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61/716,810

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德國

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(54)名稱

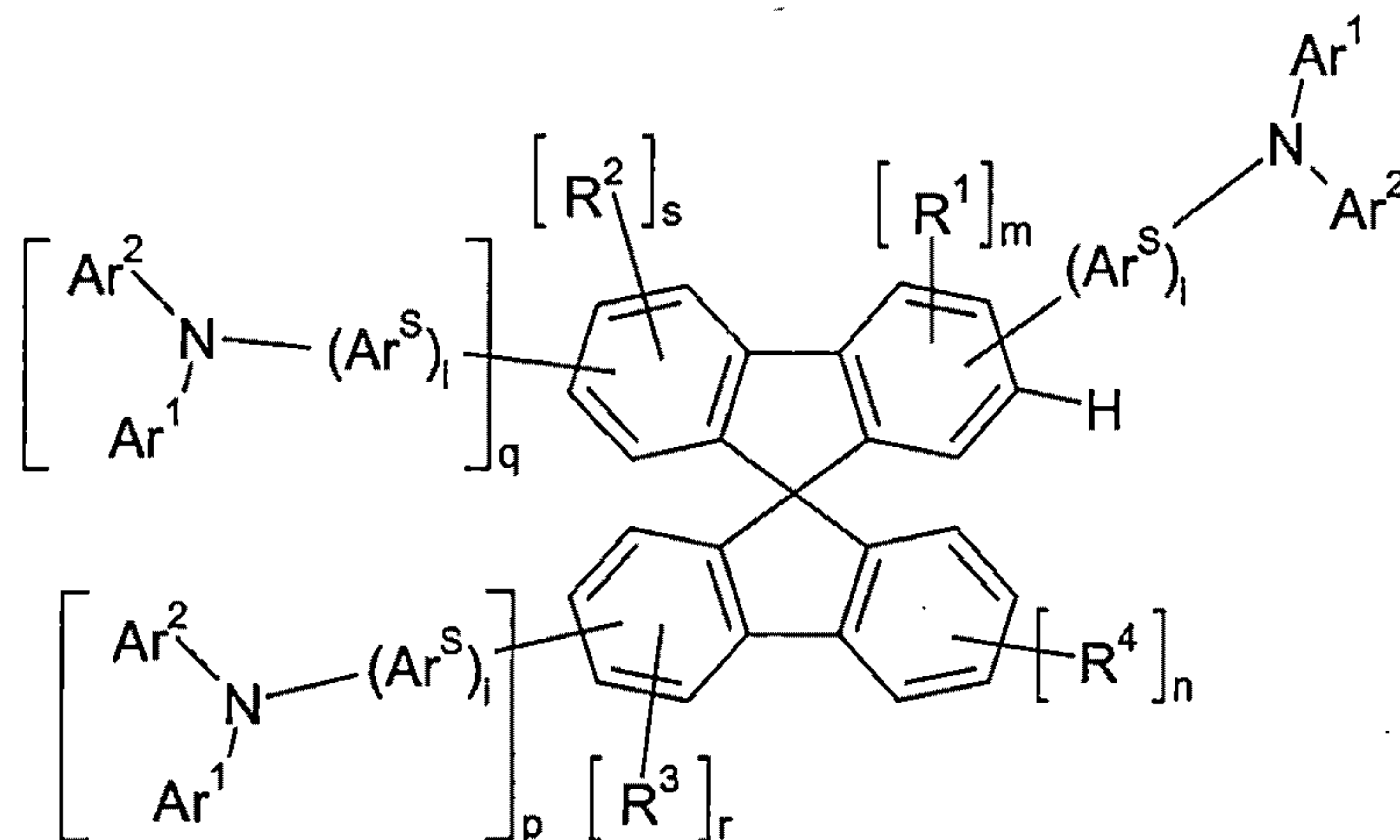
用於有機電致發光裝置的材料

(57)摘要

本發明係關於適合用於電子裝置(具體而言有機電致發光裝置)之式(1)化合物，且係關於包含該等化合物之電子裝置。

The present invention relates to compounds of the formula (1) which are suitable for use in electronic devices, in particular organic electroluminescent devices, and to electronic devices which comprise these compounds.

特徵化學式：



式(1)

I703115

發明摘要

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※ 申請日：102/02/08

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C07D 209/86 (2006.01)

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C09K 11/06 (2006.01)

H01L 51/00 (2006.01)

【發明名稱】

用於有機電致發光裝置的材料

MATERIALS FOR ORGANIC ELECTROLUMINESCENT
DEVICES

【中文】

本發明係關於適合用於電子裝置(具體而言有機電致發光裝置)之式(1)化合物，且係關於包含該等化合物之電子裝置。

【英文】

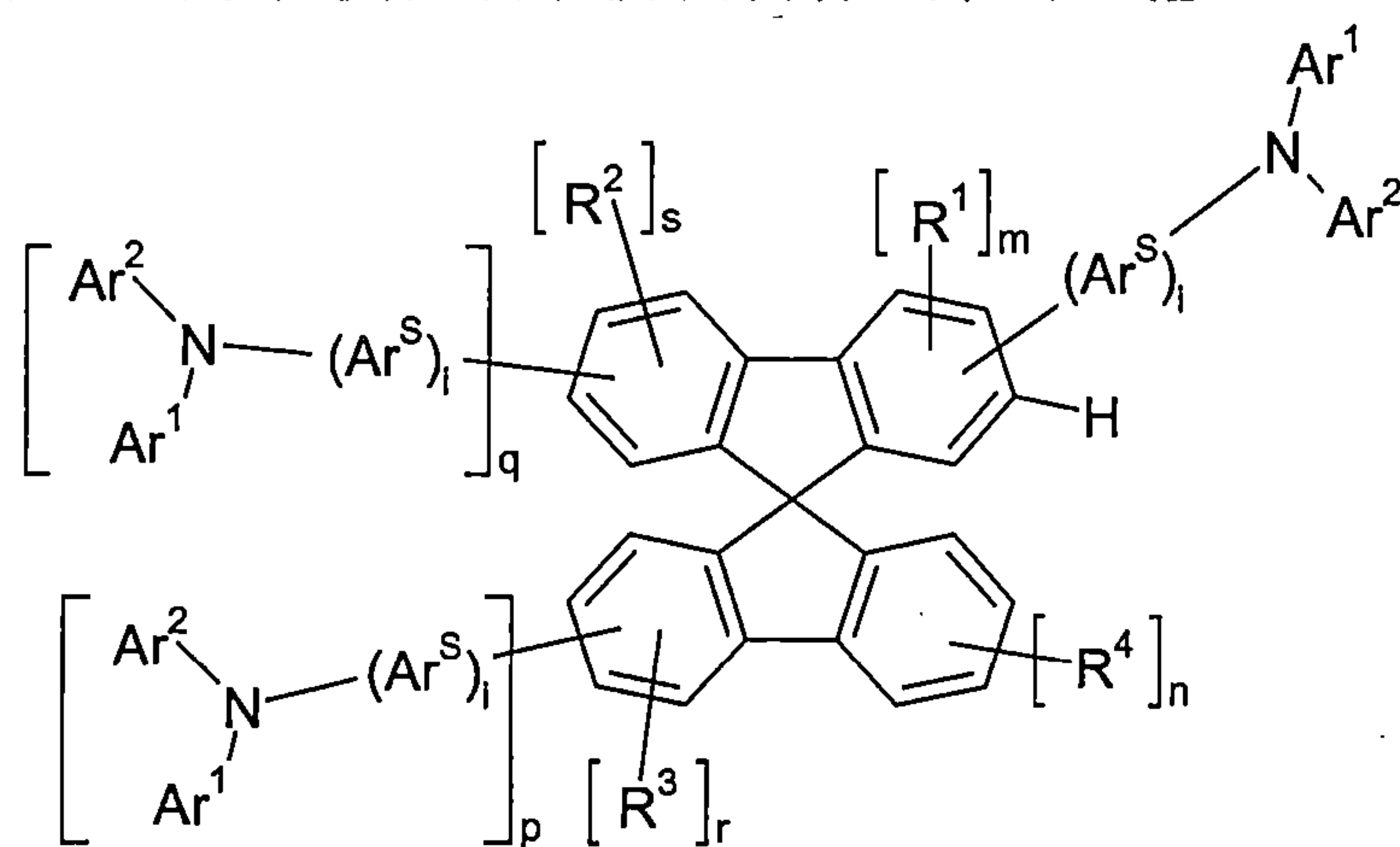
The present invention relates to compounds of the formula (1) which are suitable for use in electronic devices, in particular organic electroluminescent devices, and to electronic devices which comprise these compounds.

【代表圖】

【本案指定代表圖】：（無）

【本代表圖之符號簡單說明】：

【本案若有化學式時，請揭示最能顯示發明特徵的化學式】：



式(1)

發明專利說明書

(本說明書格式、順序，請勿任意更動)

【發明名稱】

用於有機電致發光裝置的材料

MATERIALS FOR ORGANIC ELECTROLUMINESCENT
DEVICES

本發明係關於用於電子裝置、具體而言有機電致發光裝置之材料，且係關於包含該等材料之電子裝置。

使用有機半導體作為功能材料之有機電致發光裝置(OLED)之結構闡述於(例如) US 4,539,507、US 5,151,629、EP 0676461及WO 98/27136中。此處所使用之發射材料正越來越多地為展示磷光而非螢光之有機金屬錯合物(M. A. Baldo等人，*Appl. Phys. Lett.* **1999**, 75, 4 - 6)。

根據先前技術，具體而言，用於電洞傳輸層或電洞注入層之電洞傳輸材料通常係含有至少兩個三芳基胺基或至少一個三芳基胺基及至少一個咔唑基團之三芳基胺衍生物。該等化合物通常係衍生自經二芳基胺基取代之三苯胺(TPA類型)、經二芳基胺基取代之聯苯衍生物(TAD型)或該等鹼性化合物之組合。此外，舉例而言，使用在2,7位或2,2',7,7'位經2個或4個二芳基胺基取代之螺二萘衍生物(例如，根據EP 676461或US 7,714,145)。此外，已知者係在每一情形下在4,4'位經二苯基胺基取代之螺二萘衍生物。在該等化合物之情形下，業內另外需要在螢光OLED之情形下及在磷光OLED之情形下尤其改良用於有機電致發光裝置時之效率、壽命及操作電壓。

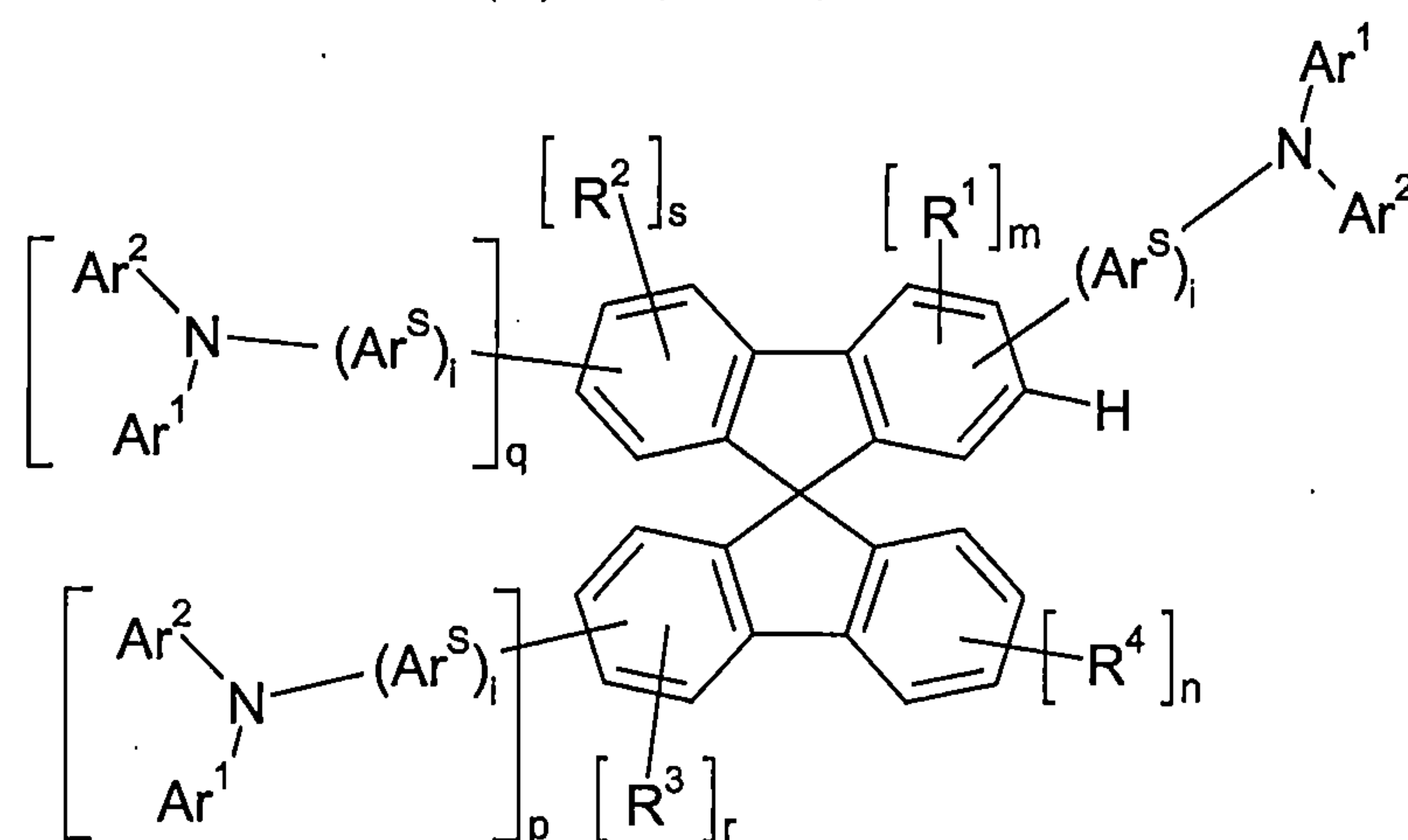
本發明之目的係提供適合(例如)作為電洞傳輸或激子阻擋層中之電洞傳輸材料或作為發射層中之基質材料用於螢光或磷光OLED、具

體而言磷光OLED之化合物。

令人驚訝的是，已發現下文更詳細闡述之某些化合物達成此目的且顯著改良有機電致發光裝置，具體而言改良其壽命、效率及操作電壓。此適用於磷光及螢光電致發光裝置，尤其利用本發明化合物作為電洞傳輸材料或作為基質材料。該等材料通常具有高熱穩定性且因此可昇華而不會分解且無殘留。因此，本發明係關於該等材料且係關於包含此類型化合物之電子裝置。

具體而言，令人驚訝之結果是，具體而言，用芳族單胺亦獲得極佳結果，因為在有機電致發光裝置中通常使用含有至少兩個氮原子之電洞傳輸材料。

因此，本發明係關於下式(1)之化合物，



式(1)

其中以下適用於所用符號及下標：

Ar^1 在每次出現時相同或不同且係具有6至60個C原子之芳族或雜芳族環系統，該芳族或雜芳族環系統選自由下列組成之群：萘、螺二萘、聯苯、聯三苯、聯四苯、呋喃、二苯并呋喃及二苯并噻吩，其每一者亦可經一或多個 R^5 基團取代；此處 Ar^1 及 Ar^2 亦可藉助E基團彼此連接；

Ar^2 在每次出現時相同或不同且係具有6至60個C原子之芳族

或雜芳族環系統，在每一情形下，其亦可經一或多個 R^5 基團取代；此處 Ar^1 及 Ar^2 亦可藉助E基團彼此連接；

Ar^5 在每次出現時相同或不同且係具有6至60個C原子之芳族或雜芳族環系統，在每一情形下，其亦可經一或多個 R^5 基團取代；

E 在每次出現時相同或不同且係單鍵、 $C(R^5)_2$ 、 NR^5 、O或S；

R^1 、 R^2 、 R^3 、 R^4 在每次出現時相同或不同且係選自由下列組成之群： H 、 D 、 F 、 Cl 、 Br 、 I 、 CN 、 $Si(R^6)_3$ ；具有1至40個C原子之直鏈烷基、烷氧基或硫烷基或具有3至40個C原子之具支鏈或環狀烷基、烷氧基或硫烷基，其每一者可經一或多個 R^6 基團取代，其中在每一情形下，一或多個非毗鄰 CH_2 基團可經 $Si(R^6)_2$ 、 $C=NR^6$ 、 $P(=O)(R^6)$ 、 SO 、 SO_2 、 NR^6 、O、S或 $CONR^6$ 替代且其中一或多個H原子可經 D 、 F 、 Cl 、 Br 或 I 替代；具有6至60個C原子之芳族或雜芳族環系統，在每一情形下，其可經一或多個 R^6 基團取代；具有5至60個芳族環原子之芳氧基或雜芳氧基，其可經一或多個 R^6 基團取代；或具有5至60個芳族環原子之芳烷基或雜芳烷基，在每一情形下，其可經一或多個 R^6 基團取代，其中兩個或更多個毗鄰取代基 R^1 或 R^2 或 R^3 或 R^4 可視情況形成可經一或多個 R^6 基團取代之單環或多環脂肪族環系統；

R^5 在每次出現時相同或不同且係選自由下列組成之群： H 、 D 、 F 、 Cl 、 Br 、 I 、 CN 、 $Si(R^6)_3$ ；具有1至40個C原子之直鏈烷基、烷氧基或硫烷基或具有3至40個C原子之具支鏈或環狀烷基、烷氧基或硫烷基，其每一者可經一或多個 R^6 基團取代，其中在每一情形下，一或多個非毗鄰 CH_2 基團可經 $Si(R^6)_2$ 、 $C=NR^6$ 、 $P(=O)(R^6)$ 、 SO 、 SO_2 、 NR^6 、O、S或 $CONR^6$ 替代且其中一或多個H原子可經 D 、 F 、 Cl 、 Br 或 I 替代；具有6至60個C原子之芳族或雜芳族環系統，在每一情形下，其可經一或多個 R^6 基團取代；具有5至60個芳族環原子之芳氧基或雜

芳氧基，其可經一或多個 R^6 基團取代；或具有5至60個芳族環原子之芳烷基或雜芳烷基，在每一情形下，其可經一或多個 R^6 基團取代，其中兩個或更多個毗鄰取代基 R^5 可視情況形成可經一或多個 R^6 基團取代之單環或多環脂肪族環系統；

R^6 係選自由下列組成之群：H、D、F、具有1至20個C原子之脂肪族烴基或具有5至30個C原子之芳族或雜芳族環系統，其中一或多個H原子可經D或F替代，其中兩個或更多個毗鄰取代基 R^6 可與彼此形成單環或多環脂肪族環系統；

i 每次出現時相同或不同且係0或1；

m 係0、1或2；

n 每次出現時相同或不同且係0、1、2、3或4；

p、q 每次出現時相同或不同且係0或1；

r、s 每次出現時相同或不同且係0、1、2、3或4，其中 $p + r \leq 4$ 且 $q + s \leq 4$ 。

另外，本發明係關於式(1)之化合物，條件係以下定義而非上文定義適用於 Ar^1 及 Ar^2 基團：

如上文所定義， Ar^1 及 Ar^2 基團經由E基團彼此連接，且

Ar^1 及 Ar^2 基團在每次出現時相同或不同且係具有6至60個C原子之芳族或雜芳族環系統，在每一情形下，其亦可經一或多個 R^5 基團取代。

【圖式簡單說明】

(無)

在本發明意義上，芳基意指簡單芳族環(即苯)或稠合(condensed, anellated)芳基(例如萘或菲)。相比而言，藉助單鍵彼此連接之芳族基團(例如，聯苯或萸)不稱為芳基，而是作為芳族環系統。

在本發明意義上，雜芳基在芳族環中包含至少一個雜原子，較佳選自N、O及S之雜原子。雜芳基可僅包含簡單雜芳族環，例如吡啶、三嗪或噻吩，或其可為稠合雜芳基，例如喹啉或呋唑。

在本發明意義上，芳族環系統在環系統中含有6至60個C原子，其中該芳族環系統可自(例如)苯、萘、菲、蒽及螺二蒽或該等基團之組合建構。具體而言，在本發明意義上，芳族環系統亦意欲另外意指複數個芳基係直接或經由碳原子彼此連接之系統。因此，具體而言，在本發明意義上，諸如聯苯、聯三苯、聯四苯、蒽、9,9'-螺二蒽、9,9-二芳基蒽等系統亦意欲為芳族環系統。此處定義之芳族環系統不含胺基。因此，芳族環系統之定義不包括三芳基胺基。

類似定義適用於術語雜芳族環系統，其應理解為兩個或更多個互連芳基或雜芳基之組合，該等互連芳基或雜芳基中之至少一個係雜芳基。

芳烷基應理解為經芳基取代之烷基，其中該芳基係如上文所定義，且該烷基可具有1至20個C原子，且可如上文針對烷基所述經取代，且可具有一或多個如上文針對烷基所述經替代之 CH_2 基團。在芳烷基中，烷基係鍵結至該化合物之其餘部分之基團。類似定義適用於術語雜芳烷基，只是存在雜芳基而非芳基。

芳氧基應理解為經由二價(醚)氧原子鍵結之芳基。類似定義適用於術語雜芳氧基，只是存在雜芳基而非芳基。

出於本發明之目的，脂肪族烴基或烷基或烯基或炔基(其通常可含有1至40亦或1至20個C原子且另外，其中個別H原子或 CH_2 基團可經上述基團取代)較佳意指以下基團：甲基、乙基、正丙基、異丙基、正丁基、異丁基、第二丁基、第三丁基、2-甲基丁基、正戊基、第二戊基、新戊基、環戊基、正己基、新己基、環己基、正庚基、環庚基、正辛基、環辛基、2-乙基己基、三氟甲基、五氟乙基、2,2,2-三

氟乙基、乙烯基、丙烯基、丁烯基、戊烯基、環戊烯基、己烯基、環己烯基、庚烯基、環庚烯基、辛烯基、環辛烯基、乙炔基、丙炔基、丁炔基、戊炔基、己炔基、庚炔基或辛炔基。

具有1至40個C原子之烷氧基較佳意指甲氧基、三氟甲氧基、乙氧基、正丙氧基、異丙氧基、正丁氧基、異丁氧基、第二丁氧基、第三丁氧基、正戊氧基、第二戊氧基、2-甲基丁氧基、正己氧基、環己氧基、正庚氧基、環庚氧基、正辛氧基、環辛氧基、2-乙基己氧基、五氟乙氧基或2,2,2-三氟乙氧基。

具體而言，具有1至40個C原子之硫烷基意指甲硫基、乙硫基、正丙硫基、異丙硫基、正丁硫基、異丁硫基、第二丁硫基、第三丁硫基、正戊硫基、第二戊硫基、正己硫基、環己硫基、正庚硫基、環庚硫基、正辛硫基、環辛硫基、2-乙基己硫基、三氟甲硫基、五氟乙硫基、2,2,2-三氟乙硫基、乙烯硫基、丙烯硫基、丁烯硫基、戊烯硫基、環戊烯硫基、己烯硫基、環己烯硫基、庚烯硫基、環庚烯硫基、辛烯硫基、環辛烯硫基、乙炔硫基、丙炔硫基、丁炔硫基、戊炔硫基、己炔硫基、庚炔硫基或辛炔硫基。

一般而言，本發明之烷基、烷氧基或硫烷基可為直鏈、具支鏈或環狀，其中一或多個非毗鄰 CH_2 基團可經上述基團替代；此外，一或多個H原子亦可經D、F、Cl、Br、I、CN或 NO_2 替代，較佳F、Cl或CN，又較佳F或CN，尤佳CN。

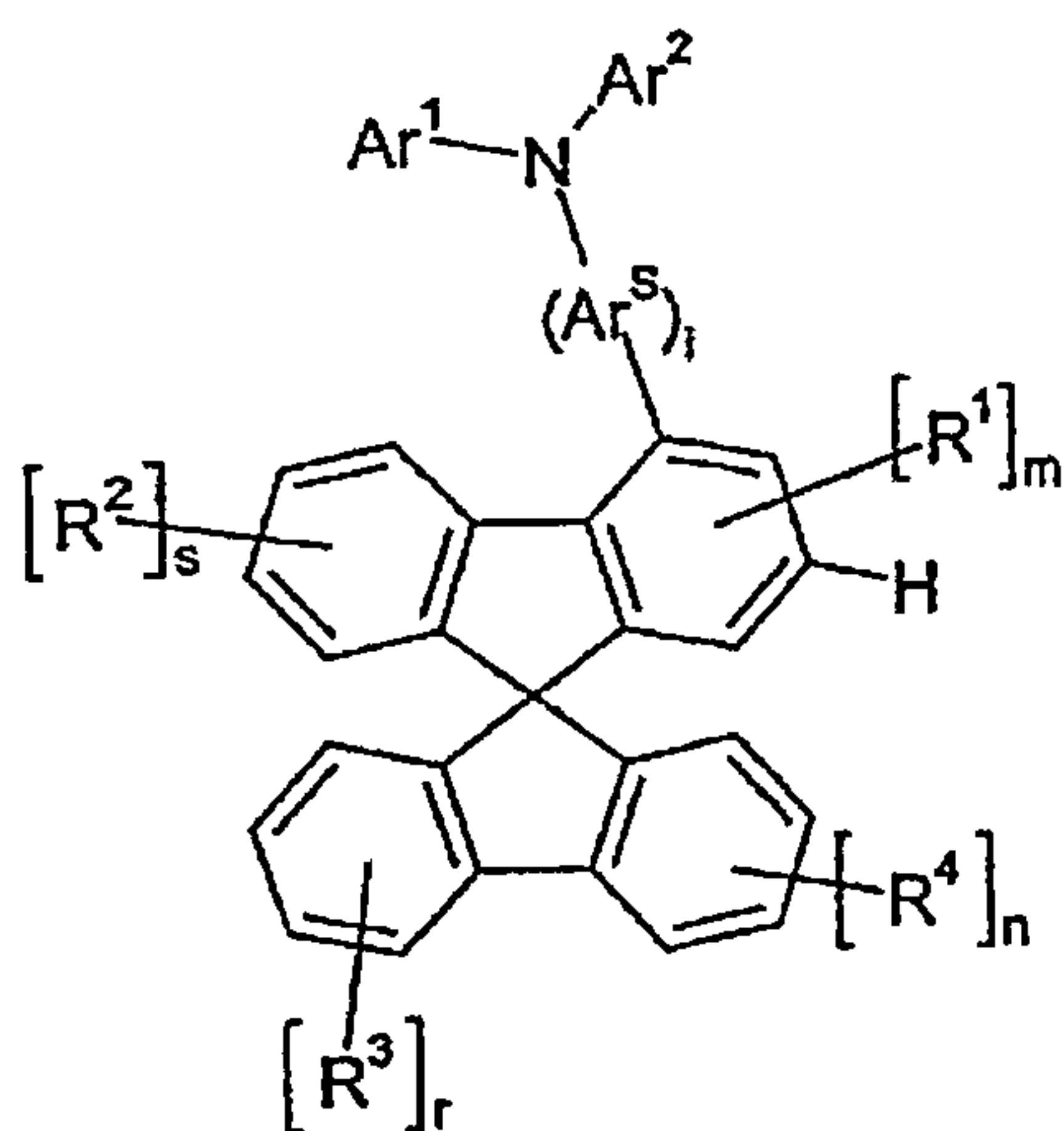
在本發明之較佳實施例中， $p + q = 0$ 或1。因此，本發明化合物較佳含有1或2個二芳基胺基。

在較佳實施例中， m 、 s 、 r 及 n 每次出現時相同或不同且係0或1，更佳係0。

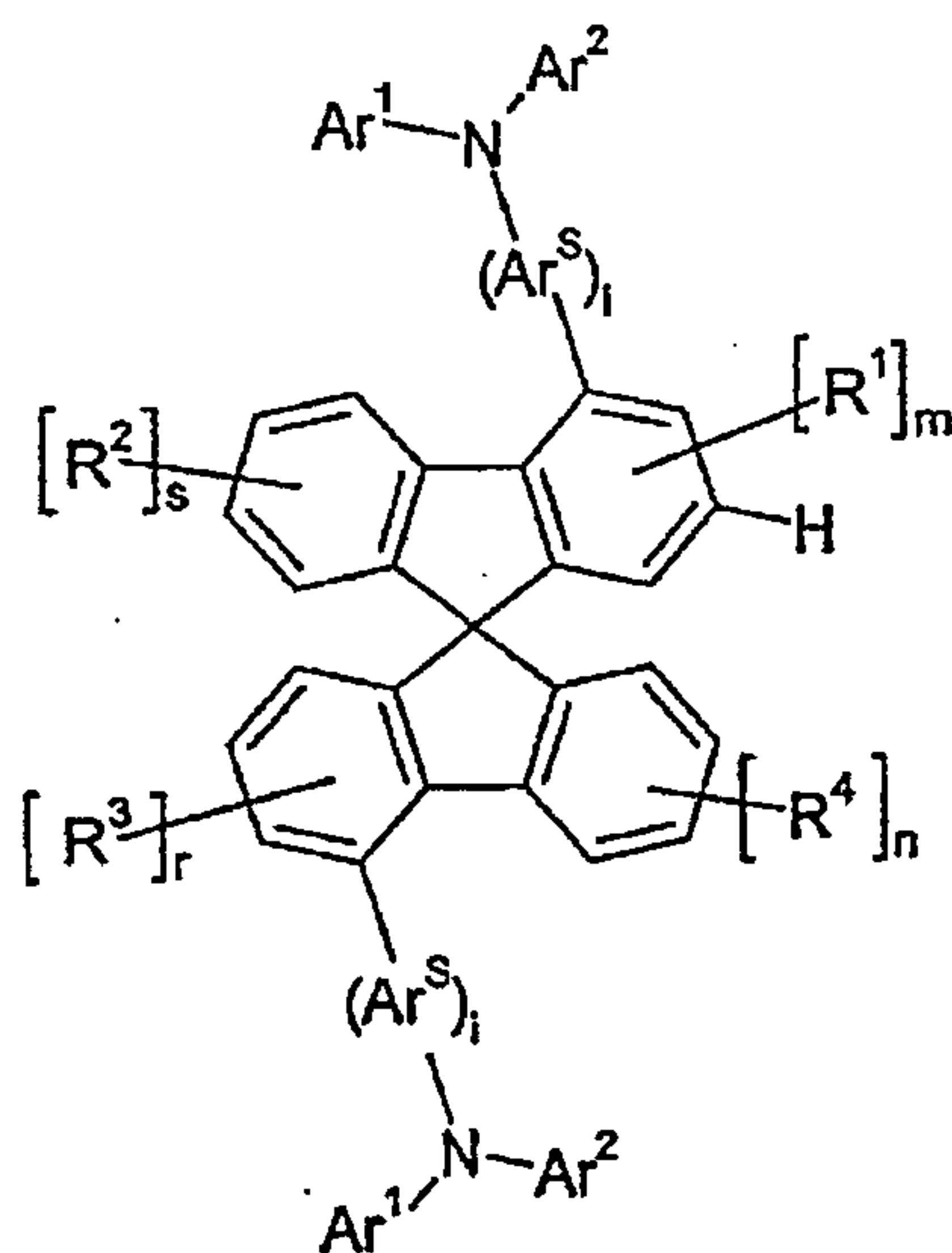
根據本發明之另一較佳實施例，在式(1)中一個以上下標 i 係1。更佳地，下標 i 通常等於0。對於下標 i 係0之情形，應瞭解，螺二萸與

氮原子係直接連接。

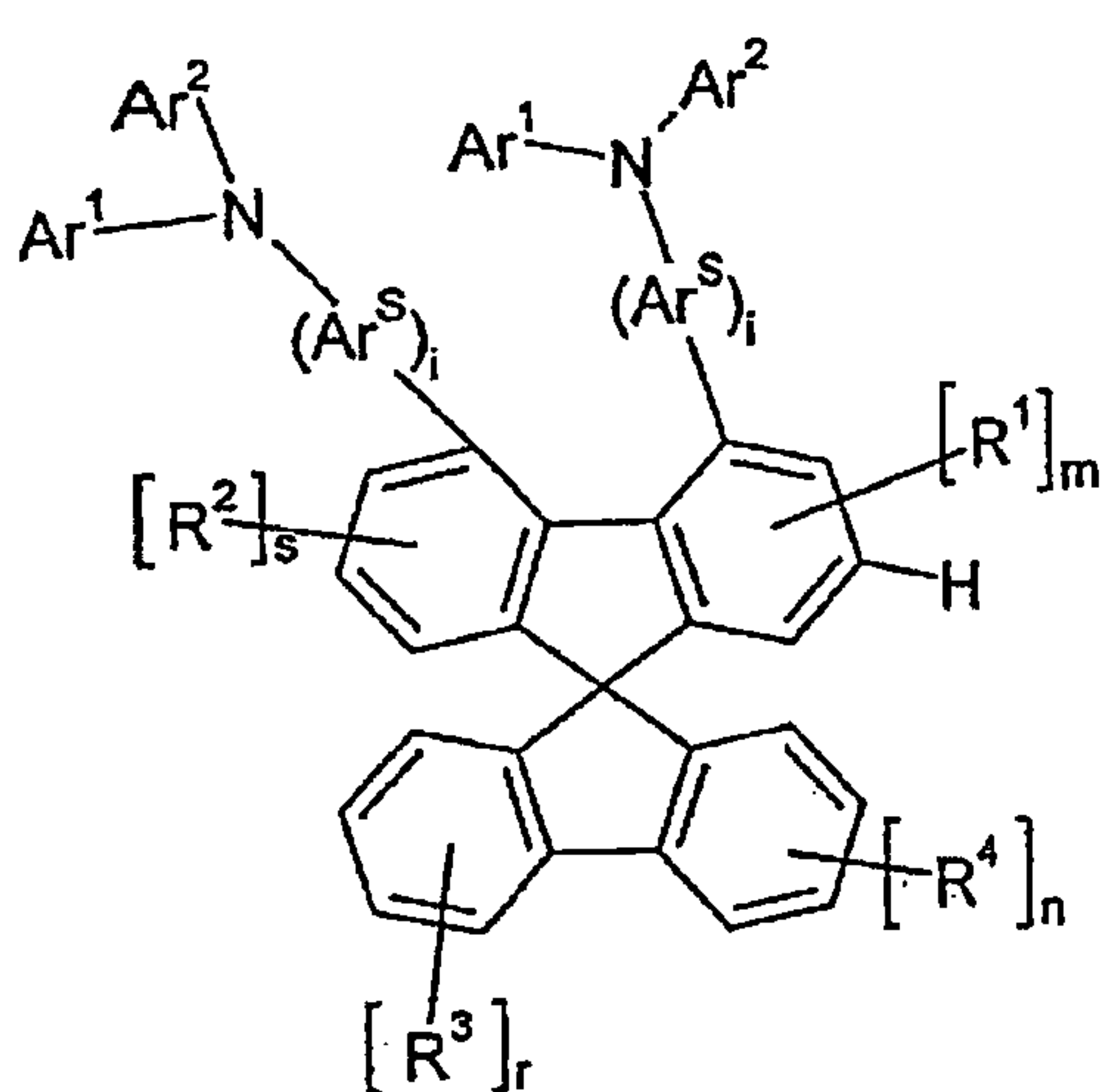
在本發明之較佳實施例中，式(1)之化合物係選自式(2)至(10)之化合物，



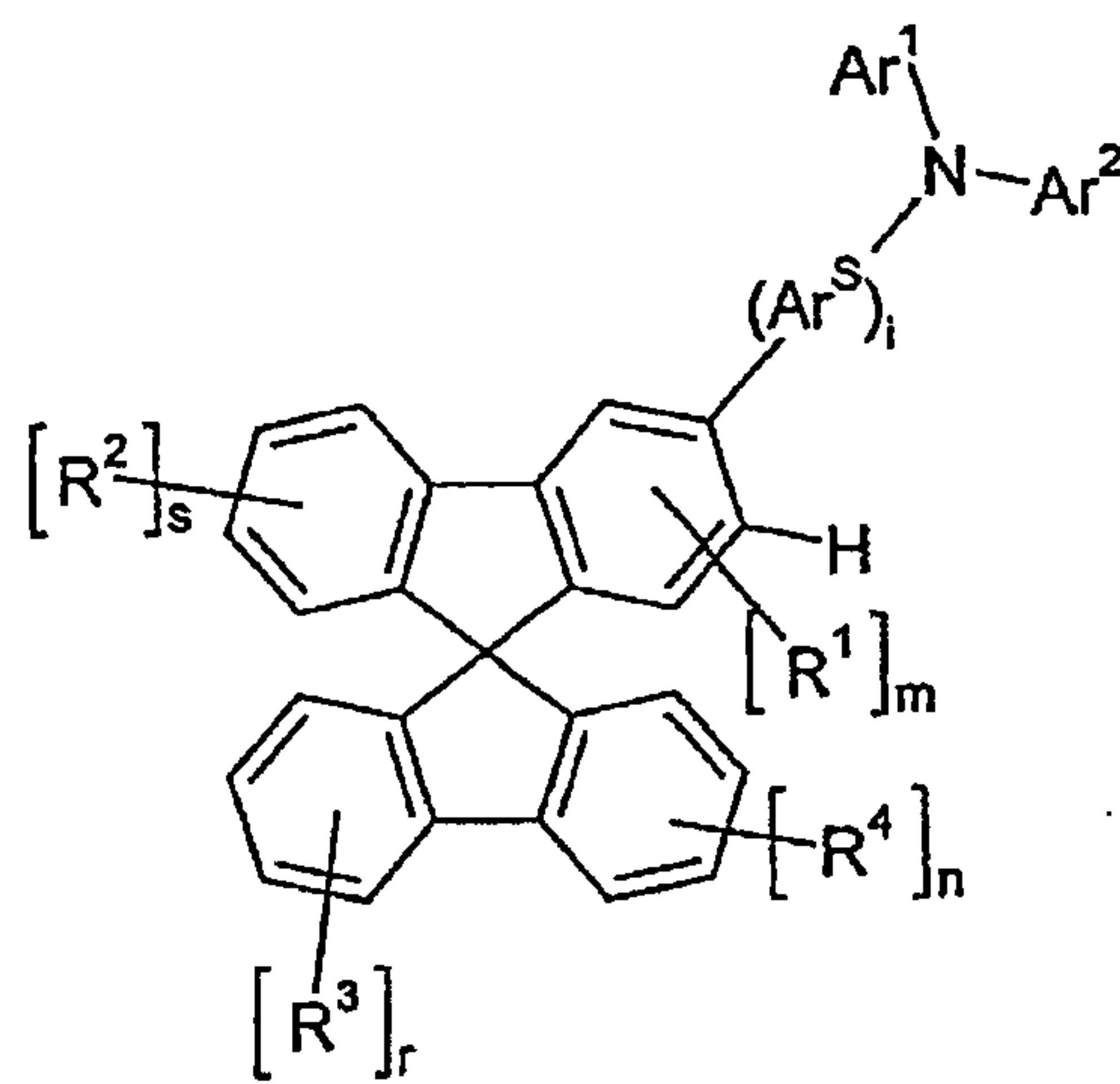
式(2)



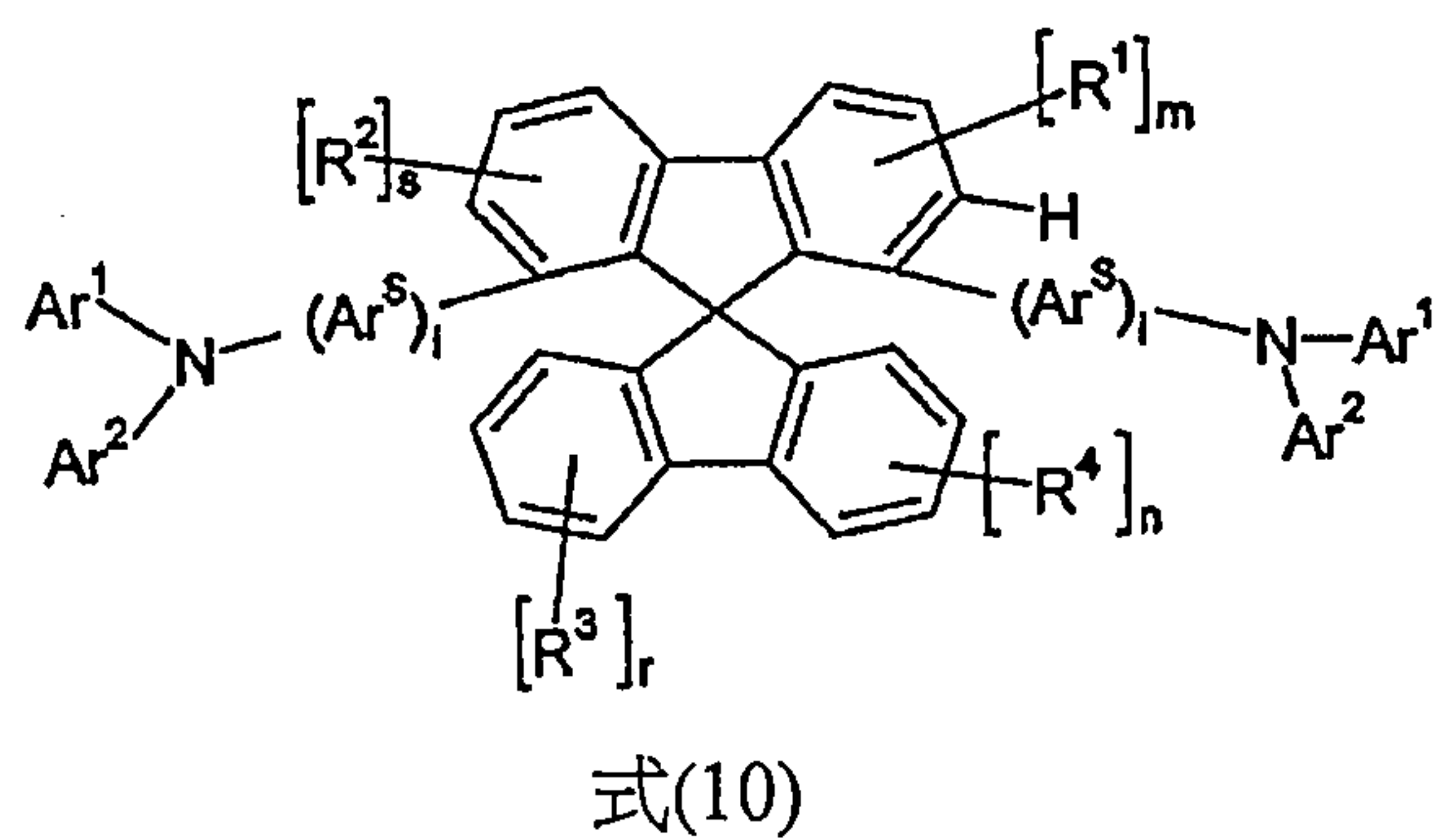
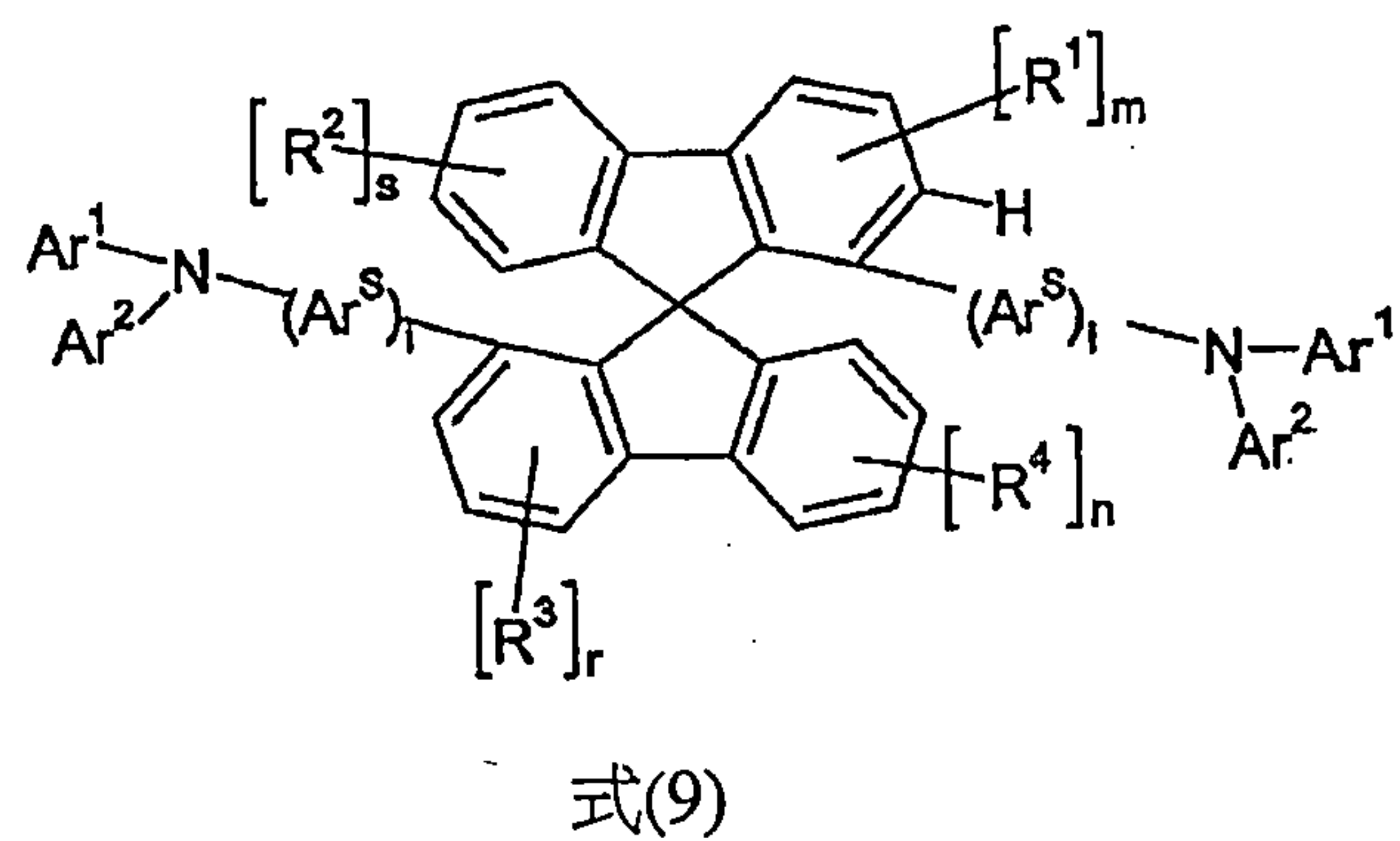
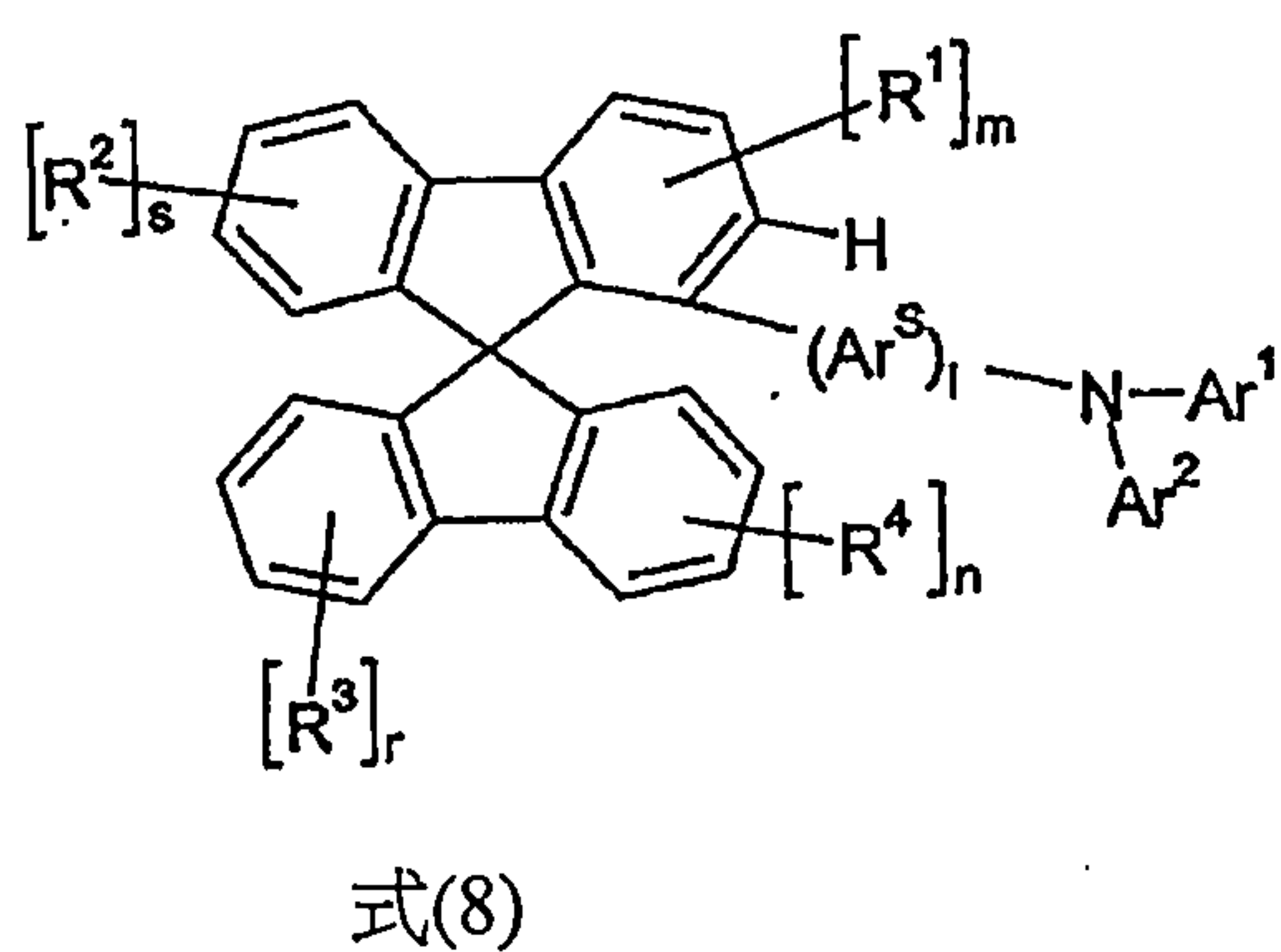
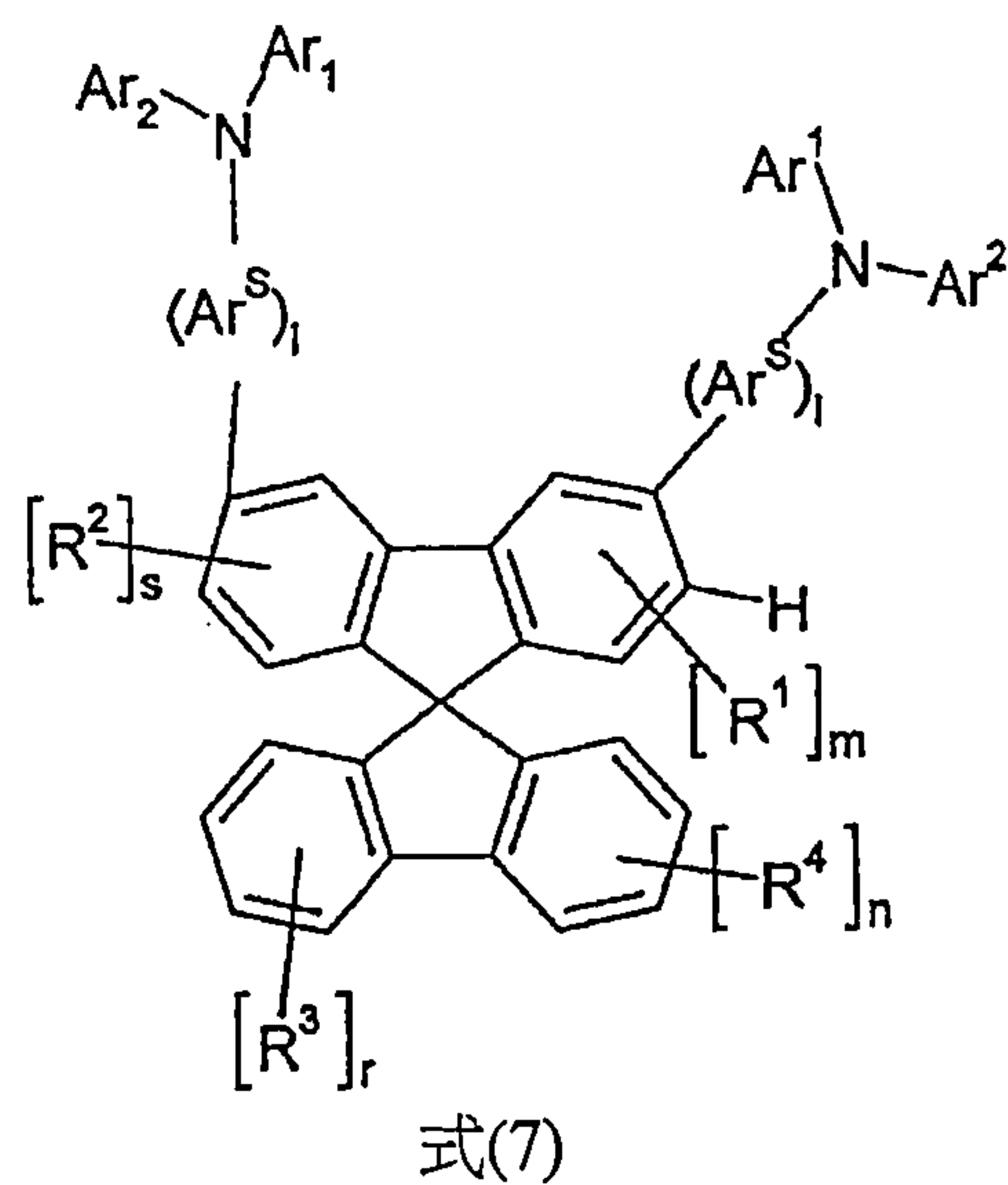
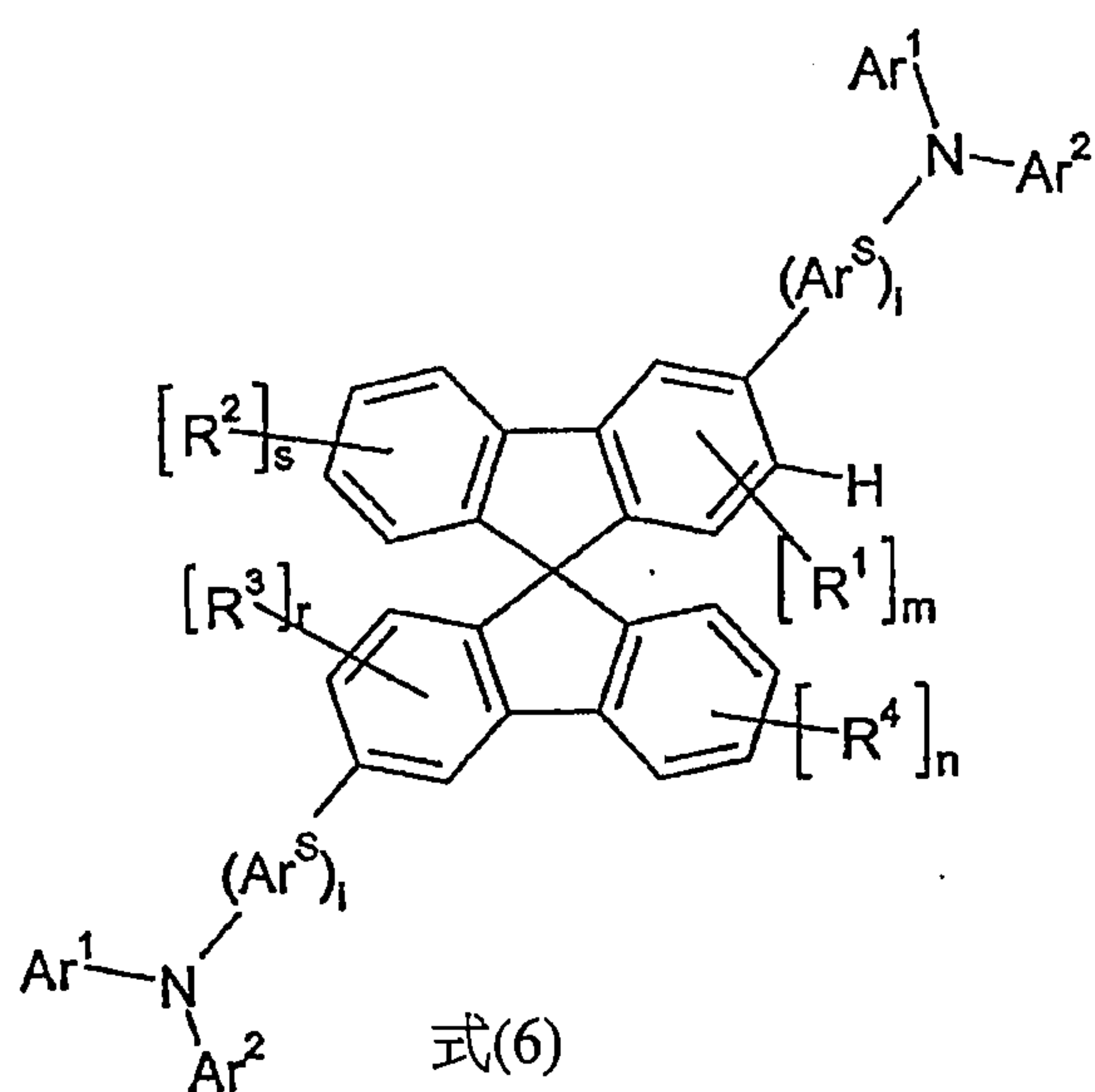
式(3)



式(4)



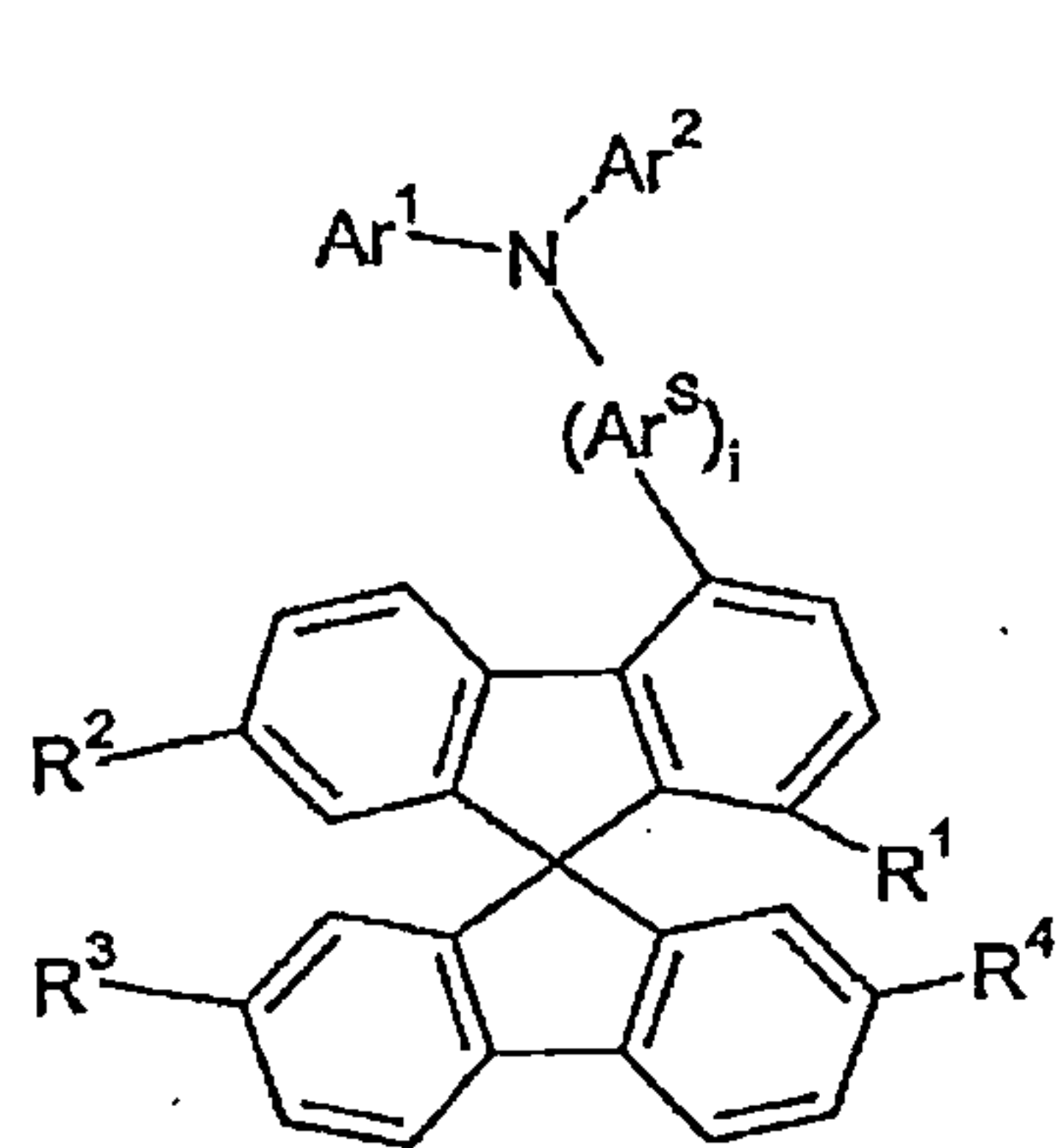
式(5)



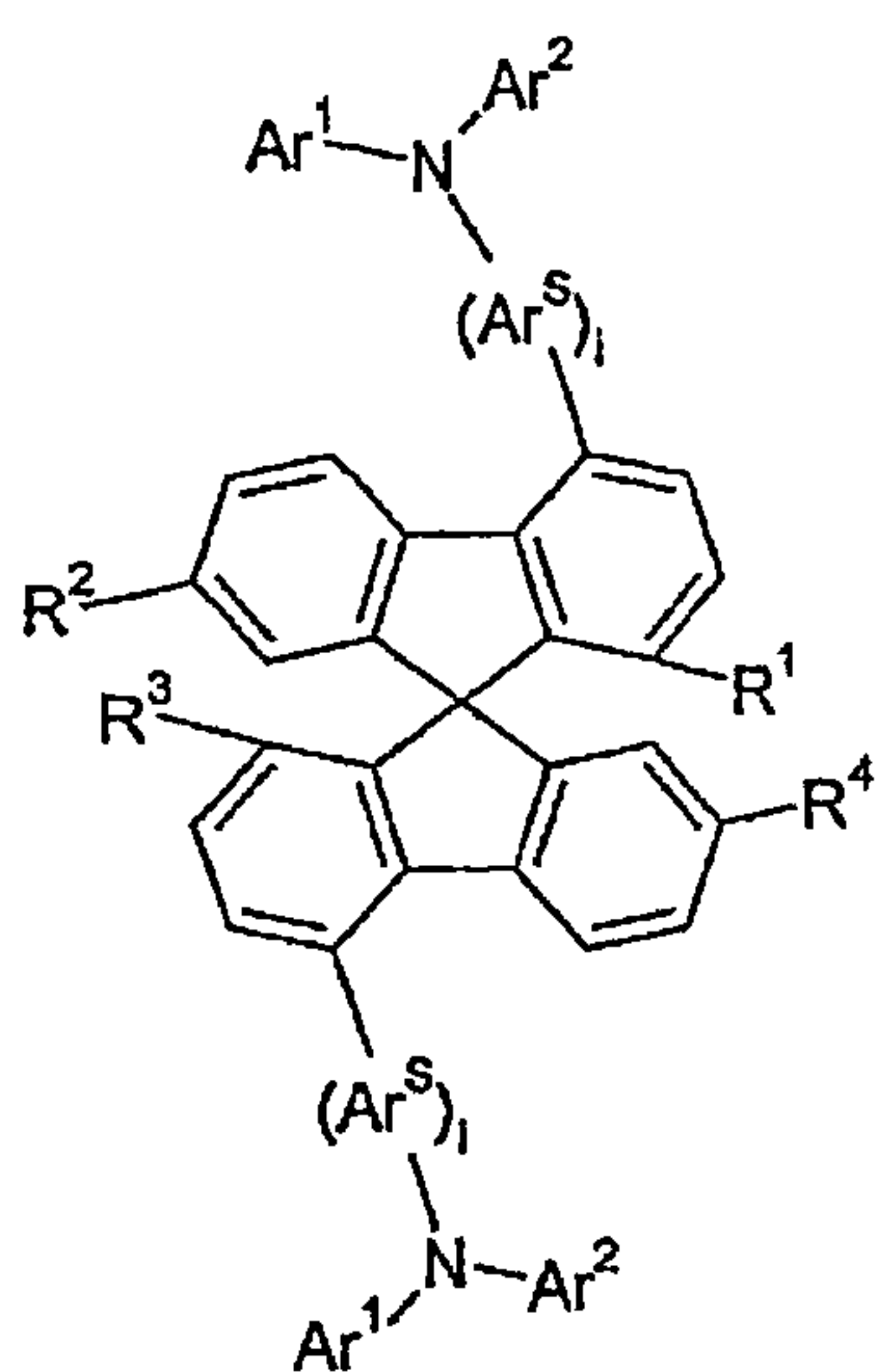
其中所用符號及下標具有上文所給出之含義。

對於上文式(2)至(10)之化合物，較佳 $i = 0$ 。

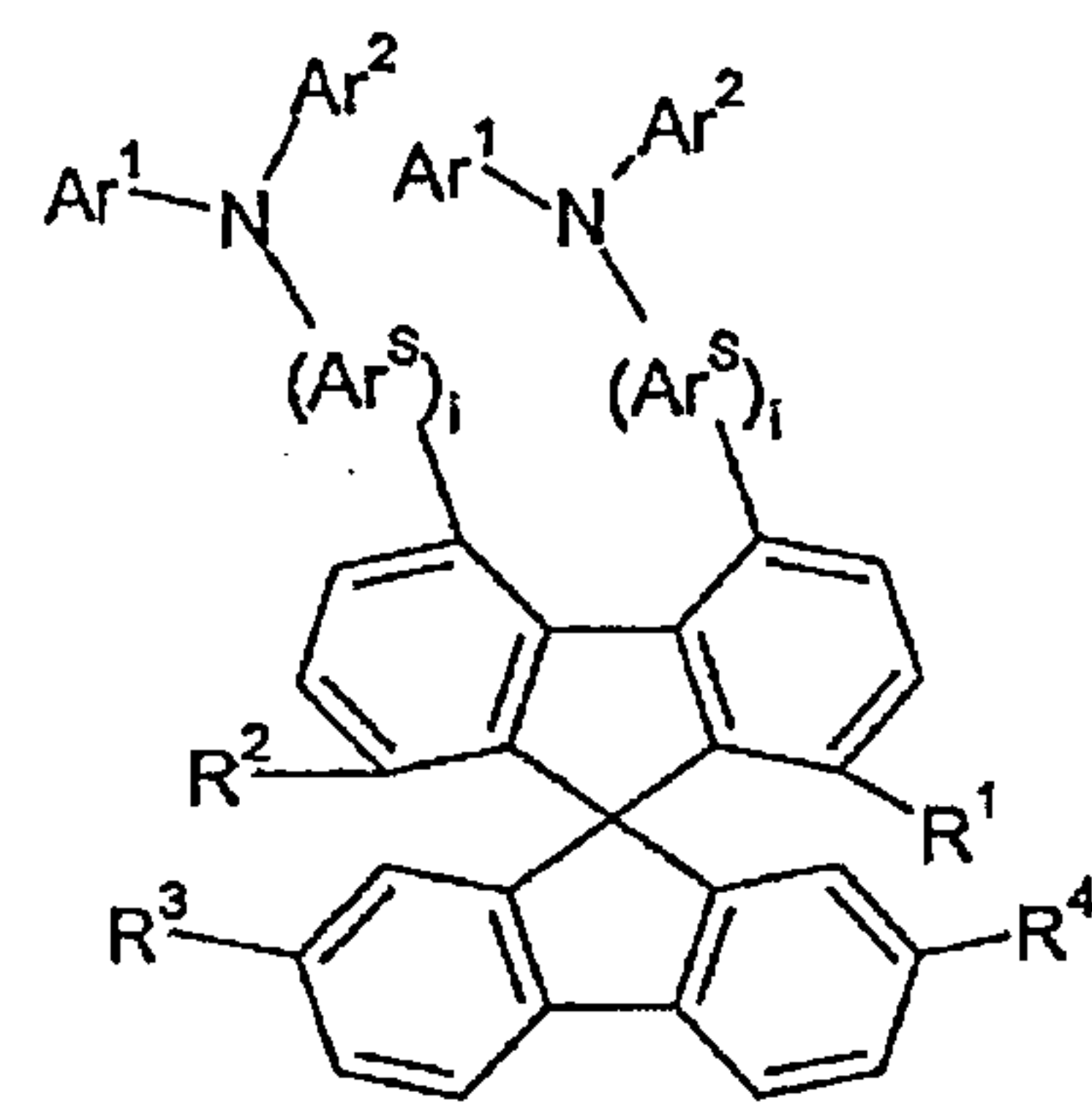
在本發明之尤佳實施例中，式(2)至(10)之化合物選自下式(2a)至(10a)之化合物，



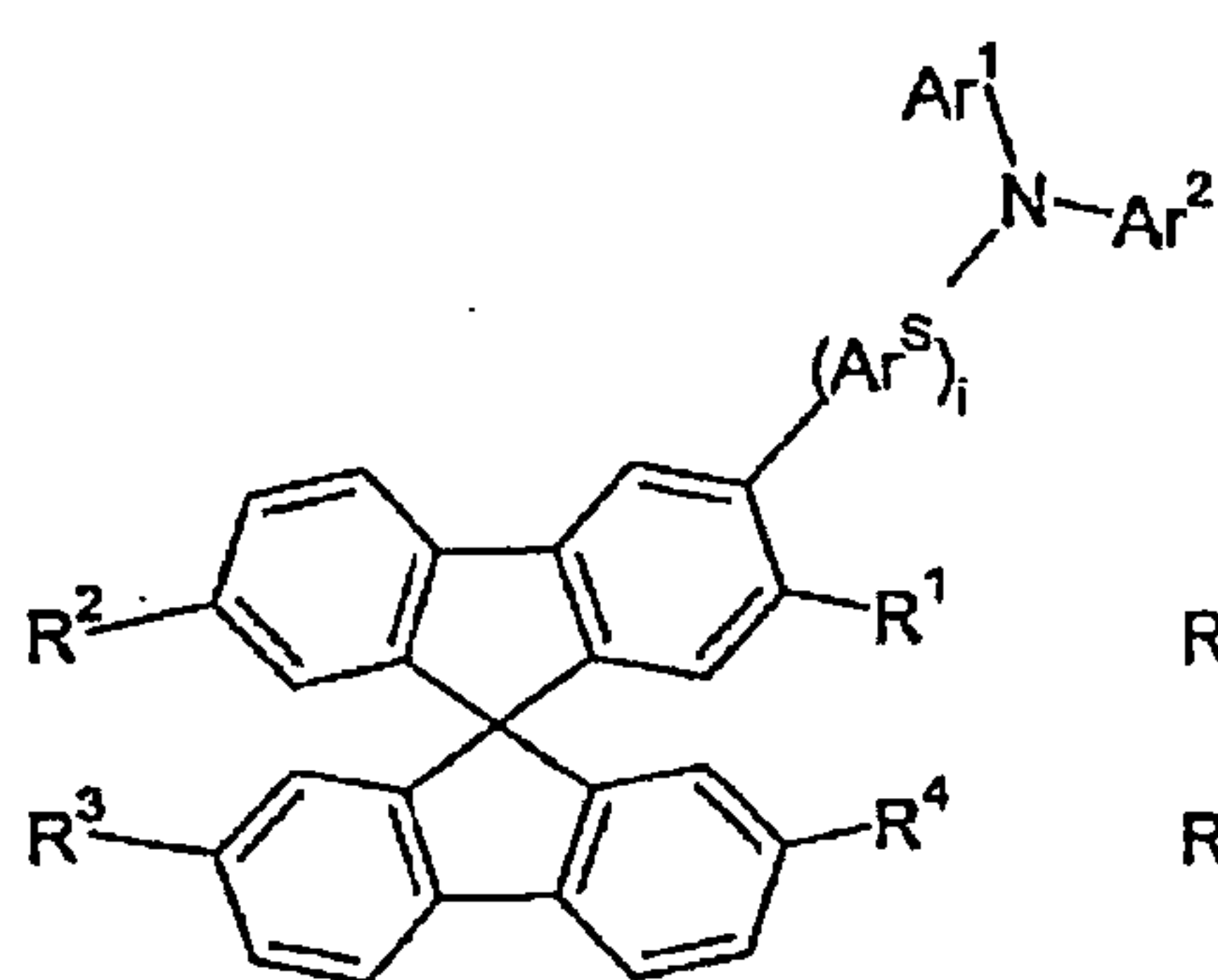
式(2a)



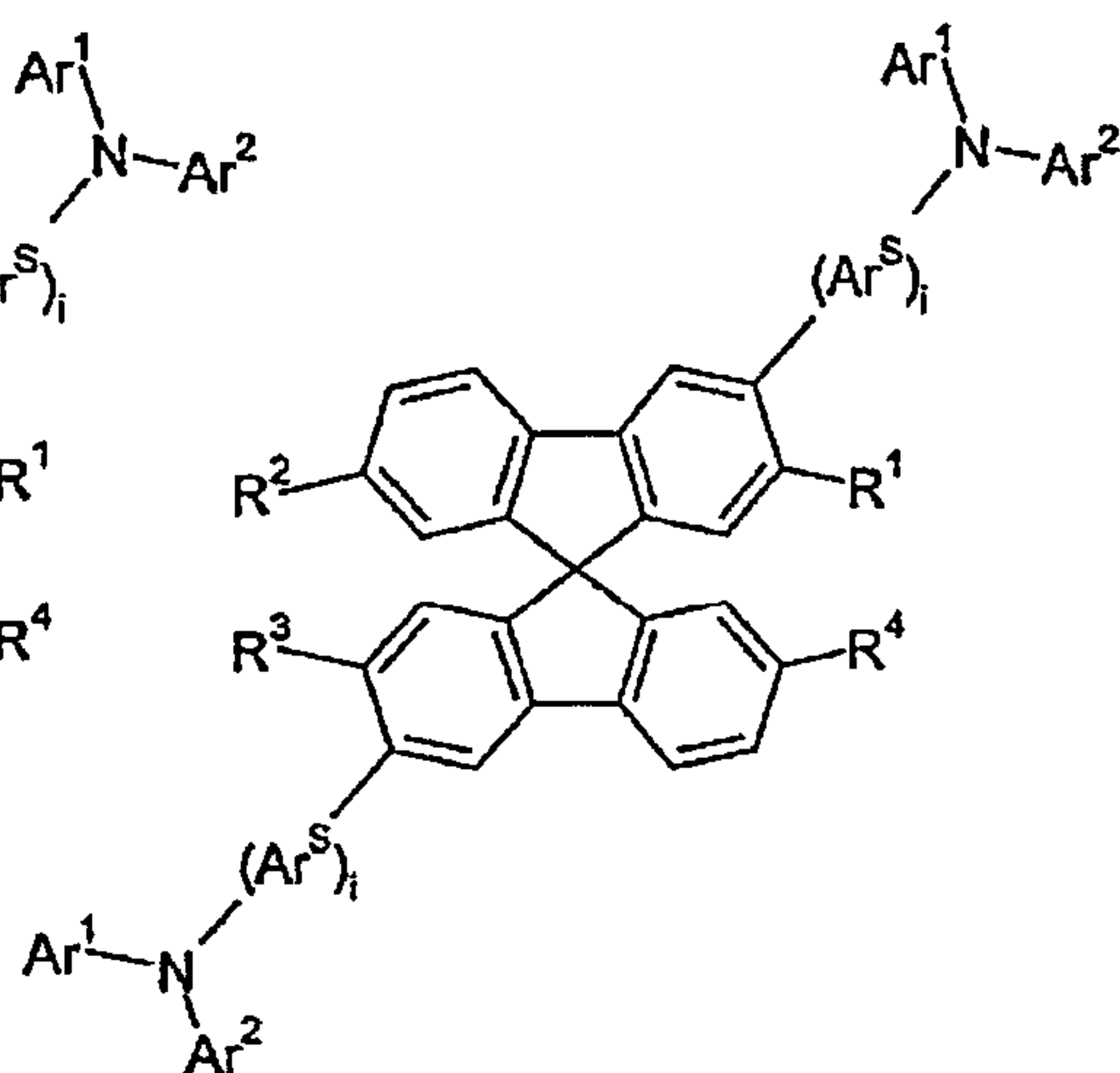
式(3a)



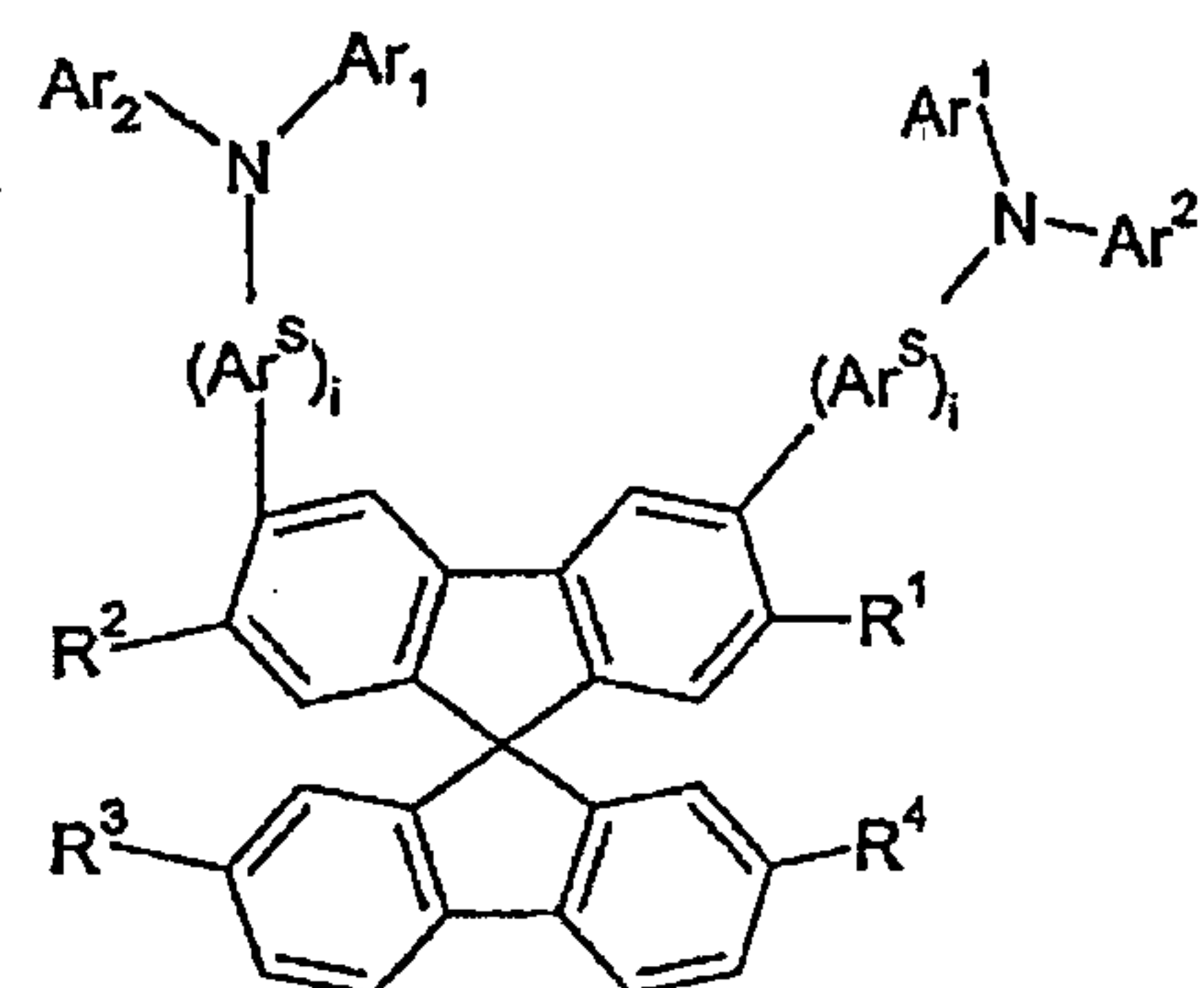
式(4a)



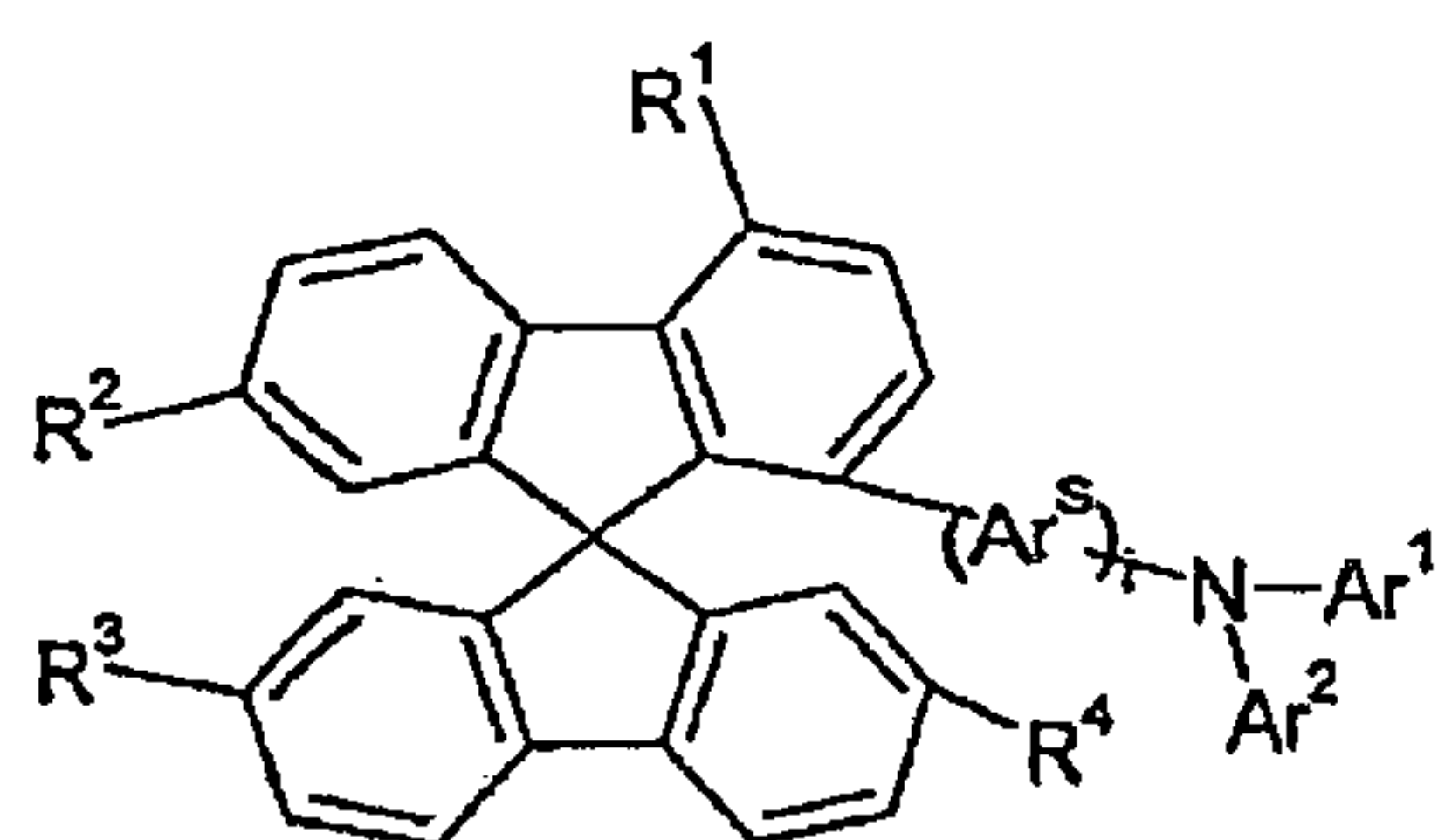
式(5a)



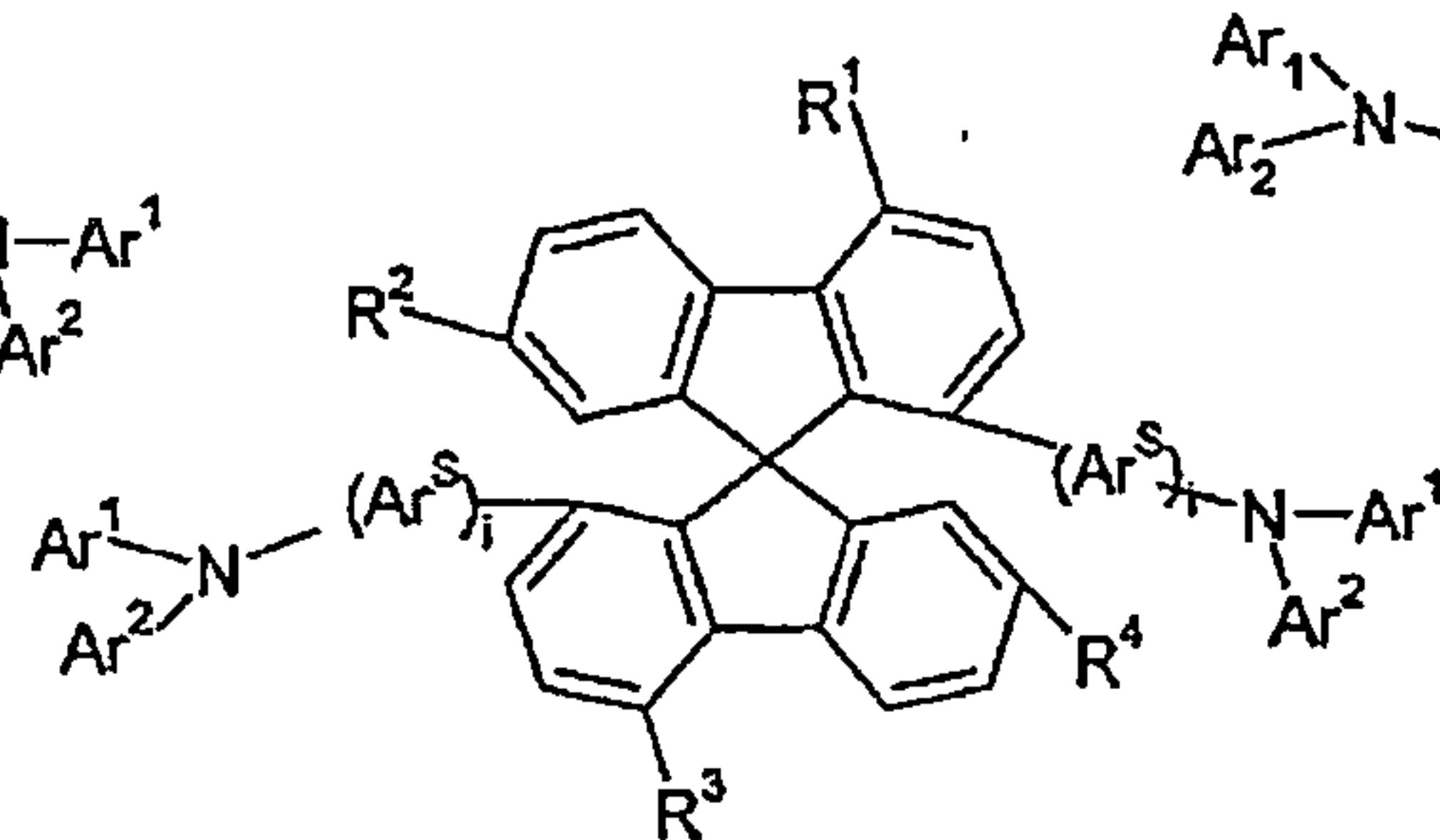
式(6a)



