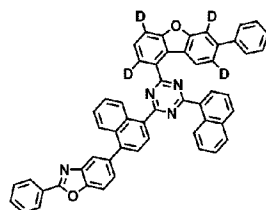
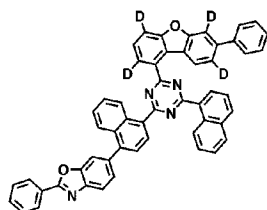
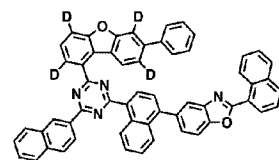
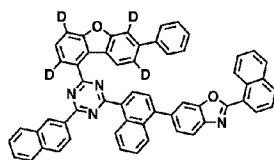
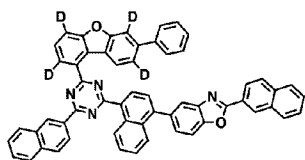
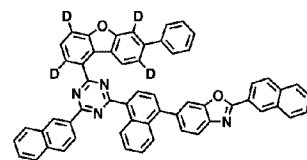
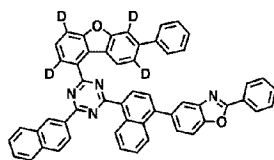
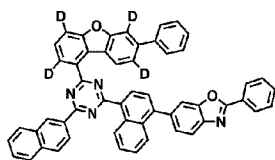


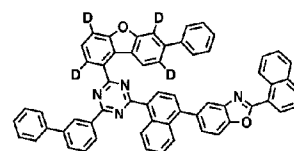
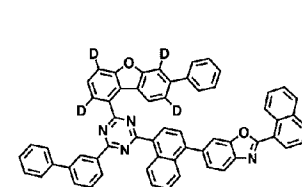
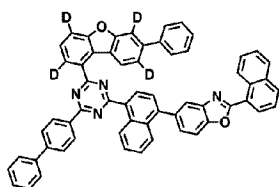
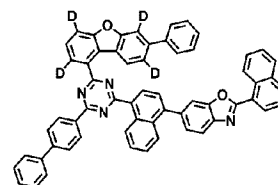
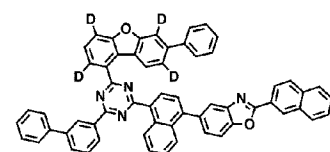
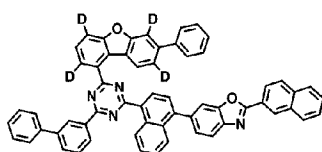
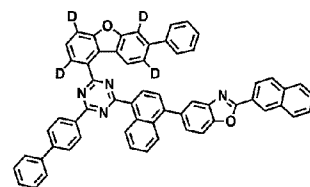
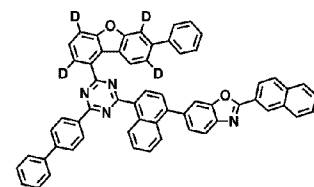
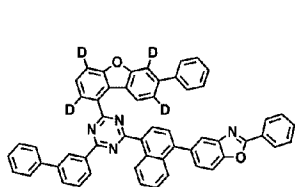
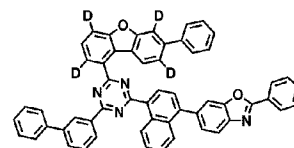
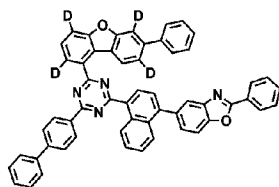
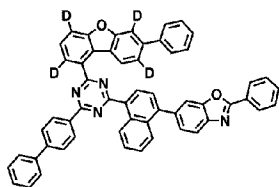


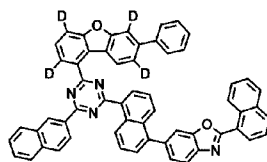
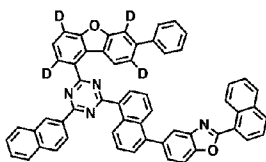
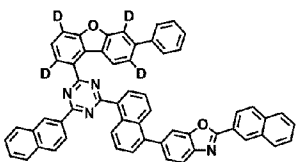
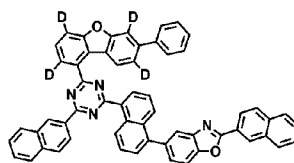
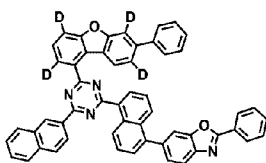
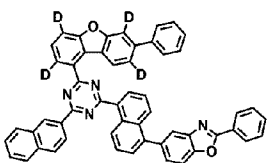
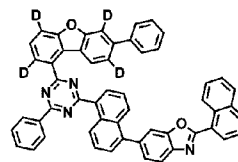
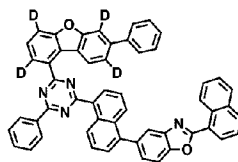
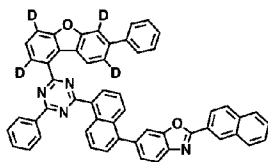
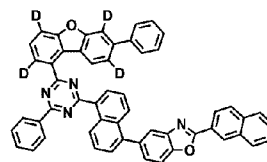
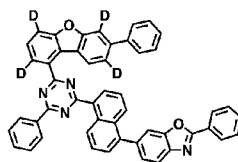
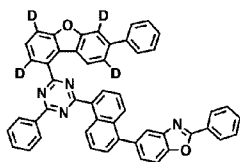


