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(54) 새로운 유기 발광 소자 재료 및 이를 이용한 유기 발광소자(8)

요약

본 발명은 제 1 전극, 발광층, 1층 이상의 유기물층 및 제 2 전극을 적층된 형태로 포함하는 유기 발광 소자에 있어서, 상기 유기물층 중 1층 이상이 하기 화학식 1의 화합물, 또는 이 화합물에 열 경화성 또는 광경화성 작용기가 도입된 화합물을 포함하는 것인 유기 발광 소자를 제공한다.

대표도

도 1

색인어

유기 발광 소자, 유기물층, 정공주입물질, 정공수송물질, 아크리딘

명세서

도면의 간단한 설명

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

도 2는 기판 (1), 양극 (2), 정공주입층 (5), 정공수송층 (6), 발광층 (7), 전자수송층 (8) 및 음극 (4)으로 이루어진 유기 발광 소자의 예를 도시한 것이다.

발명의 상세한 설명

발명의 목적

발명이 속하는 기술 및 그 분야의 종래기술

본 발명은 유기 발광 소자의 수명, 효율, 전기 화학적 안정성 및 열적 안정성을 크게 향상시킬 수 있는 플루오렌 유도체를 포함하는 유기 발광 소자에 관한 것이다.

유기 발광 현상은 특정 유기 분자의 내부 프로세스에 의하여 전류가 가시광으로 전환되는 예의 하나이다. 유기 발광 현상의 원리는 다음과 같다. 양극과 음극 사이에 유기물 층을 위치시켰을 때 두 전극 사이에 전압을 걸어주게 되면 음극과 양극으로부터 각각 전자와 정공이 유기물 층으로 주입된다. 유기물 층으로 주입된 전자와 정공은 재결합하여 엑시톤 (exciton)을 형성하고, 이 엑시톤이 다시 바닥 상태로 떨어지면서 빛이 나게 된다. 이러한 원리를 이용하는 유기 발광소자는 일반적으로 음극과 양극 및 그 사이에 위치한 유기물층, 예컨대 정공주입층, 정공수송층, 발광층, 전자수송층을 포함하는 유기물층으로 구성될 수 있다.

유기 발광 소자에서 사용되는 물질로는 순수 유기 물질 또는 유기 물질과 금속이 착물을 이루는 착화합물이 대부분을 차지하고 있으며, 용도에 따라 정공주입 물질, 정공수송 물질, 발광 물질, 전자수송 물질, 전자주입 물질 등으로 구분될 수 있다. 여기서, 정공주입 물질이나 정공수송 물질로는 p-타입의 성질을 가지는 유기 물질, 즉 쉽게 산화가 되고 산화시에 전기화학적으로 안정한 상태를 가지는 유기물이 주로 사용되고 있다. 한편, 전자주입 물질이나 전자수송 물질로는 n-타입 성질을 가지는 유기 물질, 즉 쉽게 환원이 되고 환원시에 전기화학적으로 안정한 상태를 가지는 유기물이 주로 사용되고 있다. 발광층 물질로는 p-타입 성질과 n-타입 성질을 동시에 가진 물질, 즉 산화와 환원 상태에서 모두 안정한 형태를 갖는 물질이 바람직하며, 엑시톤이 형성되었을 때 이를 빛으로 전환하는 발광 효율이 높은 물질이 바람직하다.

위에서 언급한 외에, 유기 발광 소자에서 사용되는 물질은 다음과 같은 성질을 추가적으로 갖는 것이 바람직하다.

첫째로 유기 발광 소자에서 사용되는 물질은 열적 안정성이 우수한 것이 바람직하다. 유기 발광 소자 내에서는 전하들의 이동에 의한 줄열 (joule heating)이 발생하기 때문이다. 현재 정공수송층 물질로 주로 사용되는 NPB는 유리 전이 온도가 100 ^{o}C 이하의 값을 가지므로, 높은 전류를 필요로 하는 유기 발광 소자에서는 사용하기 힘든 문제가 있다.

둘째로 저전압 구동 가능한 고효율의 유기 발광 소자를 얻기 위해서는 유기 발광 소자 내로 주입된 정공 또는 전자들이 원활하게 발광층으로 전달되는 동시에, 주입된 정공과 전자들이 발광층 밖으로 빠져나가지 않도록 하여야 한다. 이를 위해서 유기 발광 소자에 사용되는 물질은 적절한 밴드갭 (band gap)과 HOMO 또는 LUMO 에너지 준위를 가져야 한다. 현재 용액 도포법에 의해 제조되는 유기 발광 소자에서 정공수송 물질로 사용되는 PEDOT:PSS의 경우, 발광층 물질로 사용되는 유기물의 LUMO 에너지 준위에 비하여 LUMO 에너지 준위가 낮기 때문에 고효율 장수명의 유기 발광 소자 제조에 어려움이 있다.

이외에도 유기 발광 소자에서 사용되는 물질은 화학적 안정성, 전하이동도, 전극이나 인접한 층과의 계면 특성 등이 우수하여야 한다. 즉, 유기 발광소자에서 사용되는 물질은 수분이나 산소에 의한 물질의 변형이 적어야 한다. 또한, 적절한 정공 또는 전자 이동도를 가짐으로써 유기 발광 소자의 발광층에서 정공과 전자의 밀도가 균형을 이루도록 하여 엑시톤 형성을 극대화할 수 있어야 한다. 그리고, 소자의 안정성을 위해 금속 또는 금속 산화물을 포함한 전극과의 계면을 좋게 할 수 있어야 한다.

그러므로 당 기술 분야에서는 상기와 같은 요건을 갖춘 유기물을 포함하는 유기발광소자의 개발이 요구되고 있다.

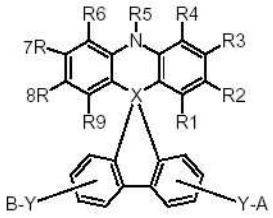
발명이 이루고자 하는 기술적 과제

이에 본 발명자들은 유기 발광 소자에서 사용 가능한 물질에 요구되는 조건, 예컨대 적절한 에너지 준위, 전기 화학적 안정성 및 열적 안정성 등을 만족시킬 수 있으며, 치환기에 따라 유기 발광 소자에서 요구되는 다양한 역할을 할 수 있는 화학 구조를 갖는 플루오렌 유도체를 포함하는 유기 발광 소자를 제공하는 것을 목적으로 한다.

발명의 구성 및 작용

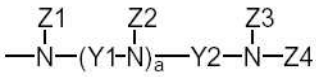
본 발명은 제 1 전극, 발광층, 1층 이상의 유기물층 및 제 2 전극을 적층된 형태로 포함하는 유기 발광 소자에 있어서, 상기 유기물층 중 1층 이상이 하기 화학식 1의 화합물, 또는 이 화합물에 열 경화성 또는 광경화성 작용기가 도입된 화합물을 포함하는 유기 발광 소자를 제공한다.

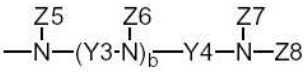
화학식 1



상기 화학식 1에 있어서,

X는 C 또는 Si이고,

A는  이고

B는  이며,

a 및 b는 0 또는 1 이상의 정수이고,

Y는 결합이거나 2가 방향족 탄화수소; 니트로, 니트릴, 할로겐, 알킬기, 알콕시기 및 아미노기로 이루어진 군으로부터 선택되는 1개 이상의 치환기로 치환된 2가 방향족 탄화수소; 2가 헤테로 고리기; 또는 니트로, 니트릴, 할로겐, 알킬기, 알콕시기 및 아미노기로 이루어진 군으로부터 선택되는 1개 이상의 치환기로 치환된 2가 헤테로 고리기이고,

Y1 내지 Y4는 각각 독립적으로 2가 방향족 탄화수소; 니트로, 니트릴, 할로겐, 알킬기, 알콕시기 및 아미노기로 이루어진 군으로부터 선택되는 1개 이상의 치환기로 치환된 2가 방향족 탄화수소; 2가 헤테로 고리기; 또는 니트로, 니트릴, 할로겐, 알킬기, 알콕시기 및 아미노기로 이루어진 군으로부터 선택되는 1개 이상의 치환기로 치환된 2가 헤테로 고리기이고,

Z1 내지 Z8는 각각 독립적으로 수소; 탄소수 1-20의 지방족 탄화수소; 방향족 탄화수소; 니트로, 니트릴, 할로겐, 알킬기, 알콕시기, 아미노기, 방향족 탄화수소 및 헤테로 고리기로 이루어진 군으로부터 선택되는 1개 이상의 치환기로 치환된 방

항족 탄화수소; 방향족 탄화수소로 치환된 실리콘기; 헤테로고리기; 니트로, 니트릴, 할로겐, 알킬기, 알콕시기, 아미노기, 방향족 탄화수소 및 헤테로 고리기로 이루어진 군으로부터 선택되는 1개 이상의 치환기로 치환된 헤테로고리기; 탄소수 1-20의 탄화수소 또는 탄소수 6-20의 방향족 탄화수소로 치환된 티오펜기; 또는 방향족 탄화수소로 치환된 붕소기이고,

R1 내지 R4 및 R6 내지 R9은 각각 독립적으로 수소, 치환 또는 비치환된 알킬기, 치환 또는 비치환된 알콕시기, 치환 또는 비치환된 알케닐기, 치환 또는 비치환된 아릴기, 치환 또는 비치환된 아릴 아민기, 치환 또는 비치환된 헤테로 고리기, 아미노기, 니트릴기, 니트로기, 할로겐기, 아미드기, 에스테르기로 이루어진 군에서 선택되며, 여기서 이들은 서로 인접하는 기와 지방족 또는 헤테로의 축합 고리를 형성할 수 있고,

R5는 수소, 치환 또는 비치환된 알킬기, 치환 또는 비 치환된 사이클로알킬기, 치환 또는 비치환된 알케닐기, 치환 또는 비치환된 아릴기 또는 치환 또는 비치환된 헤테로 고리기로 이루어진 군에서 선택되며,

여기서, R5가 아릴기 또는 헤테로 고리기인 경우, 아릴 또는 헤테로 고리기의 오르소(ortho) 위치의 탄소와 R4 또는 R6는 O, S, NR, PR, C=O, CRR', SiRR'로 이루어진 군에서 선택되는 기와 함께 축합고리를 형성할 수 있으며, 여기서 R 및 R'는 각각 독립적으로 수소, 치환 또는 비치환된 알킬기, 치환 또는 비치환된 알콕시기, 치환 또는 비치환된 알케닐기, 치환 또는 비치환된 아릴기, 치환 또는 비치환된 아릴 아민기, 치환 또는 비치환된 헤테로 고리기, 니트릴기, 아미드기, 에스테르기로 이루어진 군에서 선택되고, 여기서 R과 R'는 축합고리를 형성하여 스피로 화합물을 형성할 수 있다.

상기 화학식 1의 치환기를 상세히 설명하면 다음과 같다.

상기 화학식 1의 치환기인 Z1 내지 Z8에 있어서, 상기 방향족 화합물의 예로는 페닐, 비페닐, 터페닐 등의 단환식 방향족환 및 나프틸, 안트라세닐, 파이레닐, 페릴레닐등의 다환식 방향족환 등을 들 수 있다. 상기 헤테로 방향족 화합물의 예로는 티오펜, 퓨란, 피롤, 이미다졸, 티아졸, 옥사졸, 옥사디아졸, 티아디아졸, 트리아졸, 피리딜, 피리다질, 피라진, 퀴놀린, 이소퀴놀린 등이 있다.

상기 탄소수 1내지 20의 지방족 탄화수소는 직쇄 지방족 탄화수소와 분지쇄 지방족 탄화수소, 포화 지방족 탄화수소와 불포화 지방족 탄화수소를 모두 포함하며, 이들의 예로는 메틸기, 에틸기, 노말-프로필기, 이소-프로필기, 노말-부틸기, sec-부틸기, 이소-부틸기, 터-부틸기, 펜틸기, 헥실기 등의 알킬기; 스티릴과 같은 이중결합을 갖는 알케닐기; 및 아세틸렌기와 같은 삼중결합을 갖는 알키닐기가 있다.

상기 화학식 1의 R1 내지 R9 중 알킬기, 알콕시기, 알케닐기는 탄소수는 특별히 한정되지 않으나 1-20인 것이 바람직하다.

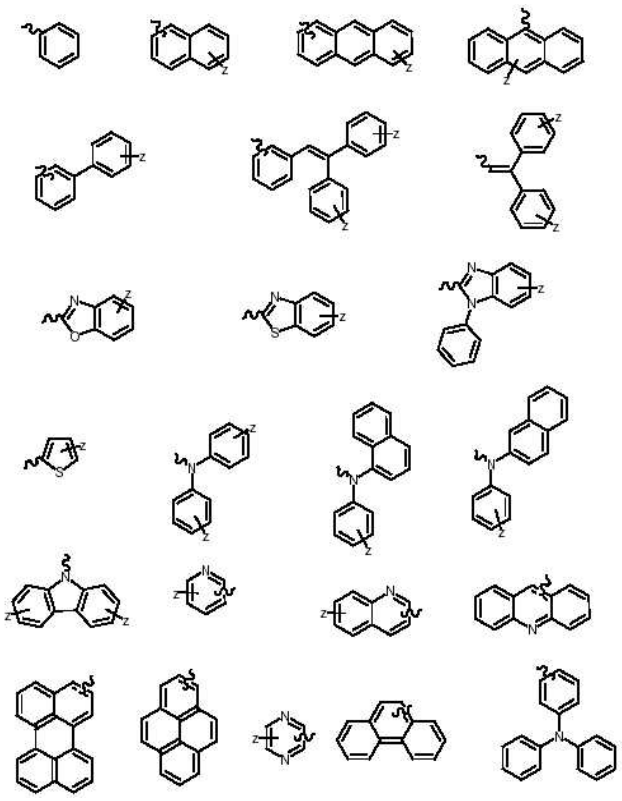
화합물 중에 포함 되어 있는 알킬기의 길이는 화합물의 공액 길이에는 영향을 미치지 않고, 다만 부수적으로 화합물의 유기 발광 소자에의 적용 방법, 예컨대 진공증착법 또는 용액도포법의 적용에 영향을 미칠 수 있다.

상기 화학식 1의 R1 내지 R9 중 아릴기의 예로는 페닐기, 비페닐기, 터페닐기, 스틸벤 등의 단환식 방향족 및 나프틸기, 안트라세닐기, 페나트렌기, 파이레닐기, 페릴레닐기등의 다환식 방향족환등이 있으나, 이들에만 한정되는 것은 아니다.

상기 화학식 1의 R1 내지 R9 중 아릴 아민기의 예로는 디페닐 아민기, 디나프틸 아민기, 디비페닐 아민기, 페닐 나프틸 아민기, 페닐 디페틸 아민기, 디톨릴 아민기, 페닐 톨릴 아민기, 카바졸기, 트리페닐 아민기 등이 있으나, 이들에만 한정되는 것은 아니다.

상기 화학식 1의 R1 내지 R9 중 헤테로 고리기의 예로는 티오펜기, 퓨란기, 피롤기, 이미다졸기, 티아졸기, 옥사졸기, 옥사디아졸기, 트리아졸기, 피리딜기, 피라다진기, 퀴놀리닐기, 이소퀴톨린기, 아크리딜기 등이 있으나, 이들에만 한정되는 것은 아니다.

상기 예들 이외에, 상기 화학식 1의 R1 내지 R9 중 알케닐기, 아릴기, 아릴 아민기, 헤테로 고리기의 구체적인 예로는 하기 화학식들로 나타낸 예들이 있으나, 이들에만 한정되는 것은 아니다.



상기 화학식에 있어서, Z는 수소, 탄소수 1 내지 20의 지방족 탄화 수소, 알콕시기, 아릴아민기, 아릴기, 헤테로 고리기, 니트릴기, 아세틸렌기 등으로 이루어진 군에서 선택되는 기이다. 상기 Z 중 아릴아민기, 아릴기, 헤테로 고리기의 구체적인 예로는 전술한 R1 내지 R9의 치환기에 기재한 예들이 있다.

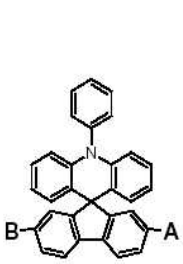
본 발명의 하나의 바람직한 실시 상태에 있어서, 상기 화학식 1 중 R5가 아릴기 또는 헤테로 고리기이다.

본 발명의 또 하나의 바람직한 실시 상태에 있어서, 상기 화학식 1 중 R5가 아릴기 또는 헤테로 고리기이며, 상기 아릴 또는 헤테로 고리기의 오르소(ortho) 위치의 탄소와 R4 또는 R6는 O, S, NR, PR, C=O, CRR', SiRR' (여기서, R 및 R'는 화학식 1에서 정의한 바와 같다)로 이루어진 군에서 선택되는 기와 함께 축합고리를 형성할 수 있다.

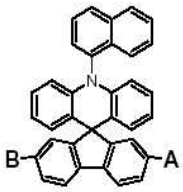
본 발명의 또 하나의 바람직한 실시 상태에 있어서, 상기 화학식 1 중 R5가 아릴기 또는 헤테로 고리기이며, 상기 아릴 또는 헤테로 고리기의 오르소(ortho) 위치의 탄소와 R4 및 상기 아릴 또는 헤테로 고리기의 오르소(ortho) 위치의 탄소와 R6는 O, S, NR, PR, C=O, CRR', SiRR' (여기서, R 및 R'는 화학식 1에서 정의한 바와 같다)로 이루어진 군에서 선택되는 기와 함께 축합고리를 형성할 수 있다.

본 발명의 바람직한 실시상태에 있어서, 상기 화학식 1의 화합물의 예로 하기 화학식 2 내지 화학식 119의 화합물이 있다. 그러나, 하기 화학식의 화합물들은 본 발명의 이해를 돕기 위한 것이며, 이들에 의하여 본 발명의 범위가 한정되는 것은 아니다.

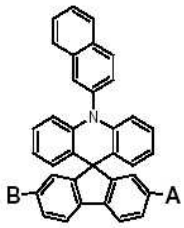
[화학식 2 내지 화학식 119]



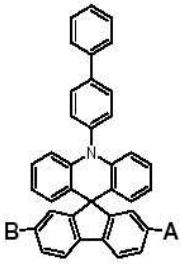
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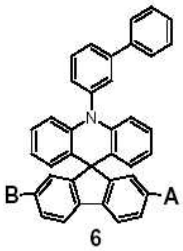
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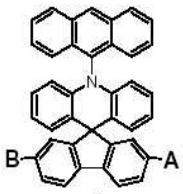
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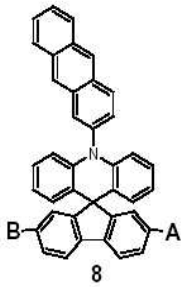
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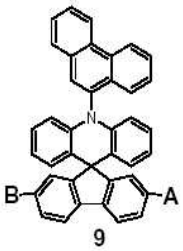
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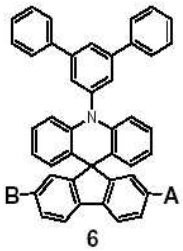
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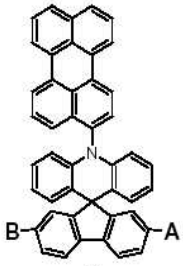
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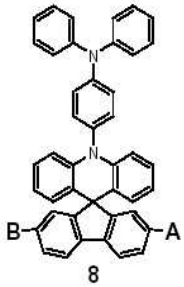
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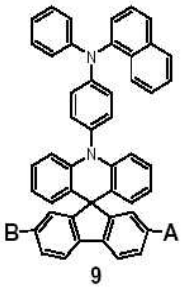
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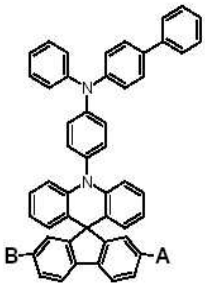
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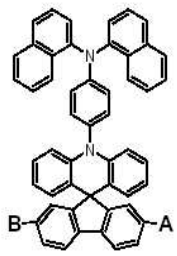
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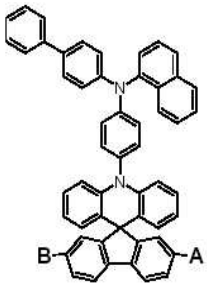
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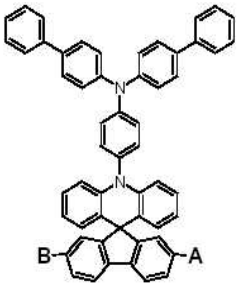
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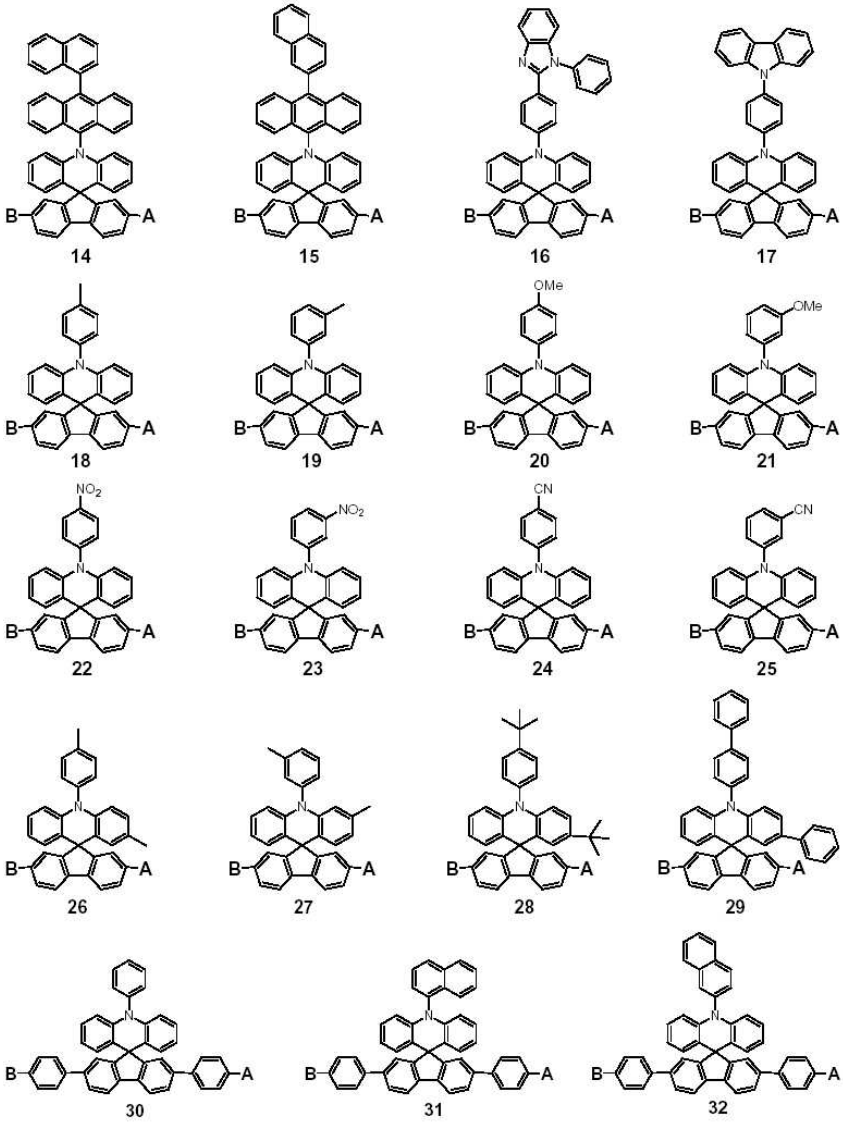
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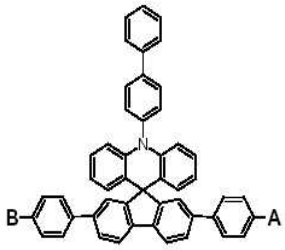


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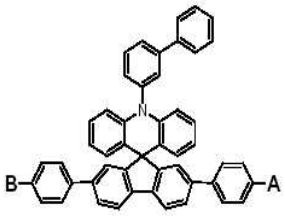


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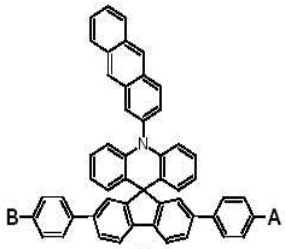
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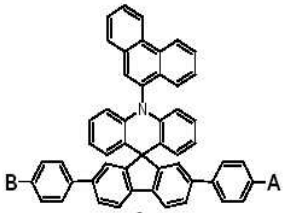
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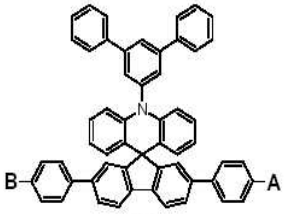
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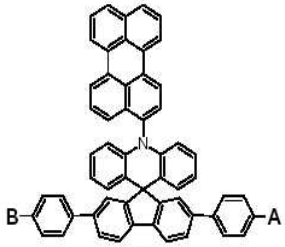
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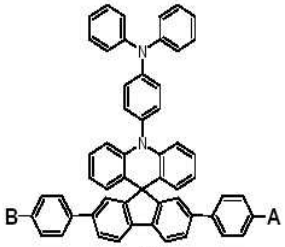
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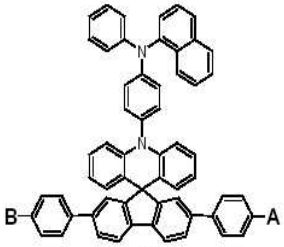
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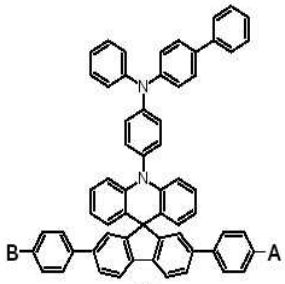
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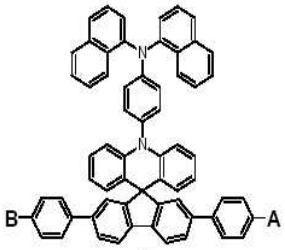
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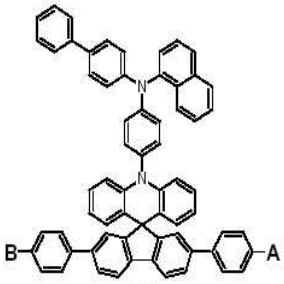
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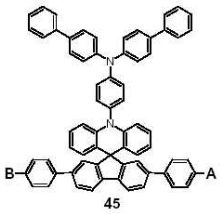
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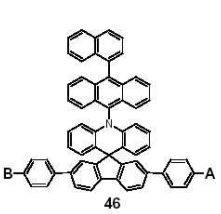
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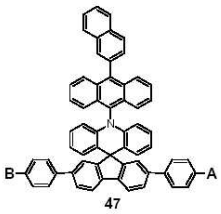
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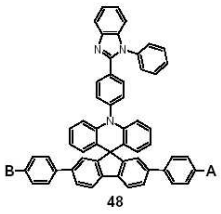
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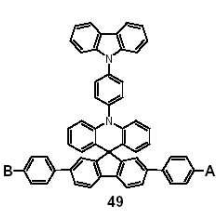
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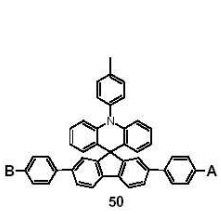
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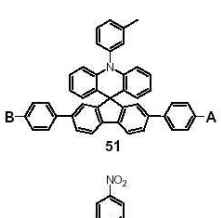
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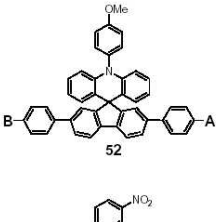
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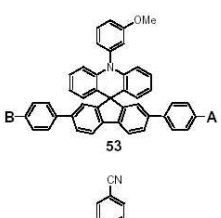
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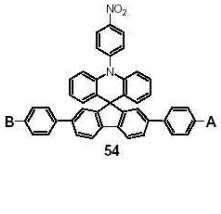
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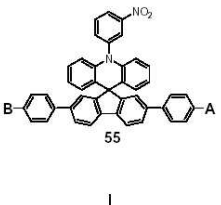
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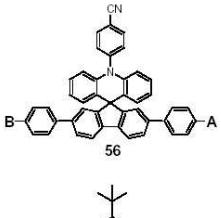
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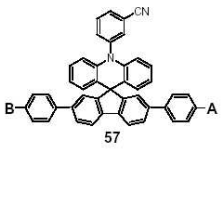
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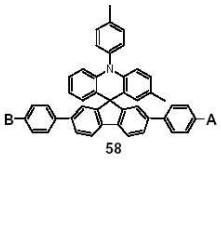
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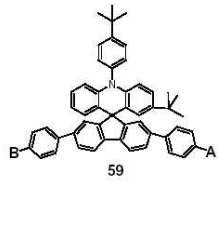
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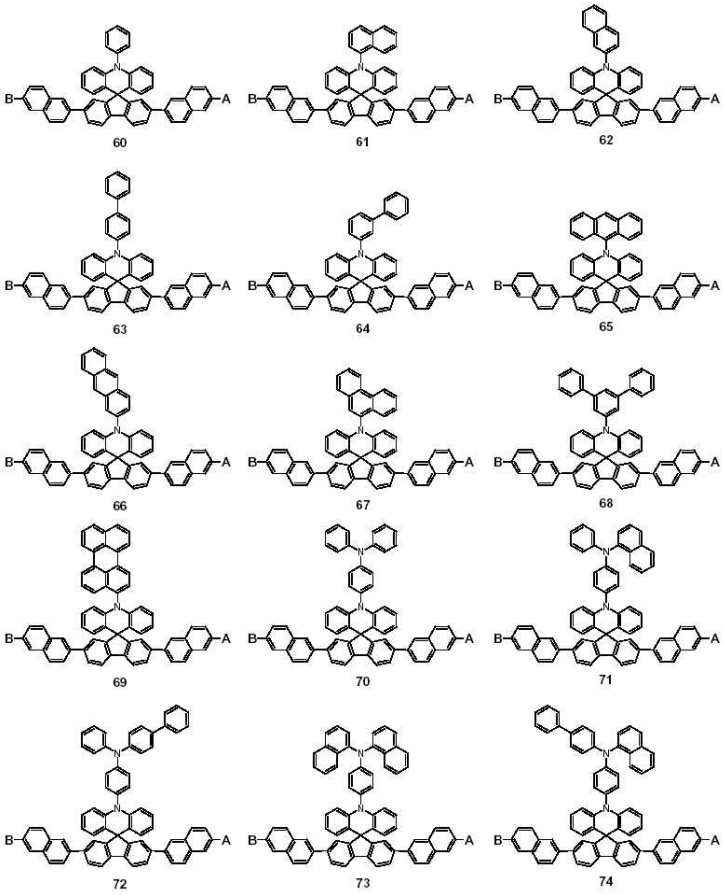
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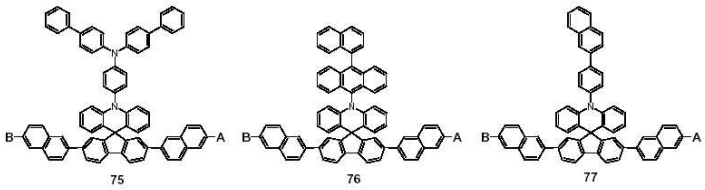


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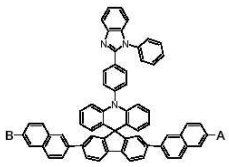
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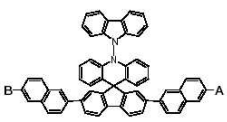

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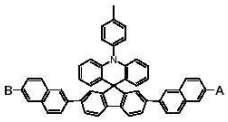

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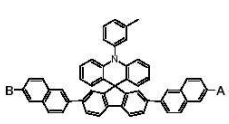
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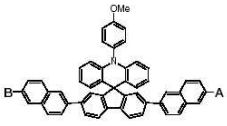
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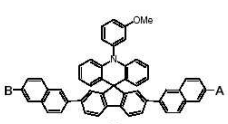

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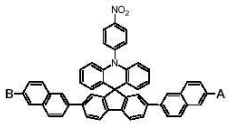