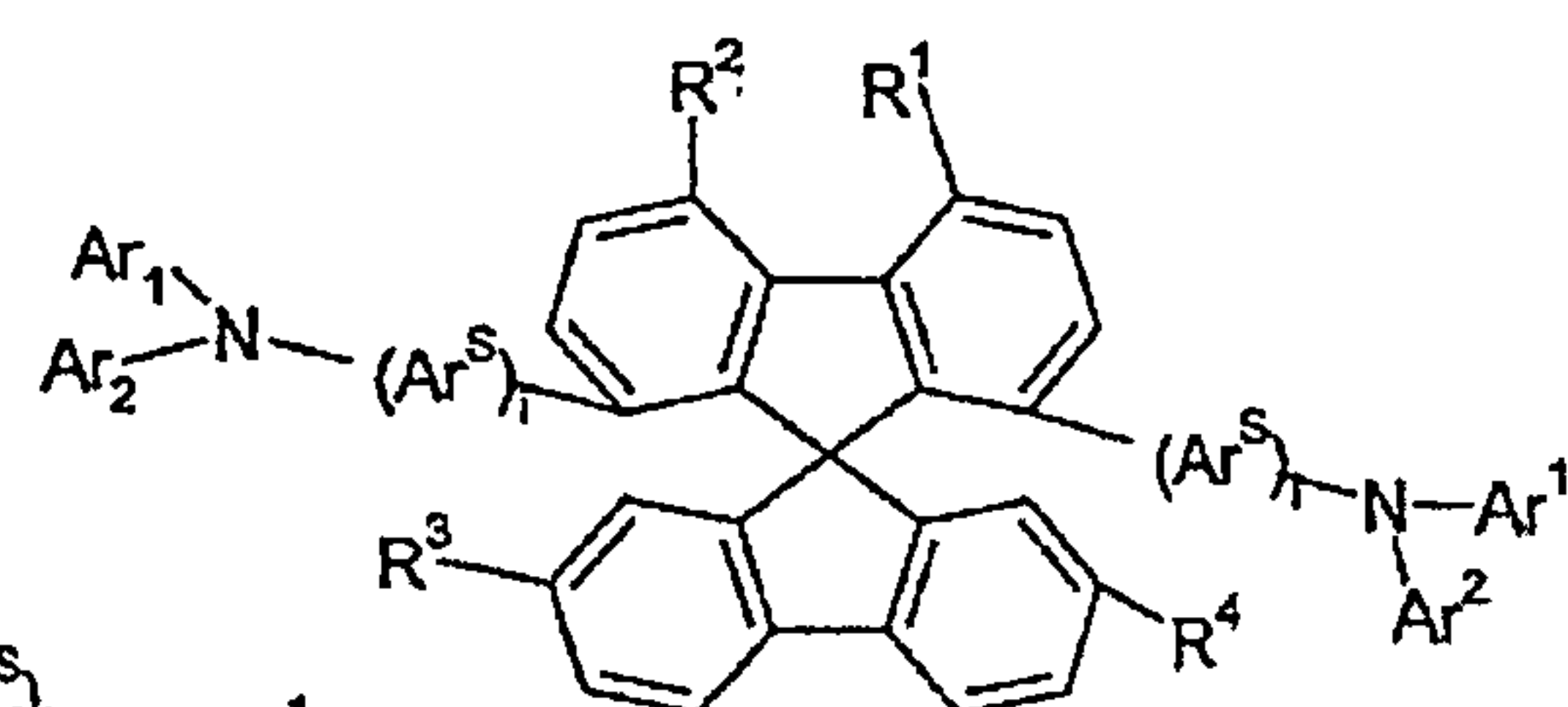
式(7a)



式(8a)



式(9a)

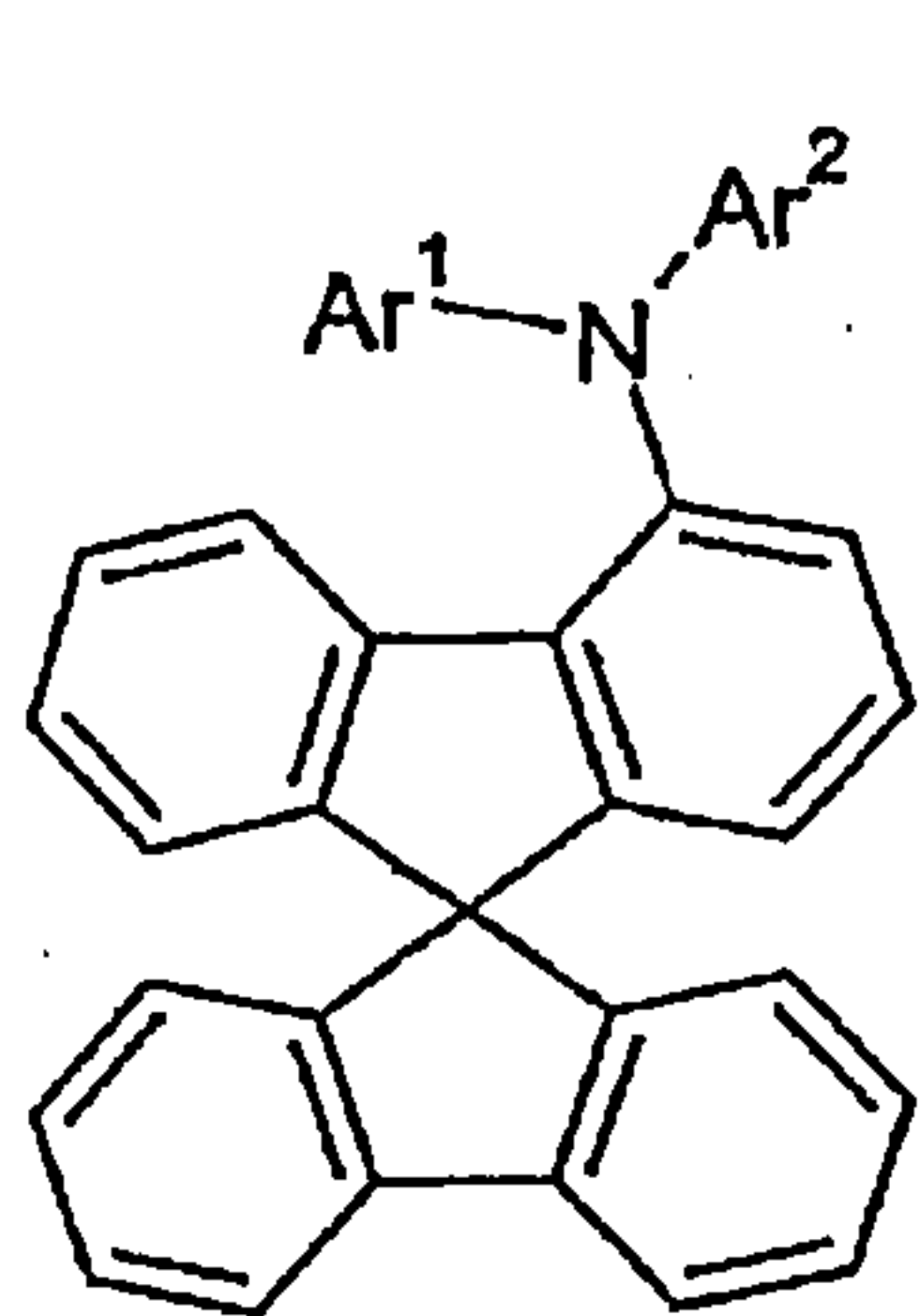


式(10a)

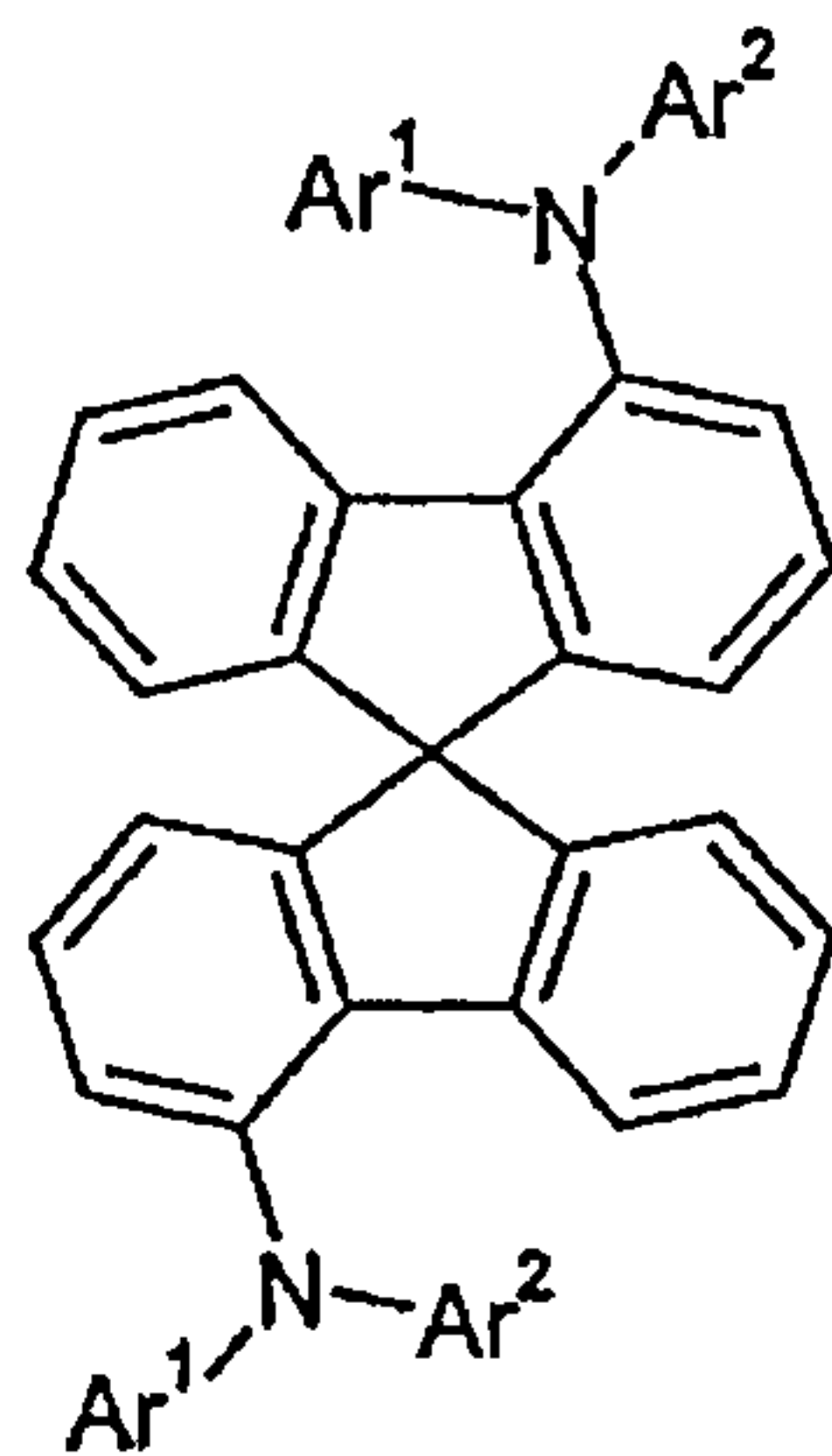
其中所用符號及下標具有上文所給出之含義。

對於上文式(2a)至(10a)之化合物，較佳 $i = 0$ 。

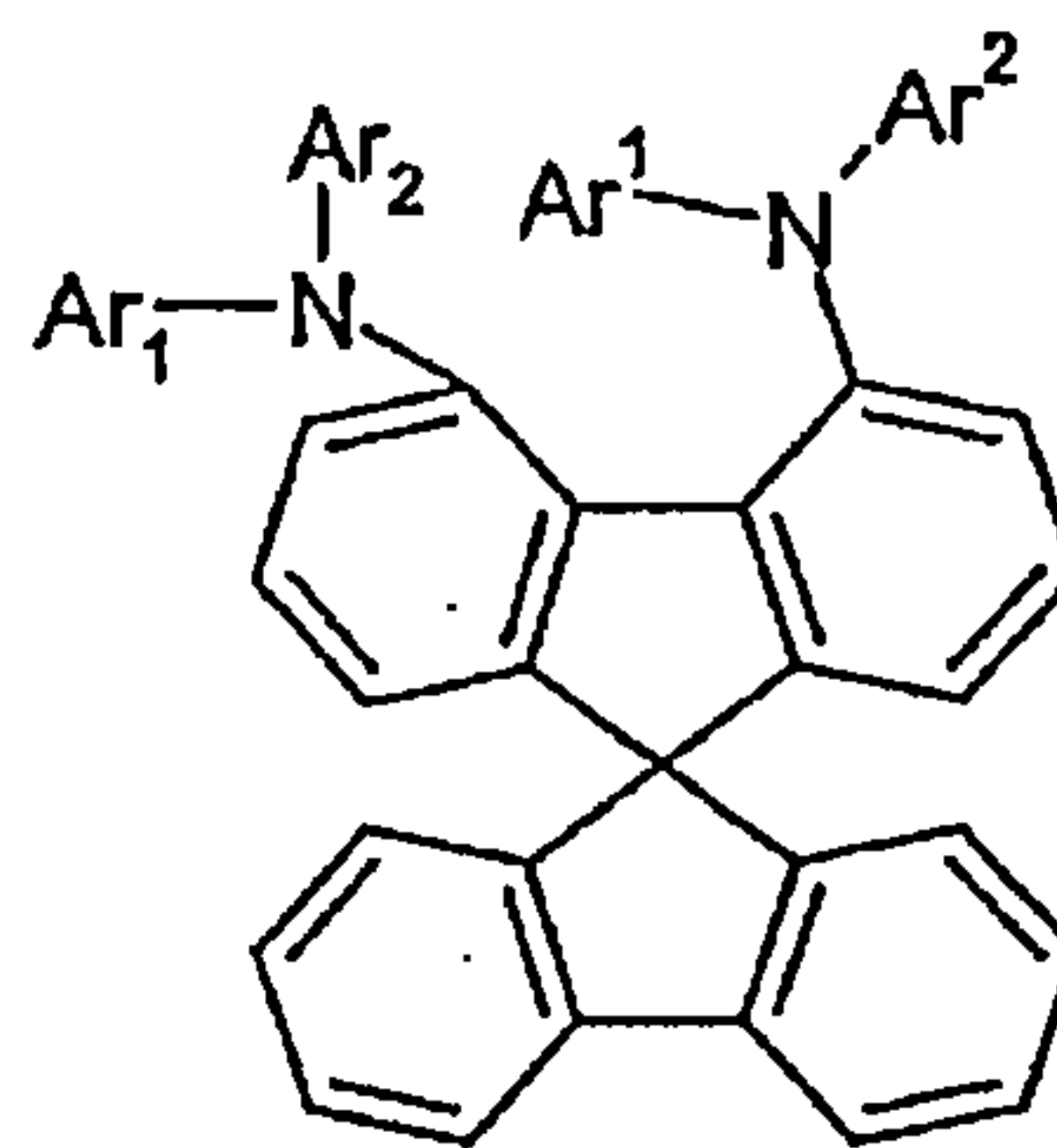
極佳者係係下式(2b)至(10b)之化合物，



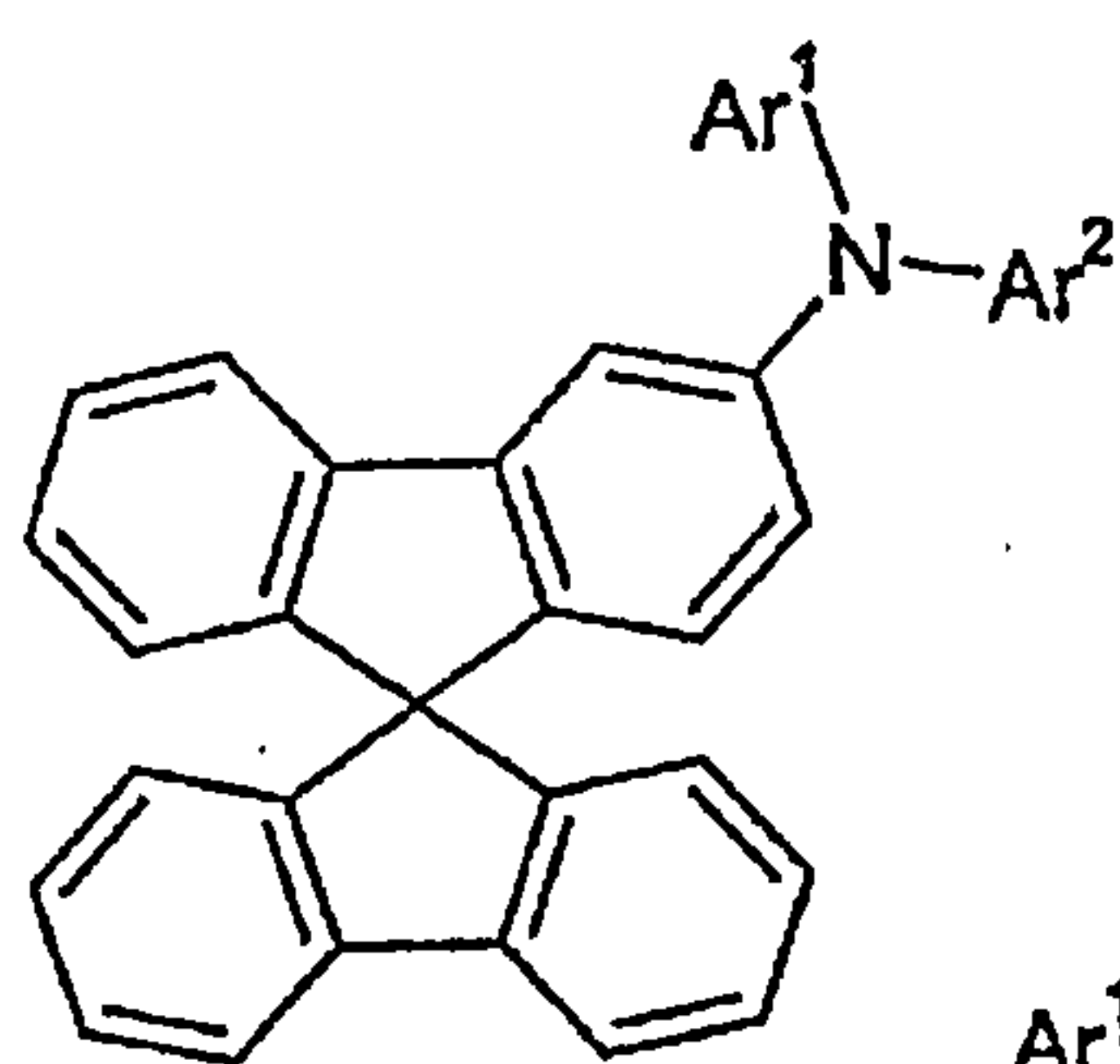
式(2b)



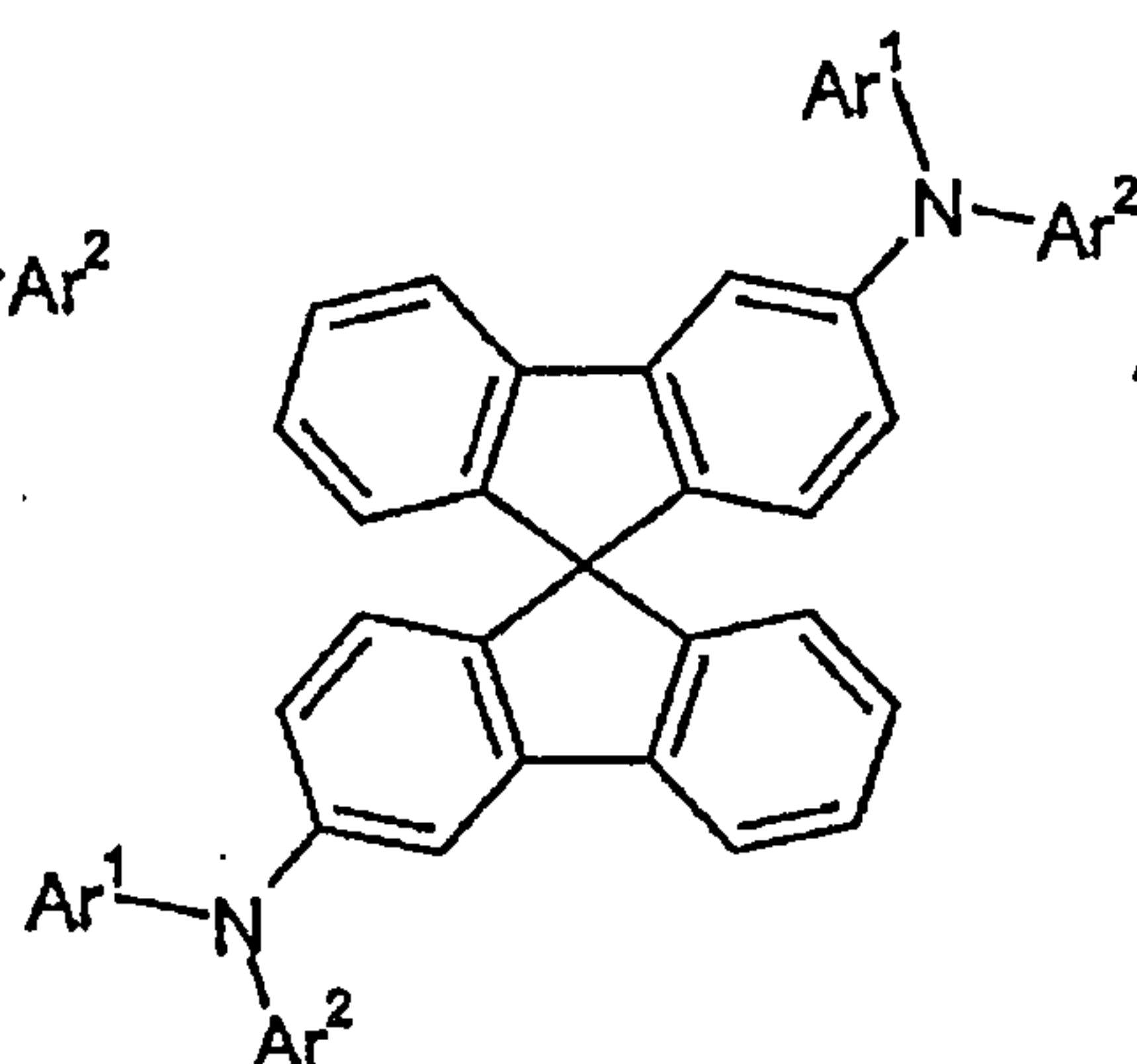
式(3b)



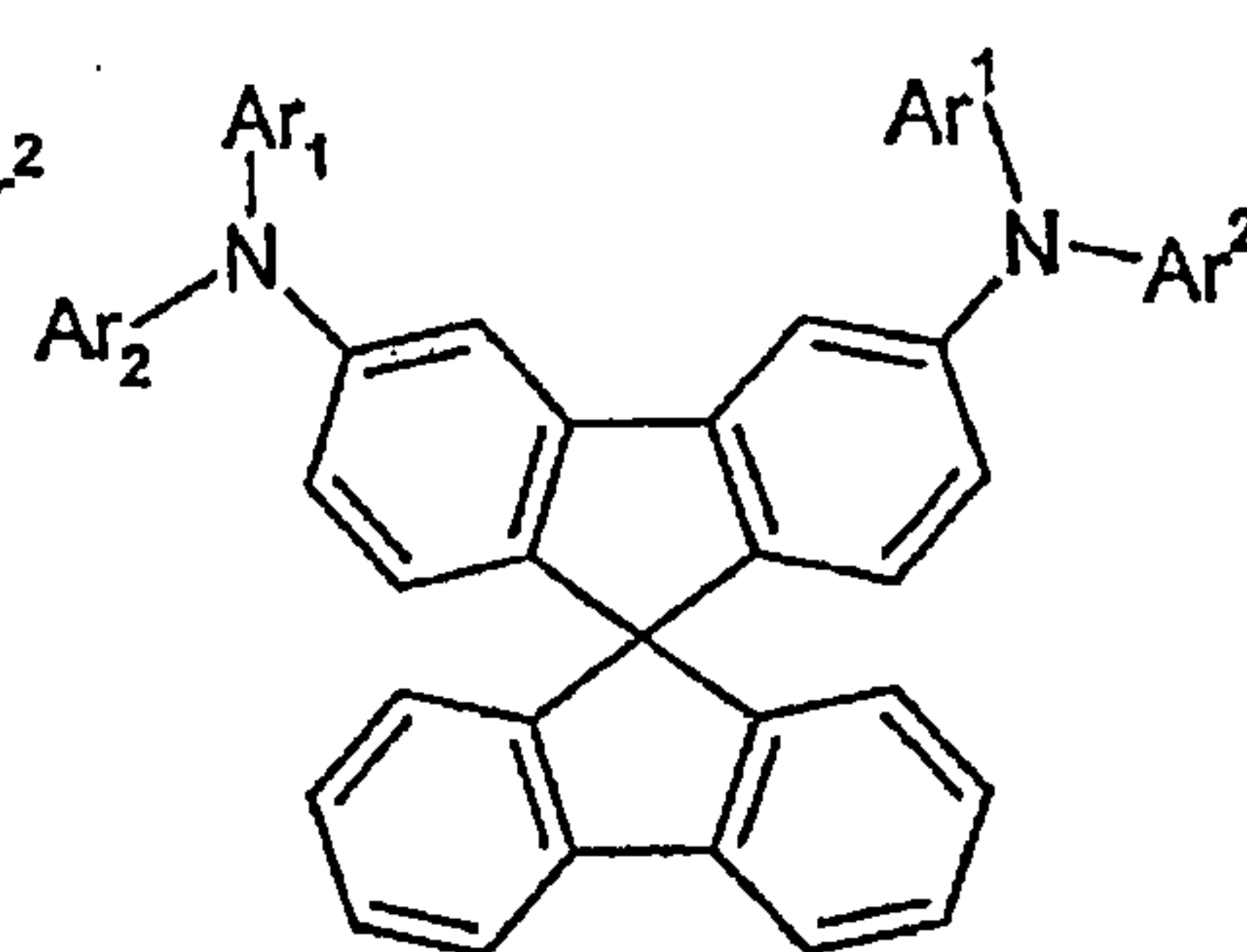
式(4b)



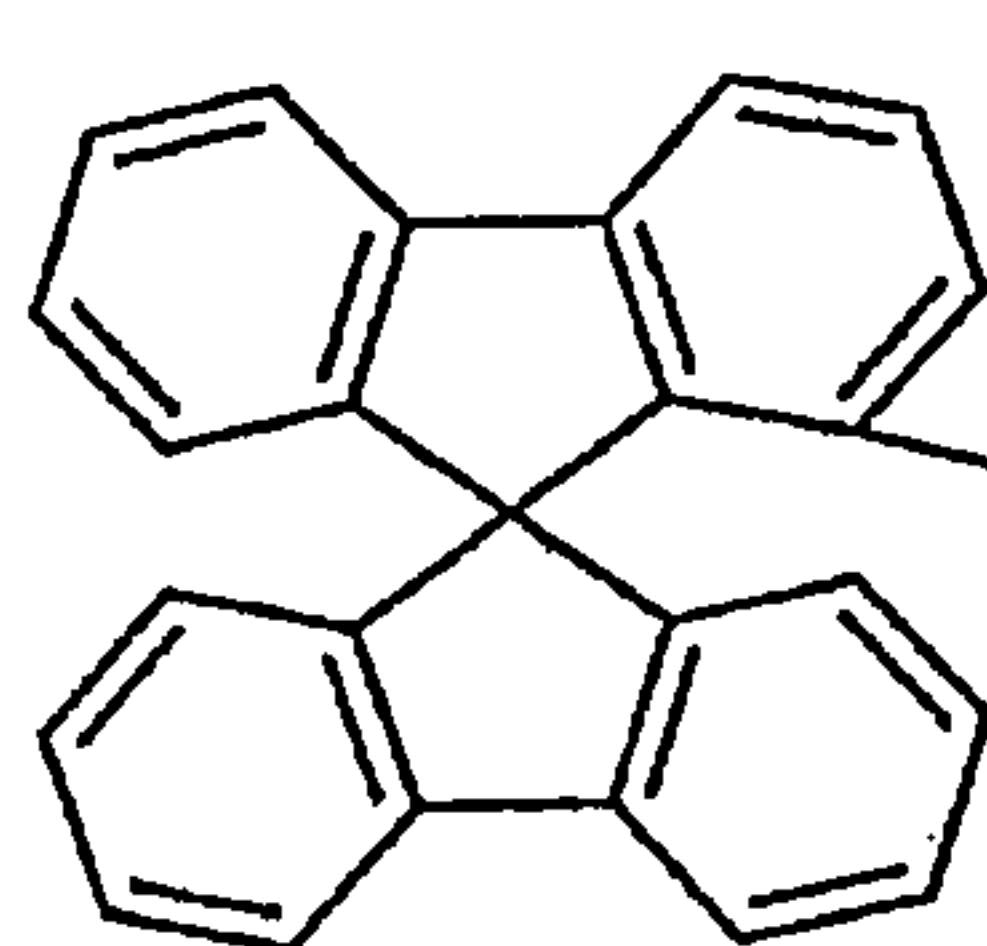
式(5b)



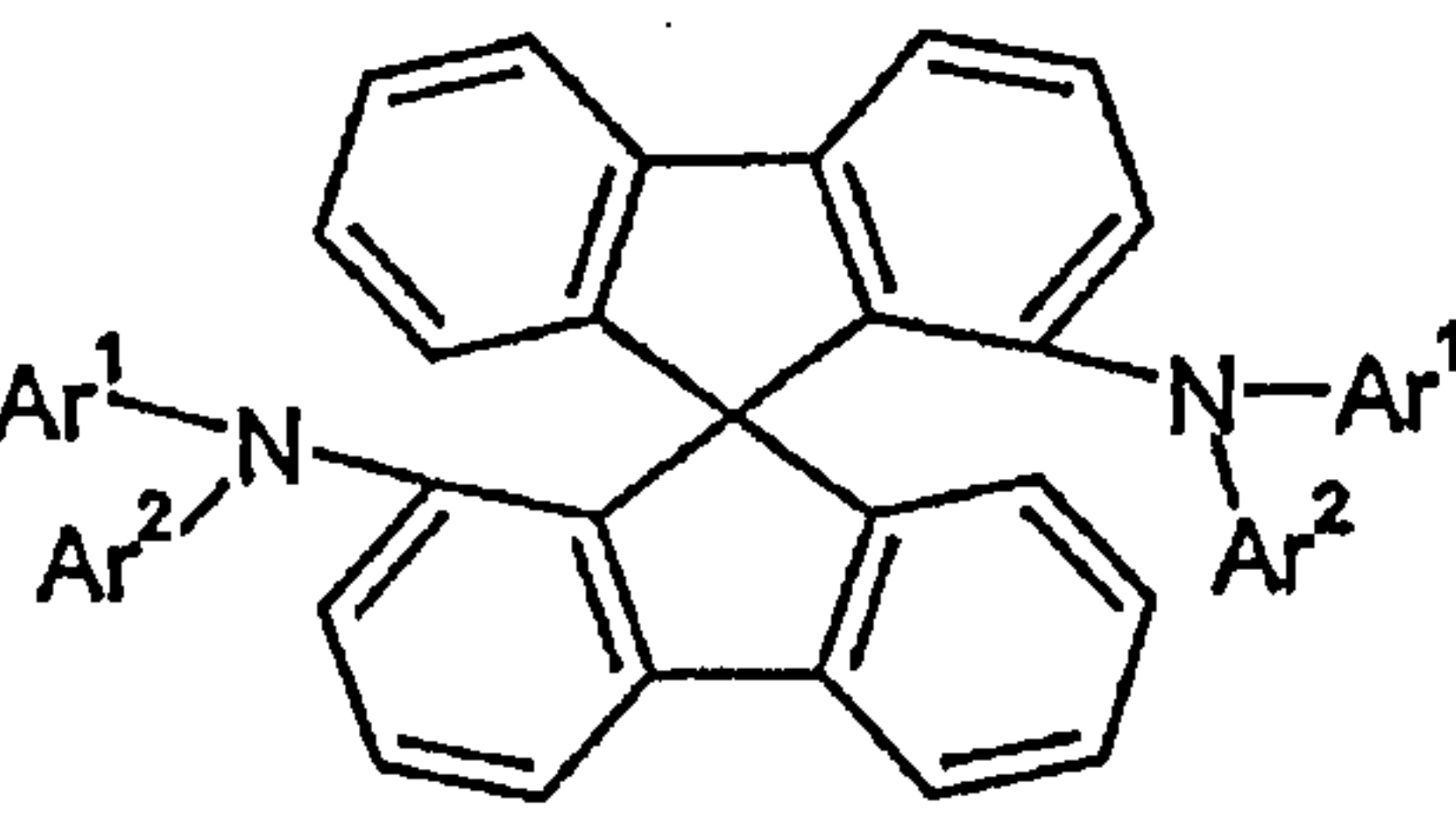
式(6b)



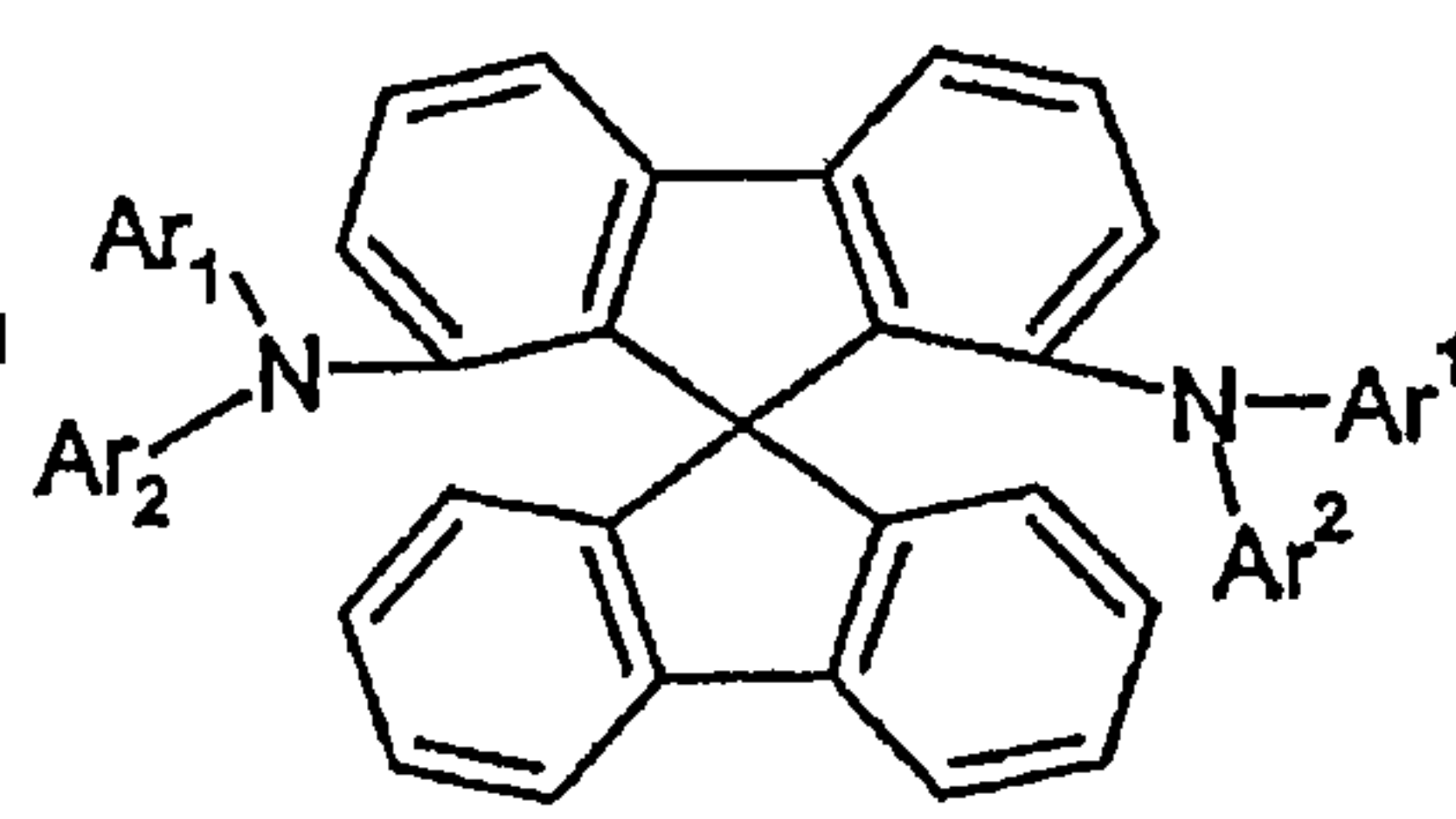
式(7b)



式(8b)



式(9b)



式(10b)

其中所用符號具有上文所給出之含義。

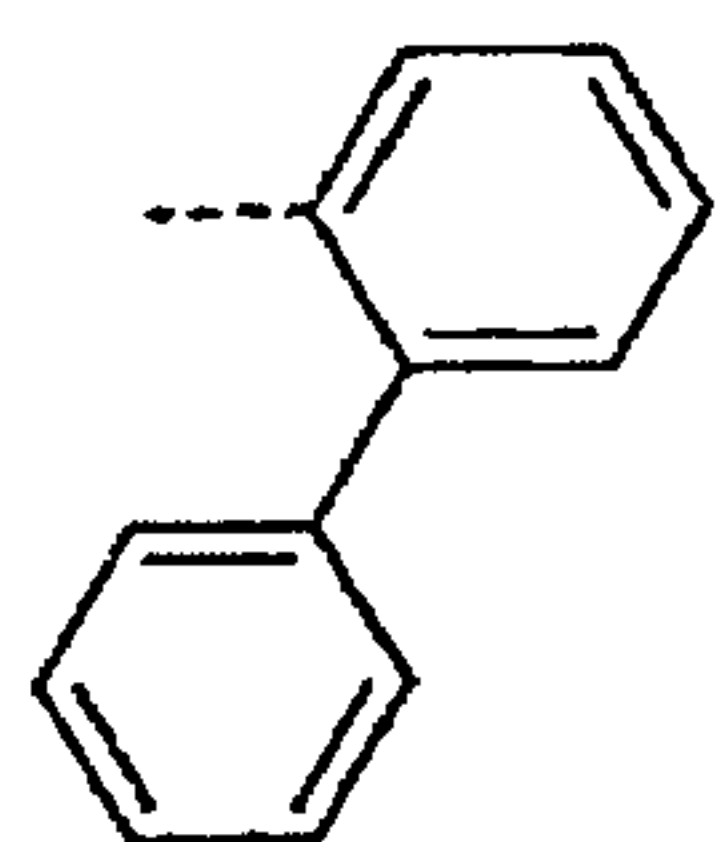
在本發明之尤佳實施例中，本發明化合物僅含有一個二芳基胺基- NAr^1Ar^2 。因此，此較佳係關於式(2)、(5)及(8)或(2a)、(5a)及(8a)或(2b)、(5b)及(8b)之化合物。

在本發明之另一較佳實施例中，二芳基胺基- NAr^1Ar^2 鍵結在螺二萘之4位或4位與4'位。因此，此較佳係關於式(2)及(3)或(2a)及(3a)或(2b)及(3b)之化合物。

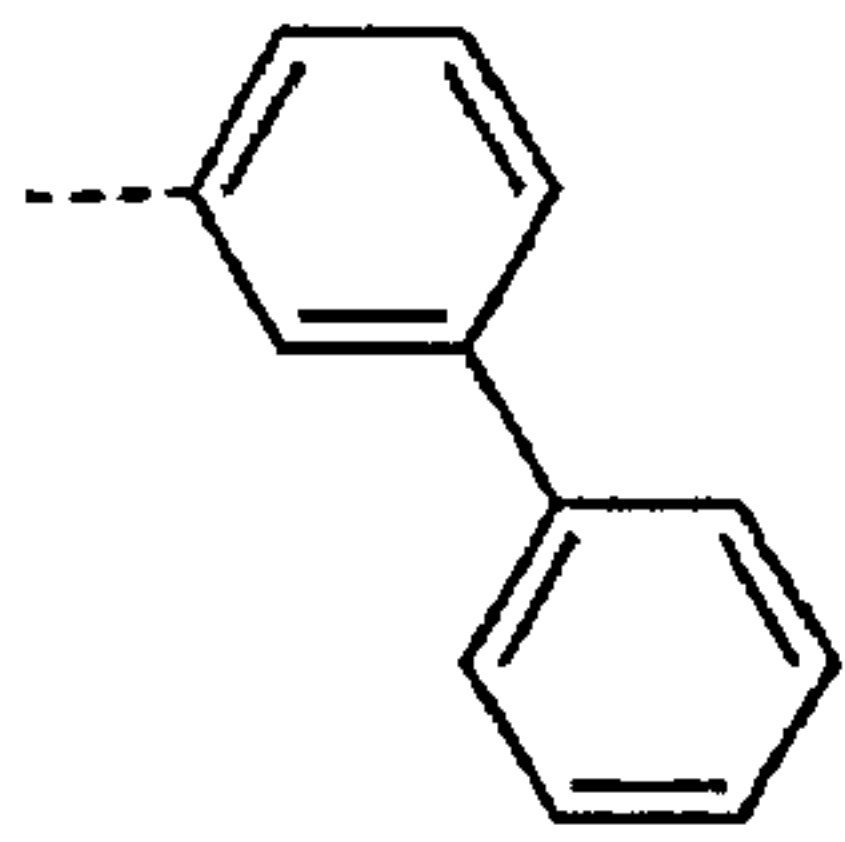
極佳者係式(2)或(2a)或(2b)之化合物。

在本發明之另一較佳實施例中， Ar^2 相同或不同且係選自由下列組成之群：萸、螺二萸、聯苯、聯三苯、聯四苯、呋唑、二苯并呋喃及二苯并噻吩，其每一者可經一或多個 R^5 基團取代。

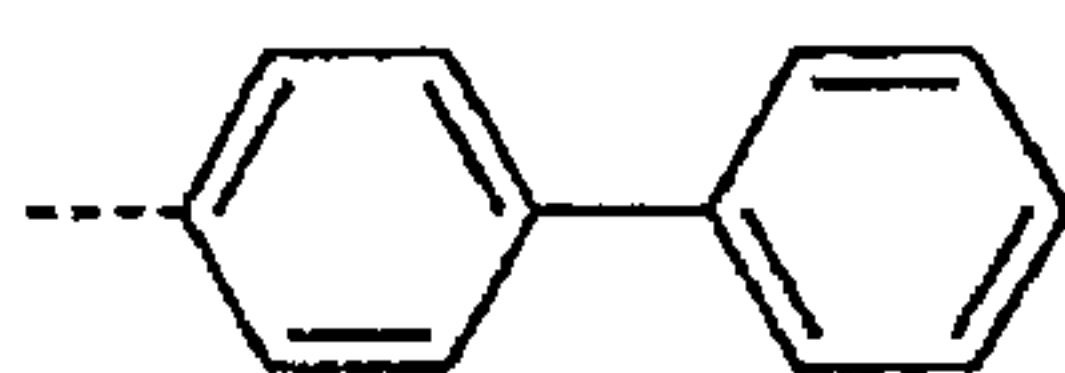
此處 Ar^1 及 Ar^2 基團較佳每次出現時相同或不同且係選自下式(11)至(66)之基團，



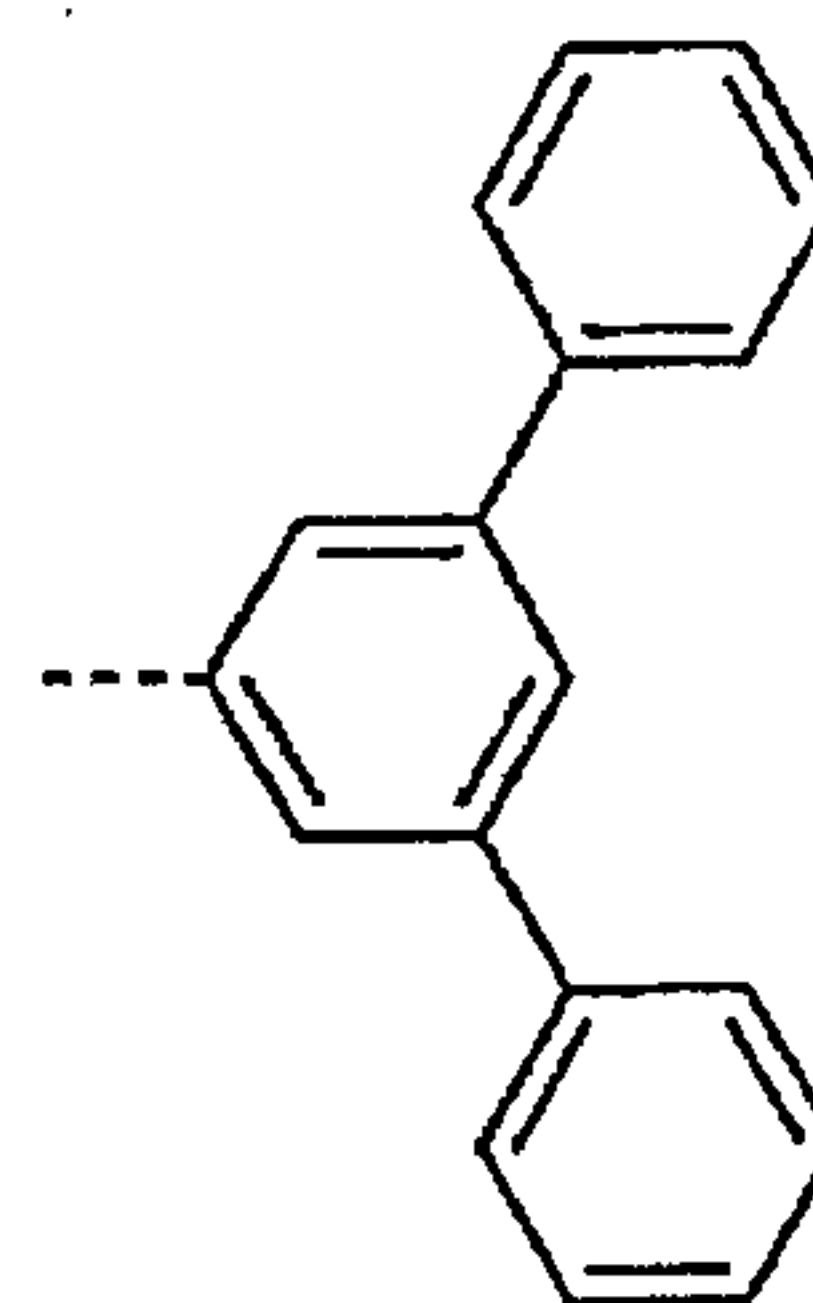
式(11)



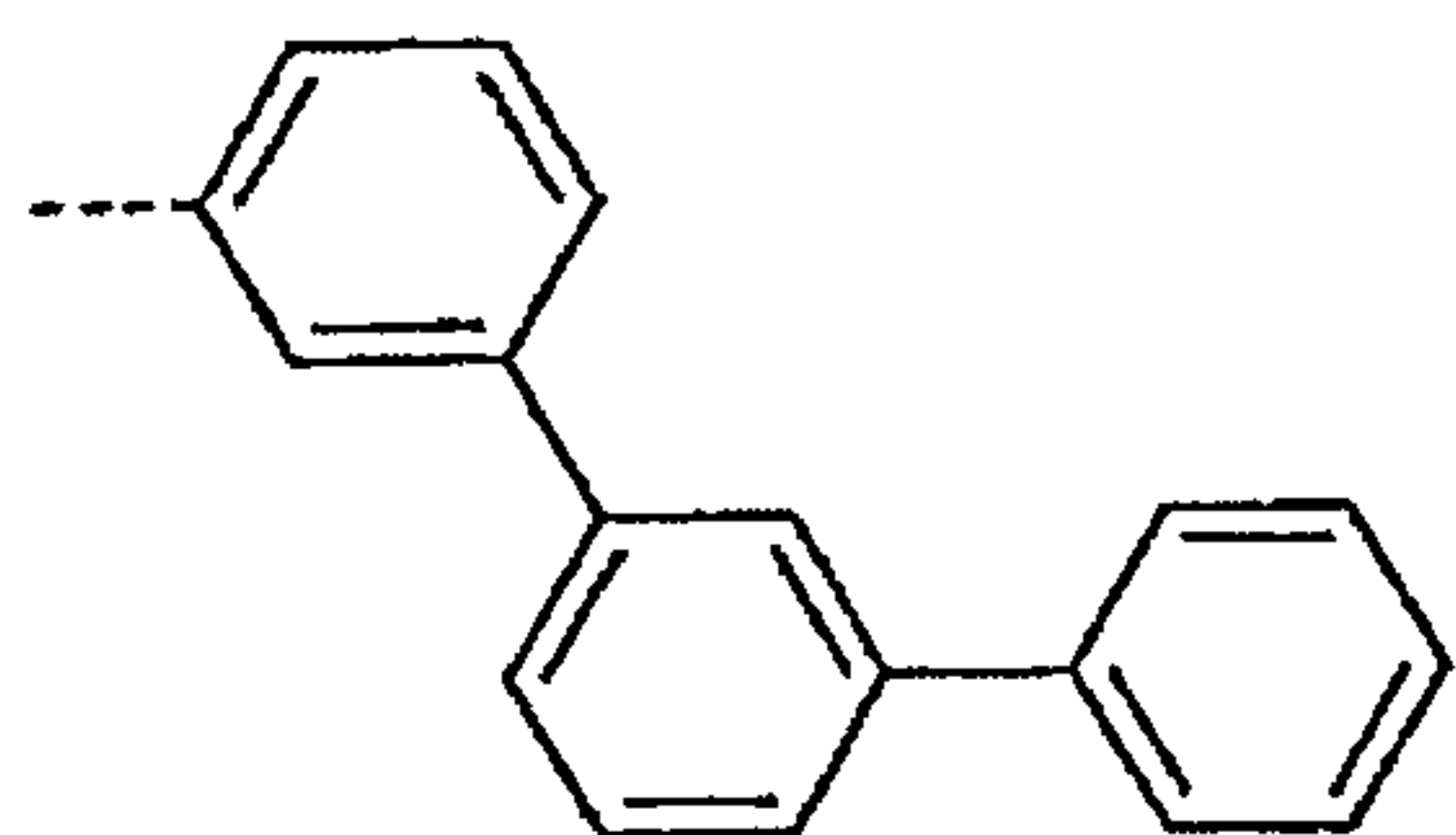
式(12)



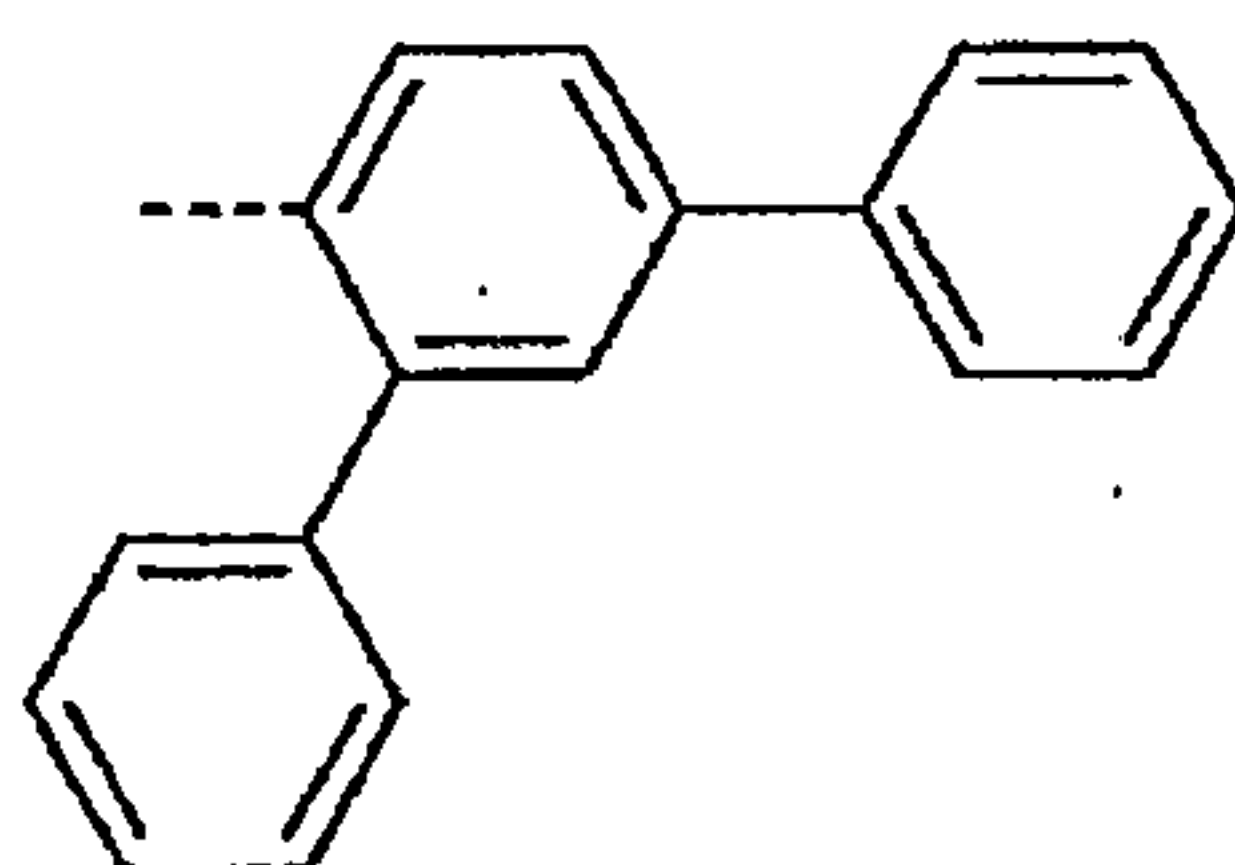
式(13)



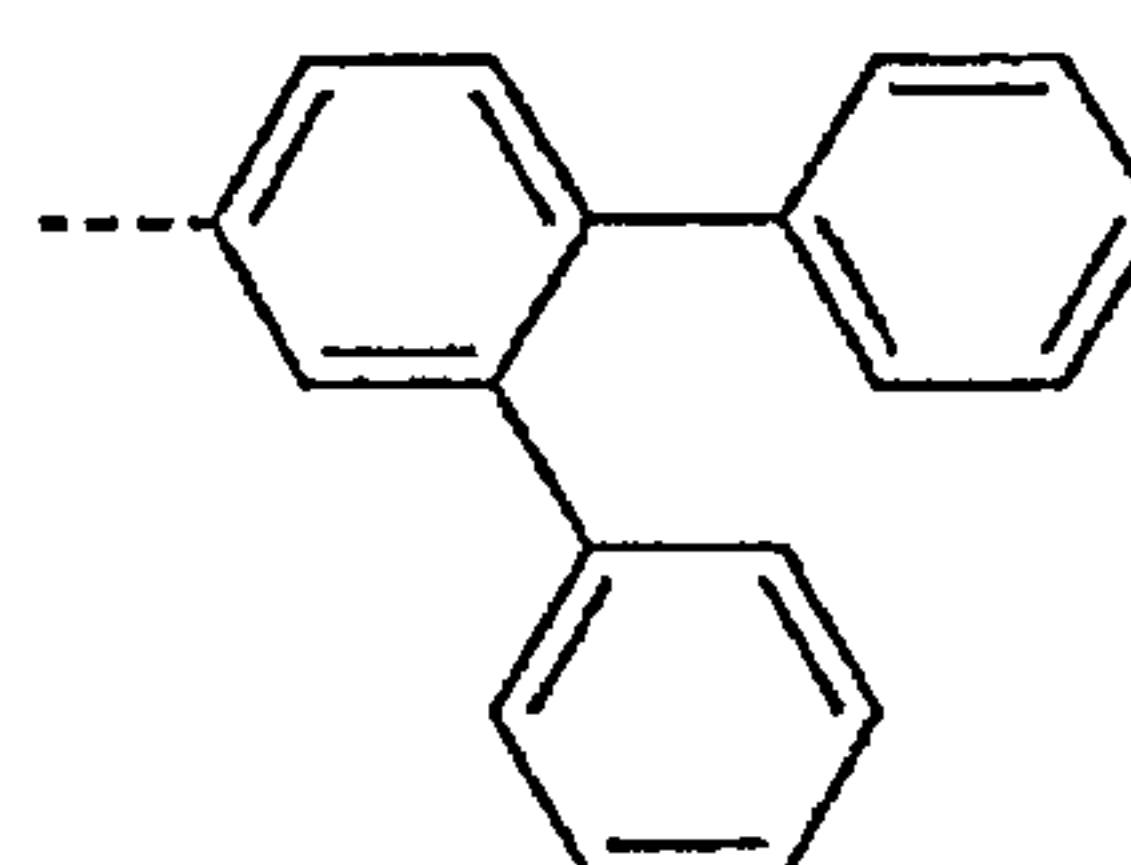
式(14)



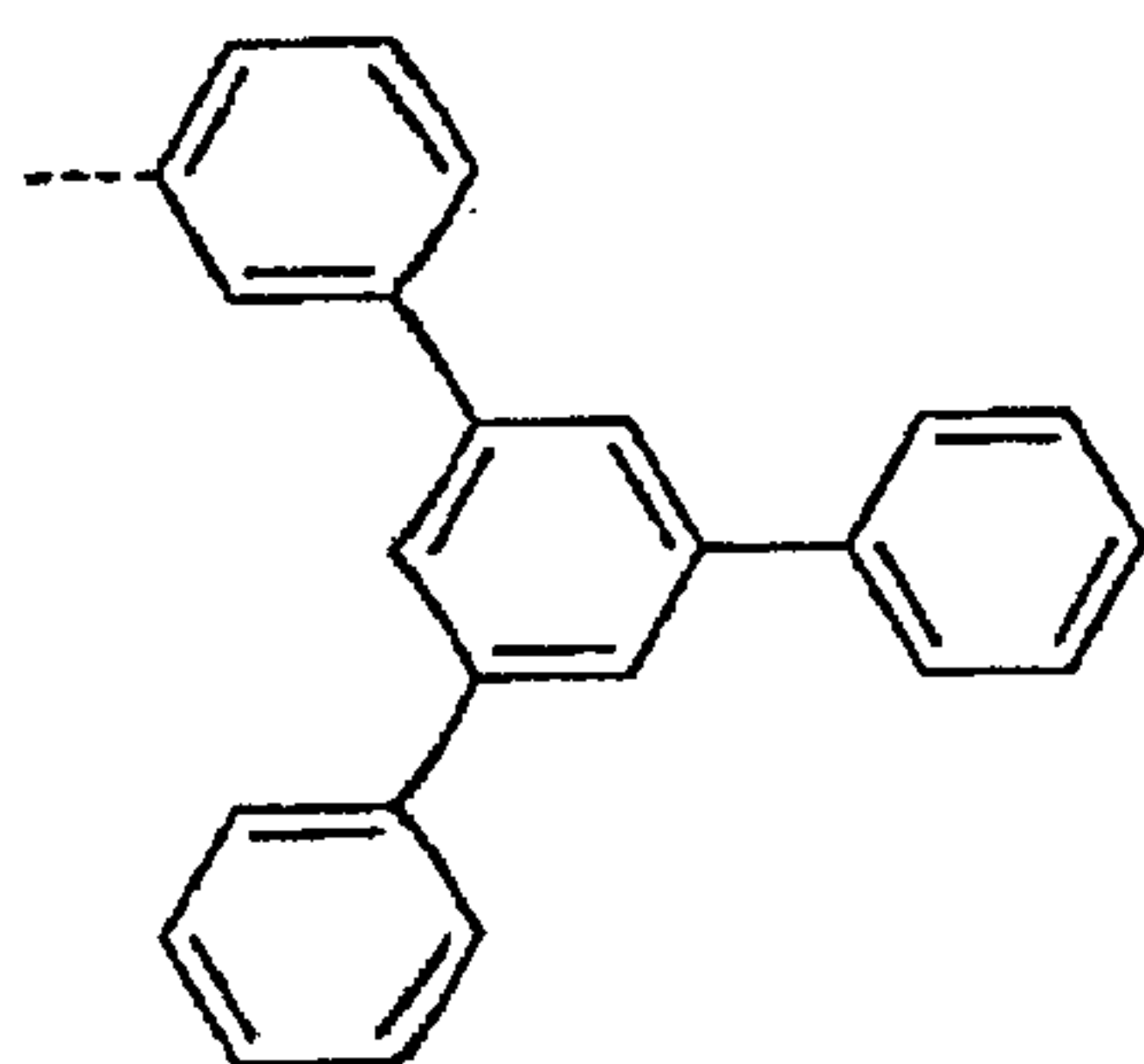
式(15)



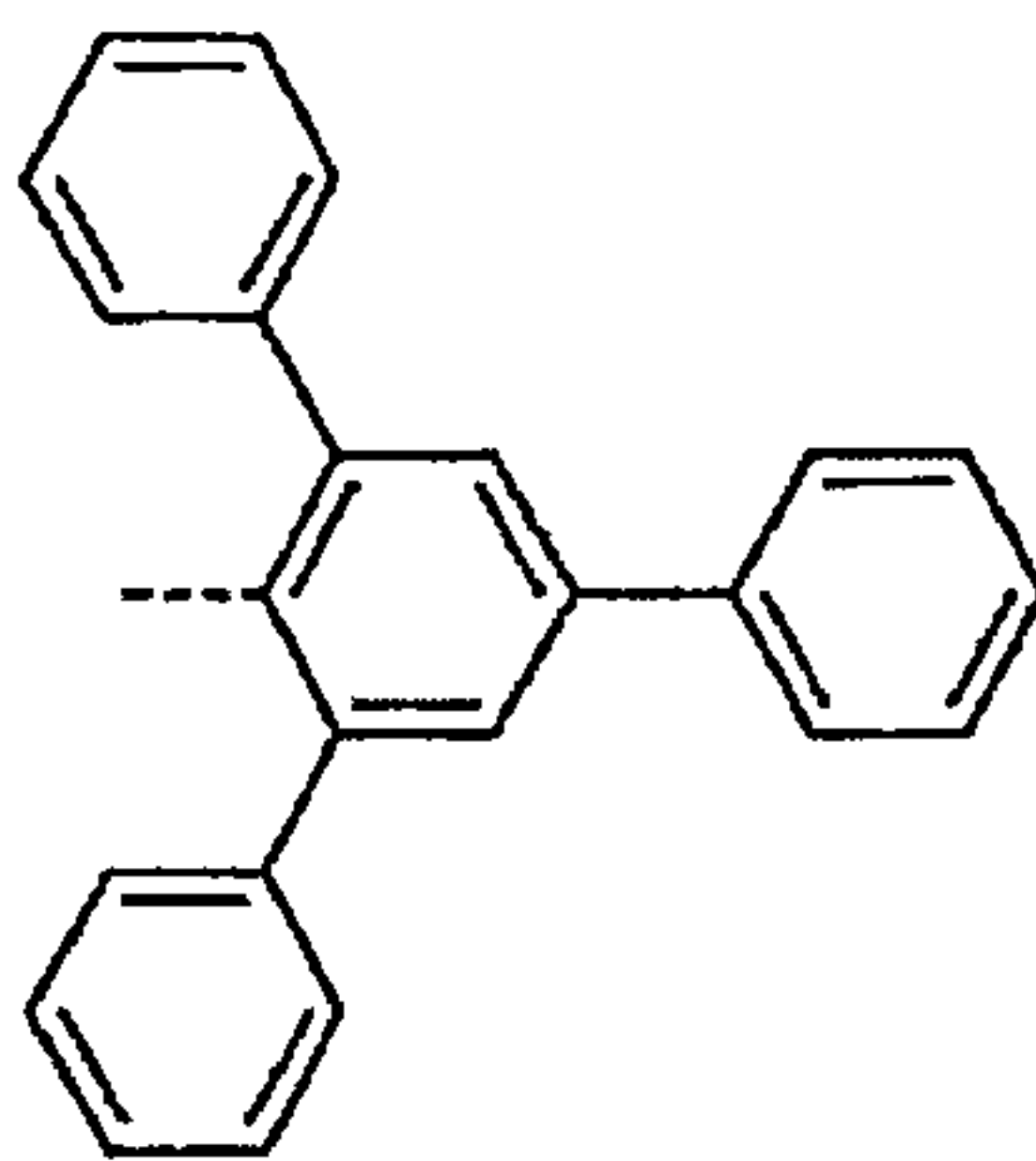
式(16)



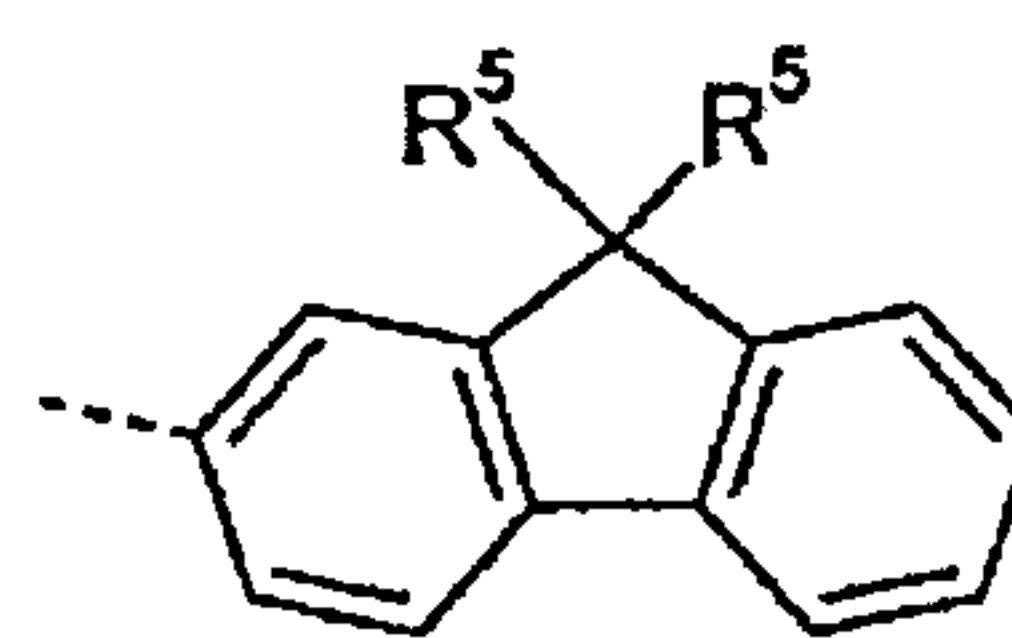
式(17)



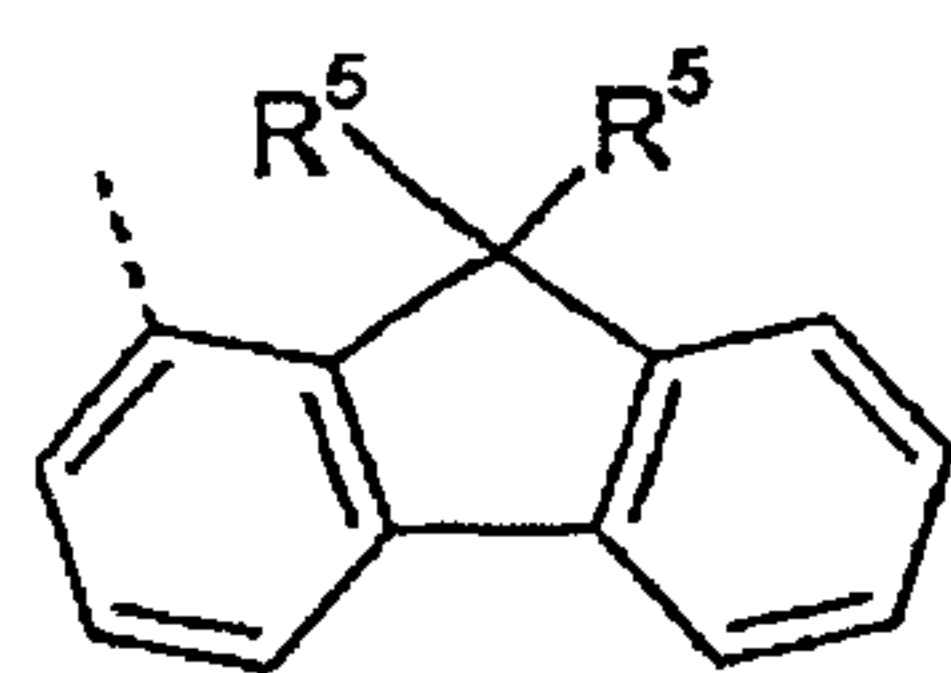
式(18)



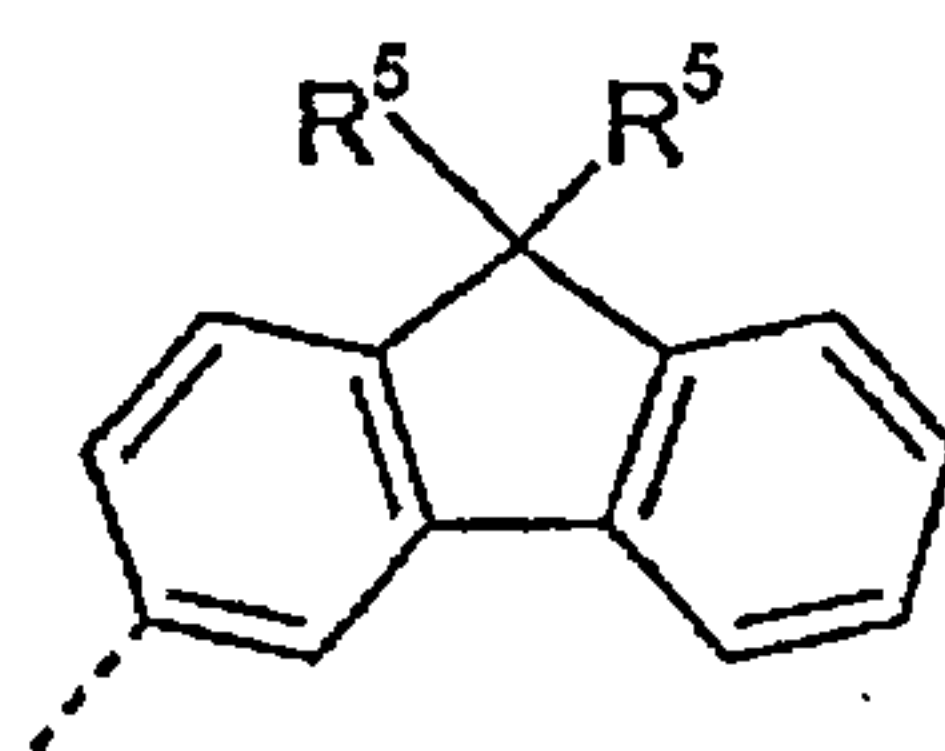
式(19)



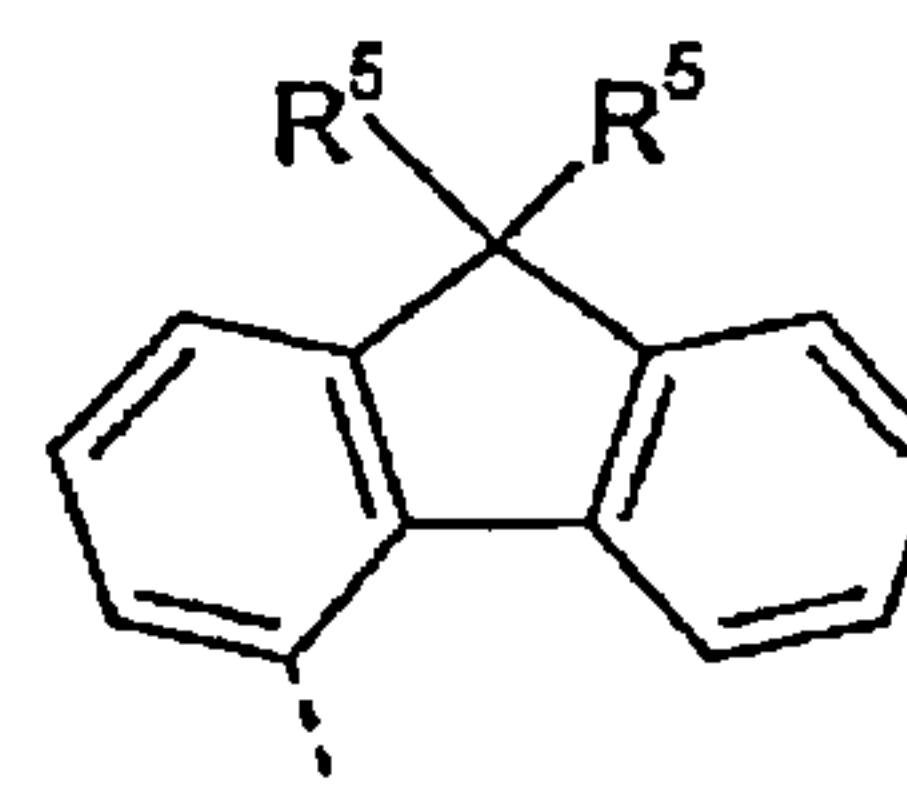
式(20)



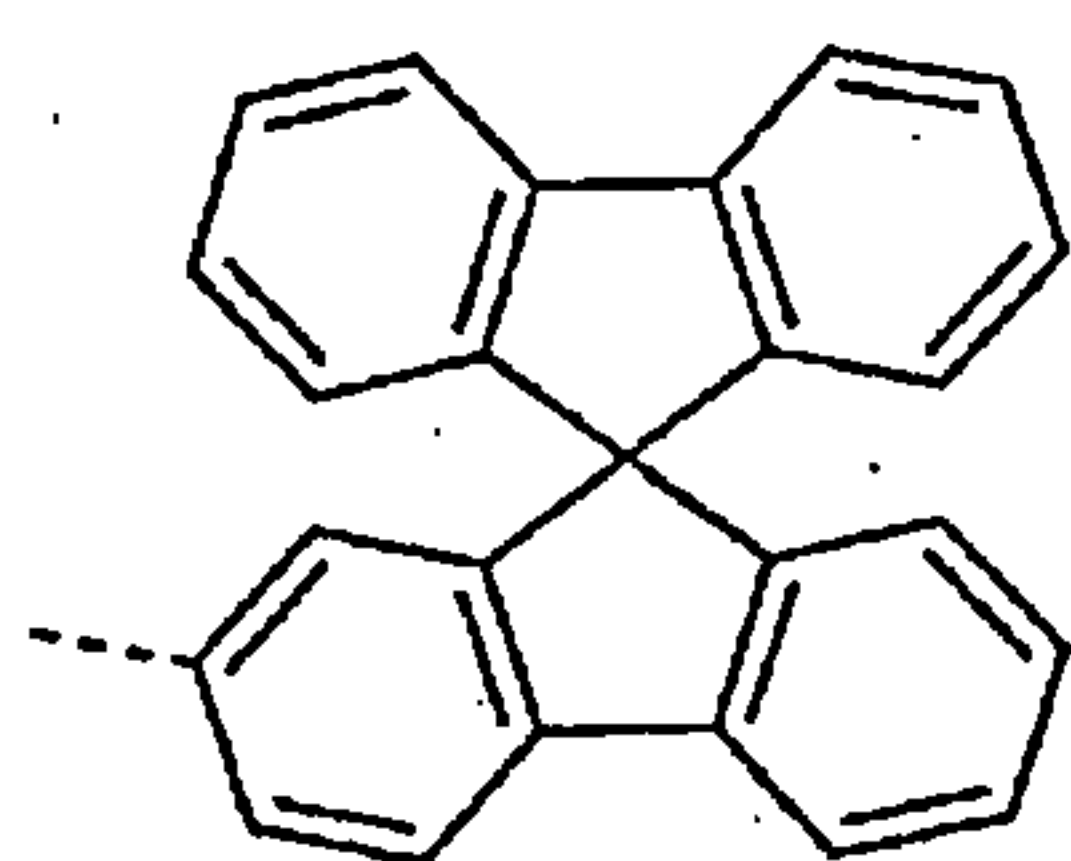
式(21)



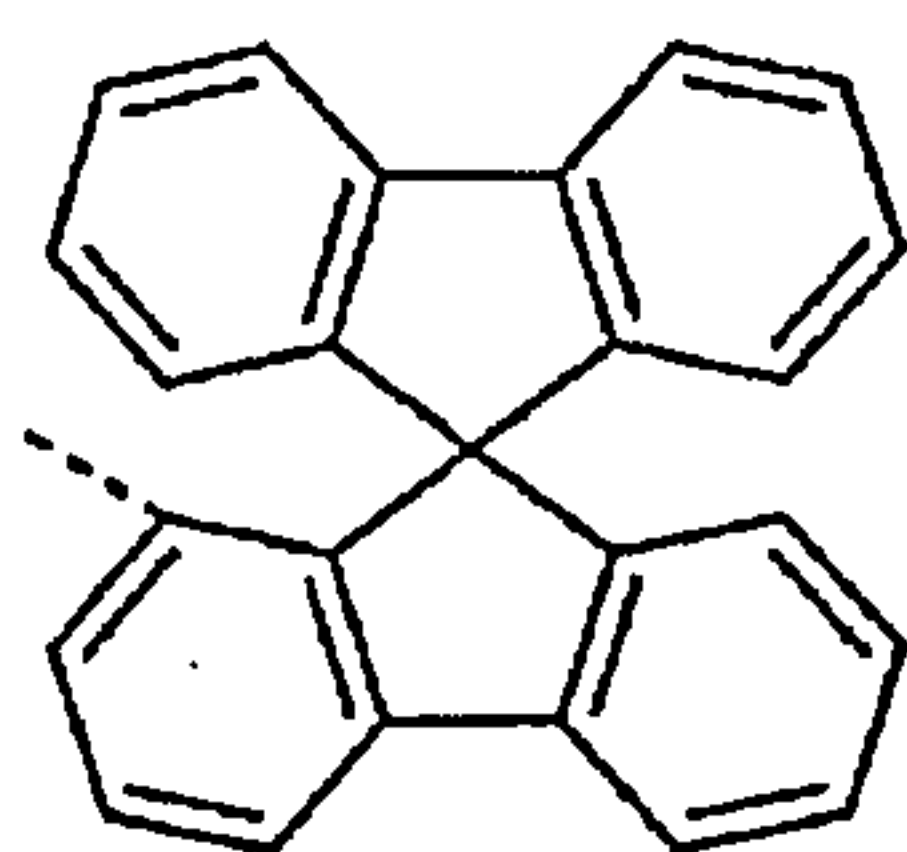
式(22)



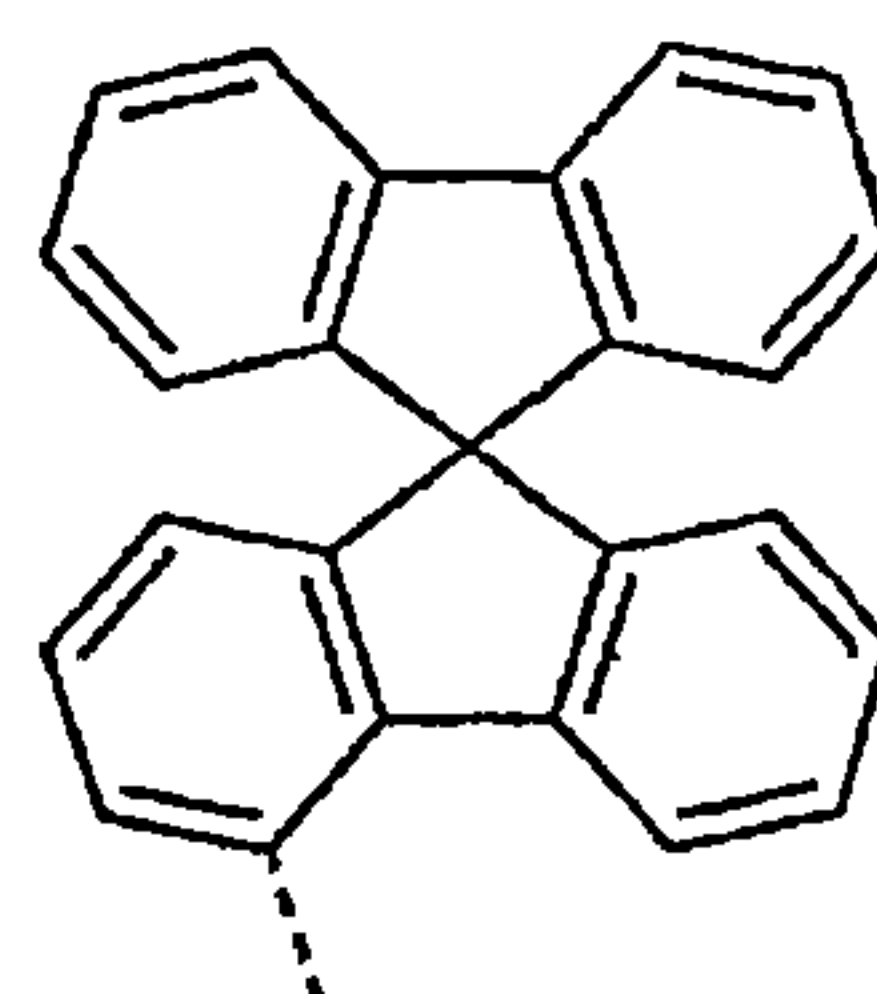
式(23)



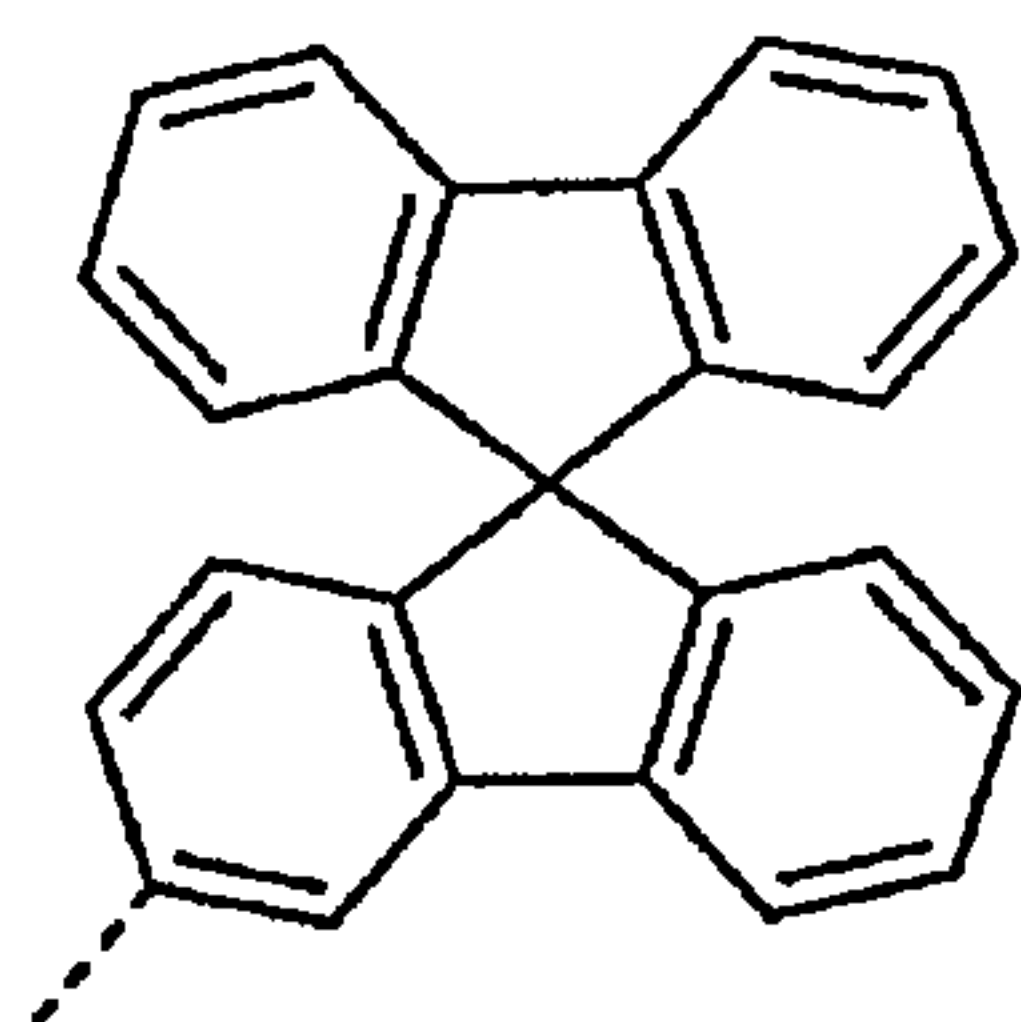
式(24)



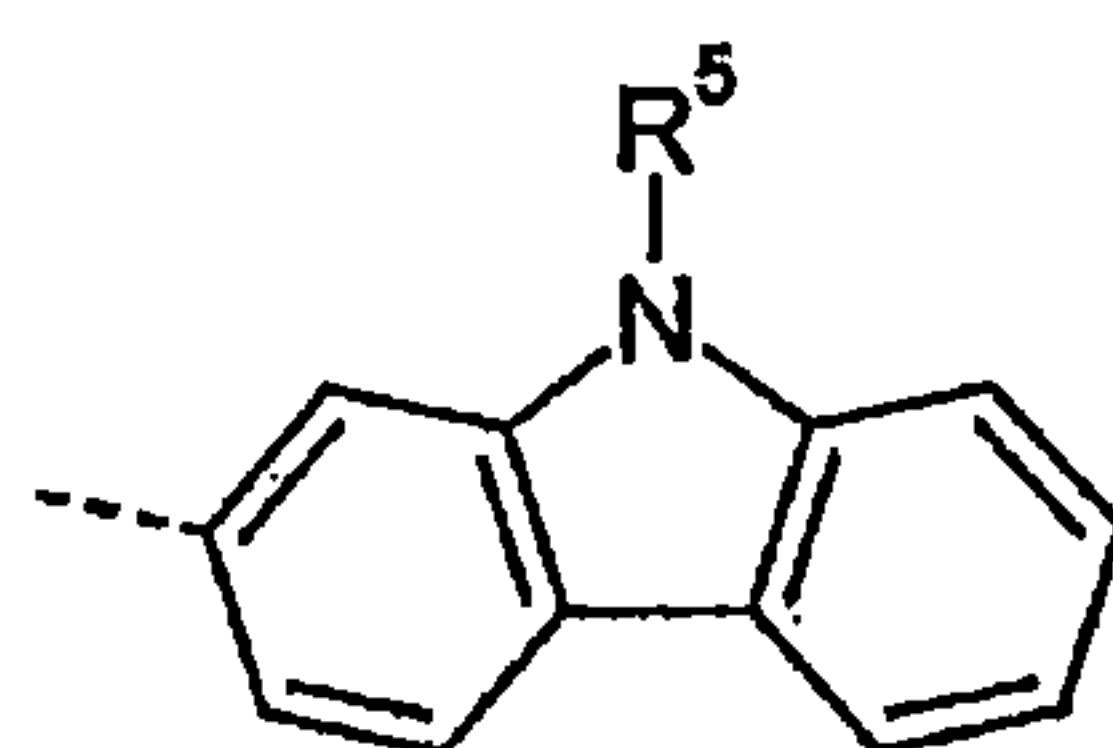
式(25)