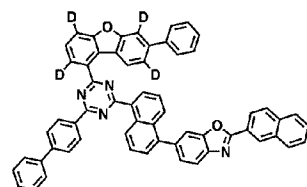
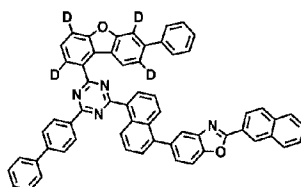
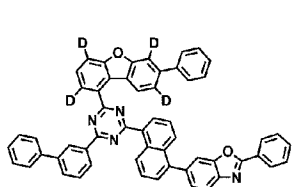
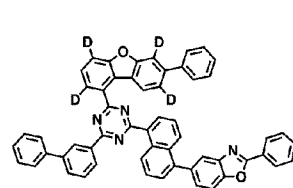
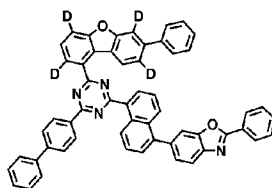
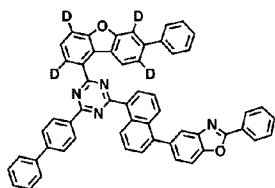
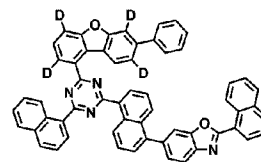
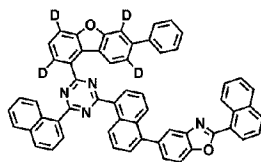
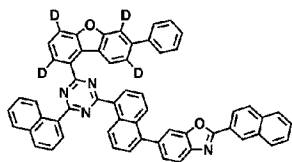
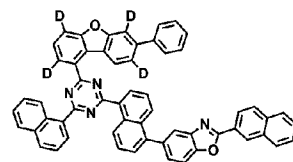
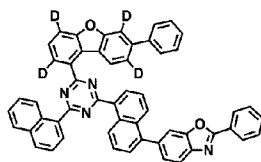
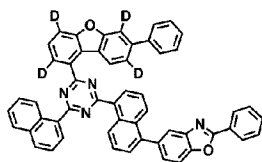


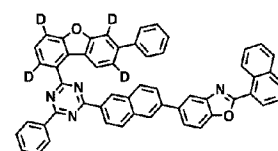
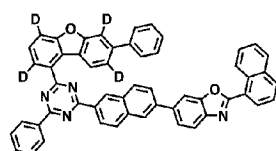
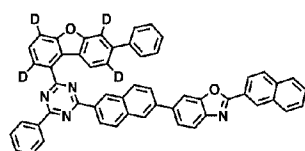
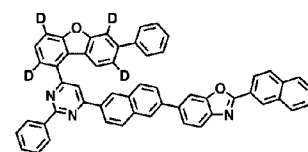
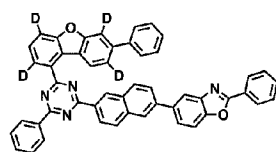
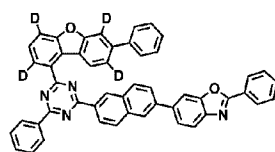
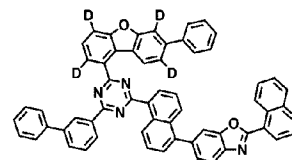
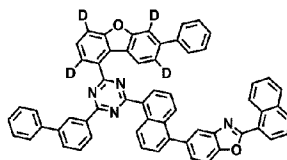
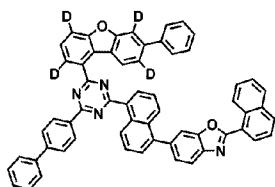
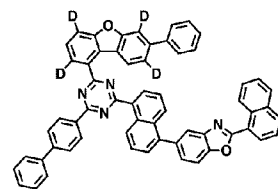
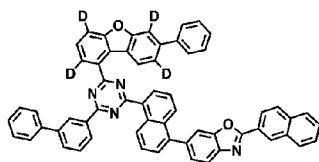
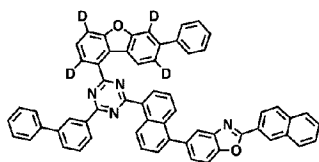