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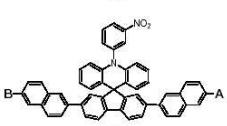

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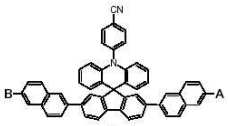

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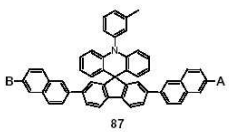

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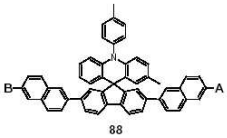

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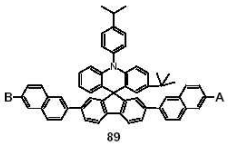

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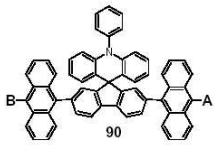

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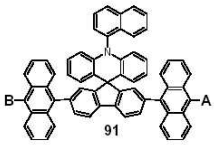

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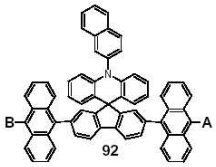

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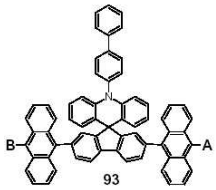

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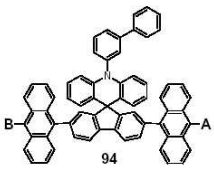

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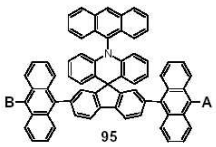

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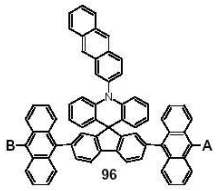

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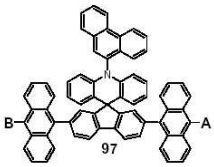

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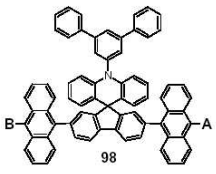

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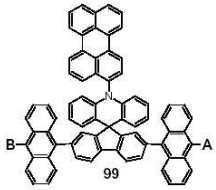

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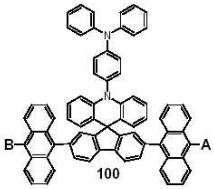

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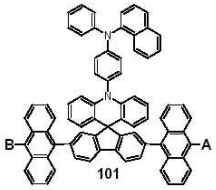

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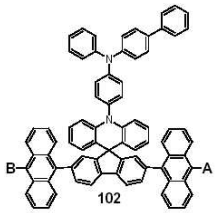

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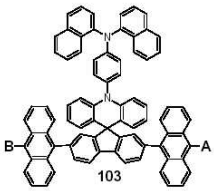

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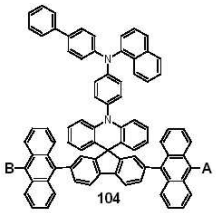

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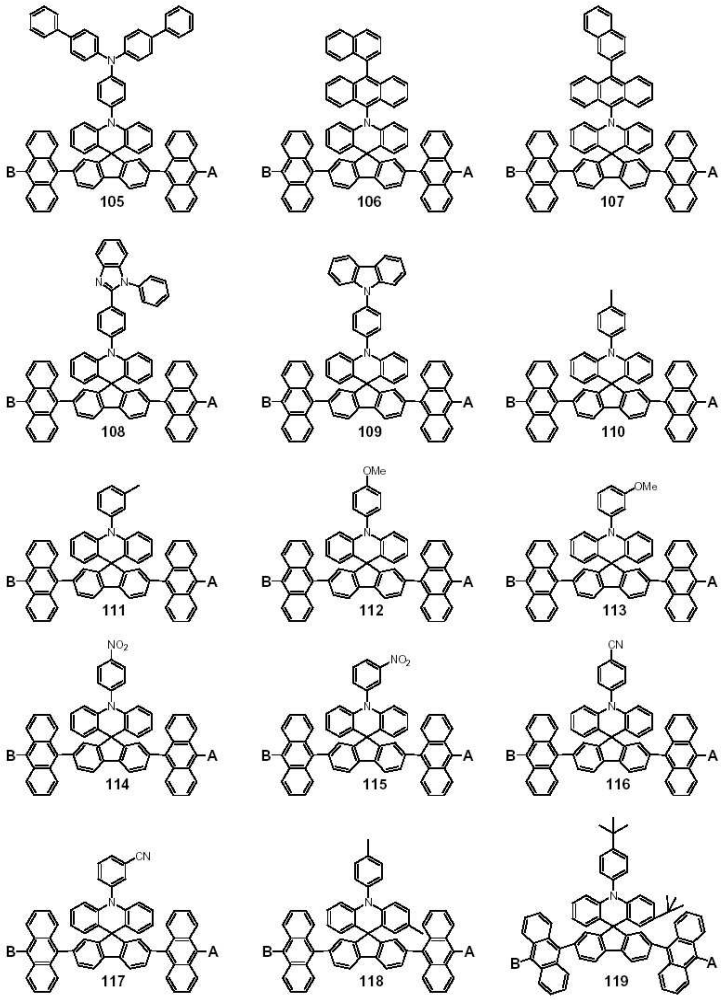

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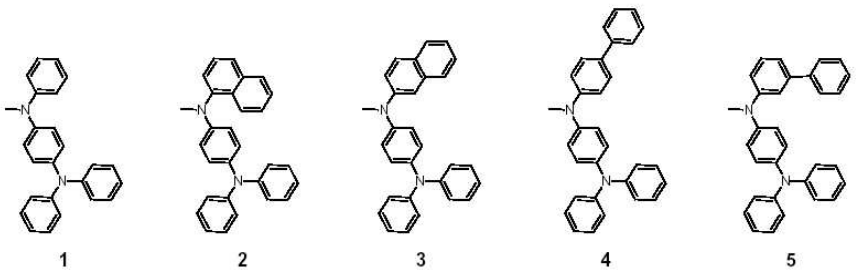


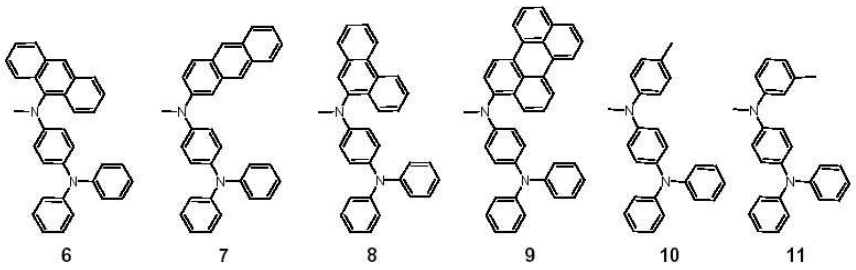
상기 화학식에서 A 및 B는 화학식 1에서 정의된 바와 같다.

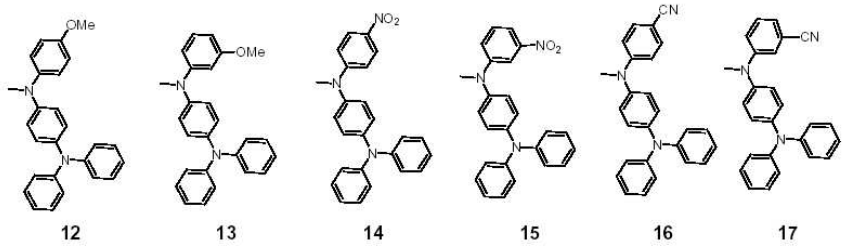
상기 A 또는 B의 바람직한 예는 하기와 같으나 이에 한정되는 것은 아니다.

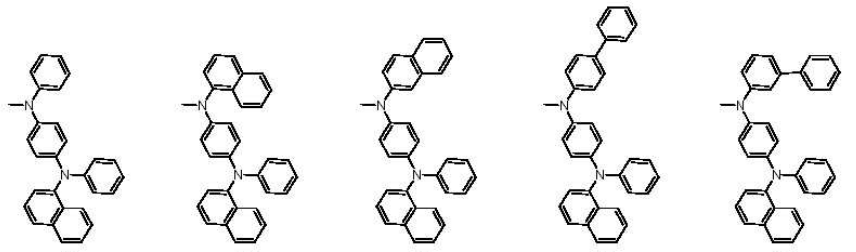
상기 화학식 2 내지 화학식 119와 아래의 치환기 A또는 B의 조합으로 여러 종류의 유도체 화합물을 형성할 수 있다. 예를 들어 화학식 2와 치환기 1이 사용되어진 경우 화합물을 2-1로 칭한다.

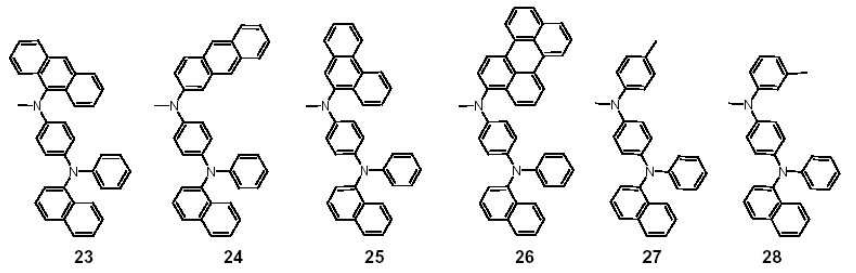
[A 및 B]

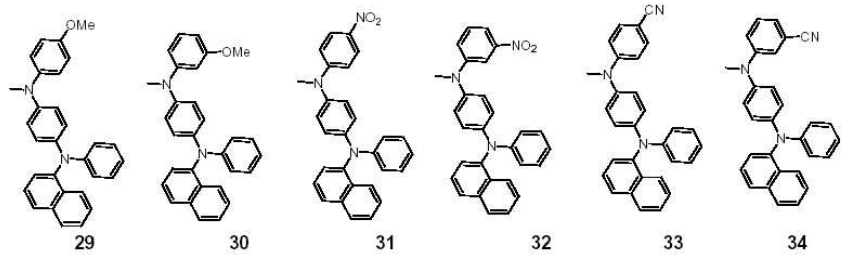

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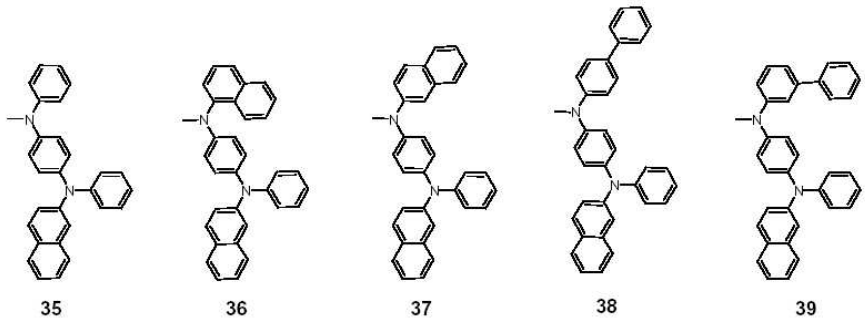

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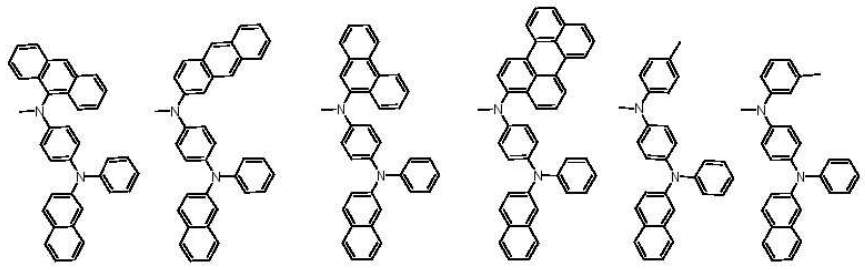

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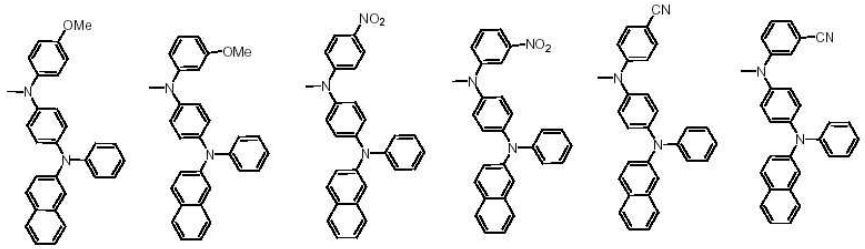

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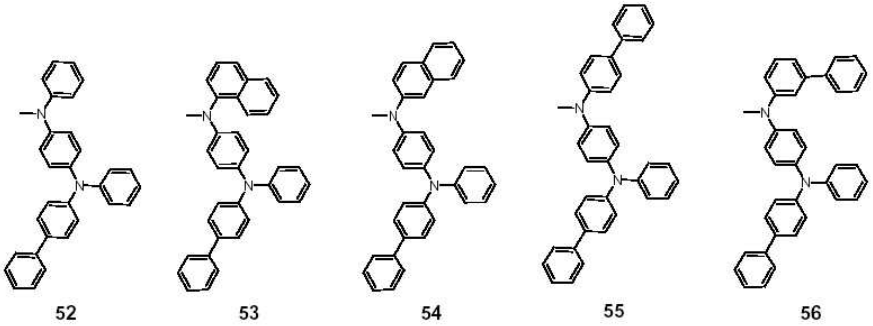
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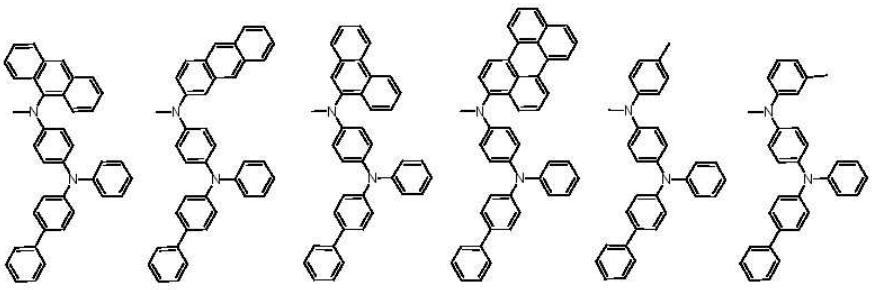
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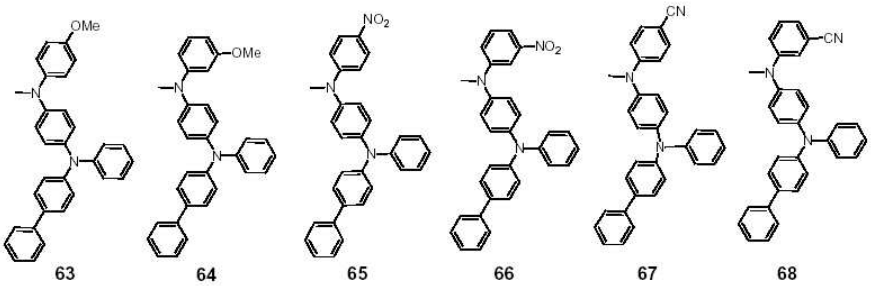
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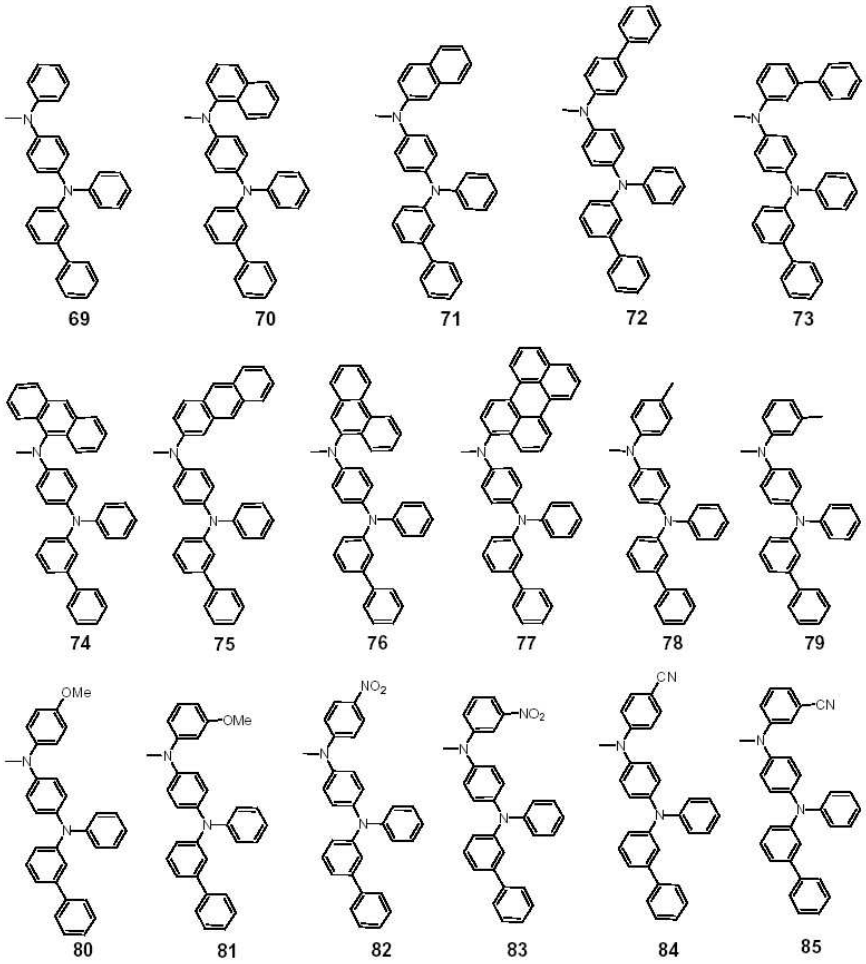
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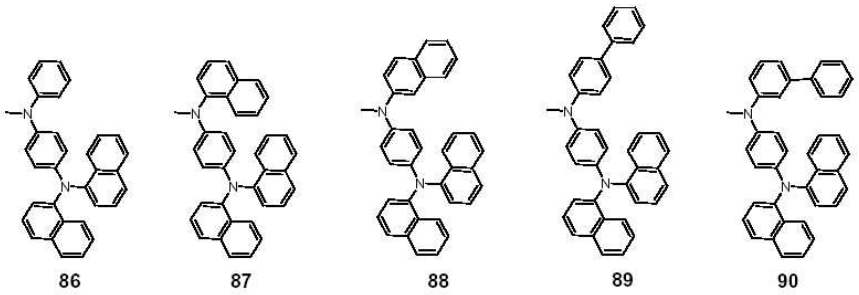


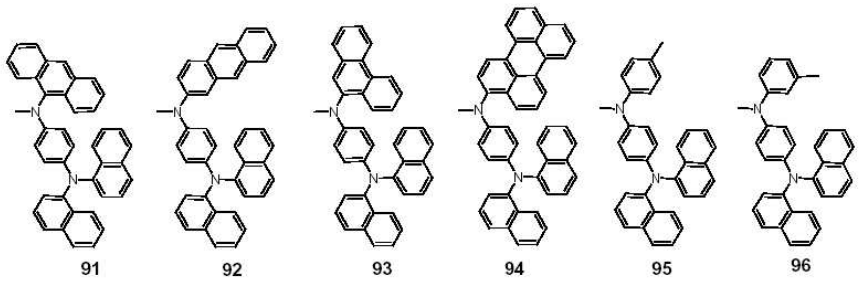
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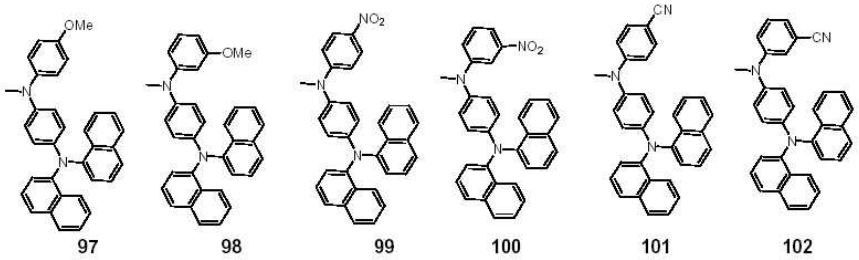


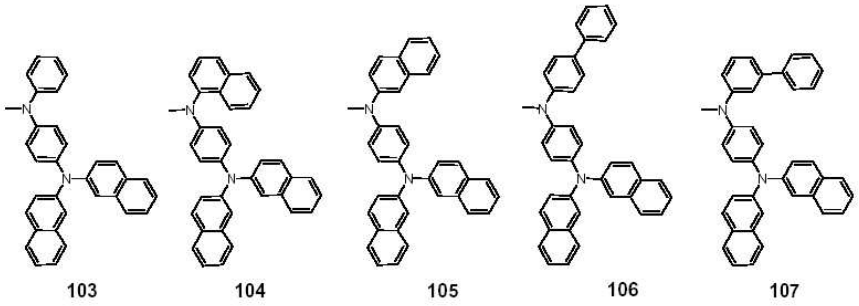
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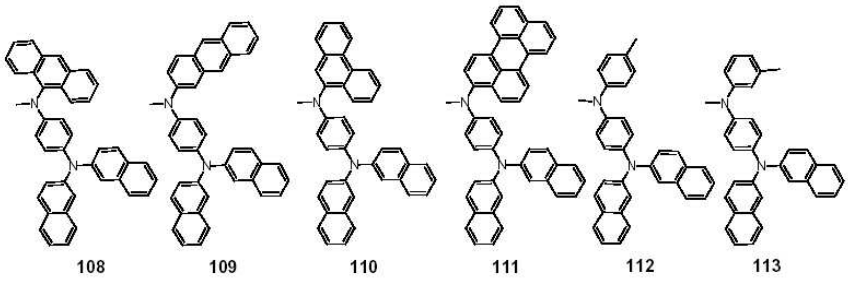

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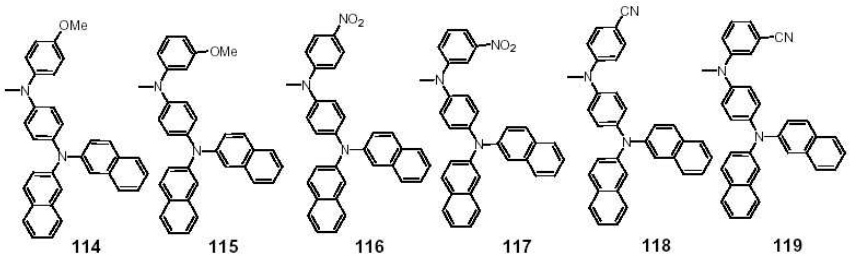

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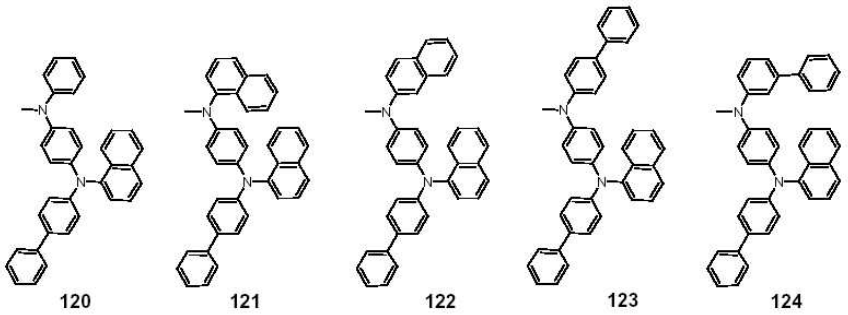

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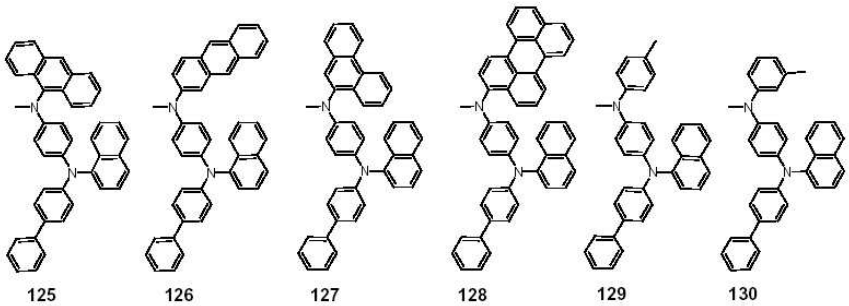
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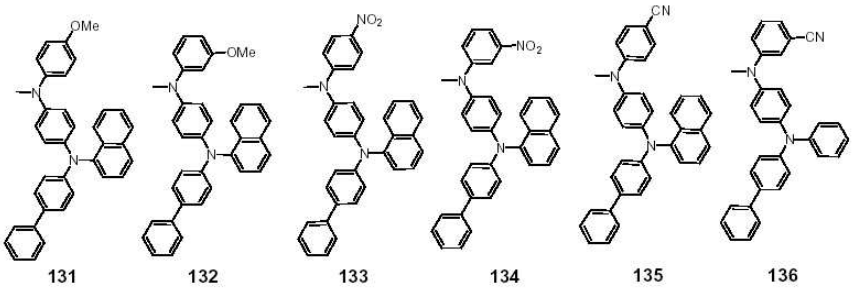
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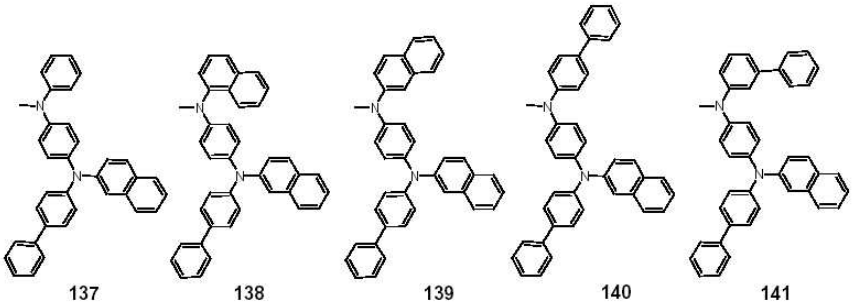
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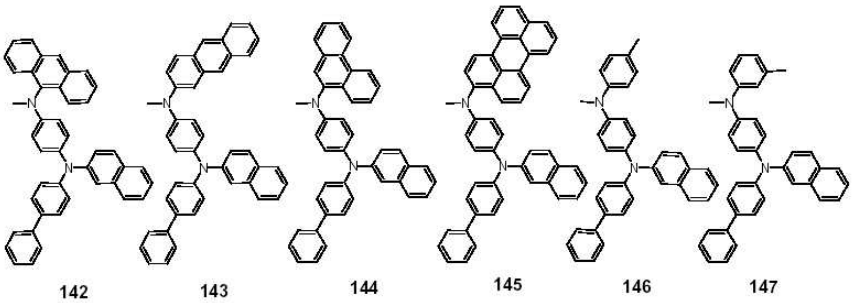
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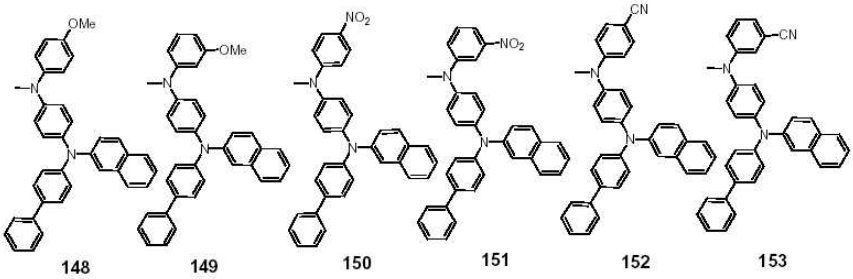
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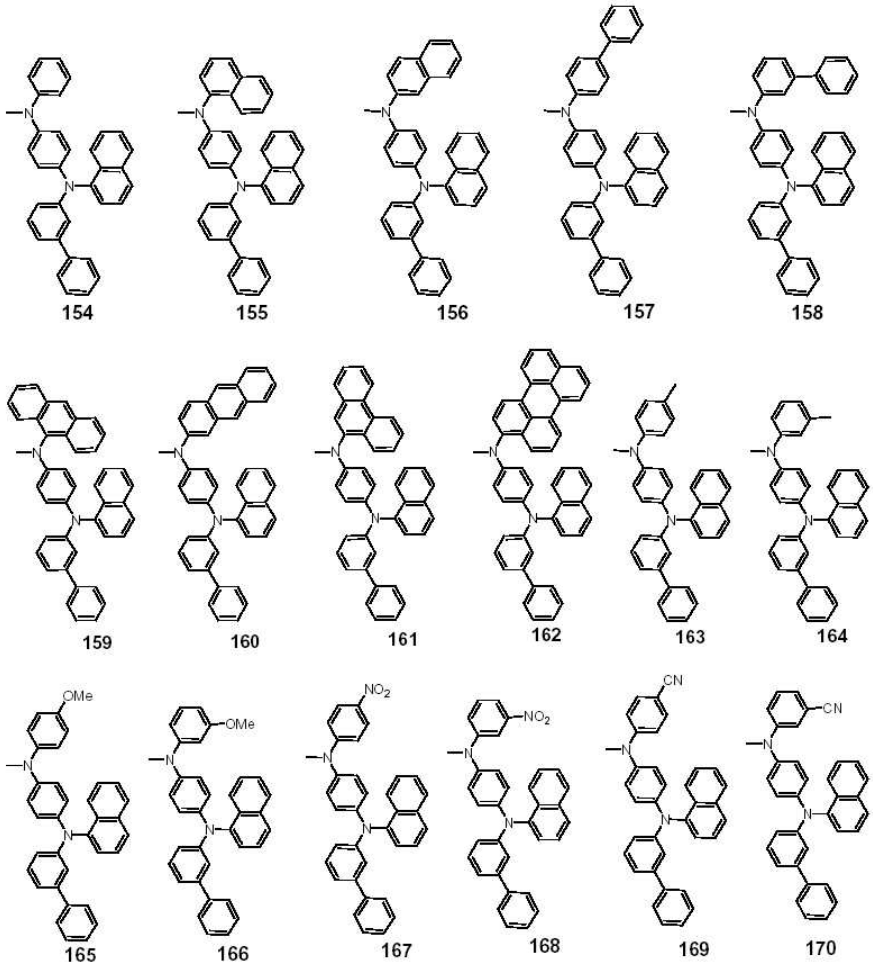
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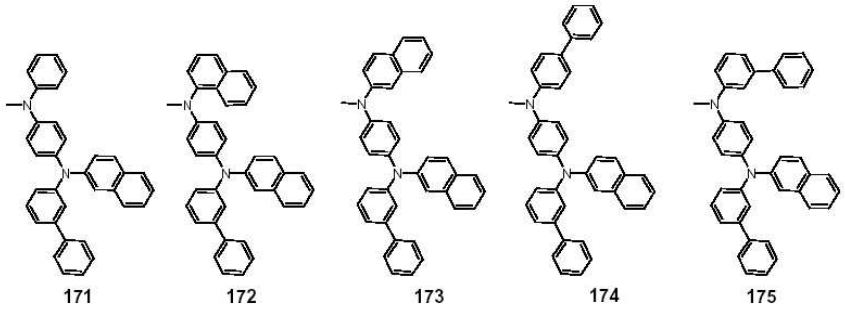


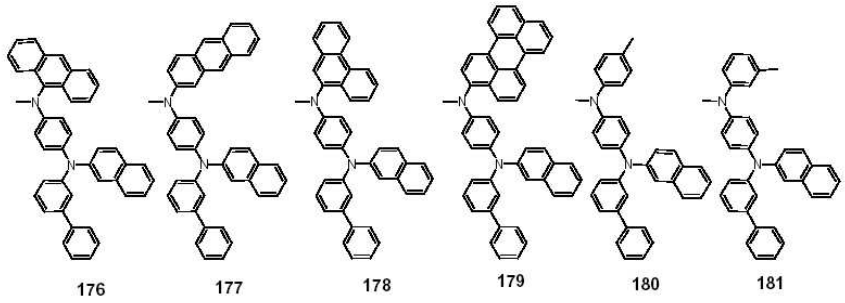
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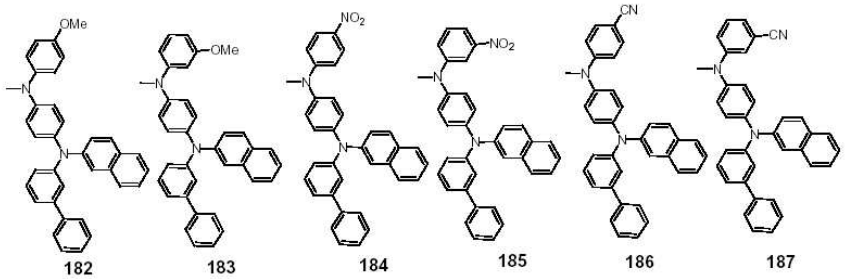