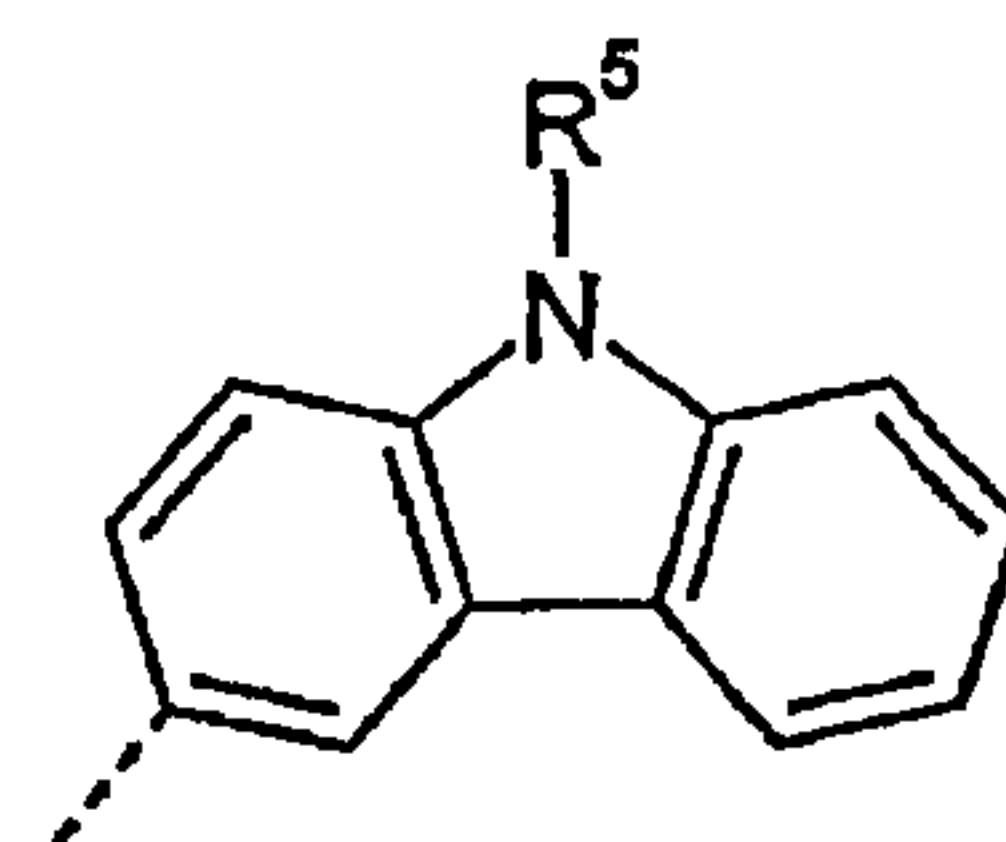
式(26)



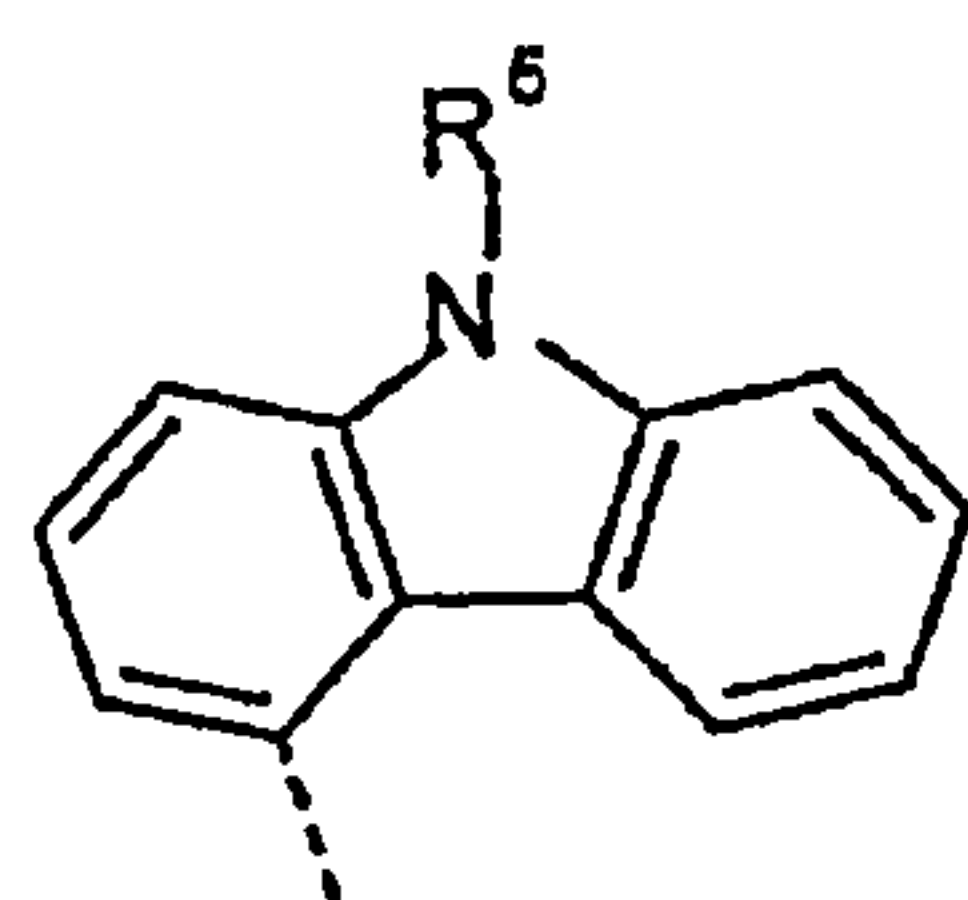
式(27)



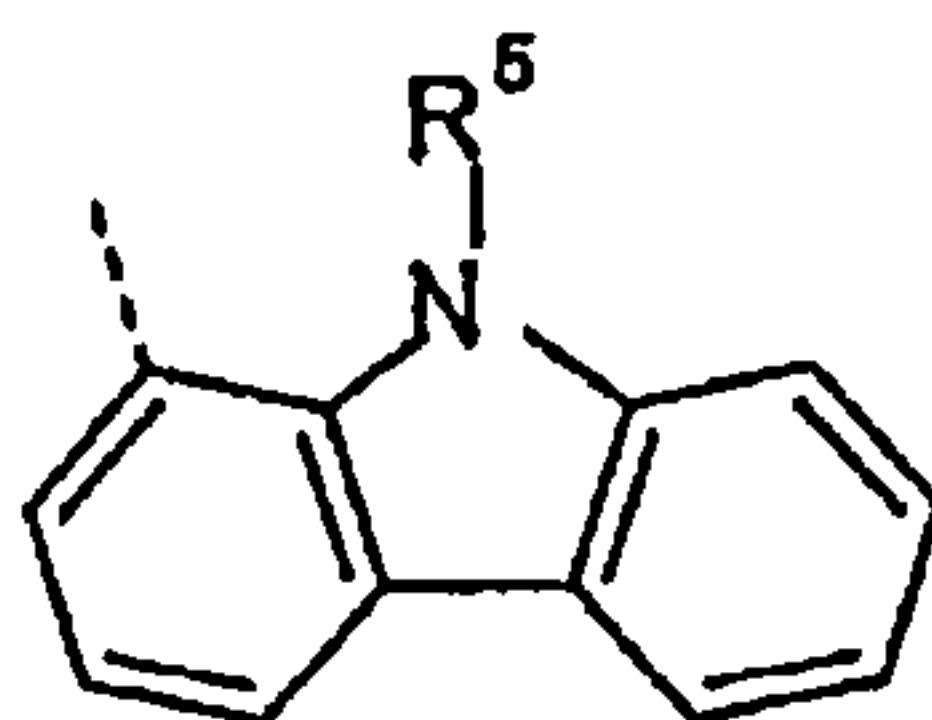
式(28)



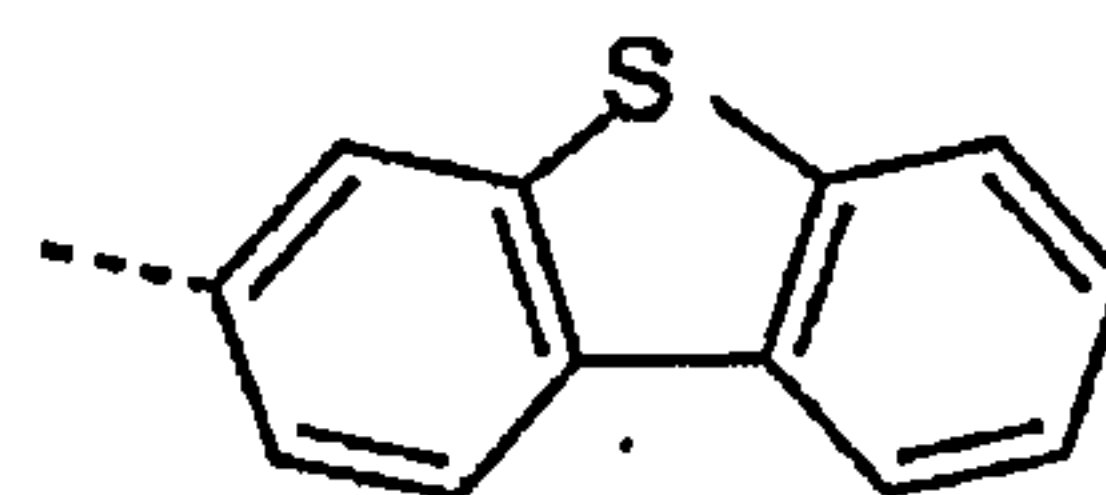
式(29)



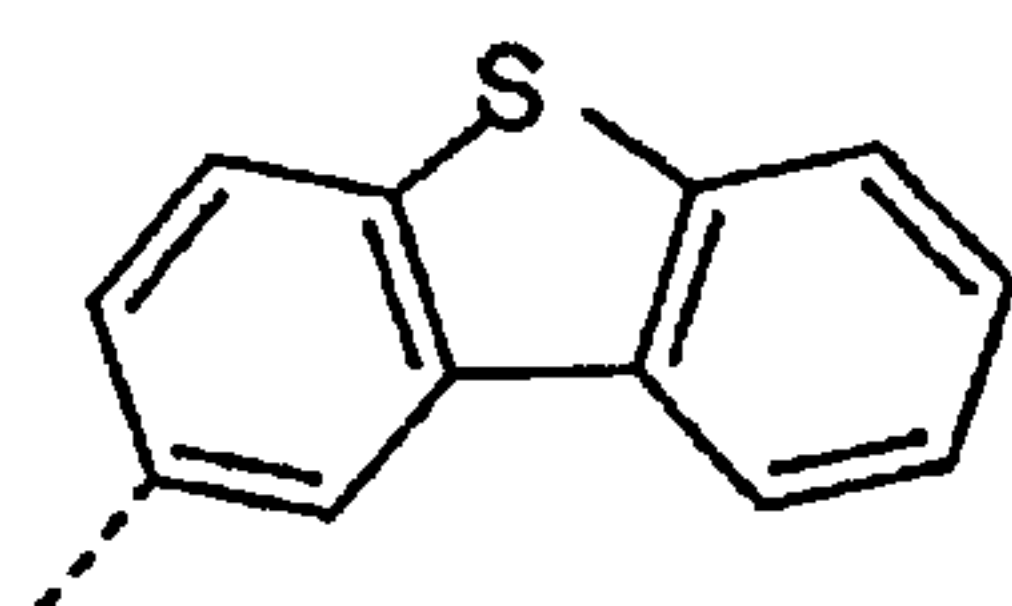
式(30)



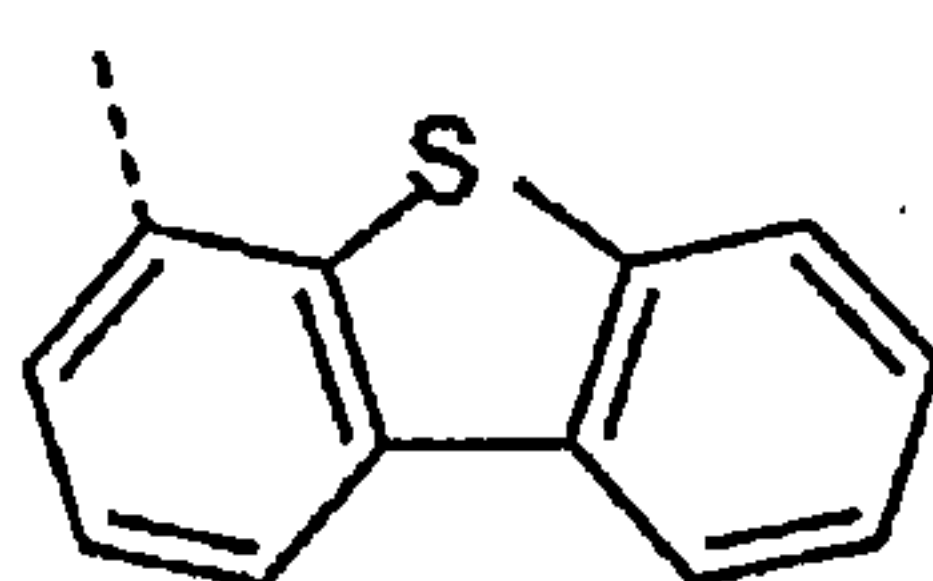
式(31)



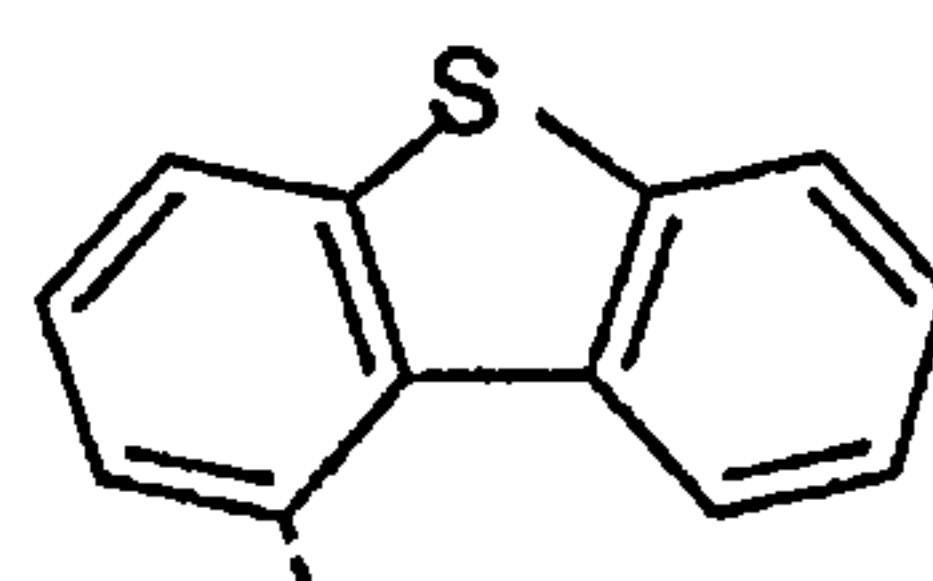
式(32)



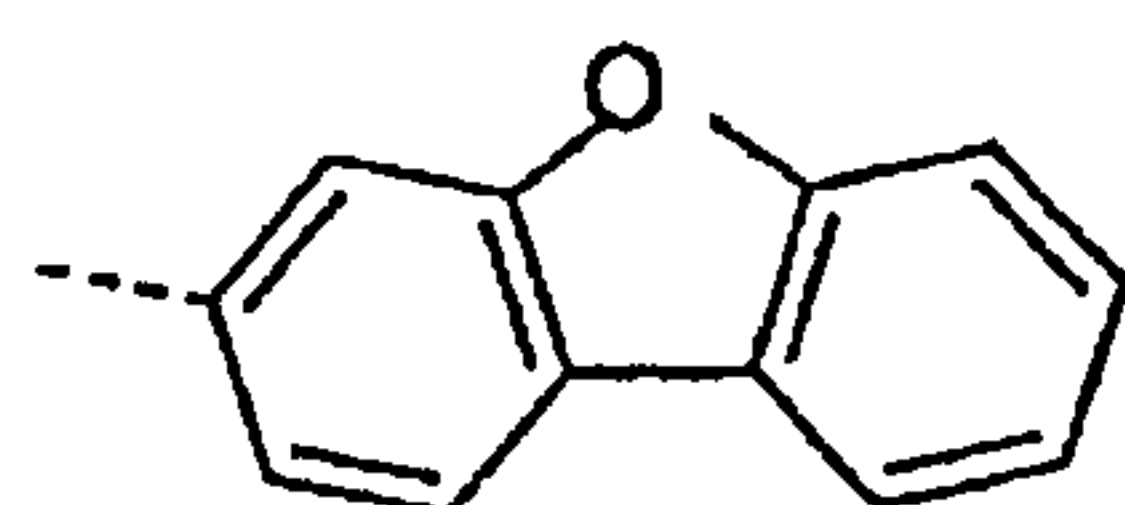
式(33)



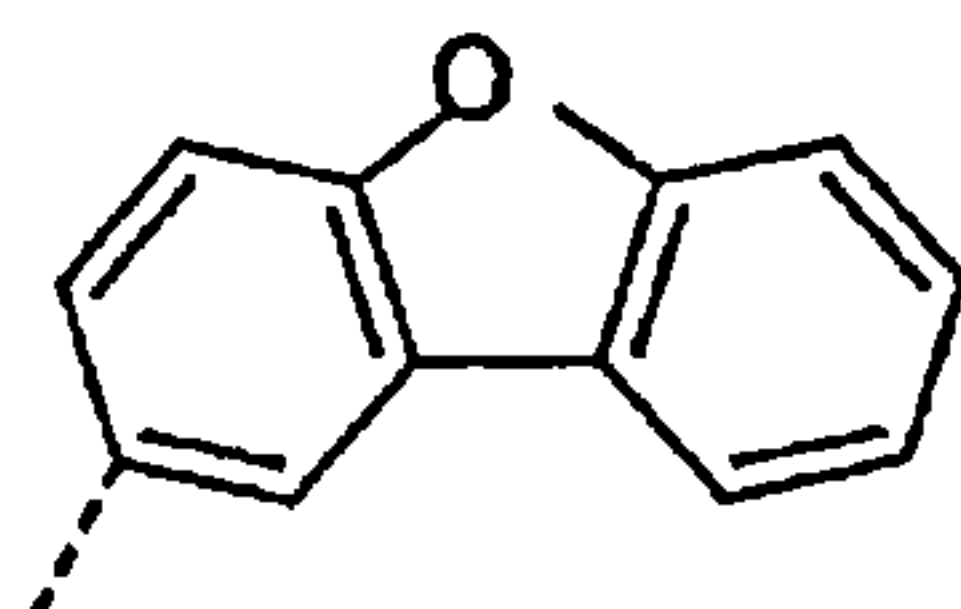
式(34)



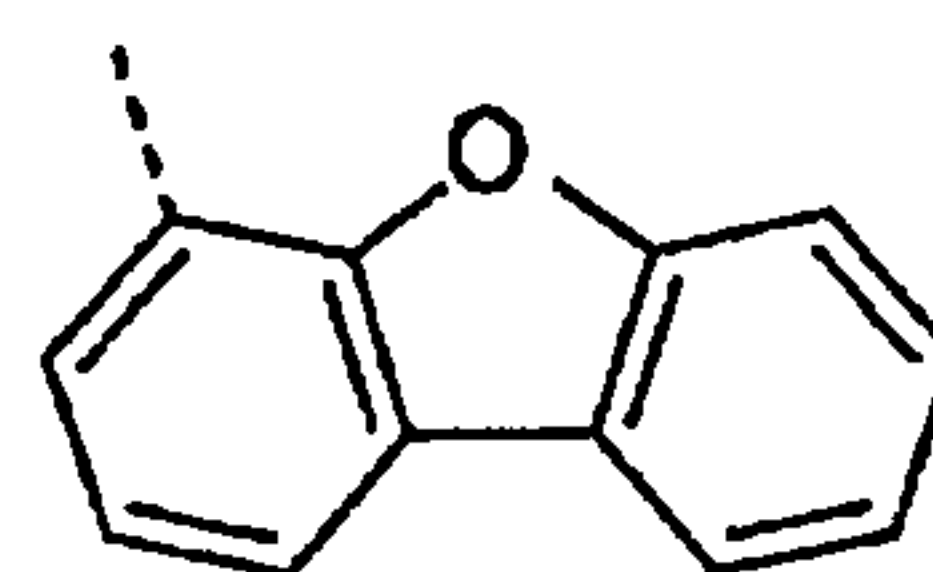
式(35)



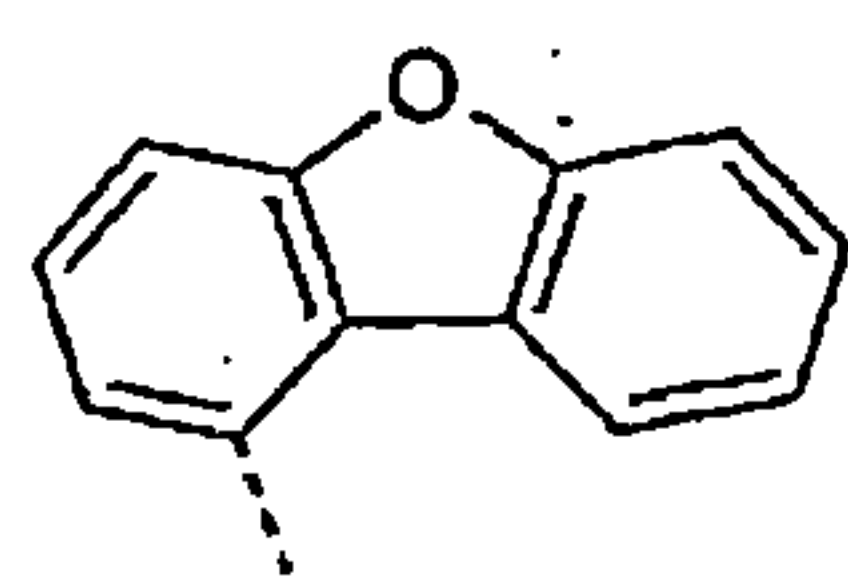
式(36)



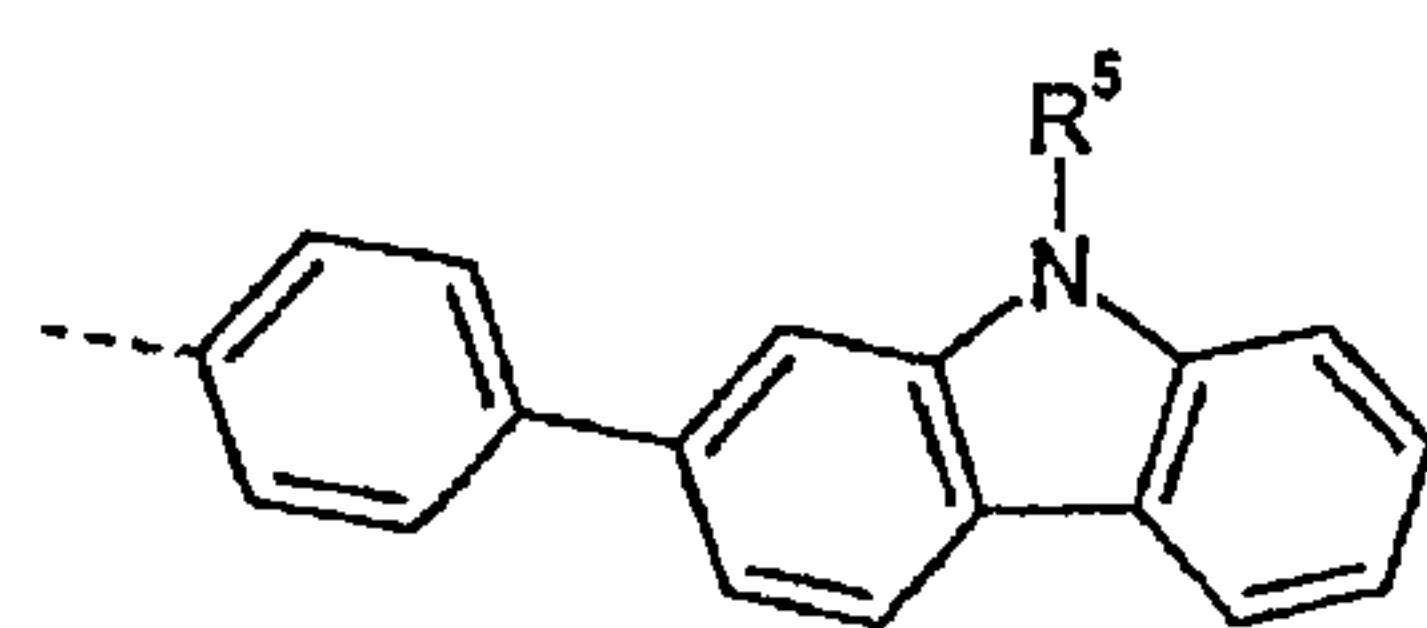
式(37)



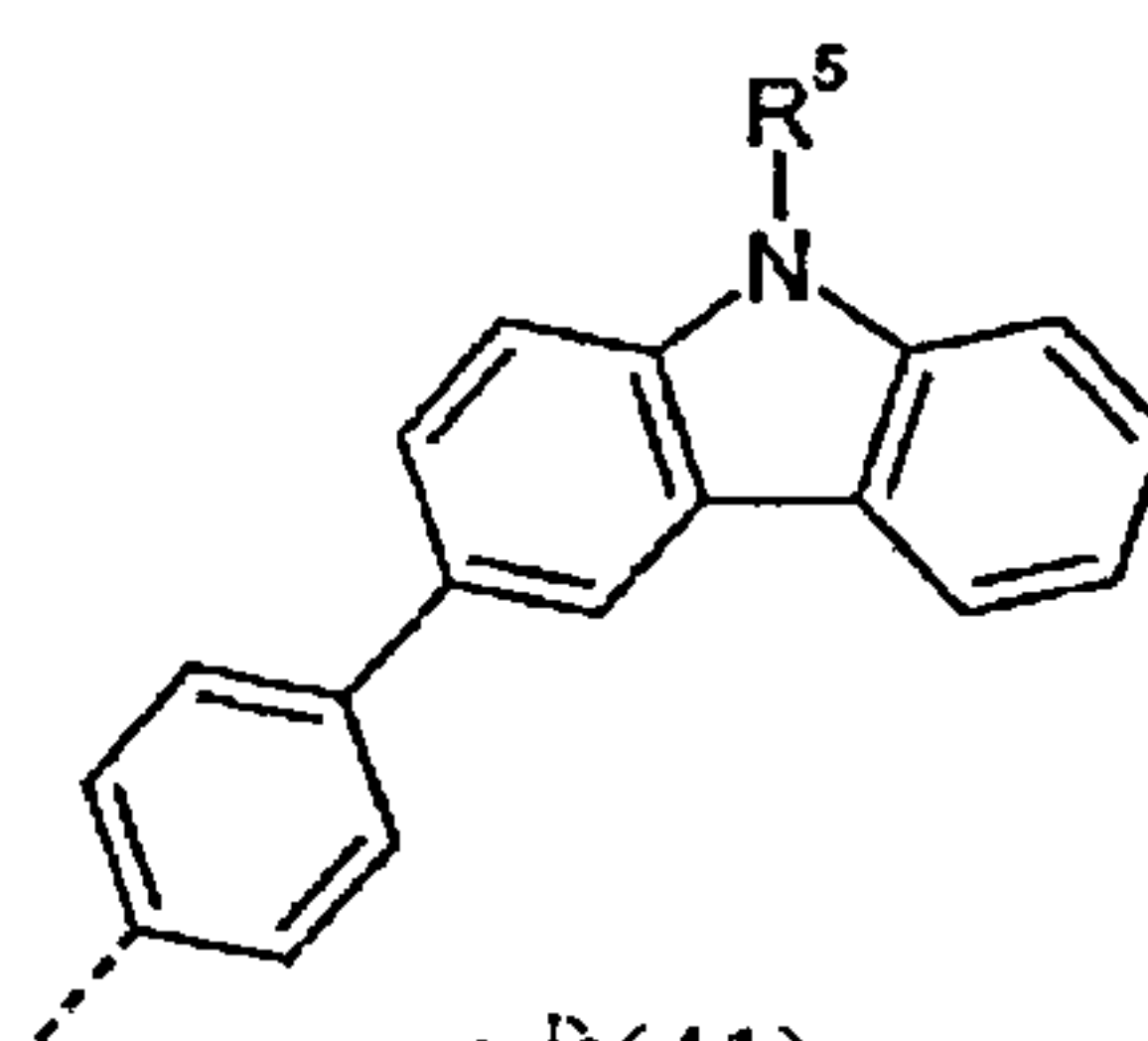
式(38)



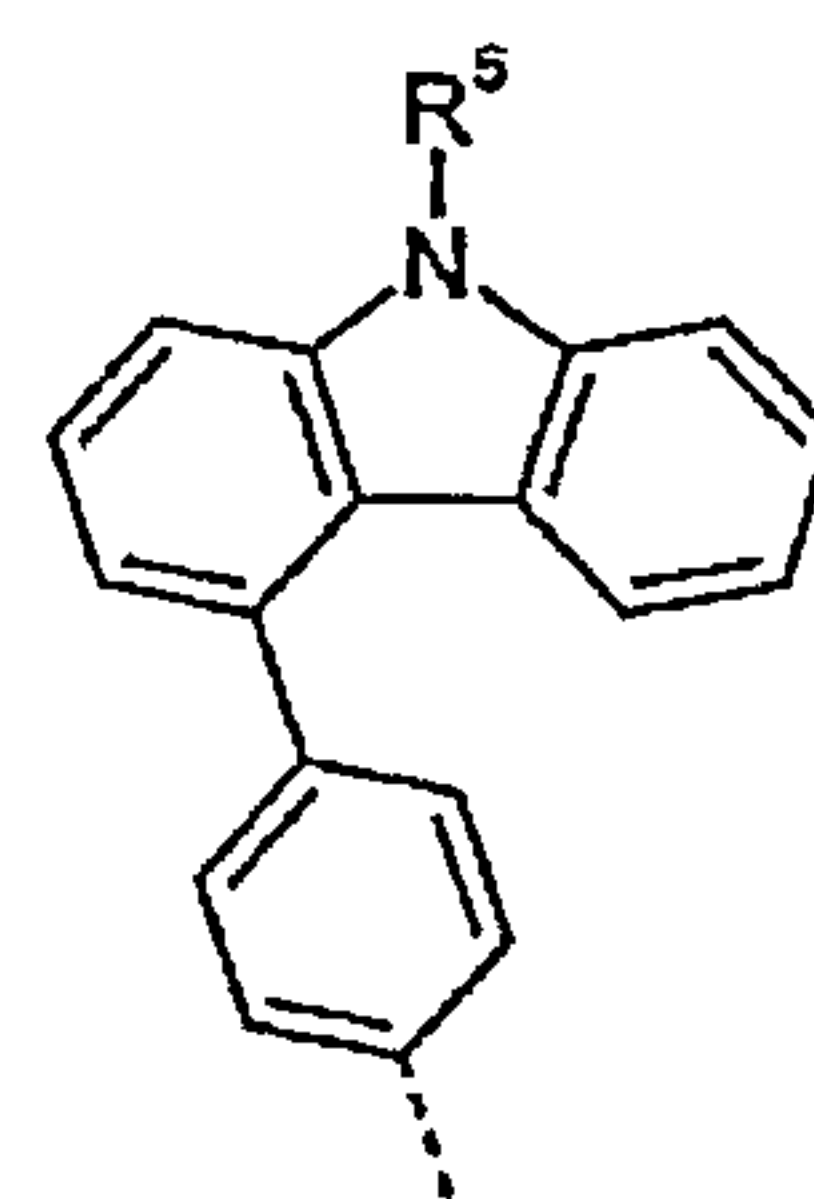
式(39)



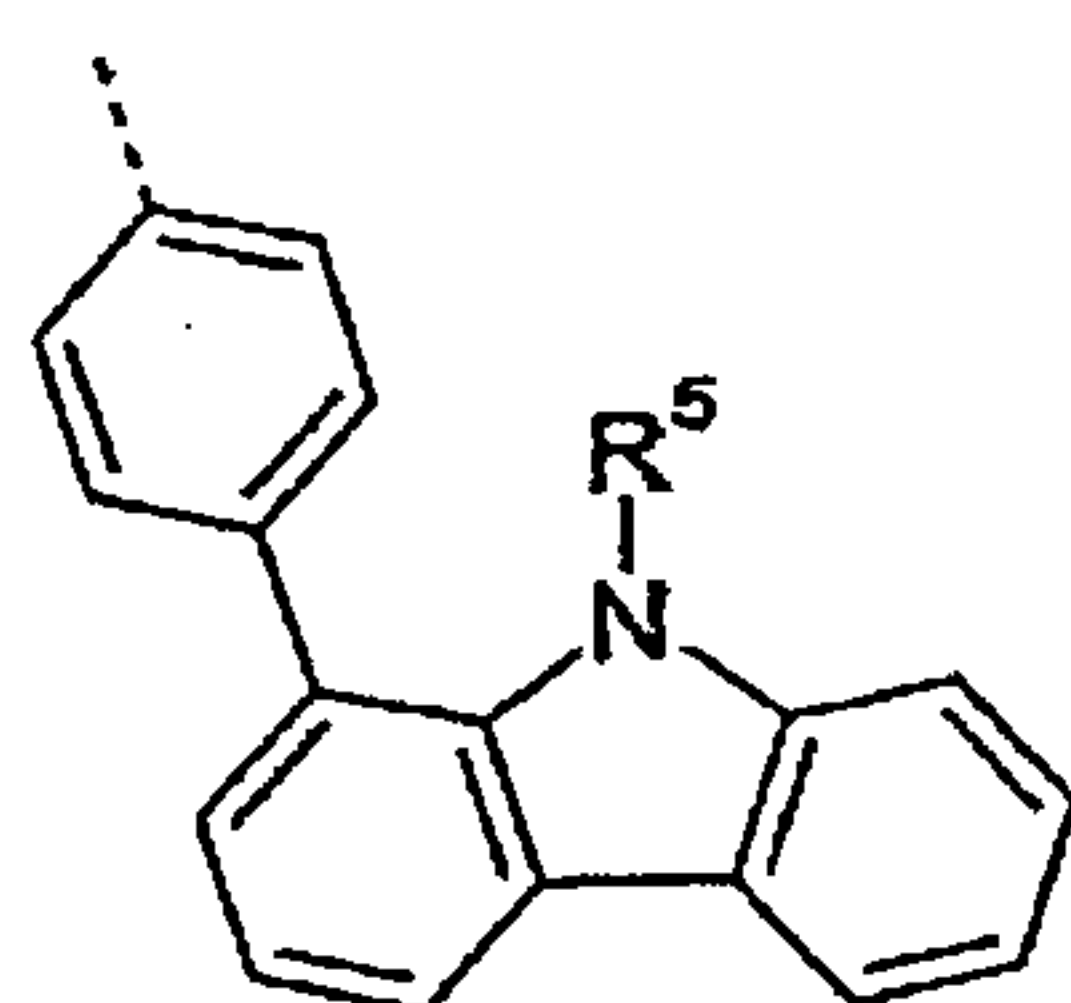
式(40)



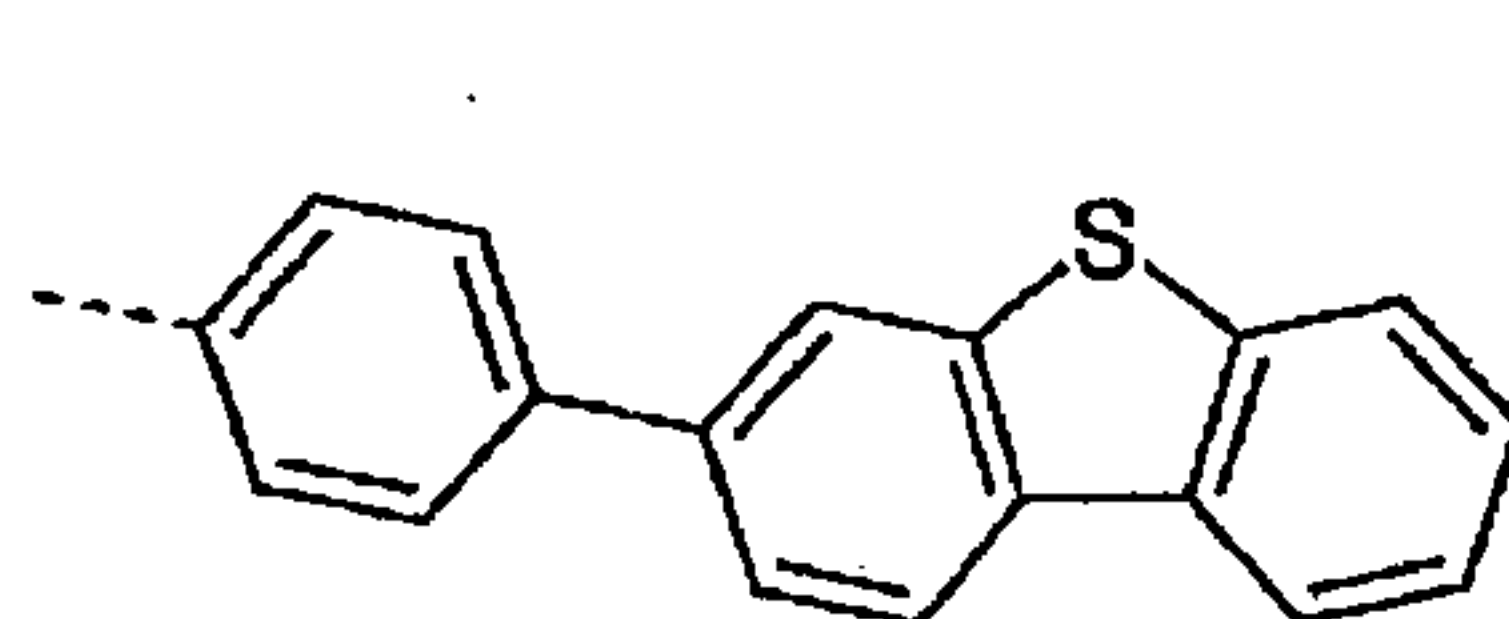
式(41)



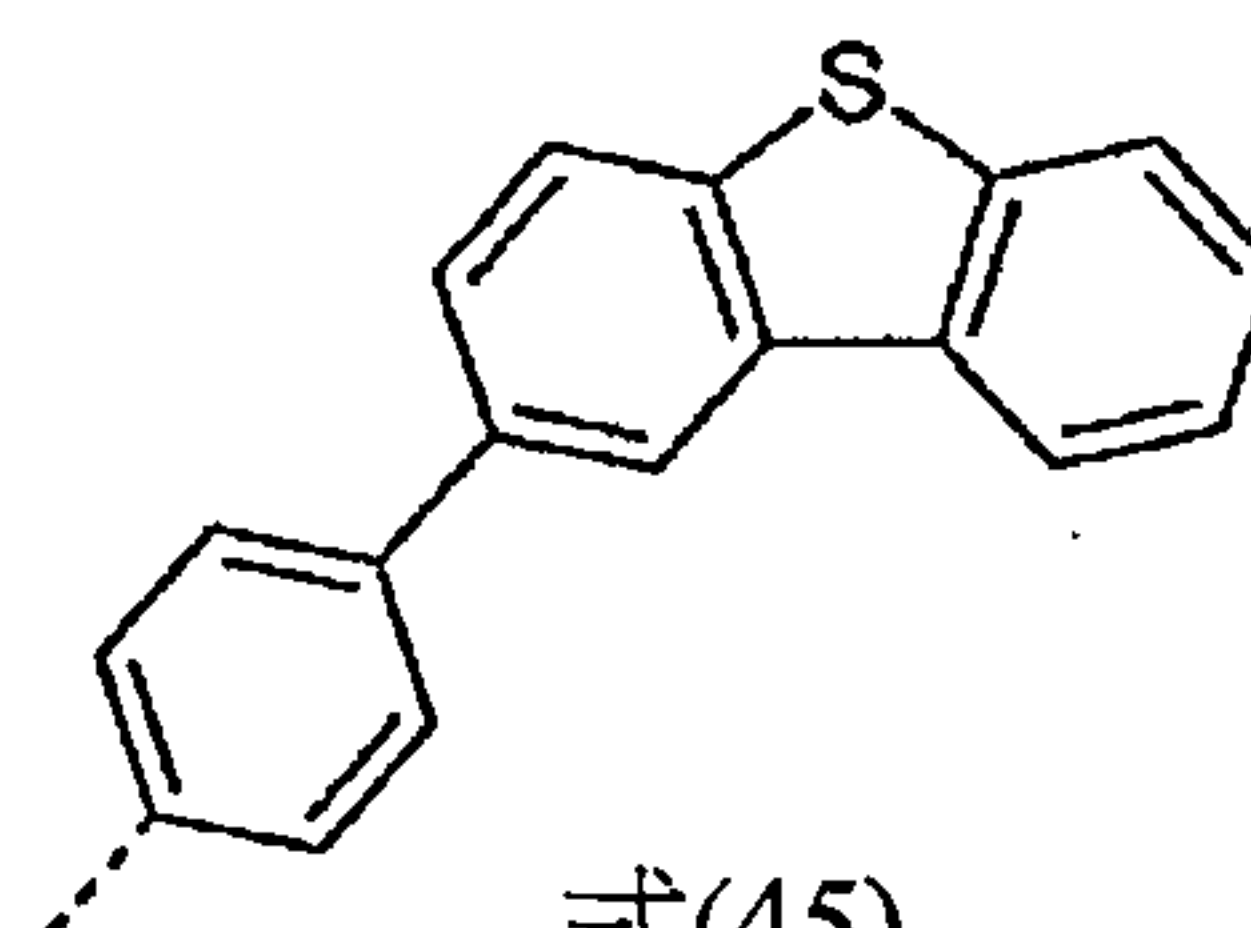
式(42)



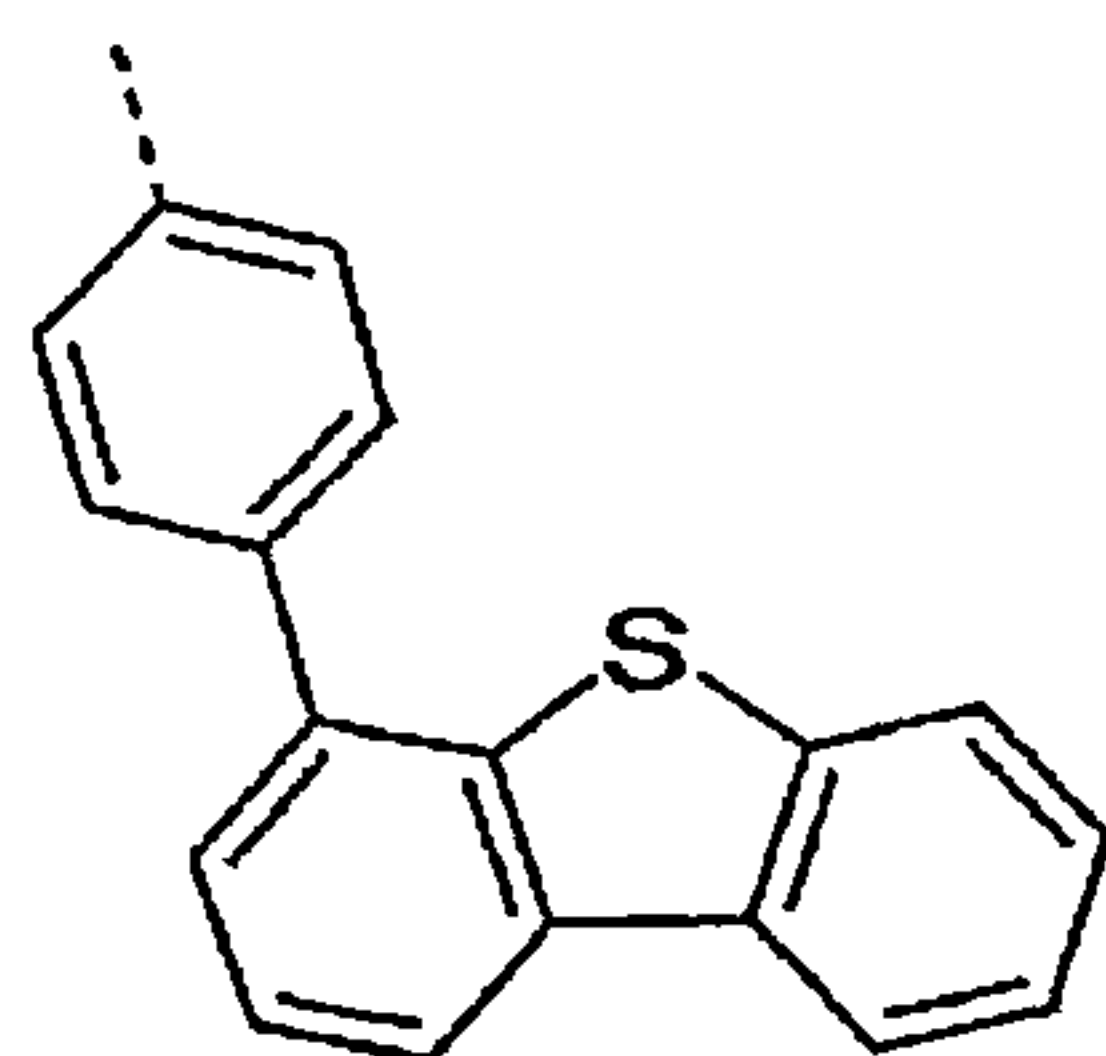
式(43)



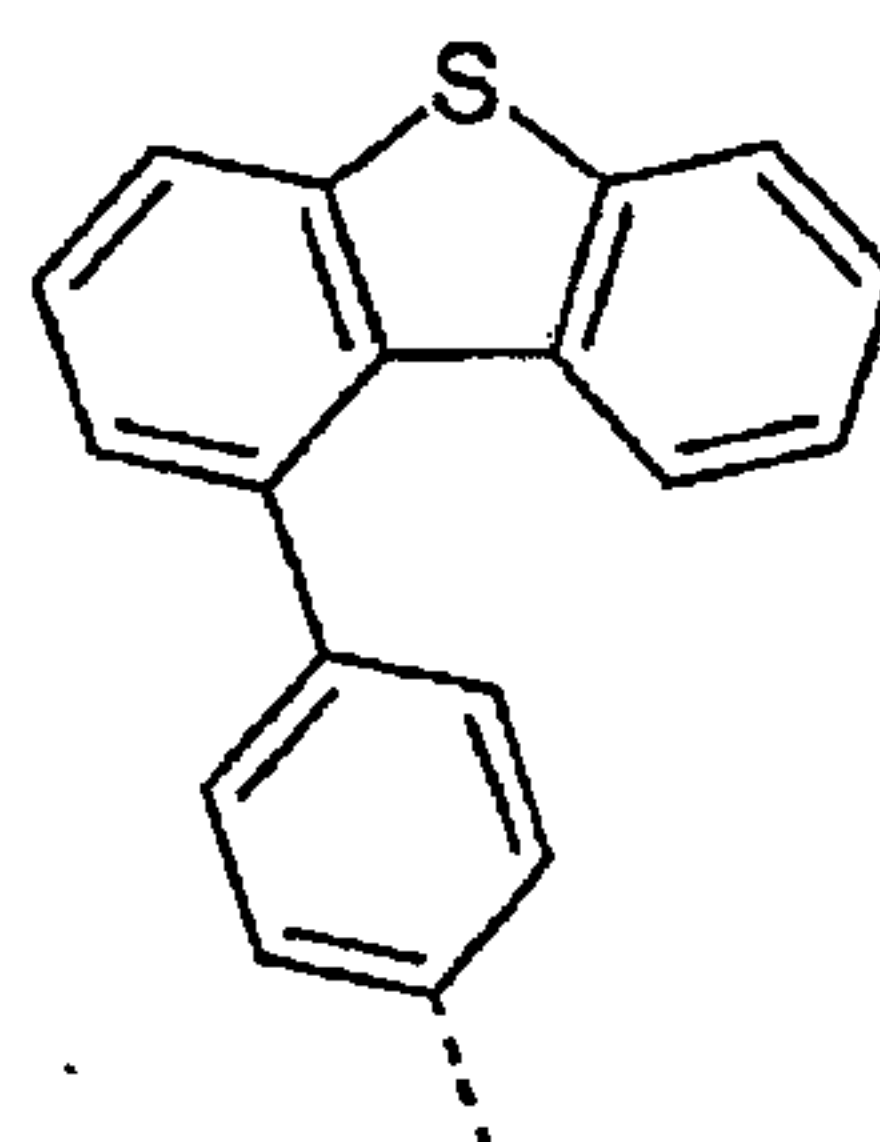
式(44)



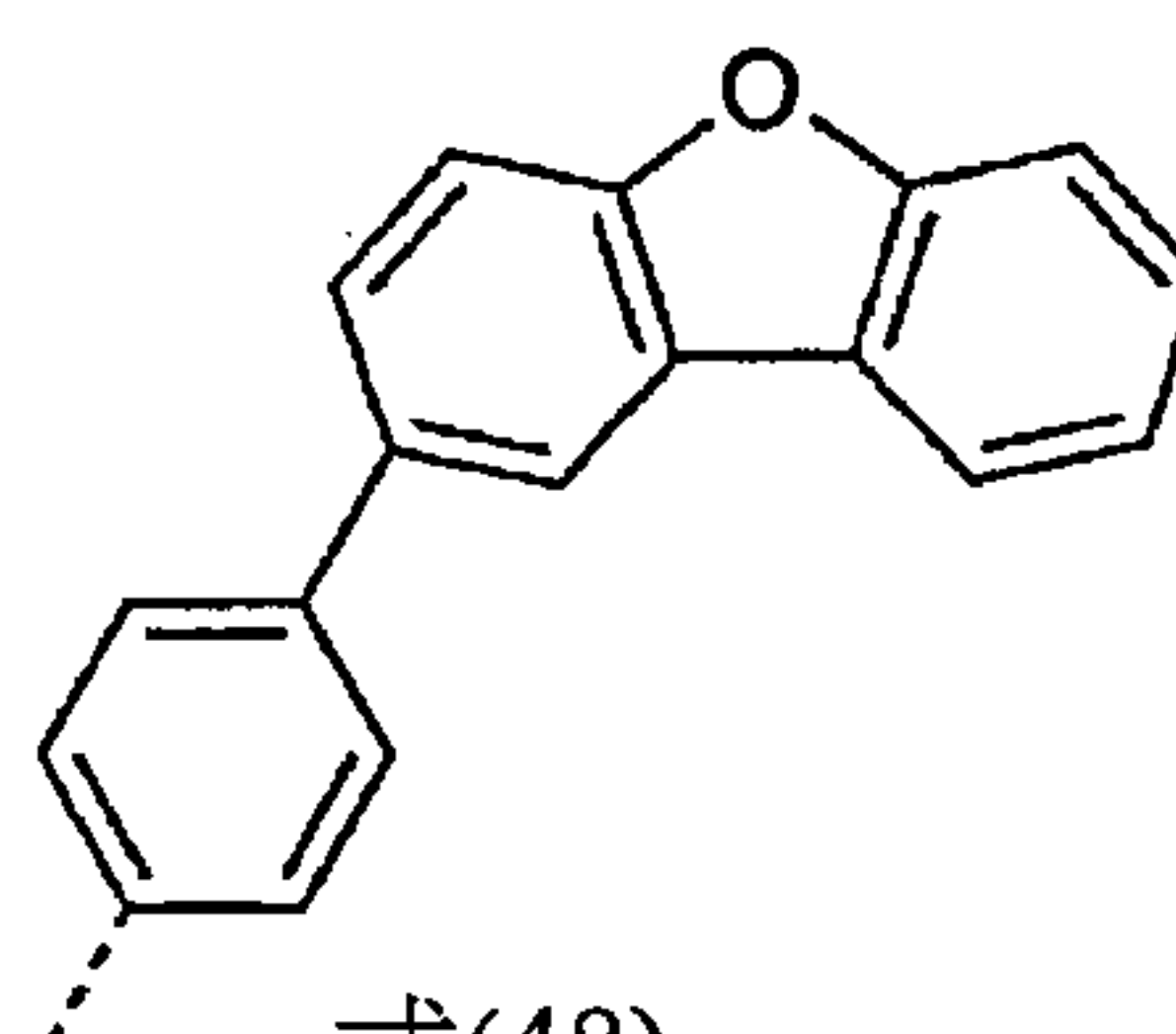
式(45)



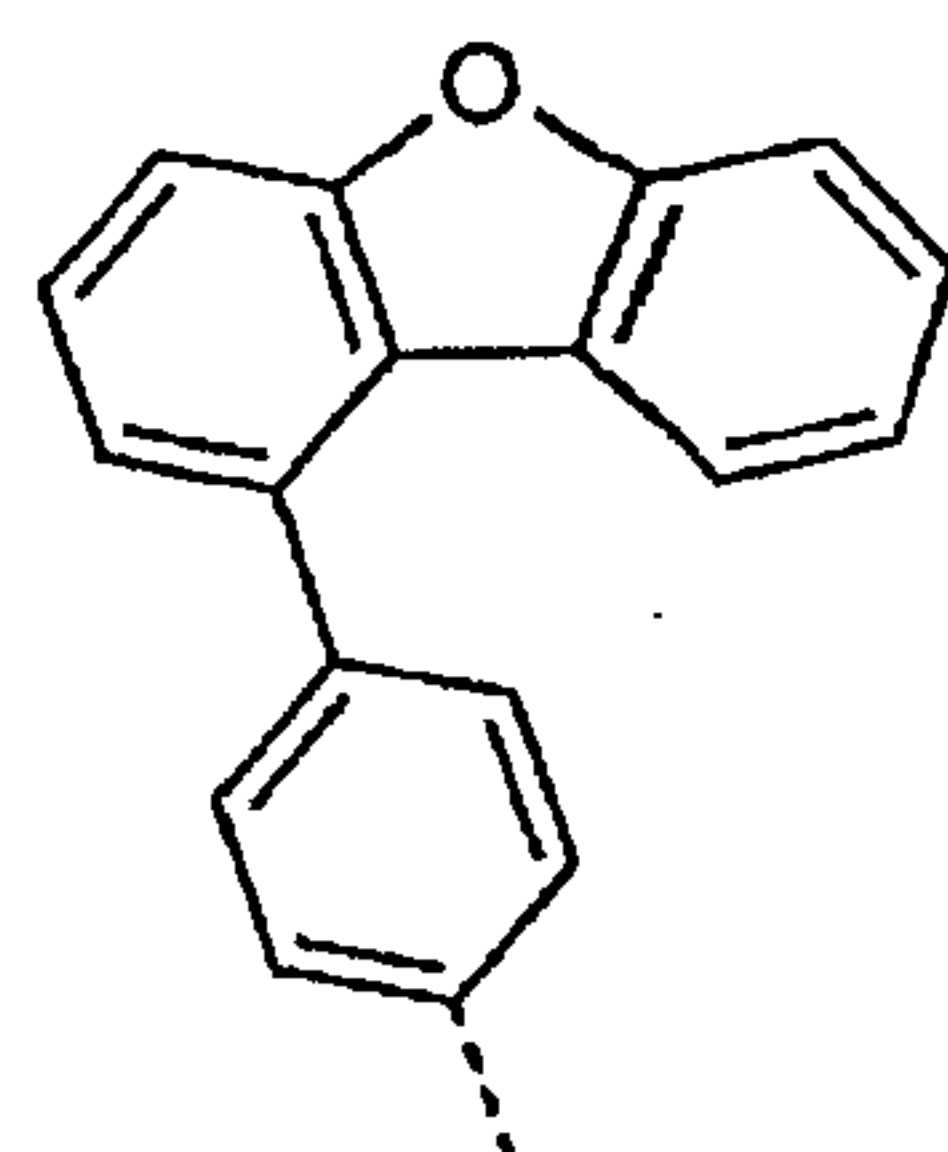
式(46)



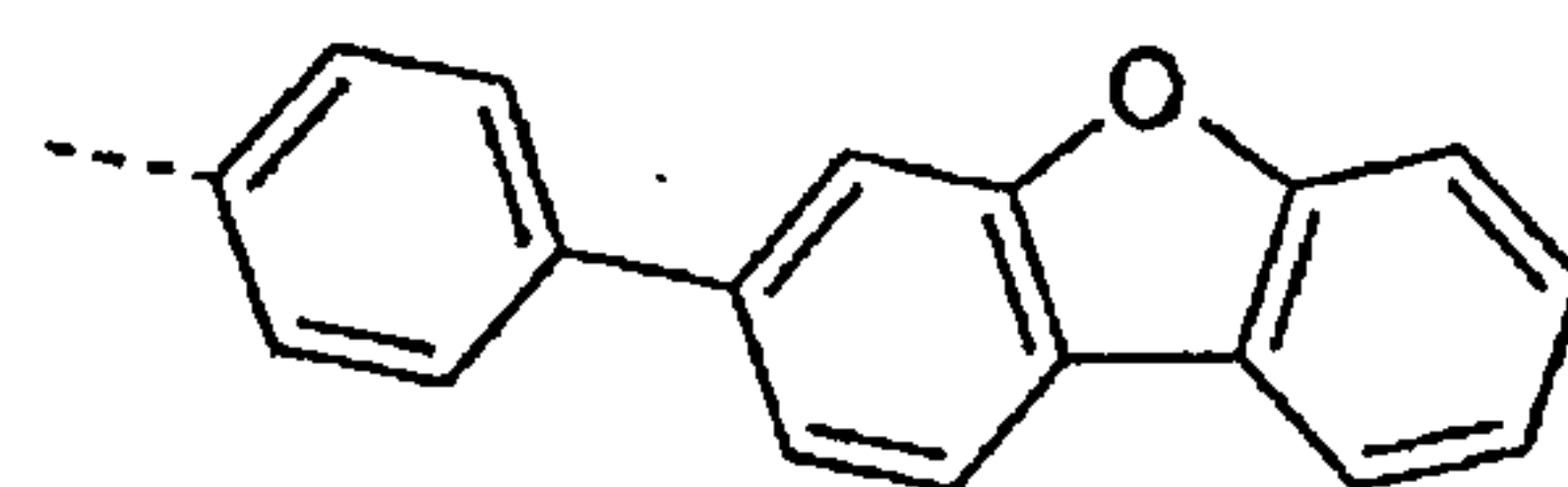
式(47)



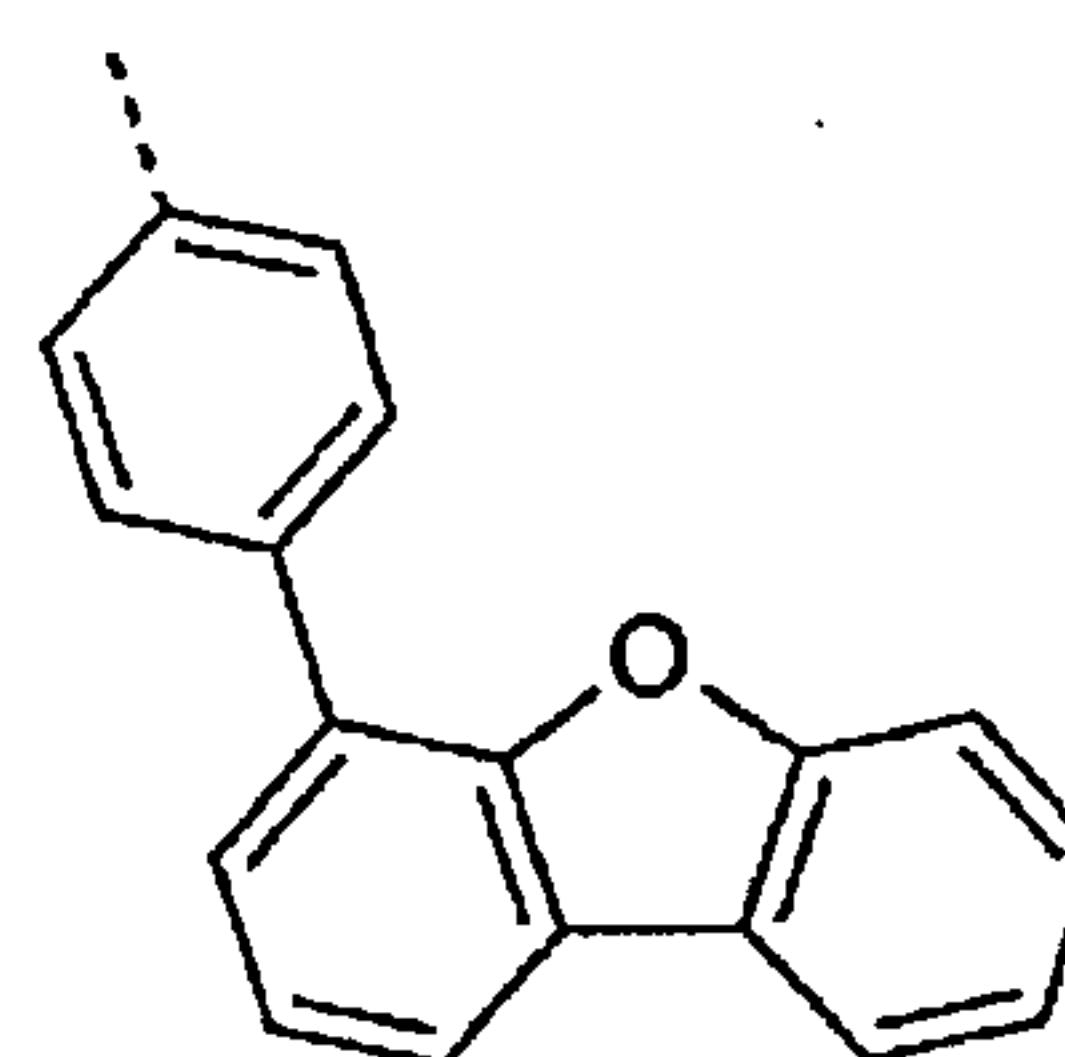
式(48)



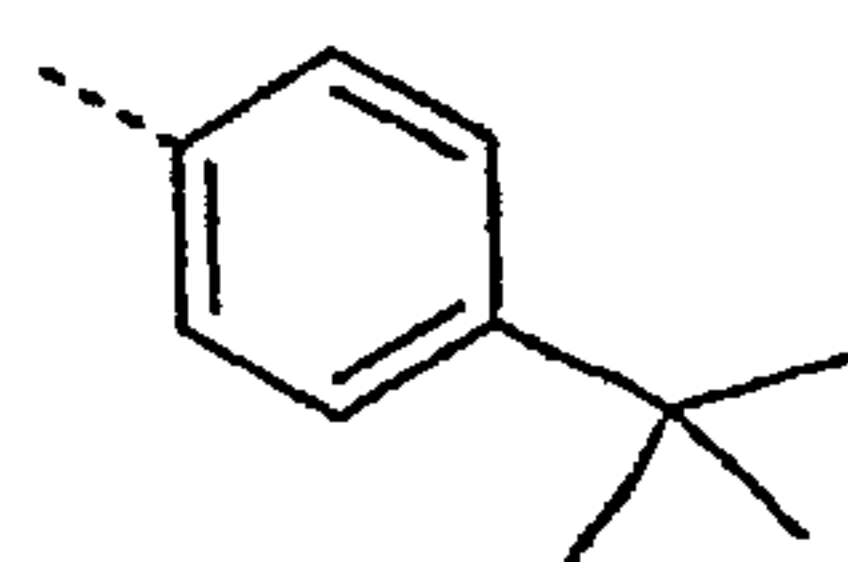
式(49)



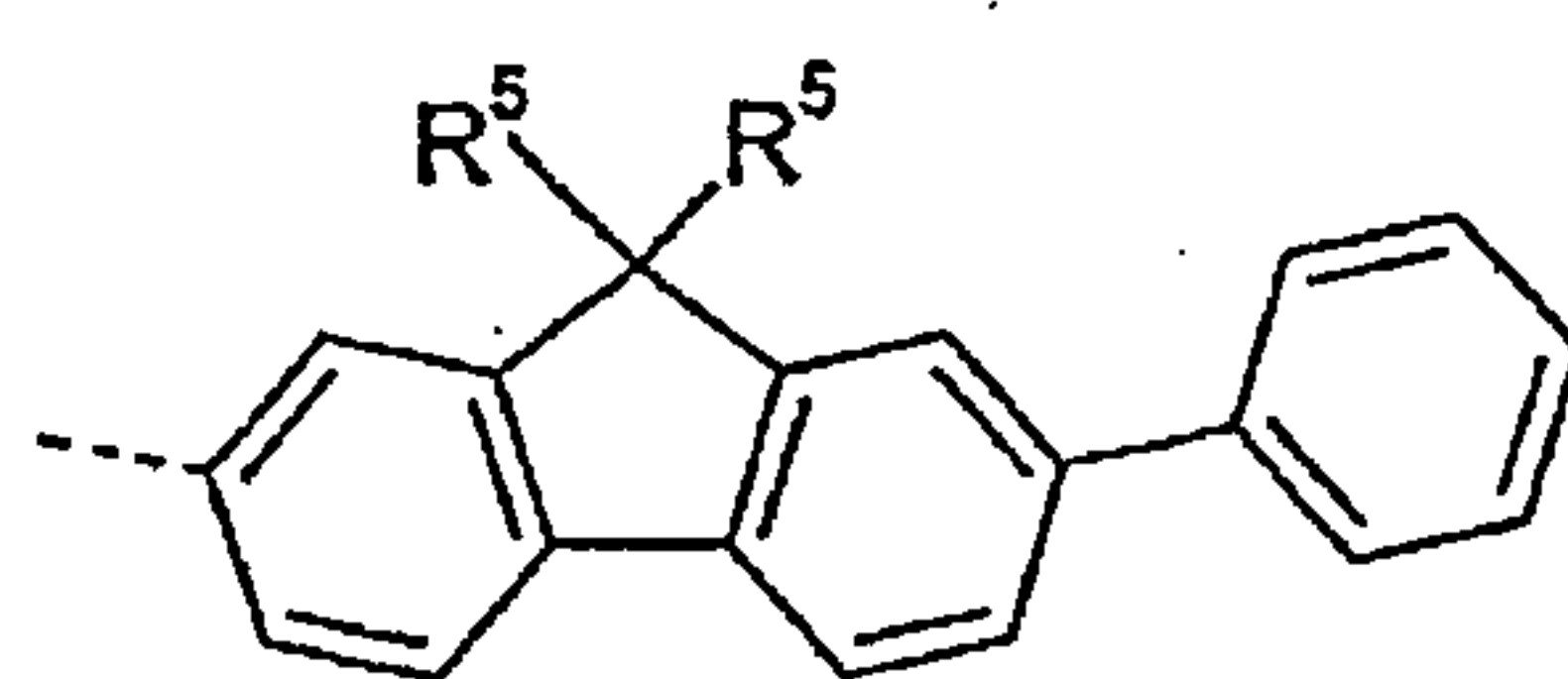
式(50)



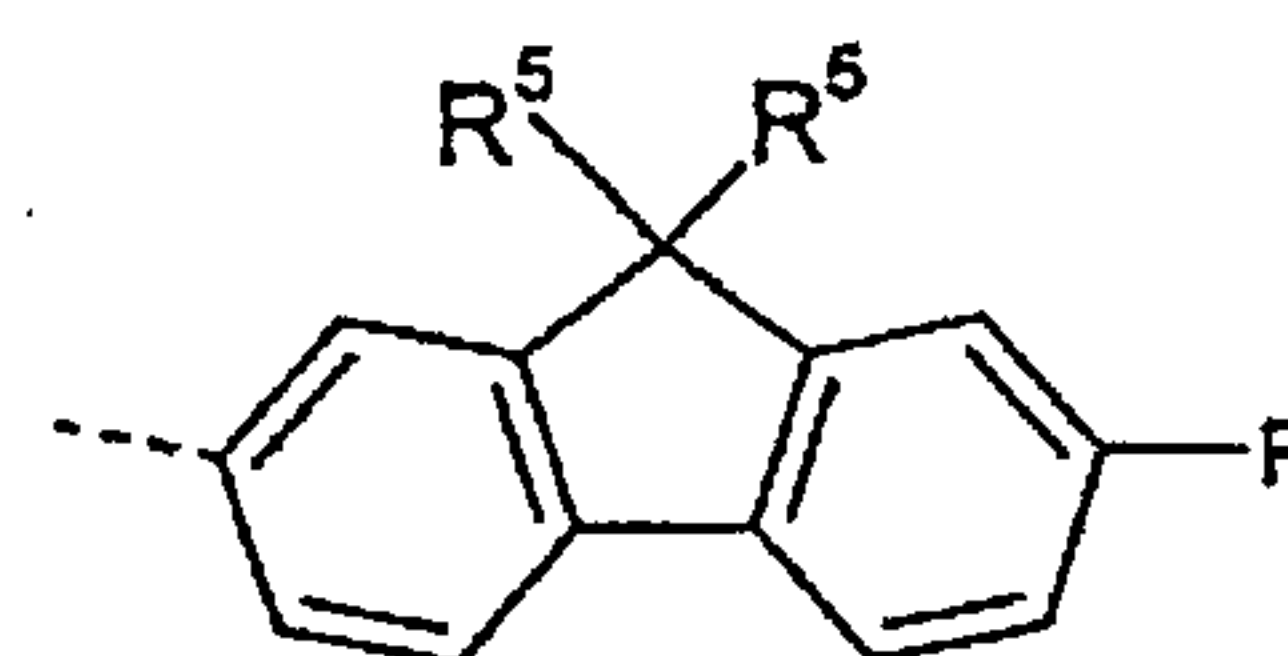
式(51)



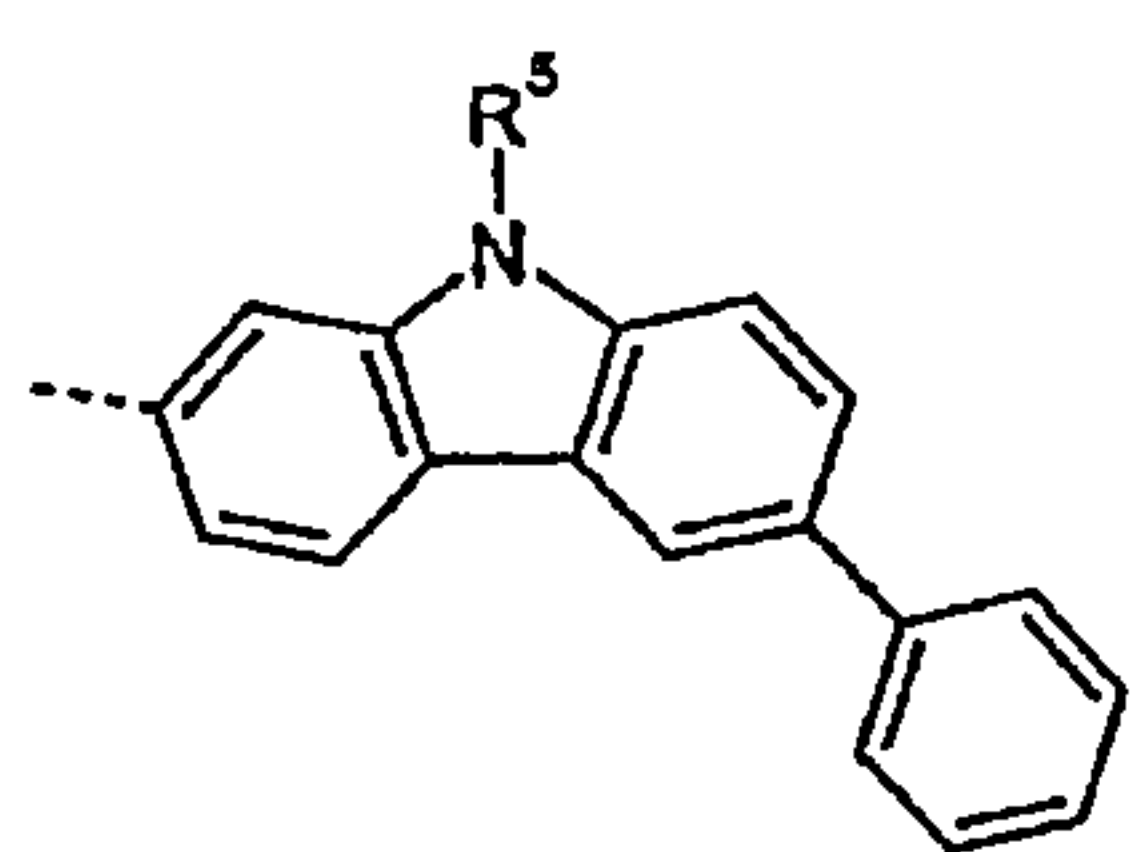
式(52)



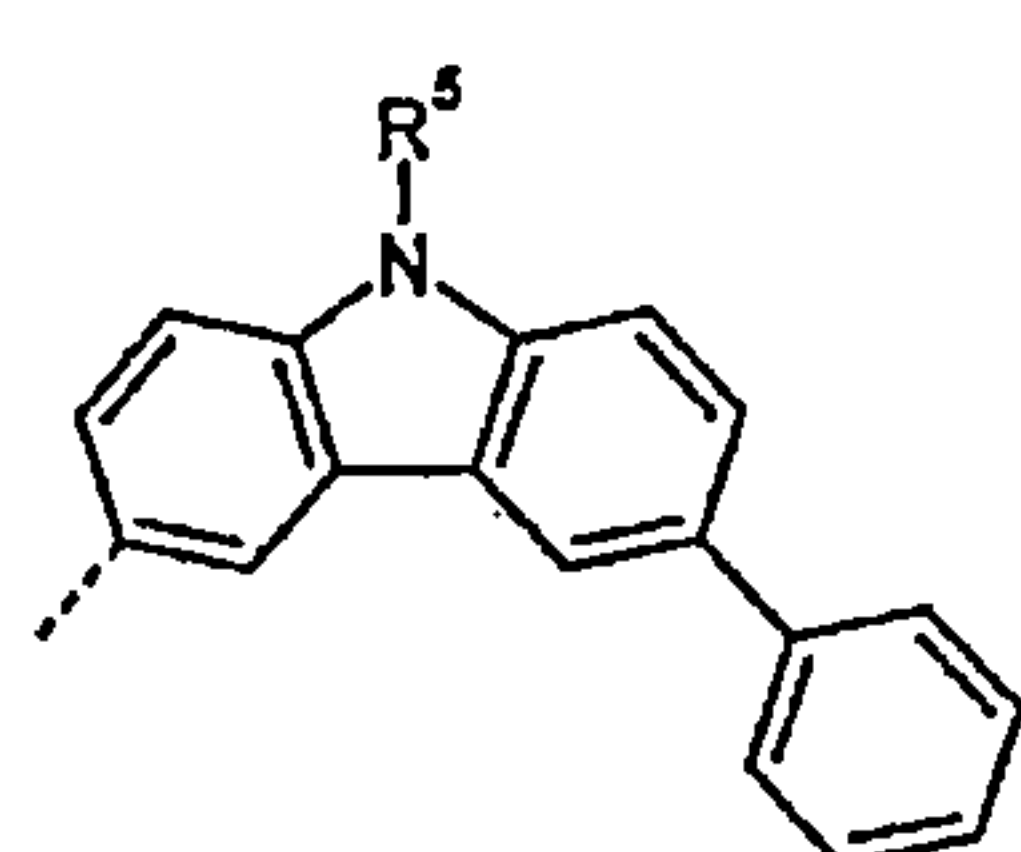
式(53)



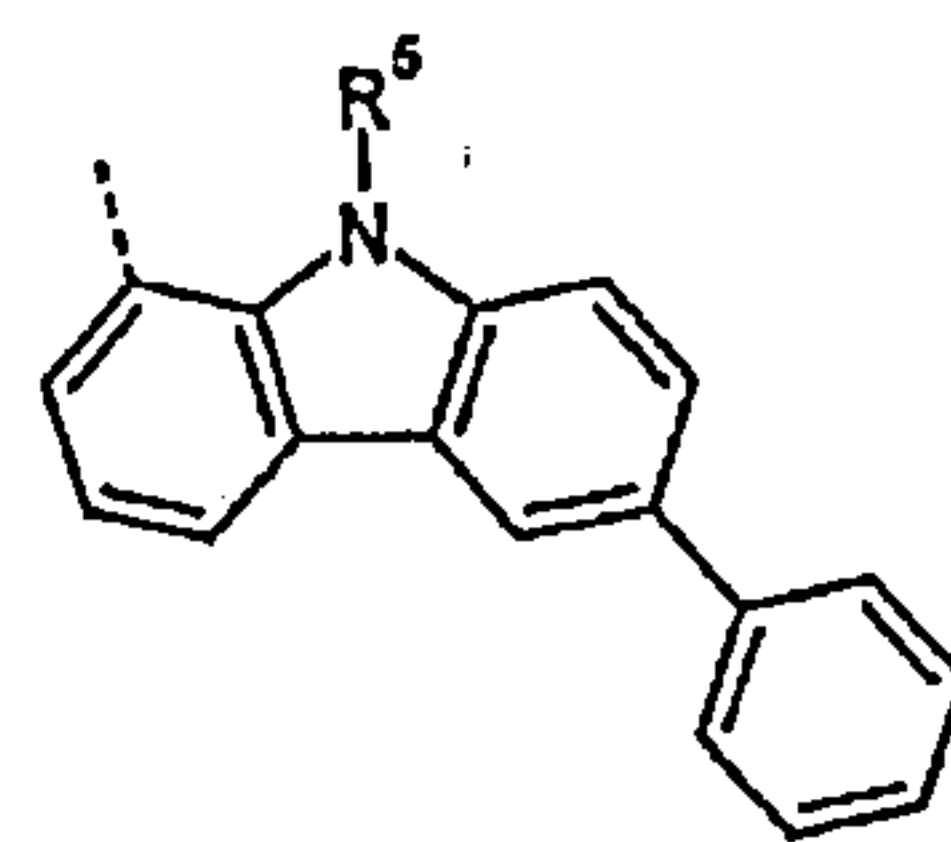
式(54)



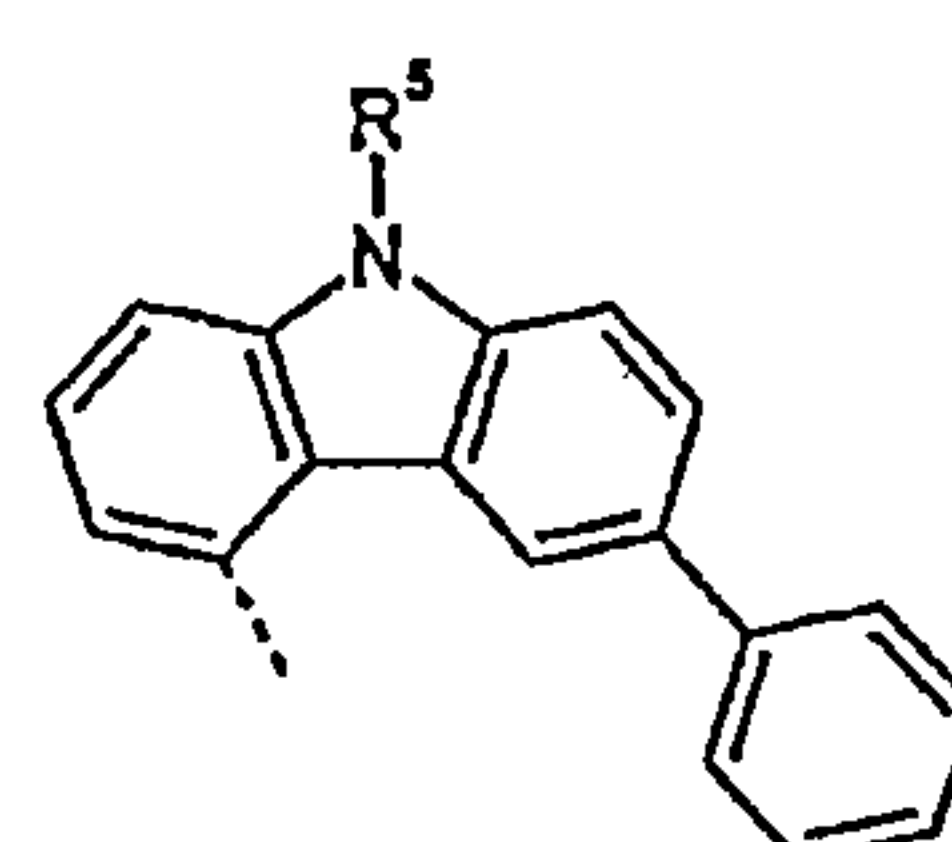
式(55)



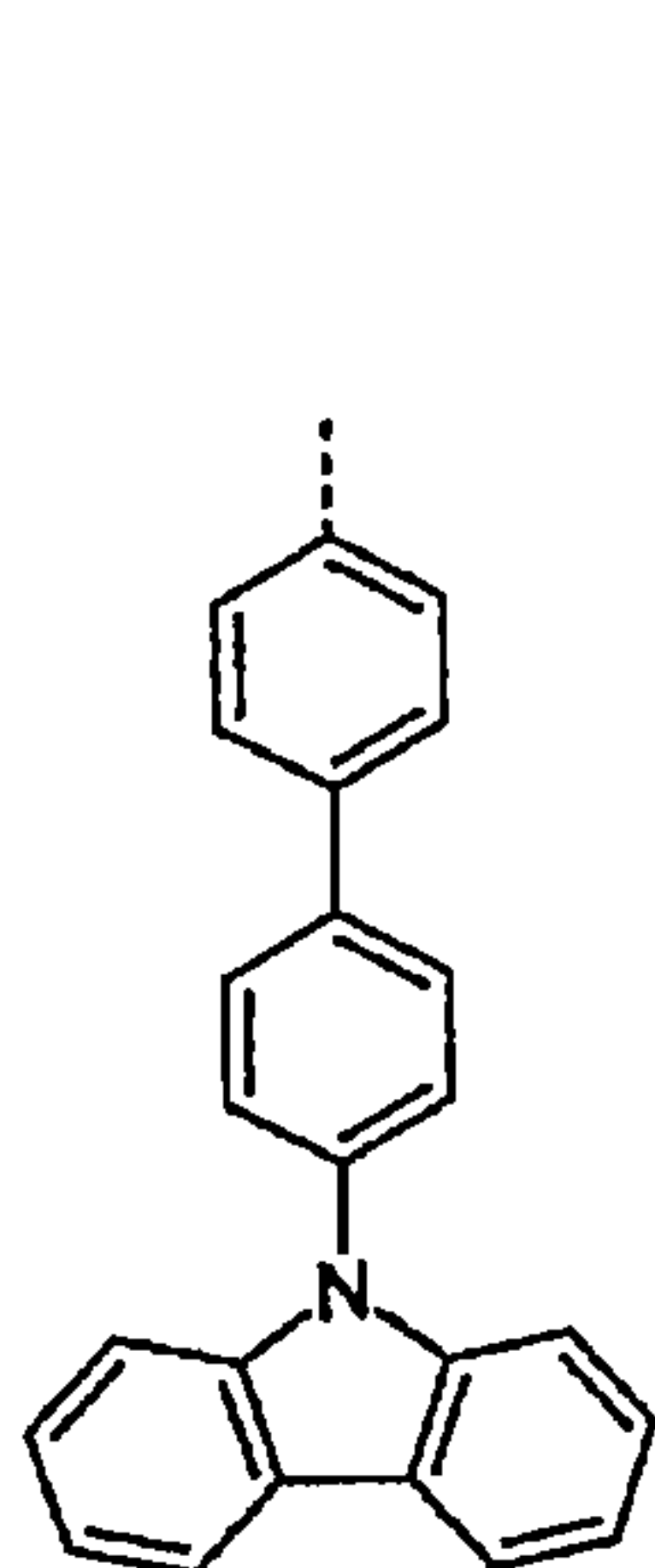
式(56)



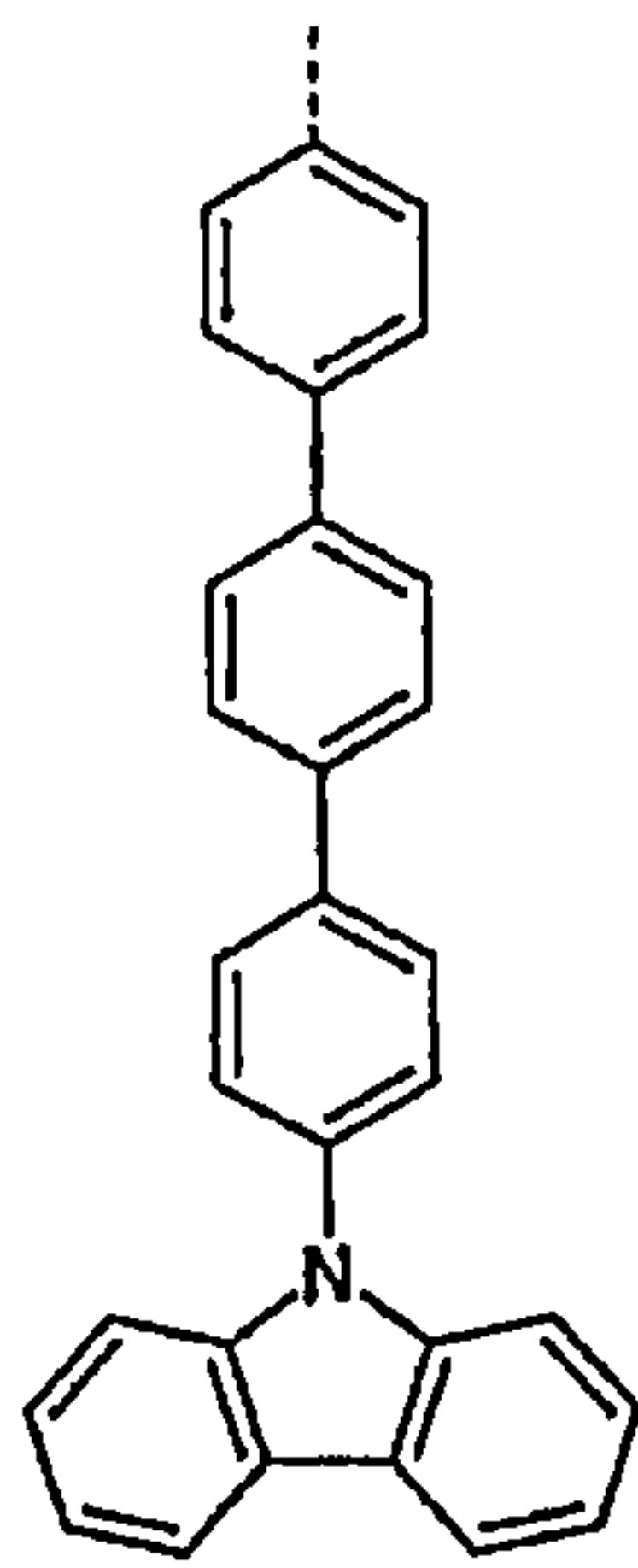
式(57)