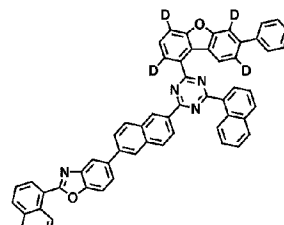
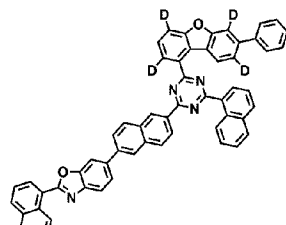
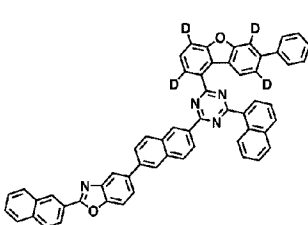
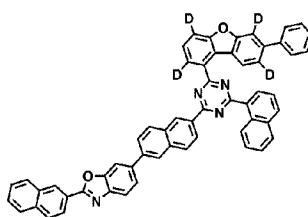
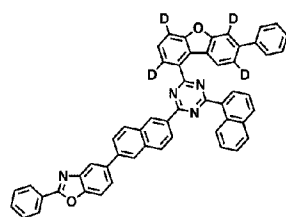
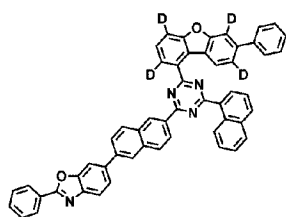
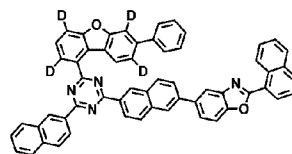
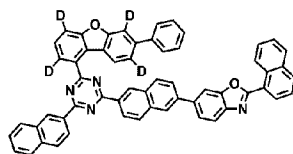
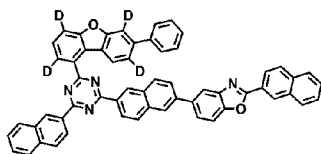
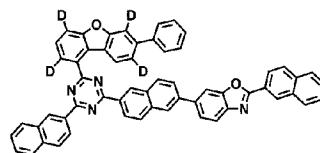
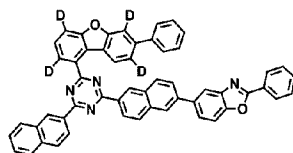
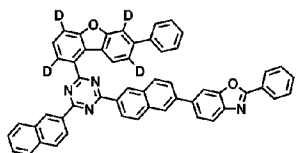


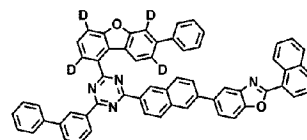
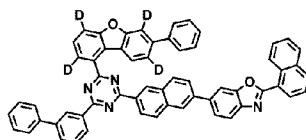
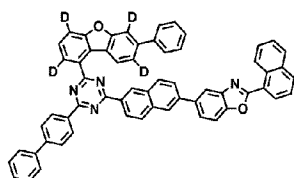
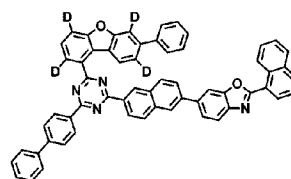
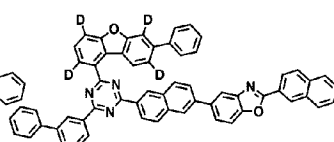
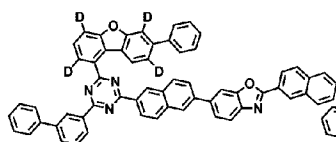
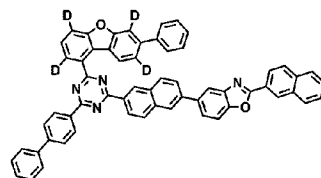
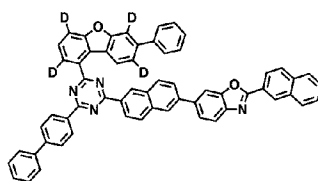
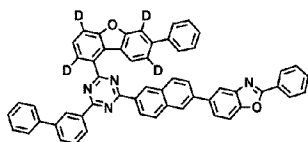
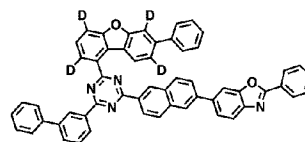
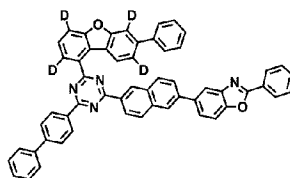
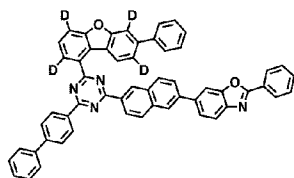