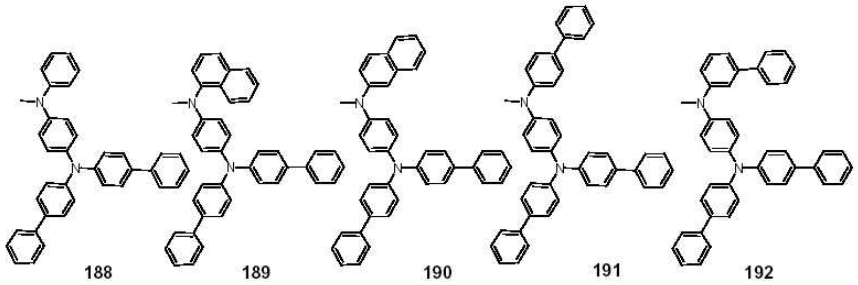
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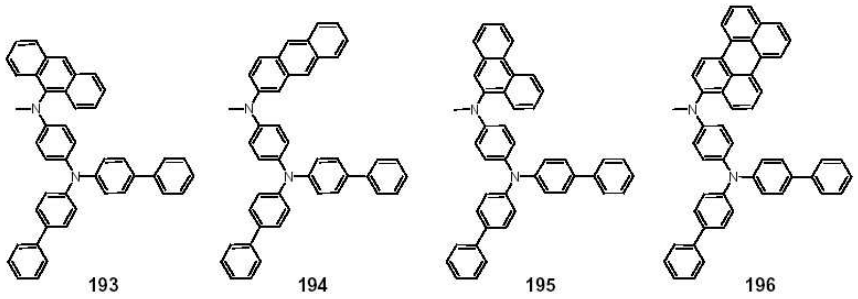

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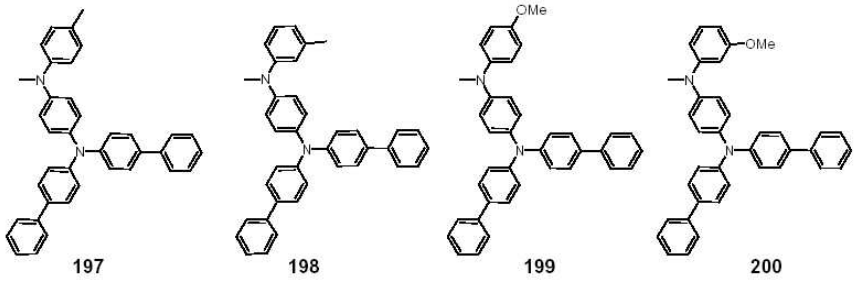

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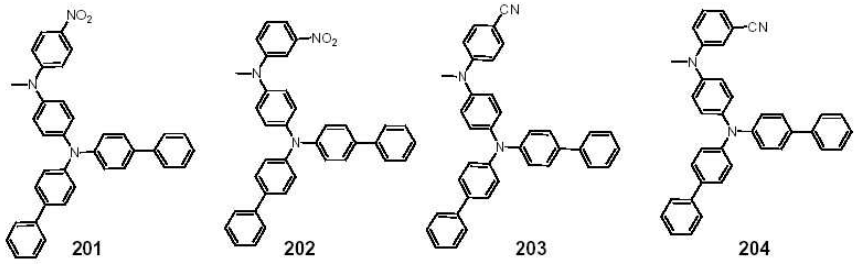

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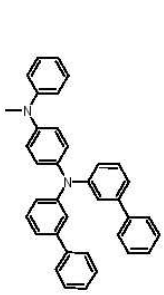

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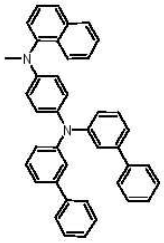
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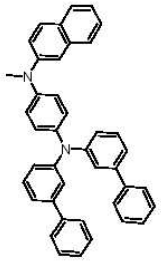
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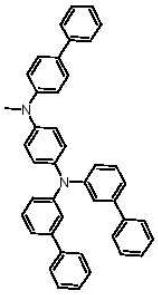
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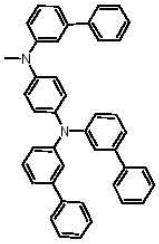
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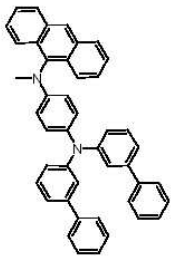
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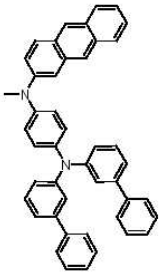
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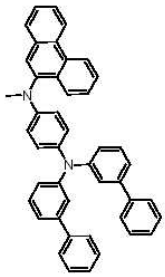
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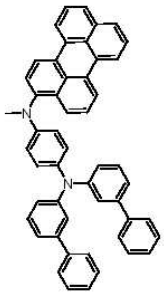
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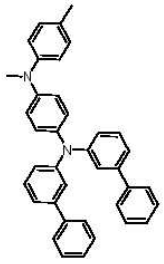
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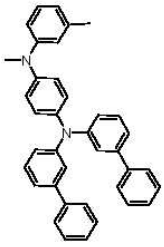
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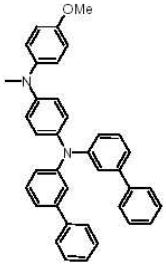
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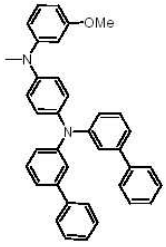
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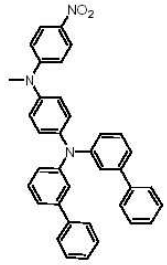
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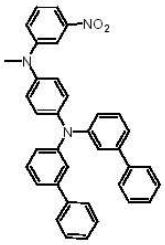
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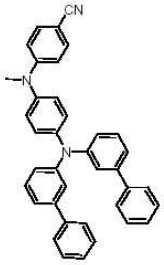
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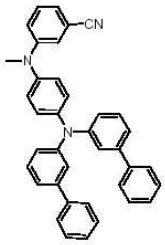
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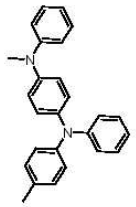
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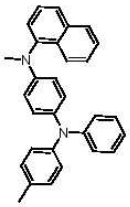
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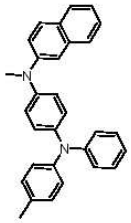
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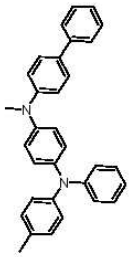
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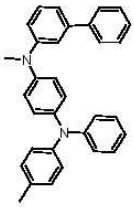
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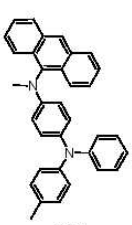
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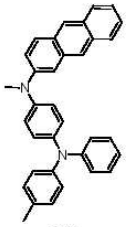
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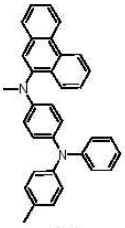
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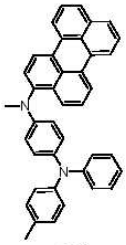
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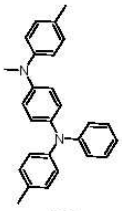
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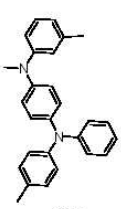
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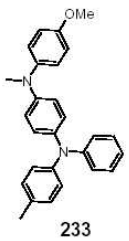
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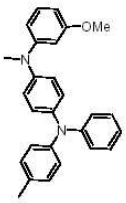
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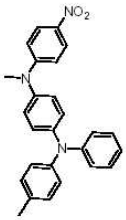
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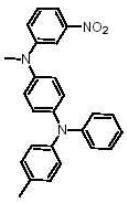
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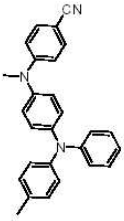
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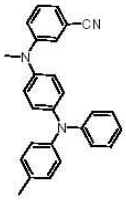
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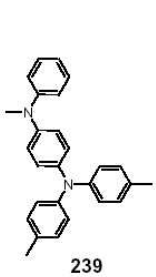
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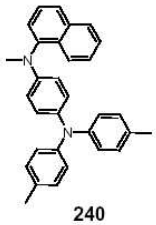


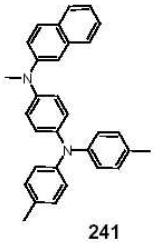
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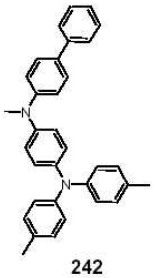


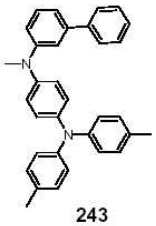
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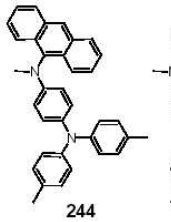

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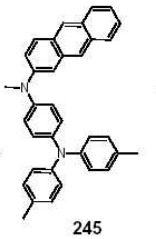

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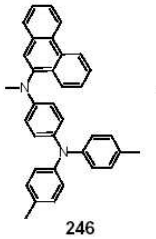

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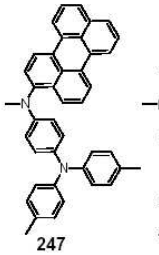

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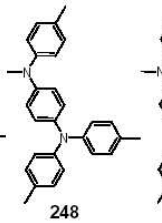

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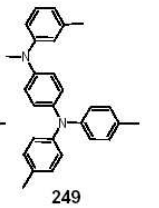

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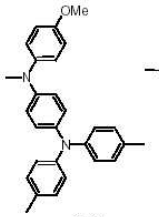

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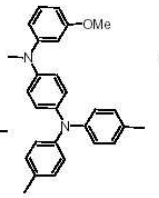

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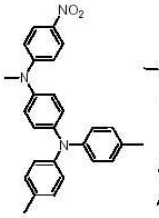

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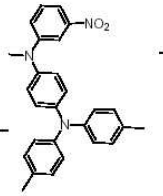

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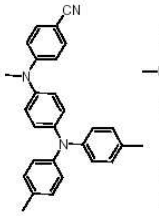

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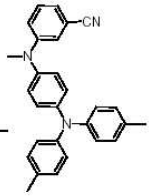

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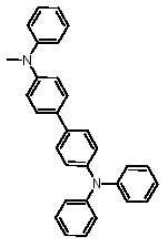

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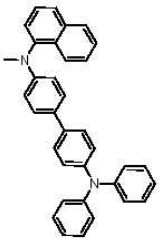

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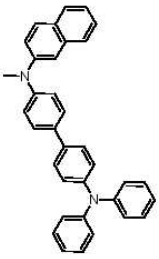

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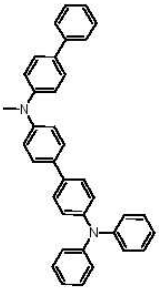

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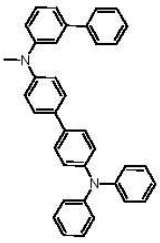

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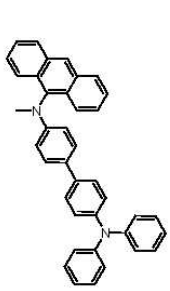

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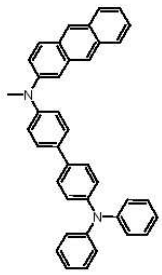

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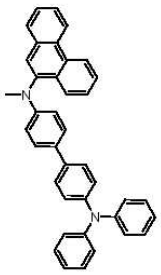

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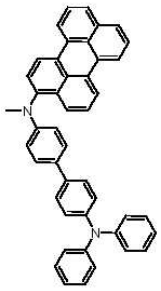
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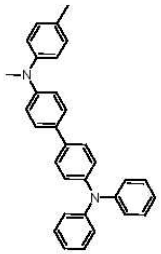
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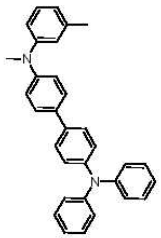
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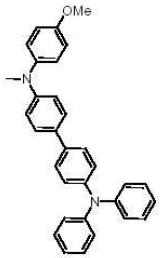
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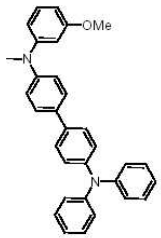
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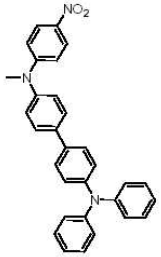
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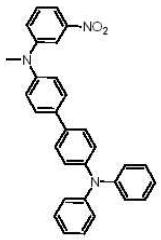
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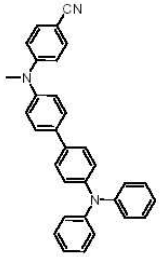
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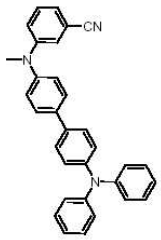
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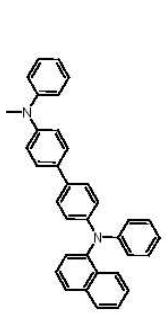
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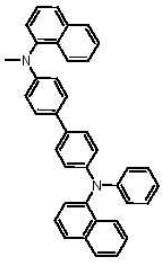
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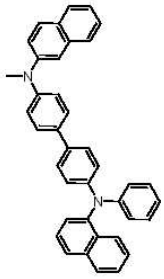
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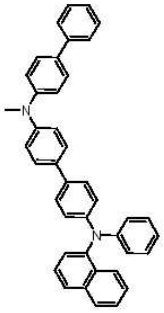
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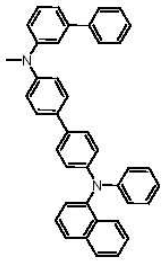
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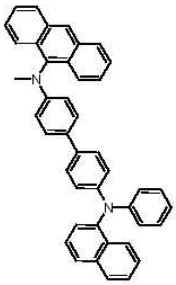
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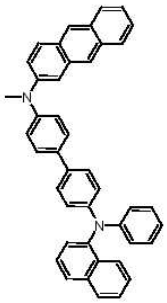
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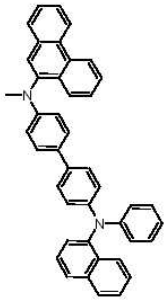
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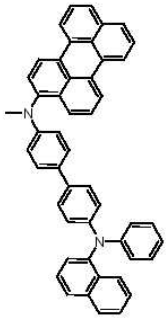
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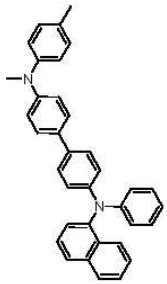
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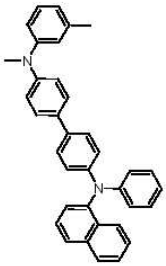
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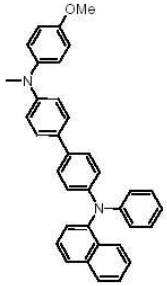
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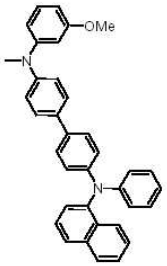
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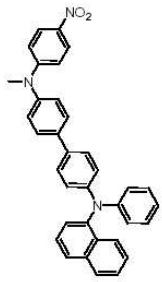
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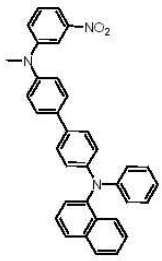
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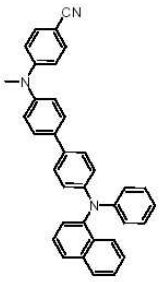
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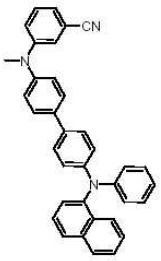
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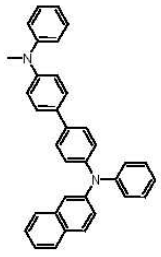
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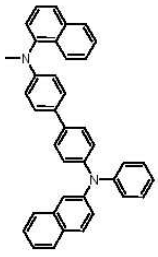
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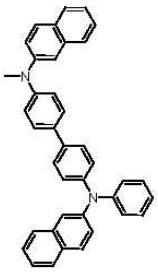
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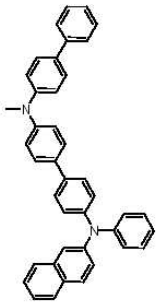
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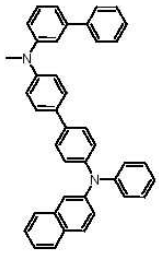
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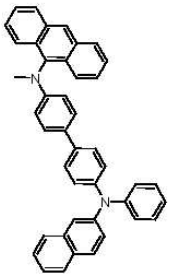
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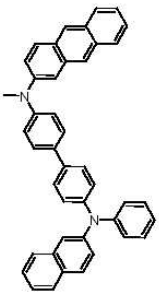
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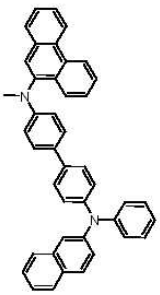
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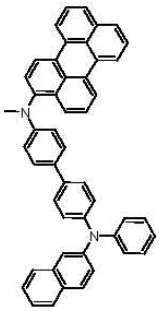
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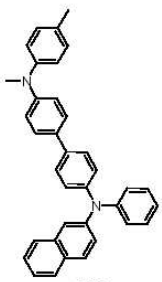
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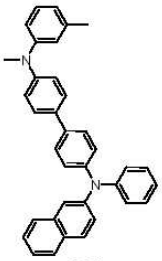
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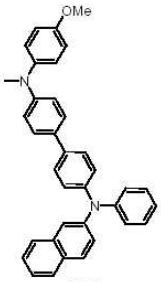
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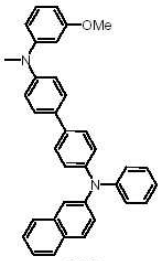
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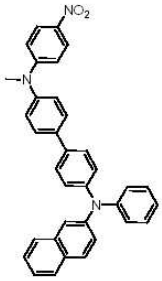
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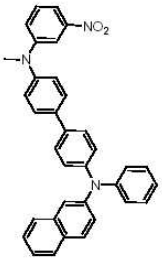
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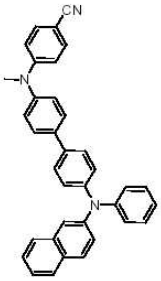
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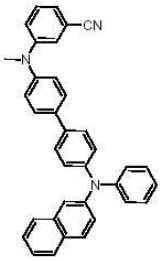
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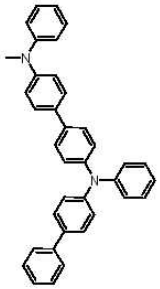
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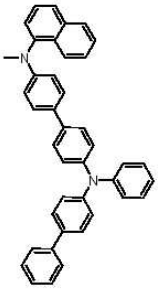
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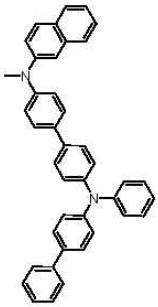
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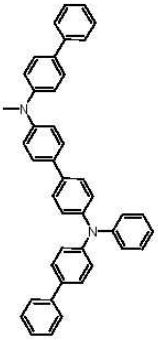
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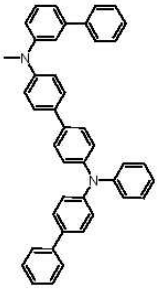
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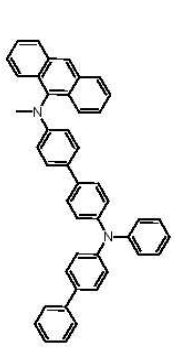
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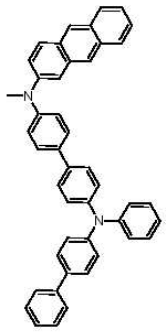
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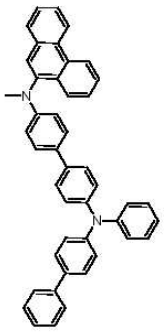
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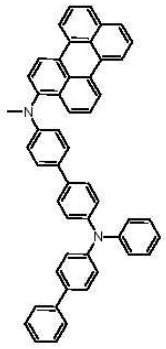
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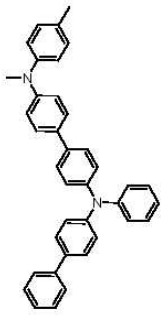
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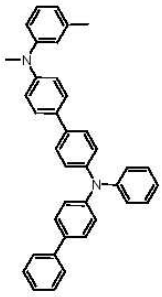
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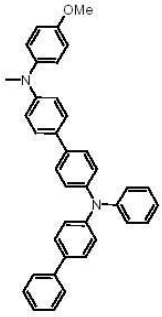
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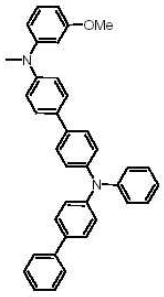
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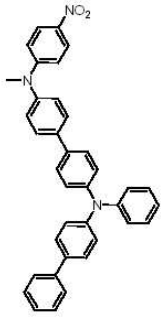
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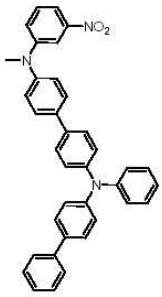
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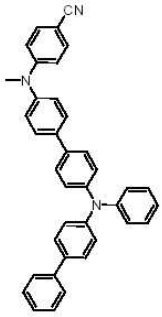
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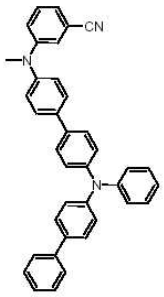
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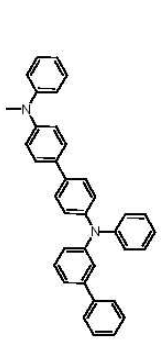
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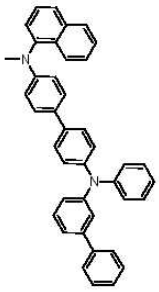
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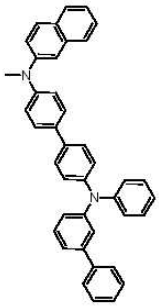
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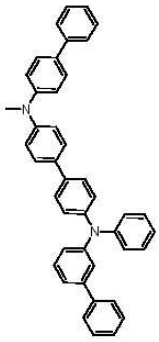
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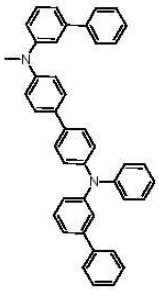
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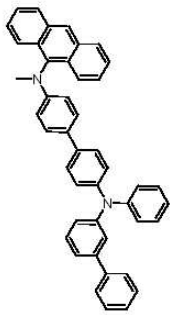
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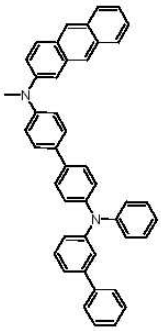
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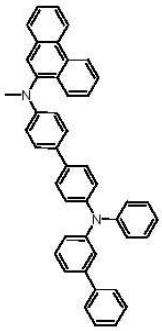
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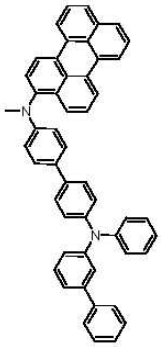
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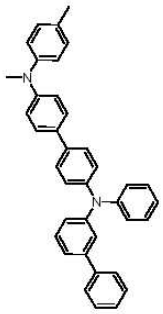
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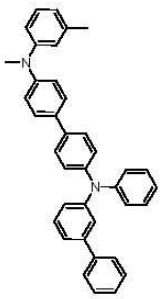
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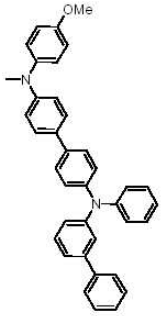
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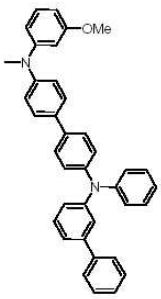
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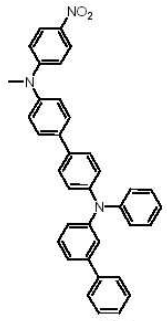
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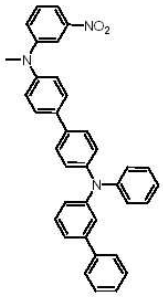


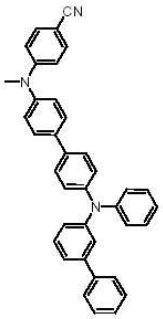
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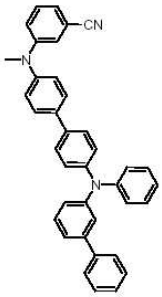


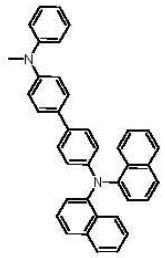
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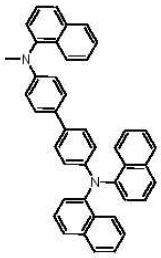

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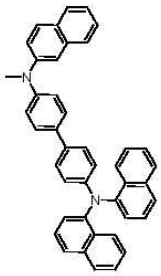

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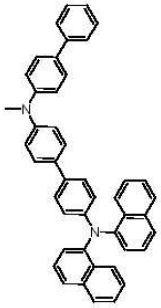

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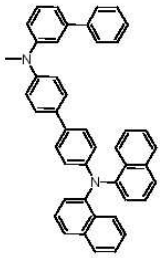

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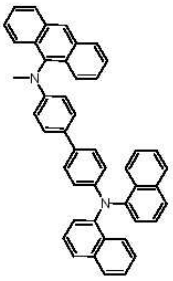

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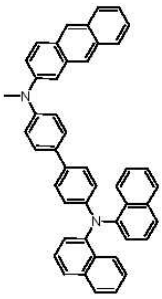

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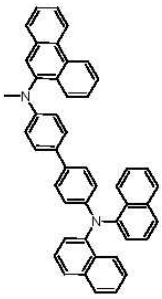

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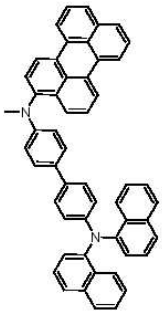

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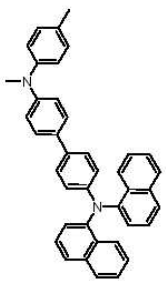

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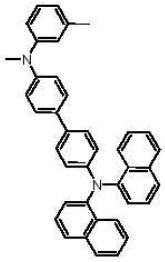

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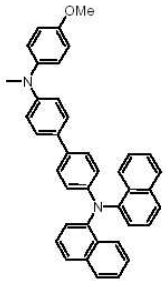

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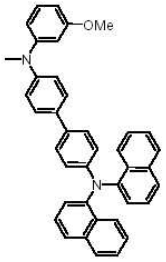
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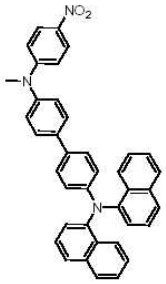
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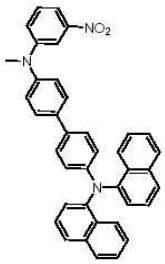
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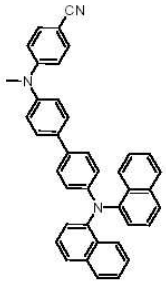
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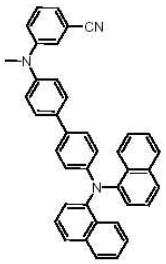
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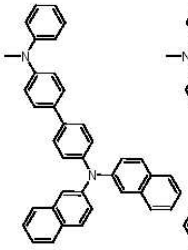
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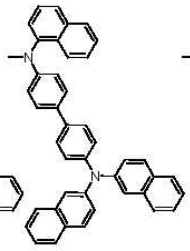
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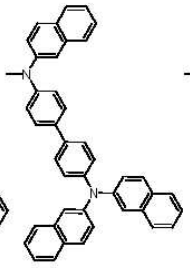
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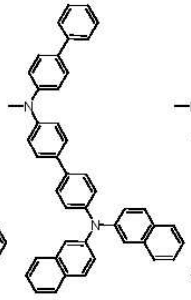
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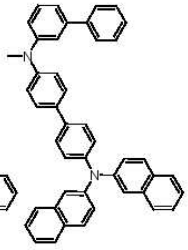
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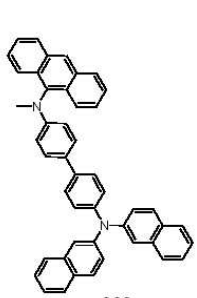
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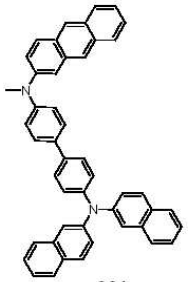
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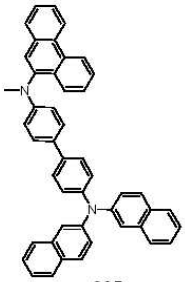
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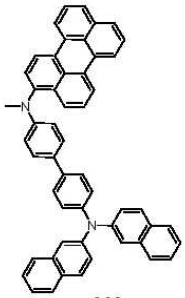
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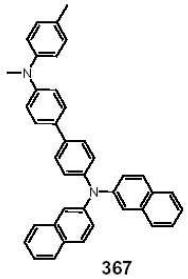
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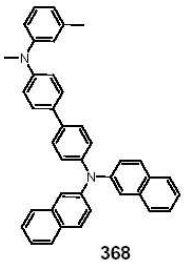
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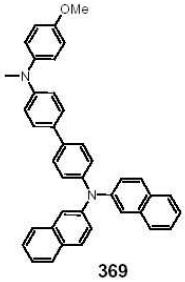
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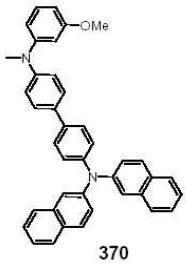
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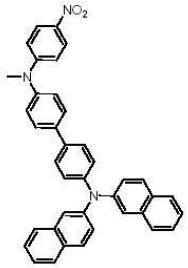
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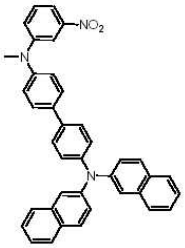
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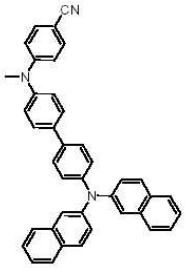
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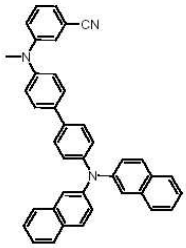
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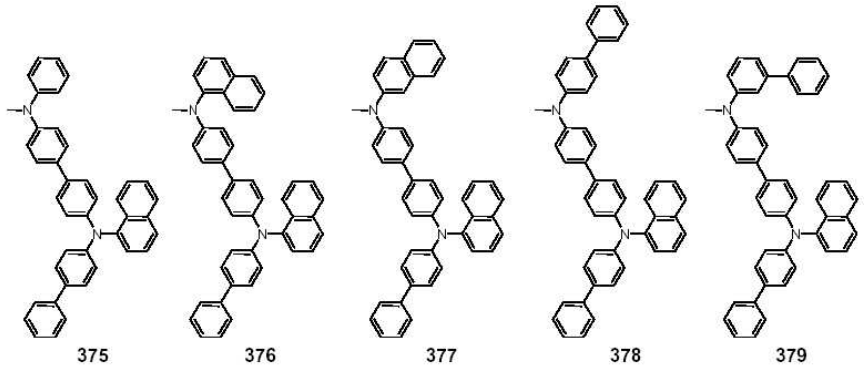
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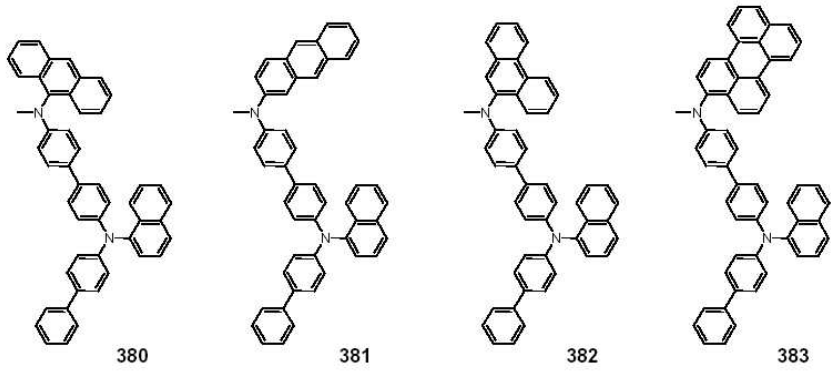
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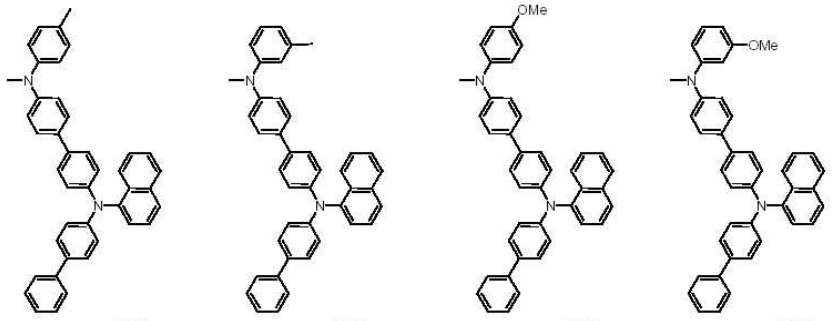
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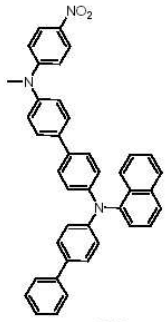
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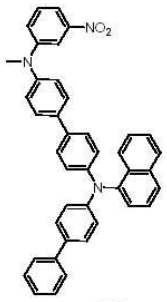