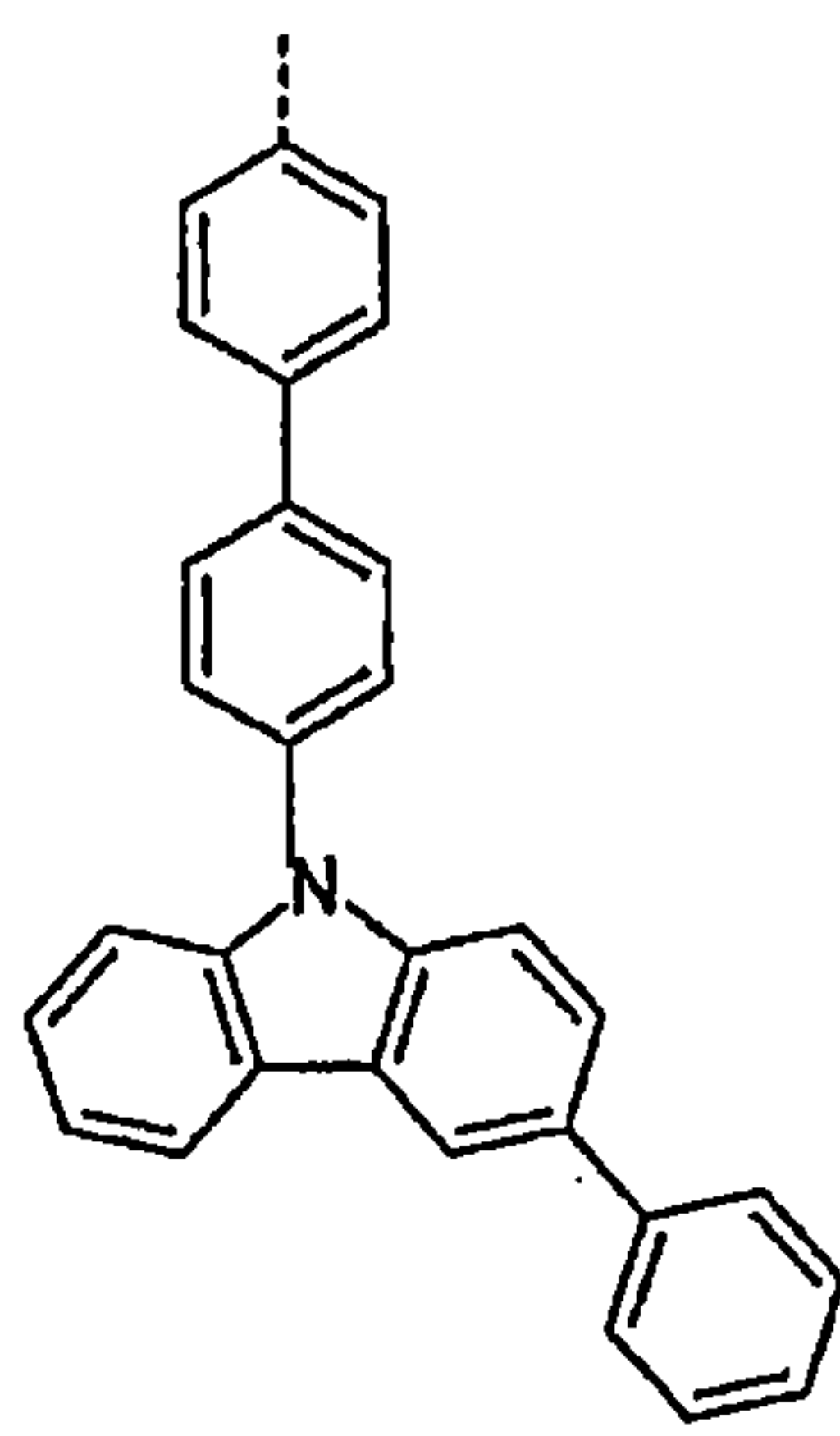
式(58)



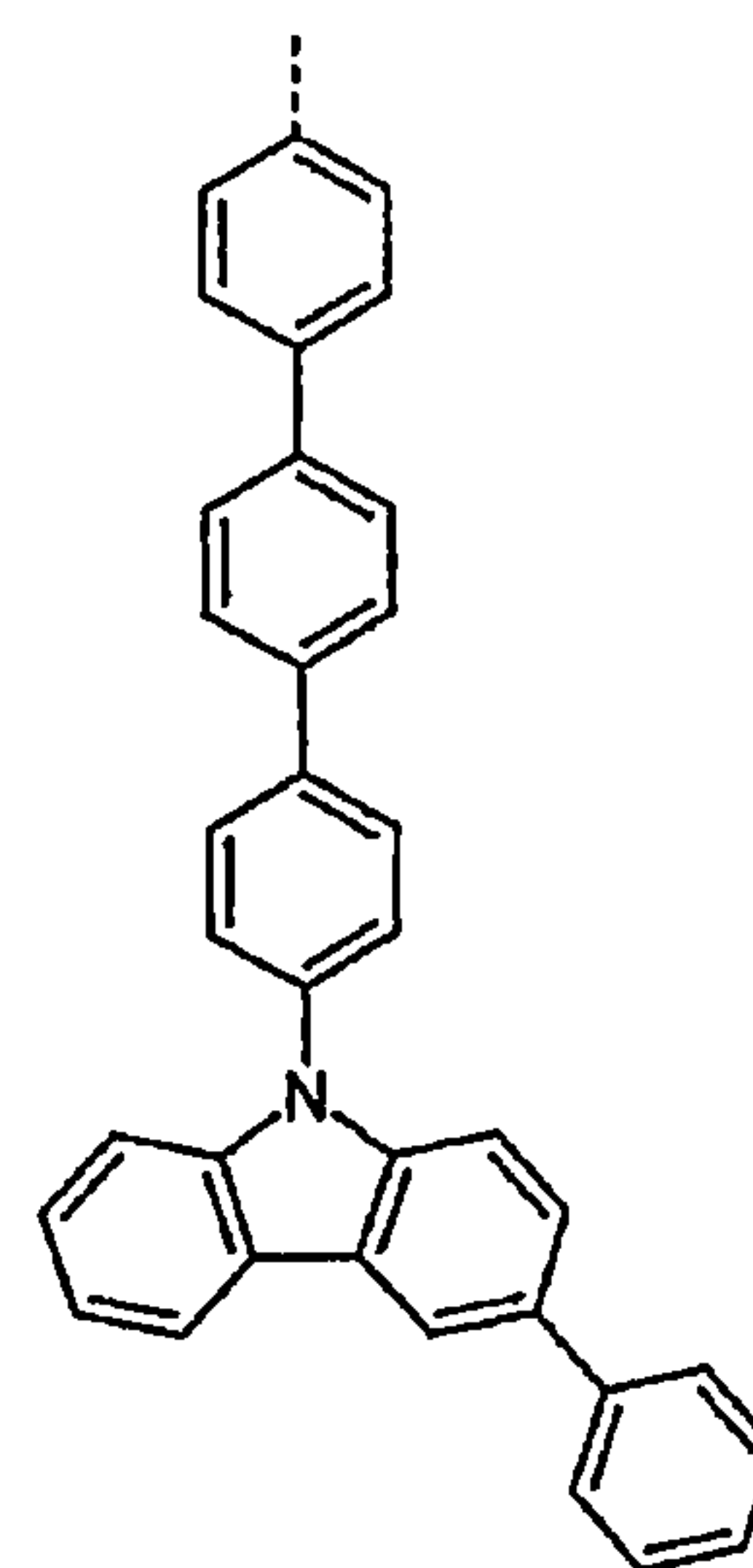
式(59)



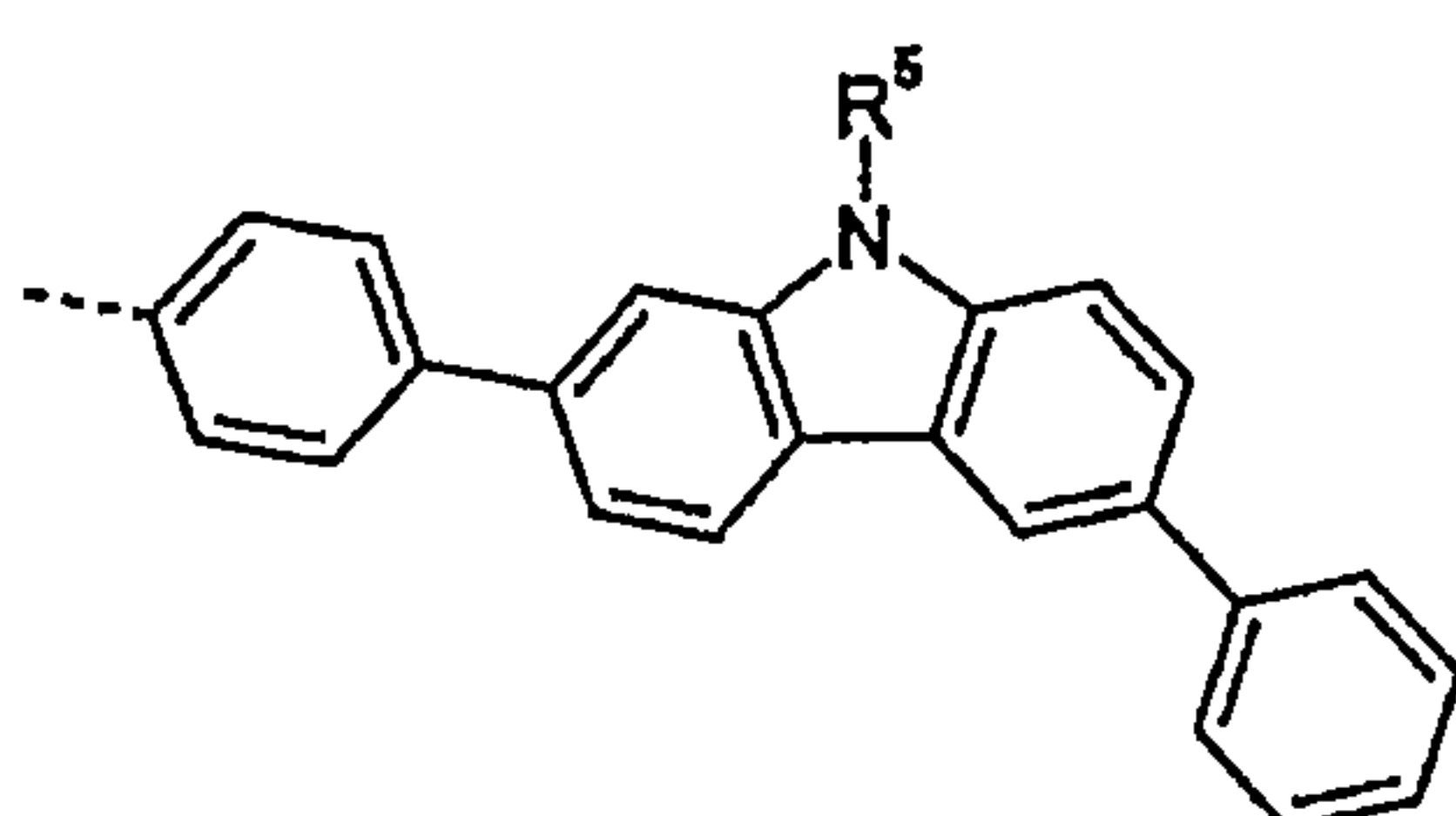
式(60)



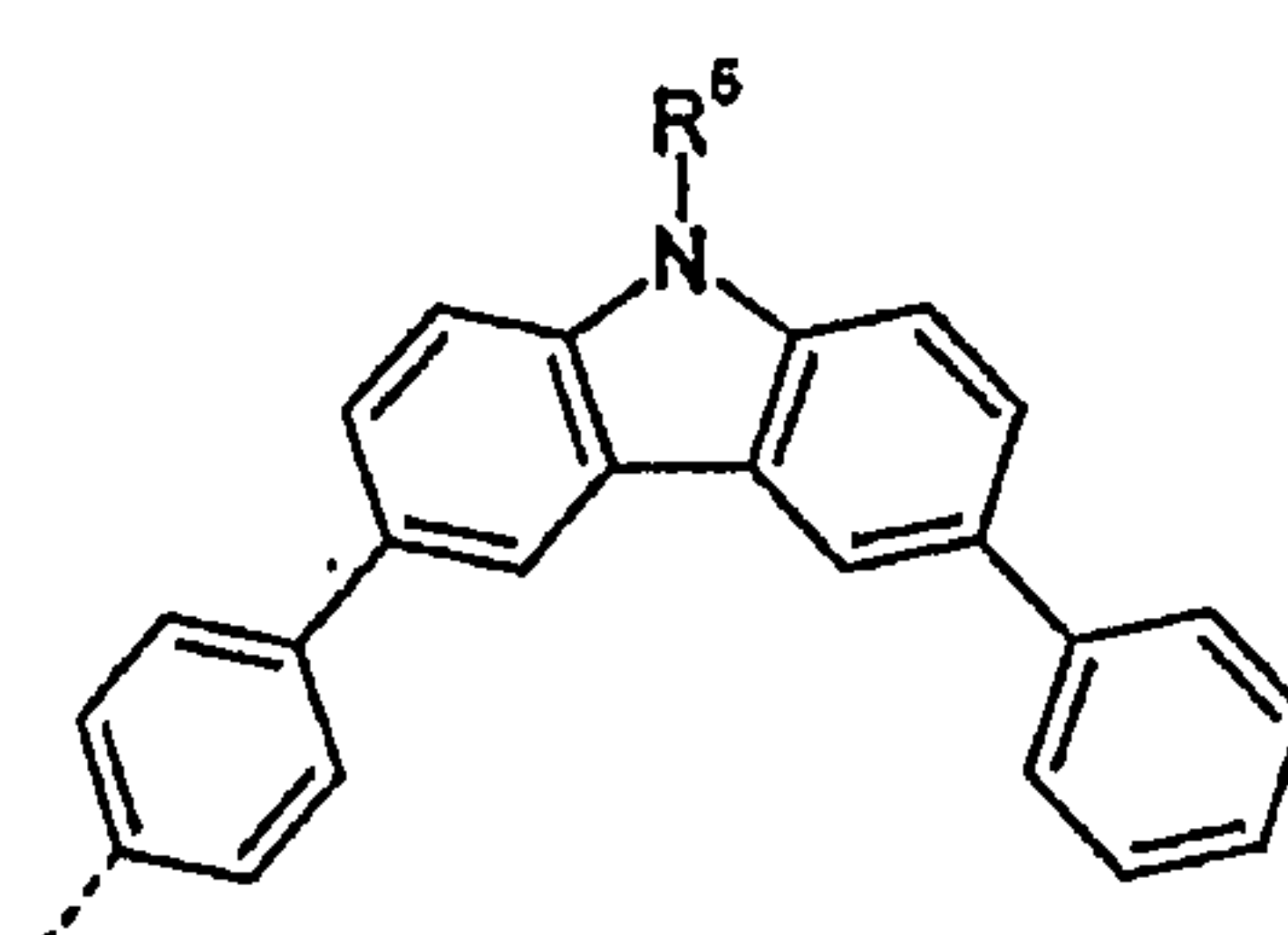
式(61)



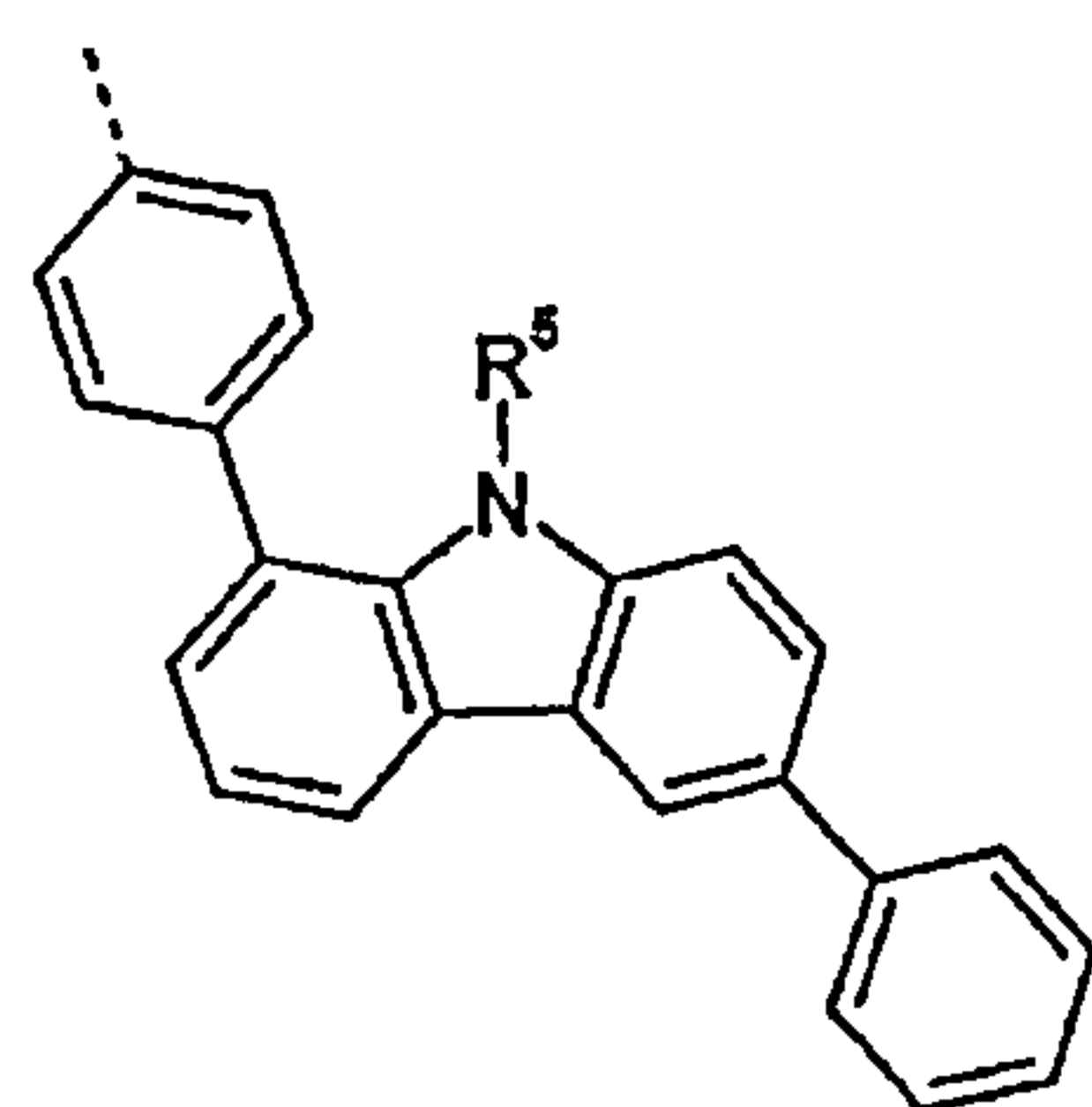
式(62)



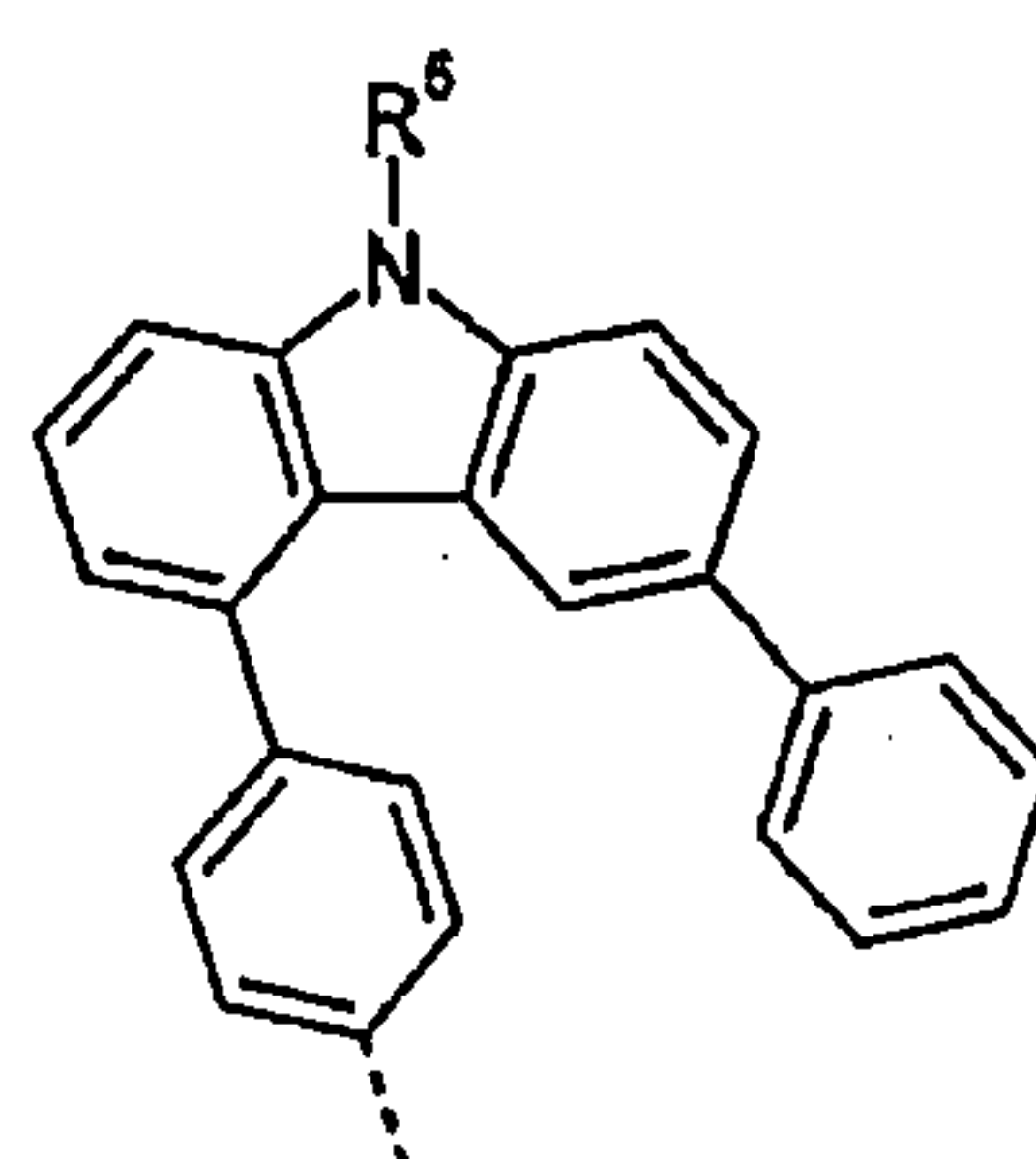
式(63)



式(64)



式(65)



式(66)

其中虛線鍵結指示至氮之鍵結，且該等基團可經一或多個 R^5 基團取代，但較佳未經取代。

在式(20)至(23)、(53)及(54)中之基團中， R^5 較佳相同或不同且代表具有1至10個C原子之烷基(具體而言甲基)或苯基，其可經一或多個

R^6 基團取代。

較佳 Ar^1 及 Ar^2 基團每次出現時相同或不同且係選自由上述式(11)、(13)、(16)、(20)、(28)、(29)、(33)、(34)、(35)、(37)、(38)、(39)、(40)、(44)、(48)、(49)、(51)及(59)組成之群。此處該等基團之所有可能之組合可能相等。

Ar^1 及 Ar^2 尤佳每次出現時相同或不同且係選自由上述式(11)、(13)、(20)、(29)、(35)、(38)、(39)、(49)、(51)及(59)組成之群。

此外，在式(28)至(31)及(40)至(43)及(55)至(58)及(63)至(66)之基團中， R^5 較佳代表苯基、鄰-聯苯基、間-聯苯基、對-聯苯基、聯三苯基、1-萘基或2-萘基，其可經一或多個 R^6 基團取代。

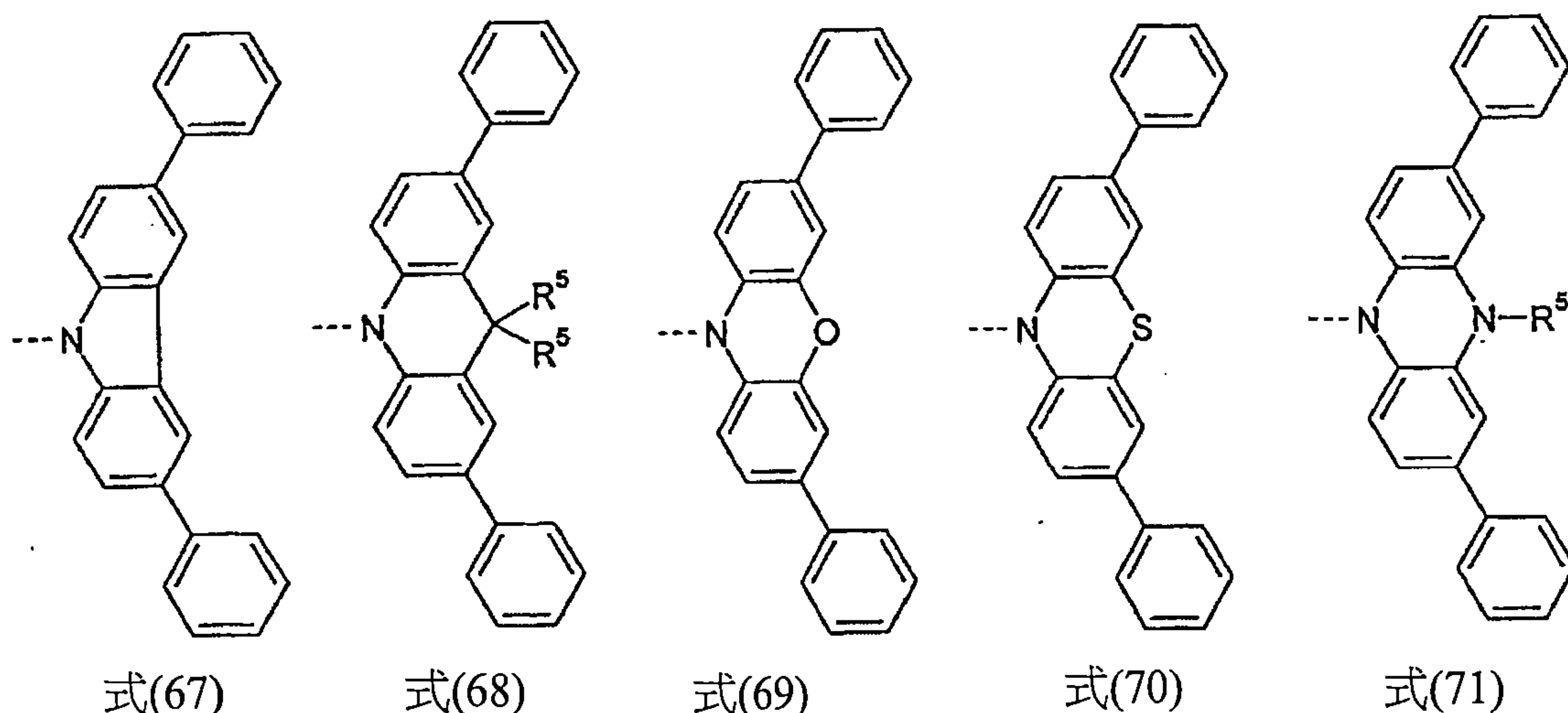
較佳地， Ar^1 及 Ar^2 每次出現時相同或不同且係選自式(11)、(20)及(24)之基團，其可經一或多個 R^5 基團取代。

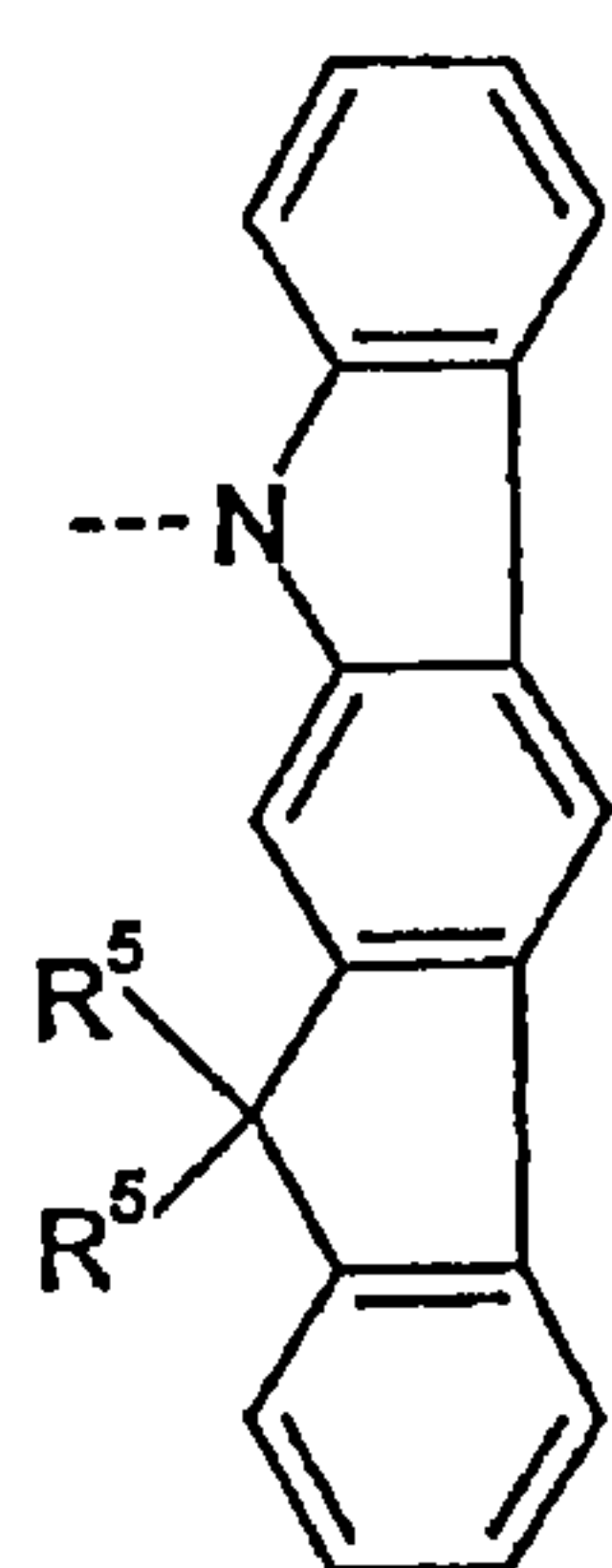
Ar^1 及 Ar^2 基團中之至少一者尤佳係式(11)或(20)之基團。極佳地， Ar^1 代表式(11)之基團且 Ar^2 代表式(20)之基團。

鍵結至氮之上述式(11)至(66)之兩個 Ar^1 及 Ar^2 基團視需要可彼此組合。

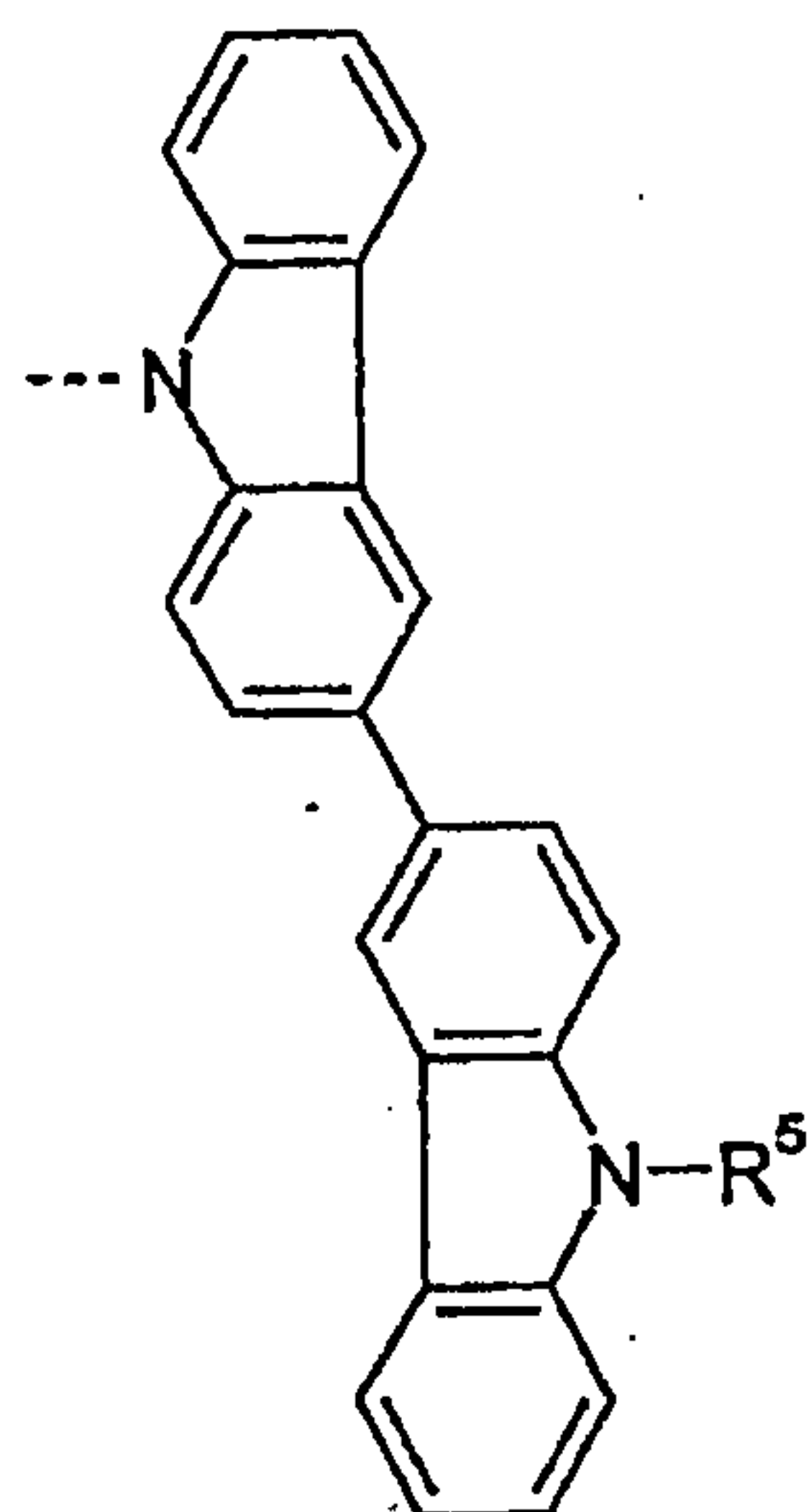
在本發明之較佳實施例中， Ar^1 及 Ar^2 基團經選擇彼此不同。

若在式(1)及(2)至(10)之化合物或較佳實施例中 Ar^1 及 Ar^2 基團係藉助E基團彼此連接，則 $-NAr^1Ar^2$ 基團較佳具有下式(67)至(74)中之一者之結構，

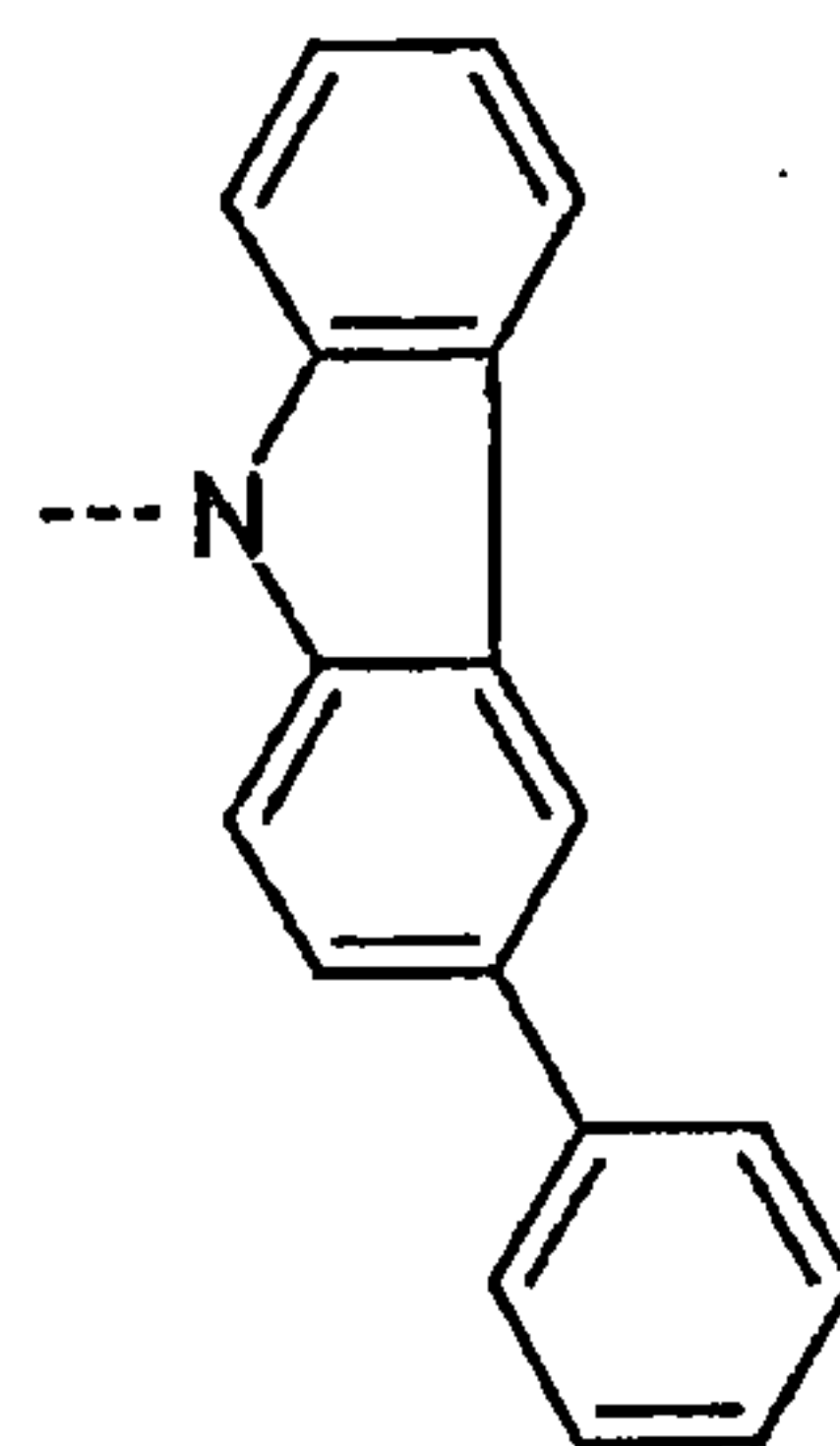




式(72)



式(73)



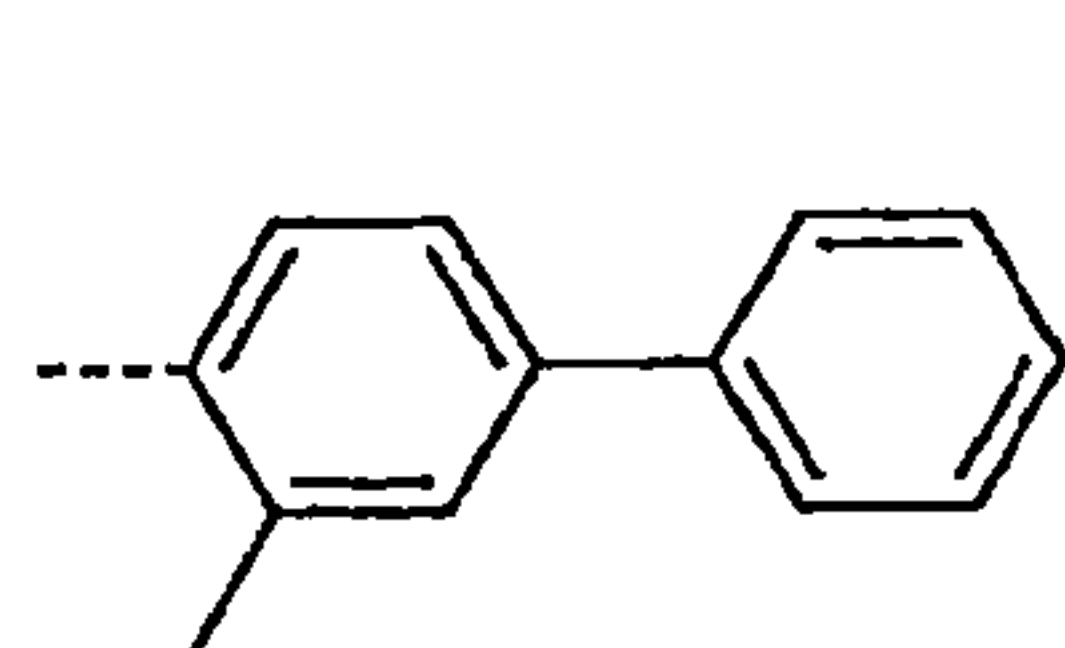
式(74)

其中所用符號具有上文所給出之含義，且虛線鍵結指示至螺二萸之鍵結。該等基團亦可經一或多個 R^5 基團取代，但較佳未經取代。

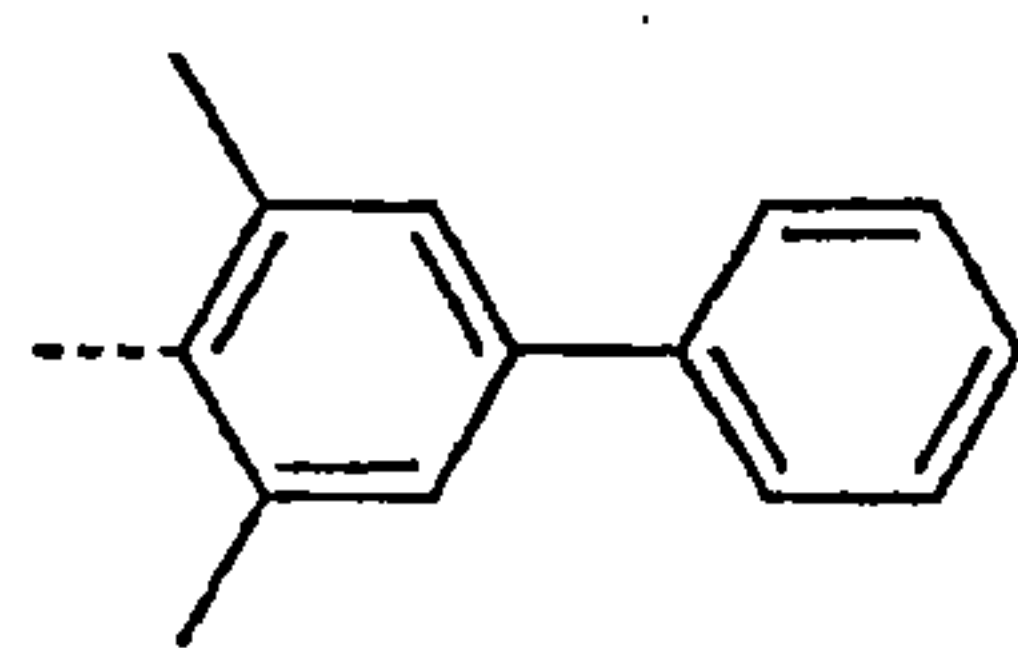
在式(68)及(72)之基團中， R^5 相同或不同且較佳代表具有1至10個C原子之烷基(具體而言甲基)或苯基，其可經一或多個 R^6 基團取代。

此外，在式(71)及(73)之基團中， R^5 較佳代表可經一或多個 R^6 基團取代之苯基。

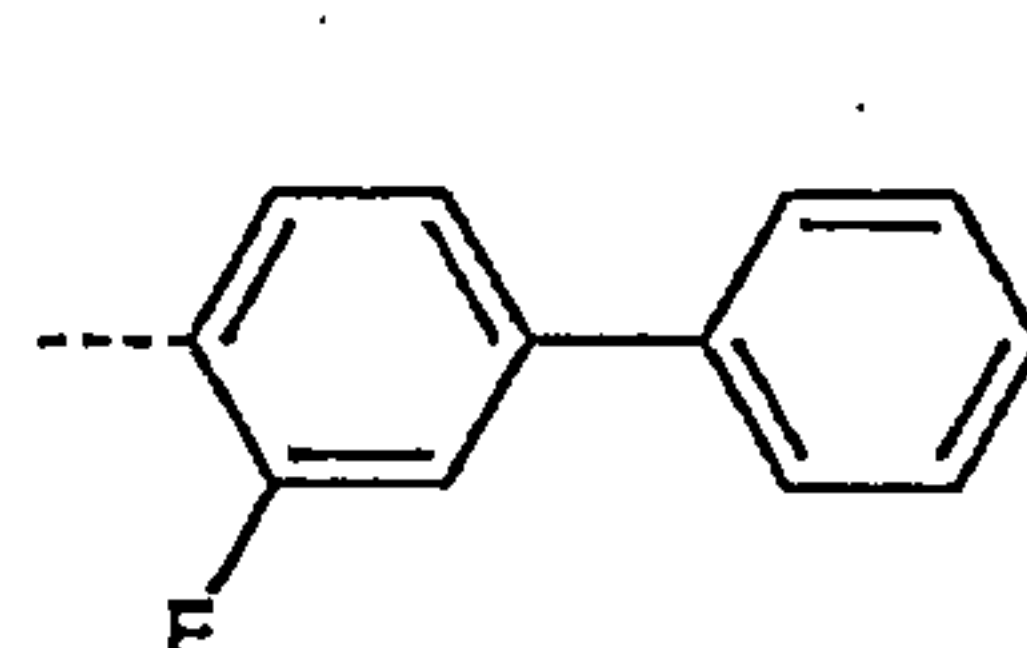
式(13)之較佳經取代實施例係下式(13a)至(13f)，式(16)之較佳實施例係式(16a)及(16b)，式(20)之較佳實施例係下式(20a)至(20i)，式(21)之較佳實施例係下式(21a)至(21g)，式(22)之較佳實施例係下式(22a)、(22b)、(22c)及(22d)，且式(23)之較佳實施例係下式(23a)、(23b)、(23c)及(23d)，



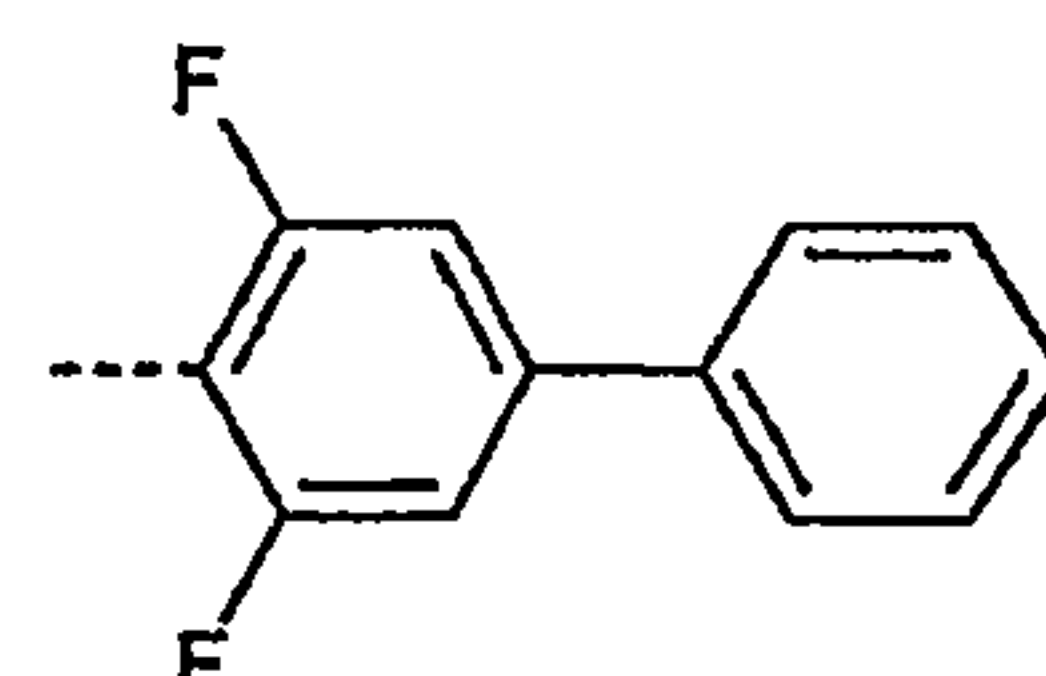
式(13a)



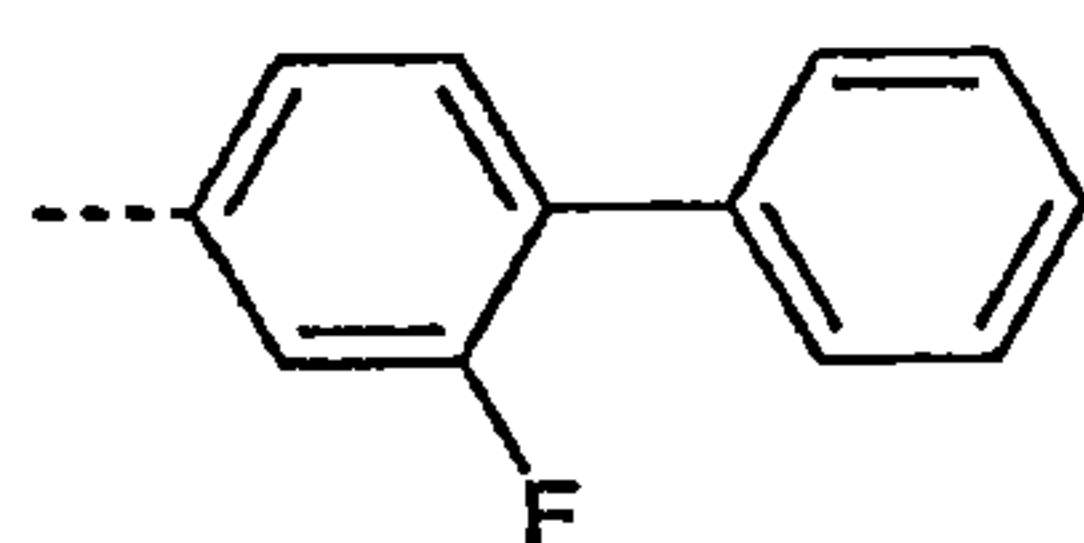
式(13b)



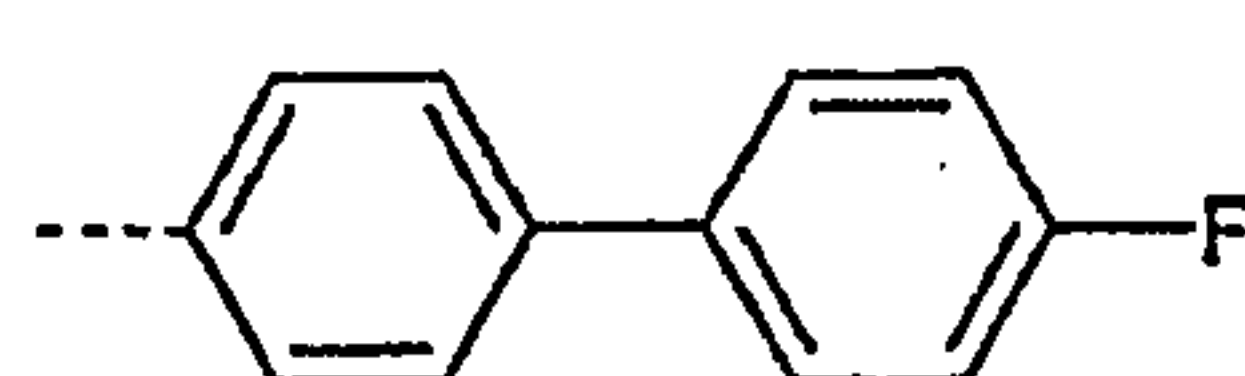
式(13c)



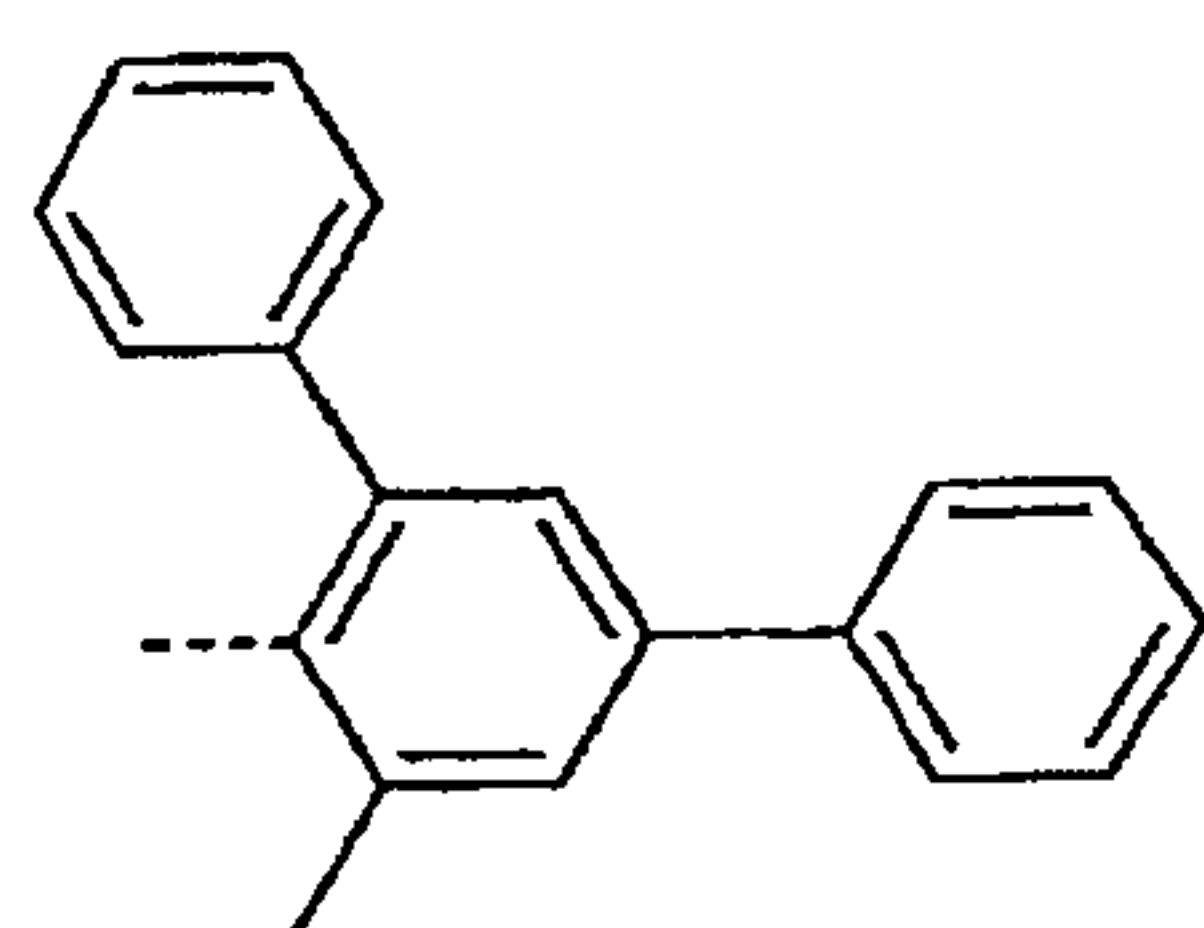
式(13d)



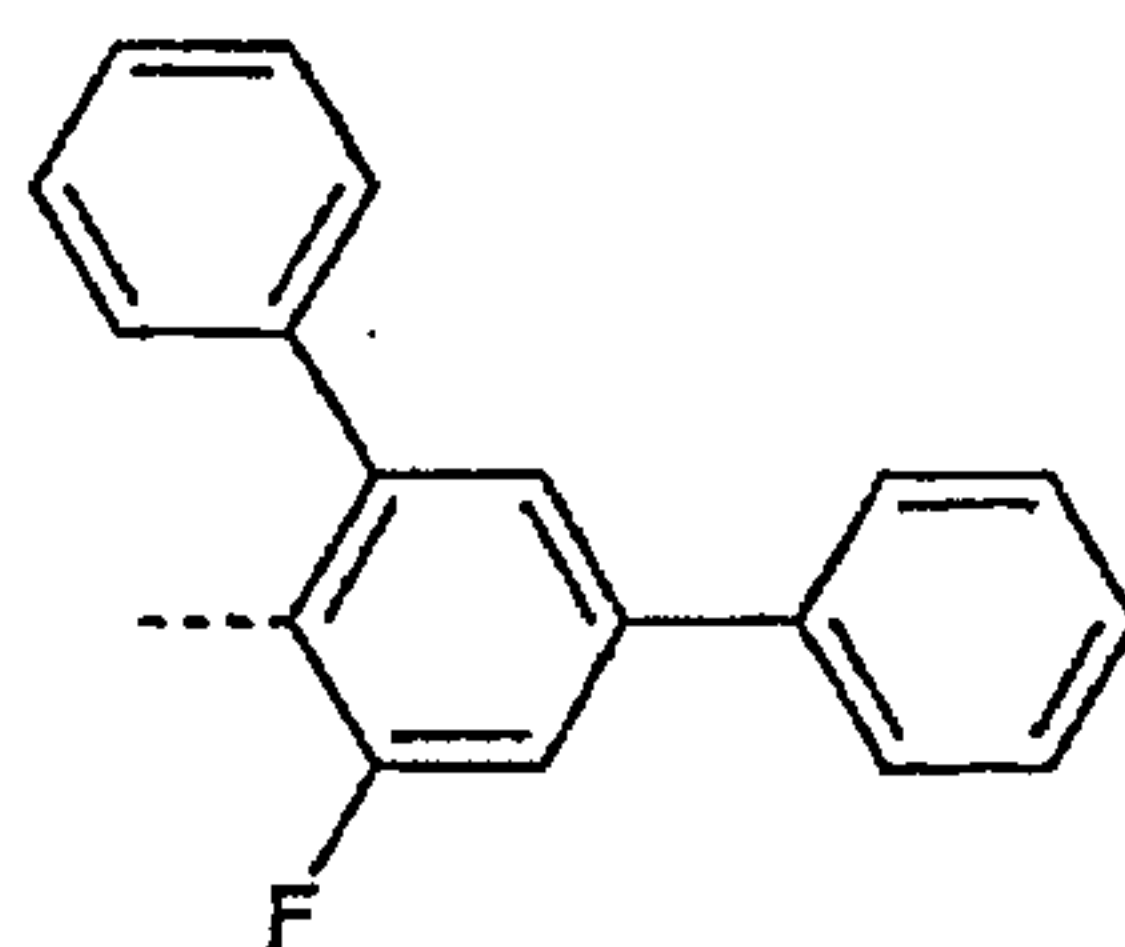
式(13e)



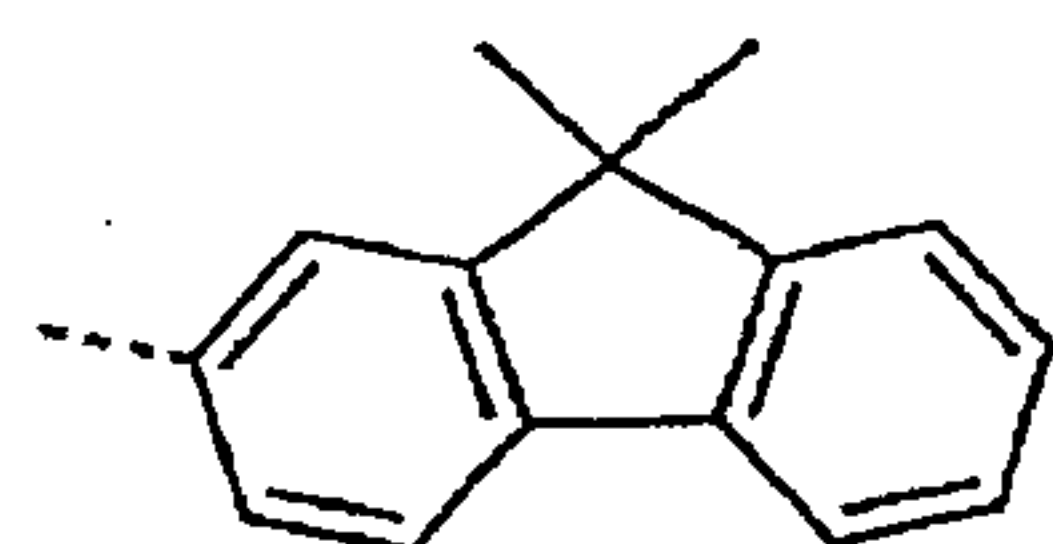
式(13f)



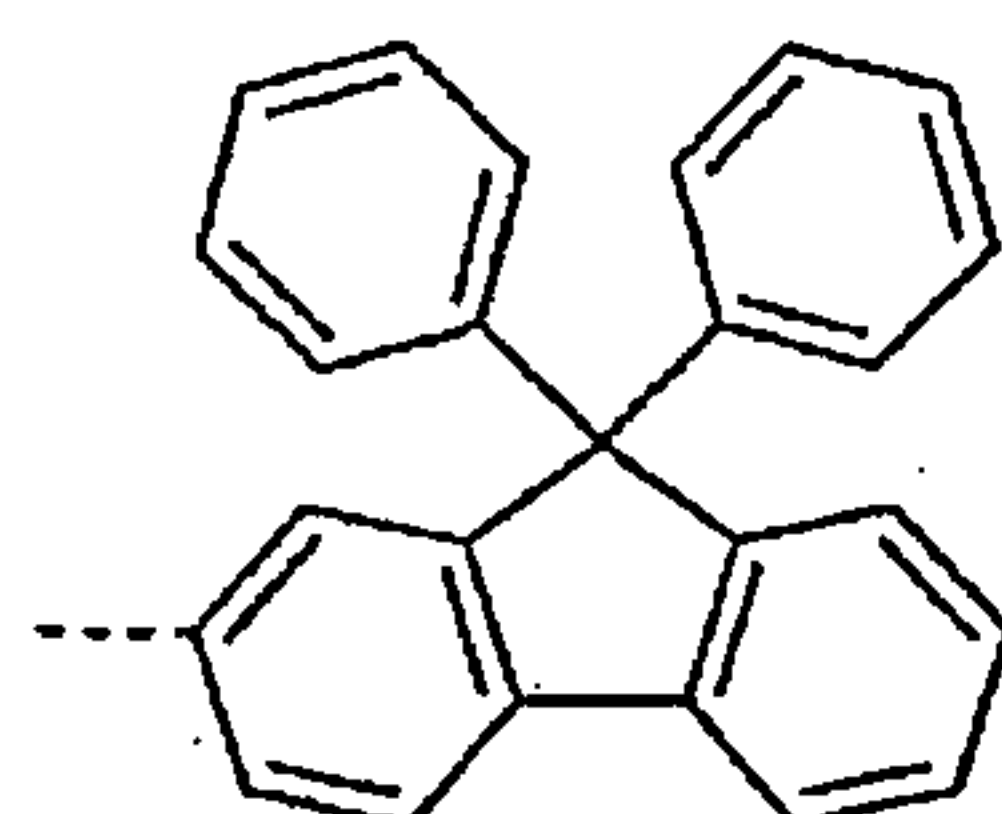
式(16a)



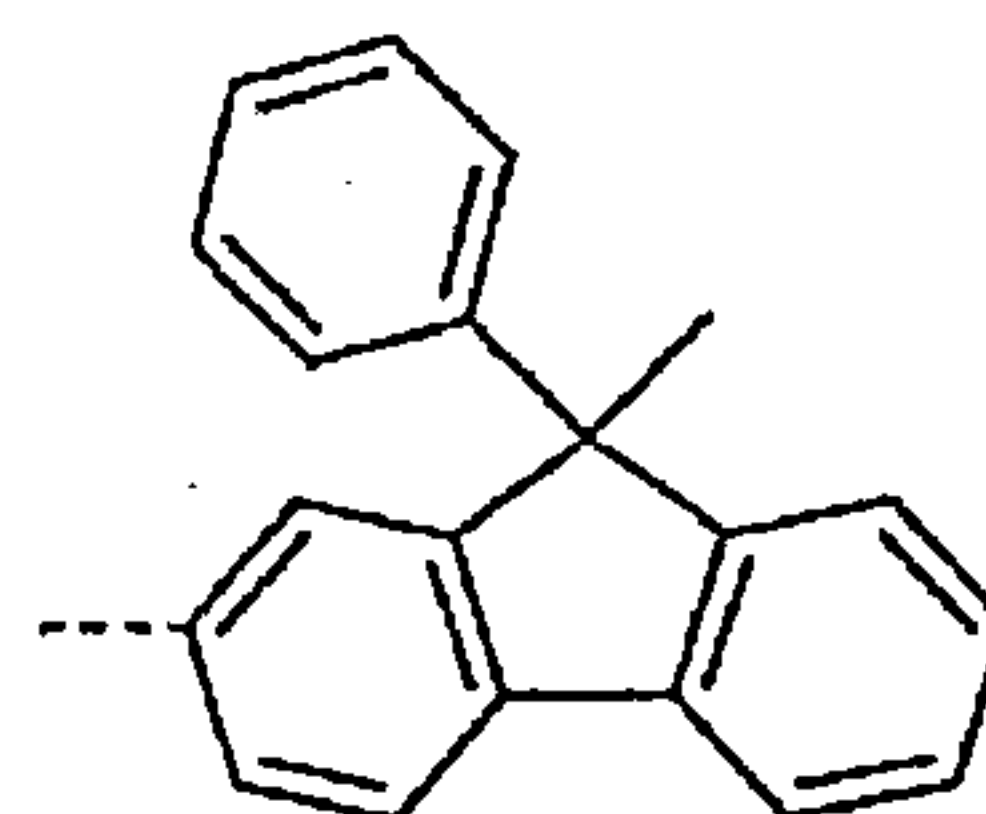
式(16b)



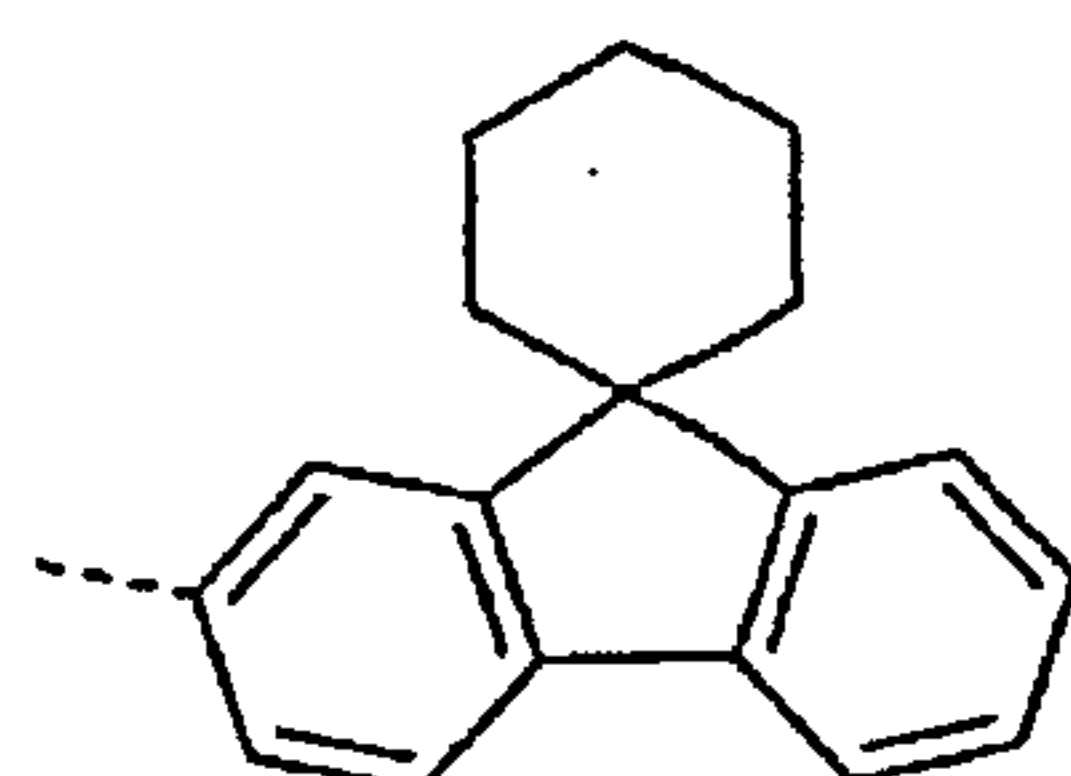
式(20a)



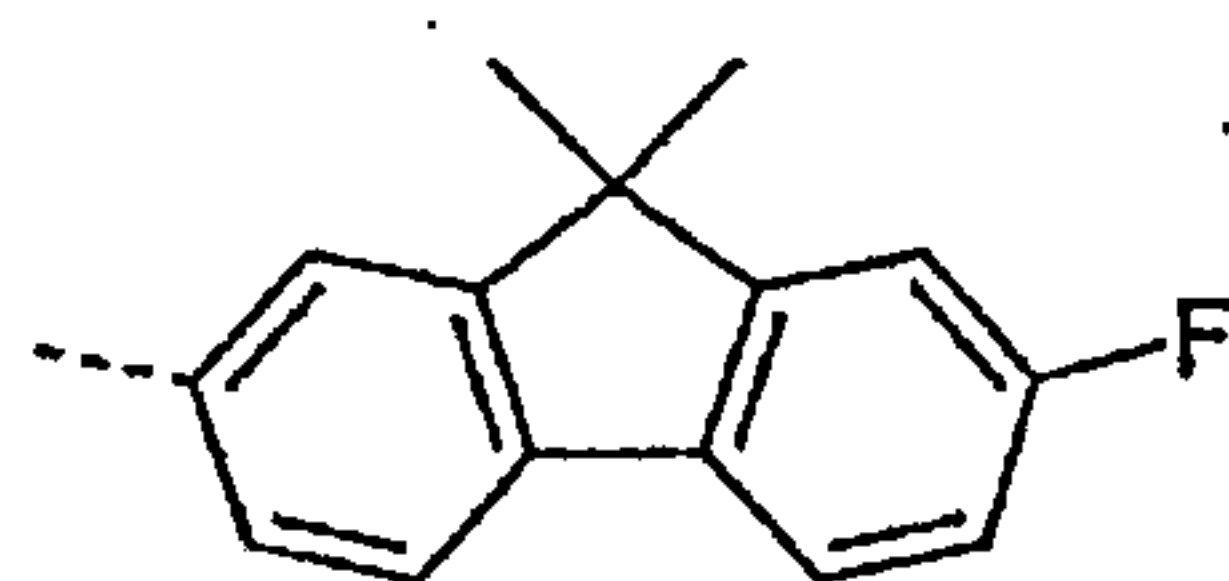
式(20b)



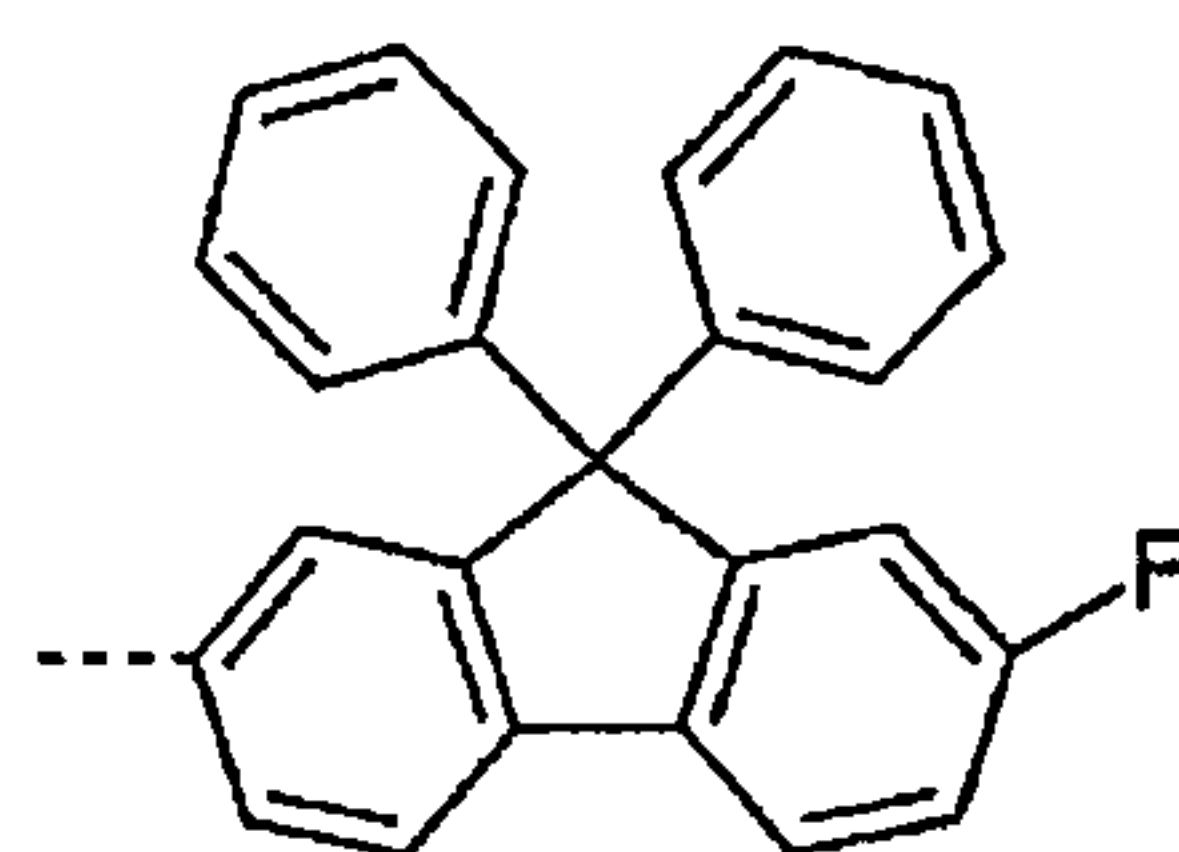
式(20c)



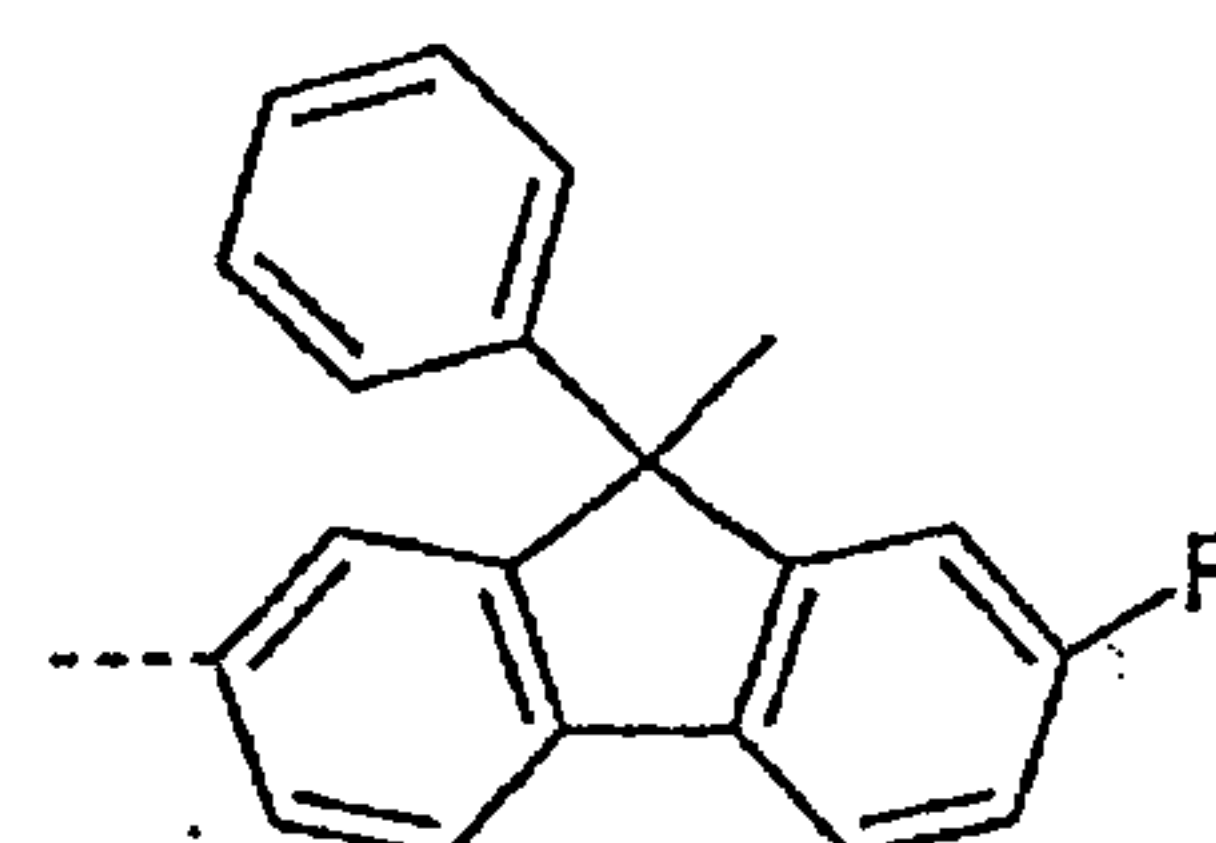
式(20d)



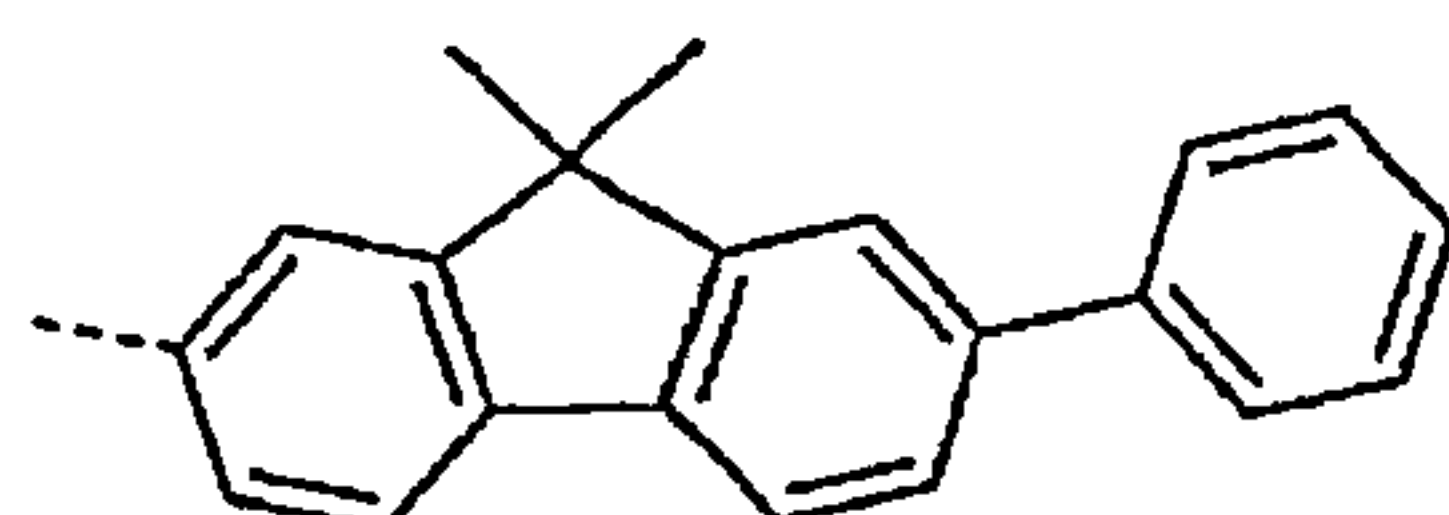
式(20e)



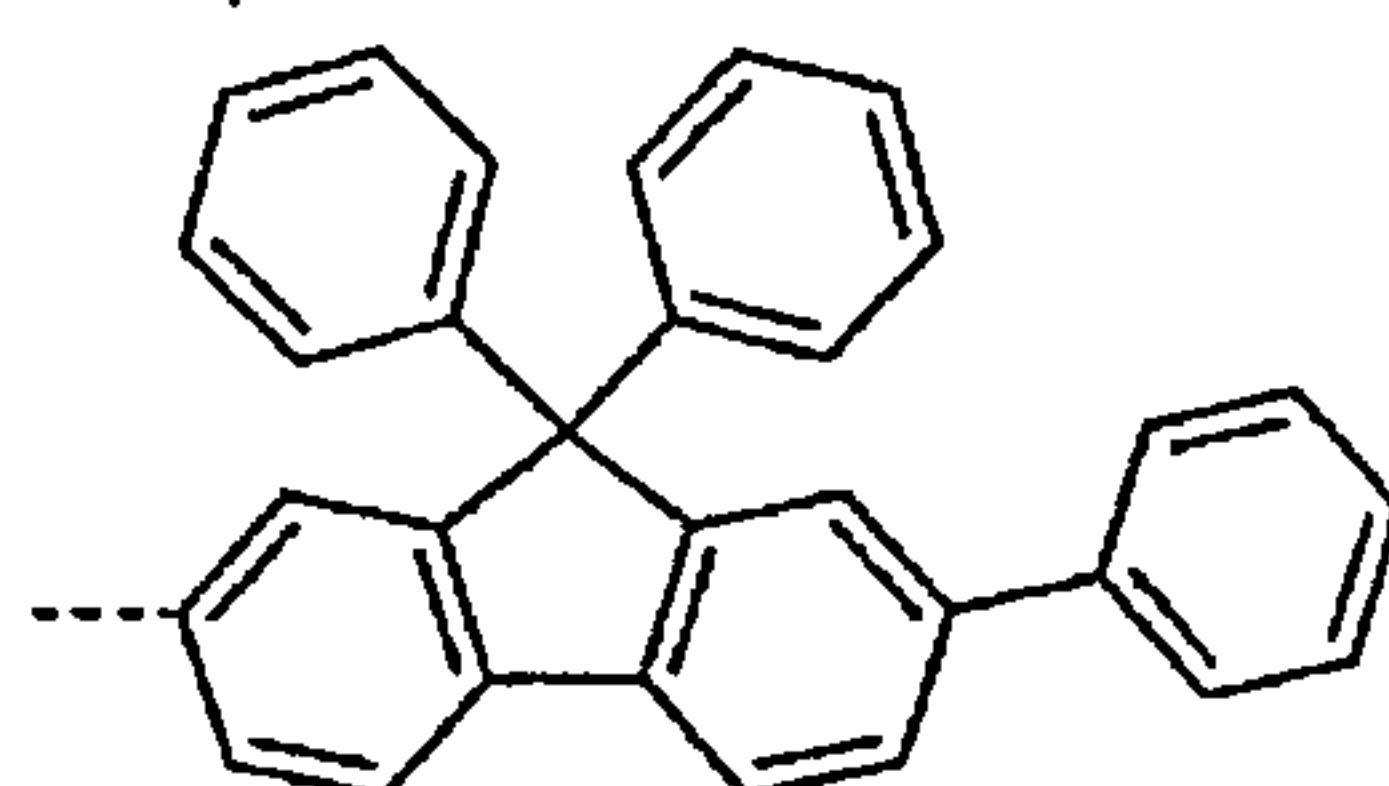
式(20f)



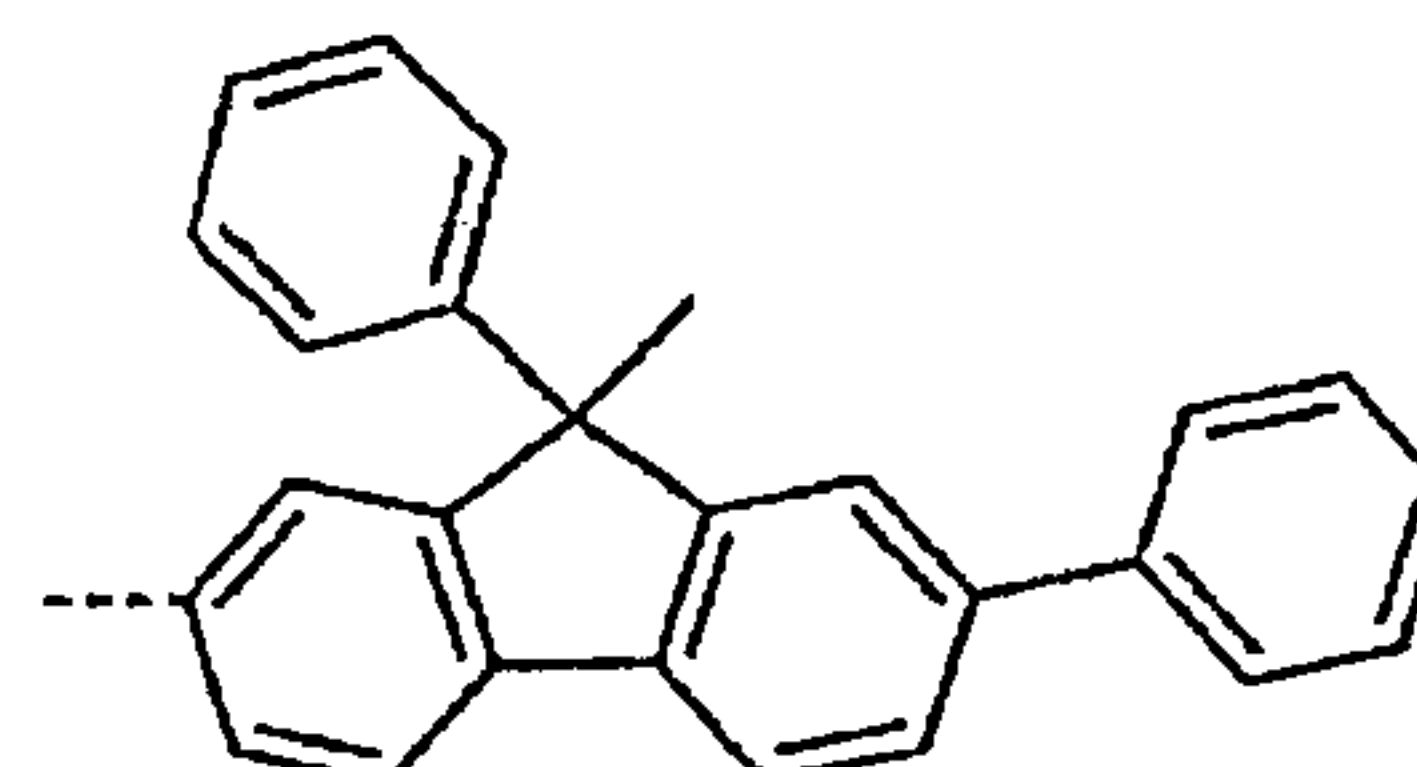
式(20g)