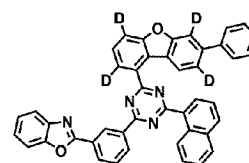
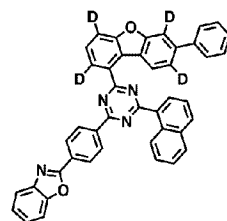
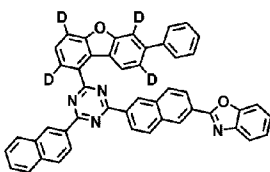
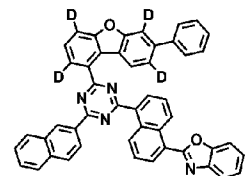
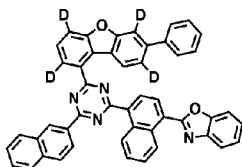
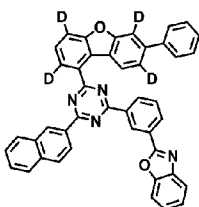
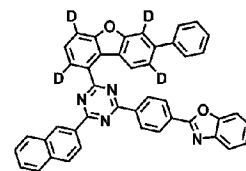
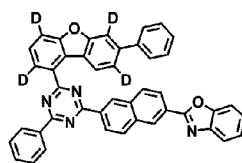
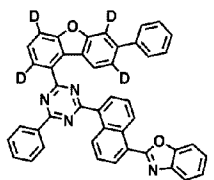
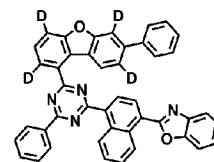
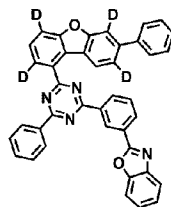
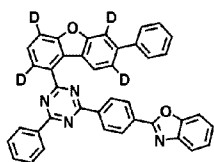


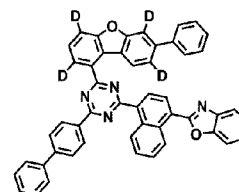
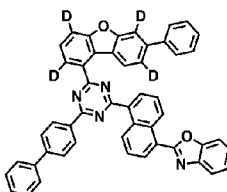
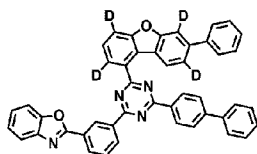
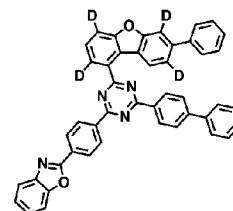
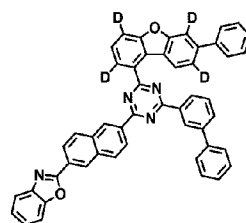
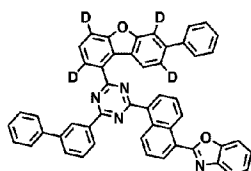
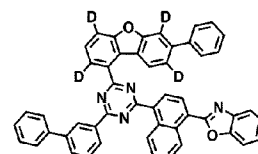
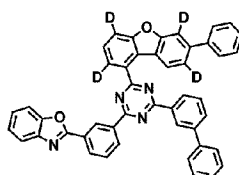
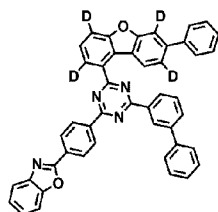
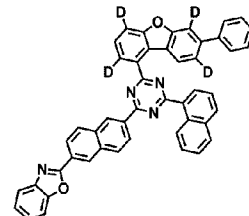
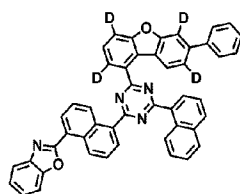
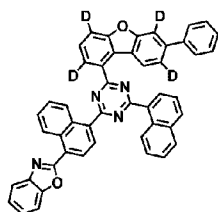


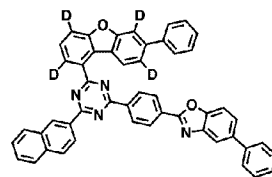
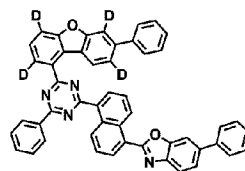
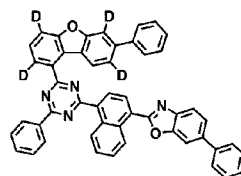
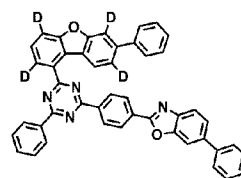