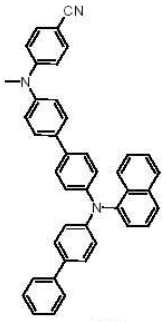
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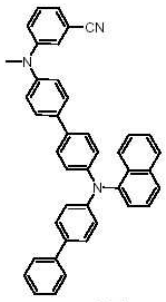


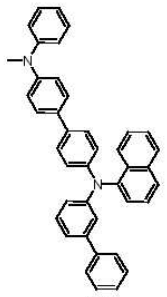
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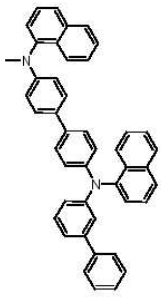

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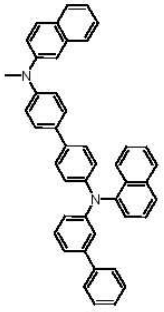

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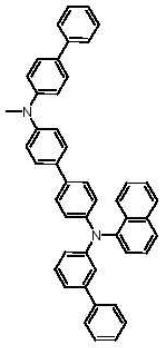

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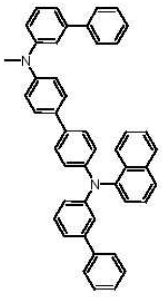

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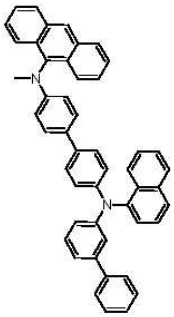

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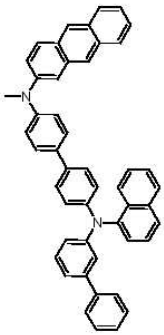

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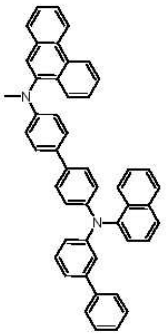

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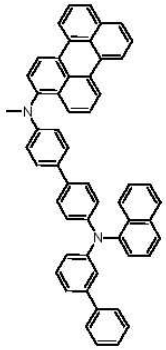

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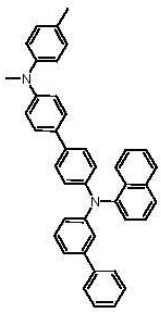

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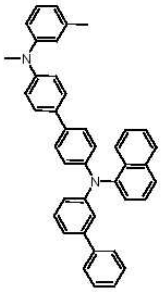

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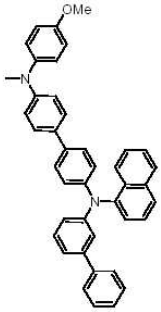

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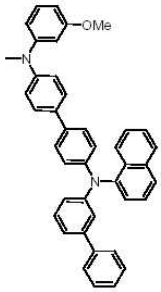
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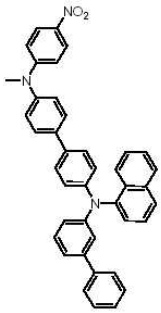
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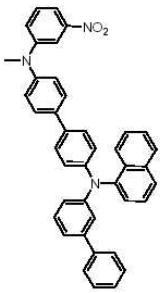
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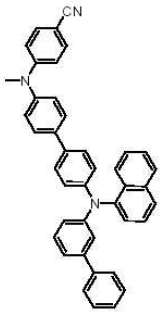
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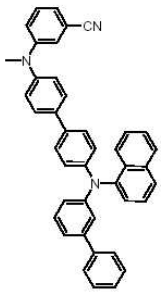
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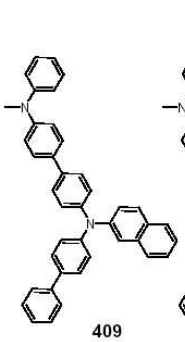
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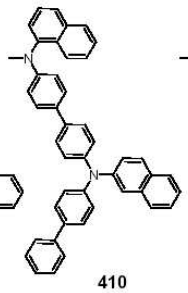
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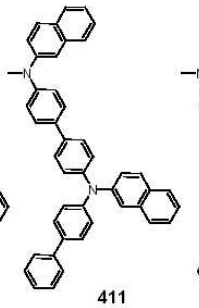
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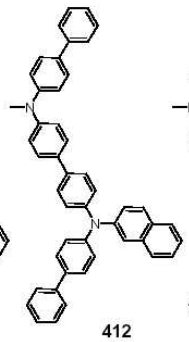
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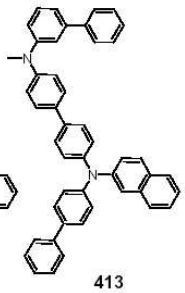
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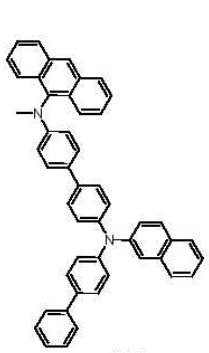
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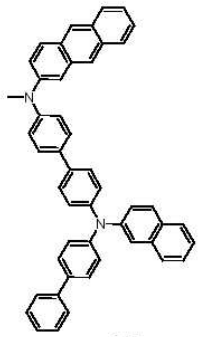
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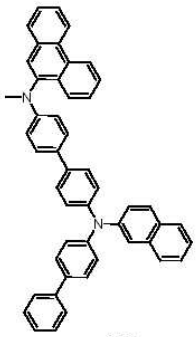
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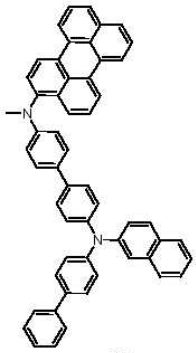
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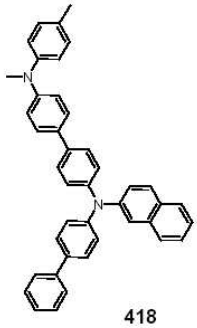
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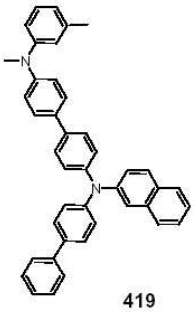
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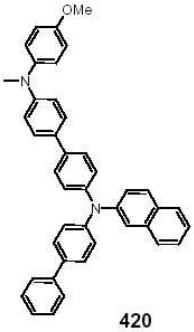
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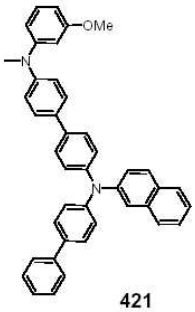
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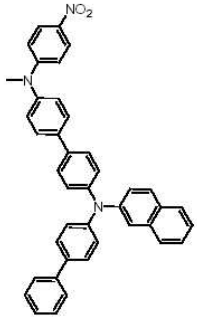
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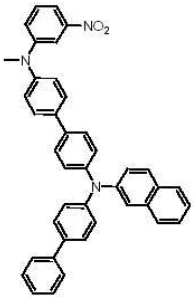
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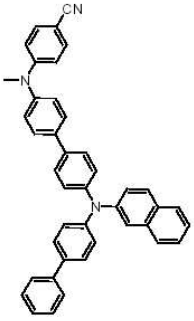
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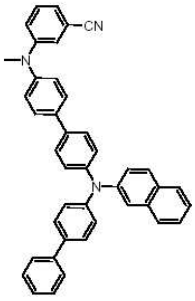
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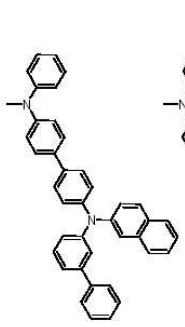
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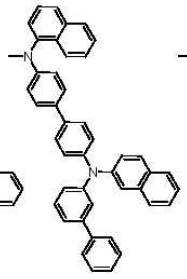


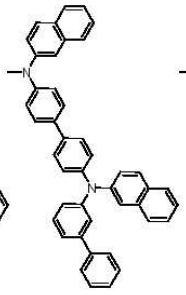
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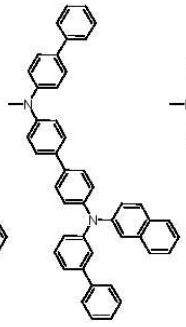


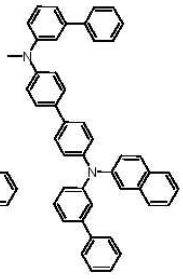
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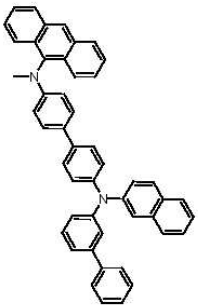

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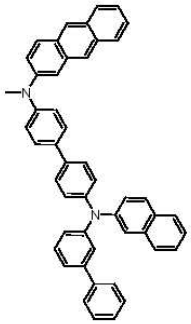

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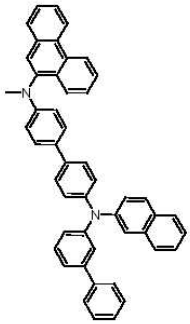

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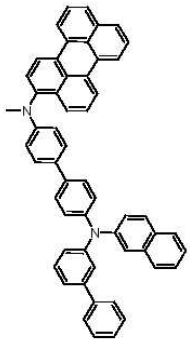

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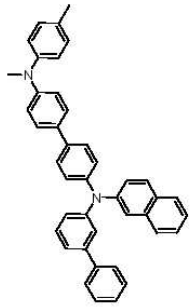

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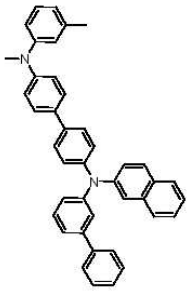

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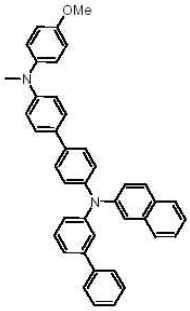

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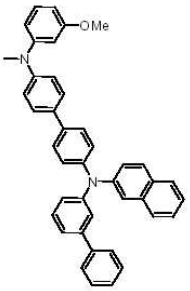

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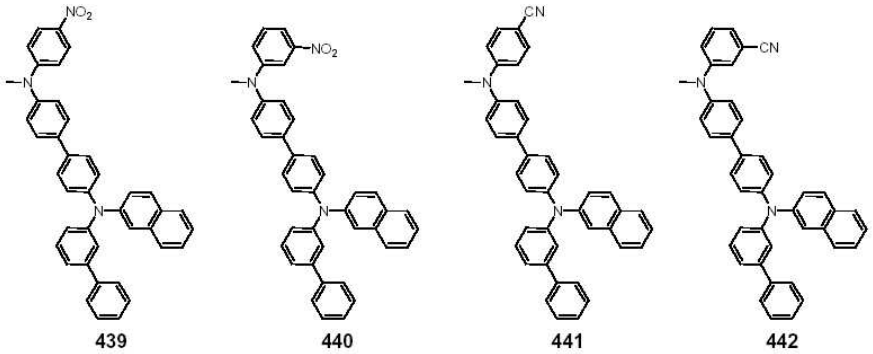

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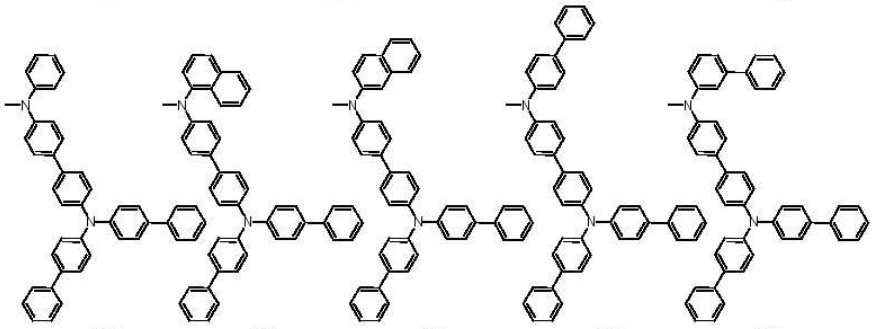

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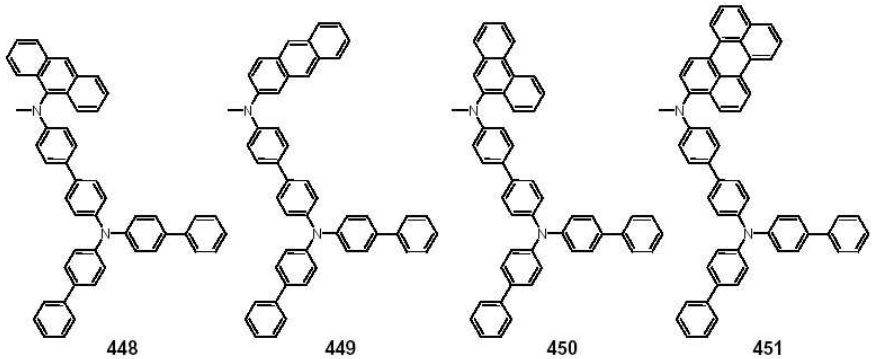

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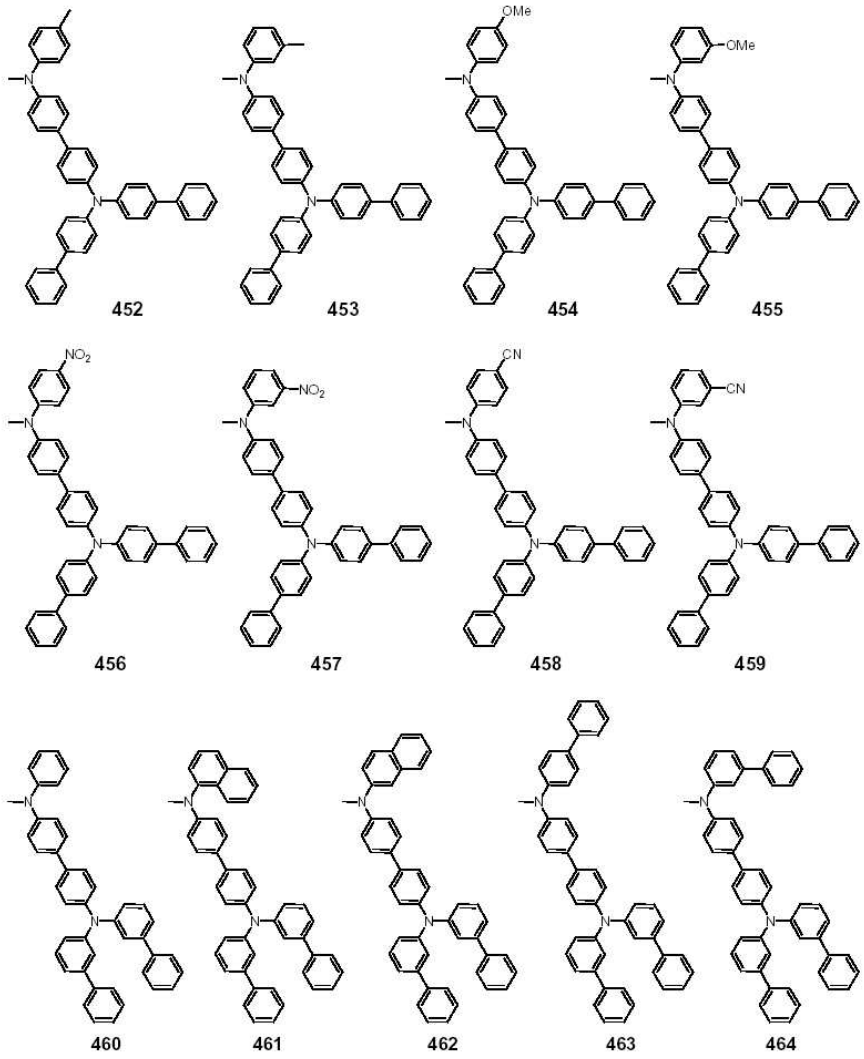
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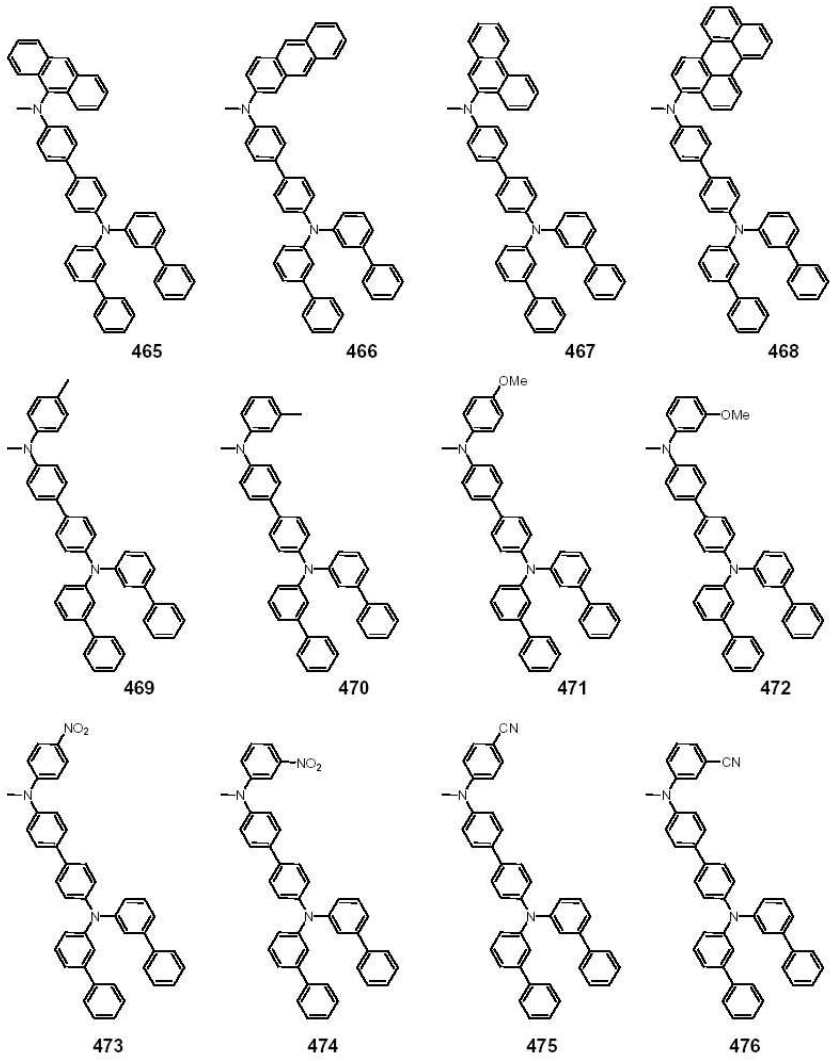


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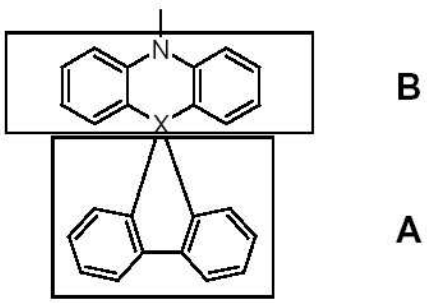

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이하는 본 발명에 대하여 상세히 설명한다.

상기 화학식 1의 화합물은 상기 화학식 1에 표시된 코어 구조, 즉 아크리딘기와 카바졸기가 융합된 구조에 플루오렌기가 스피로 구조로 결합된 코어 구조에 다양한 치환체를 도입함으로써 유기 발광 소자에서 사용되는 유기물층으로 사용되기에 적합한 특성을 가질 수 있다. 구체적으로 설명하면 다음과 같다.

상기 화학식 1의 화합물의 코어의 입체구조는 하기 그림과 같이 A와 B 부분으로 나누어 설명할 수 있다.



상기 화학식 1의 화합물의 코어는 X를 중심으로 공간적으로 평면 A와 평면 B가 직각을 이루는 입체 구조를 가지며, 여기서 X를 중심으로 A와 B 부분 사이의 컨쥬게이션은 일어나지 않는다. 또한, B 평면에서 질소원자 하나가 세 개의 아릴기 사이에 위치함으로써 B 평면 내에 컨쥬게이션을 제한하는 역할을 한다.

화합물의 컨쥬게이션 길이와 에너지 밴드갭은 밀접한 관계가 있다. 구체적으로, 화합물의 컨쥬게이션 길이가 길수록 에너지 밴드갭이 작아진다. 전술한 바와 같이, 상기 화학식 1의 화합물의 코어는 제한된 컨쥬게이션을 포함하고 있으므로, 이는 에너지 밴드 갭이 큰 성질을 성질을 갖는다.

본 발명에서는 상기와 같이 에너지 밴드 갭이 큰 코어 구조의 R1 내지 R9 및 Z1 내지 Z8 위치에 다양한 치환기를 도입함으로써 다양한 에너지 밴드 갭을 갖는 화합물을 합성할 수 있다. 통상 에너지 밴드 갭이 큰 코어 구조에 치환기를 도입하여 에너지 밴드 갭을 조절하는 것은 용이하나, 코어 구조가 에너지 밴드 갭이 작은 경우에는 치환기를 도입하여 에너지 밴드 갭을 크게 조절하기 어렵다. 또한, 본 발명에서는 상기와 같은 구조의 코어 구조의 R1 내지 R9 및 Z1 내지 Z8 에 다양한 치환기를 도입함으로써 화합물의 HOMO 및 LUMO 에너지 준위도 조절할 수 있다.

또한, 상기와 같은 구조의 코어 구조에 다양한 치환기를 도입함으로써 도입된 치환기의 고유 특성을 갖는 화합물을 합성할 수 있다. 예컨대, 유기발광소자 제조시 사용되는 정공주입층 물질, 정공수송층 물질, 발광층 물질, 전자 수송층 물질에 주로 사용되는 치환기를 상기 코어구조에 도입함으로써 각 유기물층에서 요구하는 조건들을 충족시키는 물질을 합성할 수 있다. 특히 상기 화학식 1의 화합물은 코어 구조에 아릴 아민 구조를 포함하고 있으므로, 유기 발광 소자에서 정공주입 및/또는 정공수송 물질로서의 적절한 에너지 준위를 가질 수 있다. 본 발명에서는 상기 화학식 1의 화합물 중 치환기에 따라 적절한 에너지 준위를 갖는 화합물을 선택하여 유기 발광 소자에 사용함으로써 구동 전압이 낮고 광효율이 높은 소자를 구현할 수 있다.

또한, 상기 코어구조에 다양한 치환기를 대칭 (A와 B를 코어구조 양쪽에 고정)으로 도입함으로써 에너지 밴드 갭을 미세하게 조절이 가능하게 하며, 한편으로 유기물사이에서의 계면에서의 특성을 향상되게 하며 물질의 용도를 다양하게 할 수 있다.

또한, 치환기 A 및 B에 포함된 질소 수를 각각 2개 (Y1 내지 Y4 및 Z1 내지 Z8가 헤테로 방향족 아민 화합물인 경우 이들 구조에 포함된 질소 수는 포함하지 않음) 이상으로 변화시켜, HOMO, LUMO 에너지 준위 및 에너지 밴드 갭을 미세하게 조절 가능하며, 한편으로 유기물사이에서의 계면에서의 특성을 향상되게 하며 물질의 용도를 다양하게 할 수 있다.

또한, 상기 화학식 1의 화합물은 스피로 결합에 의한 공간적 구조에 다양한 치환기를 도입하여 유기물의 삼차원 구조를 조절함으로써 유기물 내의 π-π 상호작용을 최소화하는 구조를 갖도록 하여 엑시머(excimer) 형성을 억제할 수도 있다.

한편, 상기 화학식 1의 화합물은 유리 전이 온도 (Tg)가 높아 열적 안정성이 우수하다. 예컨대, 화학식 3-1의 화합물은 유리전이온도가 159 °C 로서, 기존에 일반적으로 사용되던 NPB (Tg : 96 °C)에 비해 현저히 높음을 알 수 있다. 이러한 열적 안정성의 증가는 소자에 구동 안정성을 제공하는 중요한 요인이 된다.

또한, 상기 화학식 1의 화합물은 유기 발광 소자의 제조시 진공 증착법 뿐만 아니라 용액 도포법에 의하여 유기물층으로 형성될 수 있다. 여기서, 용액 도포법이라 함은 스핀코팅, 딥코팅, 잉크젯프린팅, 스크린 프린팅, 스프레이법, 롤 코팅 등을 의미하지만, 이들만으로 한정되는 것은 아니다.

예컨대, 화학식 1 화합물은 소자의 제조 공정 중 이용되는 용매, 예를 들어 자일렌, 디클로로 에탄, 혹은 NMP등과 같은 극성 용매등에 대한 용해도가 매우 우수할 뿐만 아니라 용액을 이용한 방법에서 박막 형성이 매우 잘 되는 특성을 가지므로, 소자의 제조시 용액 도포법을 사용할 수 있다.

본 발명의 스피로 구조의 화합물은 리티에이션(lithiation)된 아릴기와 케토기를 반응시켜 얻은 3차 알코올을 산 촉매 하에서 가열하면 물이 빠지면서 육각형의 고리구조를 형성하는 방법을 이용하여 제조될 수 있다. 이와 같은 제조 방법은 당 기술 분야에 잘 알려져 있는 방법이며, 당업자는 상기 제조 방법의 조건을 변경하여 상기 화학식 1의 화합물을 제조할 수 있다. 구체적인 제조 방법은 후술하는 제조예에 기재하였다.

본 발명의 유기 발광 소자에서는 상기 화학식 1의 화합물 대신에 상기 화학식 1의 화합물에 열경화성 또는 광경화성 작용기를 도입한 화합물을 사용할 수도 있다. 이와 같은 화합물은 전술한 화학식 1의 화합물의 기본 물성을 유지하는 동시에, 소자의 제작시 용액 도포법에 의하여 박막으로 형성한 후 경화시키는 방법에 의하여 유기물층으로 형성될 수 있다.

상기와 같이 유기 발광 소자의 제작시 유기물에 경화성 작용기를 도입하고, 용액 도포법에 의하여 상기 유기물의 박막을 형성한 후 경화하는 방법에 의하여 유기물층을 형성하는 방법은 미국 특허 공개 2003-0044518호 및 유럽 특허 공개 1146574 A2호 등에 기재되어 있다.

상기 문헌들에는 열경화 또는 광경화 가능한 비닐기 혹은 아크릴기를 가진 물질을 이용하여 상기와 같은 방법에 의하여 유기물층을 형성하여 유기 발광 소자를 제작하는 경우, 용액도포법에 의해 다층구조를 가지는 유기 발광 소자를 만들 수 있을 뿐 아니라 저전압 고휘도의 유기 발광 소자를 만들 수 있다고 기재되어 있다. 이와 같은 작용 원리는 본 발명의 화합물에도 적용될 수 있다.

본 발명에 있어서, 상기 열경화성 또는 광경화성 작용기는 비닐기 또는 아크릴기 등일 수 있다.

본 발명의 유기 발광 소자는 유기물층 중 1층 이상이 본 발명의 화합물, 즉 상기 화학식 1 의 화합물을 포함하는 것을 제외하고는 당 기술분야에 알려져 있는 재료와 방법으로 제조될 수 있다.

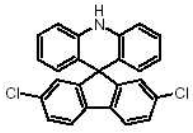
본 발명의 유기 발광 소자의 유기물층은 단층 구조로 이루어질 수도 있으나, 2층 이상의 유기물층이 적층된 다층 구조로 이루어질 수 있다. 예컨대, 본 발명의 유기 발광 소자는 유기물층으로서 정공주입층, 정공수송층, 발광층, 전자수송층, 전자주입층 등을 포함하는 구조를 가질 수 있다. 그러나, 유기 발광 소자의 구조는 이에 한정되지 않고 더 적은 수의 유기물층을 포함할 수 있다.

그리고, 본 발명의 유기 발광 소자는 예컨대 기판 상에 제1 전극, 유기물층 및 제2 전극을 순차적으로 적층시킴으로써 제조할 수 있다. 이 때 스퍼터링법(sputtering)이나 전자빔 증발법(e-beam evaporation)과 같은 PVD(Physical vapor deposition) 방법 등을 이용할 수 있으나, 이들 방법에만 한정되는 것은 아니다.

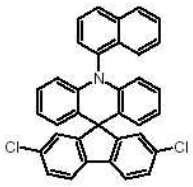
상기 화학식 1의 화합물의 제조 방법 및 이들을 이용한 유기 발광 소자의 제조는 이하의 제조예 및 실시예에서 구체적으로 설명한다. 그러나, 하기 제조예 및 실시예는 본 발명을 예시하기 위한 것이며, 본 발명의 범위가 이들에 의하여 한정되는 것은 아니다.

상기 화학식 1로 대표되는 유기 화합물의 합성방법과 이를 이용한 유기 전기발광 소자의 제조는 이하의 실시예 및 비교예에 의하여 더욱 구체적으로 설명된다. 그러나, 이들 실시예는 본 발명을 예시하기 위한 것이지 본 발명의 범위가 이들만으로 한정되는 것은 아니다.

상기 화학식 1로 표시되는 화합물의 합성을 위해서 하기 화학식 a 내지 b 화합물을 출발물질로 사용할 수 있다.



[화학식 a]



[화학식 b]

<제조예 1> 화학식 a로 표시되는 출발물질의 제조

1) 디페닐아민 10g (59 mmol)과 브로모메틸메틸에테르 8.04 ml (88.6 mmol)을 테트라하이드로퓨란 100 ml에 용해시킨 뒤, 트리에틸아민 12.4 ml (88.6 mmol)을 첨가하였다. 질소기류하에서 5시간 교반한 뒤, 증류수를 넣고 유기층을 추출하였다. 추출한 유기층은 노르말-헥산/테트라하이드로퓨란 = 15:1로 컬럼분리한 뒤, 진공건조하여 3차아민 12 g (수율 90%)을 얻었다.