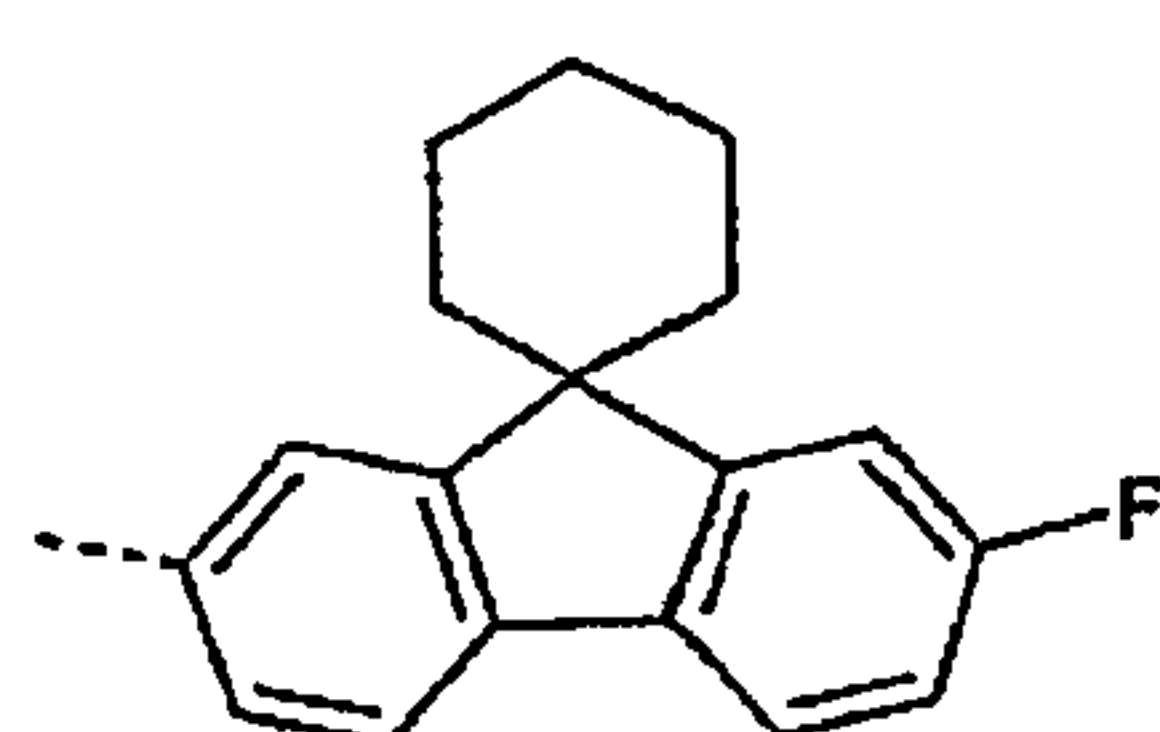
式(20h)



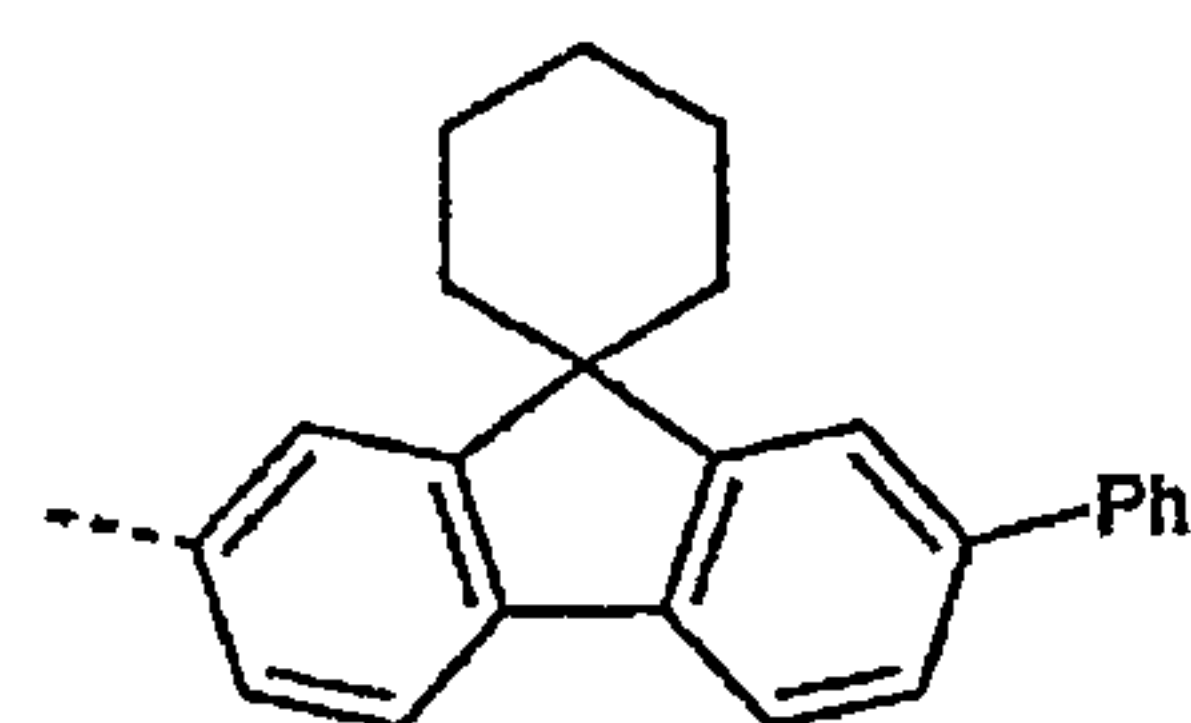
式(20i)



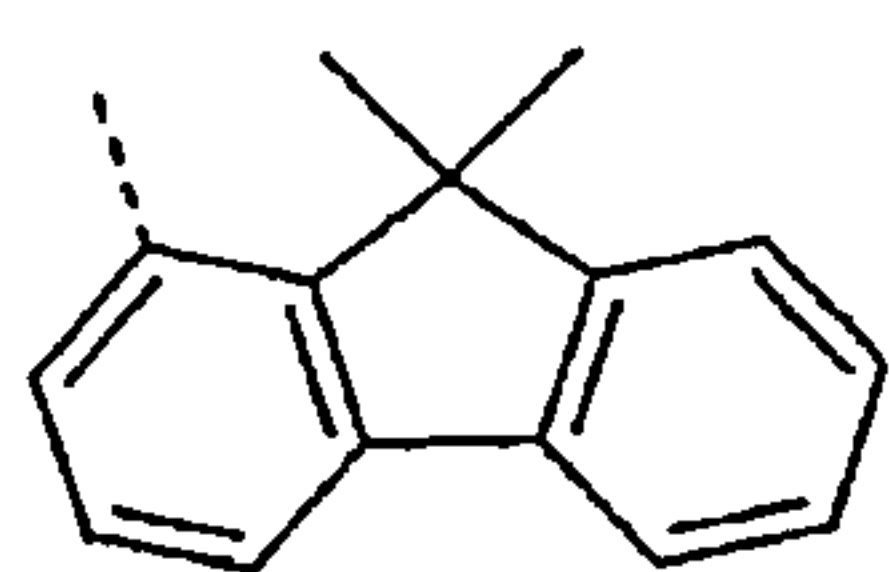
式(20j)



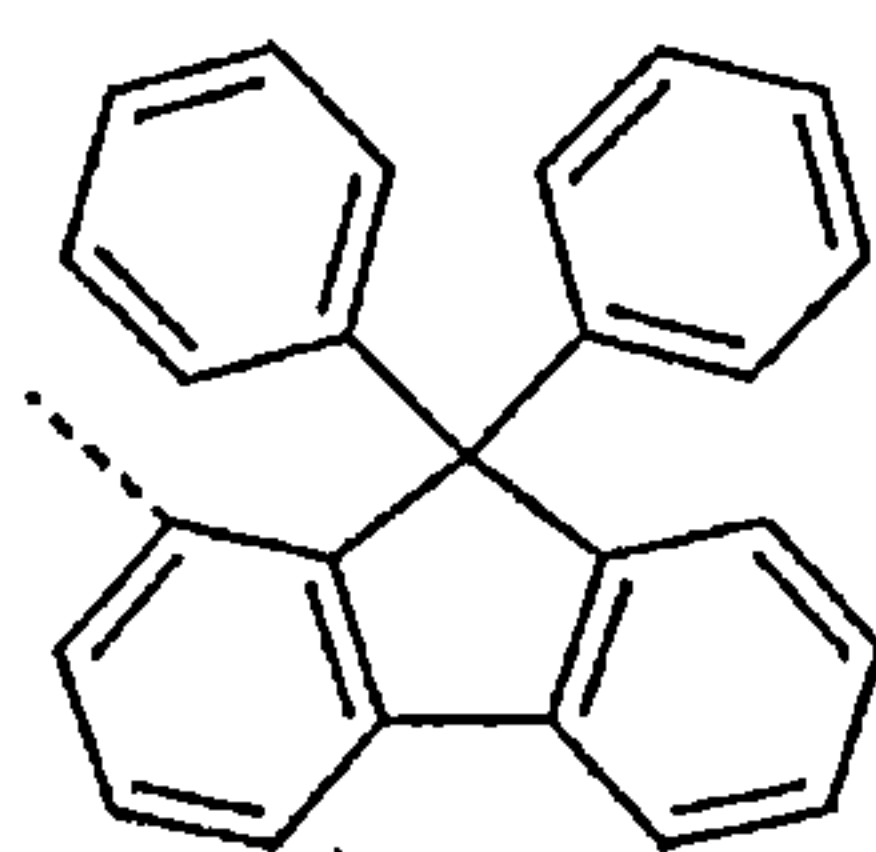
式(20k)



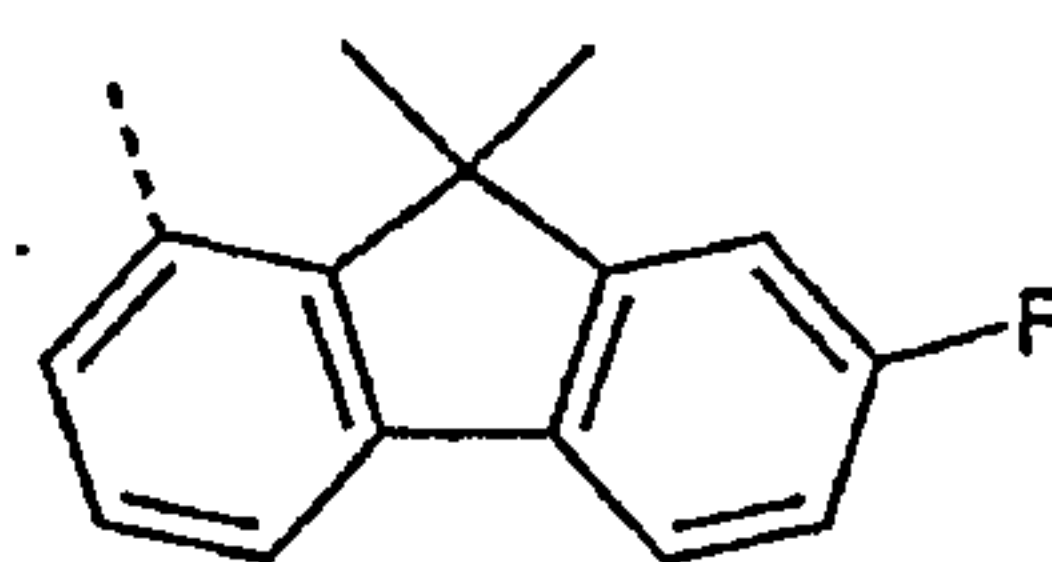
式(20l)



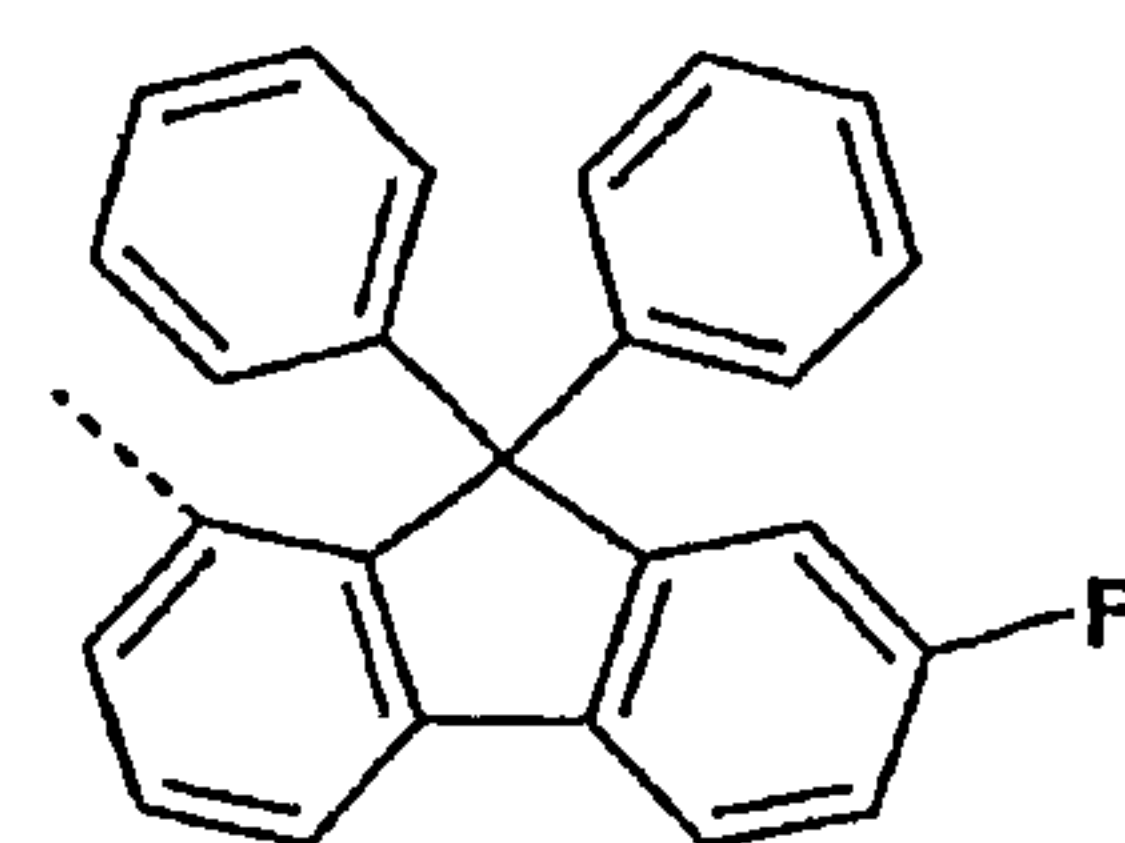
式(21a)



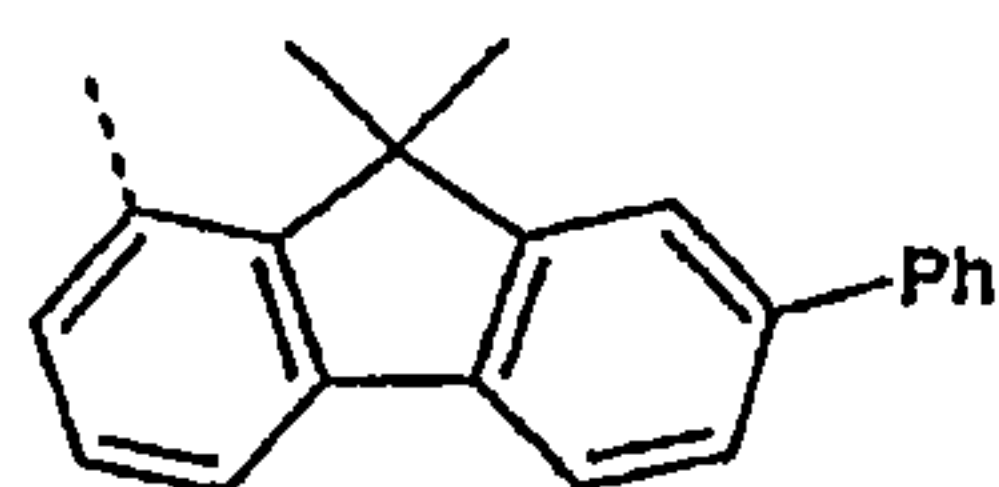
式(21b)



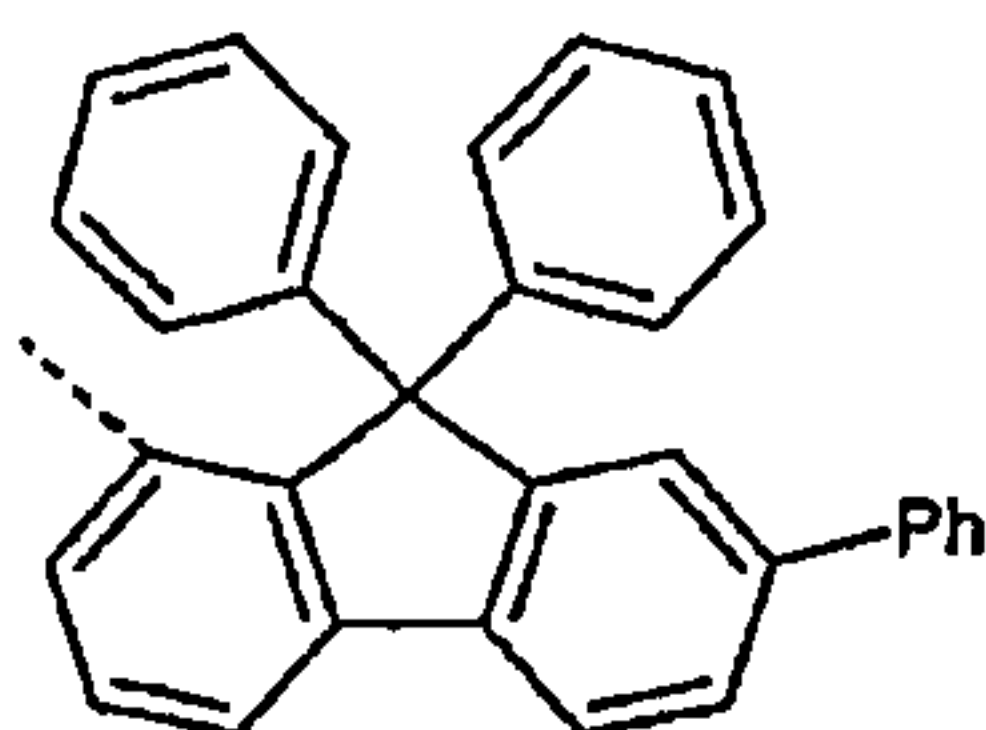
式(21c)



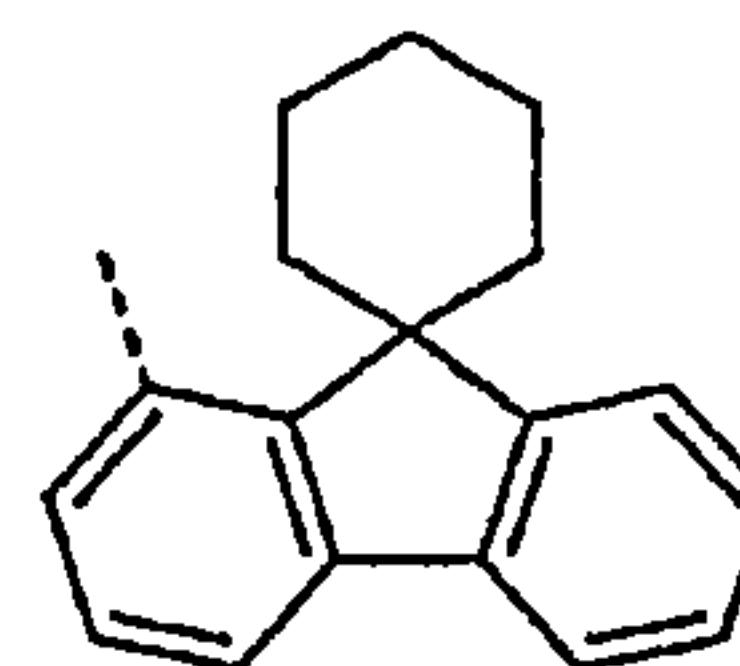
式(21d)



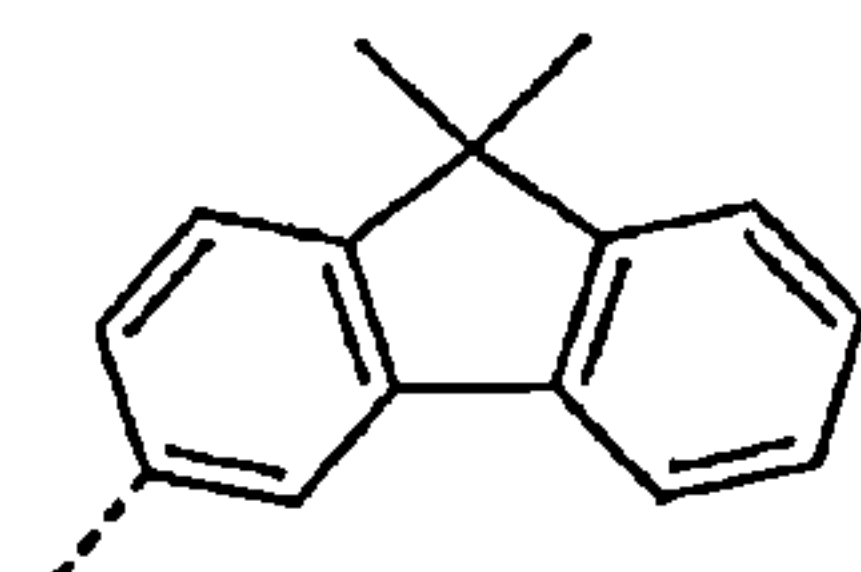
式(21e)



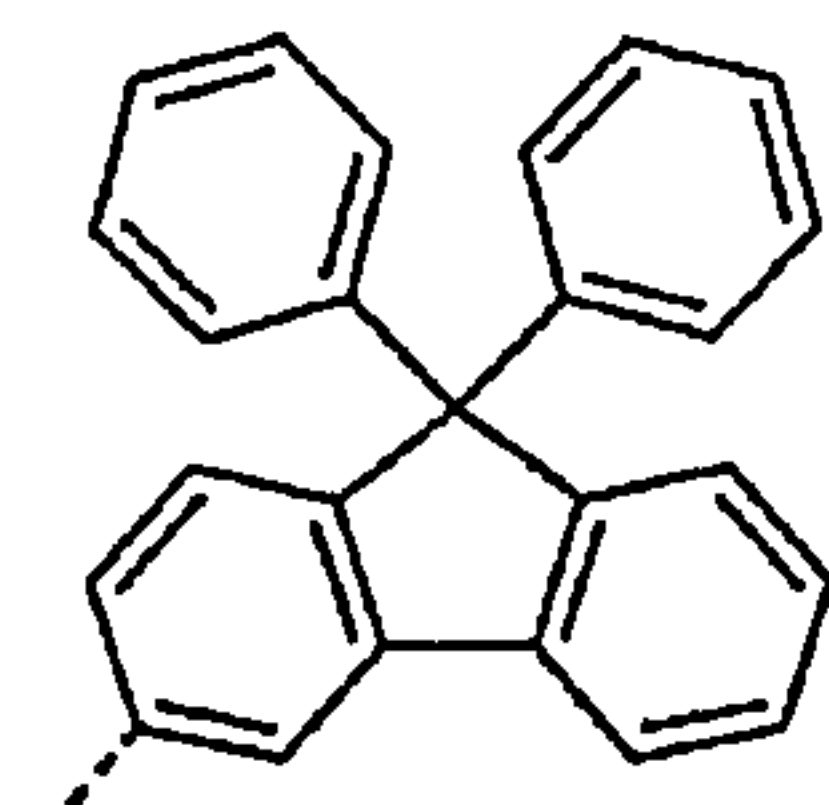
式(21f)



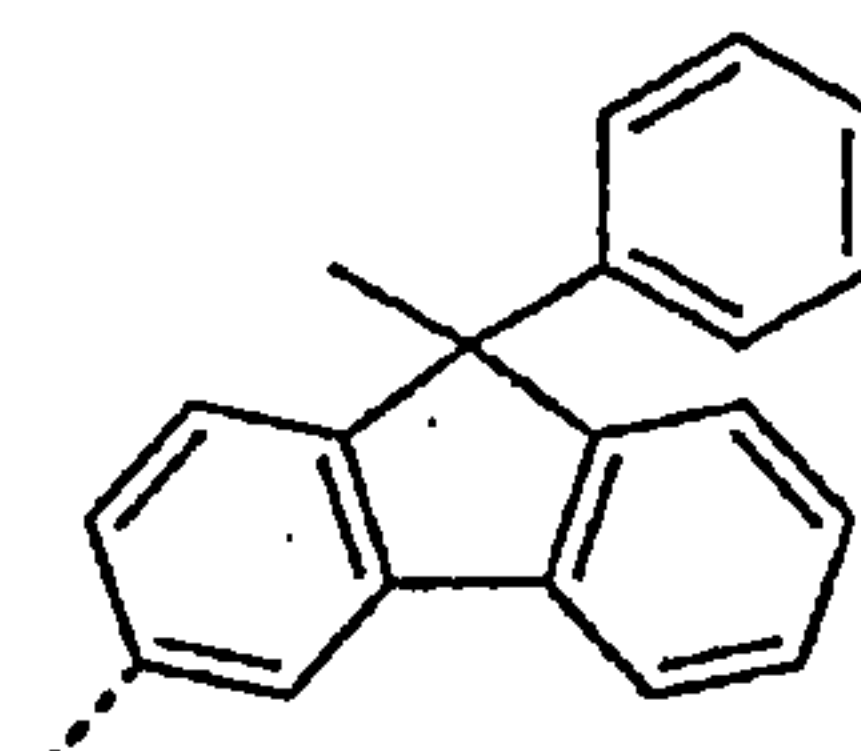
式(21g)



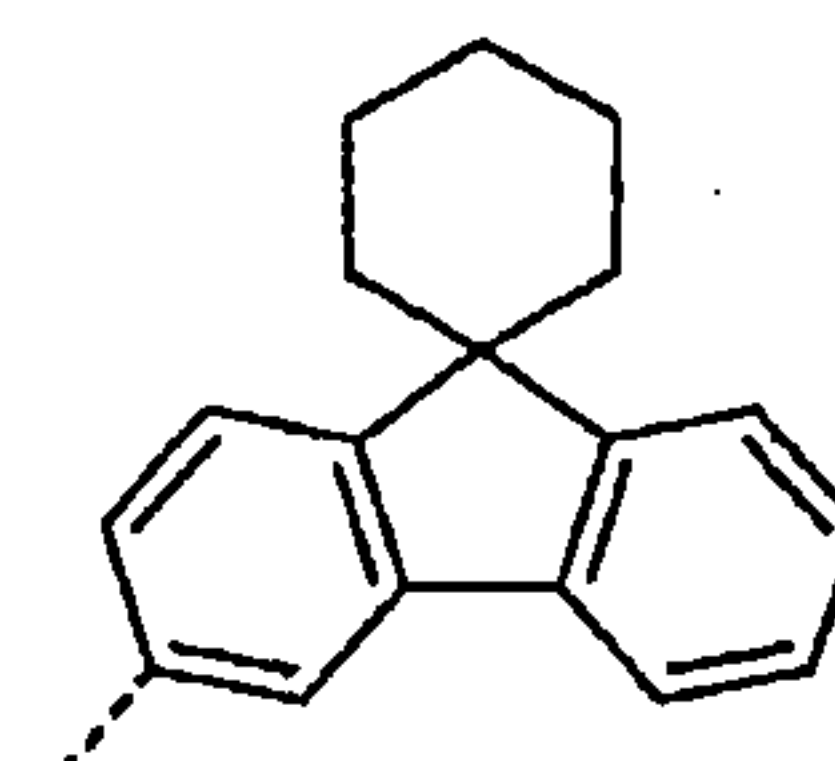
式(22a)



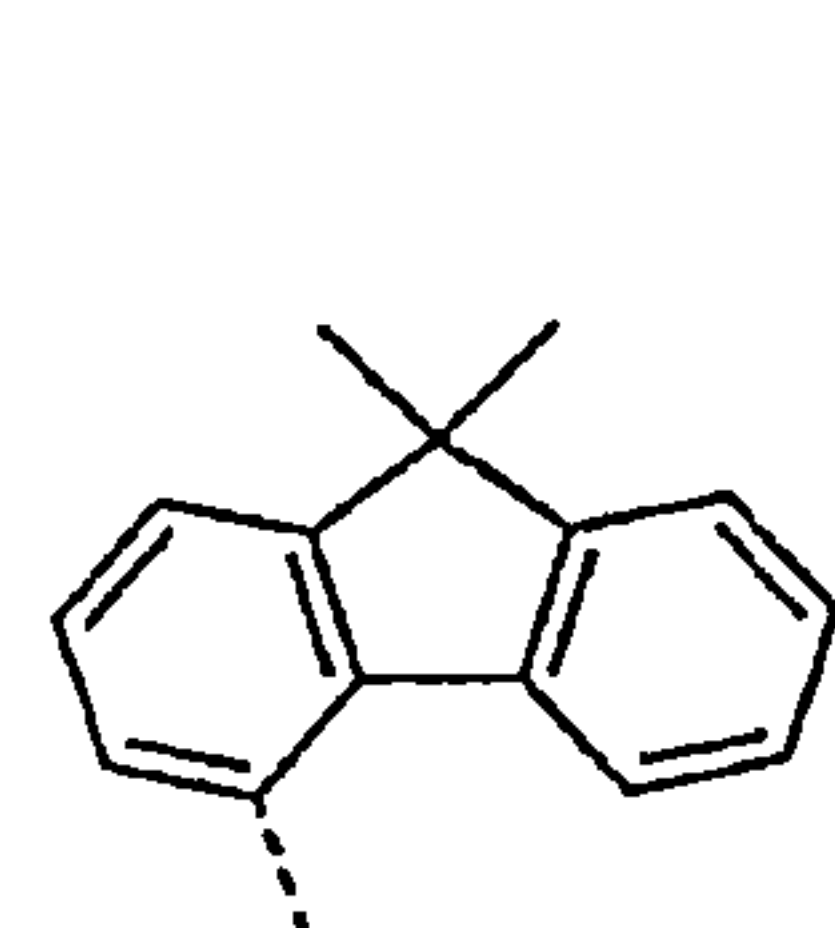
式(22b)



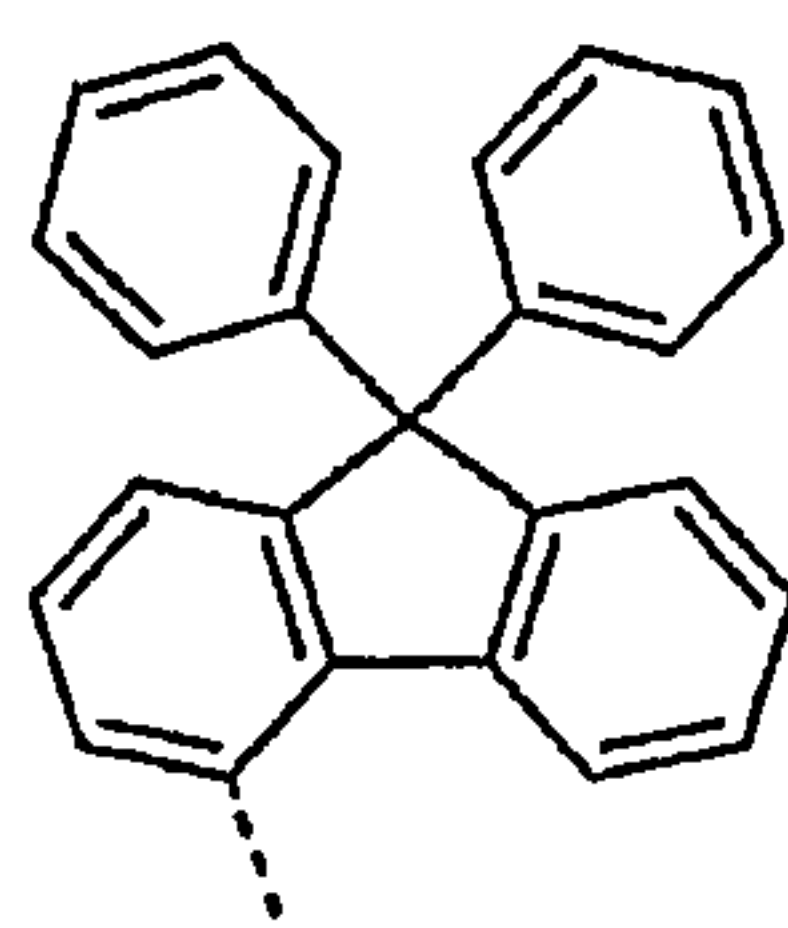
式(22c)



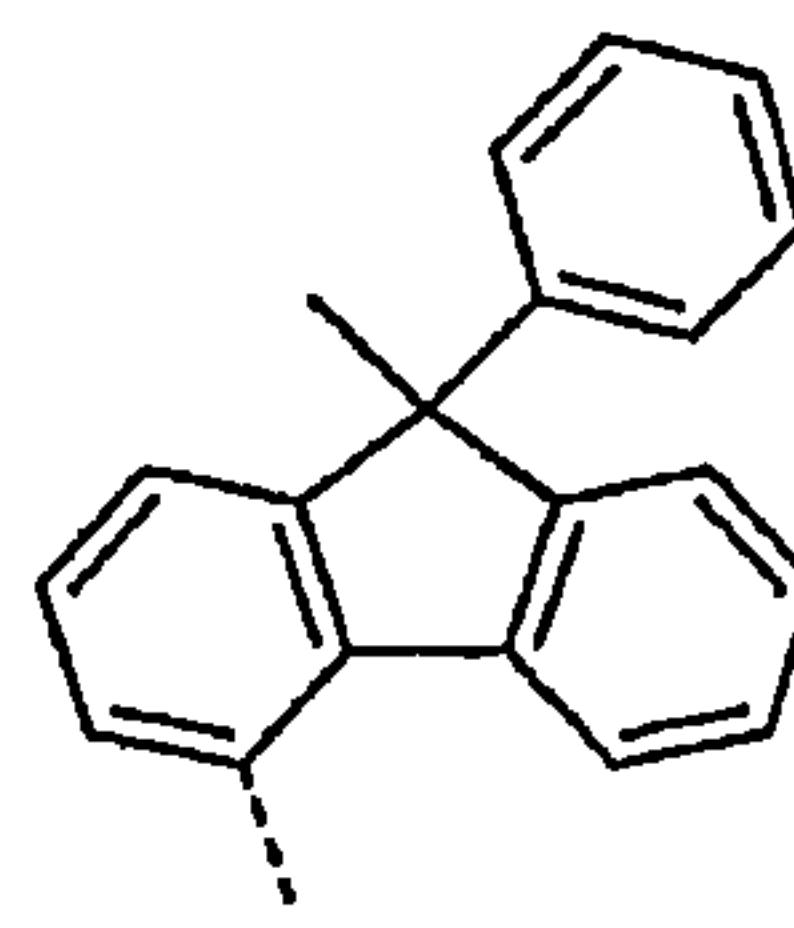
式(22d)



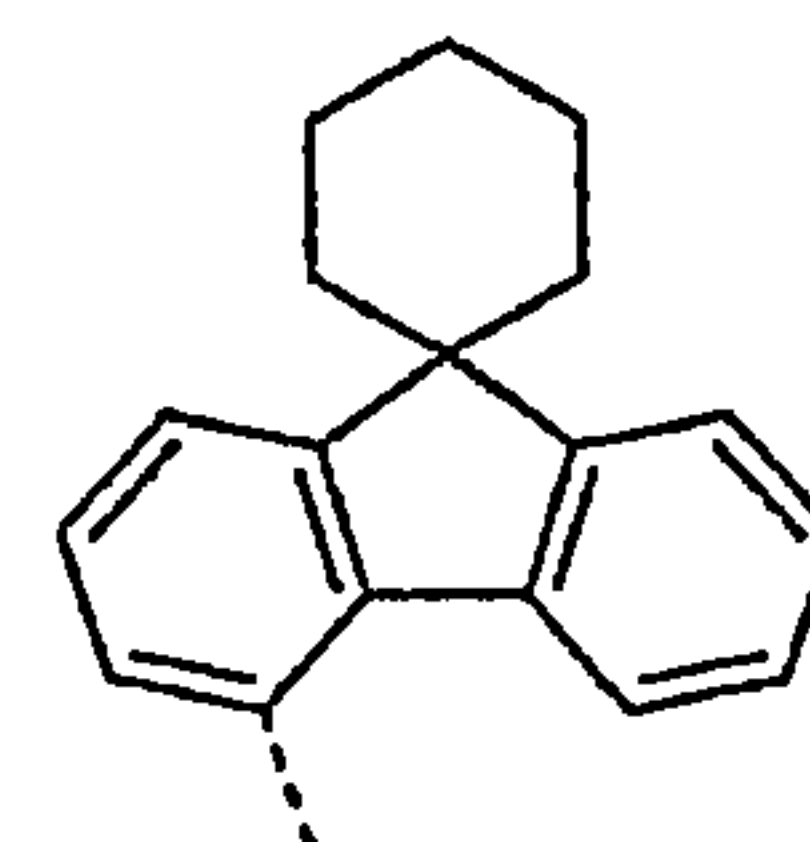
式(23a)



式(23b)



式(23c)

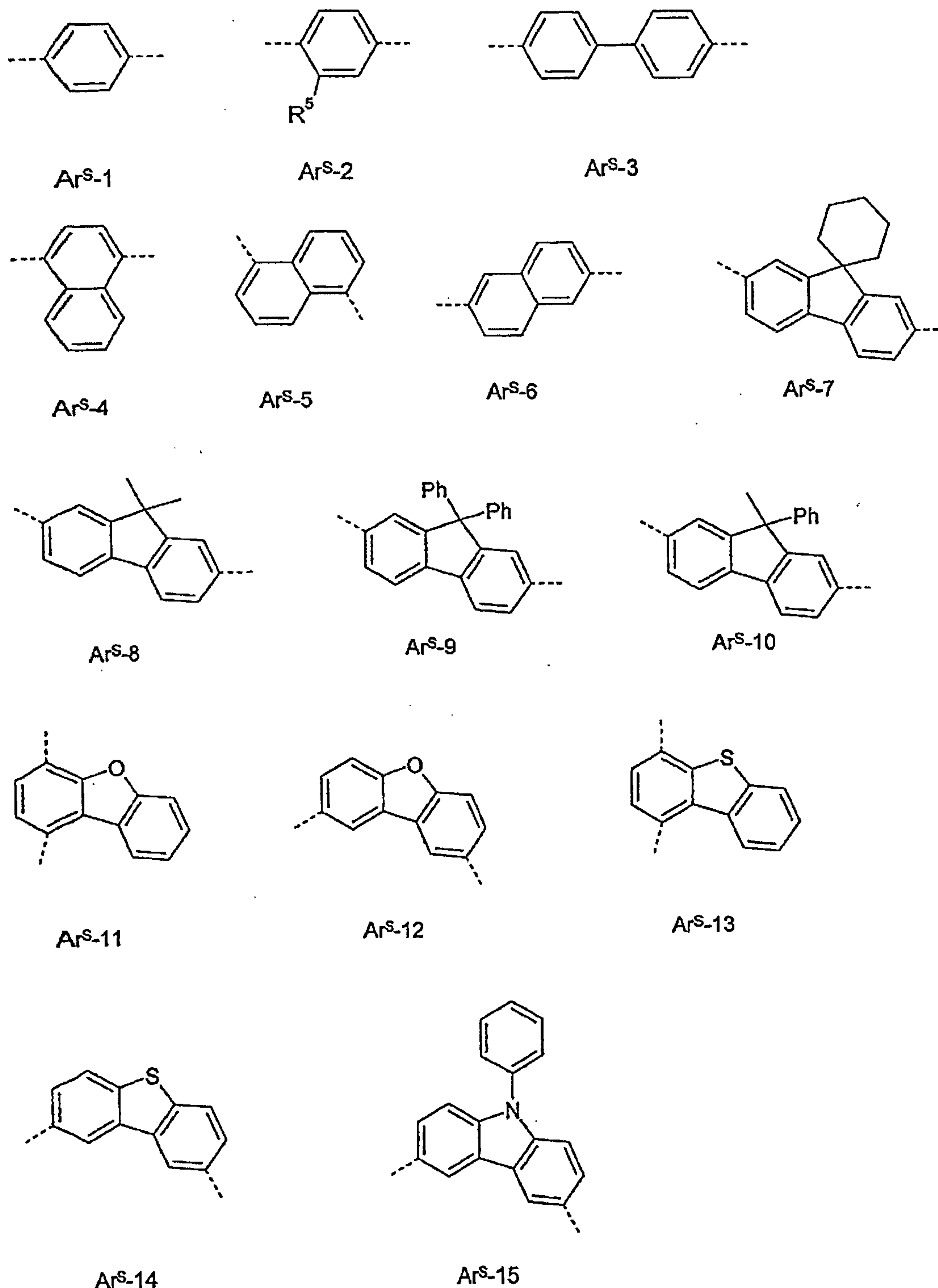


式(23d)

其中虛線鍵結指示至氮之鍵結。

Ar^S 基團每次出現時相同或不同且較佳選自具有6至18個芳族環原子之芳族或雜芳族環系統，在每一情形下，其亦可經一或多個 R^5 基團取代。

尤佳 Ar^S 基團係選自下文式(Ar^S -1)至(Ar^S -15)之基團：



其中虛線鍵結指示至螺二萸及至胺之鍵結，且其中該等基團可在每一游離位置經 R^5 基團取代，但較佳未經取代。

在本發明之較佳實施例中， R^1 至 R^4 每次出現時相同或不同且係選自由下列組成之群： H 、 F 、 CN ；具有1至10個C原子之直鏈烷基或烷氧基或具有3至10個C原子之具支鏈或環狀烷基或烷氧基，其每一者可經一或多個 R^6 基團取代，其中一或多個非毗鄰 CH_2 基團可經O替代

且其中一或多個H原子可經F替代；具有6至24個芳族環原子之芳族或雜芳族環系統，在每一情形下，其可經一或多個 R^6 基團取代。

在本發明之尤佳實施例中， R^1 至 R^4 每次出現時相同或不同且係選自由下列組成之群：H、F、具有1至5個C原子之直鏈烷基或具有3至6個C原子之具支鏈或環狀烷基；具有5至18個芳族環原子之芳族或雜芳族環系統，在每一情形下，其可經一或多個 R^6 基團取代。

最佳地， R^1 至 R^4 相同或不同且係選自H、F、苯基、甲基及第三丁基。

在式(1)及(2)至(10)及(2a)至(10a)之化合物中， R^1 至 R^4 每次出現時相同或不同且極佳係選自由H、F、甲基、第三丁基及苯基組成之群。

在本發明之另一較佳實施例中，鍵結至 Ar^1 或 Ar^2 或 Ar^S 之 R^5 基團每次出現時相同或不同且係選自由下列組成之群：H、F、CN；具有1至10個C原子之直鏈烷基、具有3至10個C原子之具支鏈或環狀烷基或具有5至24個芳族環原子之芳族或雜芳族環系統，其每一者可經一或多個 R^6 基團取代。

在本發明之尤佳實施例中，鍵結至 Ar^1 或 Ar^2 或 Ar^S 之 R^5 基團每次出現時相同或不同且係選自由下列組成之群：H；具有1至5個C原子之直鏈烷基、具有3至6個C原子之具支鏈或環狀烷基或具有5至24個芳族環原子之芳族或雜芳族環系統，其每一者可經一或多個 R^6 基團取代。

此處 R^1 至 R^6 基團較佳不含兩個以上芳族或雜芳族6員環直接彼此稠合之稠合芳基或雜芳基，即，例如不含蒽基或芘基。 R^1 至 R^6 基團尤佳絕對不含芳族或雜芳族6員環直接彼此稠合之稠合芳基或雜芳基，亦即，例如不含萘基。

此外，在萸之9位之兩個 R^5 取代基可較佳一起形成較佳具有3至8

個C原子、尤佳具有5或6個C原子之環烷基環。

同樣，在式(68)及(72)中，兩個 R^5 取代基可彼此形成環系統並由此形成螺環系統，例如較佳具有3至8個C原子、尤佳具有5或6個C原子之環烷基環。

對於藉由真空蒸發處理之化合物，烷基較佳具有不超過4個C原子，尤佳不超過1個C原子。對於自溶液處理之化合物，適宜化合物係亦彼等經具有至多10個C原子之直鏈、具支鏈或環狀烷基取代者或經寡聚伸芳基(例如鄰-、間-、對-或具支鏈聯三苯基或聯四苯基)取代者。

在本發明之較佳實施例中， R^6 每次出現時相同或不同且係選自由下列組成之群：H、具有1至10個C原子之直鏈烷基或具有3至10個C原子之具支鏈或環狀烷基或具有6至24個C原子之芳族環系統。尤佳地， R^6 每次出現時相同或不同且係H或甲基，極佳係H。

尤佳者係式(1)及(2)至(10)及(2a)至(10a)及(2b)至(10b)之化合物，其中上文所提及之較佳實施例同時出現。因此，尤佳者係如下之化合物：

Ar^1 、 Ar^2 相同或不同且係式(11)至(66)中之一者之基團；

或 $-NAr^1Ar^2$ 代表式(67)至(74)中之一者之基團；

E 每次出現時相同或不同且係單鍵或 $C(R^1)_2$ 、 $N(R^1)$ 、O或S；

R^1 至 R^4 每次出現時相同或不同且係選自由下列組成之群：H、F、CN；具有1至10個C原子之直鏈烷基或烷氧基或具有3至10個C原子之具支鏈或環狀烷基或烷氧基，其每一者可經一或多個 R^6 基團取代，其中一或多個非毗鄰 CH_2 基團可經O替代且其中一或多個H原子可經F替代；具有6至24個芳族環原子之芳族或雜芳族環系統，在每一情形下，其可經一或多個 R^6 基團取代；

R^5 若基團 R^5 係鍵結至 Ar^1 或 Ar^2 或 Ar^S ，則其每次出現時係相同或不同且係選自由下列組成之群：H、F、CN；具有1至10個C原子之直鏈烷基、具有3至10個C原子之具支鏈或環狀烷基或具有5至24個芳族環原子之芳族或雜芳族環系統，其每一者可經一或多個 R^6 基團取代；

或 R^5 在鍵結至式(20)至(23)、(53)、(54)、(68)及(72)中之碳橋時係相同或不同且係具有1至10個C原子之烷基(具體而言甲基)或苯基，其可經一或多個 R^6 基團取代；

或 R^5 在鍵結至式(28)至(31)、(40)至(43)或(55)至(58)、(63)至(66)、(71)及(73)中之氮橋時係可經一或多個 R^6 基團取代之苯基；

R^6 每次出現時相同或不同且係選自由下列組成之群：H、具有1至10個C原子之直鏈烷基或具有3至10個C原子之具支鏈或環狀烷基或具有6至24個C原子之芳族環系統；

- i 係0；
- m 係0或1，較佳係0；
- n 係0或1；
- p + q 係0或1；
- r 係0或1；
- s 係0或1。

式(1)化合物之較佳結構之實例列示於下文中。該等化合物係基於式(2a)、(5a)及(8a)之基本結構。

式	式之基本結構	i =	式之 Ar^1	式之 Ar^2
(2a-1-1)	(2a)	0	(11)	(11)
(2a-1-2)	(2a)	0	(11)	(13)
(2a-1-3)	(2a)	0	(11)	(20)
(2a-1-4)	(2a)	0	(11)	(29)

(2a-1-5)	(2a)	0	(11)	(35)
(2a-1-6)	(2a)	0	(11)	(38)
(2a-1-7)	(2a)	0	(11)	(39)
(2a-1-8)	(2a)	0	(11)	(49)
(2a-1-9)	(2a)	0	(11)	(51)
(2a-1-10)	(2a)	0	(11)	(59)
(2a-1-11)	(2a)	0	(13)	(13)
(2a-1-12)	(2a)	0	(13)	(20)
(2a-1-13)	(2a)	0	(13)	(29)
(2a-1-14)	(2a)	0	(13)	(35)
(2a-1-15)	(2a)	0	(13)	(38)
(2a-1-16)	(2a)	0	(13)	(39)
(2a-1-17)	(2a)	0	(13)	(49)
(2a-1-18)	(2a)	0	(13)	(51)
(2a-1-19)	(2a)	0	(13)	(59)
(2a-1-20)	(2a)	0	(20)	(20)
(2a-1-21)	(2a)	0	(20)	(29)
(2a-1-22)	(2a)	0	(20)	(35)
(2a-1-23)	(2a)	0	(20)	(38)
(2a-1-24)	(2a)	0	(20)	(39)
(2a-1-25)	(2a)	0	(20)	(49)
(2a-1-26)	(2a)	0	(20)	(51)
(2a-1-27)	(2a)	0	(20)	(59)
(2a-1-28)	(2a)	0	(29)	(29)
(2a-1-29)	(2a)	0	(29)	(35)
(2a-1-30)	(2a)	0	(29)	(38)
(2a-1-31)	(2a)	0	(29)	(39)
(2a-1-32)	(2a)	0	(29)	(49)
(2a-1-33)	(2a)	0	(29)	(51)
(2a-1-34)	(2a)	0	(29)	(59)

(2a-1-35)	(2a)	0	(35)	(35)
(2a-1-36)	(2a)	0	(35)	(38)
(2a-1-37)	(2a)	0	(35)	(39)
(2a-1-38)	(2a)	0	(35)	(49)
(2a-1-39)	(2a)	0	(35)	(51)
(2a-1-40)	(2a)	0	(35)	(59)
(2a-1-41)	(2a)	0	(38)	(38)
(2a-1-42)	(2a)	0	(38)	(39)
(2a-1-43)	(2a)	0	(38)	(49)
(2a-1-44)	(2a)	0	(38)	(51)
(2a-1-45)	(2a)	0	(38)	(59)
(2a-1-46)	(2a)	0	(39)	(39)
(2a-1-47)	(2a)	0	(39)	(49)
(2a-1-48)	(2a)	0	(39)	(51)
(2a-1-49)	(2a)	0	(39)	(59)
(2a-1-50)	(2a)	0	(49)	(49)
(2a-1-51)	(2a)	0	(49)	(51)
(2a-1-52)	(2a)	0	(49)	(59)
(2a-1-53)	(2a)	0	(51)	(51)
(2a-1-54)	(2a)	0	(51)	(59)
(2a-1-55)	(2a)	0	(59)	(59)
(2a-2-1)	(2a)	1	(11)	(11)
(2a-2-2)	(2a)	1	(11)	(13)
(2a-2-3)	(2a)	1	(11)	(20)
(2a-2-4)	(2a)	1	(11)	(29)
(2a-2-5)	(2a)	1	(11)	(35)
(2a-2-6)	(2a)	1	(11)	(38)
(2a-2-7)	(2a)	1	(11)	(39)
(2a-2-8)	(2a)	1	(11)	(49)
(2a-2-9)	(2a)	1	(11)	(51)

(2a-2-10)	(2a)	1	(11)	(59)
(2a-2-11)	(2a)	1	(13)	(13)
(2a-2-12)	(2a)	1	(13)	(20)
(2a-2-13)	(2a)	1	(13)	(29)
(2a-2-14)	(2a)	1	(13)	(35)
(2a-2-15)	(2a)	1	(13)	(38)
(2a-2-16)	(2a)	1	(13)	(39)
(2a-2-17)	(2a)	1	(13)	(49)
(2a-2-18)	(2a)	1	(13)	(51)
(2a-2-19)	(2a)	1	(13)	(59)
(2a-2-20)	(2a)	1	(20)	(20)
(2a-2-21)	(2a)	1	(20)	(29)
(2a-2-22)	(2a)	1	(20)	(35)
(2a-2-23)	(2a)	1	(20)	(38)
(2a-2-24)	(2a)	1	(20)	(39)
(2a-2-25)	(2a)	1	(20)	(49)
(2a-2-26)	(2a)	1	(20)	(51)
(2a-2-27)	(2a)	1	(20)	(59)
(2a-2-28)	(2a)	1	(29)	(29)
(2a-2-29)	(2a)	1	(29)	(35)
(2a-2-30)	(2a)	1	(29)	(38)
(2a-2-31)	(2a)	1	(29)	(39)
(2a-2-32)	(2a)	1	(29)	(49)
(2a-2-33)	(2a)	1	(29)	(51)
(2a-2-34)	(2a)	1	(29)	(59)
(2a-2-35)	(2a)	1	(35)	(35)
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(2a-2-37)	(2a)	1	(35)	(39)
(2a-2-38)	(2a)	1	(35)	(49)
(2a-2-39)	(2a)	1	(35)	(51)

(2a-2-40)	(2a)	1	(35)	(59)
(2a-2-41)	(2a)	1	(38)	(38)
(2a-2-42)	(2a)	1	(38)	(39)
(2a-2-43)	(2a)	1	(38)	(49)
(2a-2-44)	(2a)	1	(38)	(51)
(2a-2-45)	(2a)	1	(38)	(59)
(2a-2-46)	(2a)	1	(39)	(39)
(2a-2-47)	(2a)	1	(39)	(49)
(2a-2-48)	(2a)	1	(39)	(51)
(2a-2-49)	(2a)	1	(39)	(59)
(2a-2-50)	(2a)	1	(49)	(49)
(2a-2-51)	(2a)	1	(49)	(51)
(2a-2-52)	(2a)	1	(49)	(59)
(2a-2-53)	(2a)	1	(51)	(51)
(2a-2-54)	(2a)	1	(51)	(59)
(2a-2-55)	(2a)	1	(59)	(59)
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(5a-1-2)	(5a)	0	(11)	(13)
(5a-1-3)	(5a)	0	(11)	(20)
(5a-1-4)	(5a)	0	(11)	(29)
(5a-1-5)	(5a)	0	(11)	(35)
(5a-1-6)	(5a)	0	(11)	(38)
(5a-1-7)	(5a)	0	(11)	(39)
(5a-1-8)	(5a)	0	(11)	(49)
(5a-1-9)	(5a)	0	(11)	(51)
(5a-1-10)	(5a)	0	(11)	(59)
(5a-1-11)	(5a)	0	(13)	(13)
(5a-1-12)	(5a)	0	(13)	(20)
(5a-1-13)	(5a)	0	(13)	(29)
(5a-1-14)	(5a)	0	(13)	(35)

(5a-1-15)	(5a)	0	(13)	(38)
(5a-1-16)	(5a)	0	(13)	(39)
(5a-1-17)	(5a)	0	(13)	(49)
(5a-1-18)	(5a)	0	(13)	(51)
(5a-1-19)	(5a)	0	(13)	(59)
(5a-1-20)	(5a)	0	(20)	(20)
(5a-1-21)	(5a)	0	(20)	(29)
(5a-1-22)	(5a)	0	(20)	(35)
(5a-1-23)	(5a)	0	(20)	(38)
(5a-1-24)	(5a)	0	(20)	(39)
(5a-1-25)	(5a)	0	(20)	(49)
(5a-1-26)	(5a)	0	(20)	(51)
(5a-1-27)	(5a)	0	(20)	(59)
(5a-1-28)	(5a)	0	(29)	(29)
(5a-1-29)	(5a)	0	(29)	(35)
(5a-1-30)	(5a)	0	(29)	(38)
(5a-1-31)	(5a)	0	(29)	(39)
(5a-1-32)	(5a)	0	(29)	(49)
(5a-1-33)	(5a)	0	(29)	(51)
(5a-1-34)	(5a)	0	(29)	(59)
(5a-1-35)	(5a)	0	(35)	(35)
(5a-1-36)	(5a)	0	(35)	(38)
(5a-1-37)	(5a)	0	(35)	(39)
(5a-1-38)	(5a)	0	(35)	(49)
(5a-1-39)	(5a)	0	(35)	(51)
(5a-1-40)	(5a)	0	(35)	(59)
(5a-1-41)	(5a)	0	(38)	(38)
(5a-1-42)	(5a)	0	(38)	(39)
(5a-1-43)	(5a)	0	(38)	(49)
(5a-1-44)	(5a)	0	(38)	(51)

(5a-1-45)	(5a)	0	(38)	(59)
(5a-1-46)	(5a)	0	(39)	(39)
(5a-1-47)	(5a)	0	(39)	(49)
(5a-1-48)	(5a)	0	(39)	(51)
(5a-1-49)	(5a)	0	(39)	(59)
(5a-1-50)	(5a)	0	(49)	(49)
(5a-1-51)	(5a)	0	(49)	(51)
(5a-1-52)	(5a)	0	(49)	(59)
(5a-1-53)	(5a)	0	(51)	(51)
(5a-1-54)	(5a)	0	(51)	(59)
(5a-1-55)	(5a)	0	(59)	(59)
(5a-2-1)	(5a)	1	(11)	(11)
(5a-2-2)	(5a)	1	(11)	(13)
(5a-2-3)	(5a)	1	(11)	(20)
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(5a-2-5)	(5a)	1	(11)	(35)
(5a-2-6)	(5a)	1	(11)	(38)
(5a-2-7)	(5a)	1	(11)	(39)
(5a-2-8)	(5a)	1	(11)	(49)
(5a-2-9)	(5a)	1	(11)	(51)
(5a-2-10)	(5a)	1	(11)	(59)
(5a-2-11)	(5a)	1	(13)	(13)
(5a-2-12)	(5a)	1	(13)	(20)
(5a-2-13)	(5a)	1	(13)	(29)
(5a-2-14)	(5a)	1	(13)	(35)
(5a-2-15)	(5a)	1	(13)	(38)
(5a-2-16)	(5a)	1	(13)	(39)
(5a-2-17)	(5a)	1	(13)	(49)
(5a-2-18)	(5a)	1	(13)	(51)
(5a-2-19)	(5a)	1	(13)	(59)

(5a-2-20)	(5a)	1	(20)	(20)
(5a-2-21)	(5a)	1	(20)	(29)
(5a-2-22)	(5a)	1	(20)	(35)
(5a-2-23)	(5a)	1	(20)	(38)
(5a-2-24)	(5a)	1	(20)	(39)
(5a-2-25)	(5a)	1	(20)	(49)
(5a-2-26)	(5a)	1	(20)	(51)
(5a-2-27)	(5a)	1	(20)	(59)
(5a-2-28)	(5a)	1	(29)	(29)
(5a-2-29)	(5a)	1	(29)	(35)
(5a-2-30)	(5a)	1	(29)	(38)
(5a-2-31)	(5a)	1	(29)	(39)
(5a-2-32)	(5a)	1	(29)	(49)
(5a-2-33)	(5a)	1	(29)	(51)
(5a-2-34)	(5a)	1	(29)	(59)
(5a-2-35)	(5a)	1	(35)	(35)
(5a-2-36)	(5a)	1	(35)	(38)
(5a-2-37)	(5a)	1	(35)	(39)
(5a-2-38)	(5a)	1	(35)	(49)
(5a-2-39)	(5a)	1	(35)	(51)
(5a-2-40)	(5a)	1	(35)	(59)
(5a-2-41)	(5a)	1	(38)	(38)
(5a-2-42)	(5a)	1	(38)	(39)
(5a-2-43)	(5a)	1	(38)	(49)
(5a-2-44)	(5a)	1	(38)	(51)
(5a-2-45)	(5a)	1	(38)	(59)
(5a-2-46)	(5a)	1	(39)	(39)
(5a-2-47)	(5a)	1	(39)	(49)
(5a-2-48)	(5a)	1	(39)	(51)
(5a-2-49)	(5a)	1	(39)	(59)