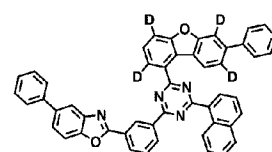
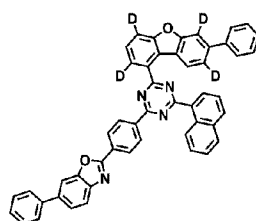
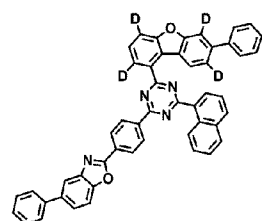
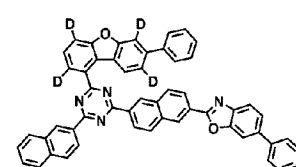
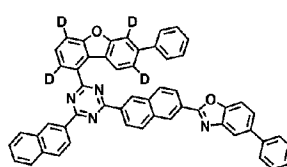
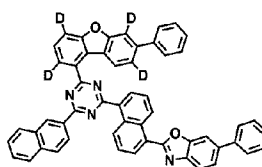
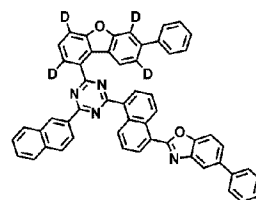
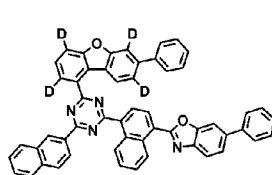
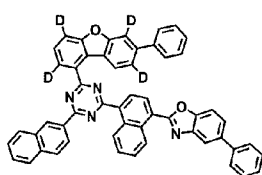
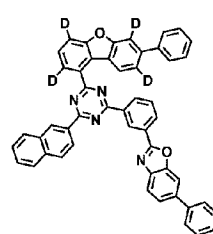
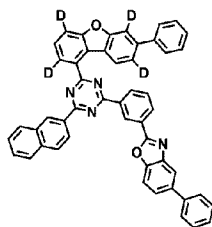
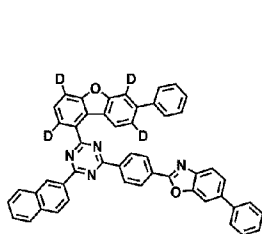


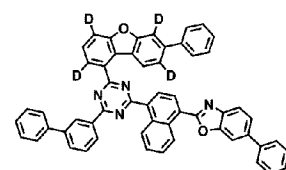
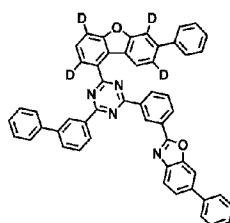
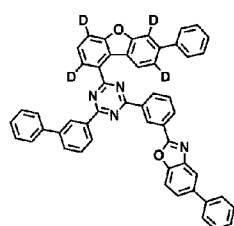
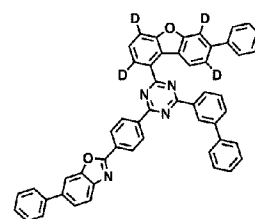
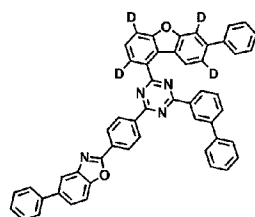
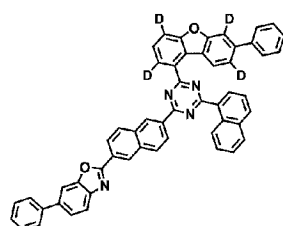
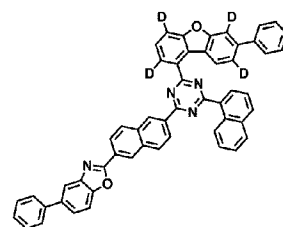
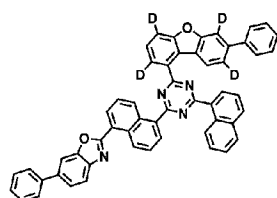
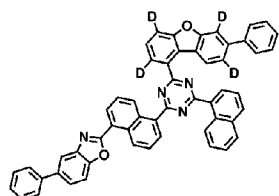
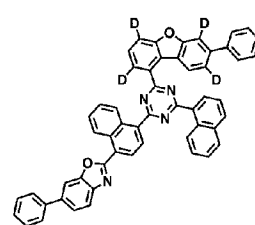
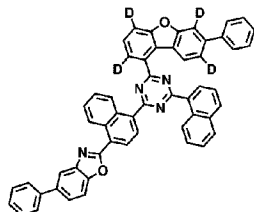
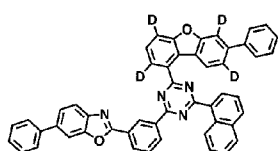


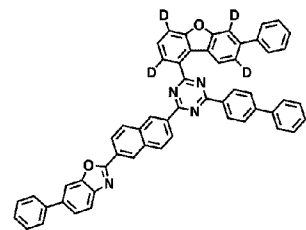
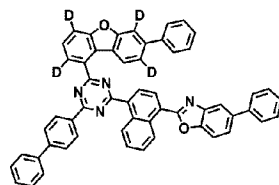
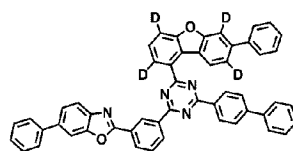
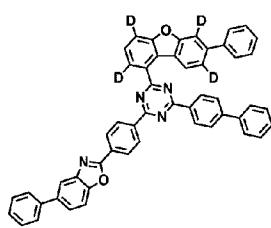
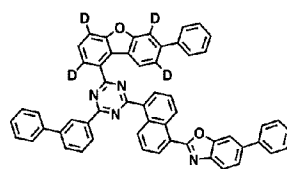