2) 상기 1)에서 합성된 아민 화합물 (12.0 g, 56.3 mmol)을 정제된 THF 100 ml에 녹인 후 -78℃로 냉각한 후 n-BuLi (2.5M 헥산용액, 22.5 ml, 56.3 mmol)을 천천히 적가하였다. 동일 온도에서 30 분간 교반한 후 화합물 2,7-디클로로-9-플루오레논 (14.0 g, 56.3 mmol)을 가하였다. 동일 온도에서 40 분간 교반한 후 상온으로 온도를 올려 3 시간 더 교반하였

다. 암모늄 클로라이드 수용액으로 반응을 종료한 후 에틸이써로 추출하였다. 유기물층으로부터 무수황산마그네슘으로 물을 제거한 후 유기 용매도 제거하였다. 얻어진 고체를 에탄올에 분산시켜 하룻동안 교반한 후 여과하고 진공 건조하여 중간 물질을 100 ml의 아세트산에 분산시킨 후 진한 황산 10 방울을 가하여 4 시간 동안 환류하였다. 얻어진 고체를 여과하고 에탄올로 씻어준 후 진공 건조하여 21.8 g (96.8% 수율)의 아민을 얻었다. MS: [M+ H]+ = 401.

<제조예 2> 화학식 b로 표시되는 출발물질의 제조

화학식 a (9.00 g, 22.5 mmol)과 1-요오드나프탈렌 (11.4 g, 45.0 mmol), 탄산 칼륨 (6.22 g, 45.0 mmol), 요오드화구리 (214 mg, 1.13 mmol) 및 자일렌(250 mL)을 질소 분위기 하에서 밤샘 가열하였다. 상온으로 냉각한 후 생성물을 에틸아세테이트로 추출하고 무수황산마그네슘으로 수분을 제거한 후 감압 하에서 용매를 제거하였다. 헥산 용매를 사용하여 실리카겔 컬럼을 통과시켜 화합물을 얻은 후 용매를 감압 하에서 제거하고 진공 건조시켜 화학식 b (5.0 g, 42% 수율)을 얻었다. MS: $[M+H]^+$ = 527.

<실시예 1> 화학식 3-1로 표시되는 화합물의 제조

1) 화학식 3-1로 표시되는 화합물을 제조하기 위한 아릴 아민 합성 (4-(N-페닐-N-페닐아미노)페닐-1-페닐아민): 4-브로모페닐-N-페닐-N-페닐아민 13.5 g (41.6 mmol)와 아닐린 3.98 ml (43.7 mmol)을 톨루엔 120 ml에 용해시키고, 나트륨-터셔리-부톡사이드 10.00 g (104.1 mmol), 비스디벤질리덴아세톤팔라듐(0) 0.48 g (0.83 mmol), 50wt% 트리-터셔리-부틸포스핀 톨루엔 용액 0.58 ml (1.25 mmol)을 첨가한 후, 2 시간 동안 질소 기류 하에서 환류하였다. 반응 용액에 증류수를 넣고 반응을 종료시키고 유기 층을 추출하였다. 노르말-헥산/테트라하이드로퓨란 = 10/1 용매로 컬럼 분리한 후, 석유에테르에 교반한 뒤 진공 건조하여 아릴 아민 연결기 (9.6 g, 수율 69%)를 얻었다. MS: $[M+H]^+$ = 336.

2) 화학식 b 4.68 g (8.88 mmol)와 4-(N-페닐-N-페닐아미노)페닐-1-페닐아민 6.86 g (20.4 mmol)을 톨루엔 120 ml에 용해시키고, 나트륨-터셔리-부톡사이드 5.89 g (61.3 mmol), 트리스디벤질리덴아세톤디팔라듐(0) 0.24 g (0.41 mmol), 50wt% 트리-터셔리-부틸포스핀 톨루엔 용액 0.25 ml (0.61 mmol)을 첨가한 후, 2 시간 동안 질소 기류 하에서 환류하였다. 반응 용액에 증류수를 넣고 반응을 종료시키고 유기 층을 추출하였다. 노르말-헥산/테트라하이드로퓨란 = 4/1 용매로 컬럼 분리한 후, 석유에테르에 교반한 뒤 진공건조하여 화학식 3-1 화합물 (5.2 g, 수율 52%)를 얻었다. MS: $[M+H]^+$ = 1127.

<실시예 2> 화학식 3-2로 표시되는 화합물의 제조

1) 화학식 3-2로 표시되는 화합물을 제조하기 위한 아릴 아민 합성 (4-(N-페닐-N-페닐아미노)페닐-1-나프틸아민): 4-브로모페닐-N-페닐-N-페닐아민 15.0 g (46.3 mmol)와 1-나프틸아민 7.29 g (50.9 mmol)을 톨루엔 200 ml에 용해시키고, 나트륨-터셔리-부톡사이드 13.34 g (138.8 mmol), 비스디벤질리덴아세톤팔라듐(0) 0.53 g (0.93 mmol), 50wt% 트리-터셔리-부틸포스핀 톨루엔 용액 0.56 ml (1.39 mmol)을 첨가한 후, 2 시간 동안 질소 기류 하에서 환류하였다. 반응 용액에 증류수를 넣고 반응을 종료시키고 유기 층을 추출하였다. 노르말-헥산/테트라하이드로퓨란 = 10/1 용매로 컬럼 분리한 후, 석유에테르에 교반한 뒤 진공 건조하여 아릴 아민 연결기 (13 g, 수율 73%)를 얻었다. MS: $[M+H]^+$ = 386.

2) 화학식 b 4.68 g (8.88 mmol)와 4-(N-페닐-N-페닐아미노)페닐-1-나프틸아민 7.88 g (20.4 mmol)을 톨루엔 120 ml 에 용해시키고, 나트륨-터셔리-부톡사이드 5.89 g (61.3 mmol), 트리스디벤질리덴아세톤디팔라듐(0) 0.24 g (0.41 mmol), 50wt% 트리-터셔리-부틸포스핀 톨루엔 용액 0.25 ml (0.61 mmol)을 첨가한 후, 2 시간 동안 질소 기류 하에서 환류하였다. 반응 용액에 증류수를 넣고 반응을 종료시키고 유기 층을 추출하였다. 노르말-헥산/테트라하이드로퓨란 = 4/1 용매로 컬럼 분리한 후, 석유에테르에 교반한 뒤 진공건조하여 화학식 3-2 화합물 (5.4 g, 수율 50%)를 얻었다. MS: $[M+H]^+$ = 1227.

<실시예 3> 화학식 3-4로 표시되는 화합물의 제조

1) 화학식 3-4로 표시되는 화합물을 제조하기 위한 아릴 아민 합성 (4-(N-페닐-N-페닐아미노)페닐-1-비페닐아민): 4-브로모페닐-N-페닐-N-페닐아민 17.4g (53.7 mmol)와 4-아미노비페닐 9.99 g (59.0 mmol)을 톨루엔 250 ml에 용해시키고, 나트륨-터셔리-부톡사이드 17.02 g (177.1 mmol), 비스디벤질리덴아세톤팔라듐(0) 0.68 g (1.2 mmol), 50wt%

트리-터셔리-부틸포스핀 톨루엔 용액 0.72 ml (1.8 mmol)을 첨가한 후, 2 시간 동안 질소 기류 하에서 환류하였다. 반응 용액에 증류수를 넣고 반응을 종료시키고 유기 층을 추출하였다. 노르말-헥산/테트라하이드로퓨란 = 10/1 용매로 컬럼 분리한 후, 석유에테르에 교반한 뒤 진공 건조하여 아릴 아민 연결기 (16 g, 수율 73%)를 얻었다. MS: $[M+H]^+$ = 412.

2) 화학식 b 4.68 g (8.88 mmol)와 4-(N,N-디페닐아미노)페닐-4-바이페닐아민 8.42 g (20.4 mmol)을 톨루엔 120 ml에 용해시키고, 나트륨-터셔리-부톡사이드 5.89 g (61.3 mmol), 트리스디벤질리덴아세톤디팔라듐(0) 0.24 g (0.41 mmol), 50wt% 트리-터셔리-부틸포스핀 톨루엔 용액 0.25 ml (0.61 mmol)을 첨가한 후, 2 시간 동안 질소 기류 하에서 환류하였다. 반응 용액에 증류수를 넣고 반응을 종료시키고 유기 층을 추출하였다. 노르말-헥산/테트라하이드로퓨란 = 4/1 용매로 컬럼 분리한 후, 석유에테르에 교반한 뒤 진공건조하여 화학식 3-4 화합물 (5.2 g, 수율 45.8%)를 얻었다. MS: $[M+H]^+$ = 1279.

<실시예 4> 화학식 3-21로 표시되는 화합물의 제조

1) 화학식 3-21로 표시되는 화합물을 제조하기 위한 아릴 아민 합성 (4-(N-페닐-N-나프틸아미노)페닐-1-비페닐아민): 4-브로모페닐-N-페닐-N-나프틸아민 14.0 g (37.4 mmol)와 4-아미노비페닐 6.96g (41.2 mmol)을 톨루엔 200ml에 용해시킨뒤, 비스디벤질리덴아세톤팔라듐(0) 0.47 g (0.82 mmol), 50wt% 트리-터셔리-부틸포스핀 톨루엔 용액 0.50 ml (1.2 mmol)과 나트륨-터셔리-부톡사이드 11.86 g (123.4 mmol)을 첨가하였다. 2시간동안 질소기류하에서 환류한 후, 반응용액에 증류수를 넣고 반응을 종결시켰다. 유기층을 추출하여 노르말-헥산/테트라하이드로퓨란 = 10/1 전개용매로 컬럼분리하고, 석유에테르에 교반한 뒤 진공건조하여 아릴 아민 연결기 (7.5 g, 수율 43%)를 얻었다. MS: $[M+H]^+$ = 462.

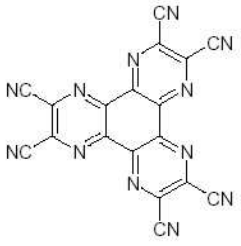
2) 화학식 b 4.68 g (8.88 mmol)와 4-(N-페닐-1-나프틸아미노)페닐-4-바이페닐아민 9.44 g (20.4 mmol)을 톨루엔 120 ml 에 용해시키고, 나트륨-터셔리-부톡사이드 5.89 g (61.3 mmol), 트리스디벤질리덴아세톤디팔라듐(0) 0.24 g (0.41 mmol), 50wt% 트리-터셔리-부틸포스핀 톨루엔 용액 0.25 ml (0.61 mmol)을 첨가한 후, 2 시간 동안 질소 기류 하에서 환류하였다. 반응 용액에 증류수를 넣고 반응을 종료시키고 유기 층을 추출하였다. 노르말-헥산/테트라하이드로퓨란 = 4/1 용매로 컬럼 분리한 후, 석유에테르에 교반한 뒤 진공건조하여 화학식 3-21 화합물 (5.5 g, 수율 45%)를 얻었다. MS: $[M+H]^+$ = 1379.

<실시예 5> 유기 발광 소자의 제조

ITO (indium tin oxide)가 1000 Å의 두께로 박막 코팅된 유리 기판 (corning 7059 glass)을 세제를 녹인 증류수에 넣고 초음파로 세척하였다. 이 때 세제로는 Fischer Co.의 제품을 사용하였으며 증류수로는 Millipore Co. 제품의 필터 (Filter)로 2차로 걸러진 증류수를 사용하였다. ITO를 30 분간 세척한 후, 증류수로 2 회 반복하여 초음파 세척을 10 분간 진행하였다. 증류수 세척이 끝난 후, 이소프로필알콜, 아세톤, 메탄올 등의 용제로 초음파 세척을 하고 건조시킨 후 플라즈마 세정기로 이송시켰다. 또한 산소플라즈마를 이용하여 상기 기판을 5 분간 건식 세정한 후 진공 증착기로 기판을 이송시켰다.

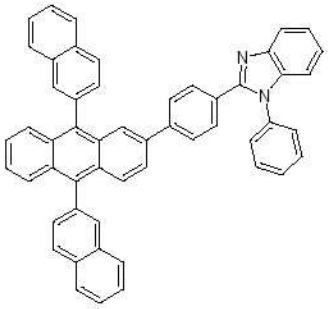
상기와 같이 준비된 ITO 투명 전극 위에 하기 화학식의 화합물인 헥사니트릴 헥사아자트리페닐렌 (hexanitrile hexaazatriphenylene: 이하 HAT라 함)을 80 Å의 두께로 열 진공 증착하여 ITO 도전층 및 N형 유기물을 가지는 양극을 형성하였다.

[HAT]



이 박막에 의하여 기판과 정공주입층 사이의 계면 특성을 향상시킬 수 있다. 이어서, 상기 박막 상에 하기 화학식의 화합물 3-1을 800 Å의 두께로 증착하여 정공주입층을 형성하였다. 상기 층 위에 NPB을 300 Å의 두께로 증착하여 정공수송층을 형성한 후, 이 위에 Alq3를 300 Å의 두께로 증착하여 발광층을 형성하였다. 상기 발광층 위에 하기 화학식의 전자수송층 물질을 200 Å의 두께로 증착하여 전자수송층을 형성하였다.

[전자수송층 물질]



상기 전자수송층 위에 순차적으로 12 Å 두께의 리튬 플루오라이드 (LiF)와 2000 Å 두께의 알루미늄을 증착하여 음극을 형성하였다.

상기의 과정에서 유기물의 증착속도는 0.3~0.8 Å/sec로 유지하였다. 또한, 음극의 리튬플루오라이드는 0.3 Å/sec, 알루미늄은 1.5~2.5 Å/sec의 증착 속도를 유지하였다. 증착시 진공도는 $1\sim3 \times 10^{-7}$로 유지하였다.

제조된 소자는 순방향 전류밀도 100 mA/cm^2에서 4.76 V의 전계를 보였으며, 1.93 lm/W의 광 효율을 보이는 스펙트럼이 관찰되었다. 이와 같이 소자가 상기 구동 전압에서 작동하여 발광을 한다는 것은 상기 기판상에 형성한 박막과 정공수송층 사이에 층을 형성한 상기 화학식 3-1의 화합물이 정공주입 역할을 하고 있다는 것을 나타낸다.

<실시예 6> 유기 발광 소자의 제조

상기 실시예 5에서 정공 주입층으로 사용한 화합물 3-1의 물질을 3-2의 화합물로 치환한 것을 제외하고는 동일한 소자를 제작하였다.

제조된 소자는 순방향 전류밀도 100 mA/cm^2에서 4.72 V의 전계를 보였으며, 1.94 lm/W의 광 효율을 보이는 스펙트럼이 관찰되었다. 이와 같이 소자가 상기 구동 전압에서 작동하여 발광을 한다는 것은 상기 기판상에 형성한 박막과 정공 수송층 사이에 층을 형성한 상기 화학식 3-2의 화합물이 정공주입 역할을 하고 있다는 것을 나타낸다.

<실시예 7> 유기 발광 소자의 제조

상기 실시예 5에서 정공 주입층으로 사용한 화합물 3-1의 물질을 3-4의 화합물로 치환한 것을 제외하고는 동일한 소자를 제작하였다.

제조된 소자는 순방향 전류밀도 100 mA/cm^2에서 4.65 V의 전계를 보였으며, 1.92 lm/W의 광 효율을 보이는 스펙트럼이 관찰되었다. 이와 같이 소자가 상기 구동 전압에서 작동하여 발광을 한다는 것은 상기 기판상에 형성한 박막과 정공 수송층 사이에 층을 형성한 상기 화학식 3-4의 화합물이 정공주입 역할을 하고 있다는 것을 나타낸다.

<실시예 7> 유기 발광 소자의 제조

상기 실시예 5에서 정공 주입층으로 사용한 화합물 3-1의 물질을 3-21의 화합물로 치환한 것을 제외하고는 동일한 소자를 제작하였다.

제조된 소자는 순방향 전류밀도 100 mA/cm^{2}에서 4.60 V의 전계를 보였으며, 1.97 lm/W의 광 효율을 보이는 스펙트럼이 관찰되었다. 이와 같이 소자가 상기 구동 전압에서 작동하여 발광을 한다는 것은 상기 기판상에 형성한 박막과 정공 수송층 사이에 층을 형성한 상기 화학식 3-21의 화합물이 정공주입 역할을 하고 있다는 것을 나타낸다.

발명의 효과

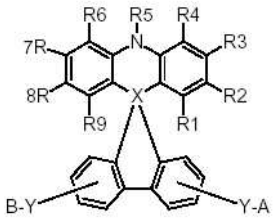
본 발명의 화합물은 유기 발광 소자에서 유기물층 물질, 특히 정공주입 물질 및/또는 정공수송 물질로 사용될 수 있으며, 이 화합물을 유기 발광 소자에 사용하는 경우 소자의 구동전압을 낮추고, 광효율을 향상시키며, 화합물의 열적 안정성에 의하여 소자의 수명 특성을 향상시킬 수 있다.

(57) 청구의 범위

청구항 1.

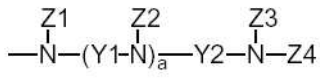
제 1 전극, 발광층, 1층 이상의 유기물층 및 제 2 전극을 적층된 형태로 포함하는 유기 발광 소자에 있어서, 상기 유기물층 중 1층 이상이 하기 화학식 1의 화합물, 또는 이 화합물에 열 경화성 또는 광경화성 작용기가 도입된 화합물을 포함하는 것인 유기 발광 소자.

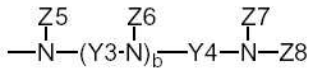
[화학식 1]



상기 화학식 1에 있어서,

X는 C 또는 Si이고,

A는  이고

B는  이며,

a 및 b는 0 또는 1 이상의 정수이고,

Y는 결합이거나 2가 방향족 탄화수소; 니트로, 니트릴, 할로겐, 알킬기, 알콕시기 및 아미노기로 이루어진 군으로부터 선택되는 1개 이상의 치환기로 치환된 2가 방향족 탄화수소; 2가 헤테로 고리기; 또는 니트로, 니트릴, 할로겐, 알킬기, 알콕시기 및 아미노기로 이루어진 군으로부터 선택되는 1개 이상의 치환기로 치환된 2가 헤테로 고리기이고,

Y1 내지 Y4는 각각 독립적으로 2가 방향족 탄화수소; 니트로, 니트릴, 할로겐, 알킬기, 알콕시기 및 아미노기로 이루어진 군으로부터 선택되는 1개 이상의 치환기로 치환된 2가 방향족 탄화수소; 2가 헤테로 고리기; 또는 니트로, 니트릴, 할로겐, 알킬기, 알콕시기 및 아미노기로 이루어진 군으로부터 선택되는 1개 이상의 치환기로 치환된 2가 헤테로 고리기이고,

Z1 내지 Z8는 각각 독립적으로 수소; 탄소수 1-20의 지방족 탄화수소; 방향족 탄화수소; 니트로, 니트릴, 할로겐, 알킬기, 알콕시기, 아미노기, 방향족 탄화수소 및 헤테로 고리기로 이루어진 군으로부터 선택되는 1개 이상의 치환기로 치환된 방

항족 탄화수소; 방향족 탄화수소로 치환된 실리콘기; 헤테로고리기; 니트로, 니트릴, 할로겐, 알킬기, 알콕시기, 아미노기, 방향족 탄화수소 및 헤테로 고리기로 이루어진 군으로부터 선택되는 1개 이상의 치환기로 치환된 헤테로고리기; 탄소수 1-20의 탄화수소 또는 탄소수 6-20의 방향족 탄화수소로 치환된 티오펜기; 또는 방향족 탄화수소로 치환된 붕소기이고,

R1 내지 R4 및 R6 내지 R9은 각각 독립적으로 수소, 치환 또는 비치환된 알킬기, 치환 또는 비치환된 알콕시기, 치환 또는 비치환된 알케닐기, 치환 또는 비치환된 아릴기, 치환 또는 비치환된 아릴 아민기, 치환 또는 비치환된 헤테로 고리기, 아미노기, 니트릴기, 니트로기, 할로겐기, 아미드기, 에스테르기로 이루어진 군에서 선택되며, 여기서 이들은 서로 인접하는 기와 지방족 또는 헤테로의 축합 고리를 형성할 수 있고,

R5는 수소, 치환 또는 비치환된 알킬기, 치환 또는 비 치환된 사이클로알킬기, 치환 또는 비치환된 알케닐기, 치환 또는 비치환된 아릴기, 또는 치환 또는 비치환된 헤테로 고리기로 이루어진 군에서 선택되며,

여기서, R5가 아릴기 또는 헤테로 고리기인 경우, 아릴 또는 헤테로 고리기의 오르소(ortho) 위치의 탄소와 R4 또는 R6는 O, S, NR, PR, C=O, CRR', SiRR'로 이루어진 군에서 선택되는 기와 함께 축합고리를 형성할 수 있으며, 여기서 R 및 R'는 각각 독립적으로 수소, 치환 또는 비치환된 알킬기, 치환 또는 비치환된 알콕시기, 치환 또는 비치환된 알케닐기, 치환 또는 비치환된 아릴기, 치환 또는 비치환된 아릴 아민기, 치환 또는 비치환된 헤테로 고리기, 니트릴기, 아미드기, 에스테르기로 이루어진 군에서 선택되고, 여기서 R과 R'는 축합고리를 형성하여 스피로 화합물을 형성할 수 있다.

청구항 2.

제1항에 있어서, 상기 화학식 1 중 R5가 아릴기 또는 헤테로 고리기인 것인 유기발광소자.

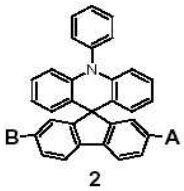
청구항 3.

제2항에 있어서, 상기 화학식 1 중 R5가 아릴기 또는 헤테로 고리기이며, 상기 아릴 또는 헤테로 고리기의 오르소(ortho) 위치의 탄소와 R4 또는 R6는 O, S, NR, PR, C=O, CRR', SiRR' (여기서, R 및 R'는 화학식 1에서 정의한 바와 같다)로 이루어진 군에서 선택되는 기와 함께 축합고리를 형성하는 것인 유기발광소자.

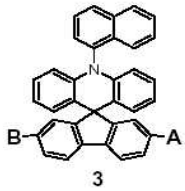
청구항 4.

제1항에 있어서, 상기 화학식 1의 화합물이 하기 화학식 2 내지 화학식 119 중 어느 하나인 것인 유기발광소자.

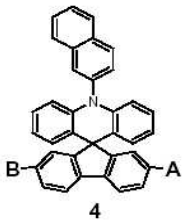
[화학식 2 내지 화학식 119]



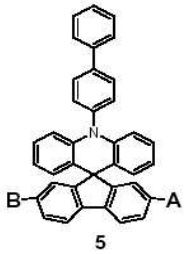
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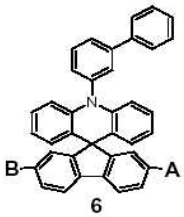
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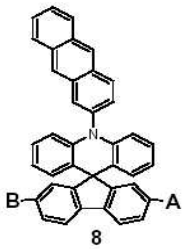
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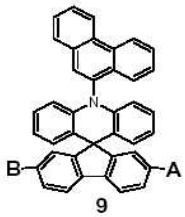
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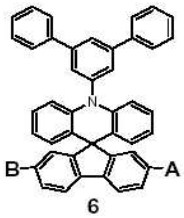
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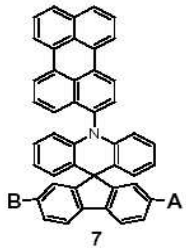
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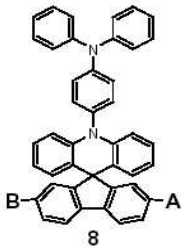
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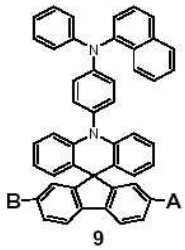
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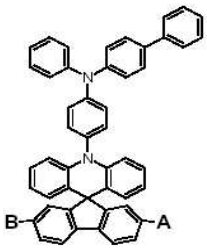
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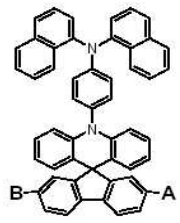
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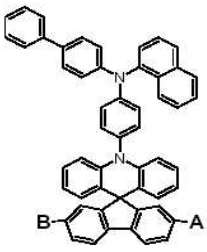
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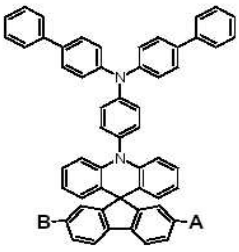
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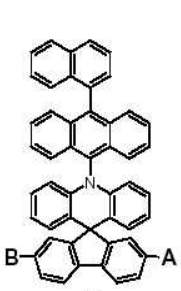
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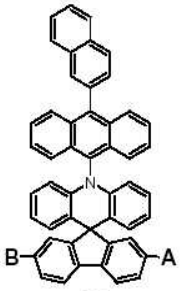
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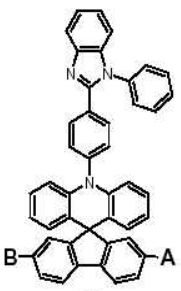
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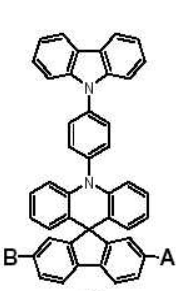
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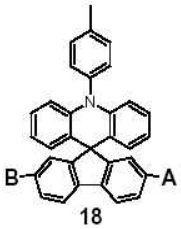
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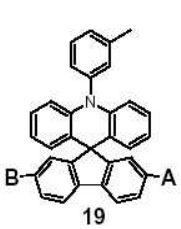
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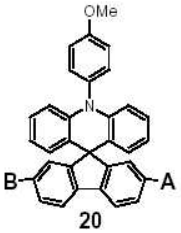
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18