(5a-2-50)	(5a)	1	(49)	(49)
(5a-2-51)	(5a)	1	(49)	(51)
(5a-2-52)	(5a)	1	(49)	(59)
(5a-2-53)	(5a)	1	(51)	(51)
(5a-2-54)	(5a)	1	(51)	(59)
(5a-2-55)	(5a)	1	(59)	(59)
(8a-1-1)	(8a)	0	(11)	(11)
(8a-1-2)	(8a)	0	(11)	(13)
(8a-1-3)	(8a)	0	(11)	(20)
(8a-1-4)	(8a)	0	(11)	(29)
(8a-1-5)	(8a)	0	(11)	(35)
(8a-1-6)	(8a)	0	(11)	(38)
(8a-1-7)	(8a)	0	(11)	(39)
(8a-1-8)	(8a)	0	(11)	(49)
(8a-1-9)	(8a)	0	(11)	(51)
(8a-1-10)	(8a)	0	(11)	(59)
(8a-1-11)	(8a)	0	(13)	(13)
(8a-1-12)	(8a)	0	(13)	(20)
(8a-1-13)	(8a)	0	(13)	(29)
(8a-1-14)	(8a)	0	(13)	(35)
(8a-1-15)	(8a)	0	(13)	(38)
(8a-1-16)	(8a)	0	(13)	(39)
(8a-1-17)	(8a)	0	(13)	(49)
(8a-1-18)	(8a)	0	(13)	(51)
(8a-1-19)	(8a)	0	(13)	(59)
(8a-1-20)	(8a)	0	(20)	(20)
(8a-1-21)	(8a)	0	(20)	(29)
(8a-1-22)	(8a)	0	(20)	(35)
(8a-1-23)	(8a)	0	(20)	(38)
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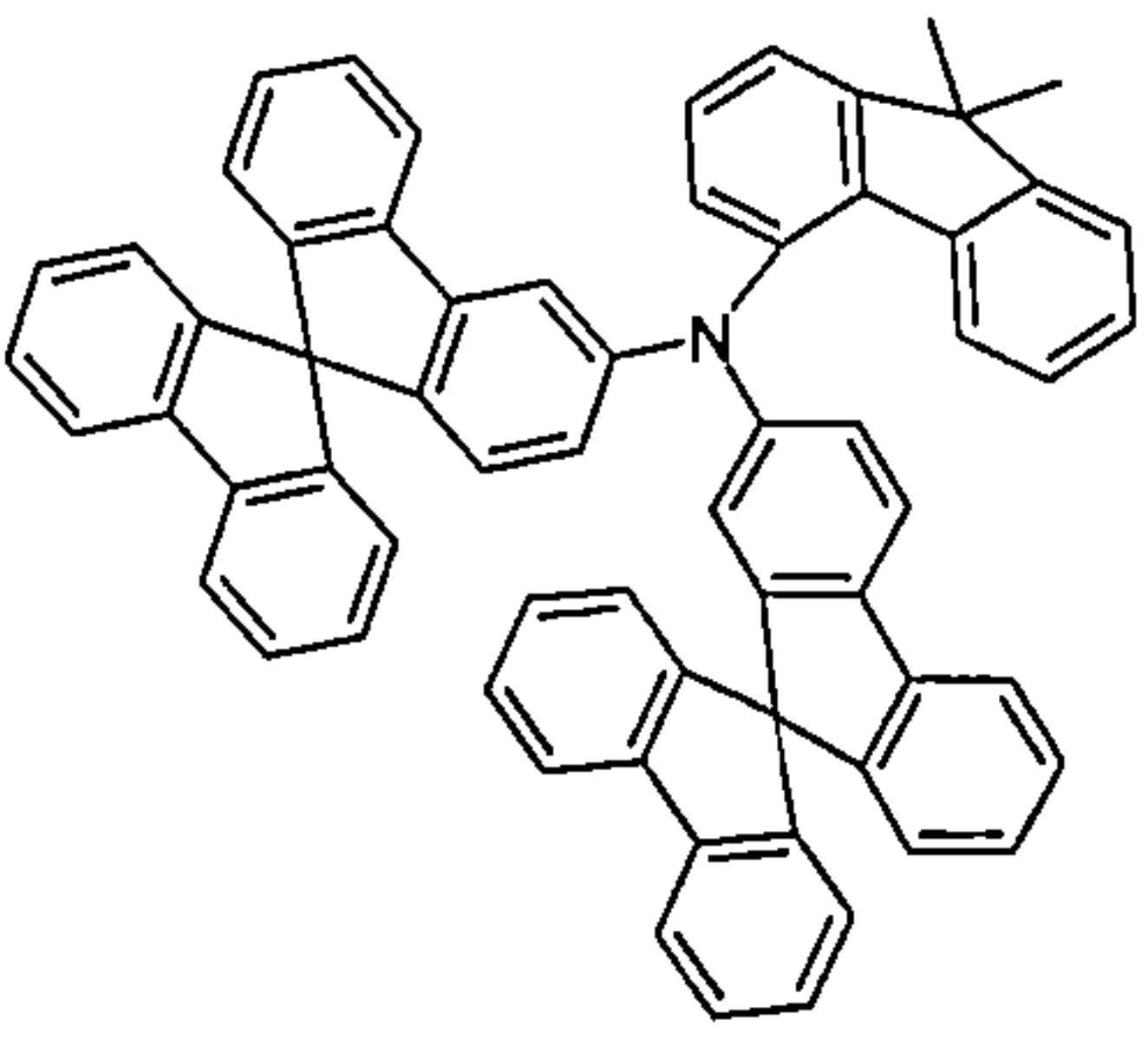
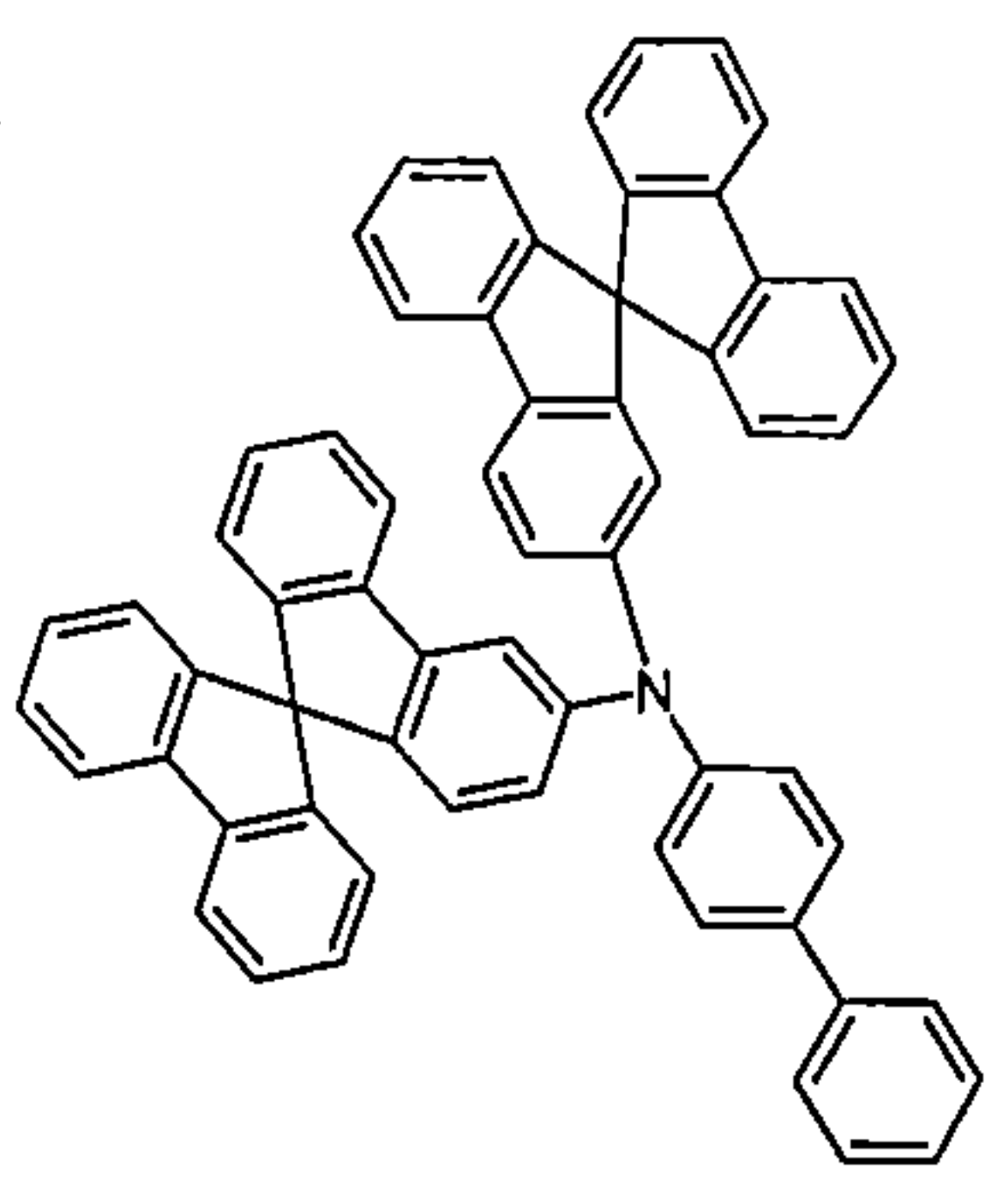
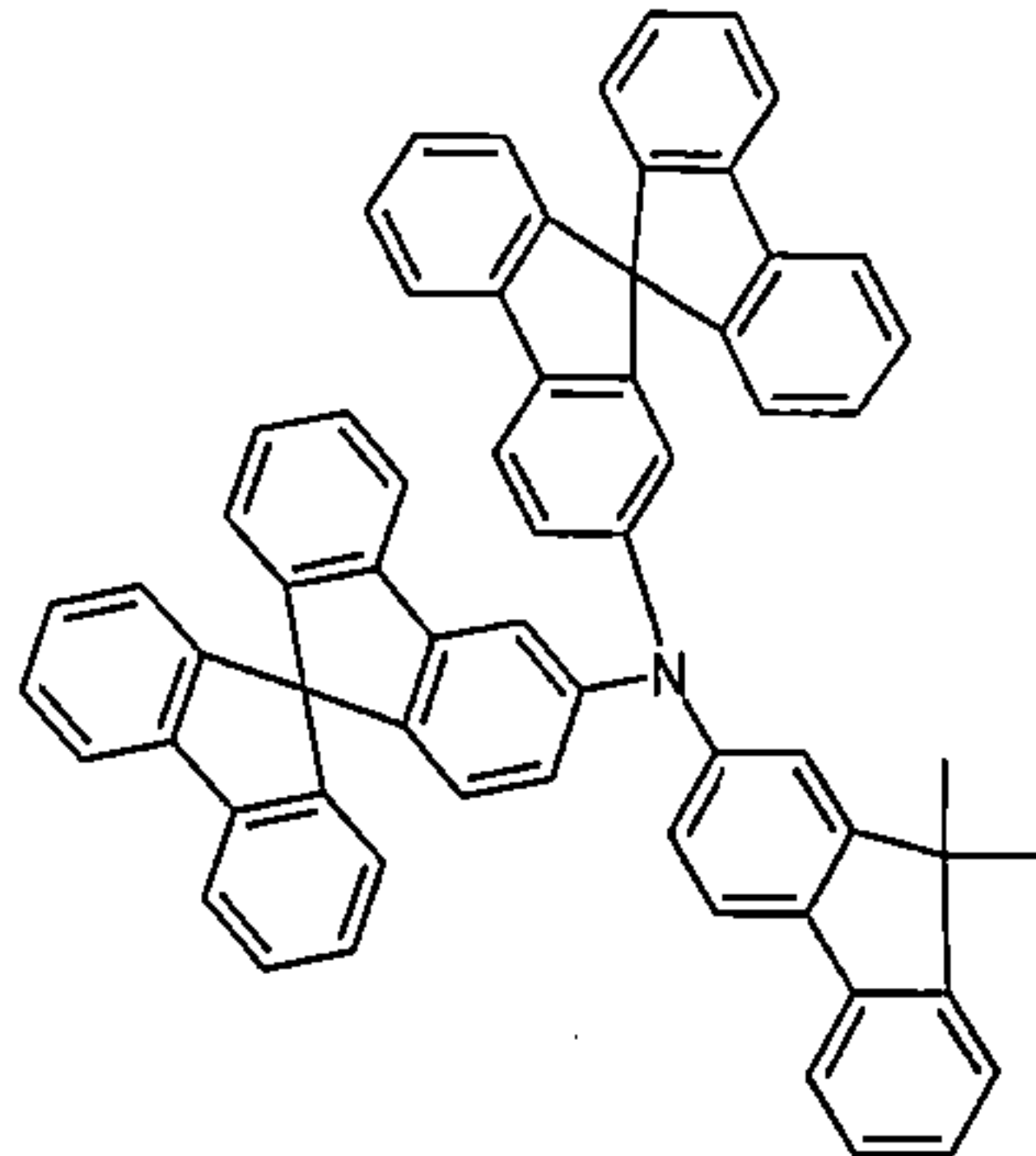
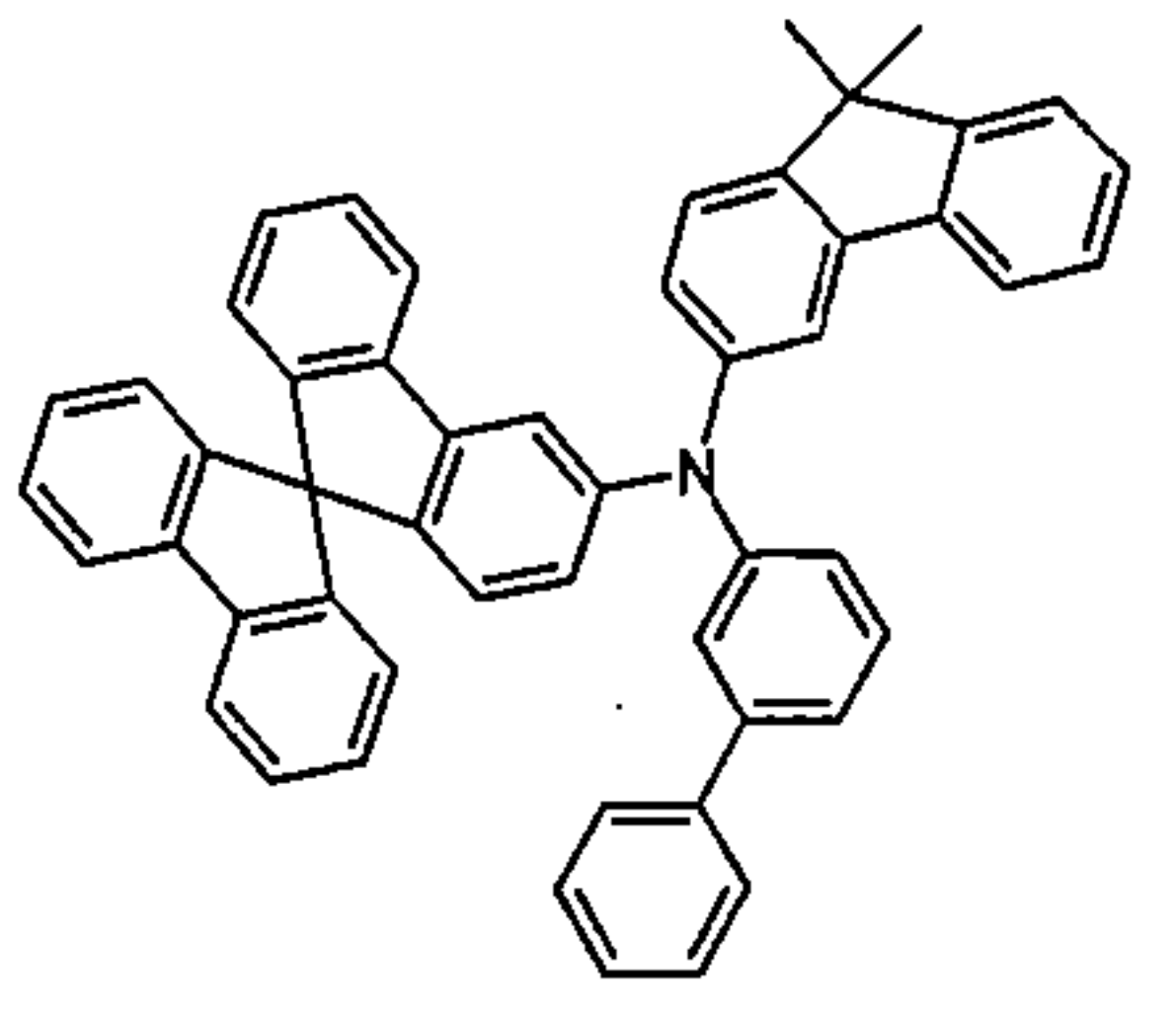
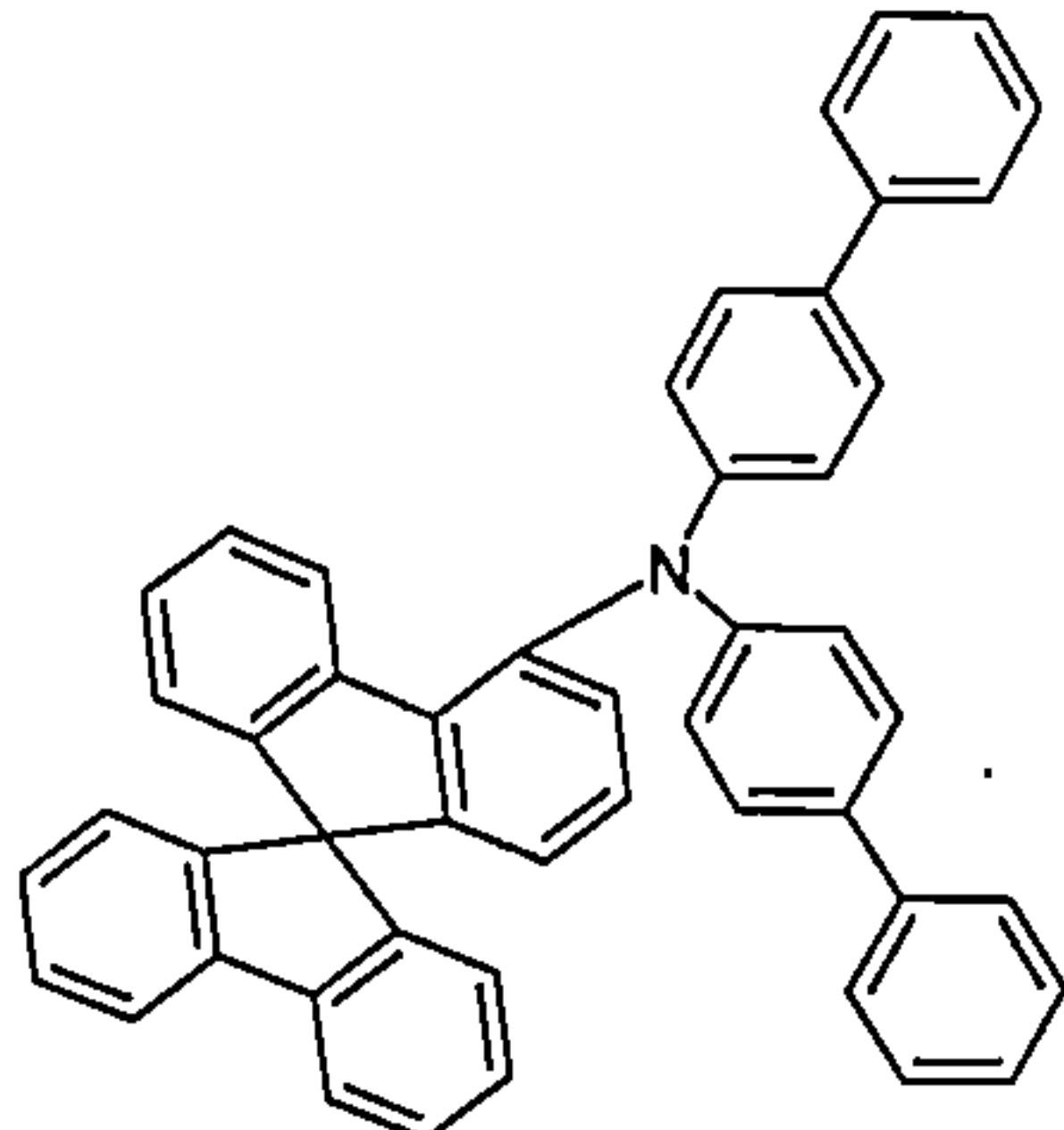
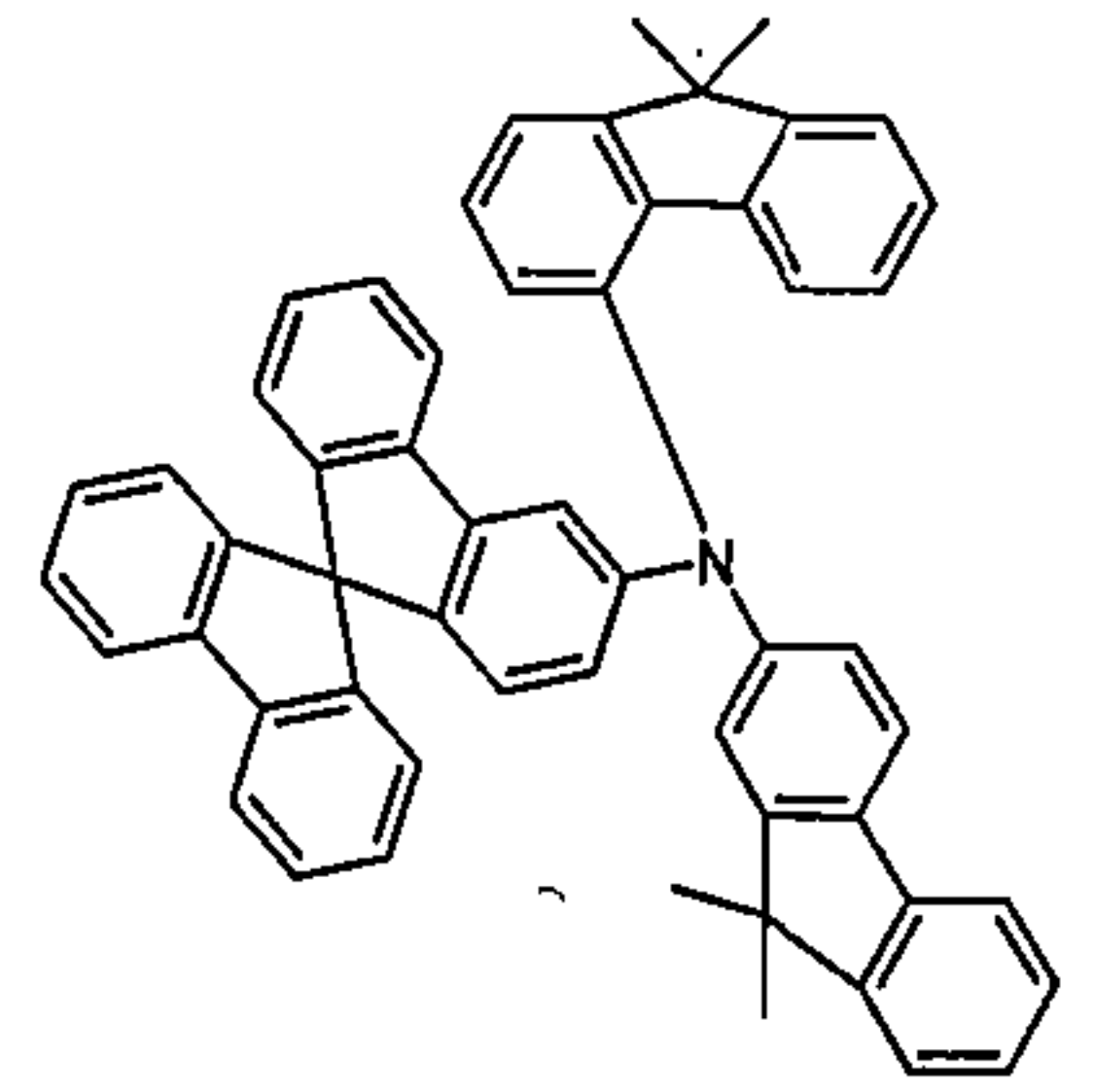
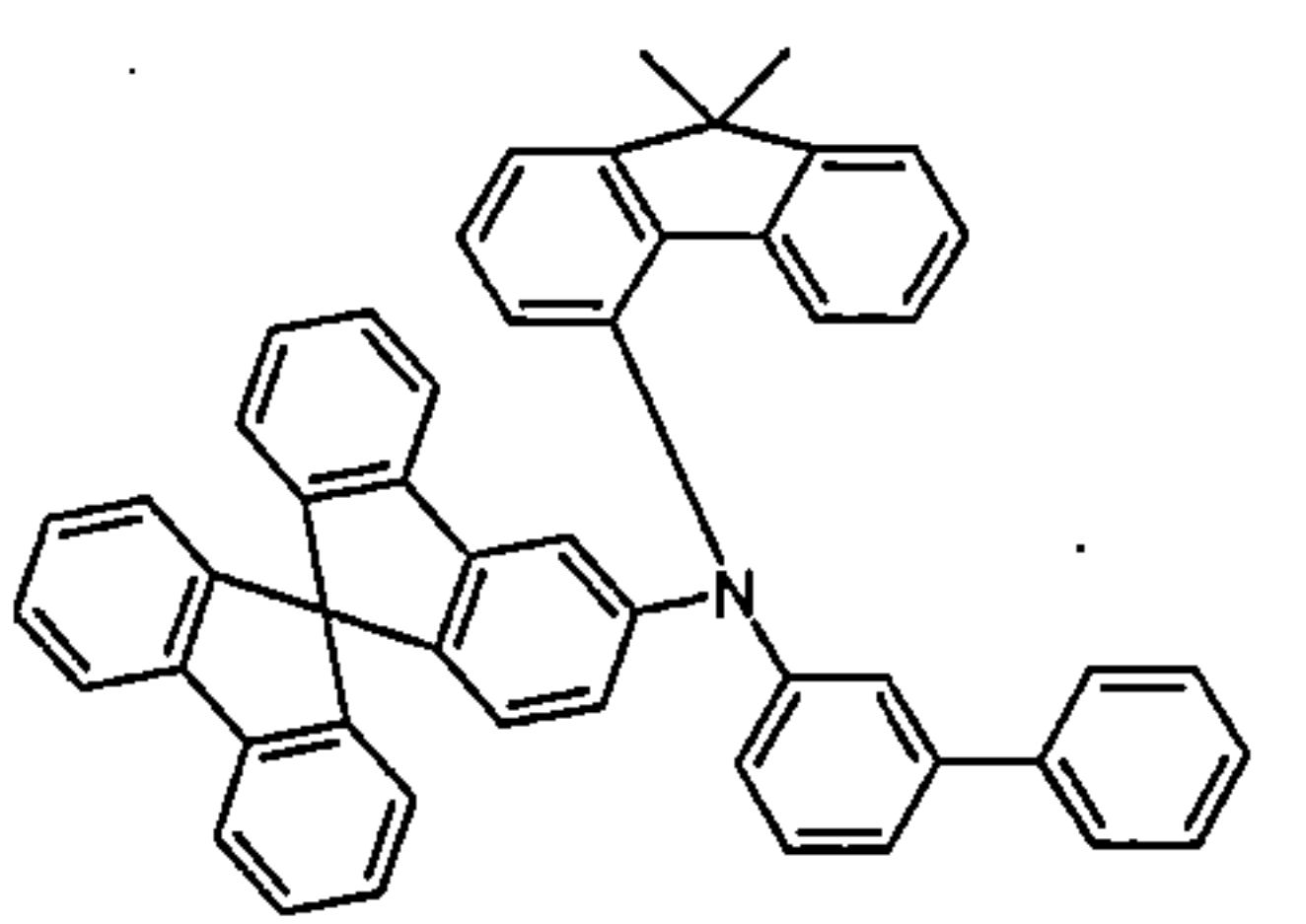
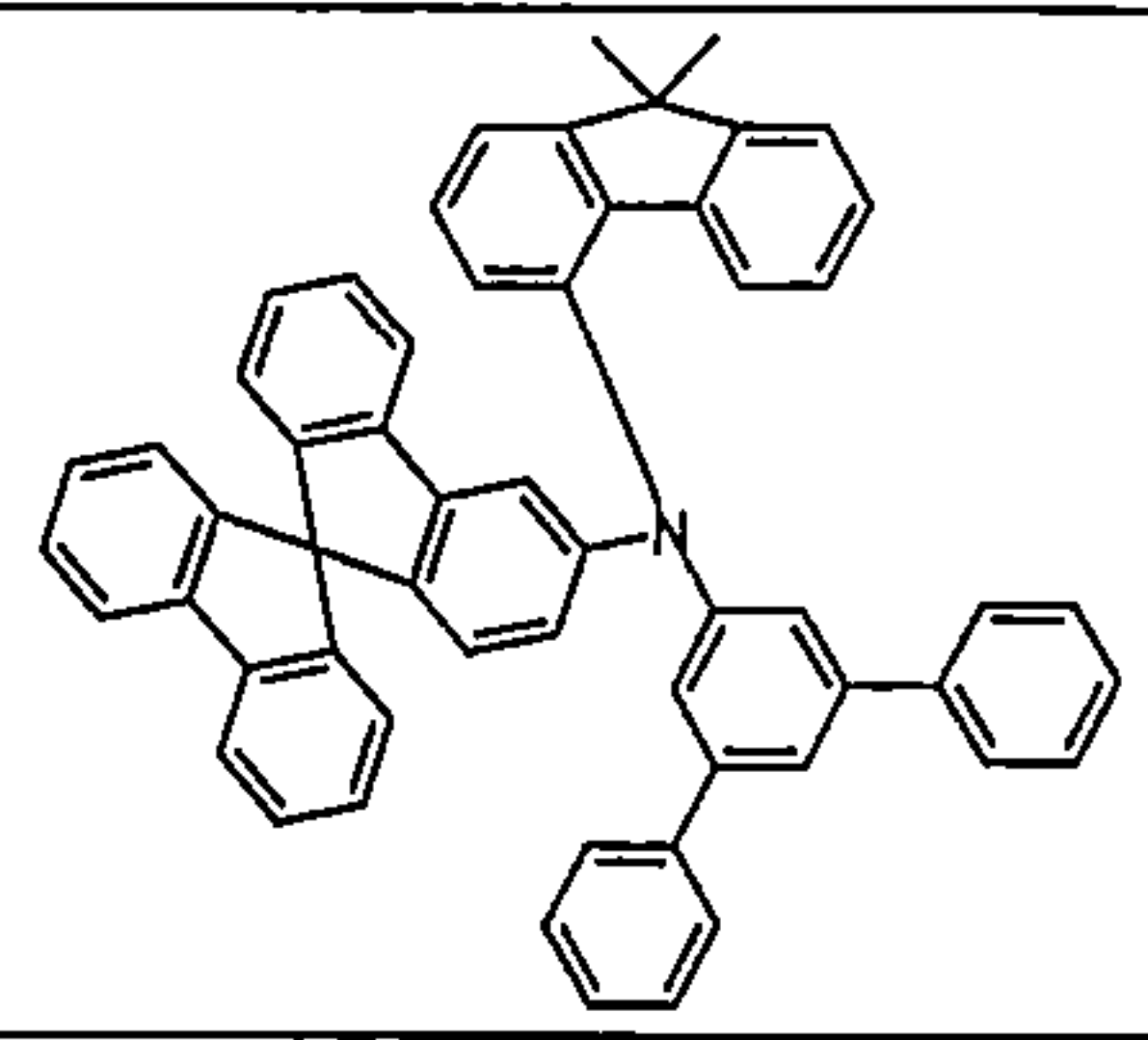
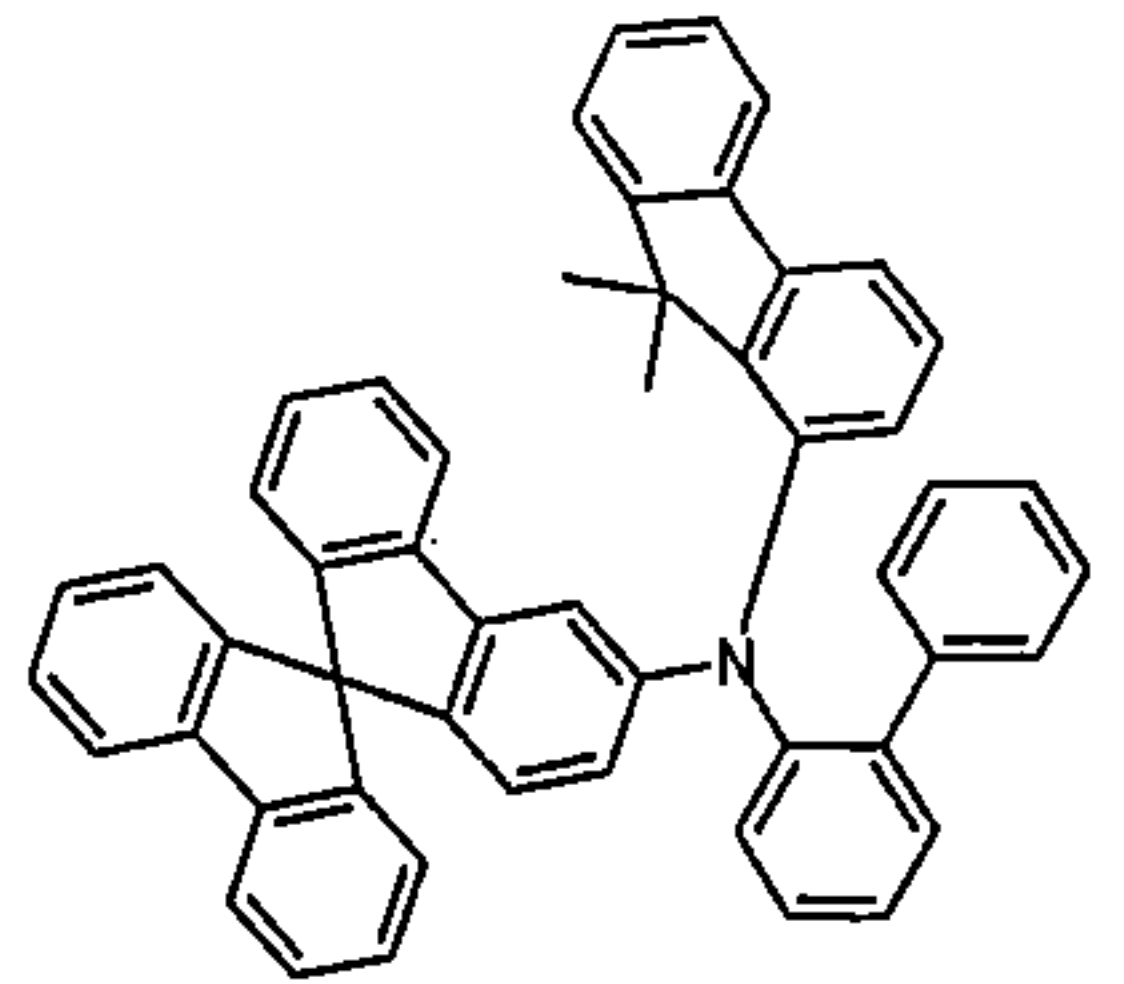
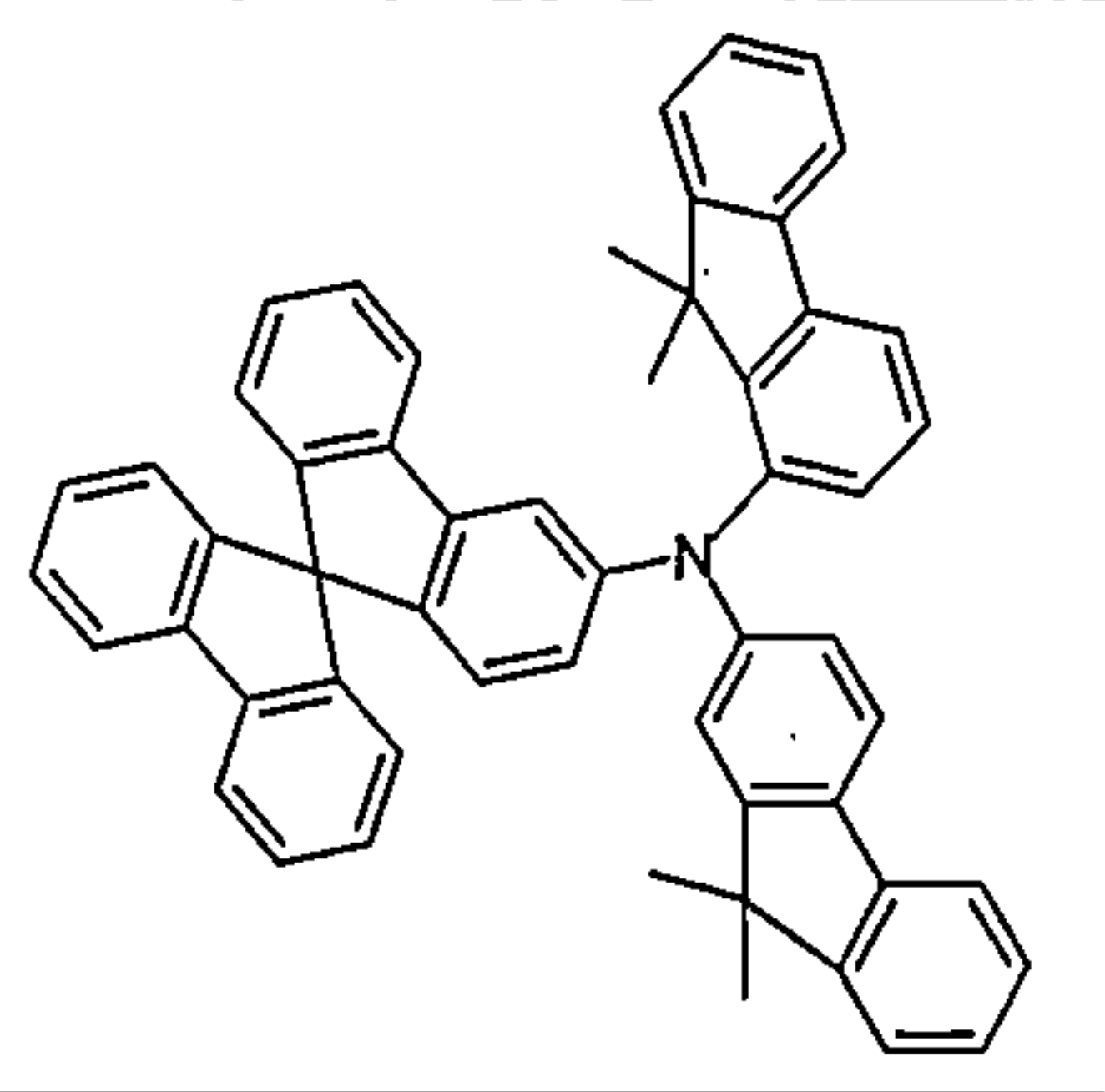
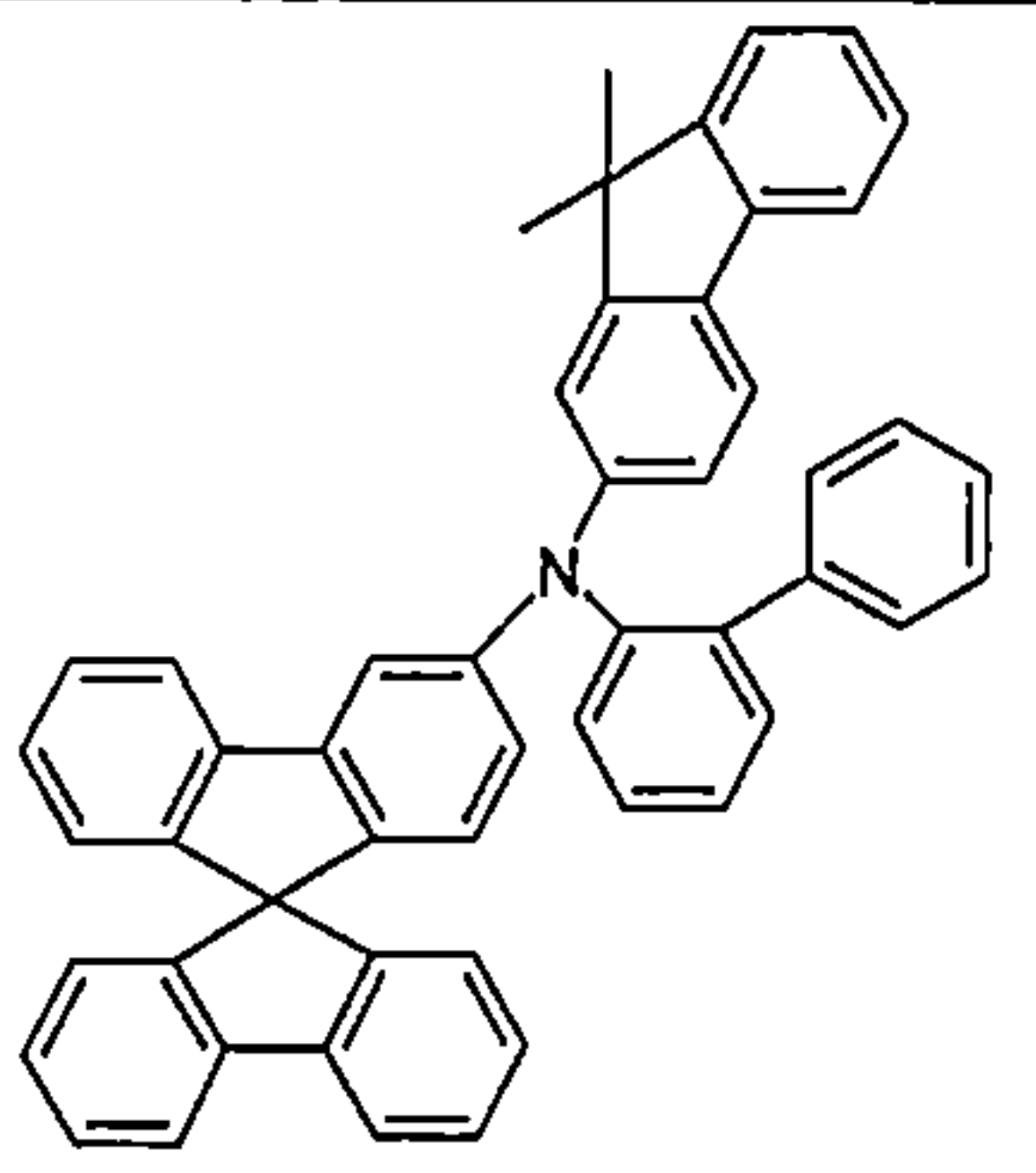
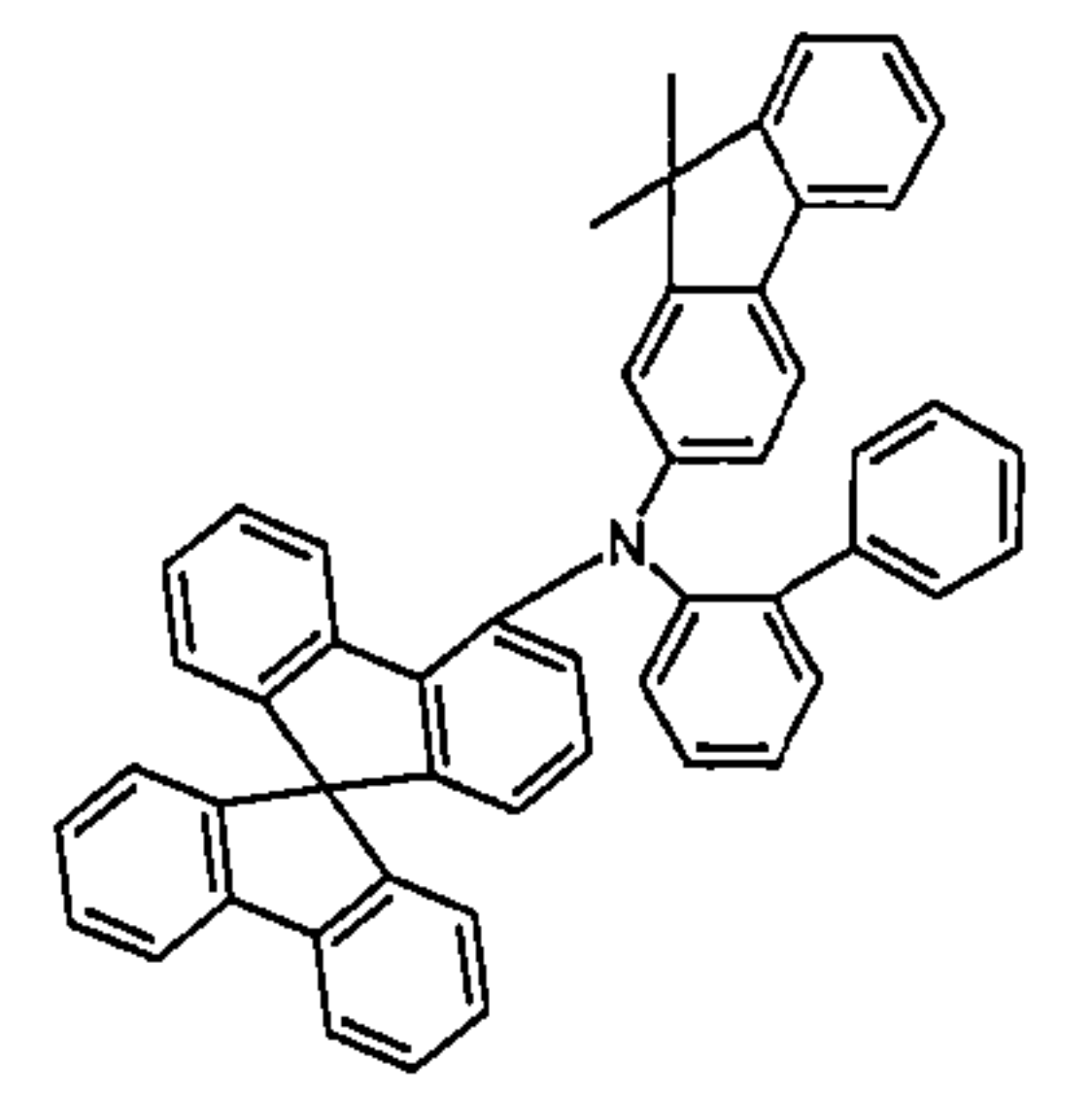
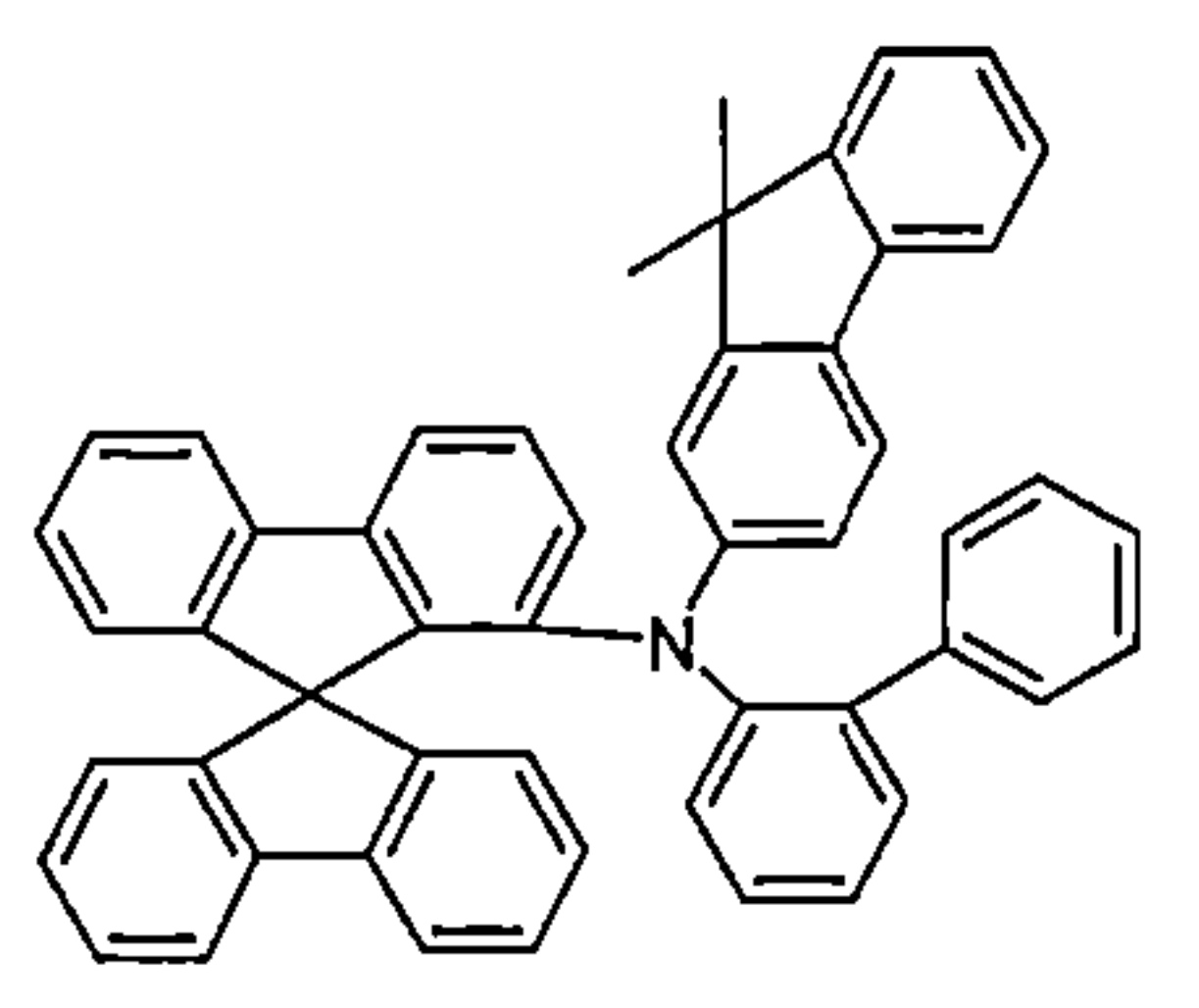
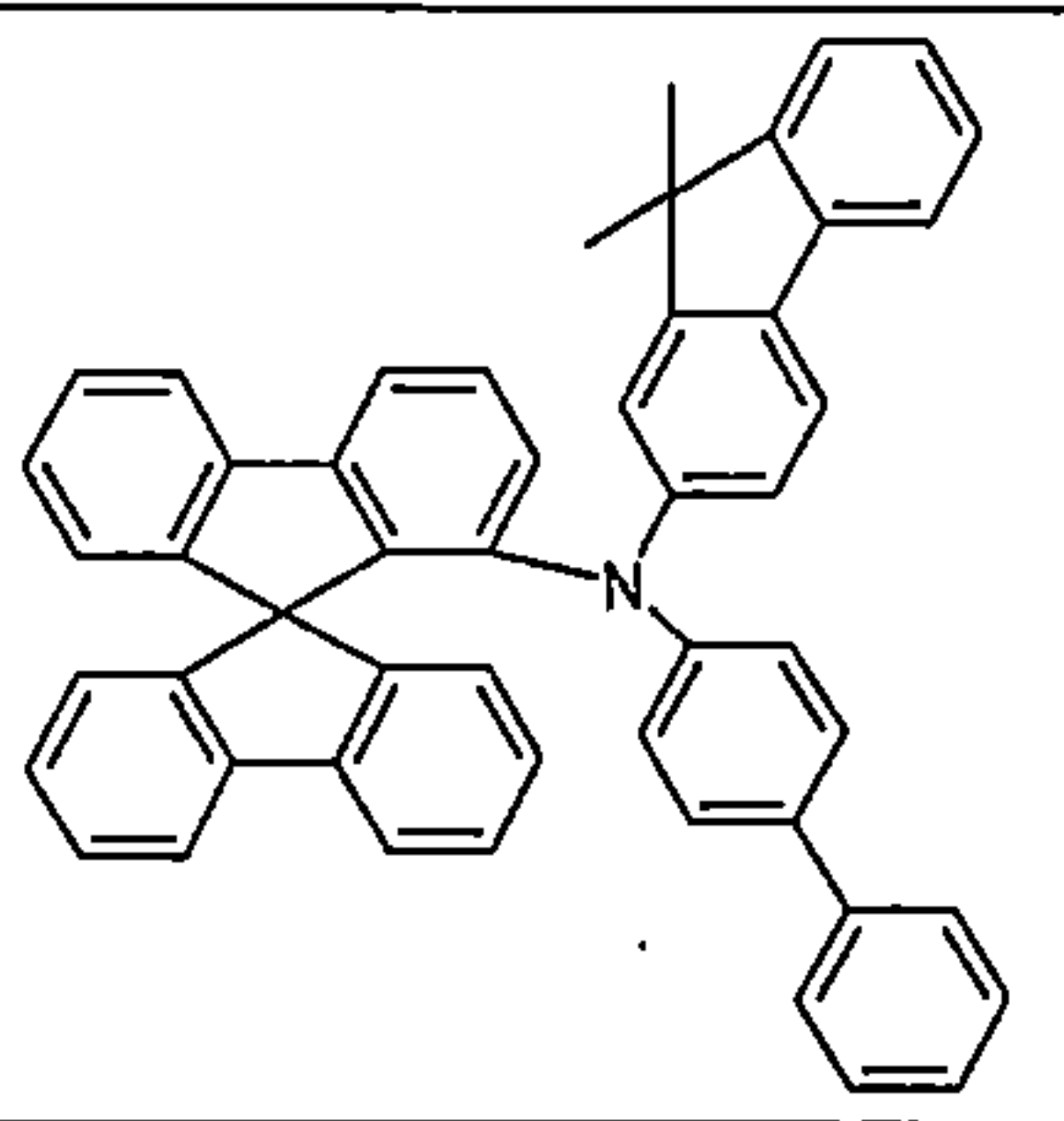
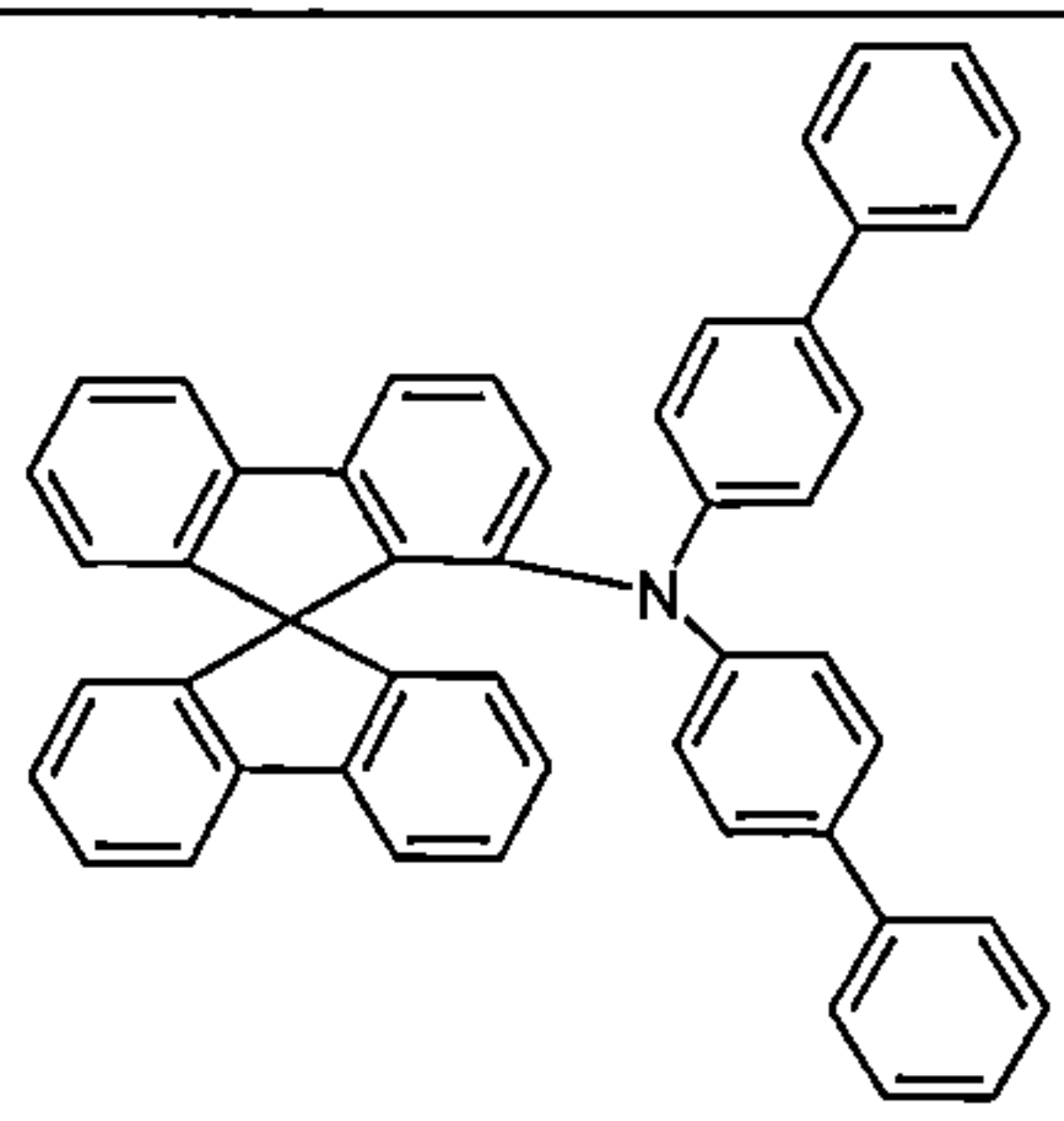
(8a-1-25)	(8a)	0	(20)	(49)
(8a-1-26)	(8a)	0	(20)	(51)
(8a-1-27)	(8a)	0	(20)	(59)
(8a-1-28)	(8a)	0	(29)	(29)
(8a-1-29)	(8a)	0	(29)	(35)
(8a-1-30)	(8a)	0	(29)	(38)
(8a-1-31)	(8a)	0	(29)	(39)
(8a-1-32)	(8a)	0	(29)	(49)
(8a-1-33)	(8a)	0	(29)	(51)
(8a-1-34)	(8a)	0	(29)	(59)
(8a-1-35)	(8a)	0	(35)	(35)
(8a-1-36)	(8a)	0	(35)	(38)
(8a-1-37)	(8a)	0	(35)	(39)
(8a-1-38)	(8a)	0	(35)	(49)
(8a-1-39)	(8a)	0	(35)	(51)
(8a-1-40)	(8a)	0	(35)	(59)
(8a-1-41)	(8a)	0	(38)	(38)
(8a-1-42)	(8a)	0	(38)	(39)
(8a-1-43)	(8a)	0	(38)	(49)
(8a-1-44)	(8a)	0	(38)	(51)
(8a-1-45)	(8a)	0	(38)	(59)
(8a-1-46)	(8a)	0	(39)	(39)
(8a-1-47)	(8a)	0	(39)	(49)
(8a-1-48)	(8a)	0	(39)	(51)
(8a-1-49)	(8a)	0	(39)	(59)
(8a-1-50)	(8a)	0	(49)	(49)
(8a-1-51)	(8a)	0	(49)	(51)
(8a-1-52)	(8a)	0	(49)	(59)
(8a-1-53)	(8a)	0	(51)	(51)
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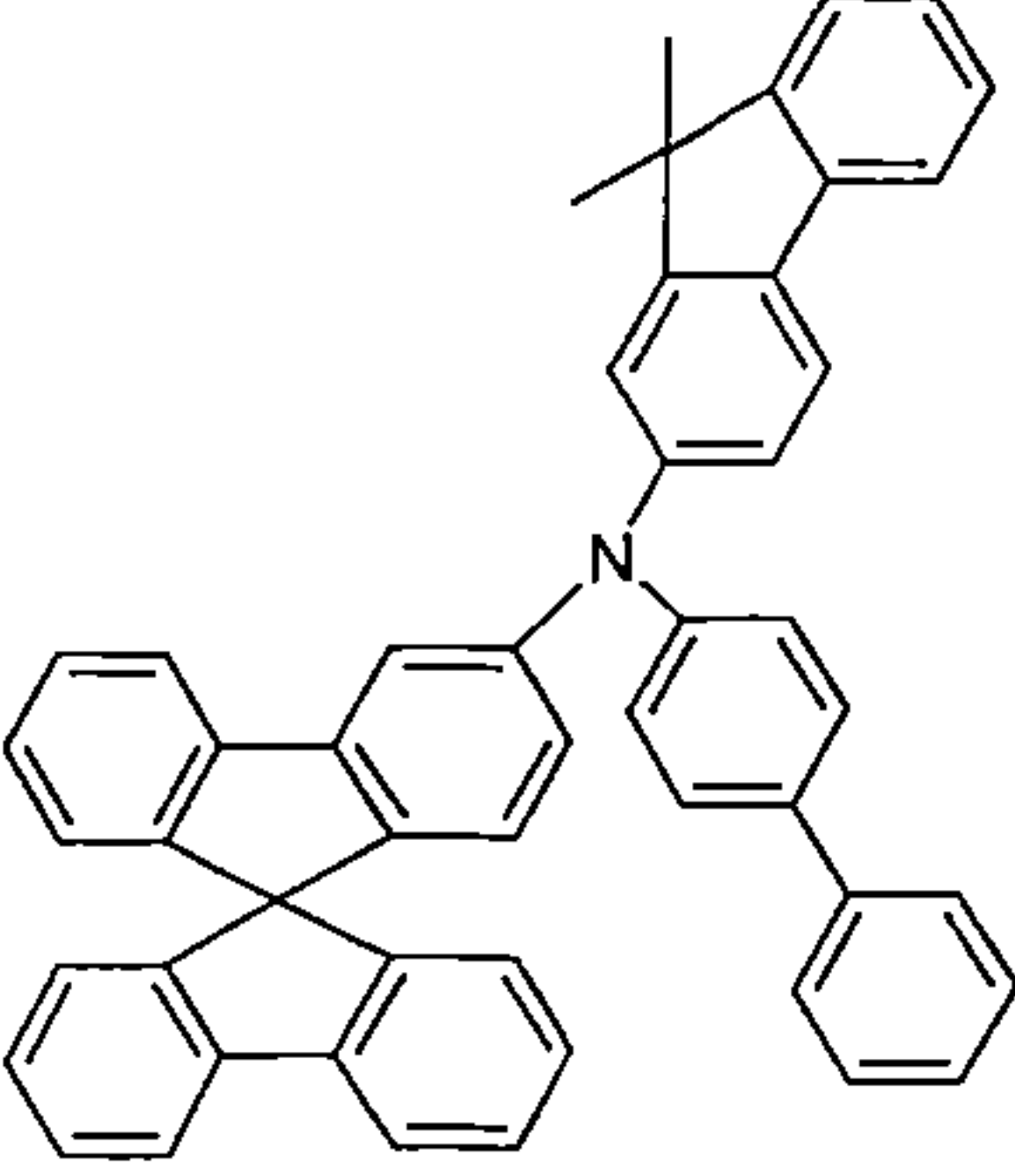
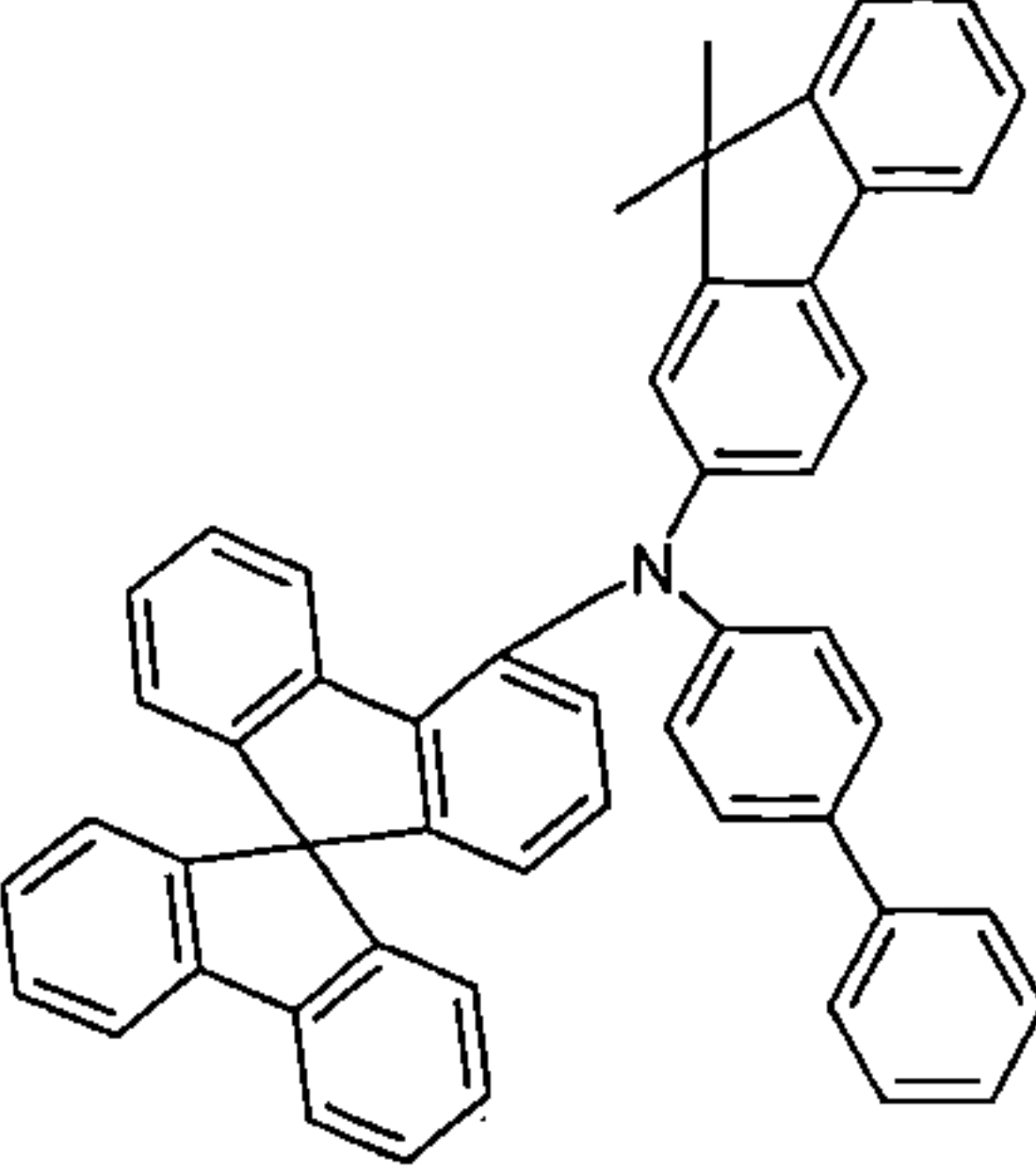
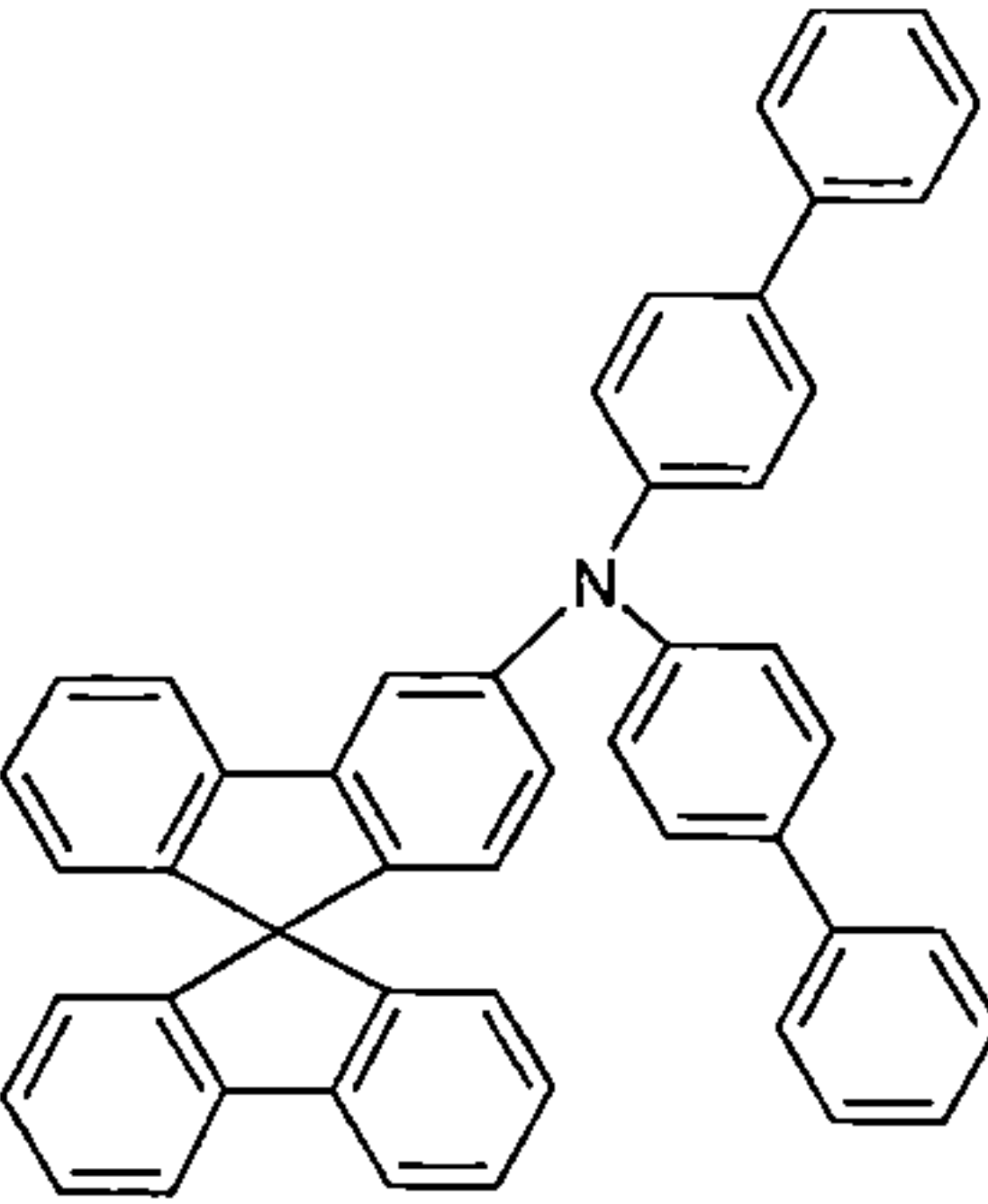
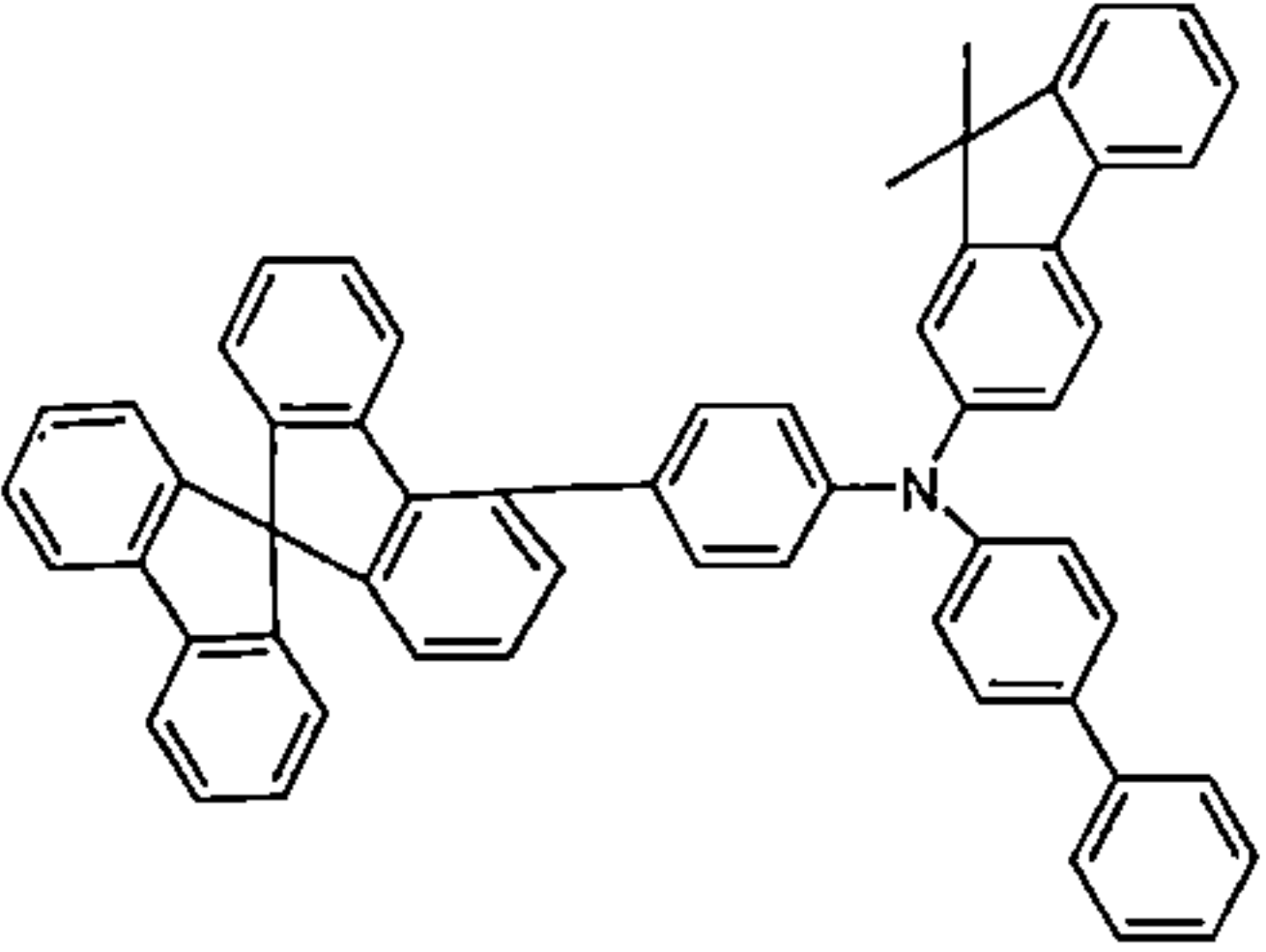
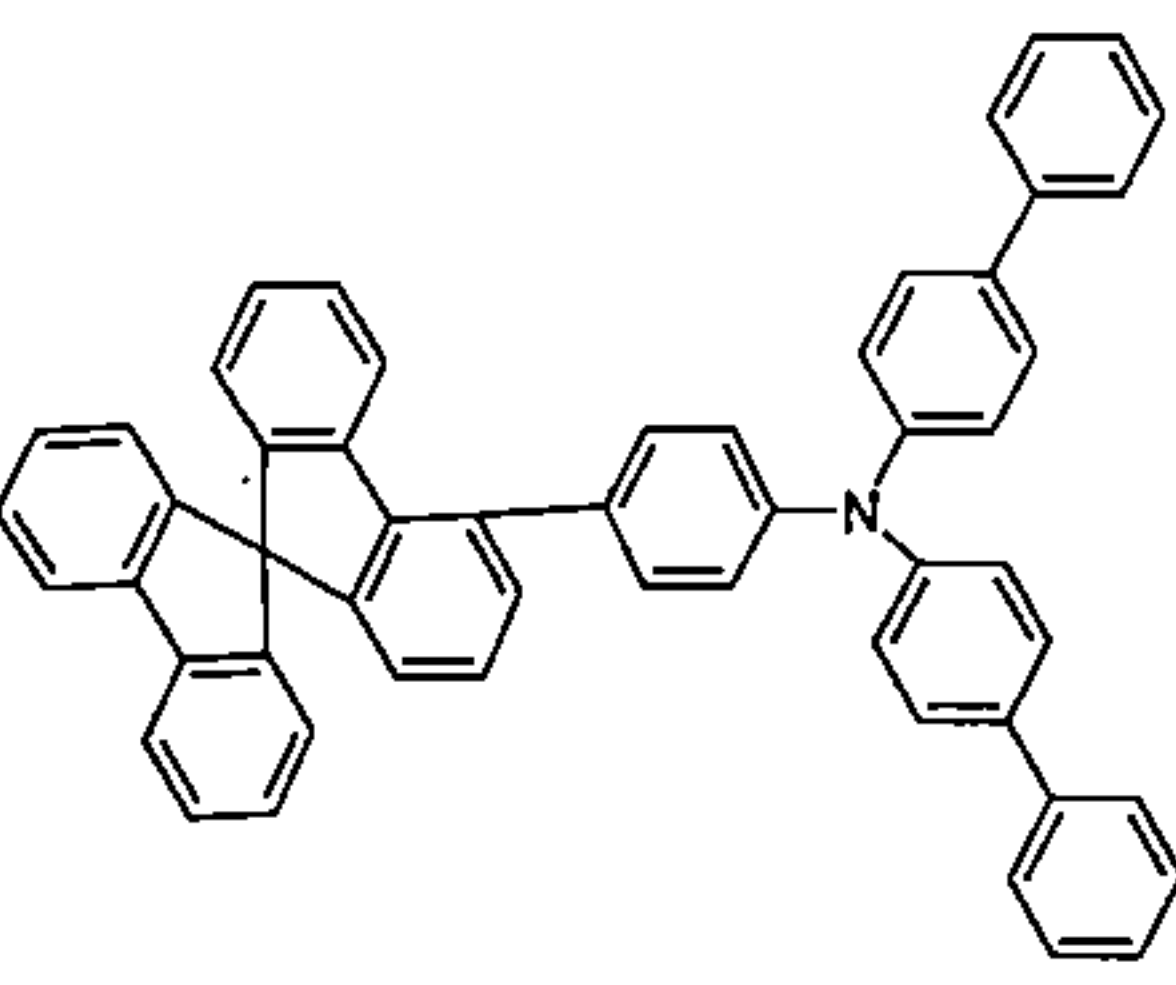
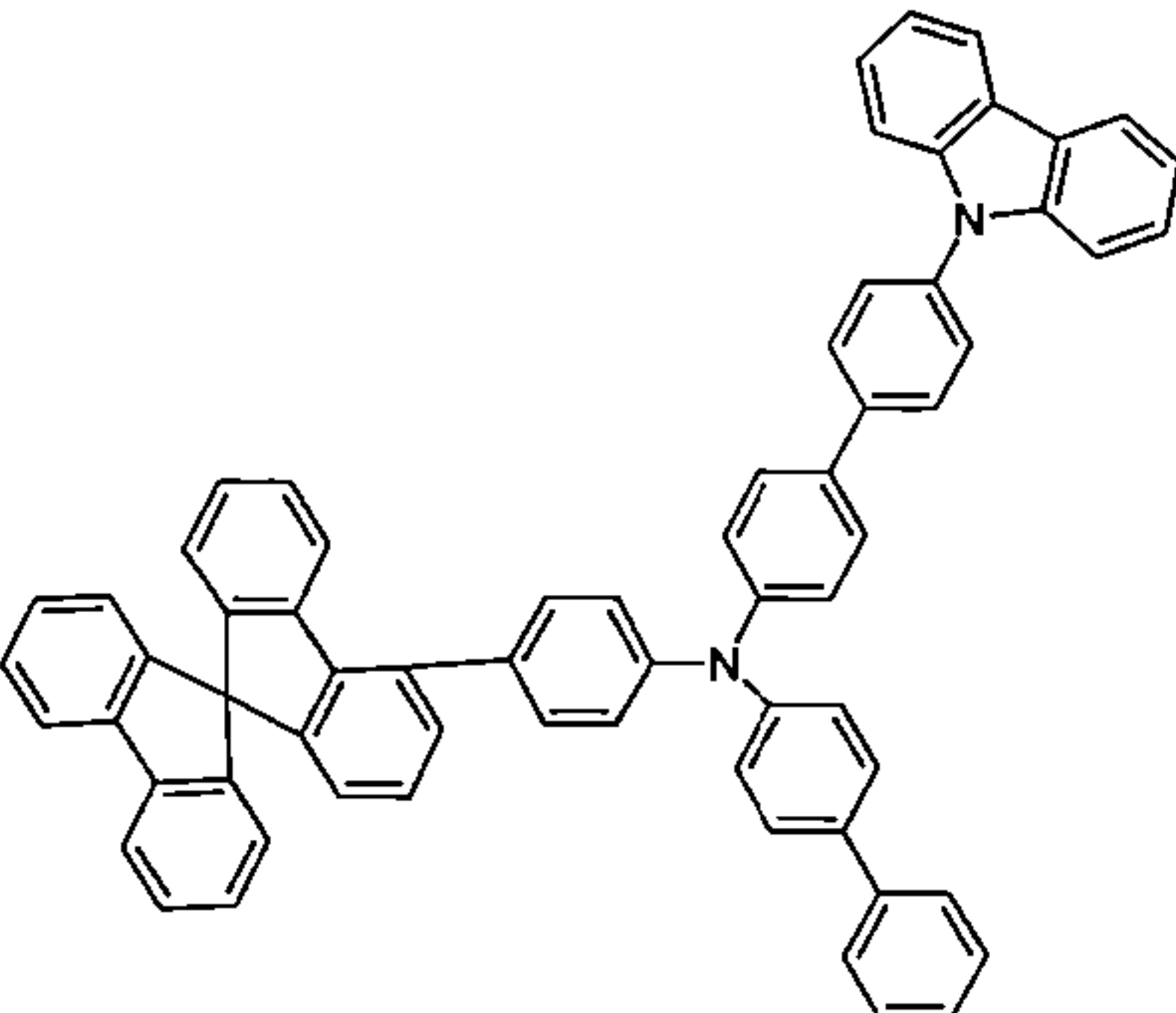
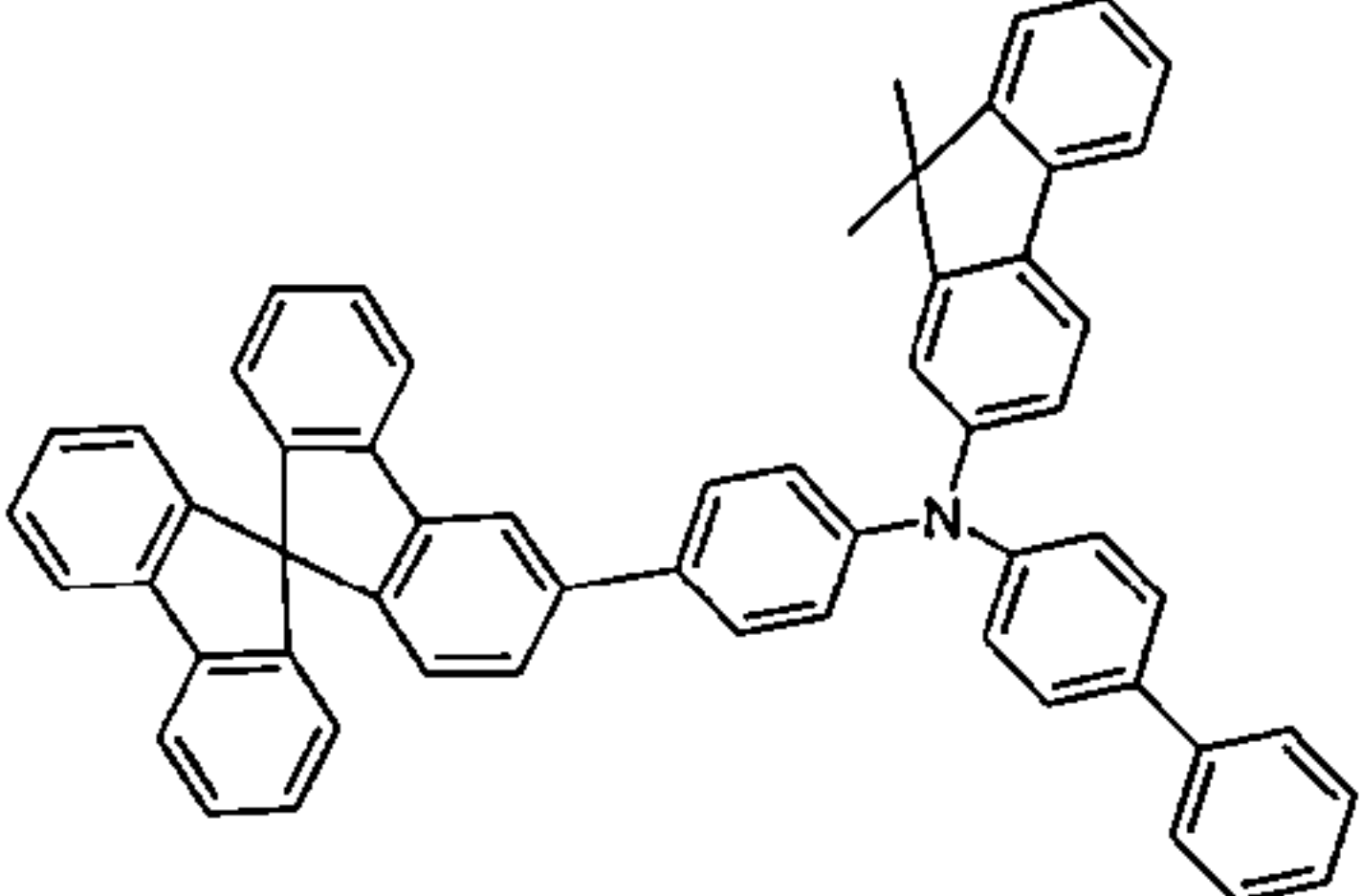
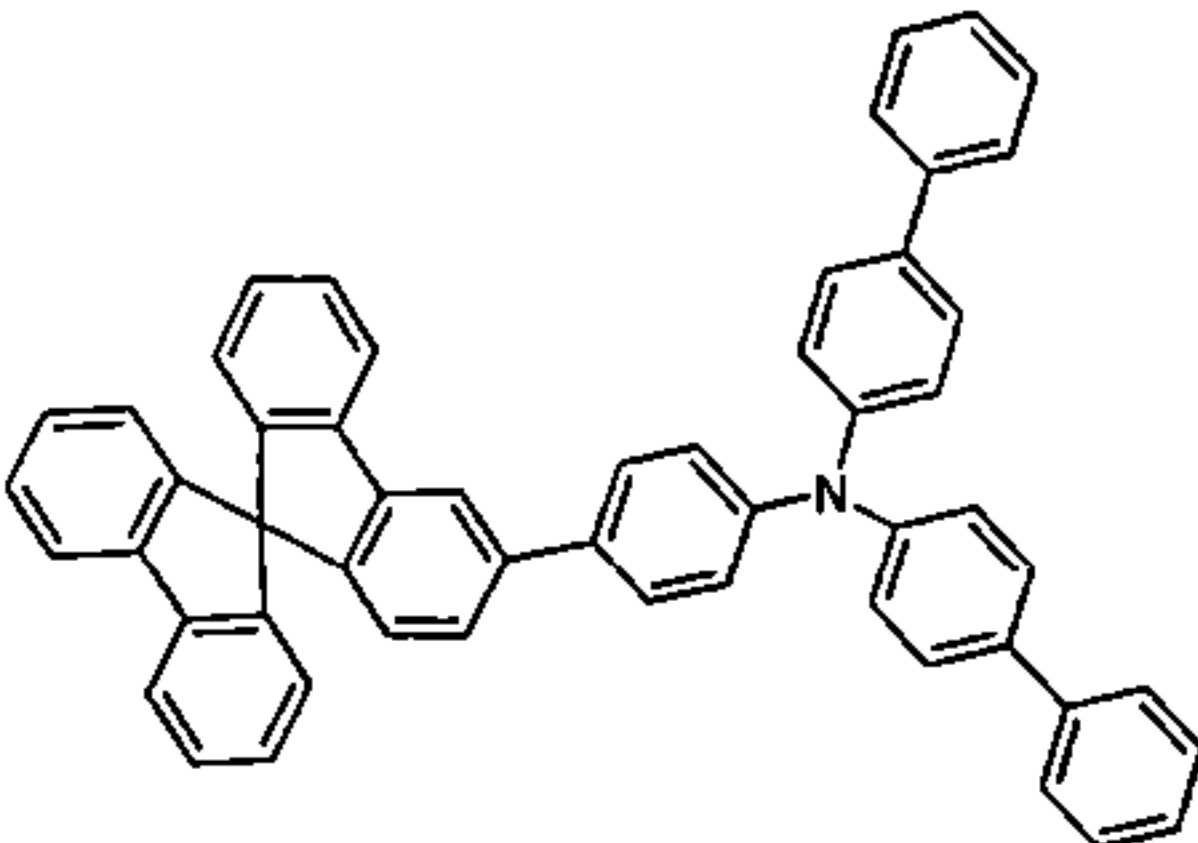
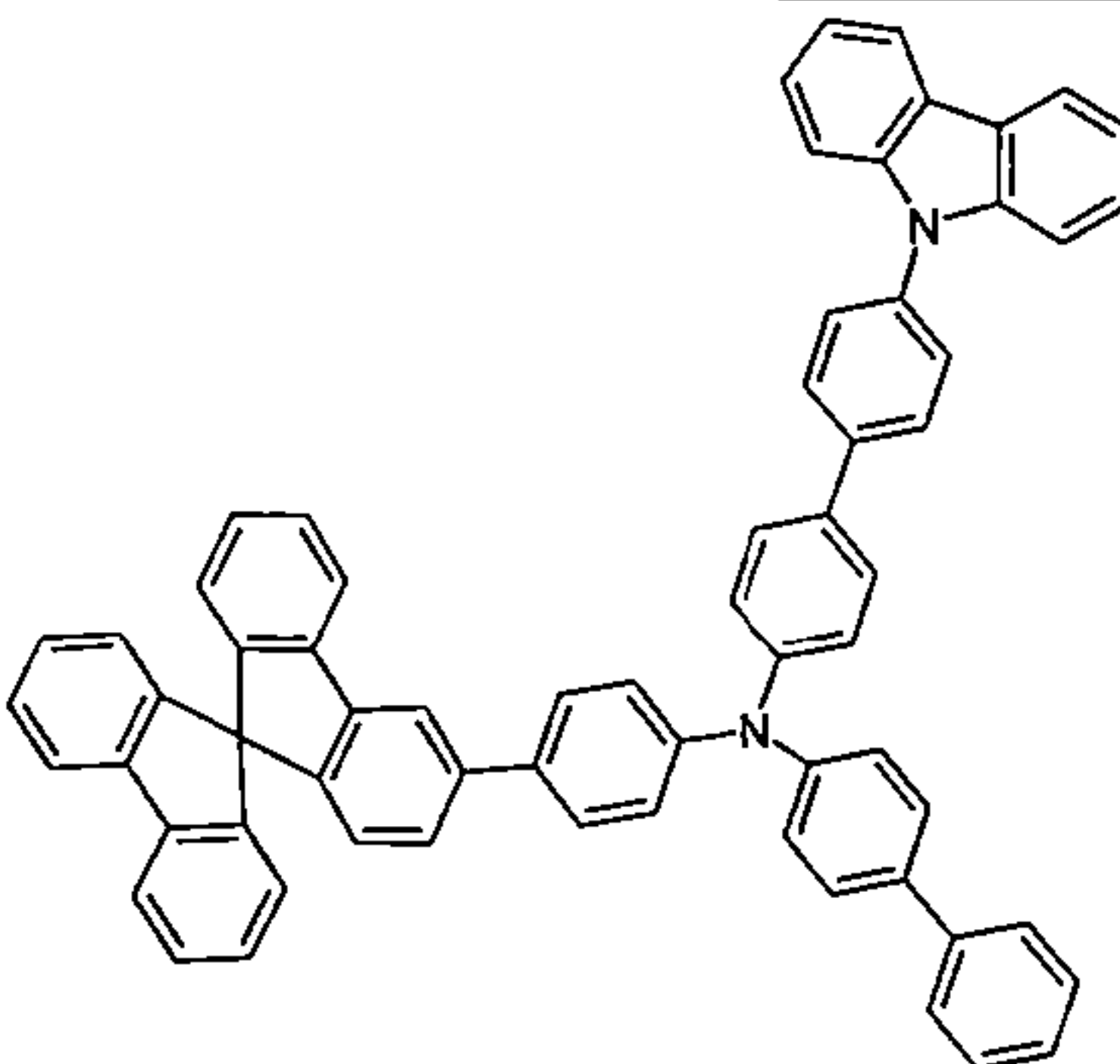
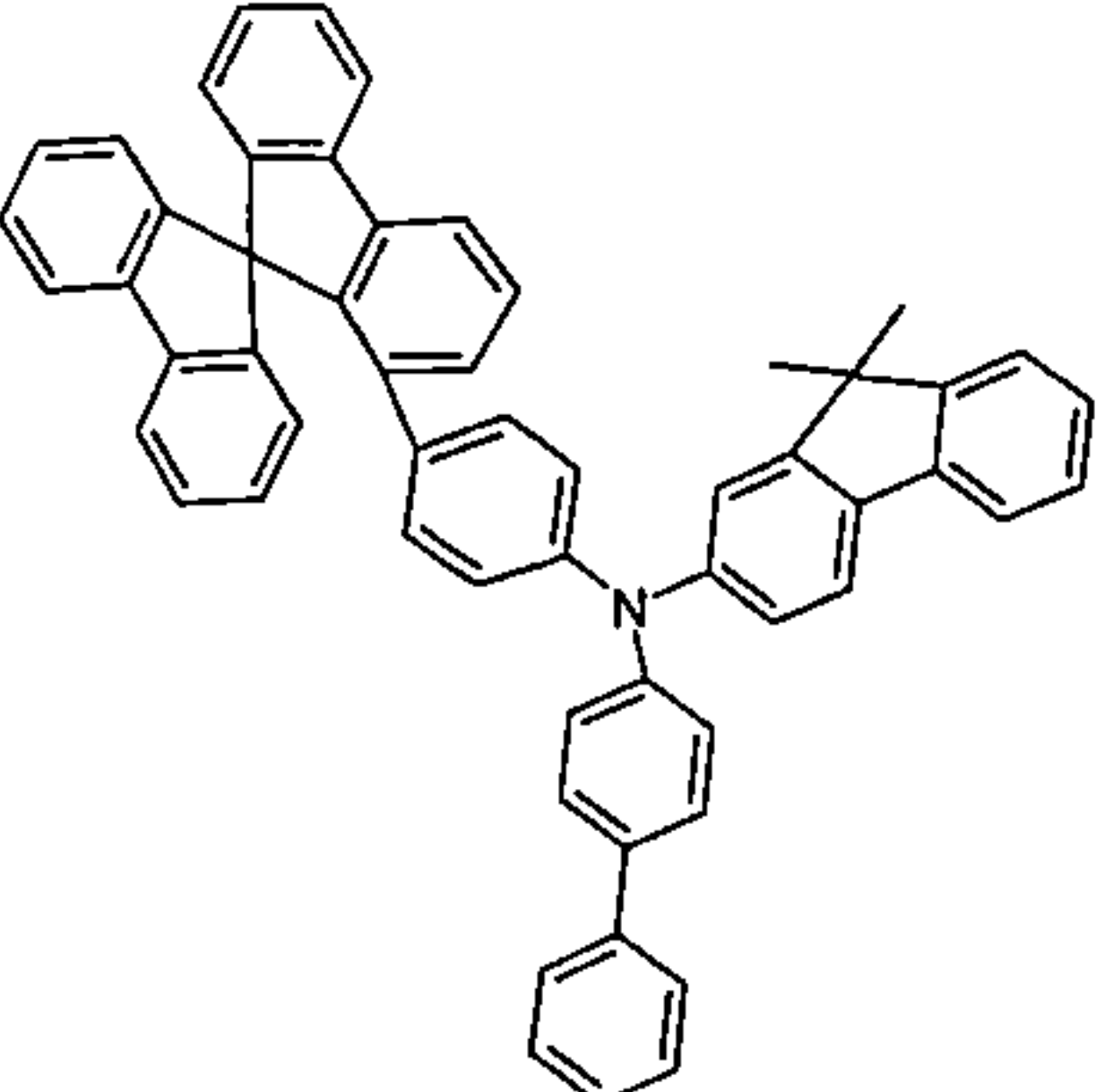
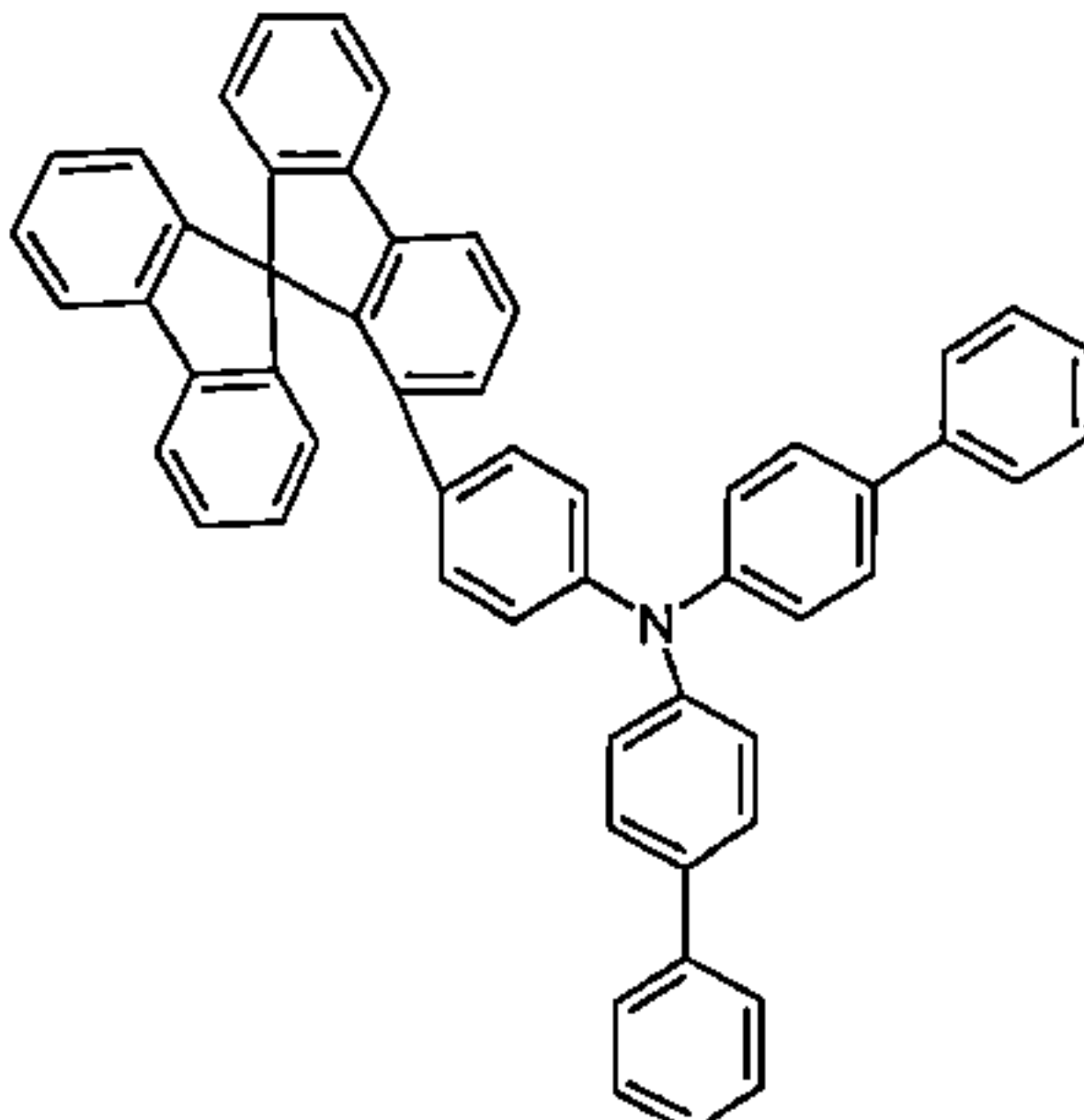
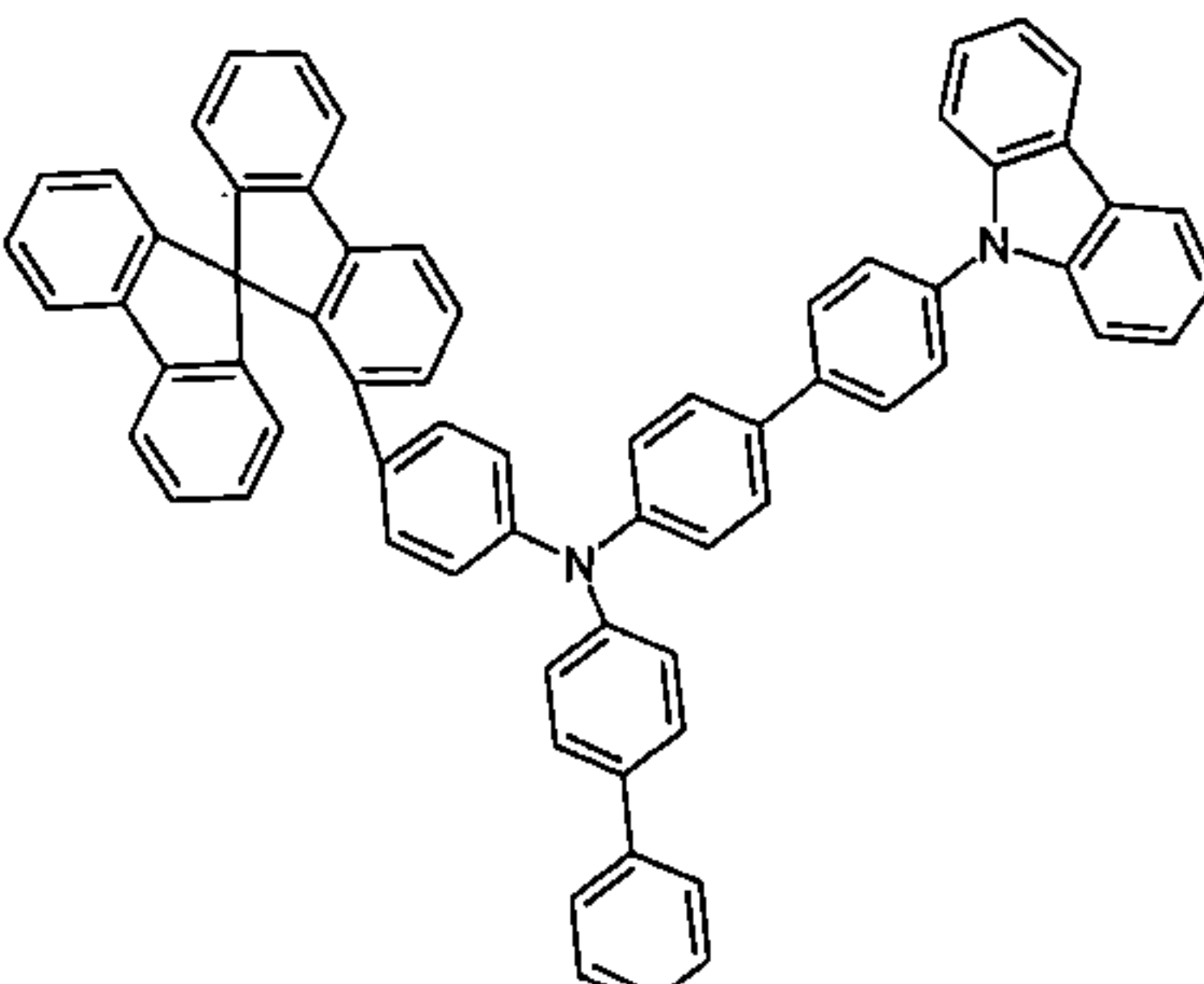
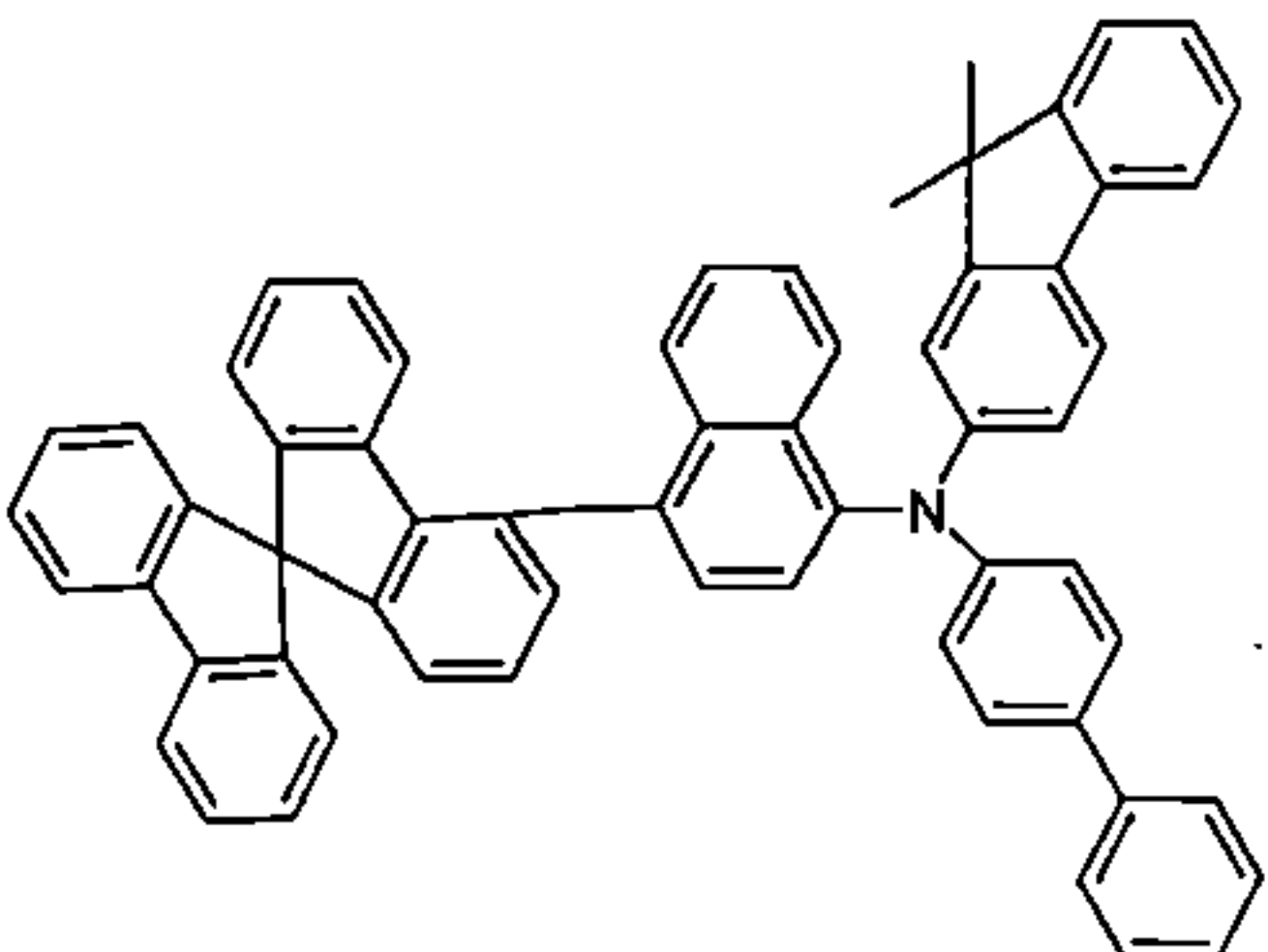
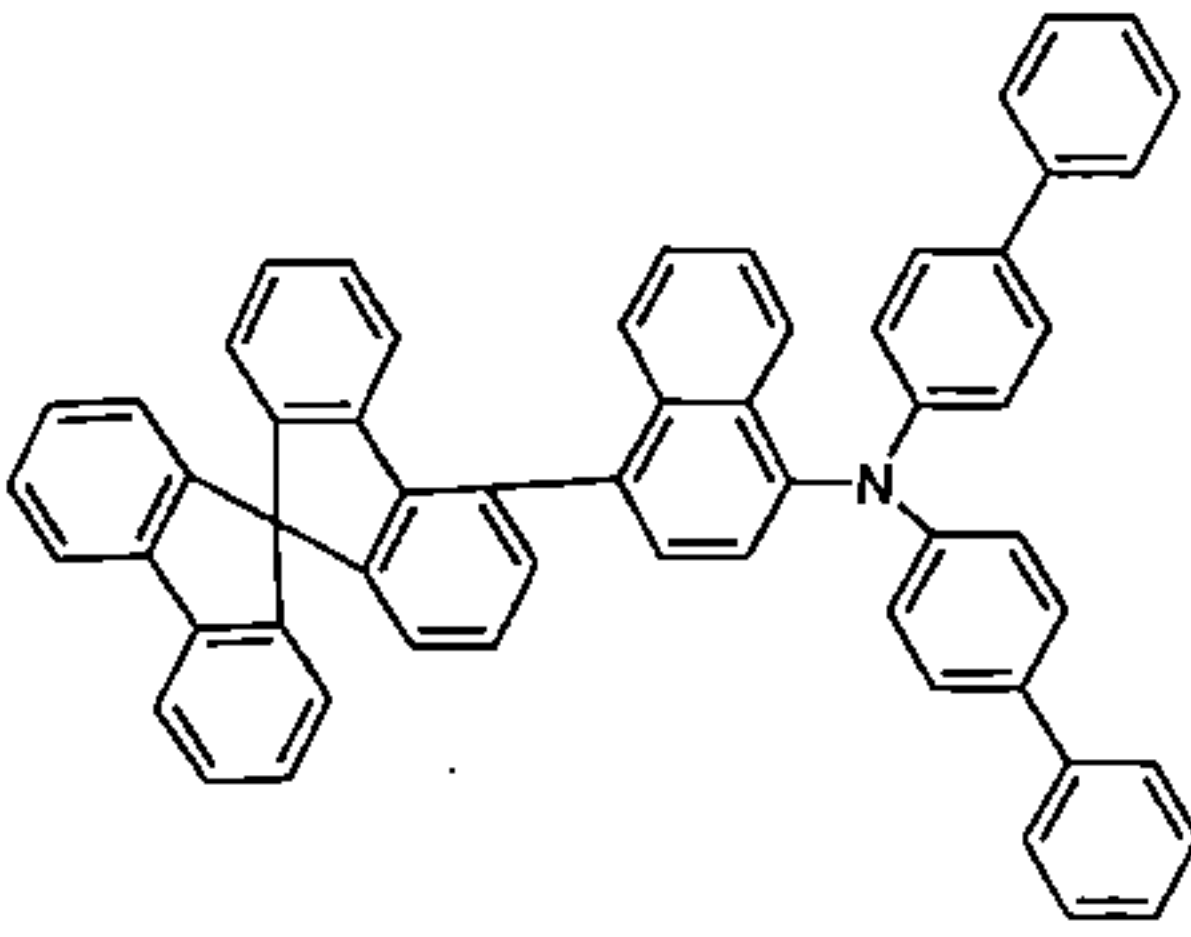
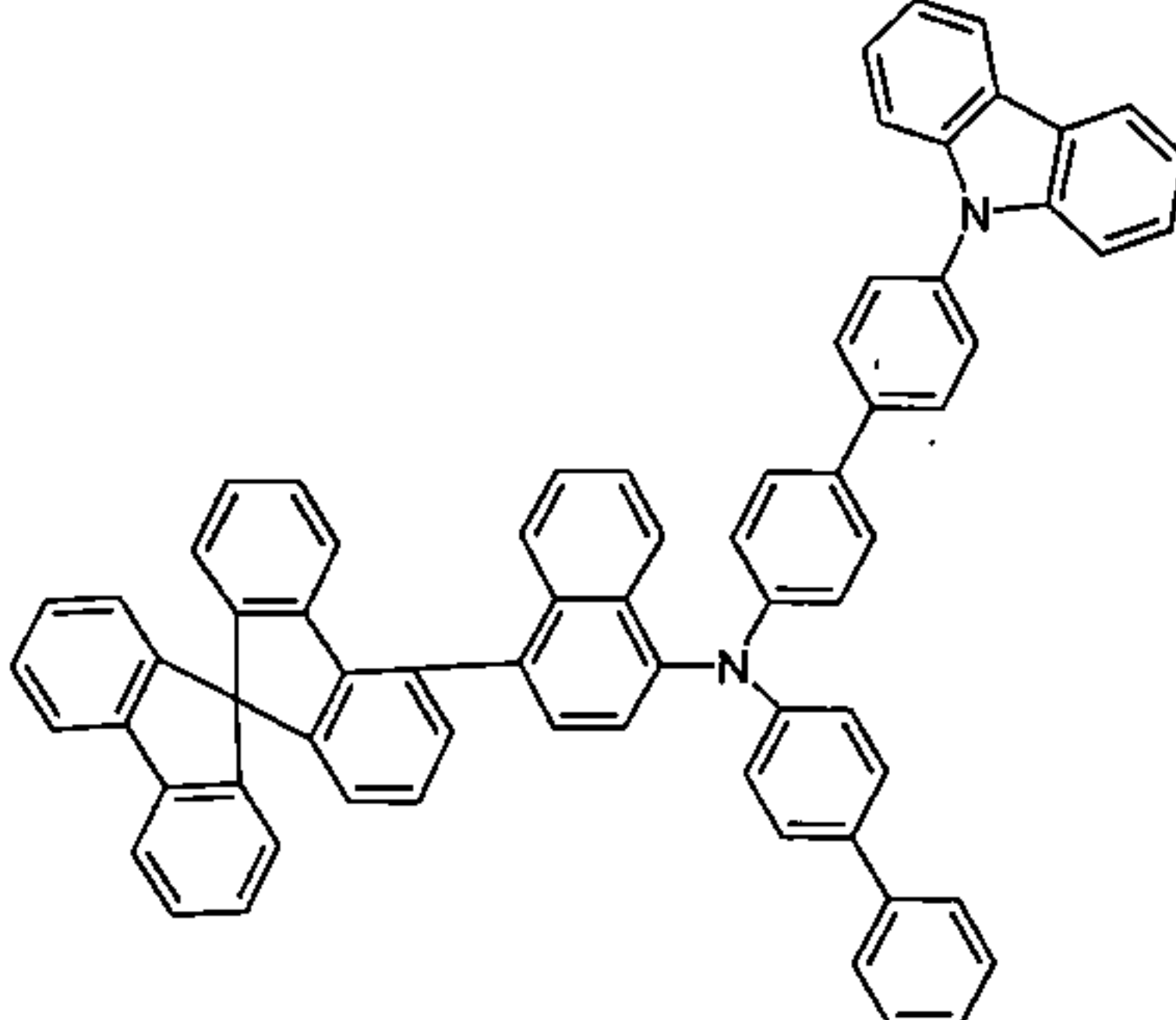
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(8a-2-1)	(8a)	1	(11)	(11)
(8a-2-2)	(8a)	1	(11)	(13)
(8a-2-3)	(8a)	1	(11)	(20)
(8a-2-4)	(8a)	1	(11)	(29)
(8a-2-5)	(8a)	1	(11)	(35)
(8a-2-6)	(8a)	1	(11)	(38)
(8a-2-7)	(8a)	1	(11)	(39)
(8a-2-8)	(8a)	1	(11)	(49)
(8a-2-9)	(8a)	1	(11)	(51)
(8a-2-10)	(8a)	1	(11)	(59)
(8a-2-11)	(8a)	1	(13)	(13)
(8a-2-12)	(8a)	1	(13)	(20)
(8a-2-13)	(8a)	1	(13)	(29)
(8a-2-14)	(8a)	1	(13)	(35)
(8a-2-15)	(8a)	1	(13)	(38)
(8a-2-16)	(8a)	1	(13)	(39)
(8a-2-17)	(8a)	1	(13)	(49)
(8a-2-18)	(8a)	1	(13)	(51)
(8a-2-19)	(8a)	1	(13)	(59)
(8a-2-20)	(8a)	1	(20)	(20)
(8a-2-21)	(8a)	1	(20)	(29)
(8a-2-22)	(8a)	1	(20)	(35)
(8a-2-23)	(8a)	1	(20)	(38)
(8a-2-24)	(8a)	1	(20)	(39)
(8a-2-25)	(8a)	1	(20)	(49)
(8a-2-26)	(8a)	1	(20)	(51)
(8a-2-27)	(8a)	1	(20)	(59)
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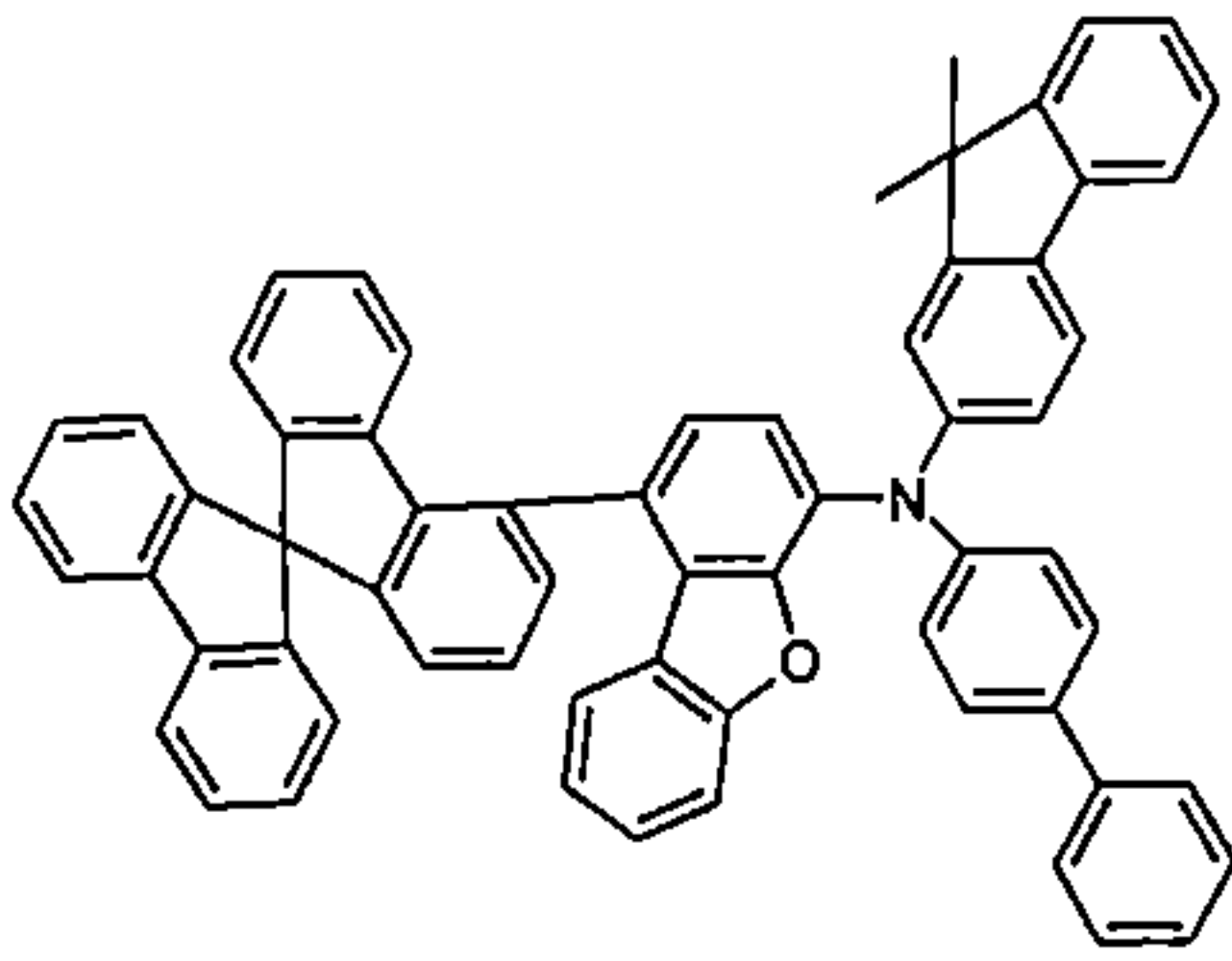
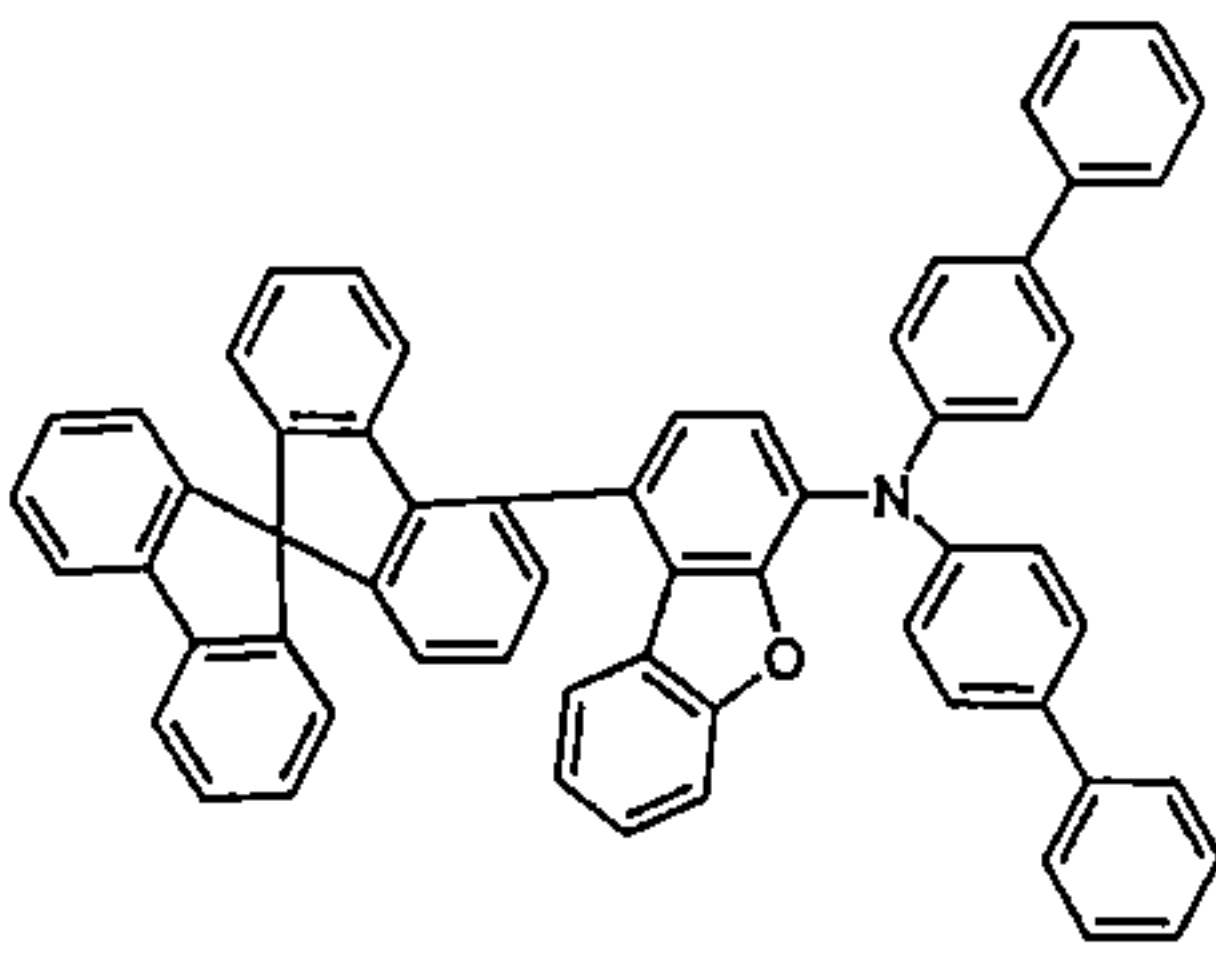
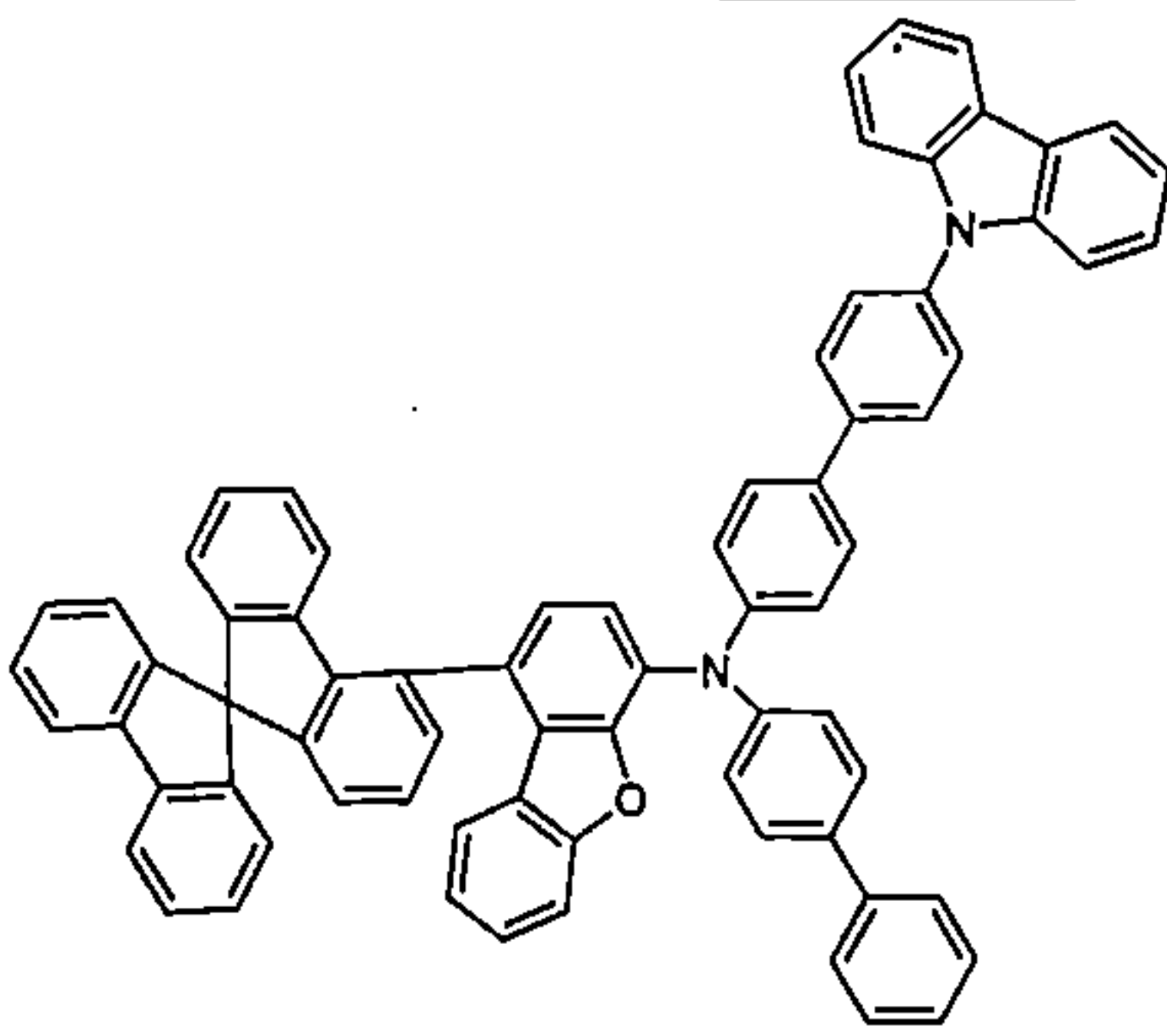
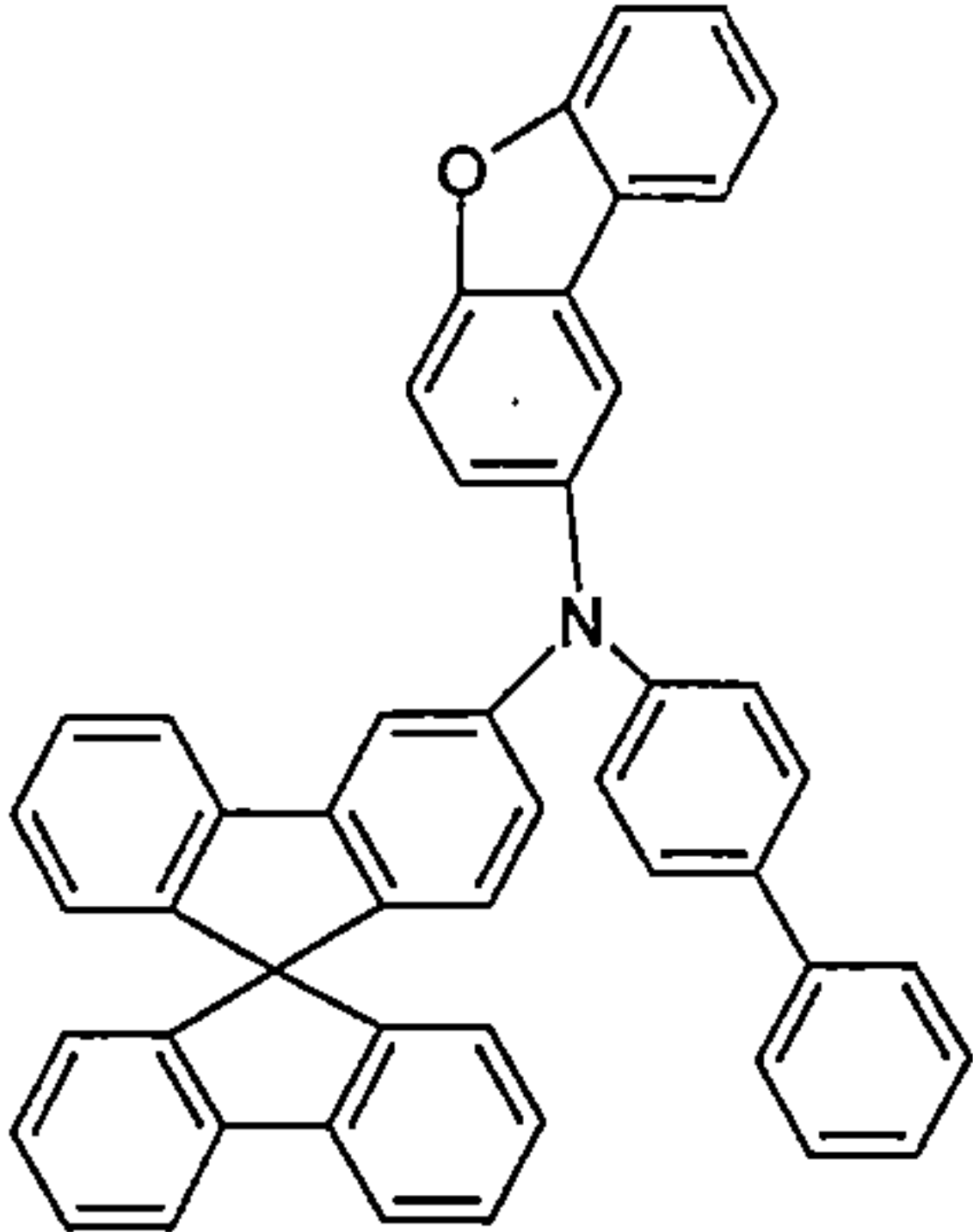
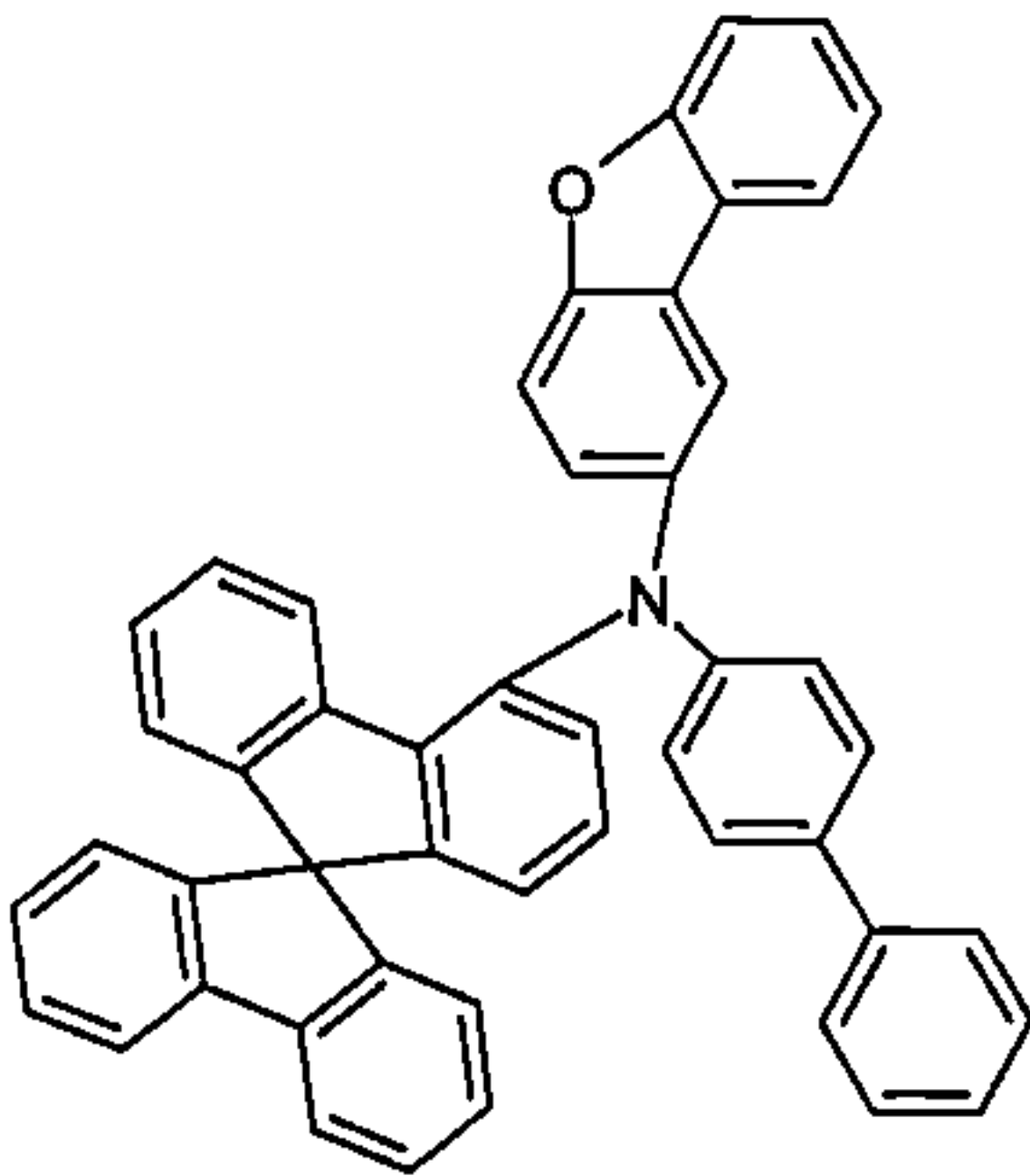
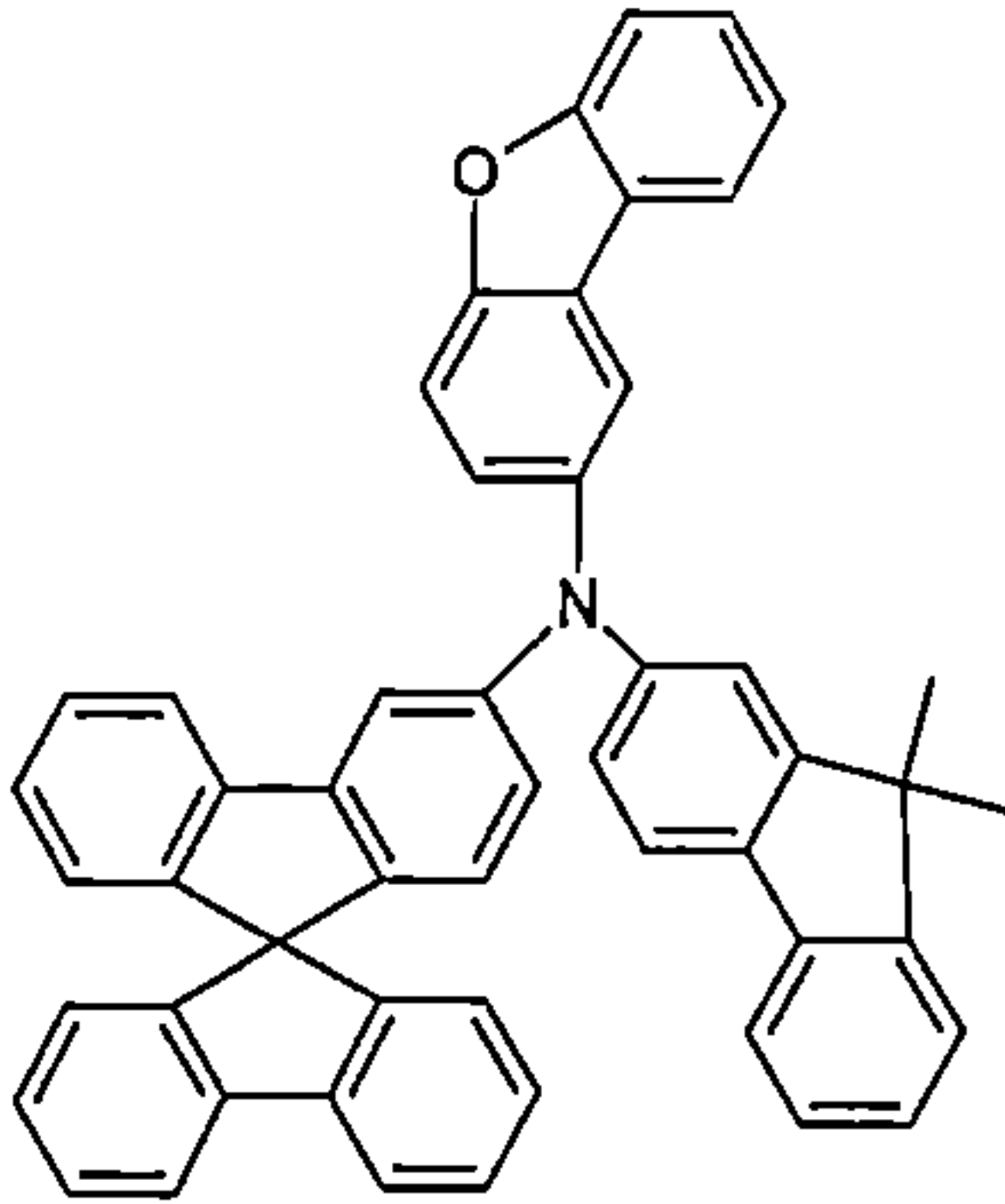
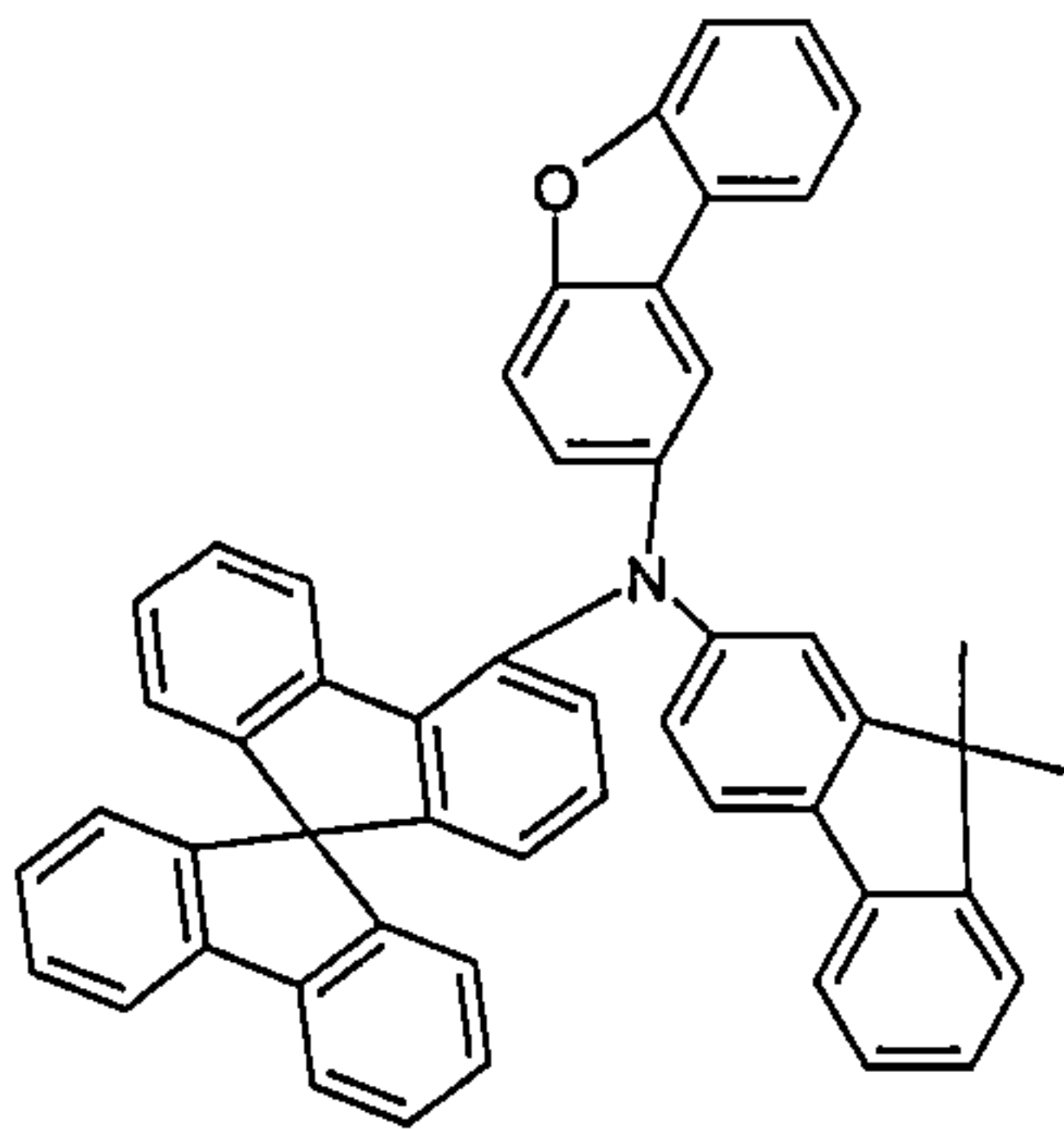
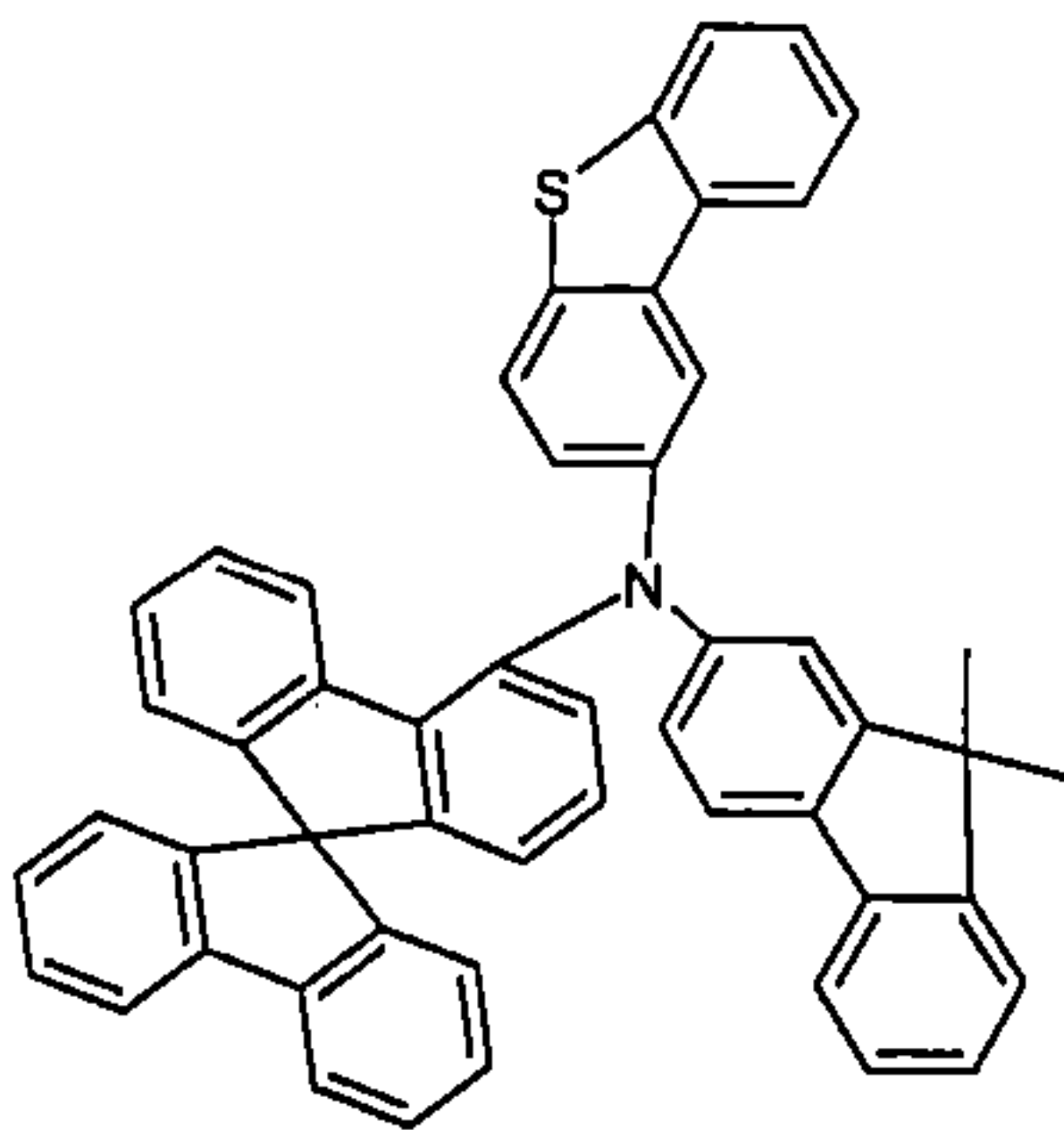
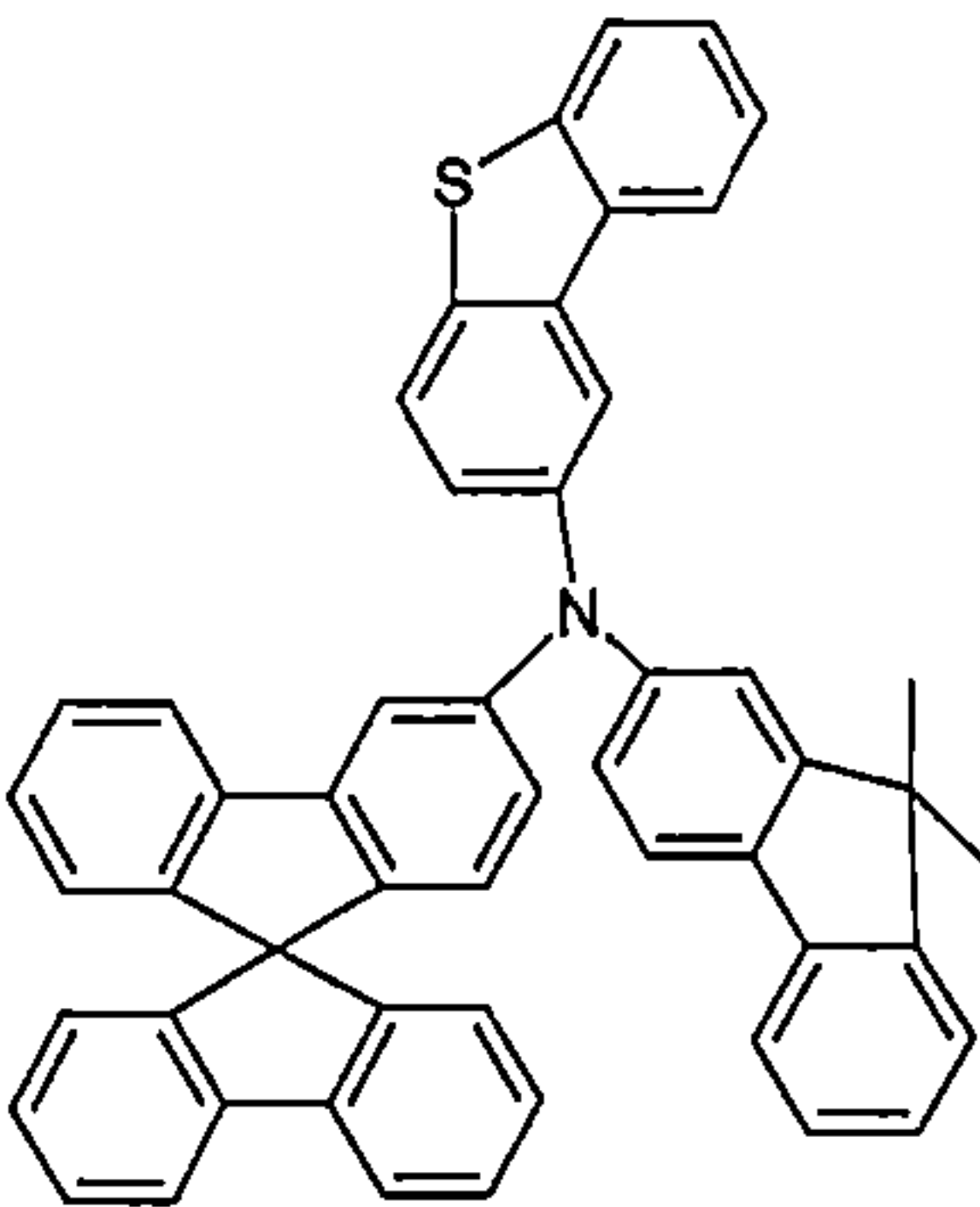
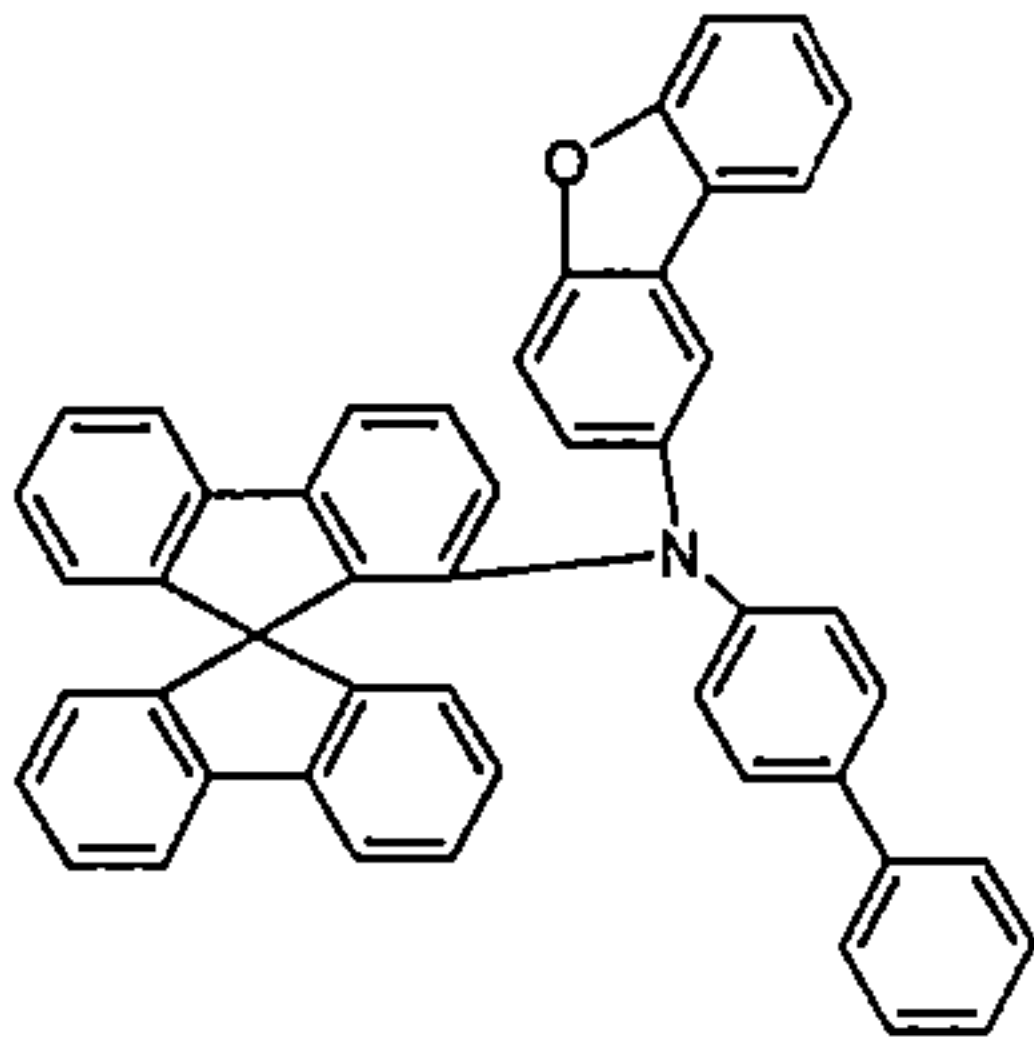
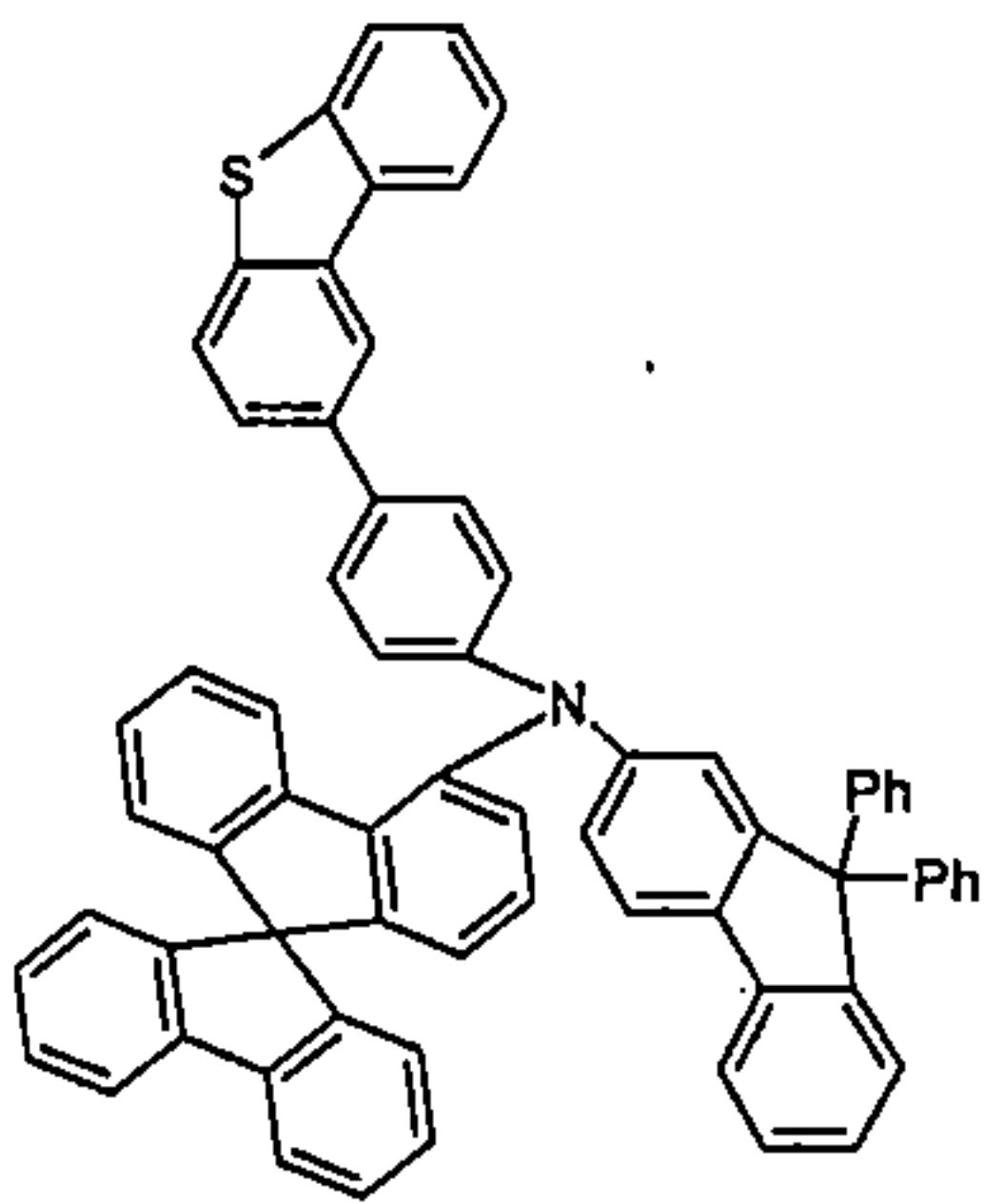
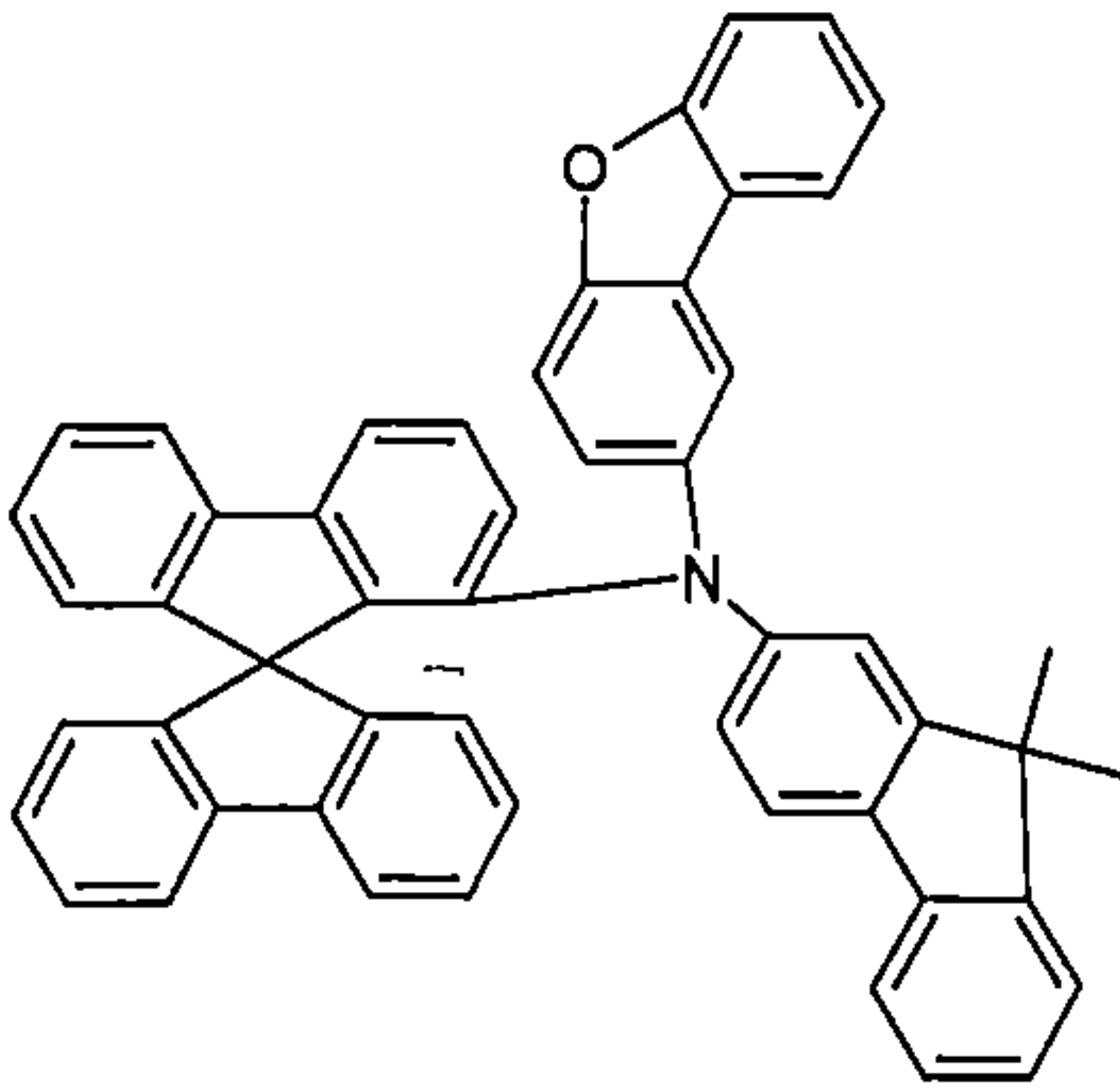
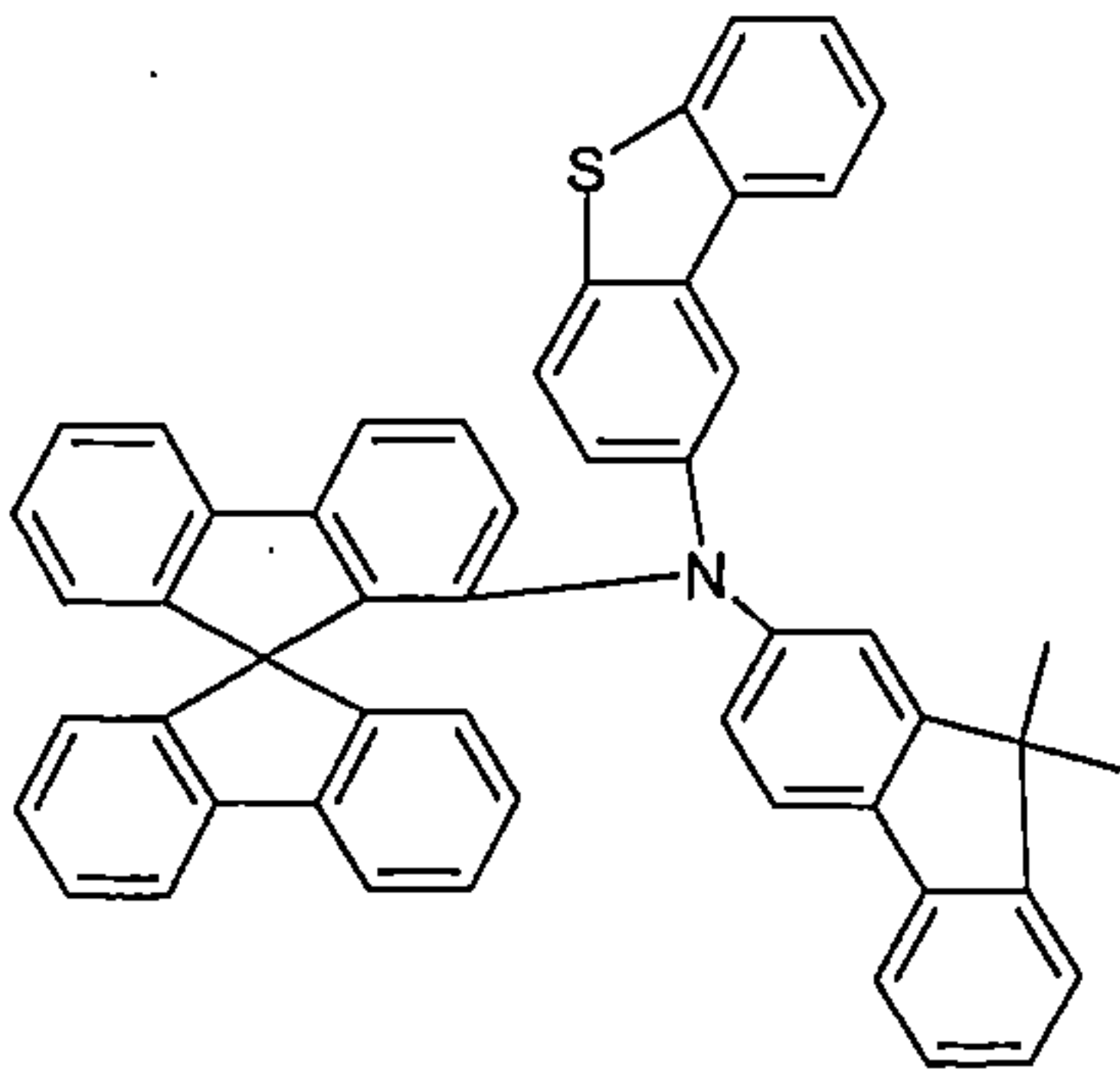
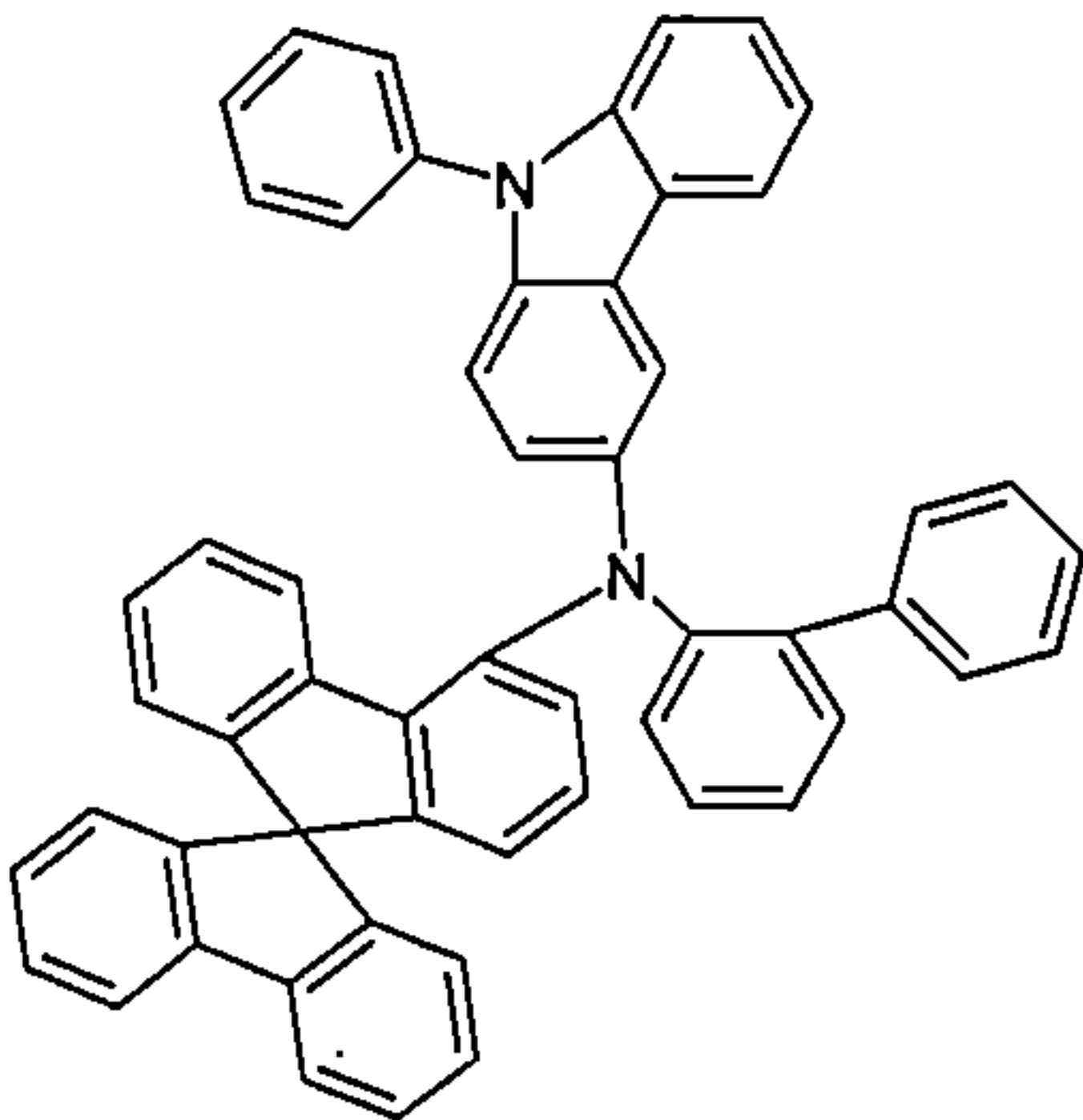
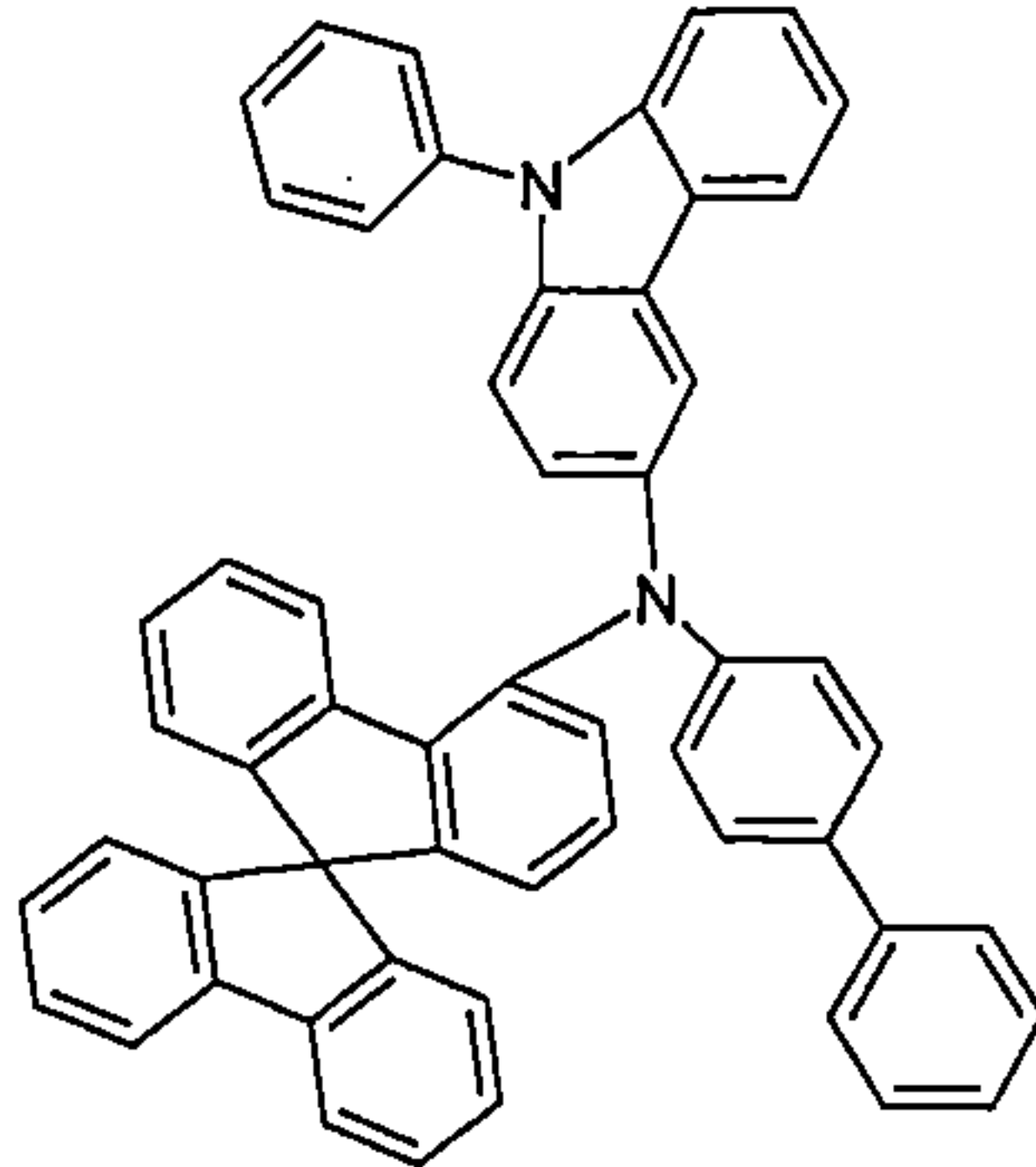
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(8a-2-33)	(8a)	1	(29)	(51)
(8a-2-34)	(8a)	1	(29)	(59)
(8a-2-35)	(8a)	1	(35)	(35)
(8a-2-36)	(8a)	1	(35)	(38)
(8a-2-37)	(8a)	1	(35)	(39)
(8a-2-38)	(8a)	1	(35)	(49)
(8a-2-39)	(8a)	1	(35)	(51)
(8a-2-40)	(8a)	1	(35)	(59)
(8a-2-41)	(8a)	1	(38)	(38)
(8a-2-42)	(8a)	1	(38)	(39)
(8a-2-43)	(8a)	1	(38)	(49)
(8a-2-44)	(8a)	1	(38)	(51)
(8a-2-45)	(8a)	1	(38)	(59)
(8a-2-46)	(8a)	1	(39)	(39)
(8a-2-47)	(8a)	1	(39)	(49)
(8a-2-48)	(8a)	1	(39)	(51)
(8a-2-49)	(8a)	1	(39)	(59)
(8a-2-50)	(8a)	1	(49)	(49)
(8a-2-51)	(8a)	1	(49)	(51)
(8a-2-52)	(8a)	1	(49)	(59)
(8a-2-53)	(8a)	1	(51)	(51)
(8a-2-54)	(8a)	1	(51)	(59)
(8a-2-55)	(8a)	1	(59)	(59)