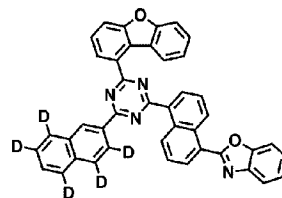
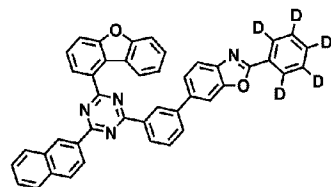
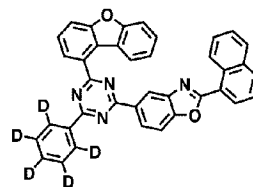
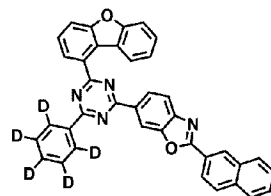


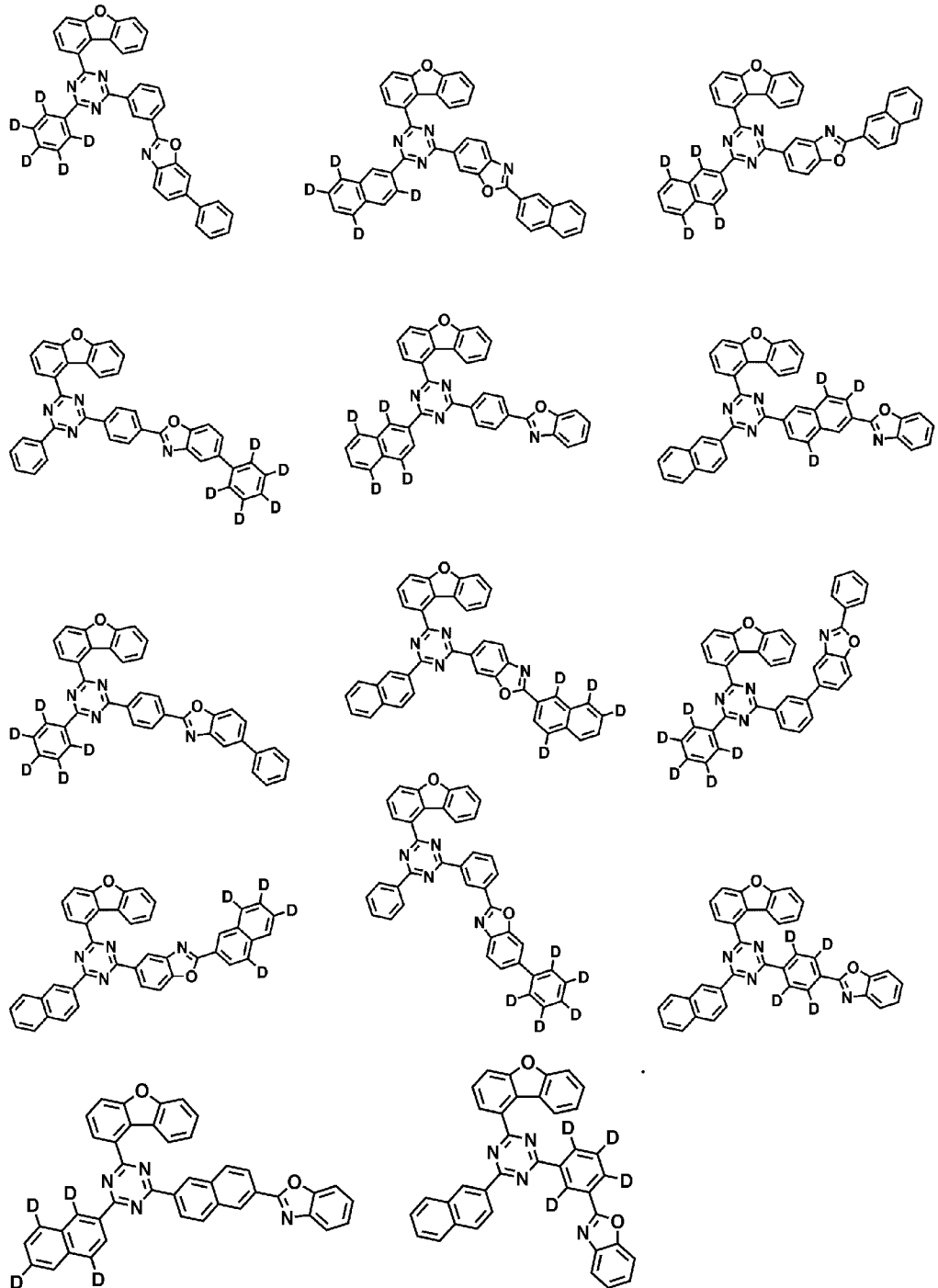












- [청구항 14] 제1 전극; 상기 제1 전극과 대향하여 구비된 제2 전극; 및 상기 제1 전극과 상기 제2 전극 사이에 구비된 1층 이상의 유기물층을 포함하는 유기 발광 소자로서, 상기 유기물층 중 1층 이상은 제1항 내지 제13항 중 어느 하나의 항에 따른 화합물을 포함하는 것인, 유기 발광 소자.
- [청구항 15] 제14항에 있어서,
상기 화합물을 포함하는 유기물층은 발광층인,
유기 발광 소자.
- [청구항 16] 제14항에 있어서,

상기 화합물은 발광층의 호스트 재료로서 포함되는,
유기 발광 소자.