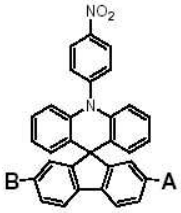
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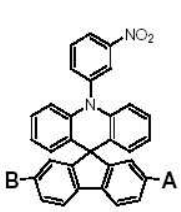
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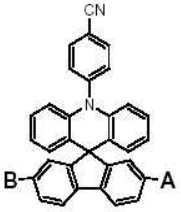
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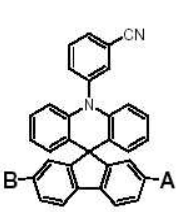
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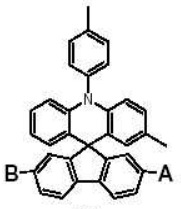
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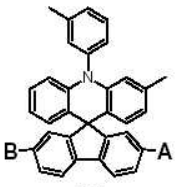
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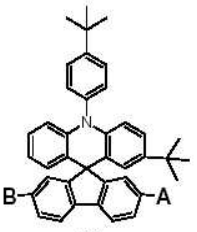
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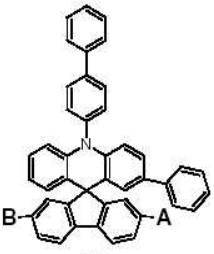
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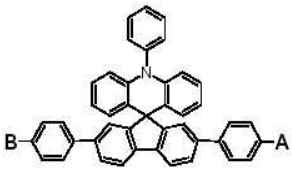
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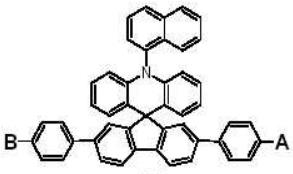
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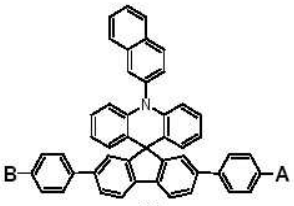
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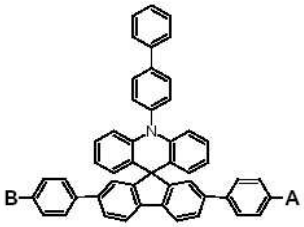
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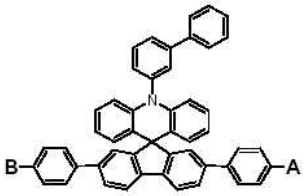
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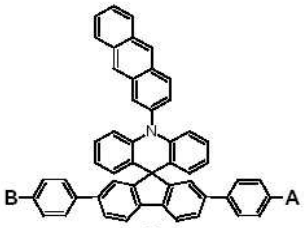
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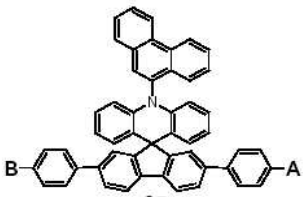
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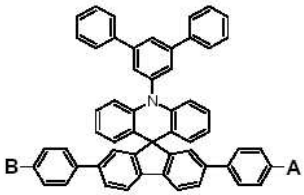
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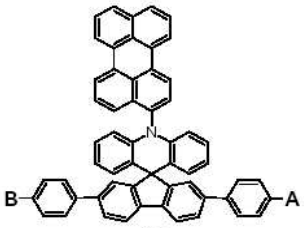
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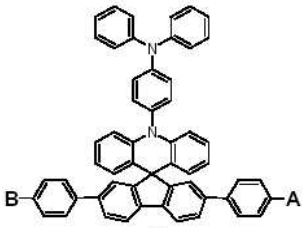
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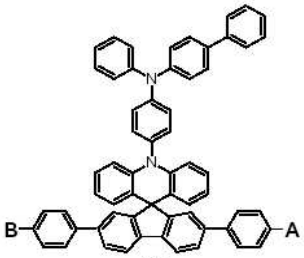
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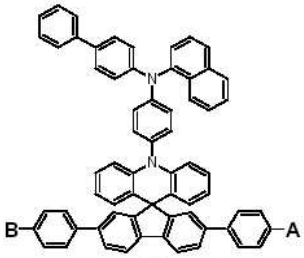
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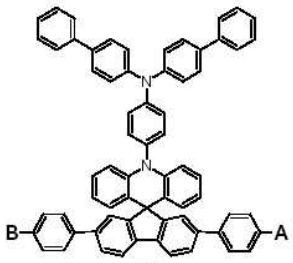
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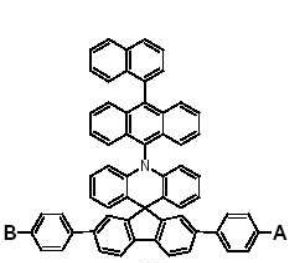
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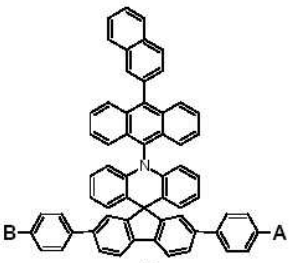
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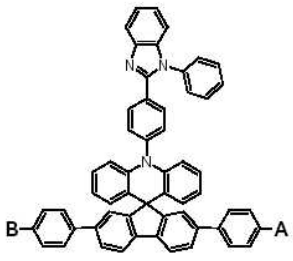
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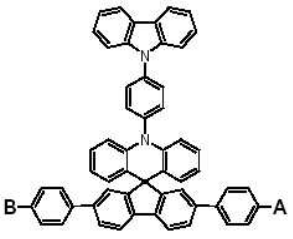
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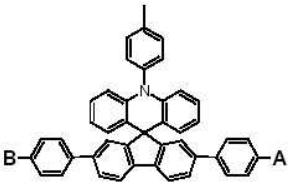
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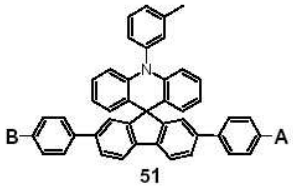
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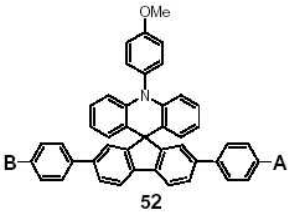
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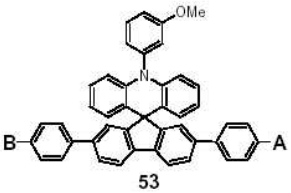
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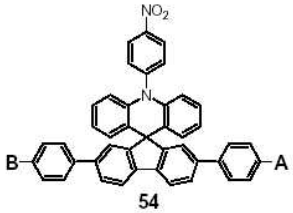
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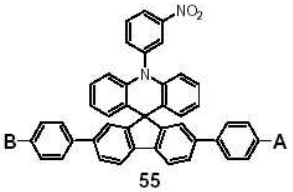
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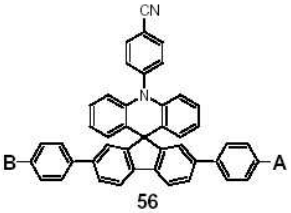
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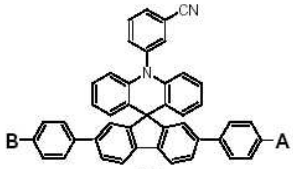
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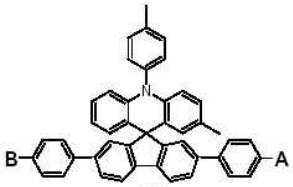
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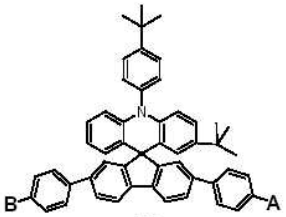
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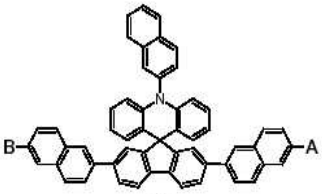
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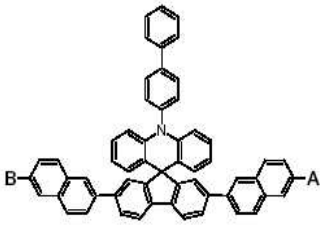
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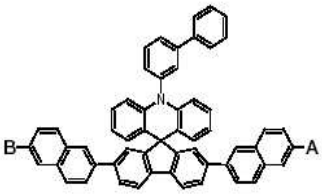
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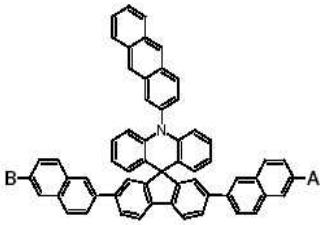
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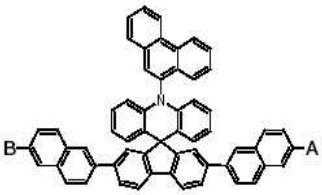
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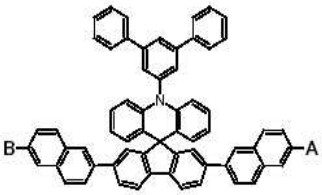
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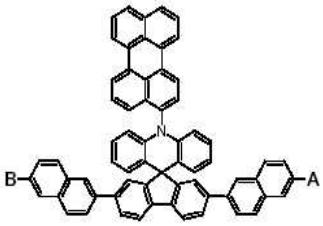
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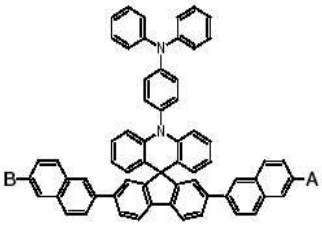
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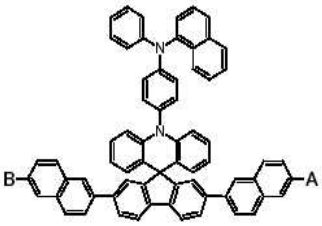
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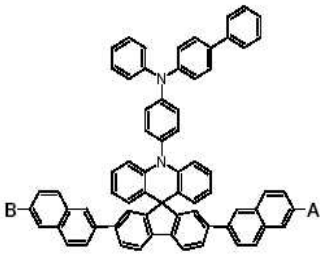
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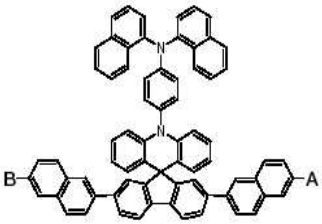
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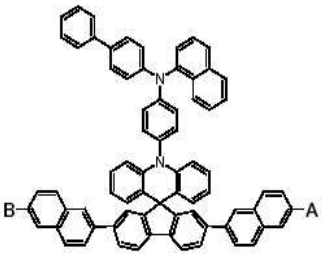
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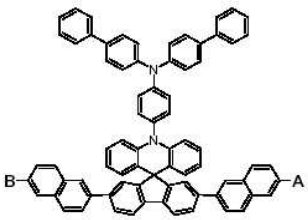
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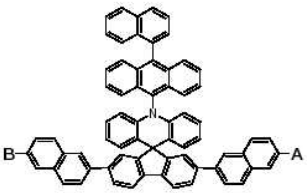
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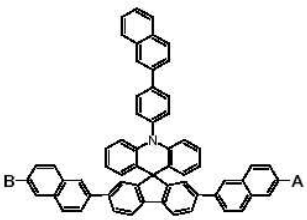
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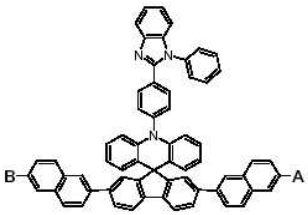
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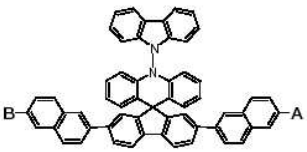
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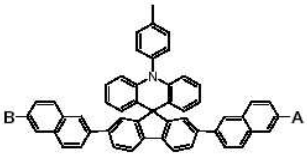
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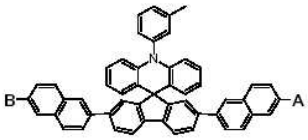
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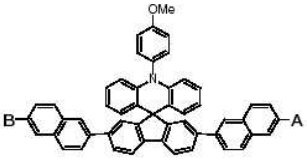
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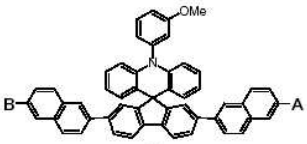
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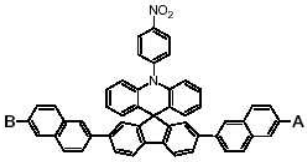
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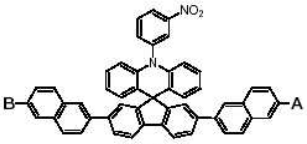
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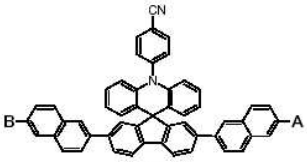
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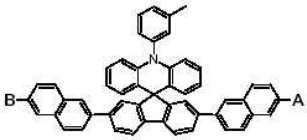
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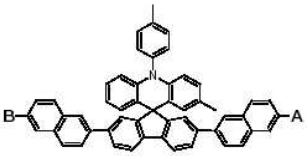
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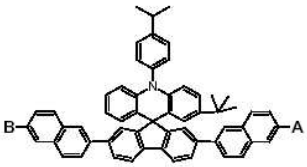
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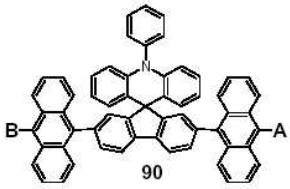
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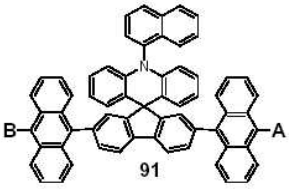
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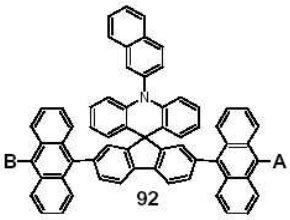
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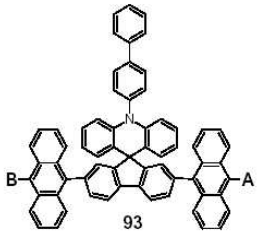
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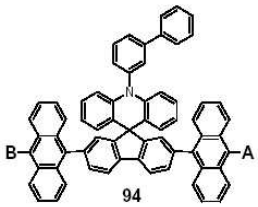


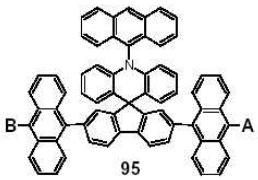
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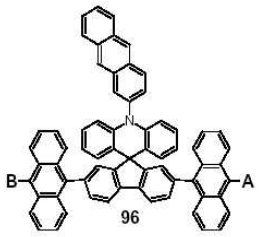


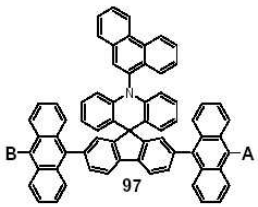
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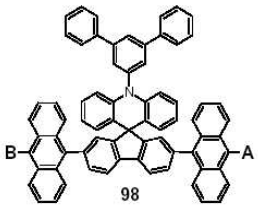

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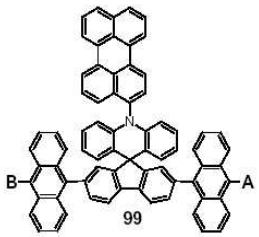

B
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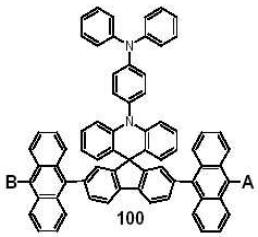

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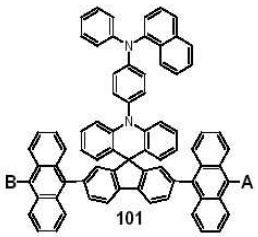

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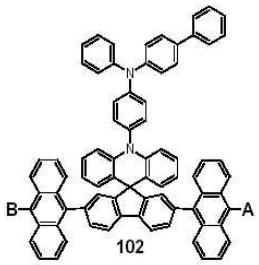

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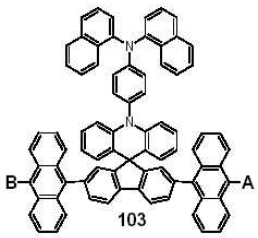

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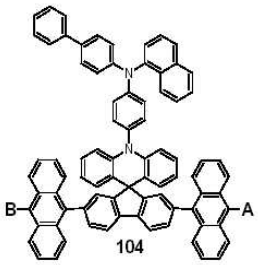

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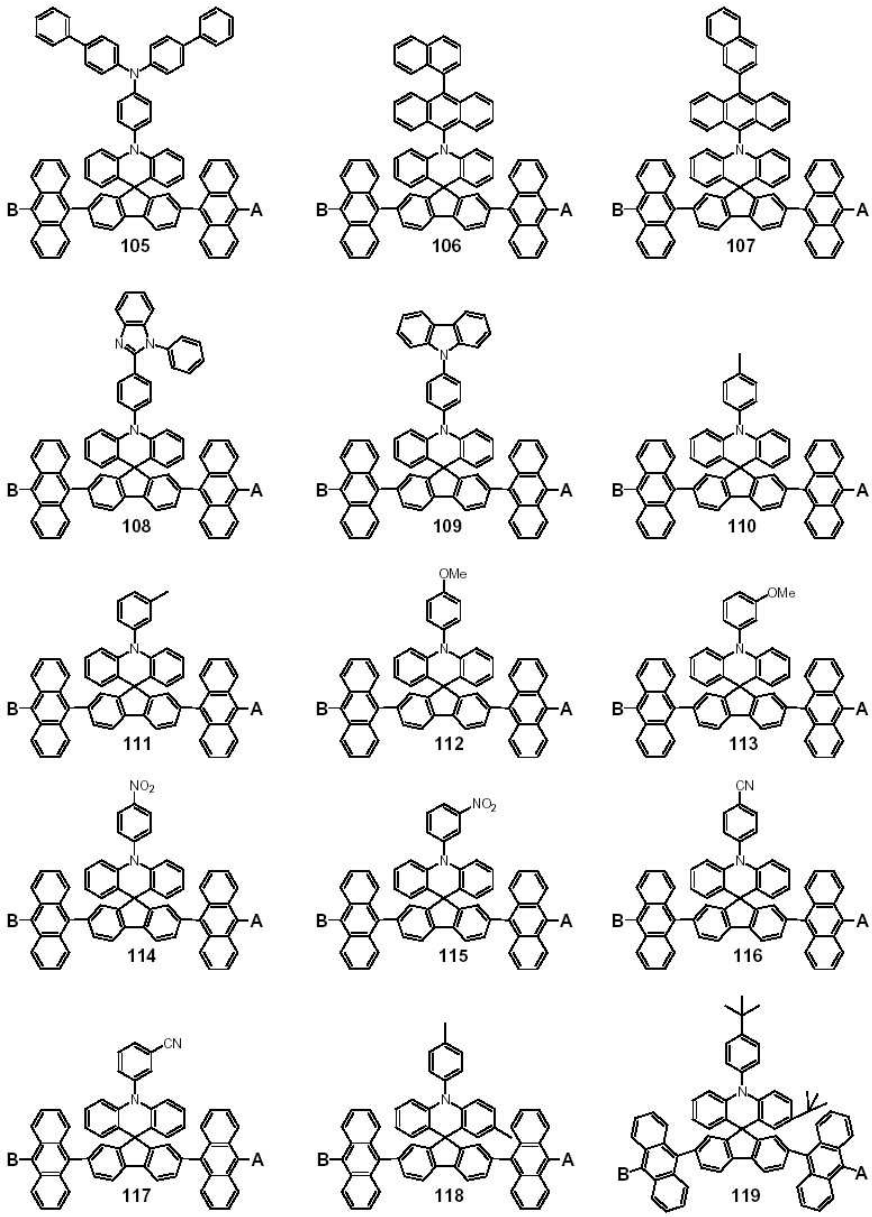

B
A
100


B
A
101


B
A
102


B
A
103

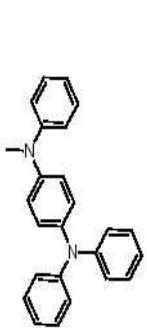

B
A
104



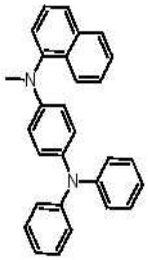
상기 화학식에서 A 및 B는 제1항에 정의된 바와 같다.

청구항 5.

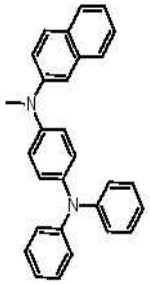
제4항에 있어서, A 및 B가 독립적으로 하기의 기 중 하나인 것인 유기 발광 소자.



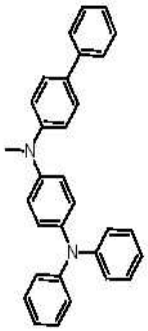
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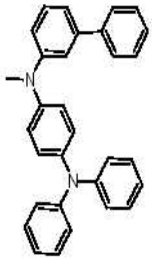
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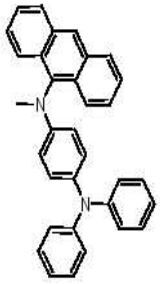
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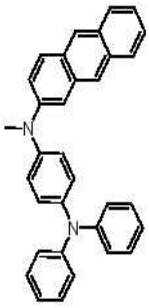
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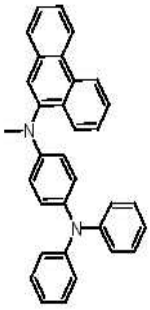
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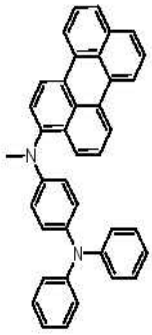
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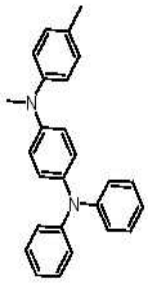
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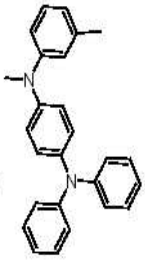
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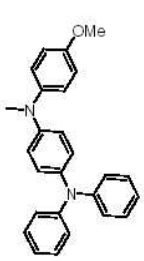
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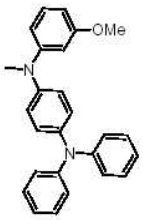


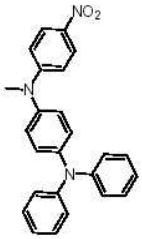
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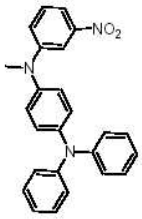


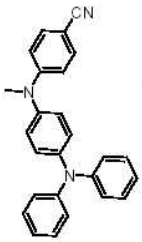
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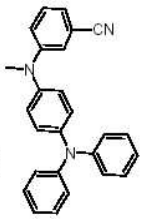

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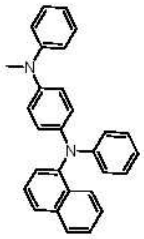

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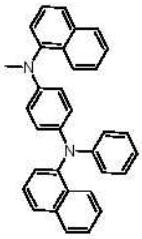

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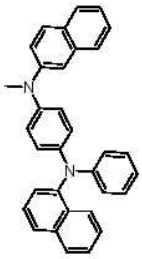

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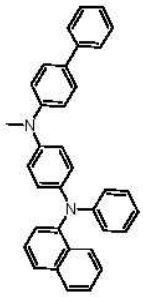

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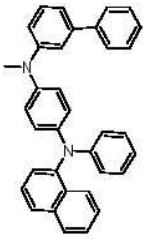

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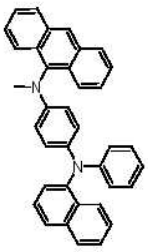

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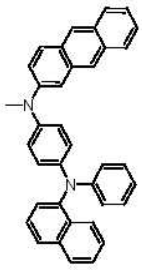

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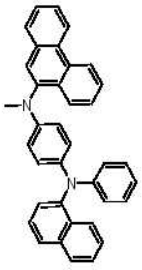

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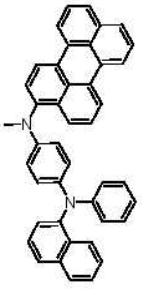

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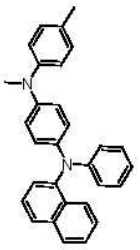

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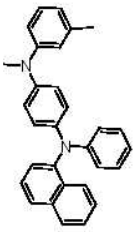

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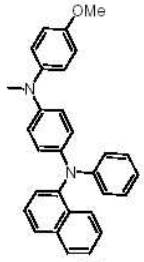

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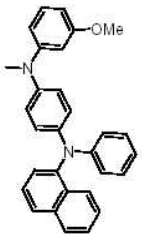

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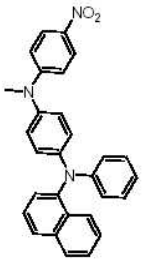

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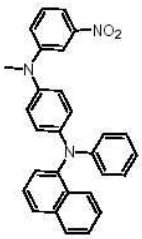

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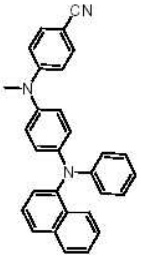

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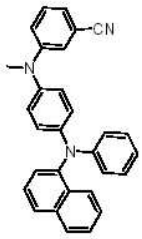

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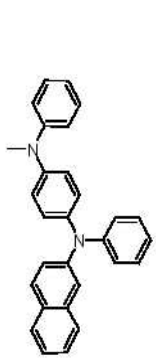

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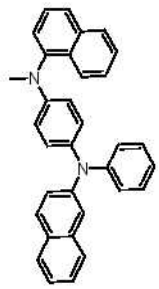

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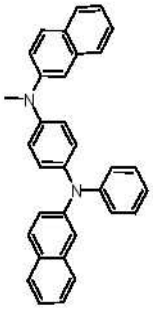

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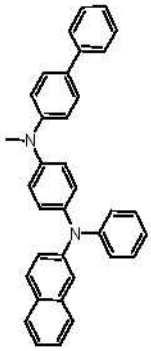
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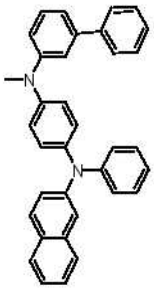
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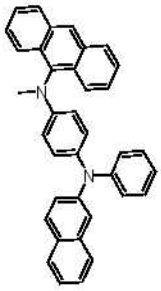
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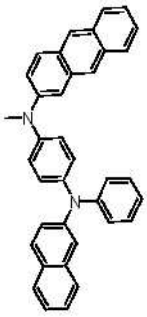
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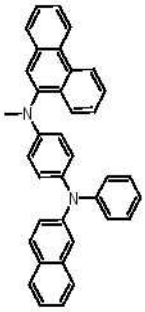
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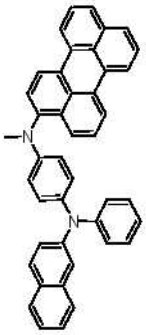
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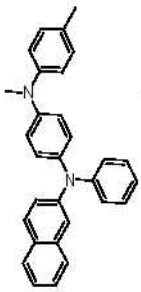
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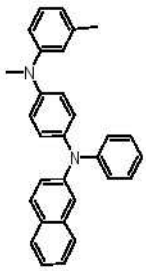
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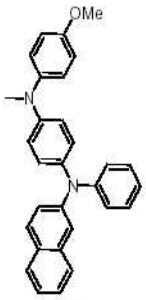
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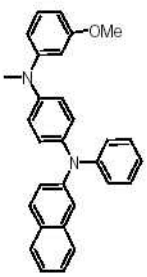
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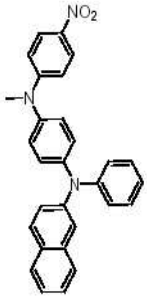
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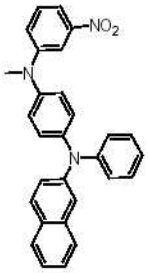
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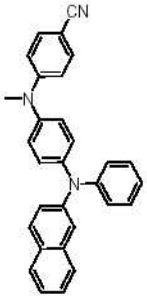
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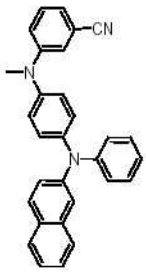
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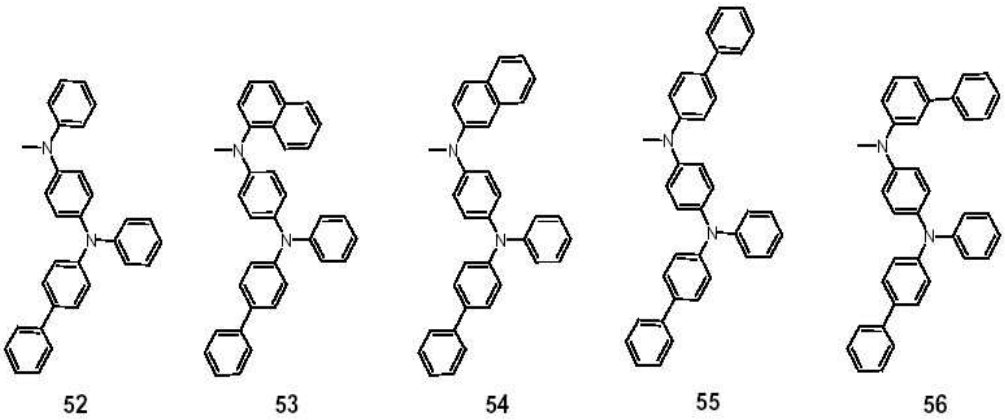
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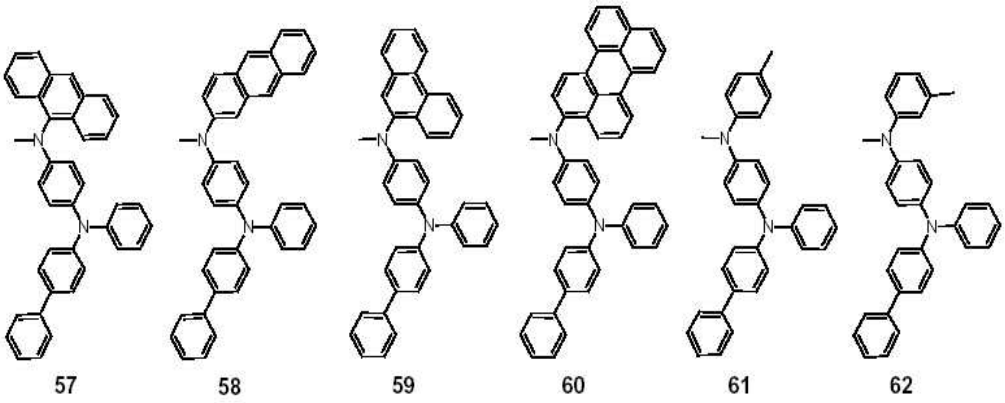
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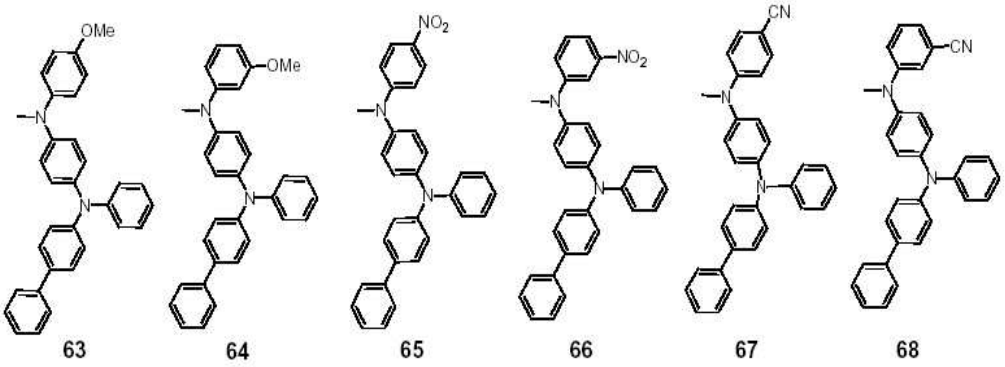
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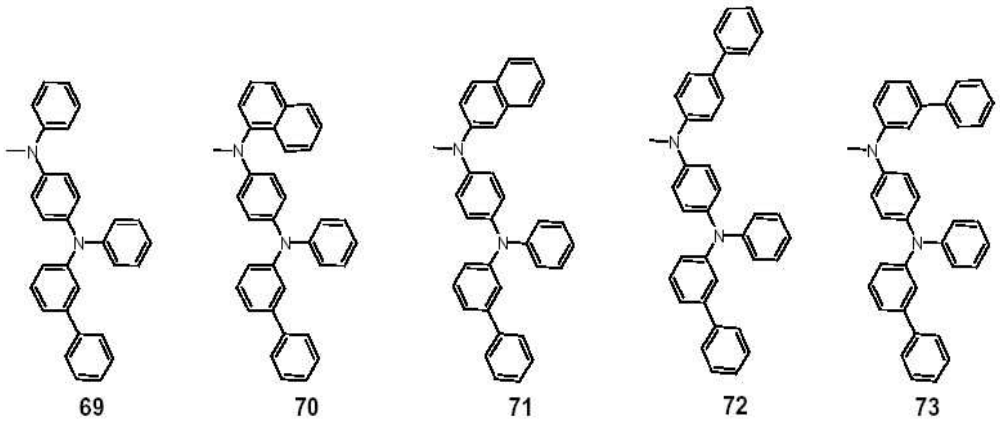
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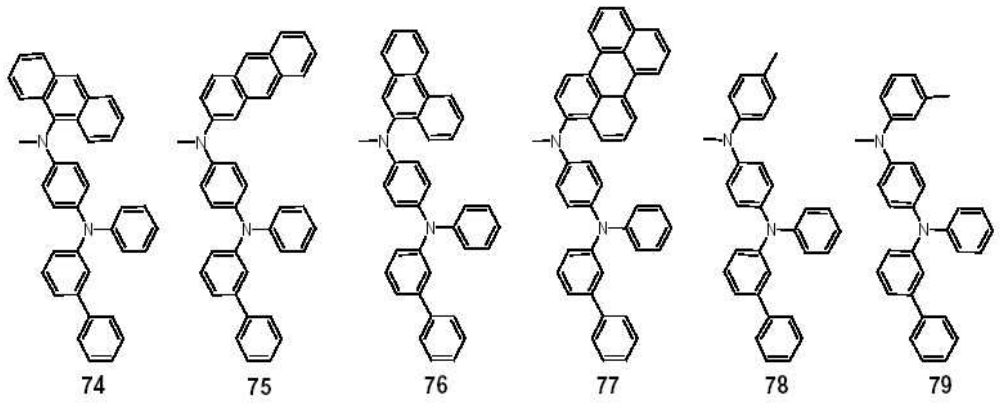


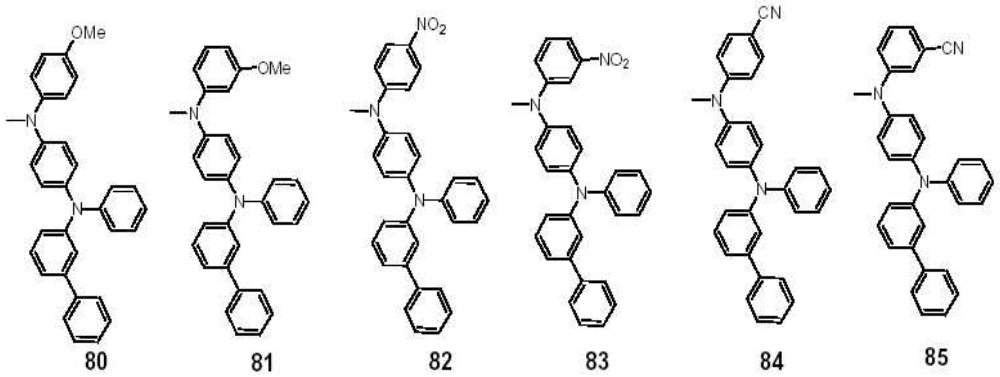
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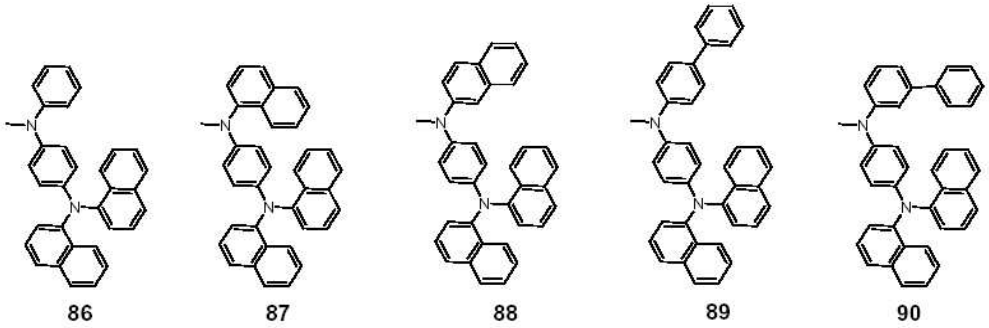


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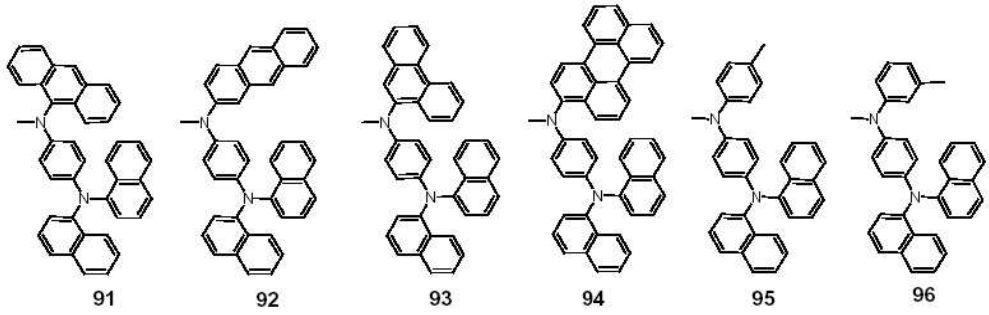

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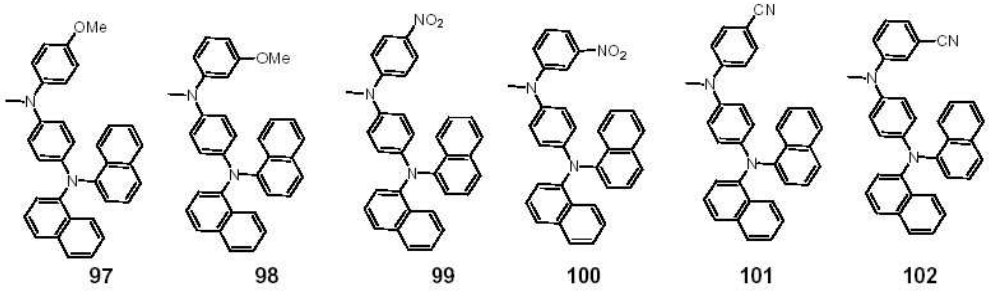