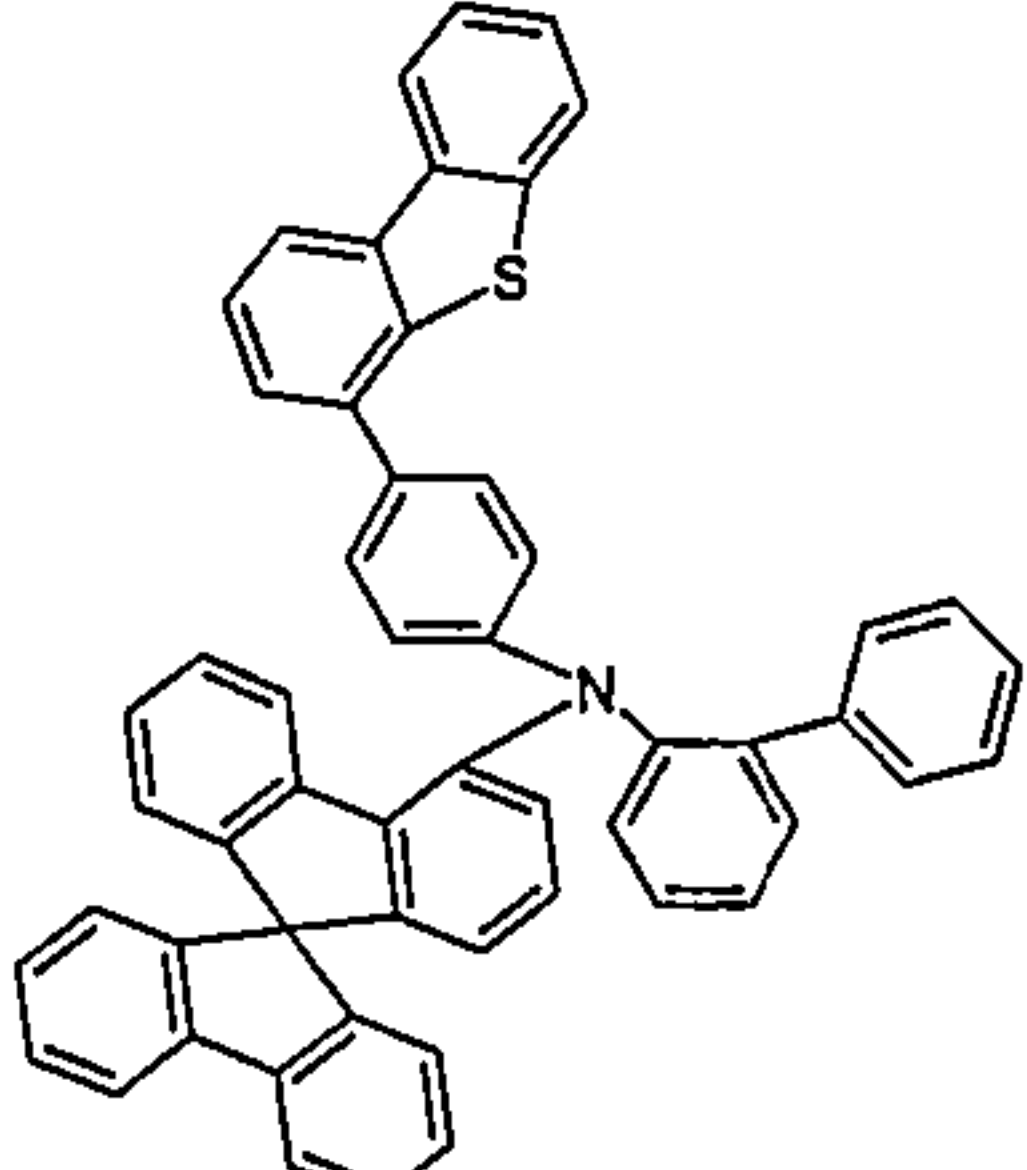
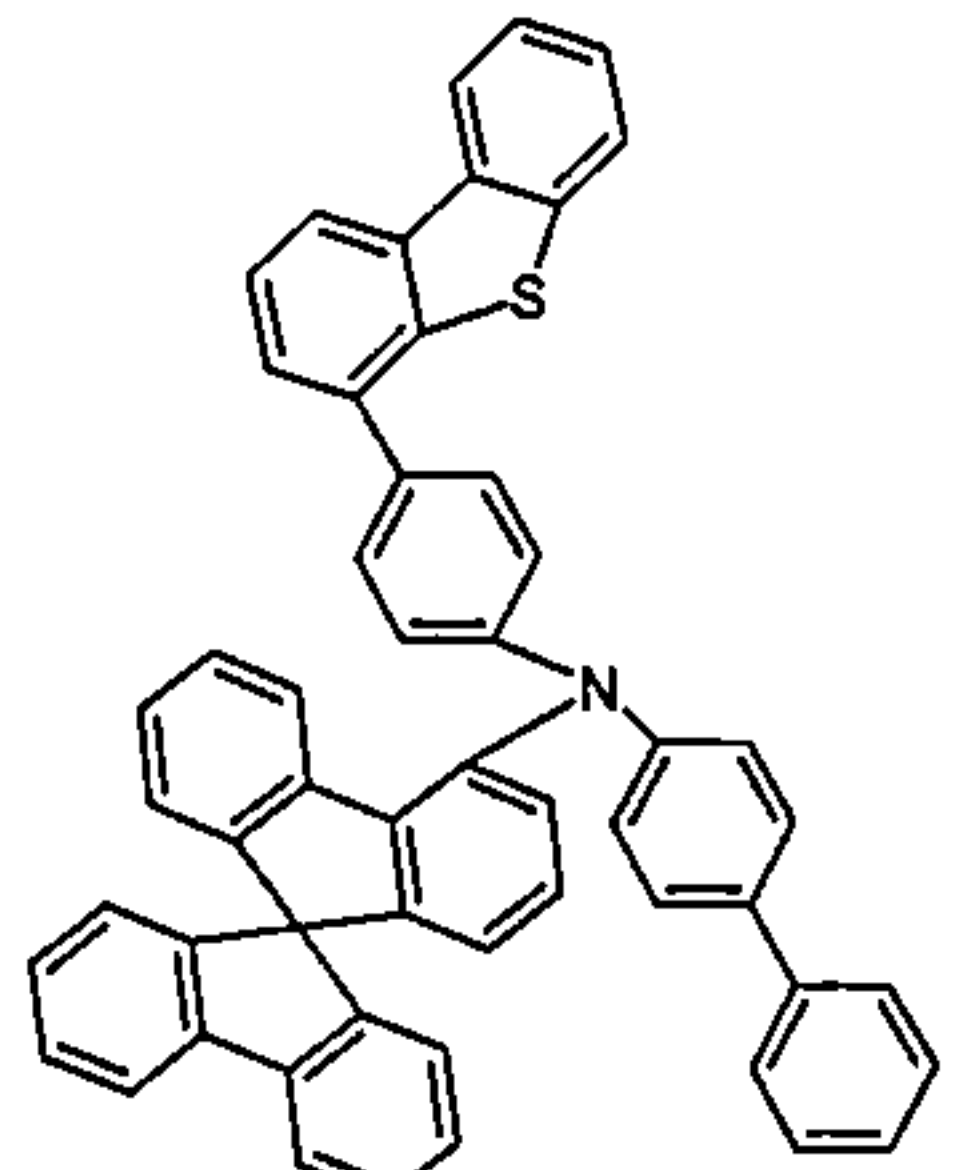
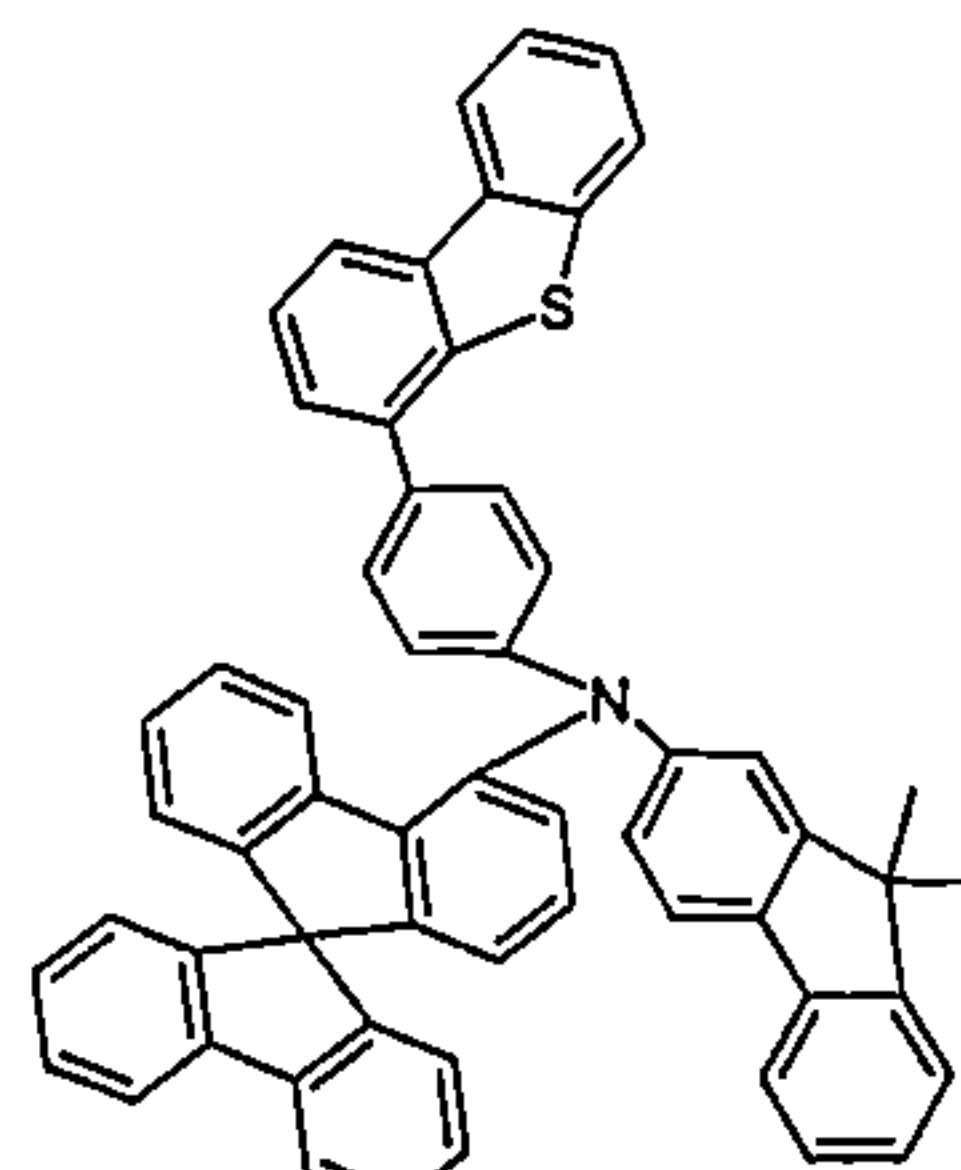
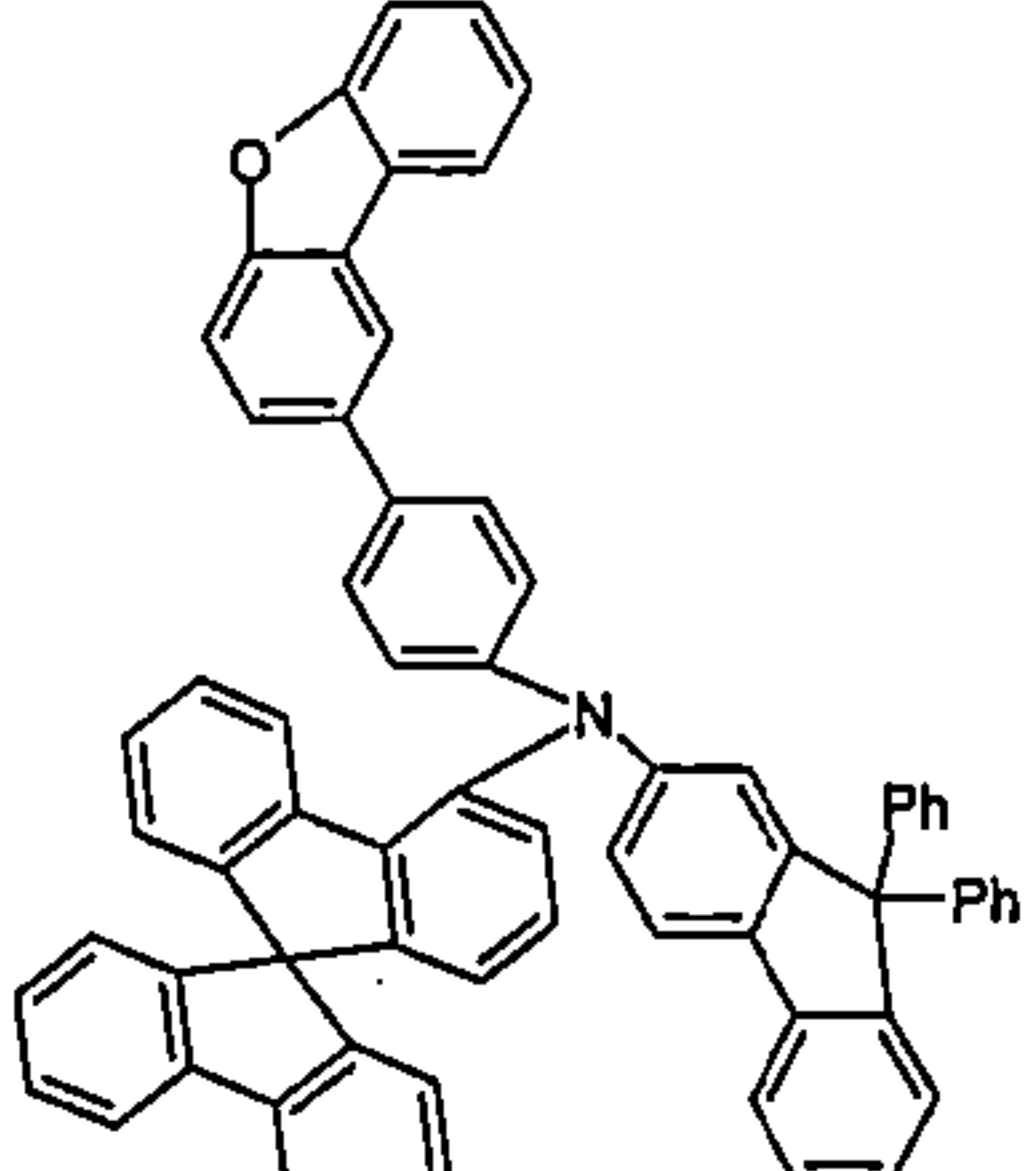
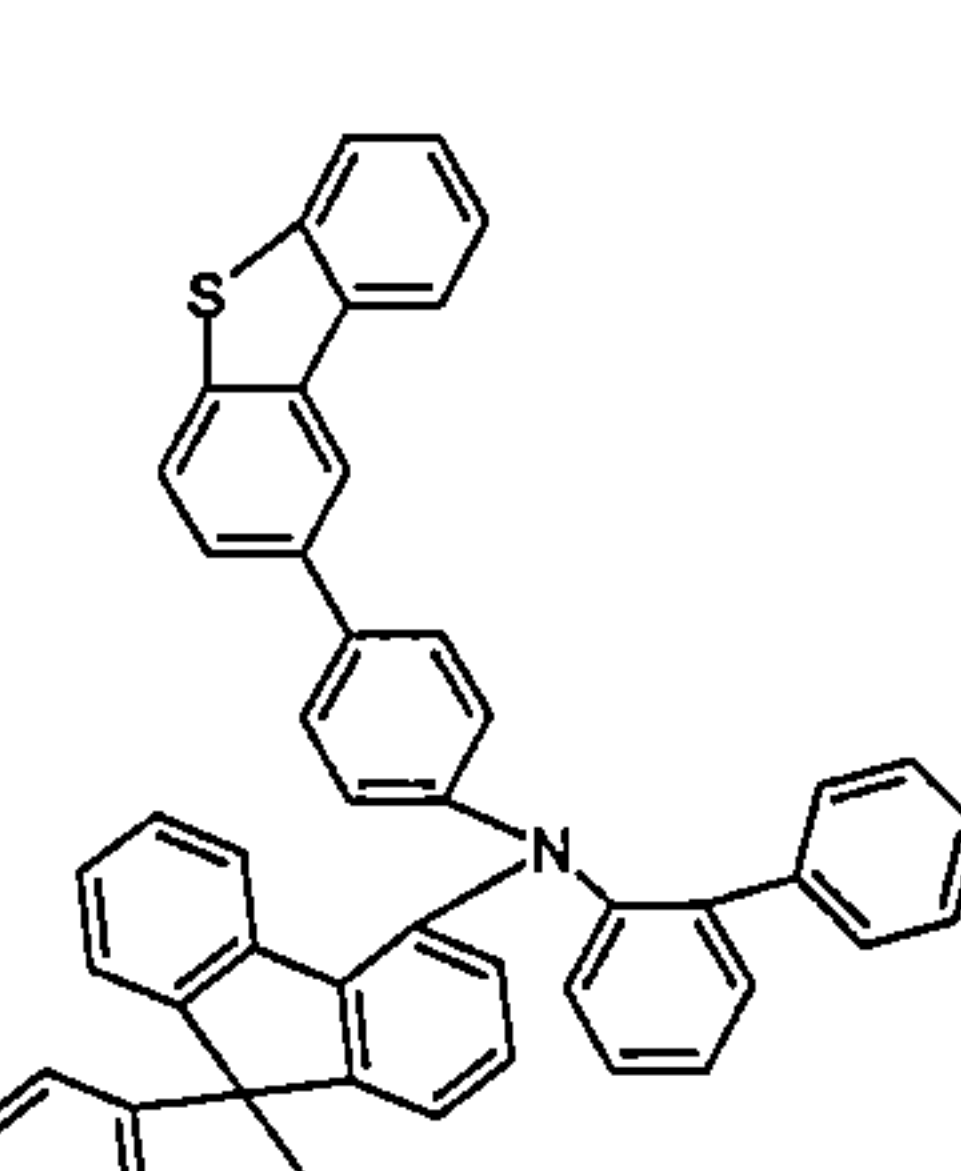
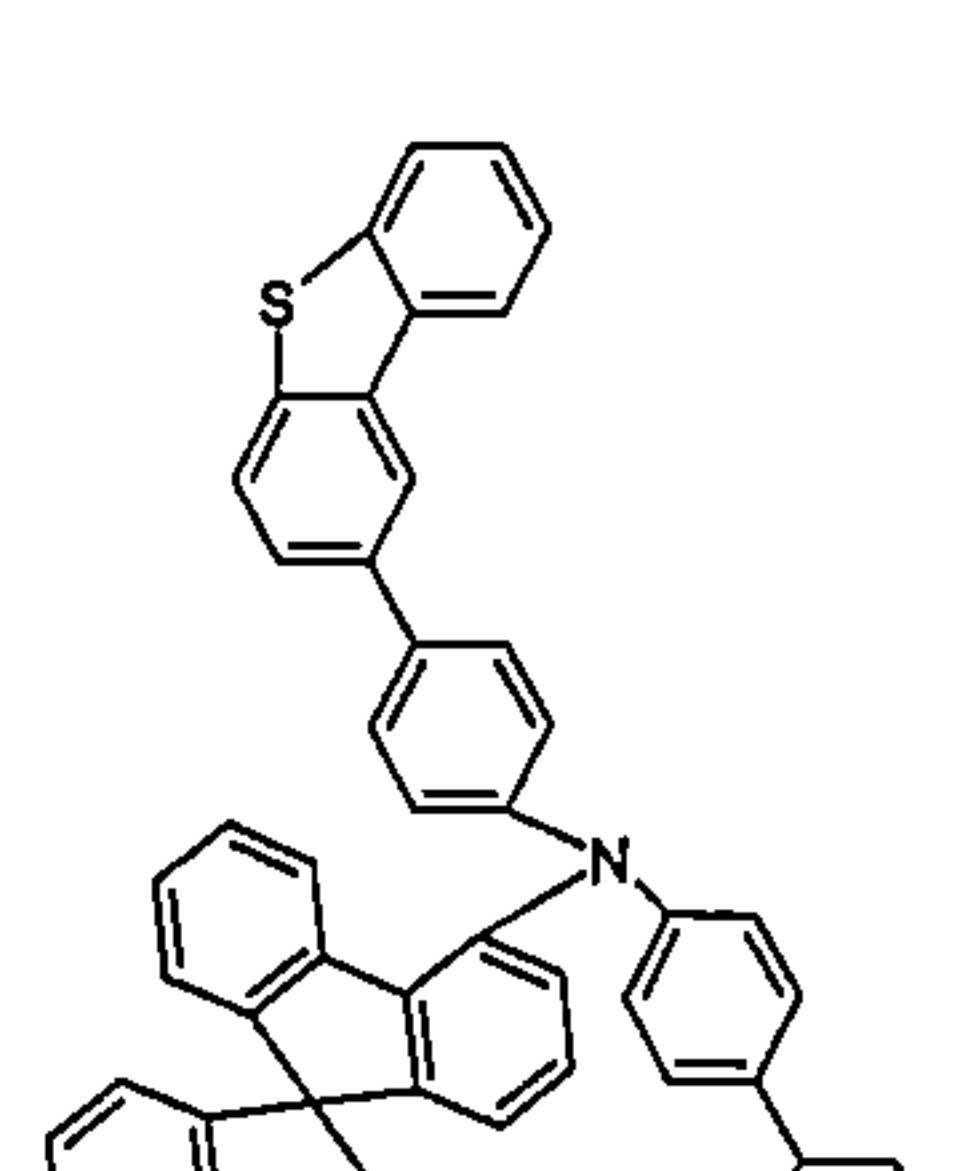
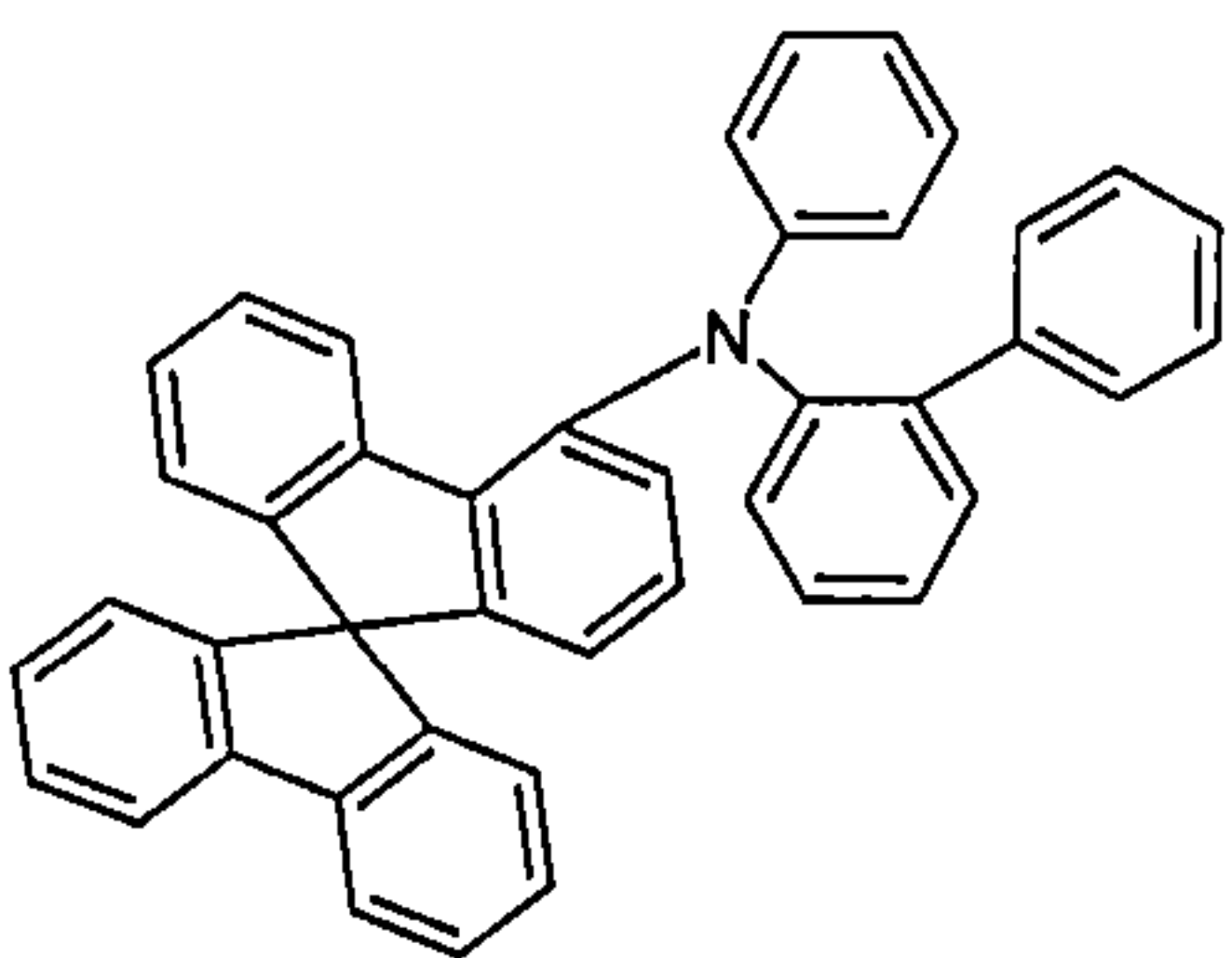
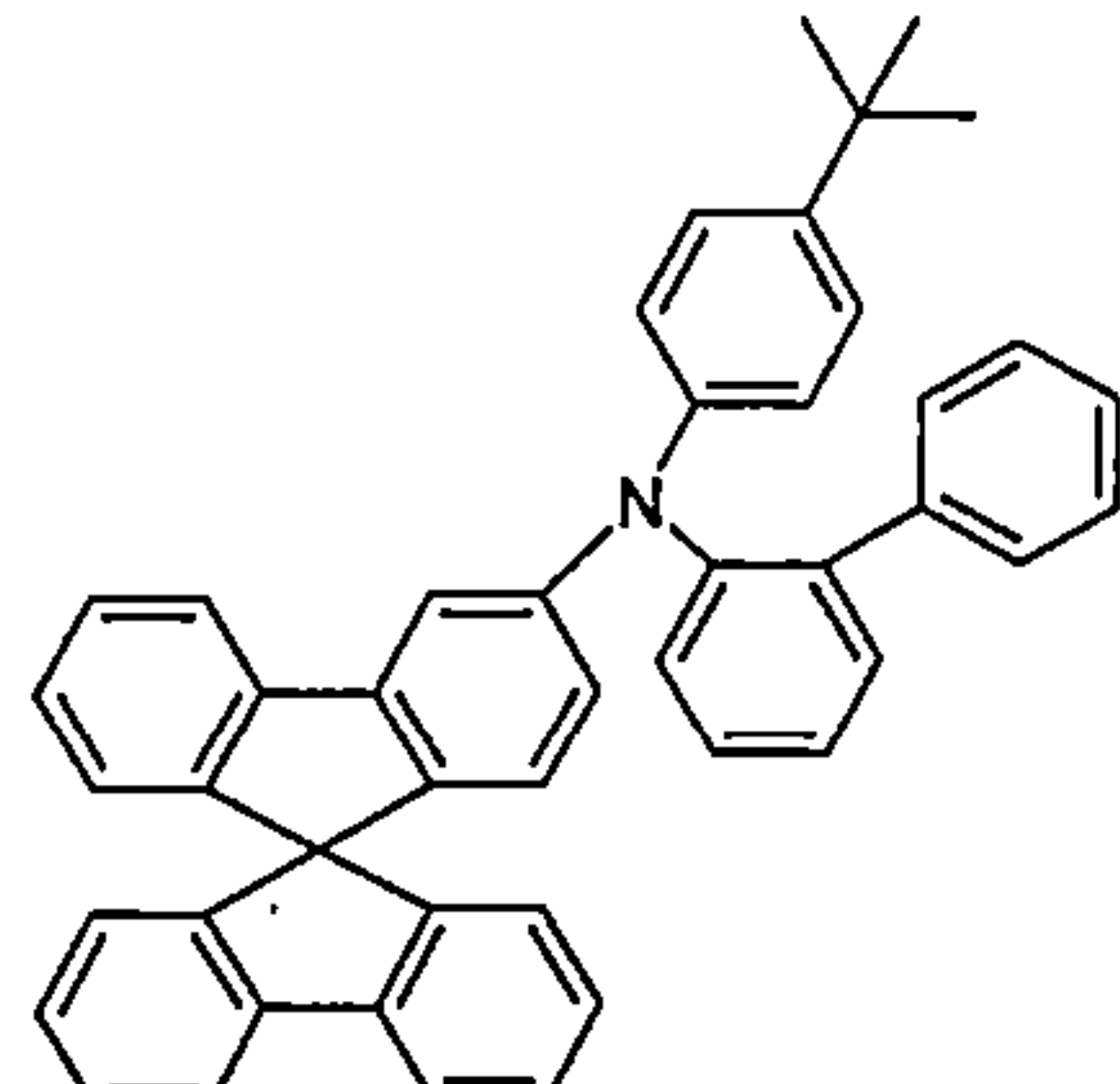
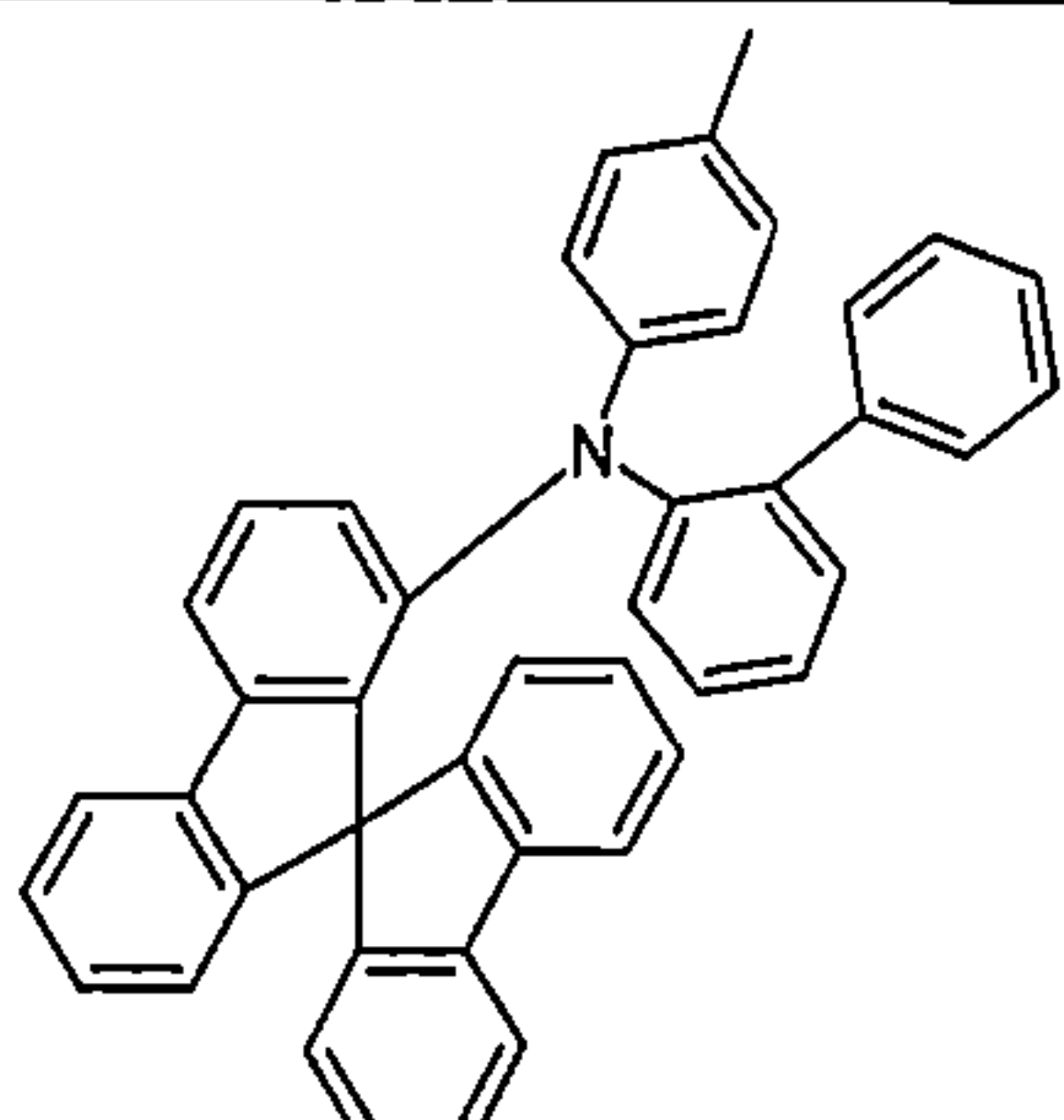
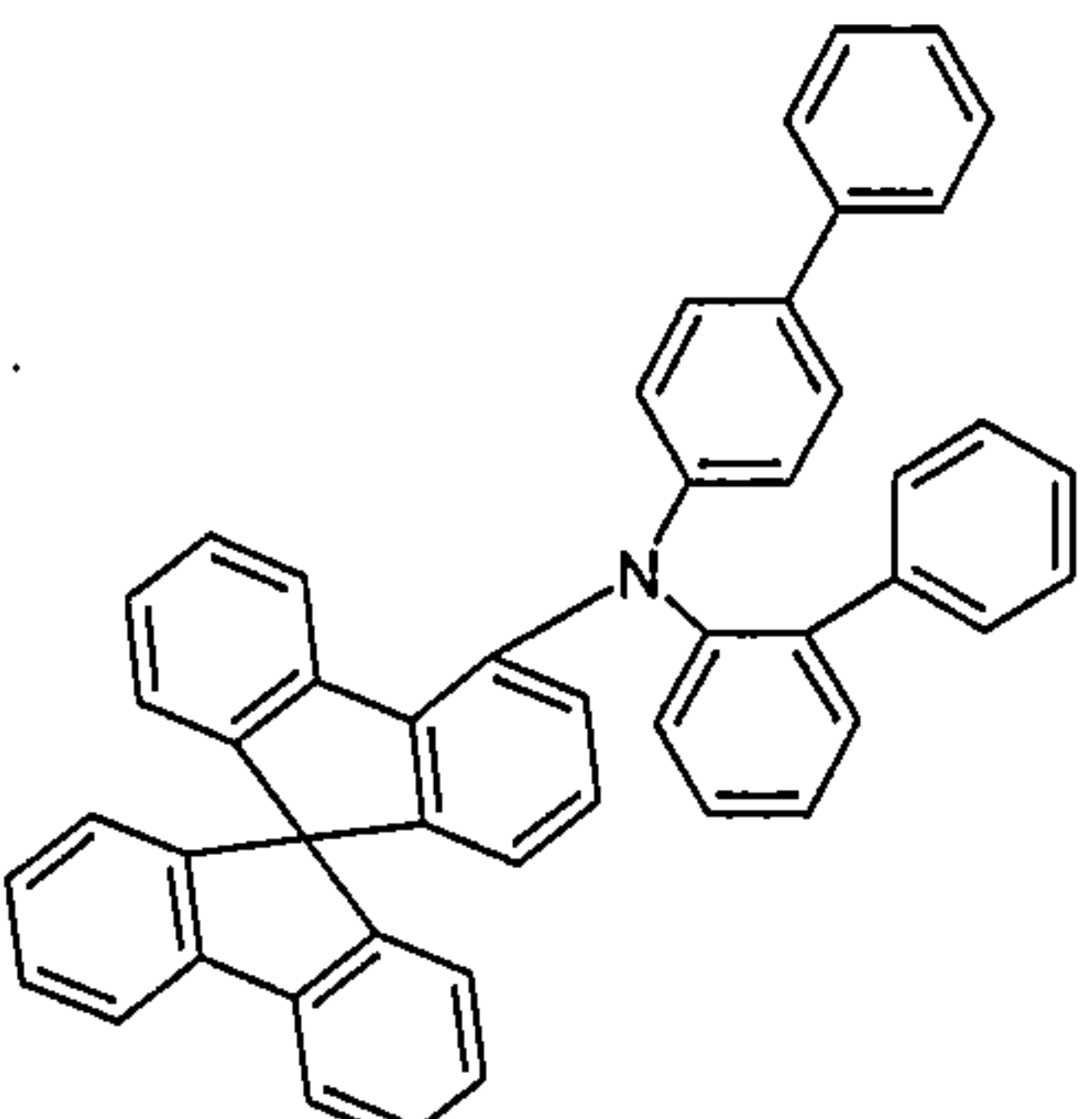
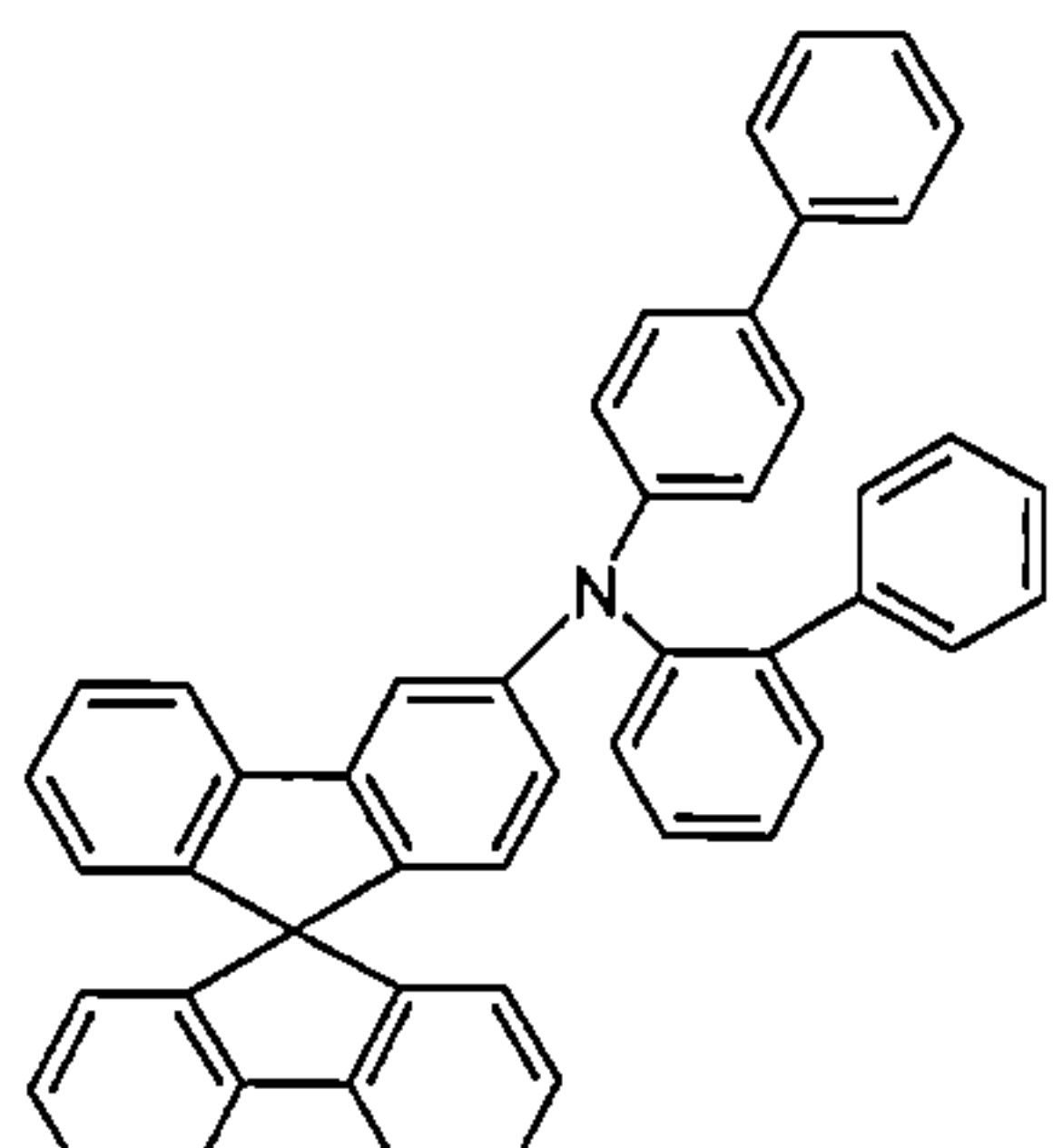
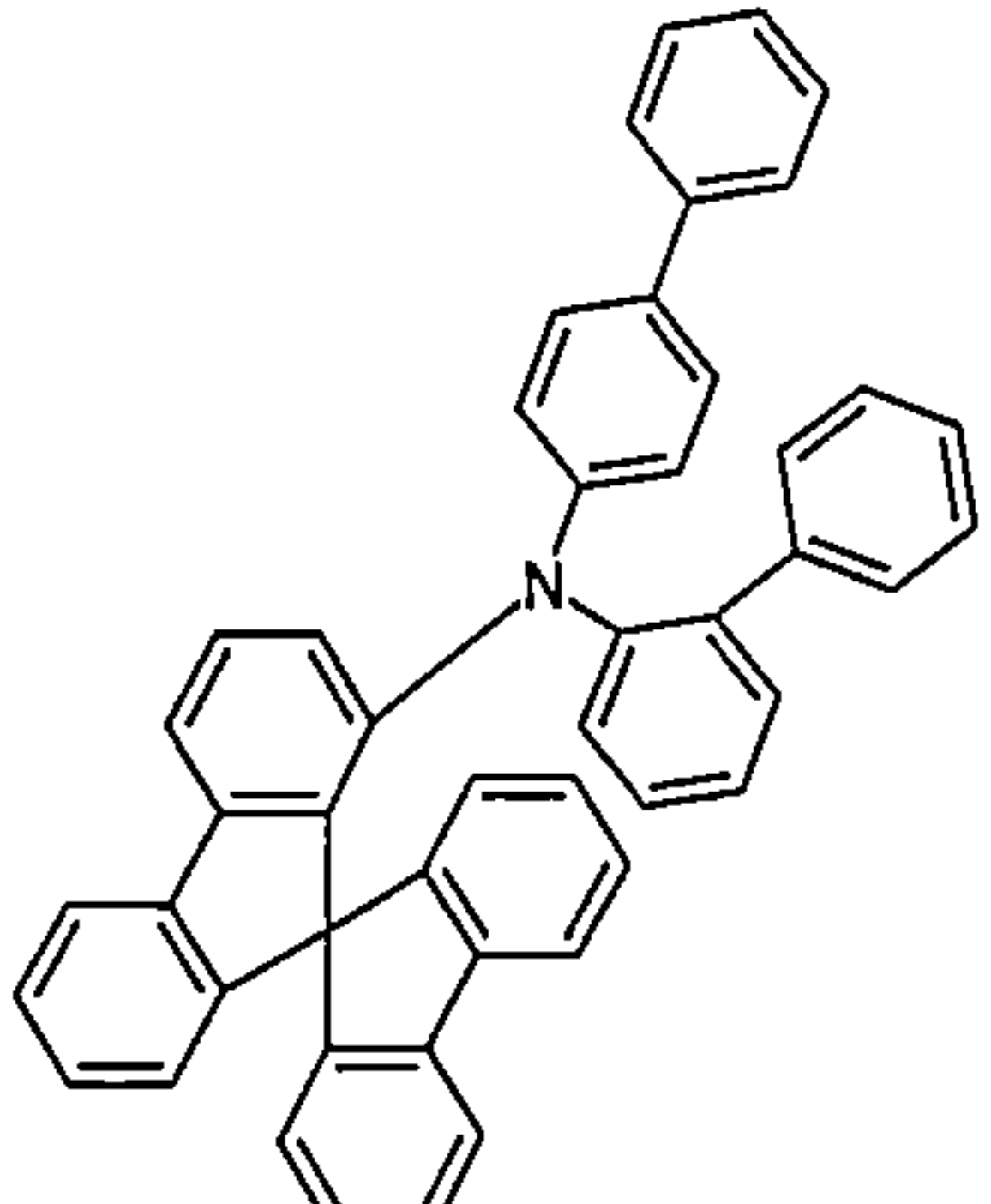
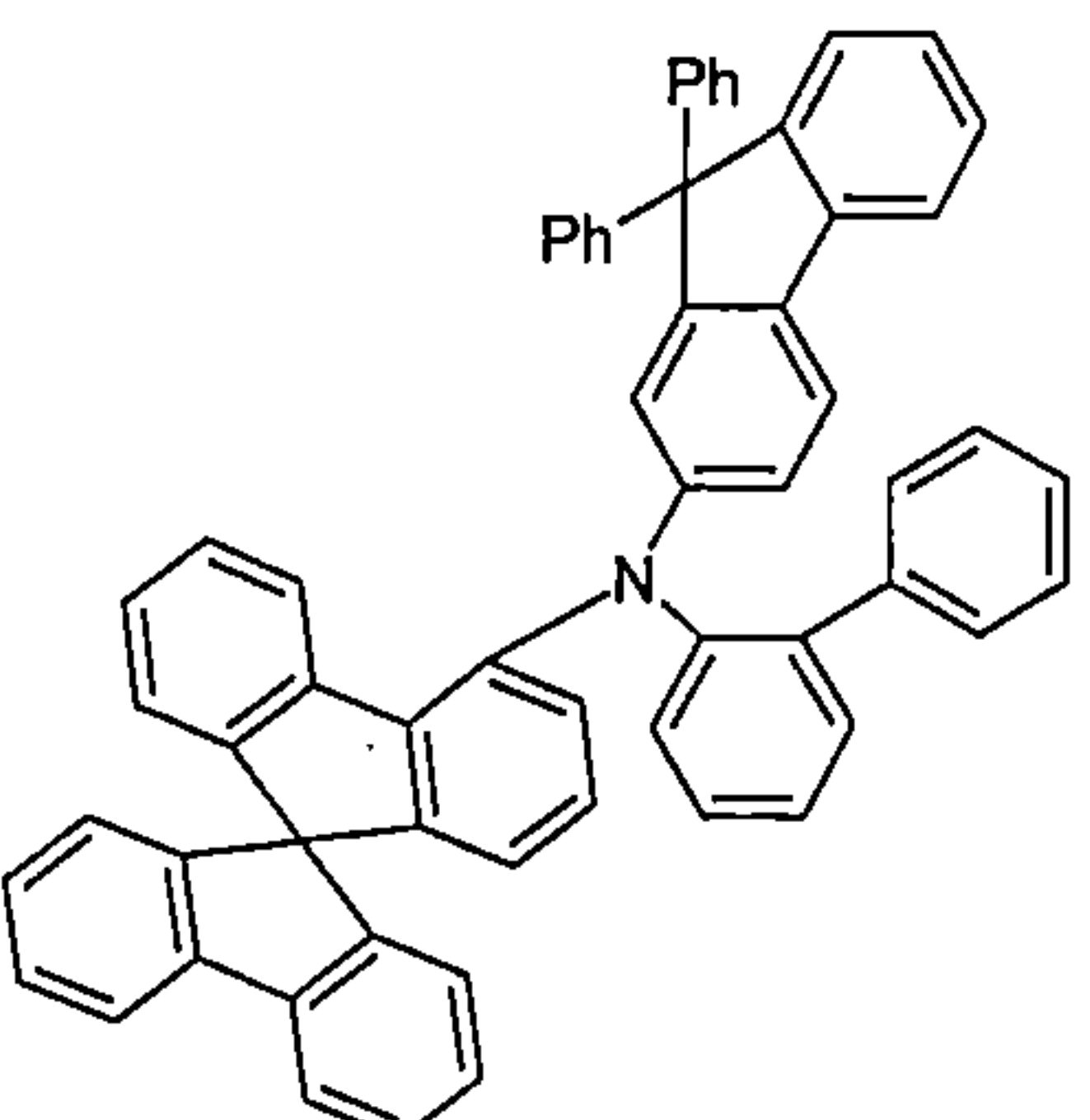
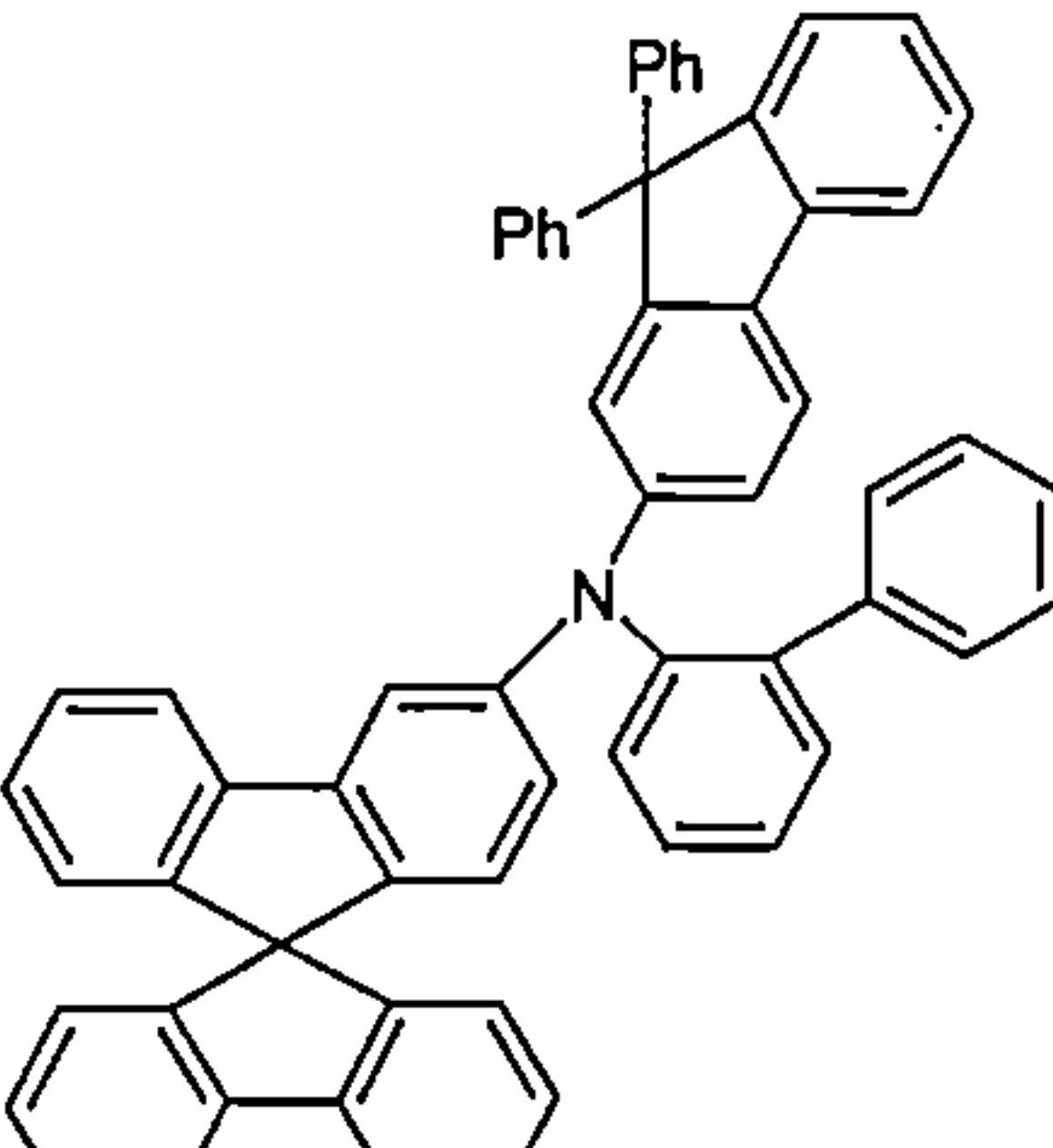
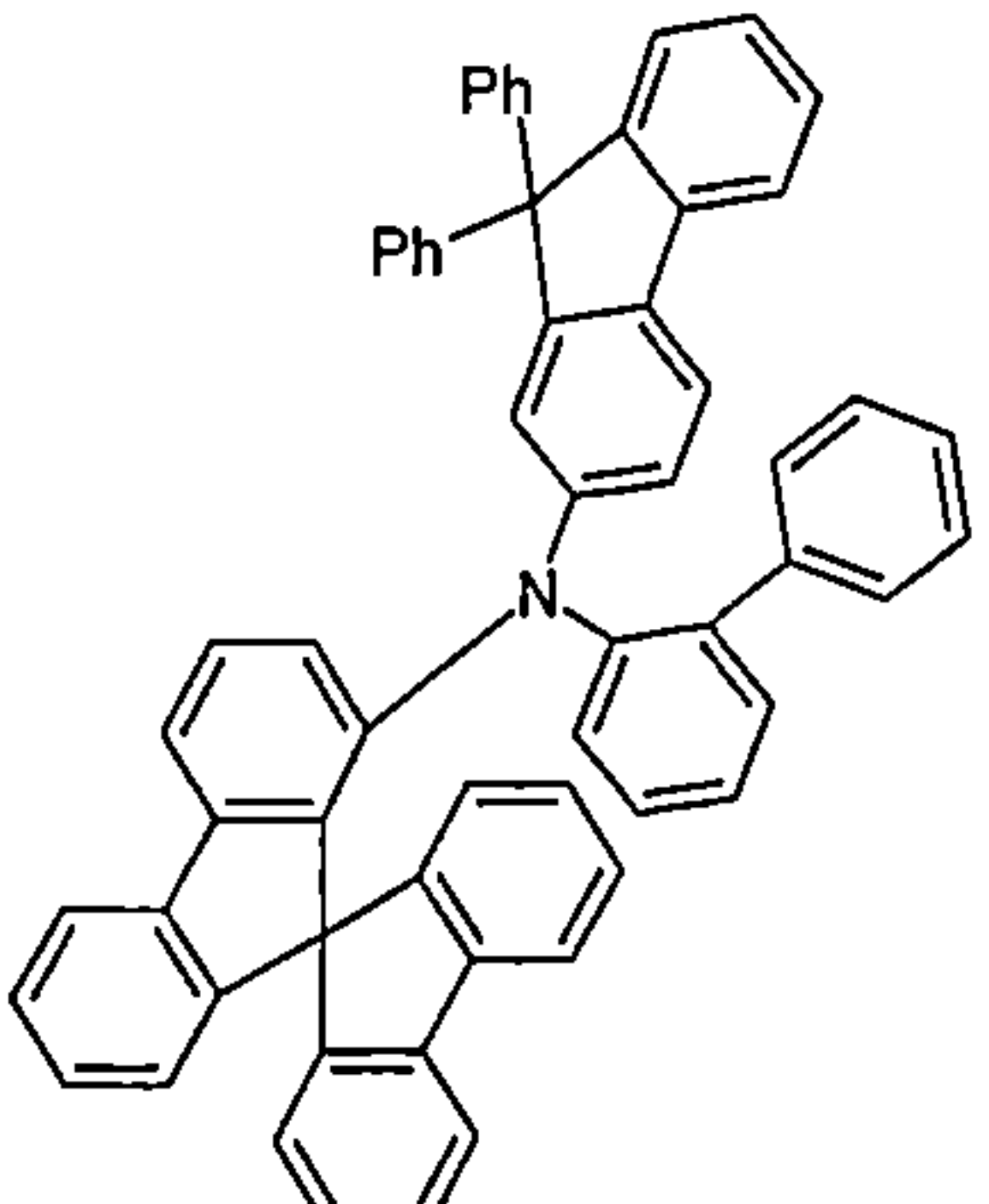
上文列表之化合物較佳具有上文已闡述之 Ar^{S} 及 R^1 至 R^4 之較佳實施例作為該等基團。更佳地，在上文所列示之化合物中， Ar^{S} 係如上文所述選自 $\text{Ar}^{\text{S}}-1$ 至 $\text{Ar}^{\text{S}}-15$ 基團。更佳地，在上文所列示之化合物中， R^1 至 R^4 相同或不同且選自H、F、苯基、甲基及第三丁基。