[도1]

4
3
2
1

[도2]

4
9
8
3
7
6
5
2
1

INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2023/007897

A. CLASSIFICATION OF SUBJECT MATTER

C07D 413/14(2006.01)i; H10K 85/60(2023.01)i; H10K 50/11(2023.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C07D 413/14(2006.01); C07D 307/91(2006.01); C07D 403/10(2006.01); C07D 405/10(2006.01); C07D 405/14(2006.01); C07D 409/14(2006.01); C07D 417/14(2006.01); C07D 487/04(2006.01); C09K 11/06(2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models: IPC as above
Japanese utility models and applications for utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPO internal), STN (Registry, Caplus) & keywords: 유기 발광 소자(OLED, organic light emitting diode), 디벤조퓨란(dibenzofuran), 디벤조티오펜(dibenzothiophene), 중수소(deuterium), 1,3,5-트리아진(1,3,5-triazine), 벤조옥사졸(benzoxazole), 벤조티아졸(benzothiazole)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2022-065761 A1 (LT MATERIALS CO., LTD.) 31 March 2022 (2022-03-31) See claims 1, 7, 8, 12 and 13; and paragraph [0070].	1-16
A	CN 113501810 A (ZHEJIANG HUADISPLAY OPTOELECTRONICS CO., LTD.) 15 October 2021 (2021-10-15) See claims 1, 6, 8 and 9.	1-16
A	KR 10-2019-0143828 A (LG CHEM, LTD.) 31 December 2019 (2019-12-31) See claims 1, 4 and 8-10.	1-16
A	KR 10-2020-0135229 A (LG CHEM, LTD.) 02 December 2020 (2020-12-02) See entire document.	1-16



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

“D” document cited by the applicant in the international application

“E” earlier application or patent but published on or after the international filing date

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

07 September 2023

Date of mailing of the international search report

08 September 2023

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
Government Complex-Daejeon Building 4, 189 Cheongsaro, Seo-gu, Daejeon 35208

Facsimile No. +82-42-481-8578

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2023/007897

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 113024566 A (SHAANXI LIGHTE OPTOELECTRONICS MATERIAL CO., LTD.) 25 June 2021 (2021-06-25) See entire document.	1-16

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2023/007897

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
WO	2022-065761	A1	31 March 2022	CN	114599647	A	07 June 2022
				CN	116323597	A	23 June 2023
				JP	2022-552464	A	16 December 2022
				KR	10-2022-0043026	A	05 April 2022
				KR	10-2022-0043027	A	05 April 2022
				KR	10-2023-0014805	A	30 January 2023
				KR	10-2492462	B1	30 January 2023
				TW	202216958	A	01 May 2022
				TW	202219042	A	16 May 2022
				US	2023-0165145	A1	25 May 2023
				WO	2022-065762	A1	31 March 2022
CN	113501810	A	15 October 2021	CN	113501810	B	20 May 2022
KR	10-2019-0143828	A	31 December 2019	KR	10-2225904	B1	10 March 2021
KR	10-2020-0135229	A	02 December 2020	CN	112912375	A	04 June 2021
				WO	2020-242161	A1	03 December 2020
CN	113024566	A	25 June 2021	CN	113024566	B	30 November 2021
				CN	114105997	A	01 March 2022
				CN	114105997	B	19 May 2023
				EP	4063368	A1	28 September 2022
				JP	2023-510445	A	14 March 2023
				JP	7307515	B2	12 July 2023
				KR	10-2022-0047661	A	18 April 2022
				KR	10-2466473	B1	11 November 2022
				US	11618754	B2	04 April 2023
				US	2023-0008185	A1	12 January 2023
				WO	2022-160661	A1	04 August 2022