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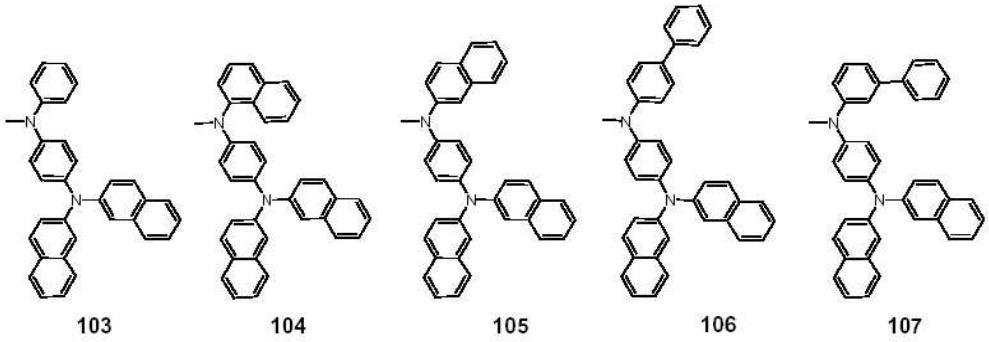
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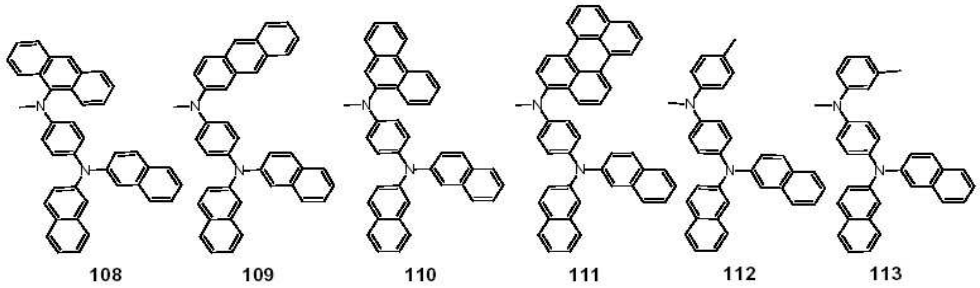
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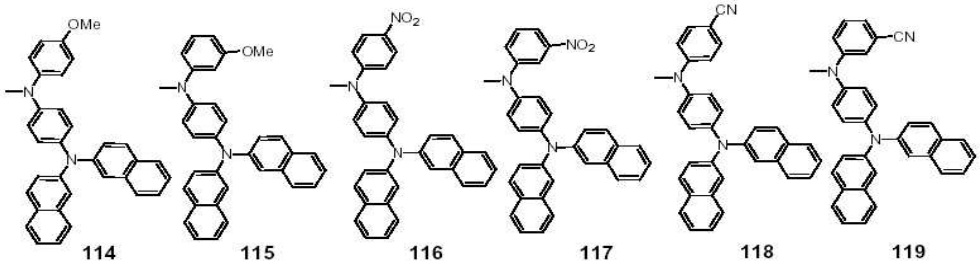
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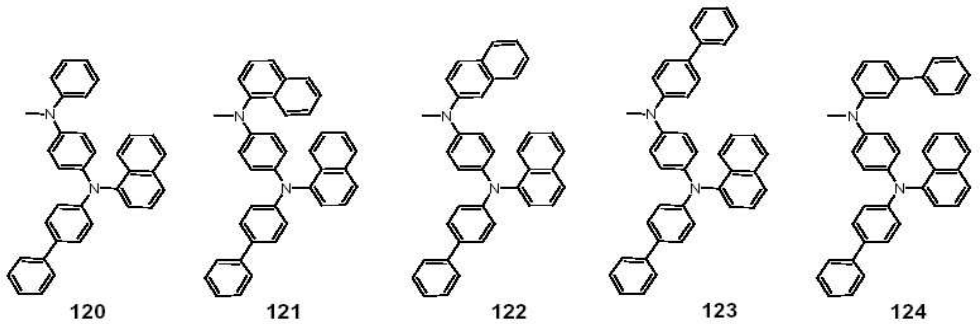
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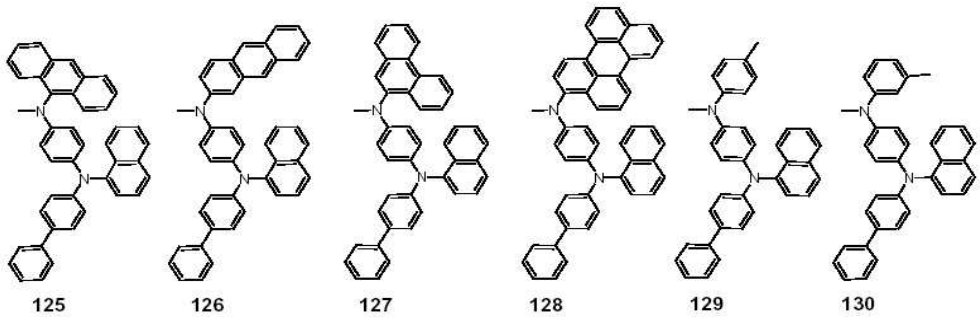
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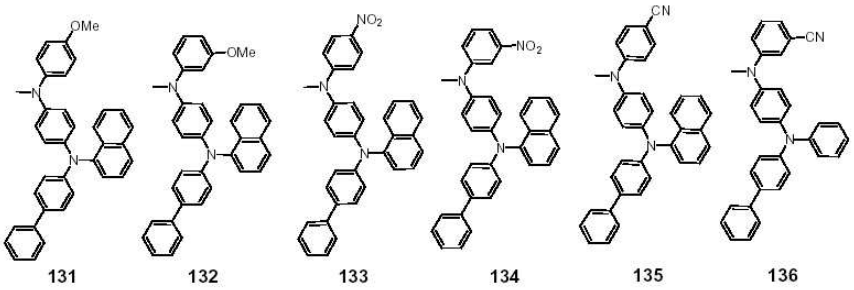
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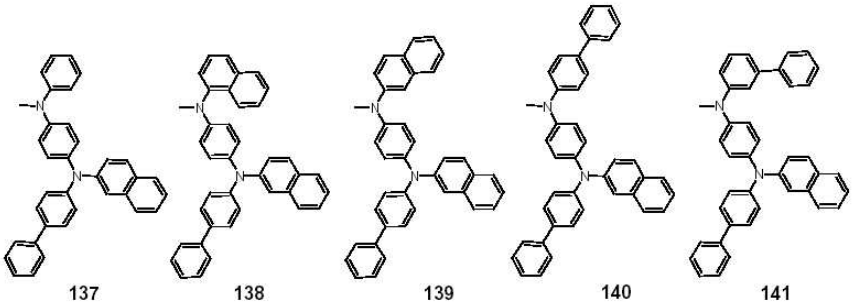
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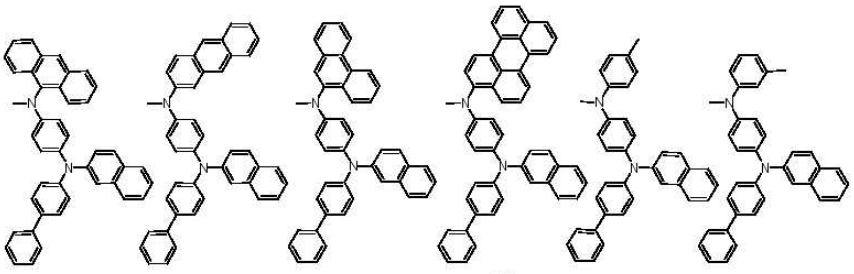
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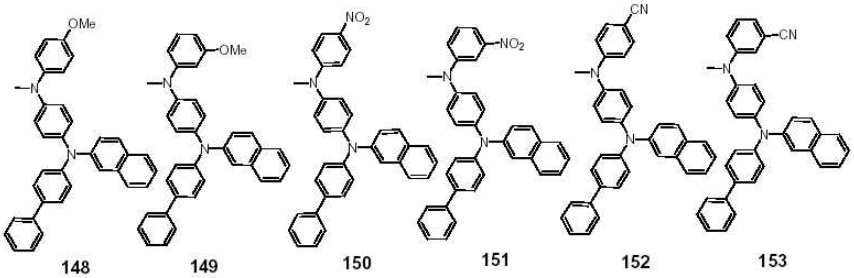
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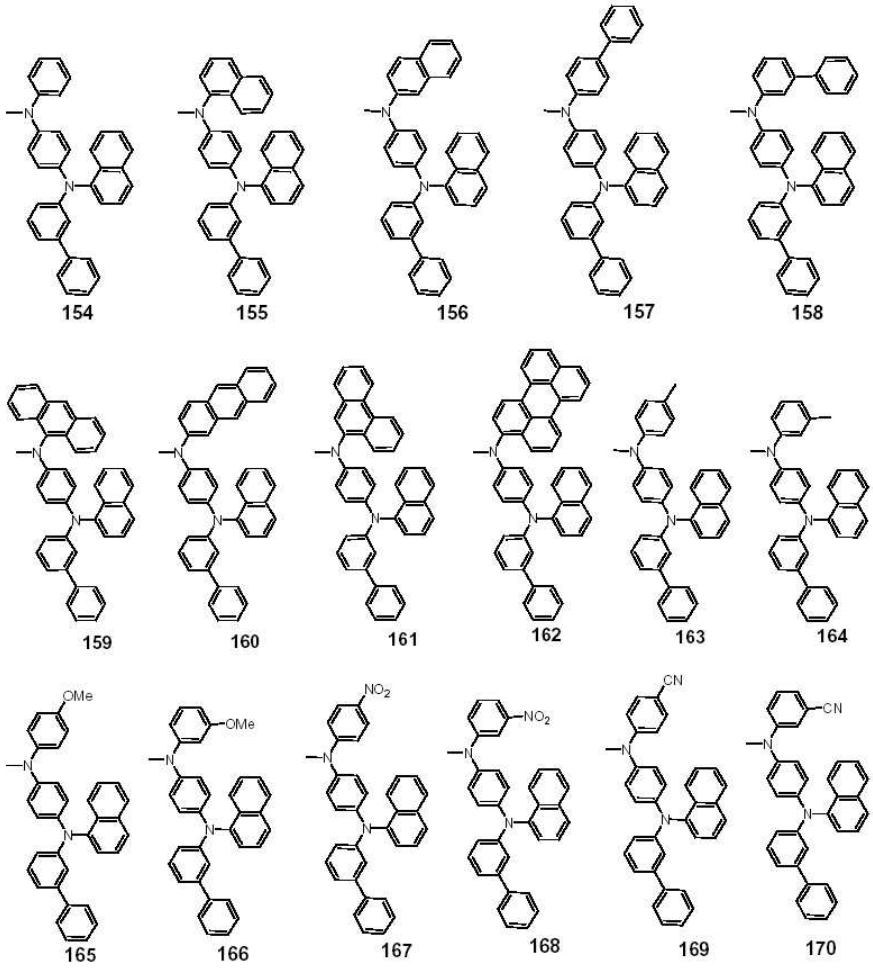
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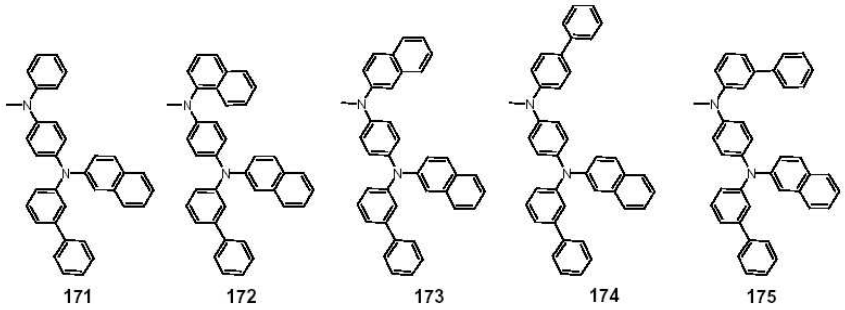


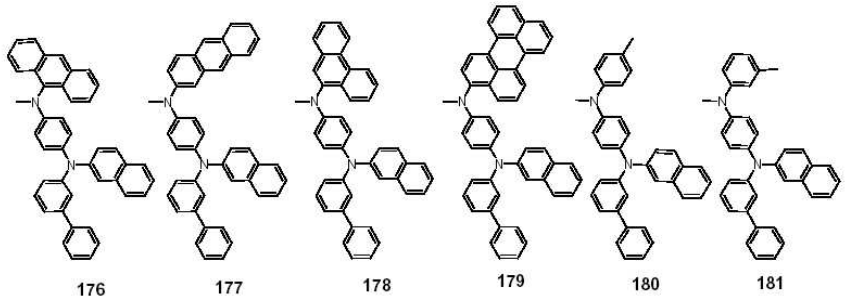
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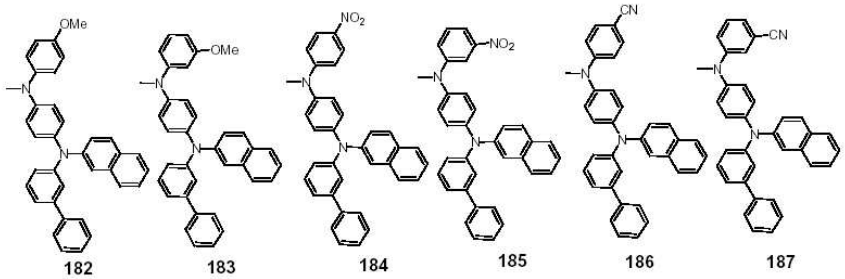


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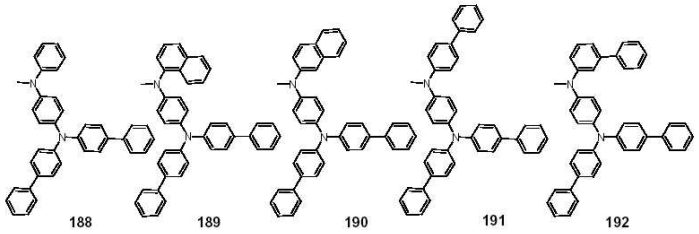

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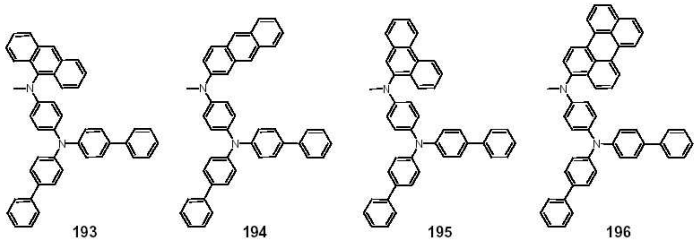

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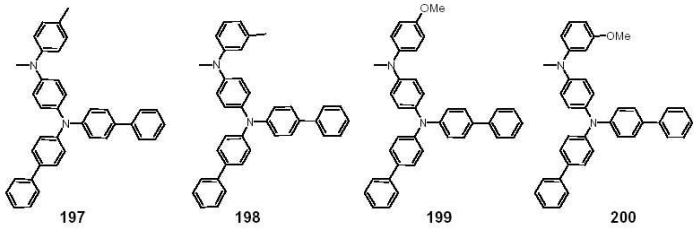
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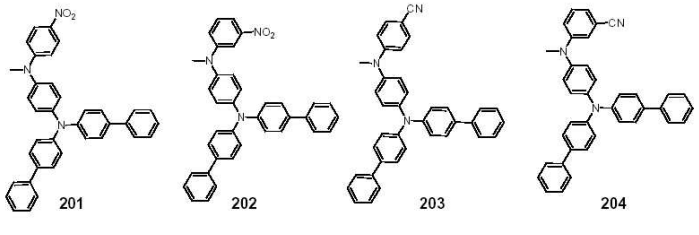
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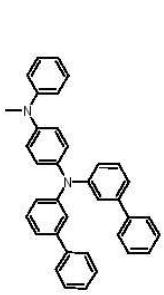
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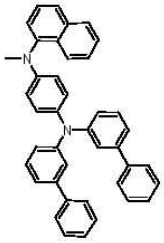
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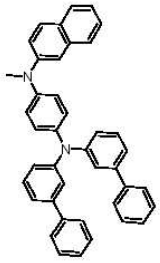
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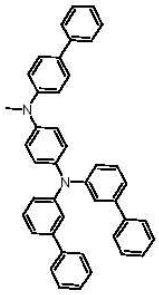
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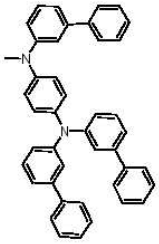
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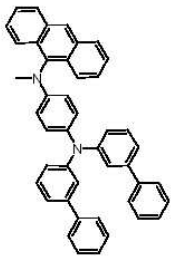
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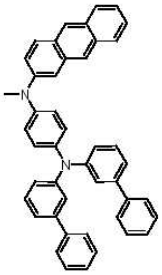
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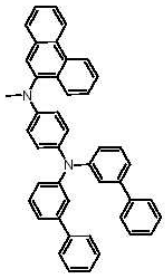
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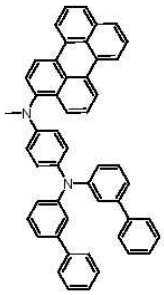
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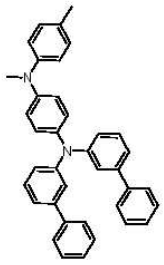
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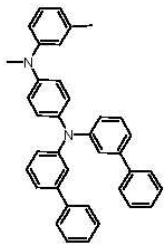
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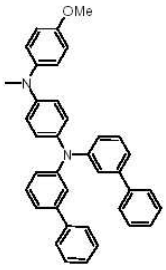
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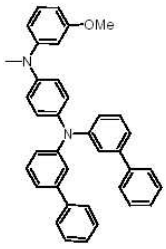
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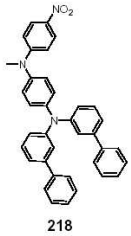
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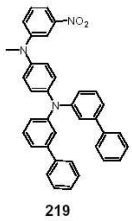


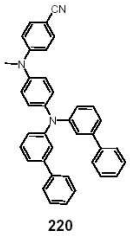
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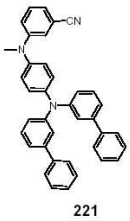


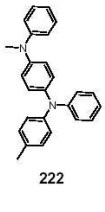
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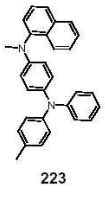

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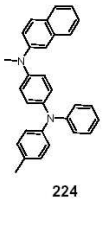

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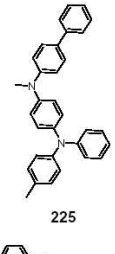

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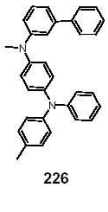

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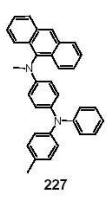

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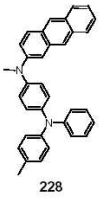

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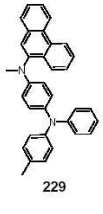

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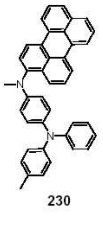

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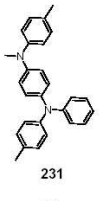

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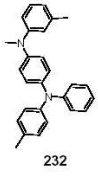

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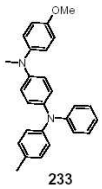

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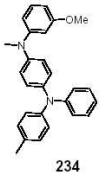

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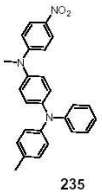

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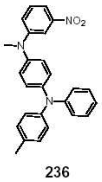

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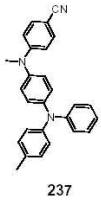

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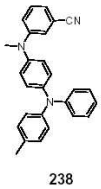

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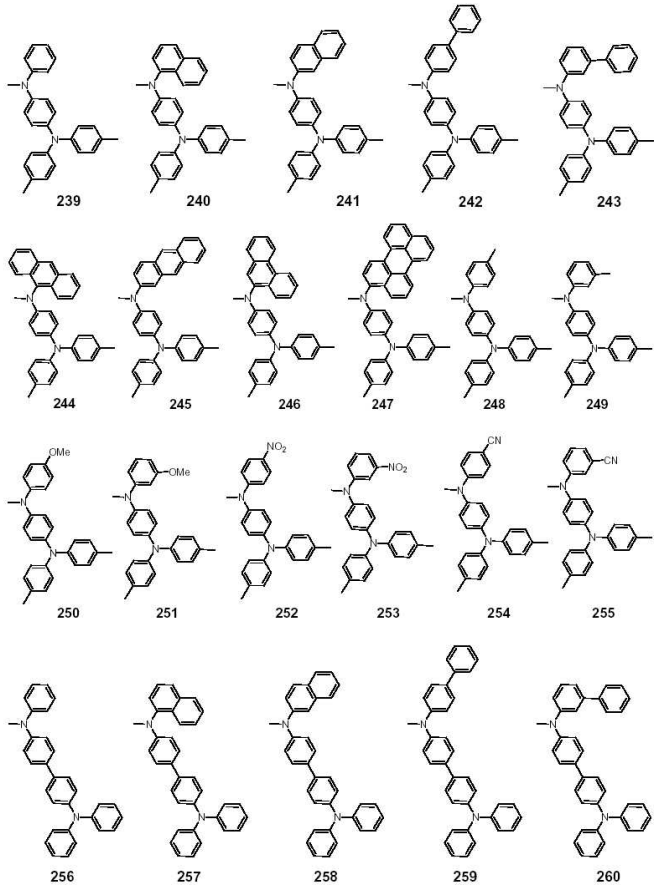

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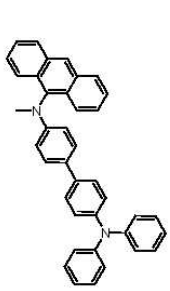

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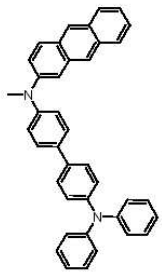

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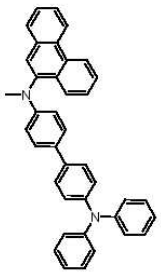

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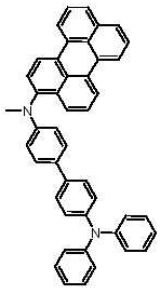
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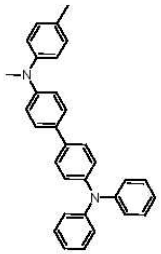
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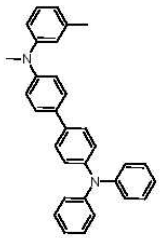
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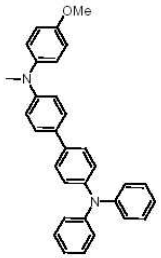
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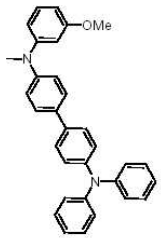
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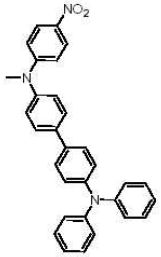
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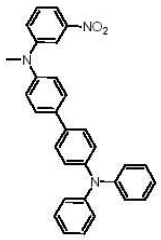
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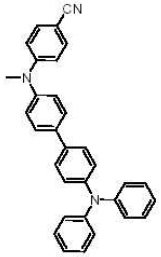
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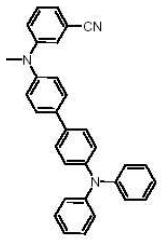
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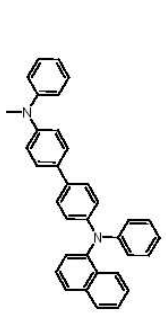
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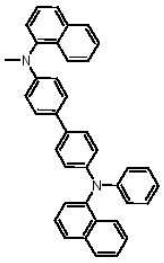
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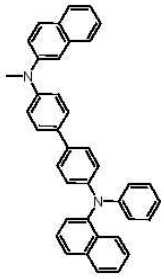
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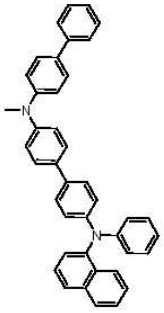
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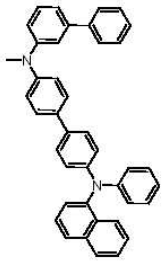
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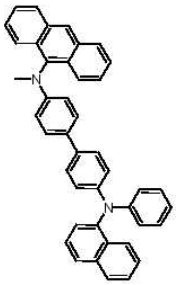
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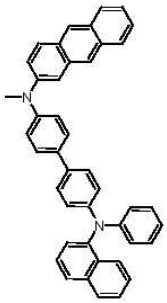
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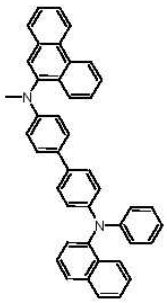
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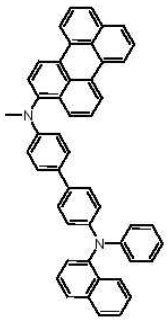
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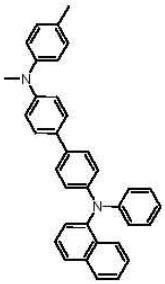
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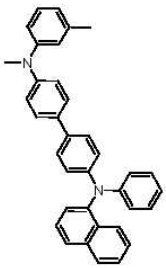
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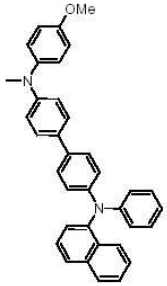
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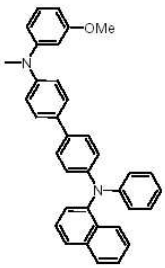
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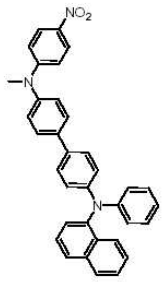
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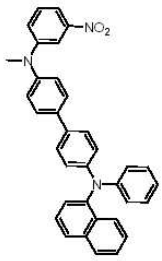
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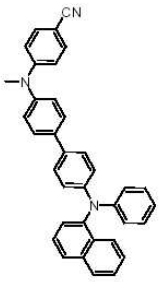
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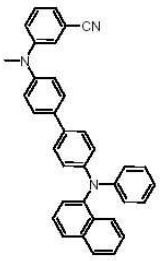
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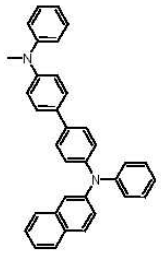
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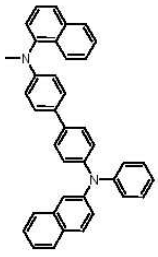
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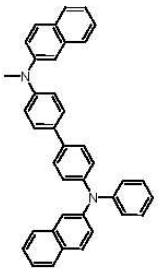
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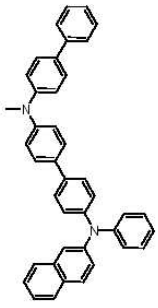
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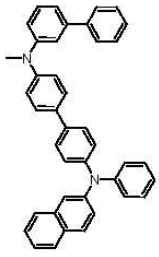
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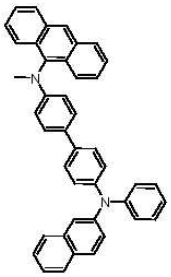
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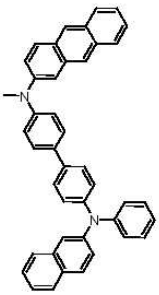
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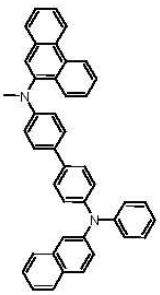
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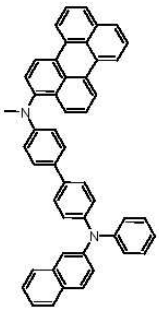
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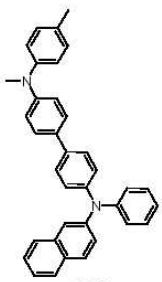
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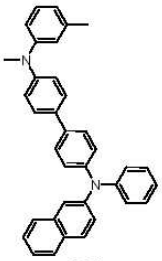
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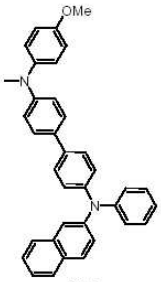
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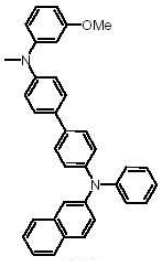
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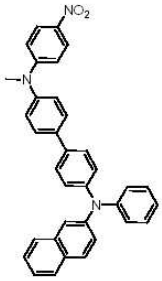
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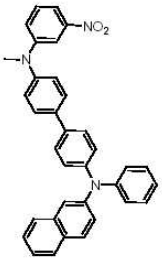
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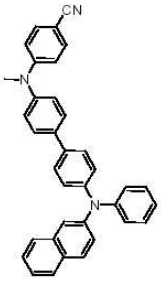
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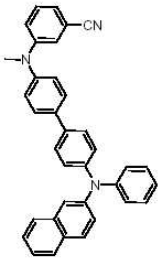
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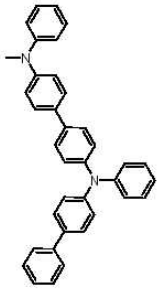
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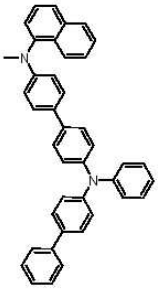
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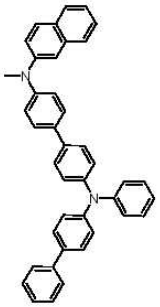
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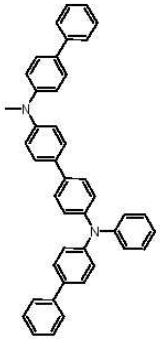
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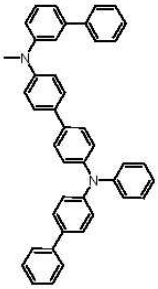
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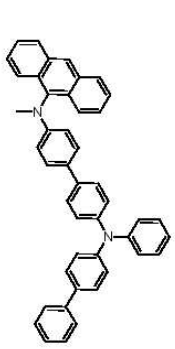
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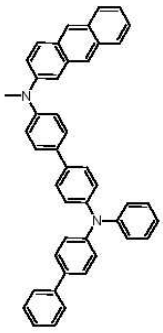
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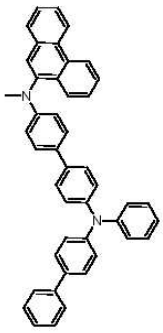
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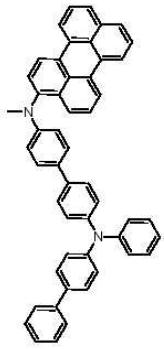
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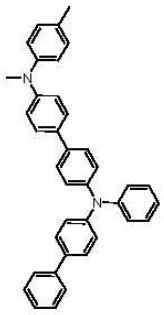
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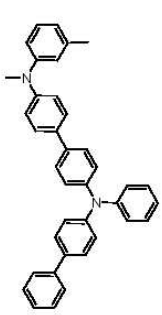
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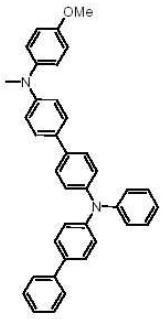
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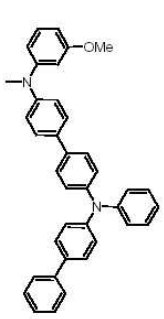
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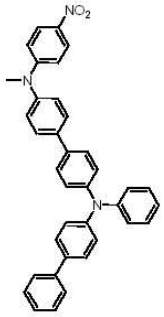
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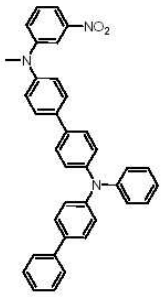
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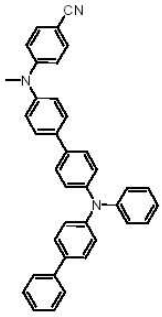
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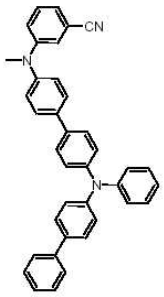
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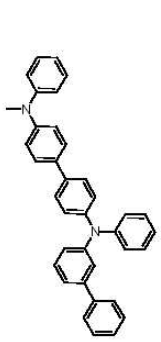
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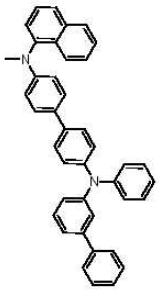
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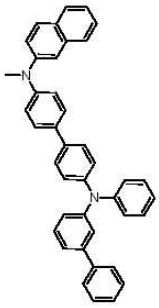
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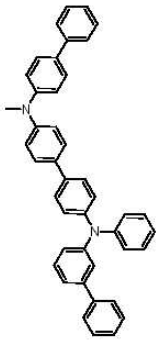
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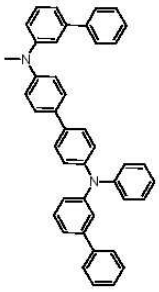
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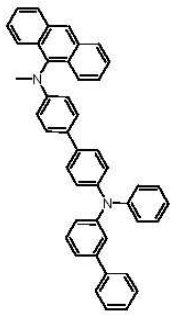
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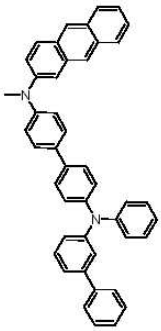
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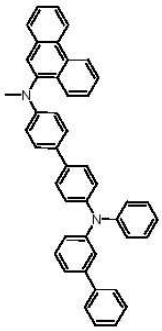
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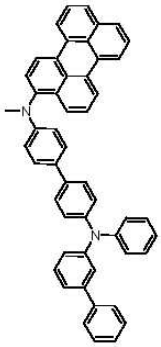
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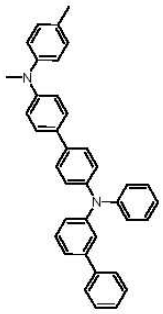
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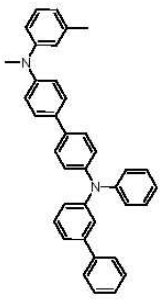
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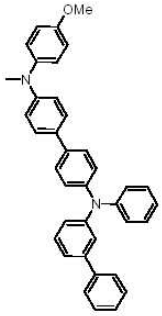
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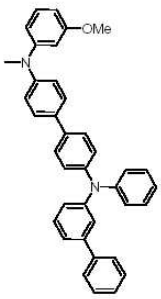
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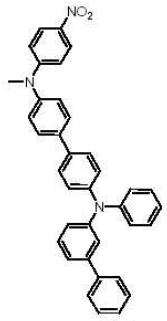
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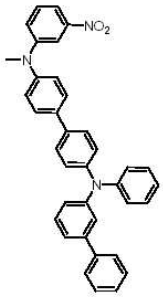