A. 발명이 속하는 기술분류(국제특허분류(IPC)) C07D 413/14(2006.01)i; H10K 85/60(2023.01)i; H10K 50/11(2023.01)i		
B. 조사된 분야 조사된 최소문헌(국제특허분류를 기재) C07D 413/14(2006.01); C07D 307/91(2006.01); C07D 403/10(2006.01); C07D 405/10(2006.01); C07D 405/14(2006.01); C07D 409/14(2006.01); C07D 417/14(2006.01); C07D 487/04(2006.01); C09K 11/06(2006.01) 조사된 기술분야에 속하는 최소문헌 이외의 문헌 한국등록실용신안공보 및 한국공개실용신안공보: 조사된 최소문헌란에 기재된 IPC 일본등록실용신안공보 및 일본공개실용신안공보: 조사된 최소문헌란에 기재된 IPC 국제조사에 이용된 전산 데이터베이스(데이터베이스의 명칭 및 검색어(해당하는 경우)) eKOMPASS(특허청 내부 검색시스템), STN(Registry, Caplus) & 키워드: 유기 발광 소자(OLED, organic light emitting diode), 디벤조퓨란(dibenzofuran), 디벤조티오펜(dibenzothiophene), 중수소(deuterium), 1,3,5-트리아진(1,3,5-triazine), 벤조옥사졸(benzoxazole), 벤조티아졸(benzothiazole)		
C. 관련 문헌		
카테고리*	인용문헌명 및 관련 구절(해당하는 경우)의 기재	관련 청구항
X	WO 2022-065761 A1 (LT MATERIALS CO., LTD.) 2022.03.31 청구항 1, 7, 8, 12, 13; 단락 [70]	1-16
A	CN 113501810 A (ZHEJIANG HUADISPLAY OPTOELECTRONICS CO., LTD.) 2021.10.15 청구항 1, 6, 8, 9	1-16
A	KR 10-2019-0143828 A (주식회사 엘지화학) 2019.12.31 청구항 1, 4, 8-10	1-16
A	KR 10-2020-0135229 A (주식회사 엘지화학) 2020.12.02 전문	1-16
A	CN 113024566 A (SHAANXI LIGHT OPTOELECTRONICS MATERIAL CO., LTD.) 2021.06.25 전문	1-16
☐ 추가 문헌이 C(계속)에 기재되어 있습니다. ☒ 대응특허에 관한 별지를 참조하십시오.		
* 인용된 문헌의 특별 카테고리: “A” 특별히 관련이 없는 것으로 보이는 일반적인 기술수준을 정의한 문헌 “D” 본 국제출원에서 출원인이 인용한 문헌 “E” 국제출원일보다 빠른 출원일 또는 우선일을 가지나 국제출원일 이후에 공개된 선출원 또는 특허 문헌 “L” 우선권 주장에 의문을 제기하는 문헌 또는 다른 인용문헌의 공개일 또는 다른 특별한 이유(이유를 명시)를 밝히기 위하여 인용된 문헌 “O” 구두 개시, 사용, 전시 또는 기타 수단을 언급하고 있는 문헌 “P” 우선일 이후에 공개되었으나 국제출원일 이전에 공개된 문헌 “T” 국제출원일 또는 우선일 후에 공개된 문헌으로, 출원과 상충하지 않으며 발명의 기초가 되는 원리나 이론을 이해하기 위해 인용된 문헌 “X” 특별한 관련이 있는 문헌. 해당 문헌 하나만으로 청구된 발명의 신규성 또는 진보성이 없는 것으로 본다. “Y” 특별한 관련이 있는 문헌. 해당 문헌이 하나 이상의 다른 문헌과 조합하는 경우로 그 조합이 당업자에게 자명한 경우 청구된 발명은 진보성이 없는 것으로 본다. “&” 동일한 대응특허문헌에 속하는 문헌		
국제조사의 실제 완료일 2023년09월07일 (07.09.2023)		국제조사보고서 발송일 2023년09월08일 (08.09.2023)
ISA/KR의 명칭 및 우편주소 대한민국 특허청 (35208) 대전광역시 서구 청사로 189, 4동 (둔산동, 정부대전청사) 팩스 번호 +82-42-481-8578		심사관 허주형 전화번호 +82-42-481-5373

국제조사보고서에서 인용된 특허문헌	공개일	대응특허문헌	공개일
WO 2022-065761 A1	2022/03/31	CN 114599647 A	2022/06/07
		CN 116323597 A	2023/06/23
		JP 2022-552464 A	2022/12/16
		KR 10-2022-0043026 A	2022/04/05
		KR 10-2022-0043027 A	2022/04/05
		KR 10-2023-0014805 A	2023/01/30
		KR 10-2492462 B1	2023/01/30
		TW 202216958 A	2022/05/01
		TW 202219042 A	2022/05/16
		US 2023-0165145 A1	2023/05/25
		WO 2022-065762 A1	2022/03/31
CN 113501810 A	2021/10/15	CN 113501810 B	2022/05/20
KR 10-2019-0143828 A	2019/12/31	KR 10-2225904 B1	2021/03/10
KR 10-2020-0135229 A	2020/12/02	CN 112912375 A	2021/06/04
		WO 2020-242161 A1	2020/12/03
CN 113024566 A	2021/06/25	CN 113024566 B	2021/11/30
		CN 114105997 A	2022/03/01
		CN 114105997 B	2023/05/19
		EP 4063368 A1	2022/09/28
		JP 2023-510445 A	2023/03/14
		JP 7307515 B2	2023/07/12
		KR 10-2022-0047661 A	2022/04/18
		KR 10-2466473 B1	2022/11/11
		US 11618754 B2	2023/04/04
		US 2023-0008185 A1	2023/01/12
		WO 2022-160661 A1	2022/08/04