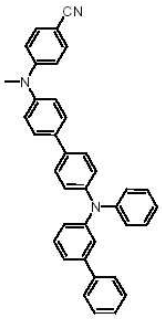
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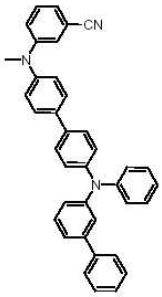


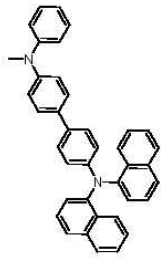
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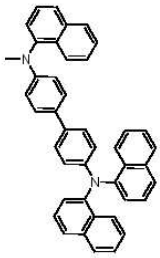

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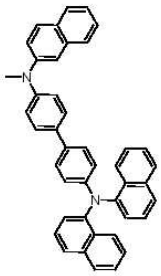

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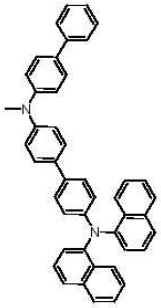

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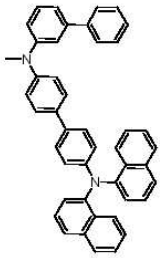

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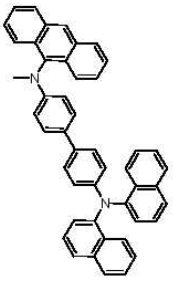

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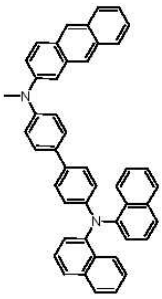

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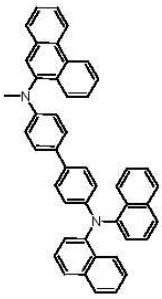

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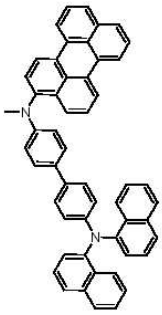

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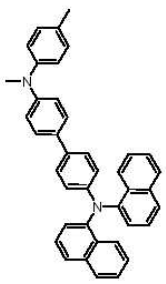

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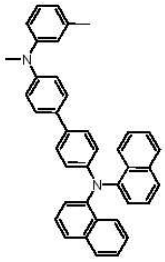

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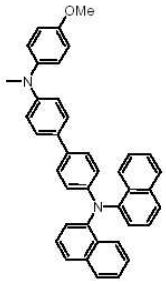

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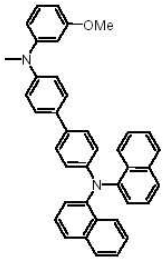
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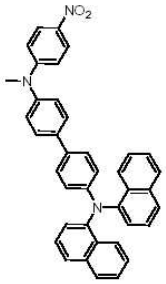
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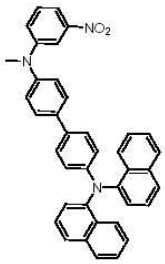
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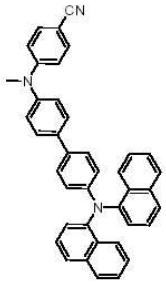
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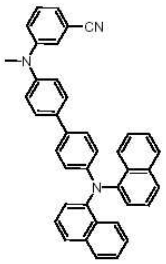
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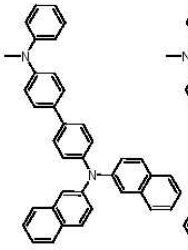
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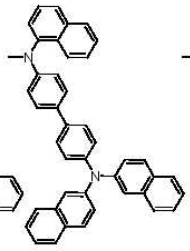
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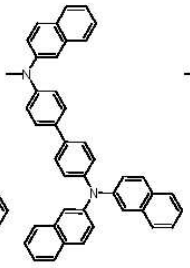
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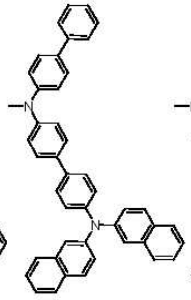
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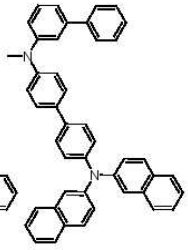
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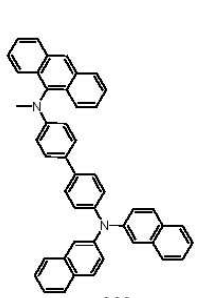
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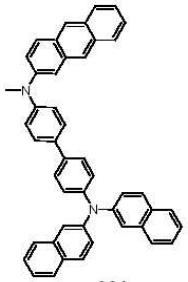
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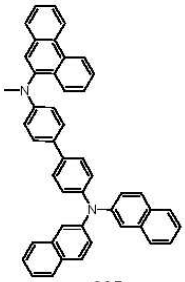
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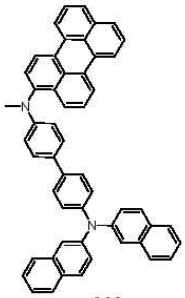
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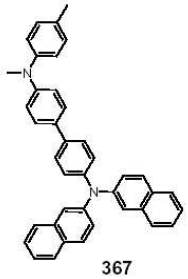
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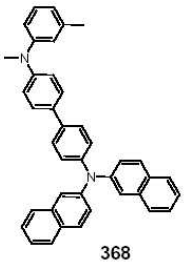
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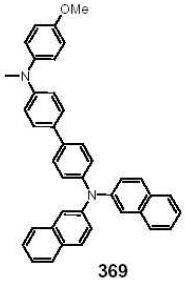
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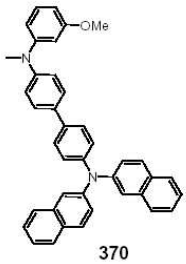
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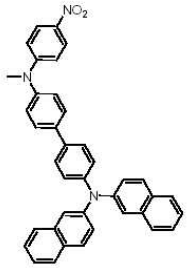
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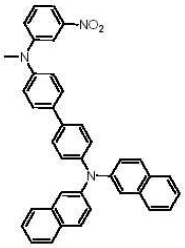
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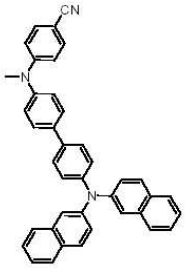
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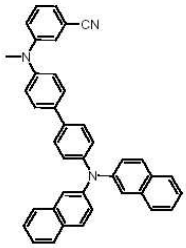
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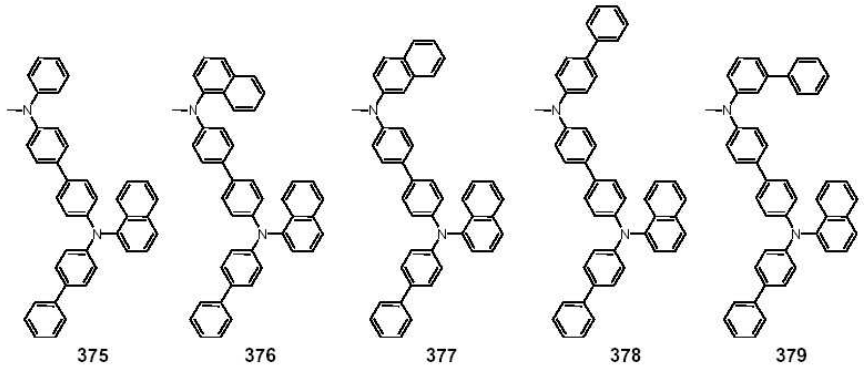
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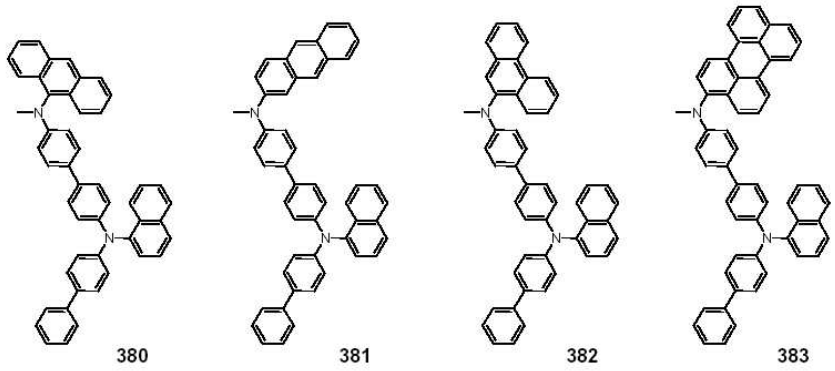


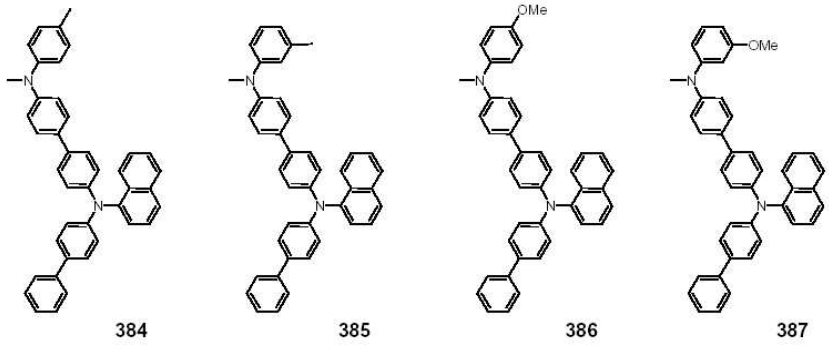
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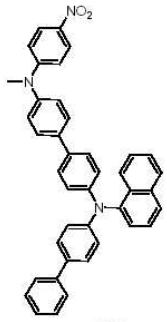


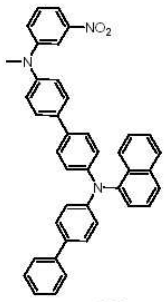
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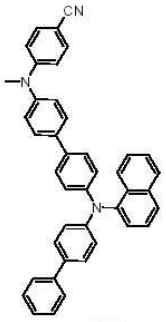

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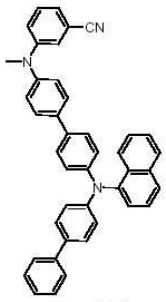

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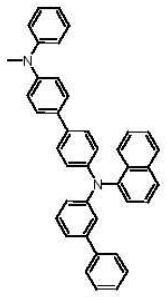

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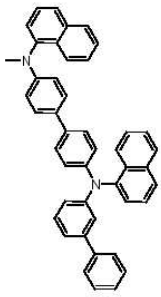

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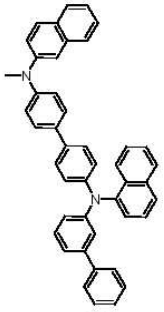

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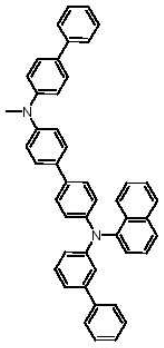

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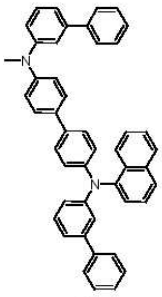

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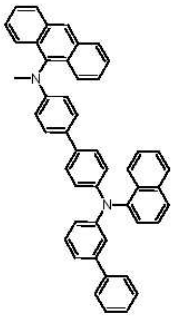

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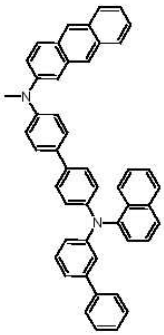

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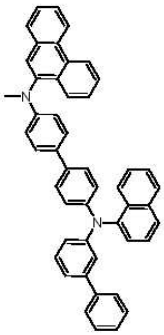

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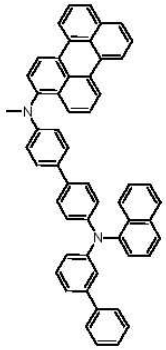

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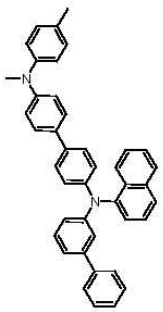

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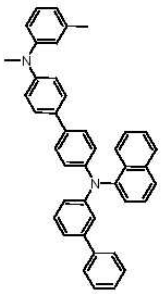

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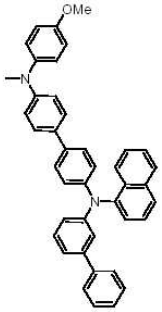

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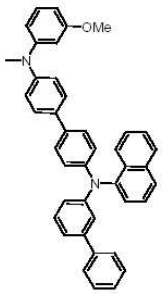
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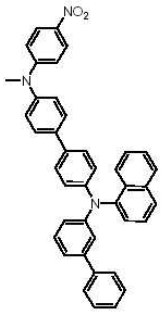
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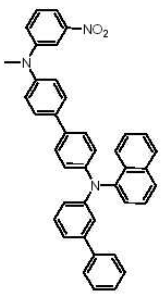
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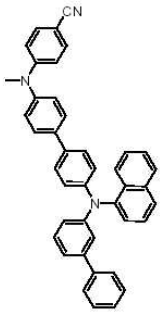
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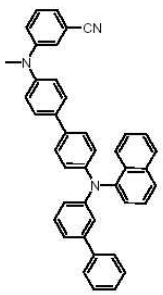
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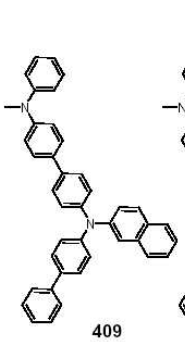
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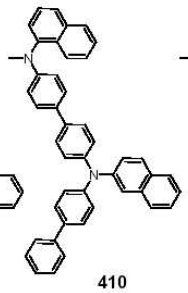
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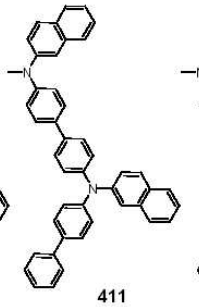
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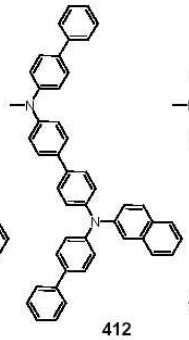
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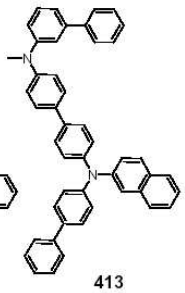
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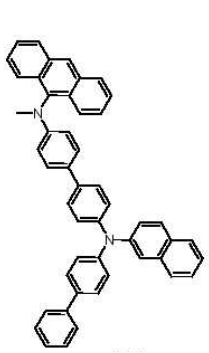
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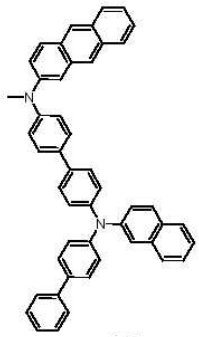
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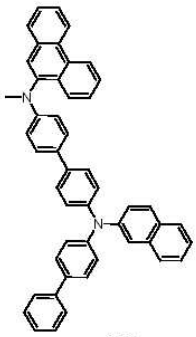
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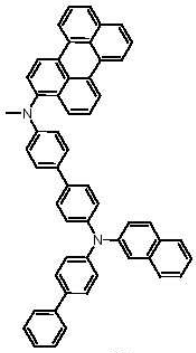
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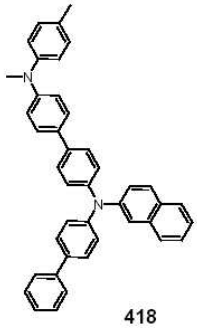
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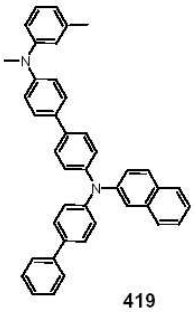
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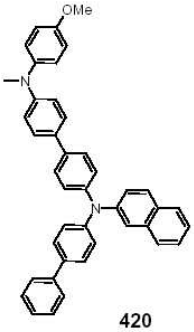
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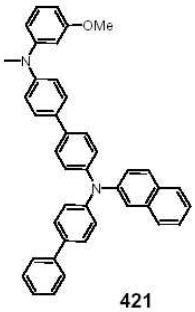
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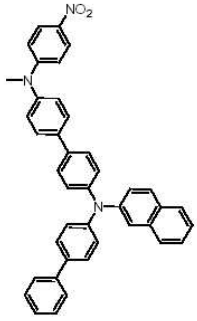
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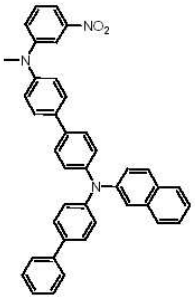
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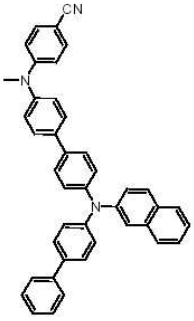
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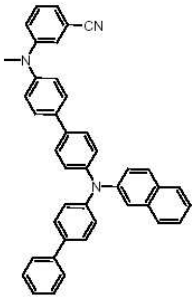
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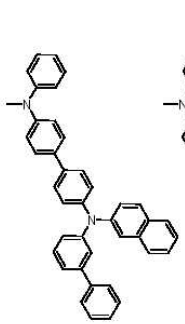
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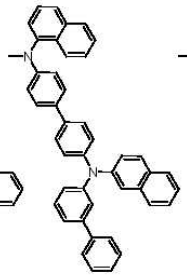


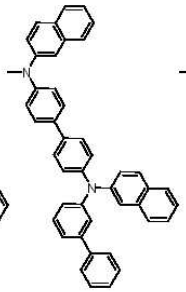
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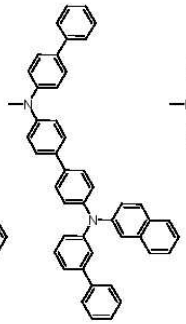


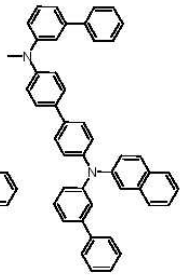
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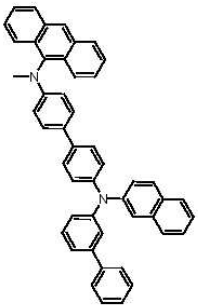

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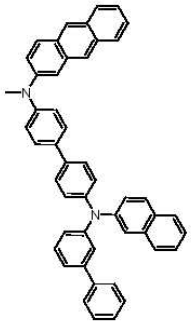

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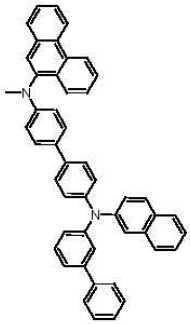

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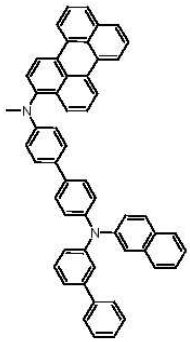

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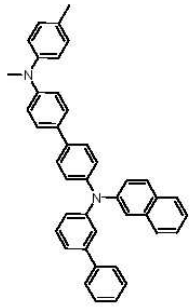

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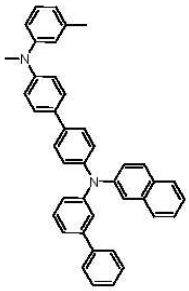

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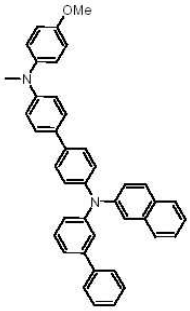

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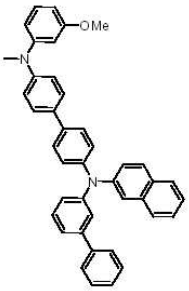

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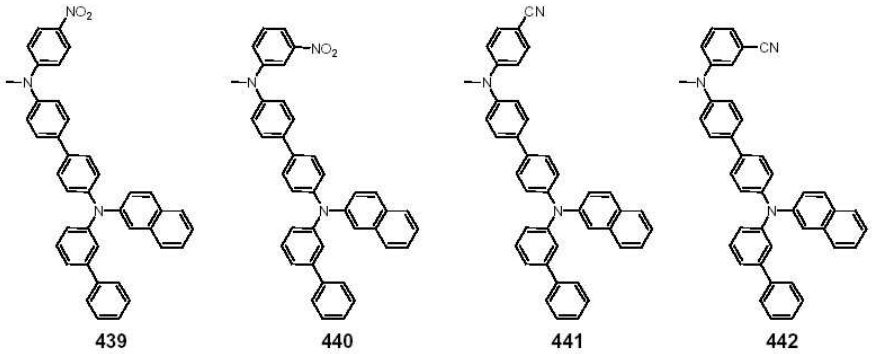

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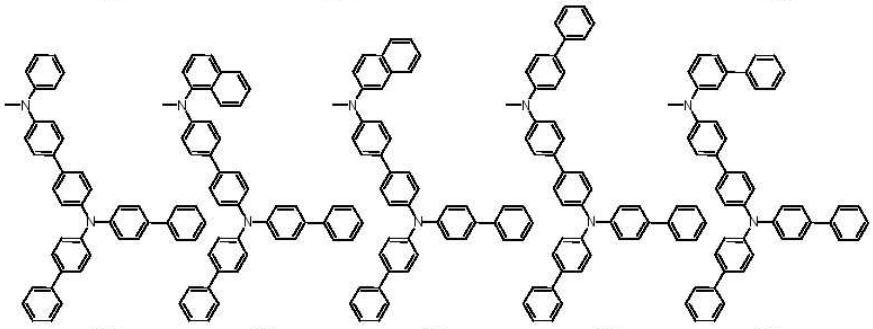

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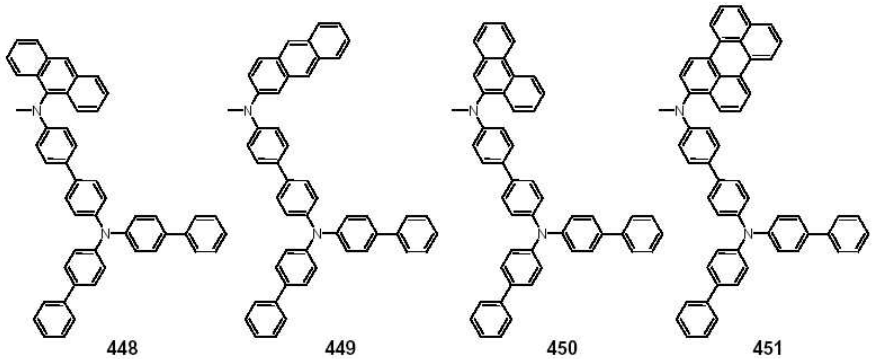

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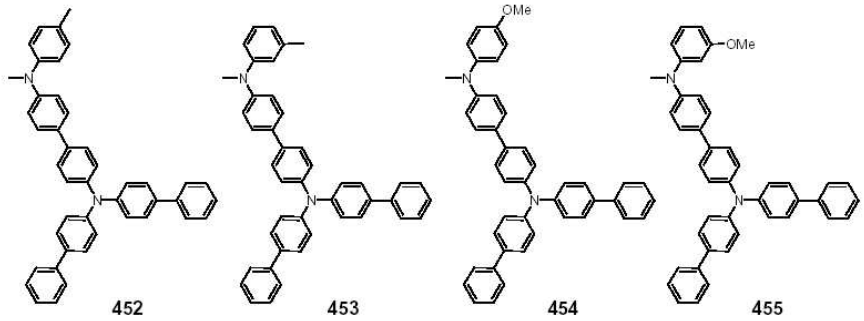
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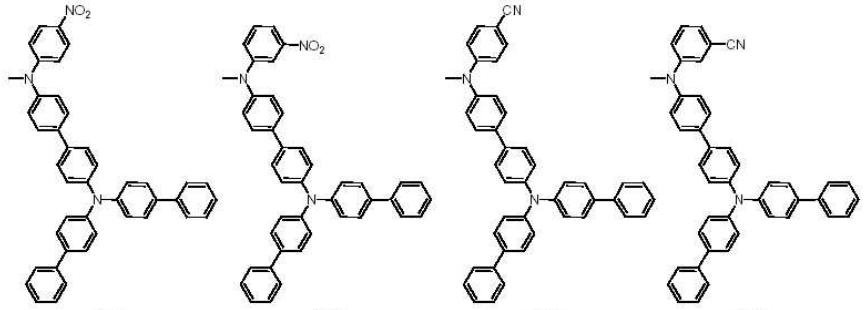
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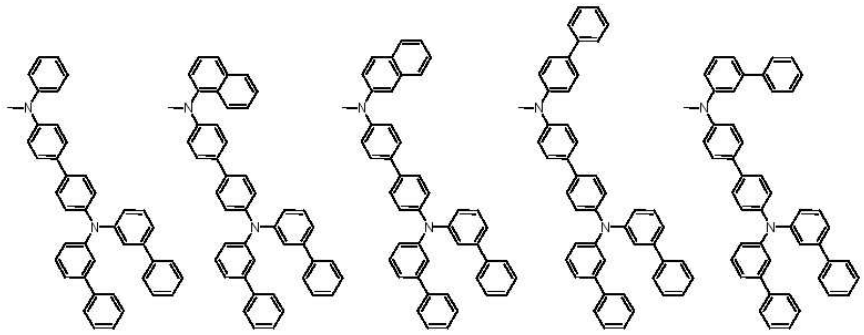
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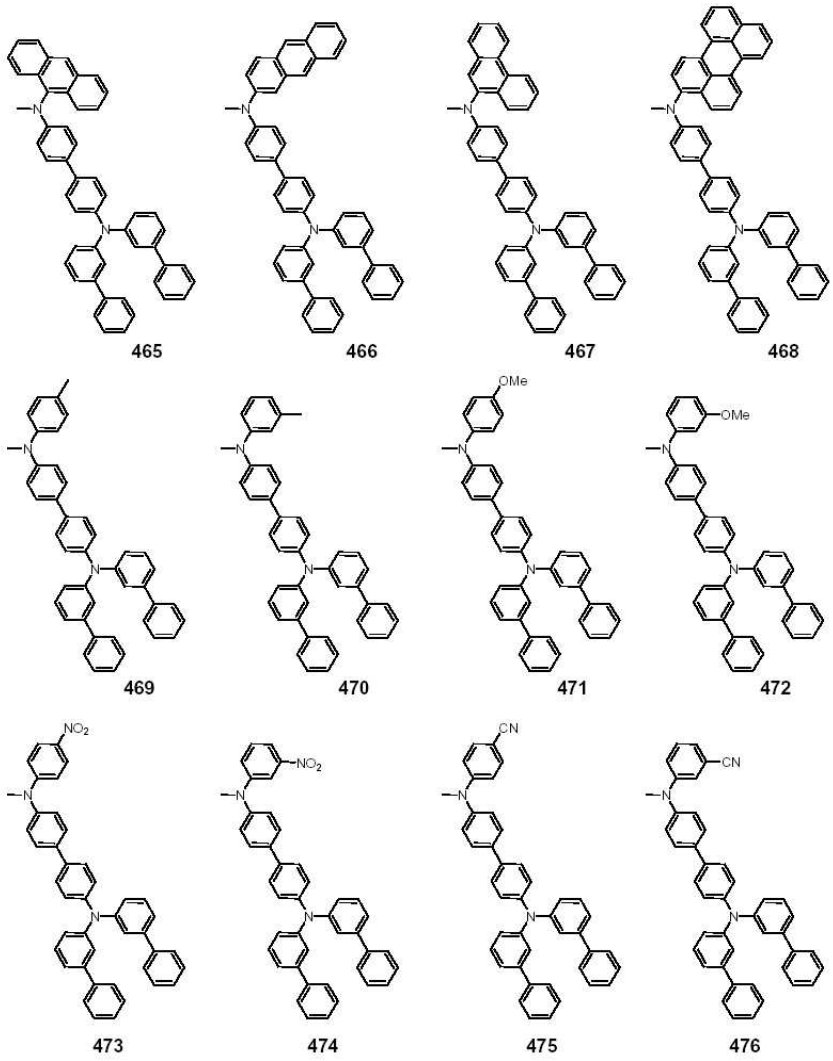
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456 457 458 459



460 461 462 463 464



청구항 6.

제1항에 있어서, 유기물층은 정공수송층을 포함하고, 이 정공수송층이 상기 화학식 1의 화합물, 또는 이 화합물에 열 경화성 또는 광경화성 작용기가 도입된 화합물을 포함하는 것인 유기 발광 소자.

청구항 7.

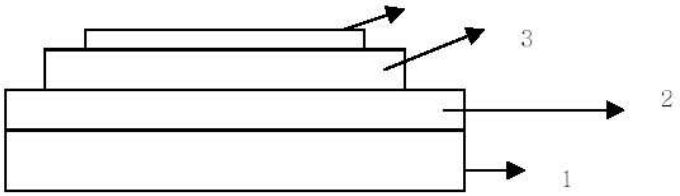
제1항에 있어서, 유기물층은 정공주입층을 포함하고, 이 정공주입층이 상기 화학식 1의 화합물, 또는 이 화합물에 열 경화성 또는 광경화성 작용기가 도입된 화합물을 포함하는 것인 유기 발광 소자.

청구항 8.

제1항에 있어서, 유기물층은 정공주입과 정공수송을 동시에 하는 층을 포함하고, 이 층이 상기 화학식 1의 화합물, 또는 이 화합물에 열 경화성 또는 광경화성 작용기가 도입된 화합물을 포함하는 것인 유기 발광 소자.

도면

도면1



도면2