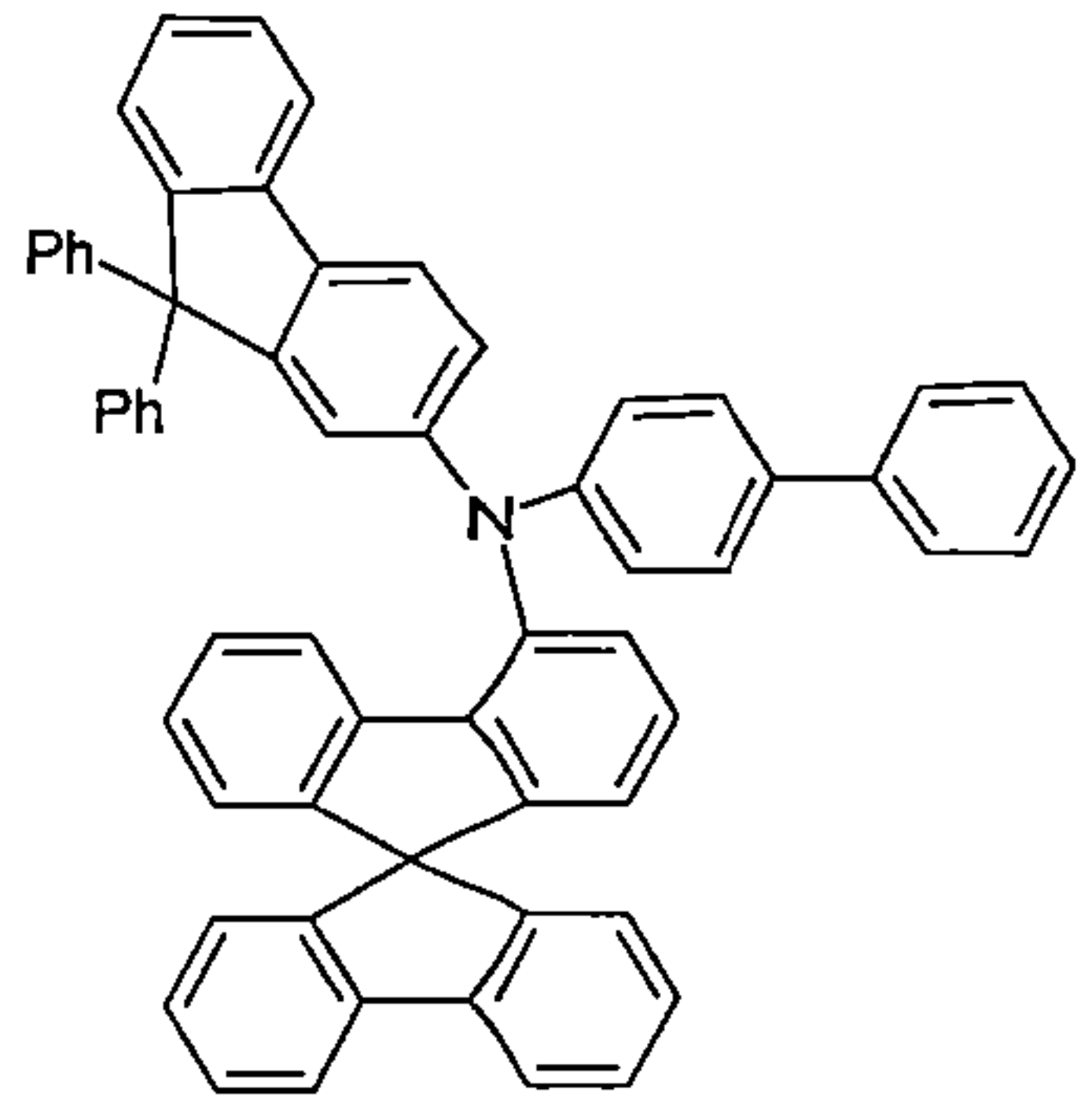
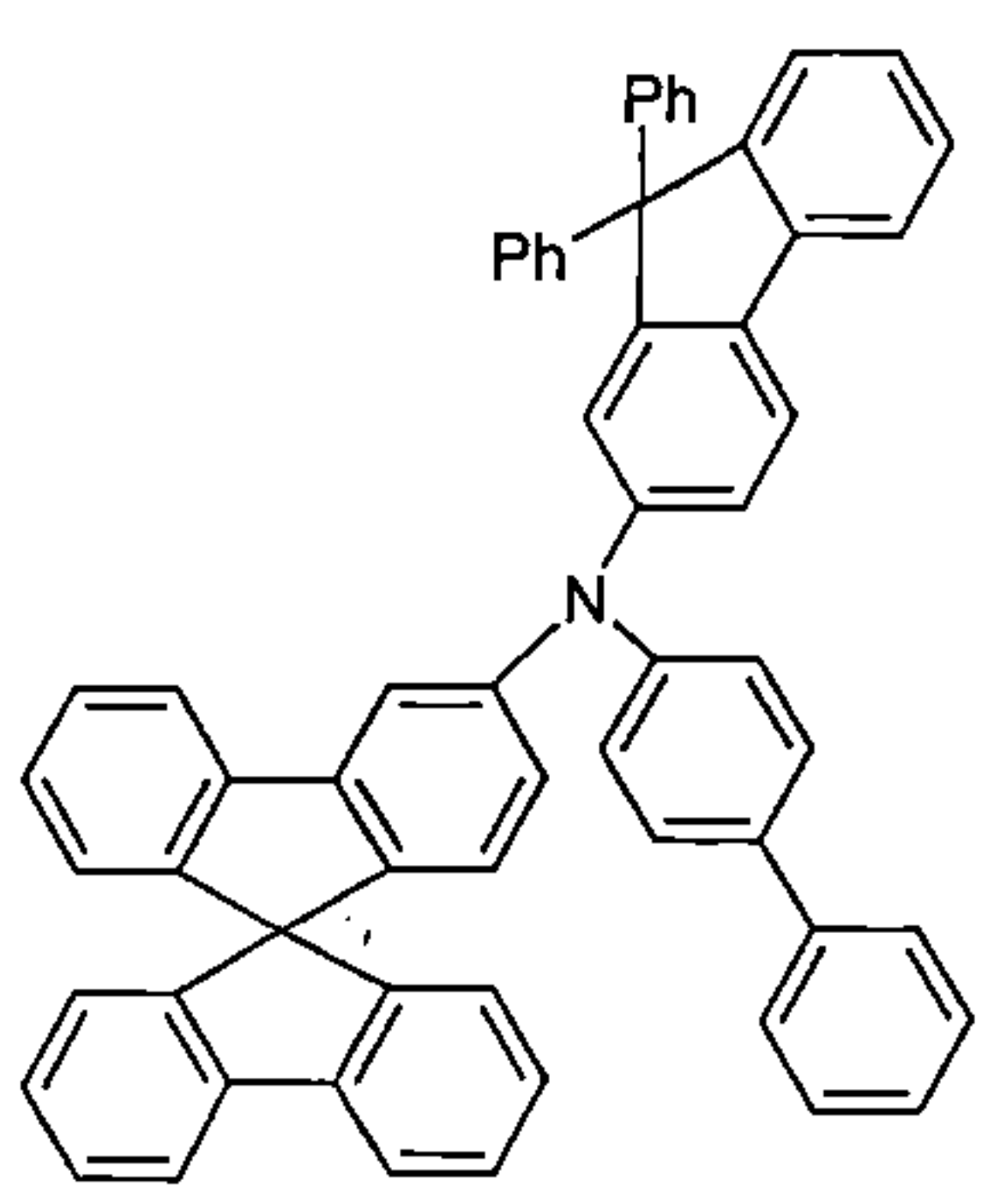
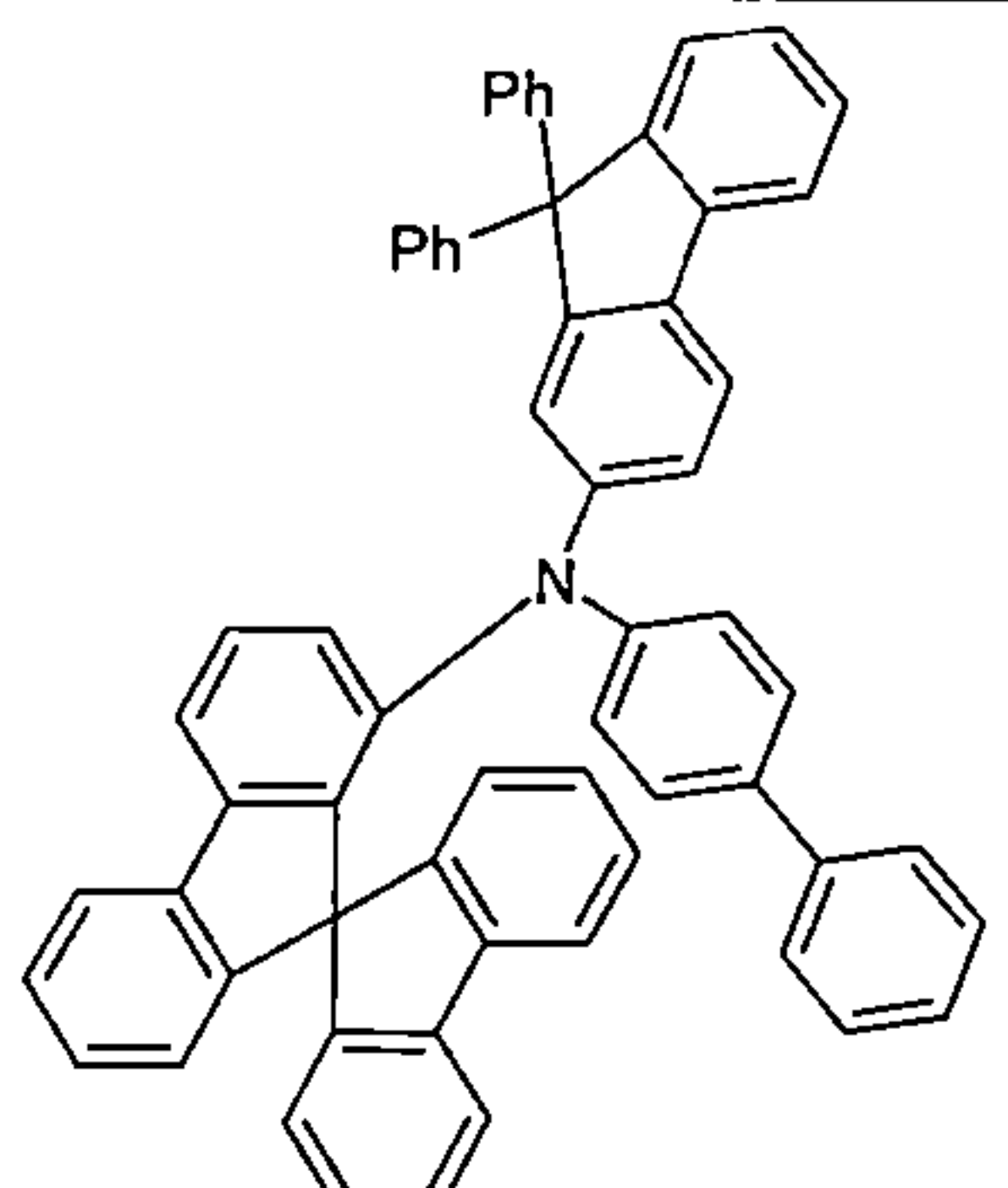
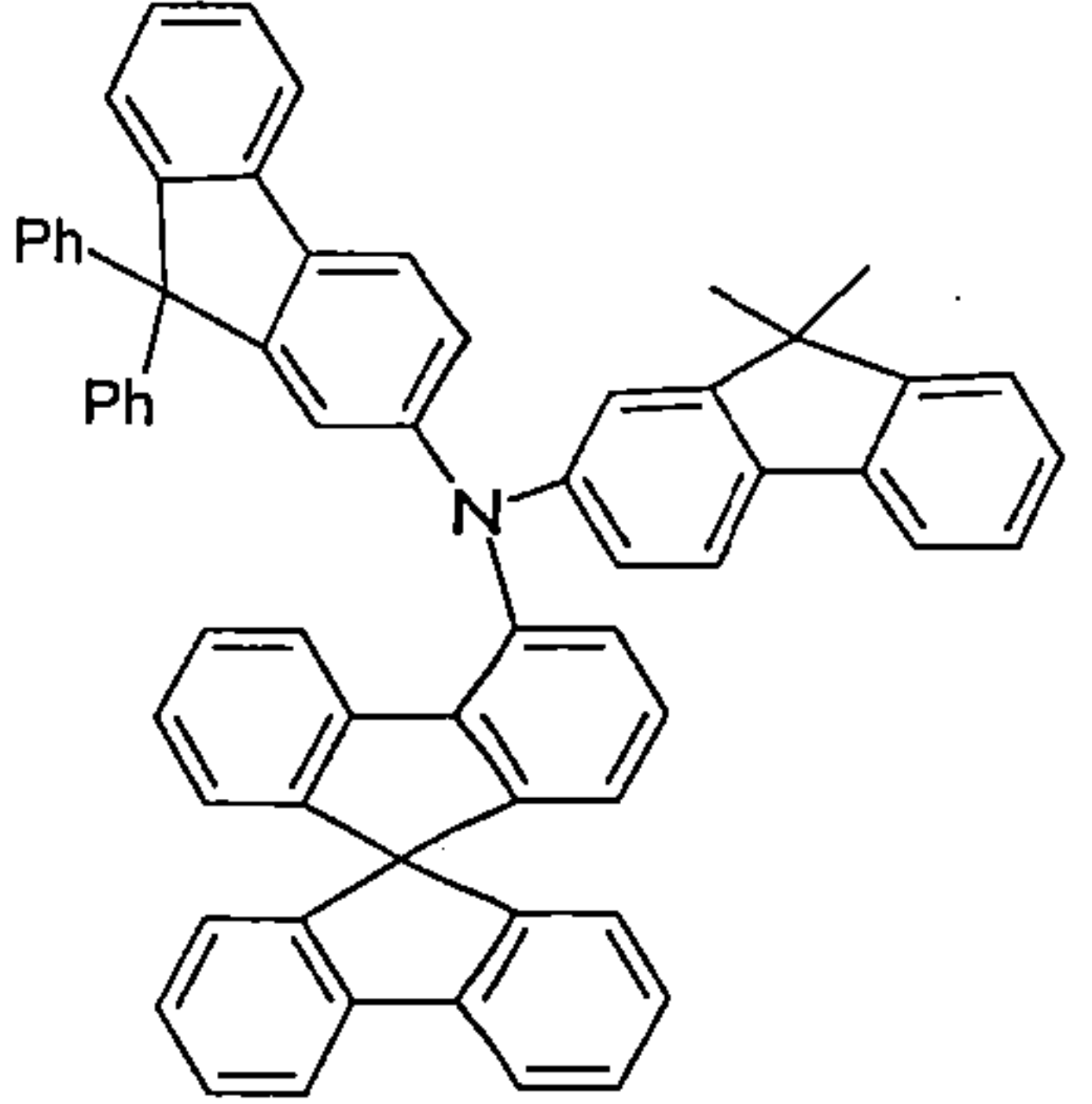
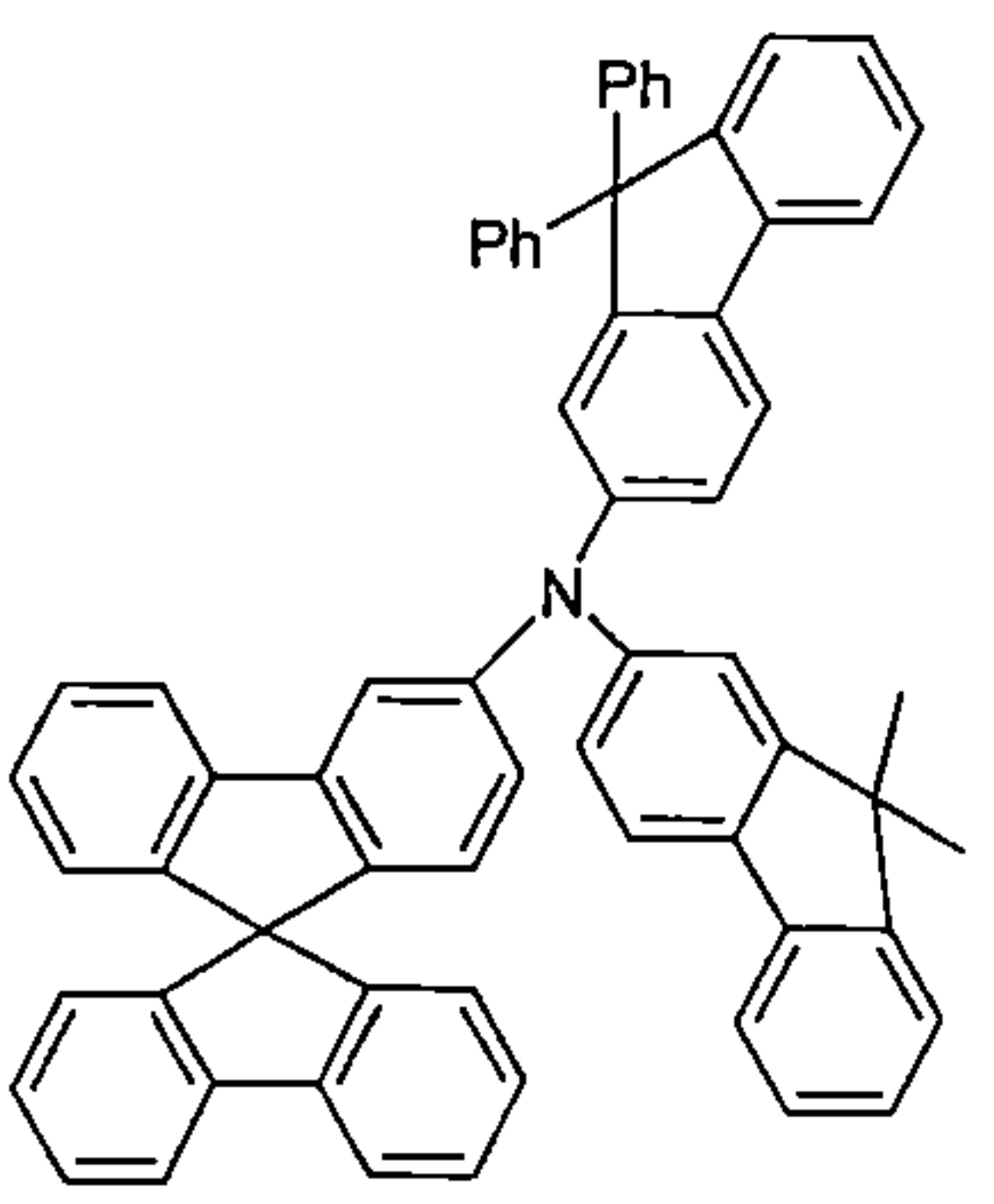
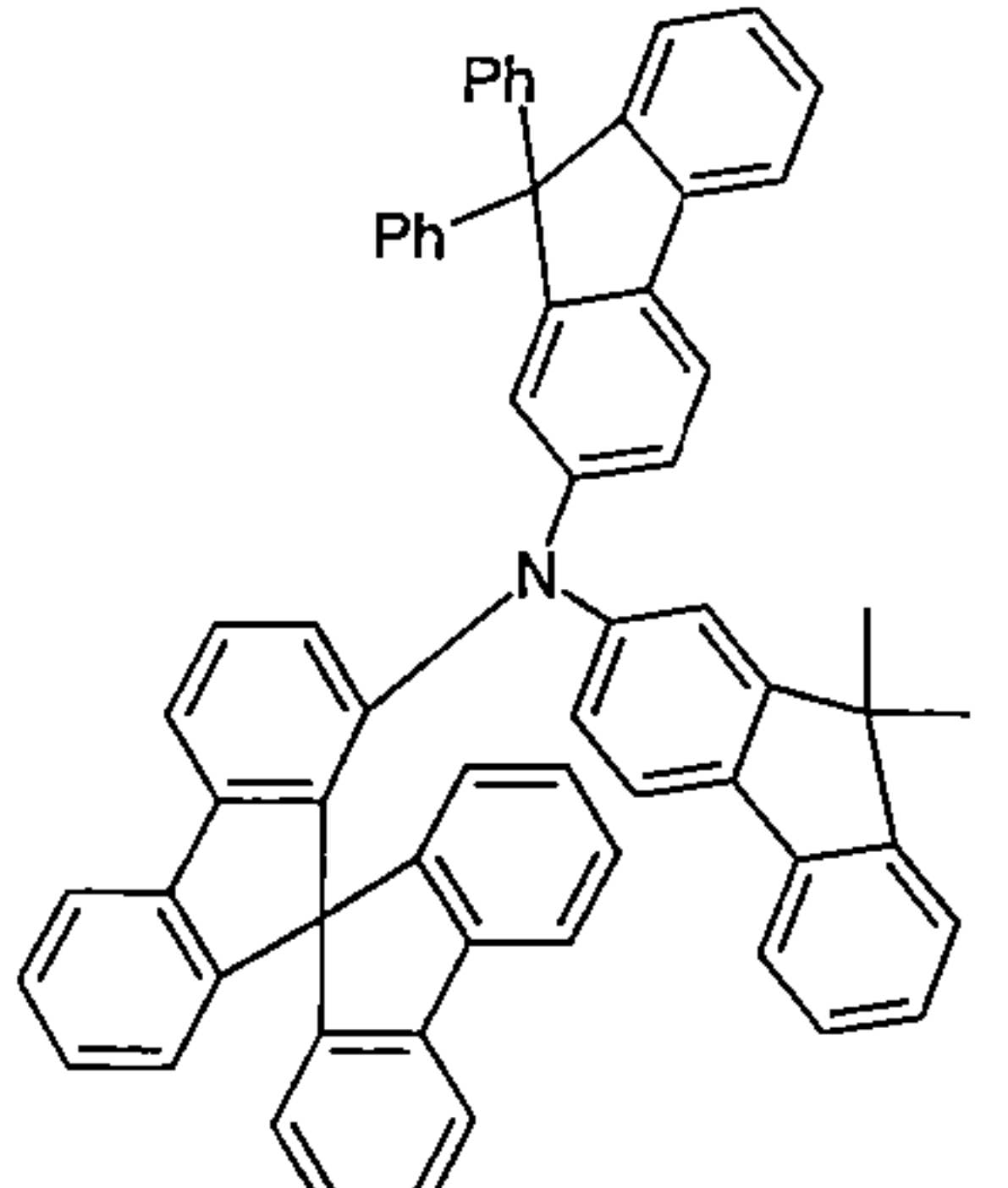
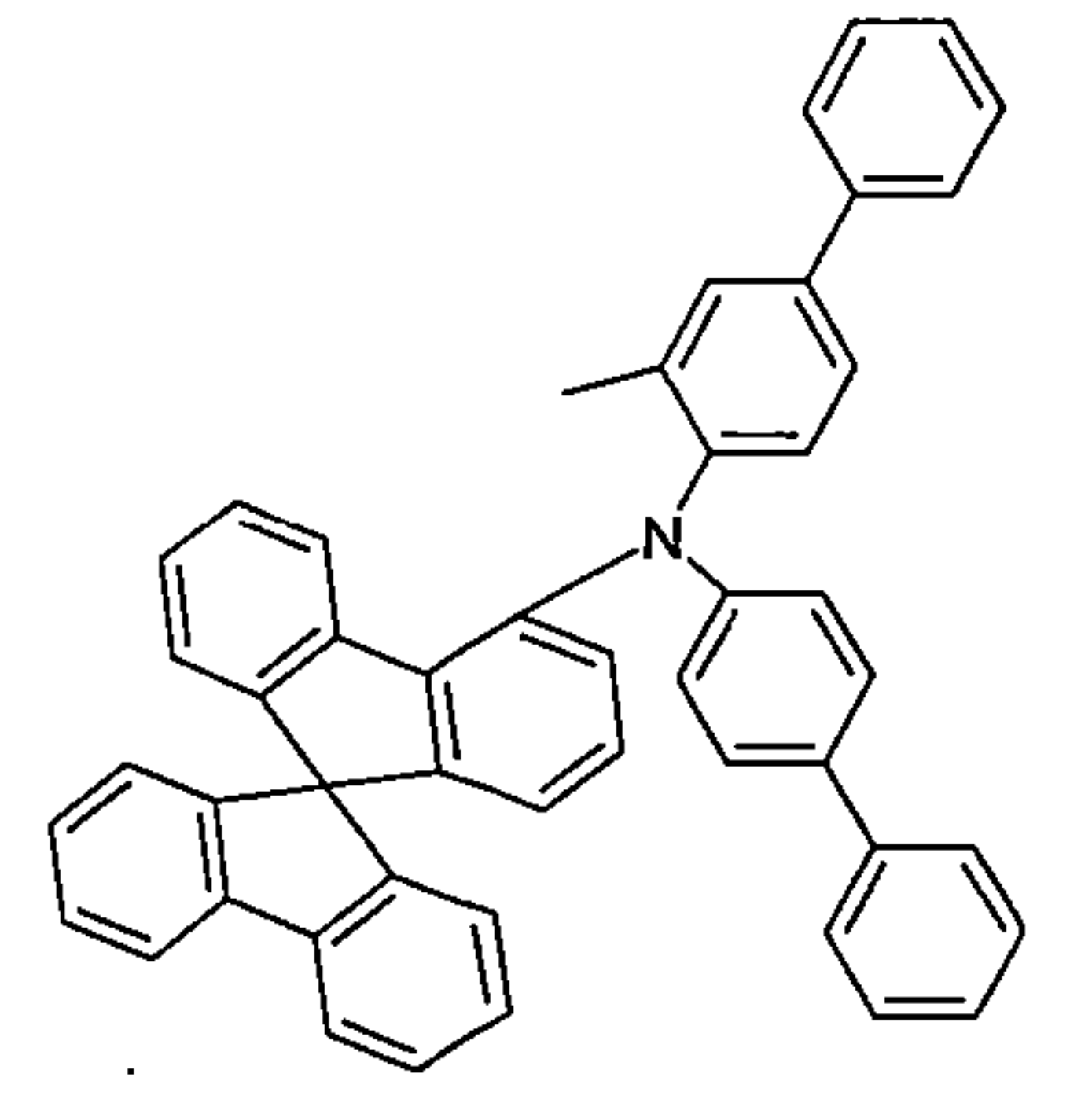
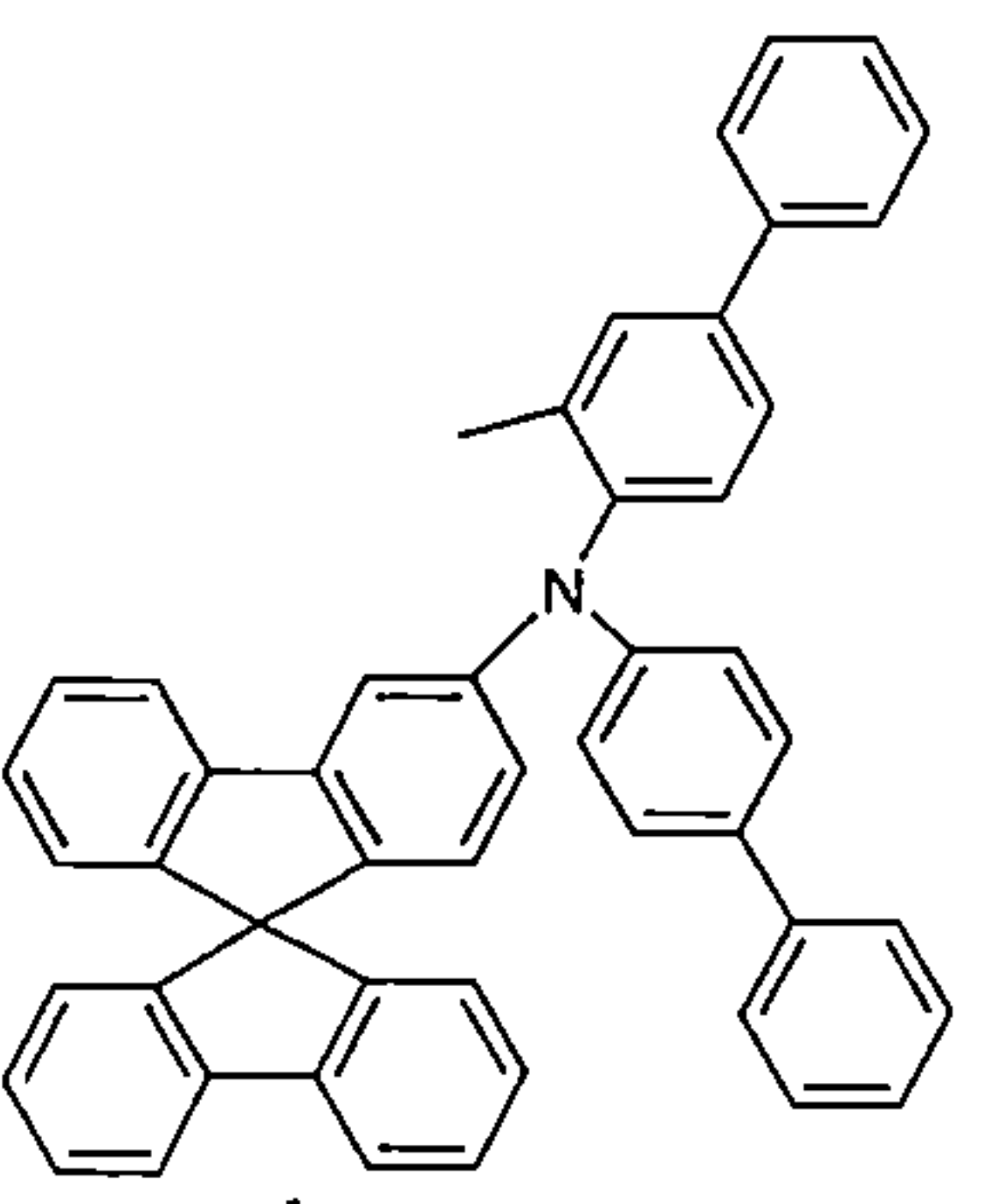
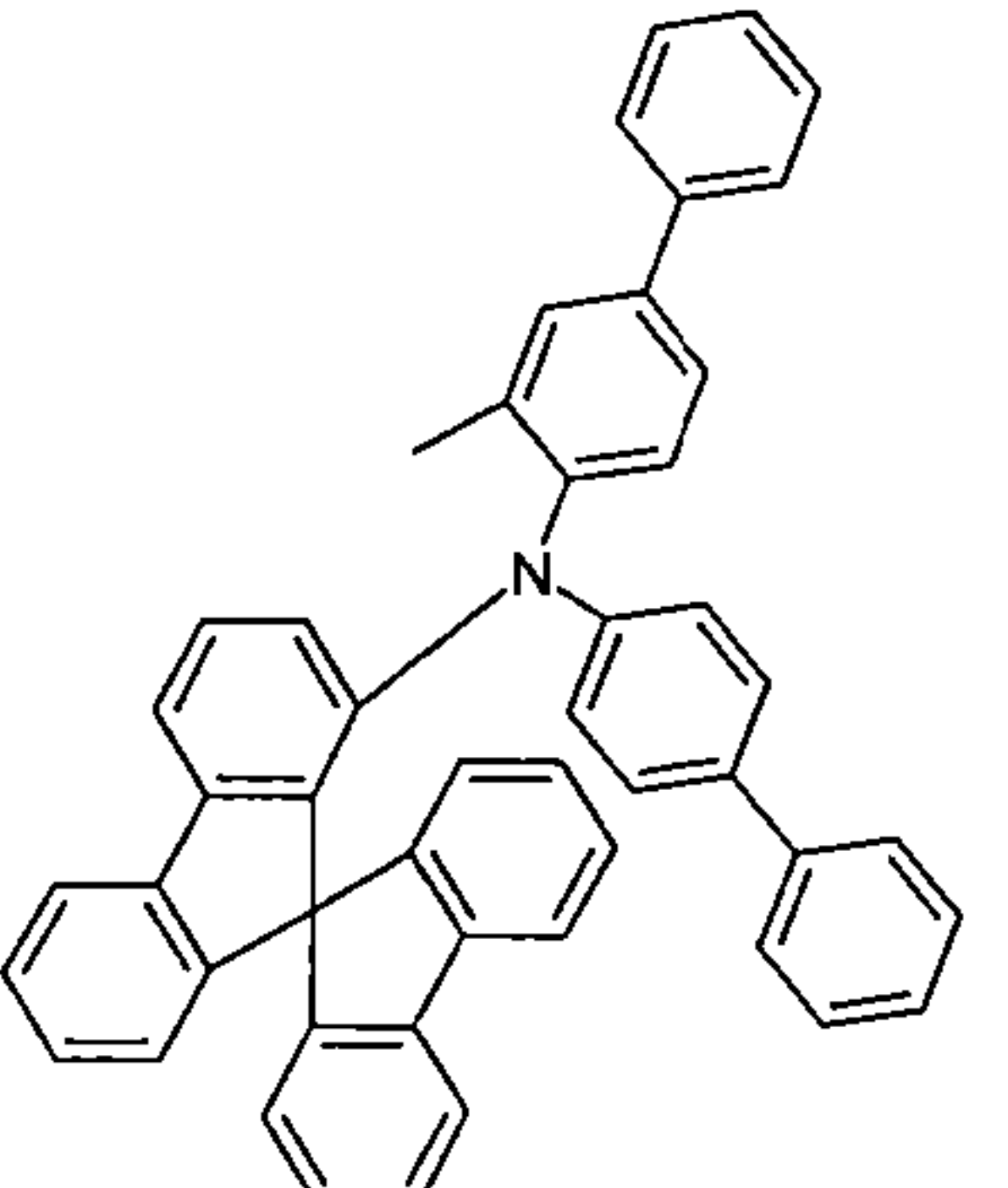
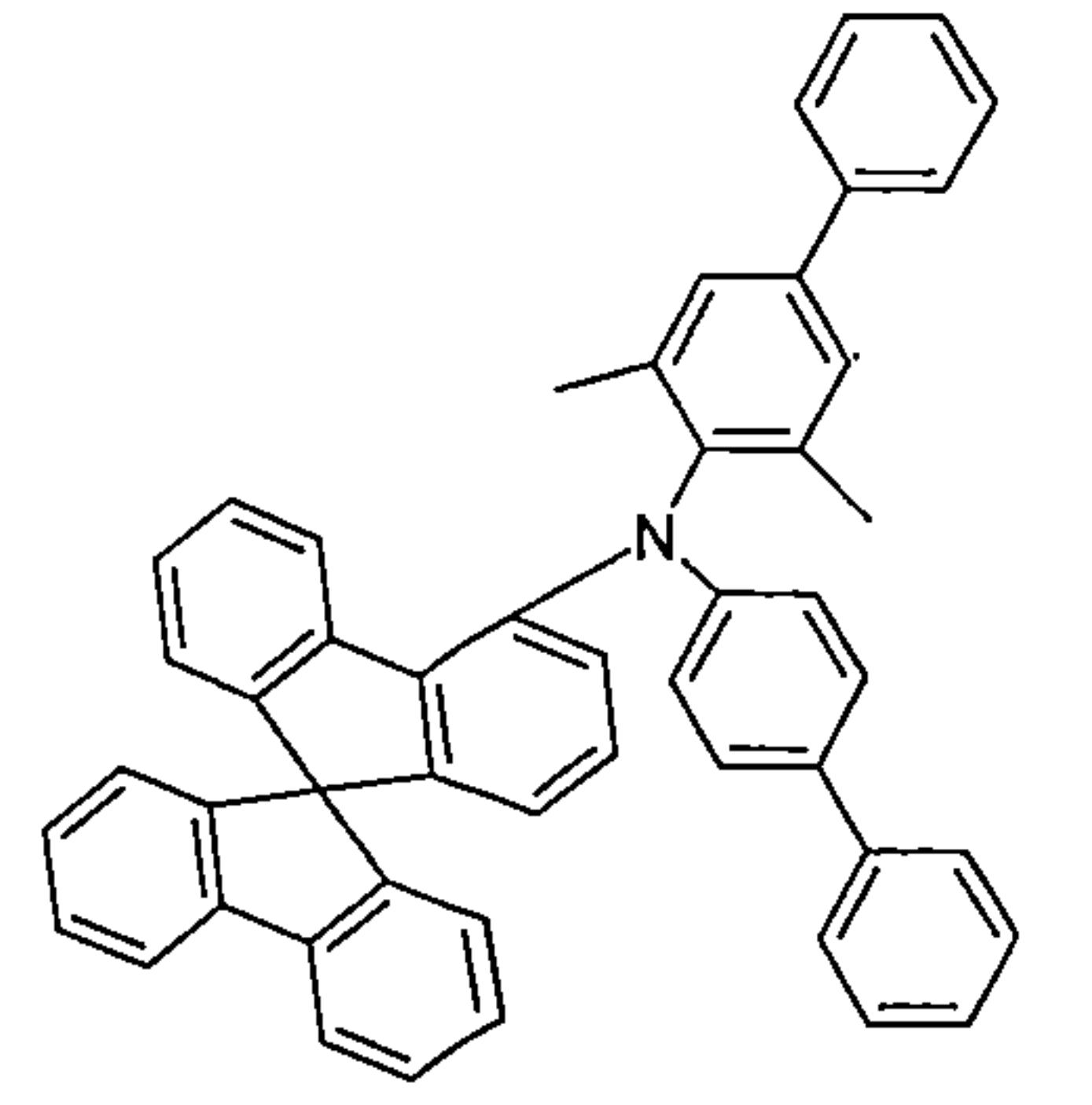
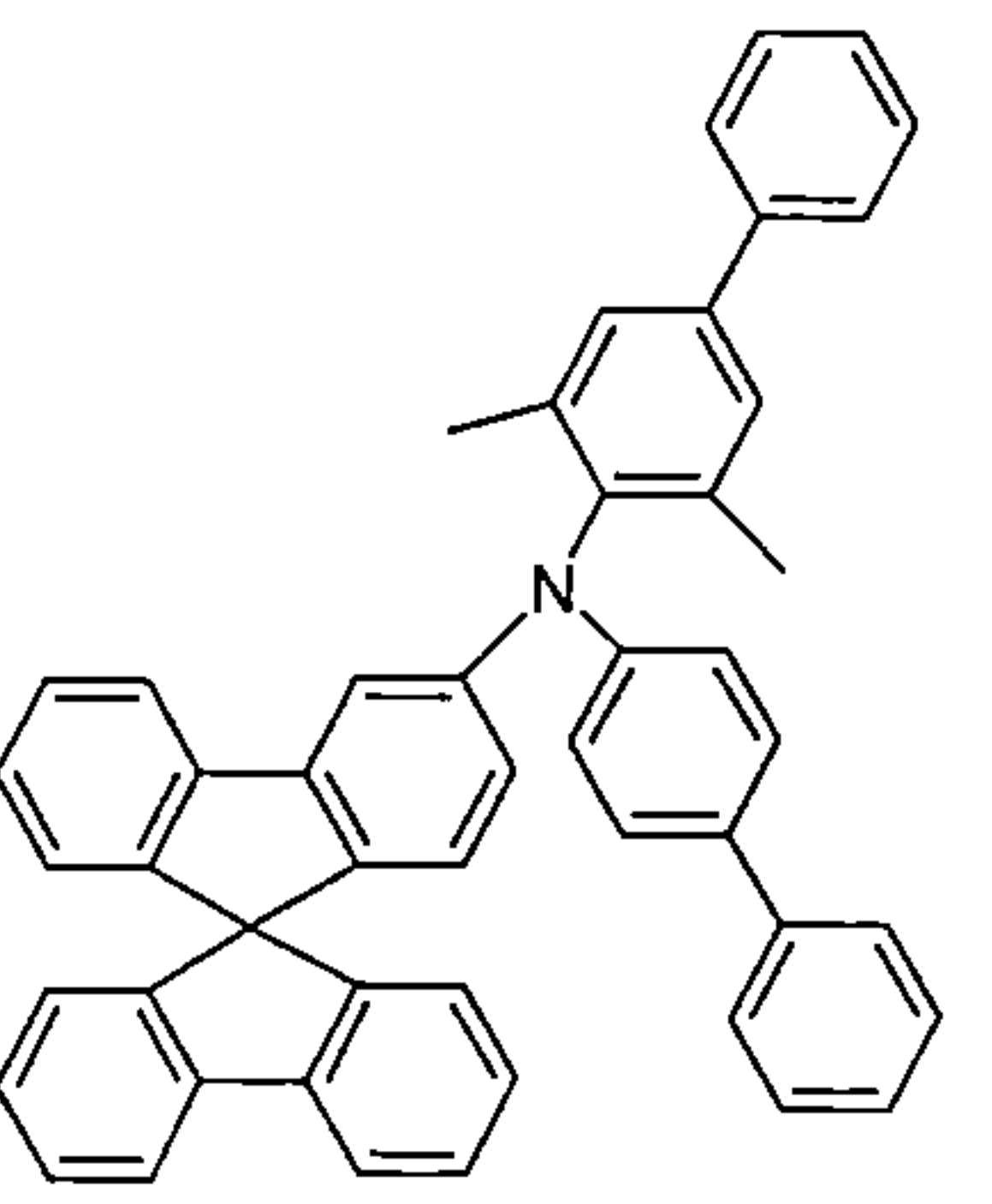
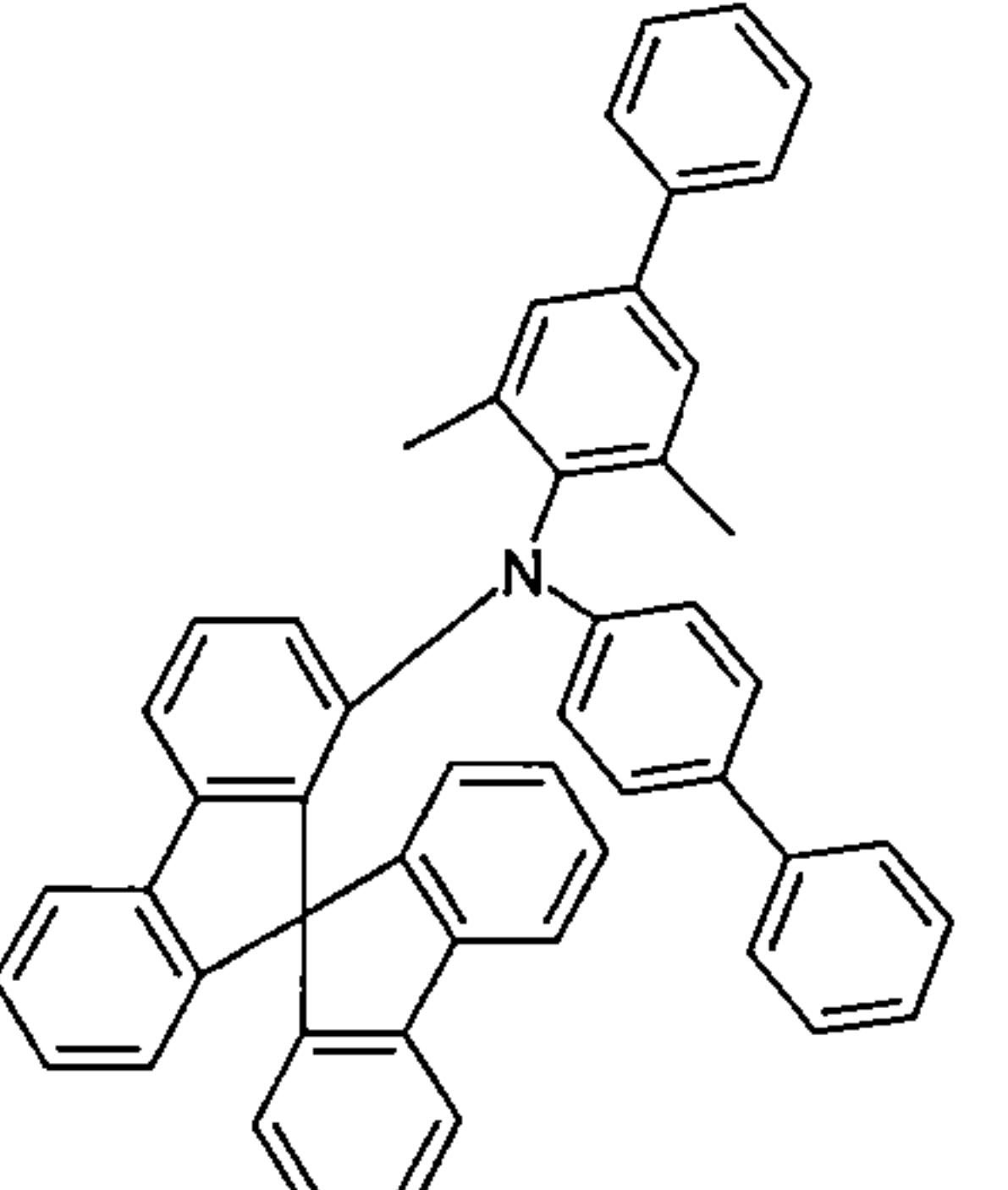
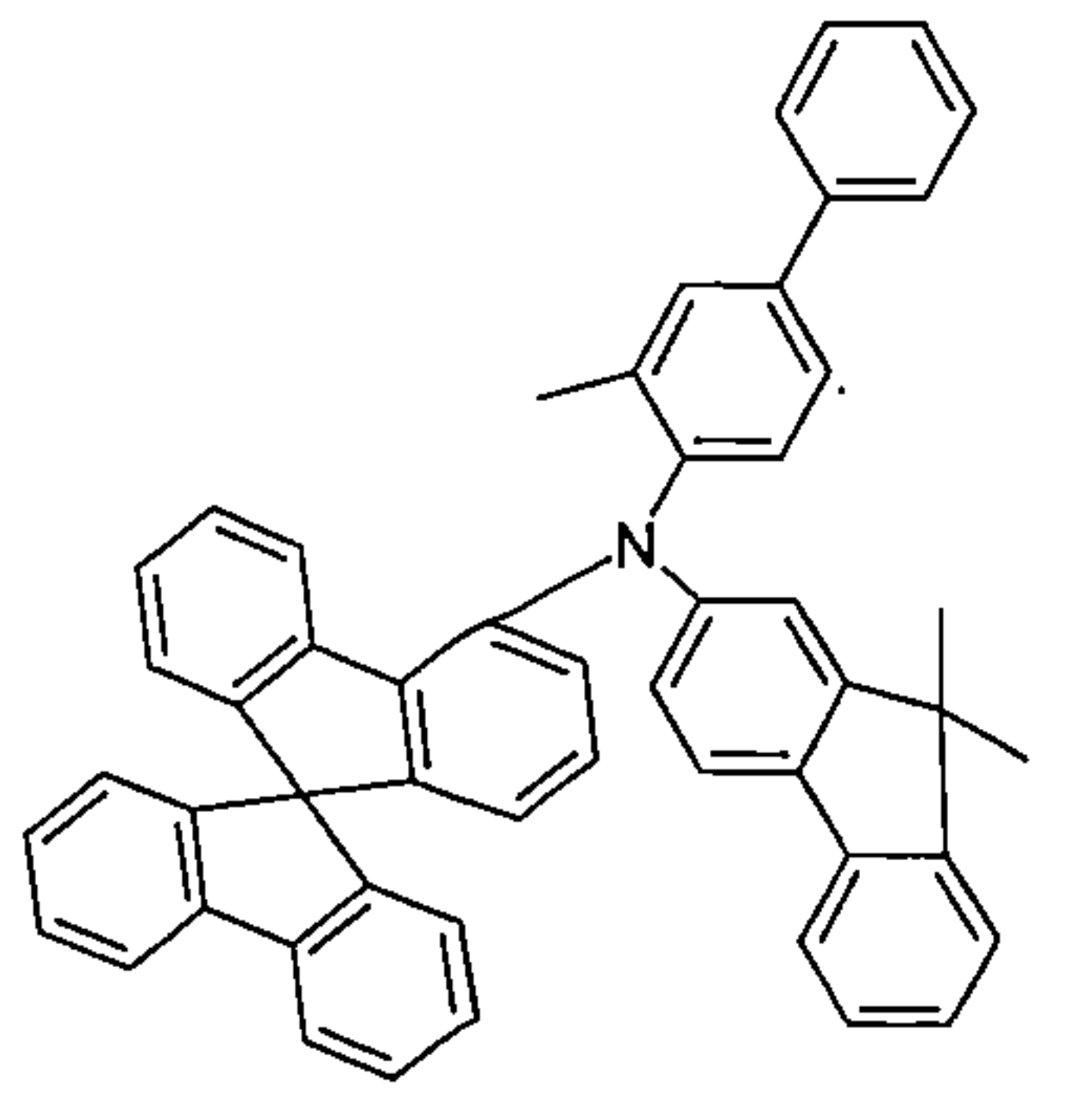
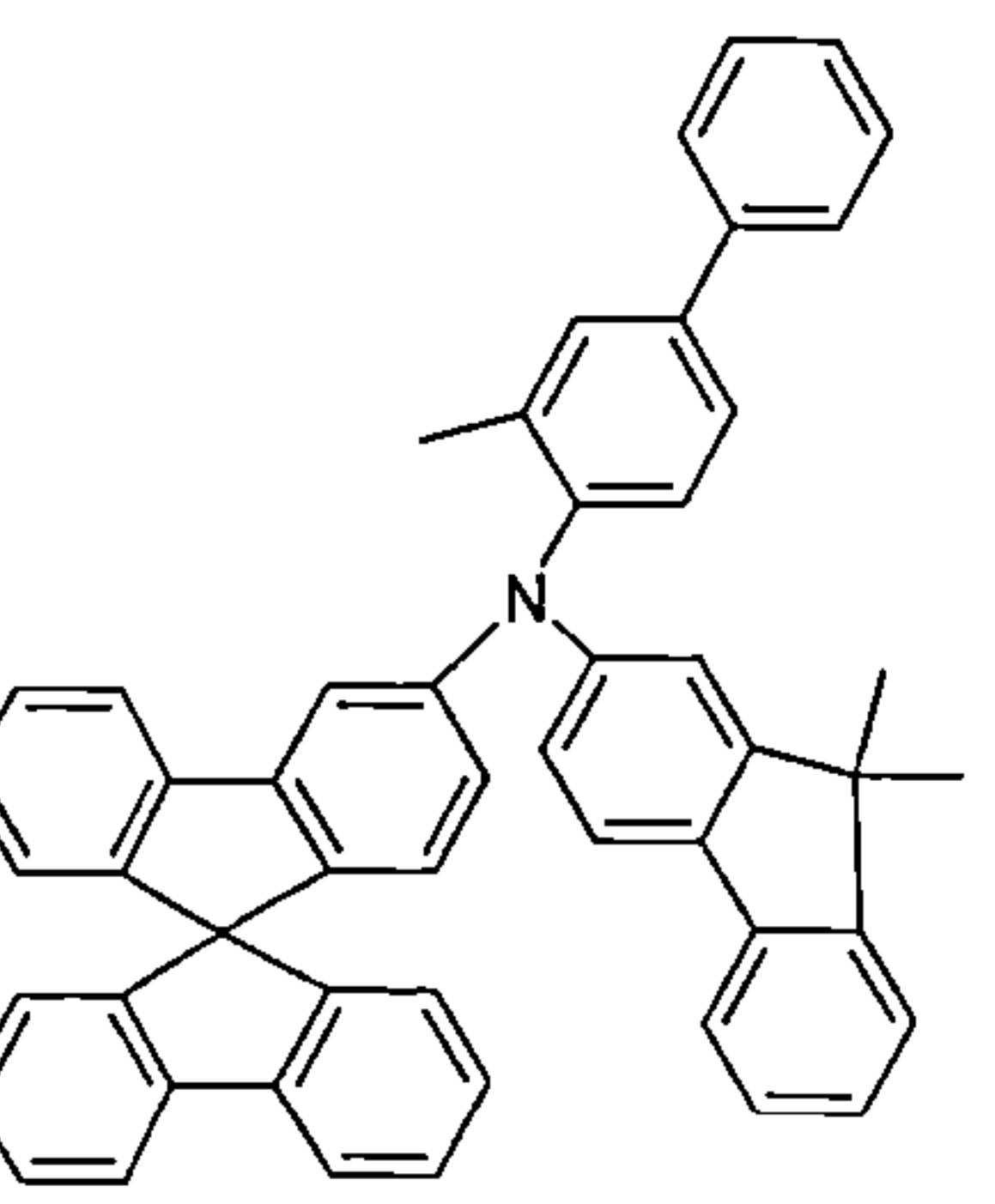
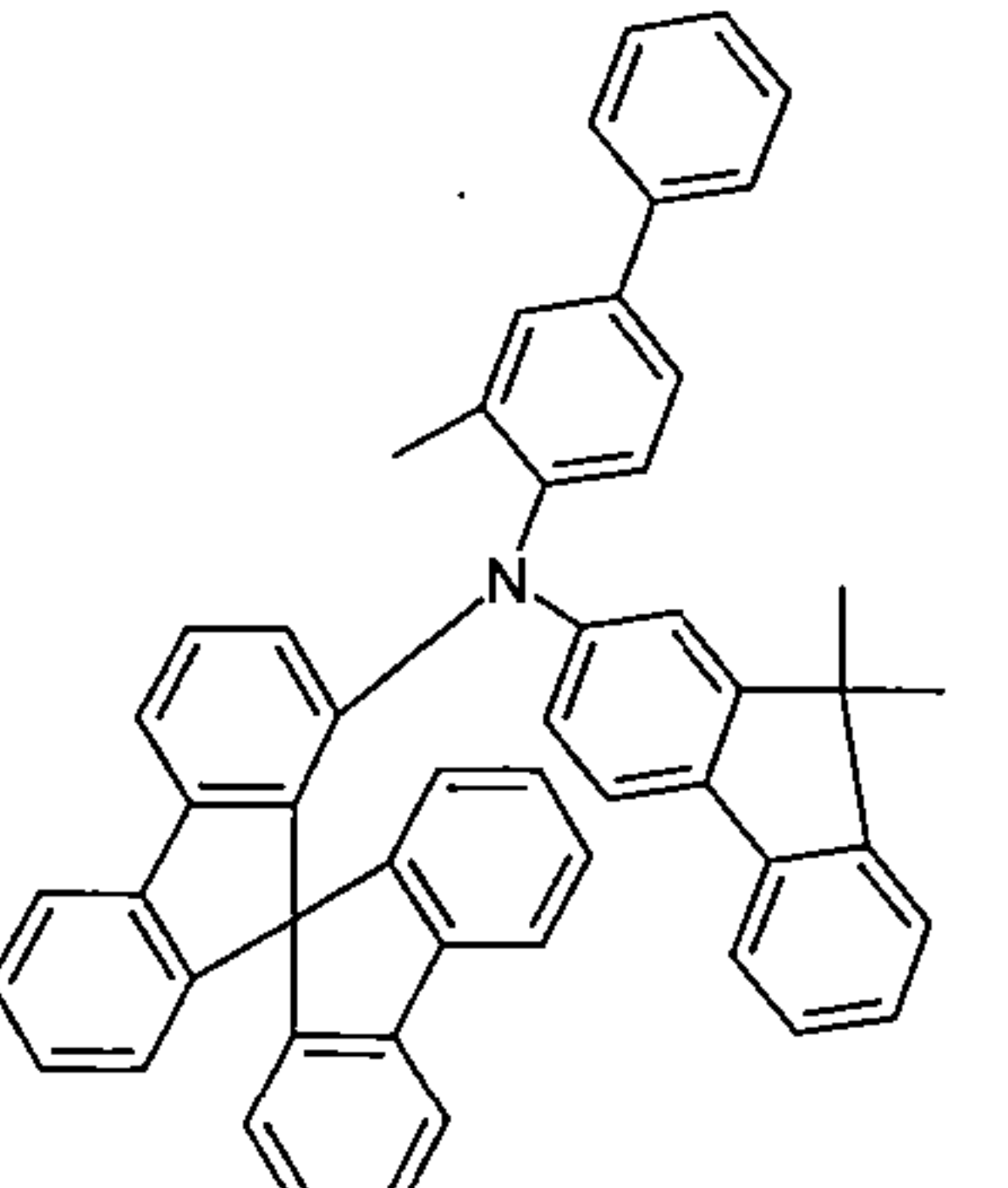
本發明適宜化合物之實例係下表中所顯示之化合物：

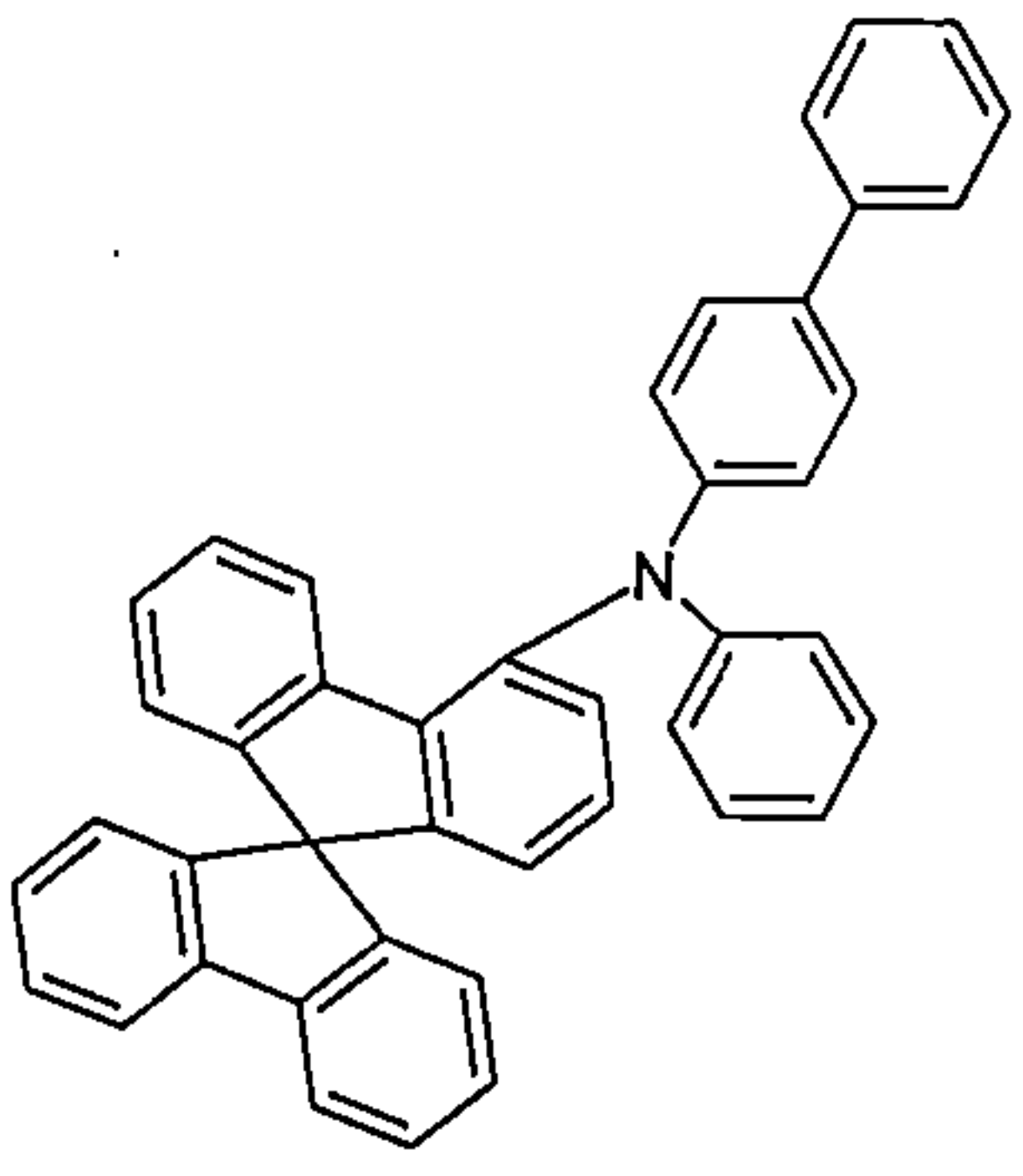
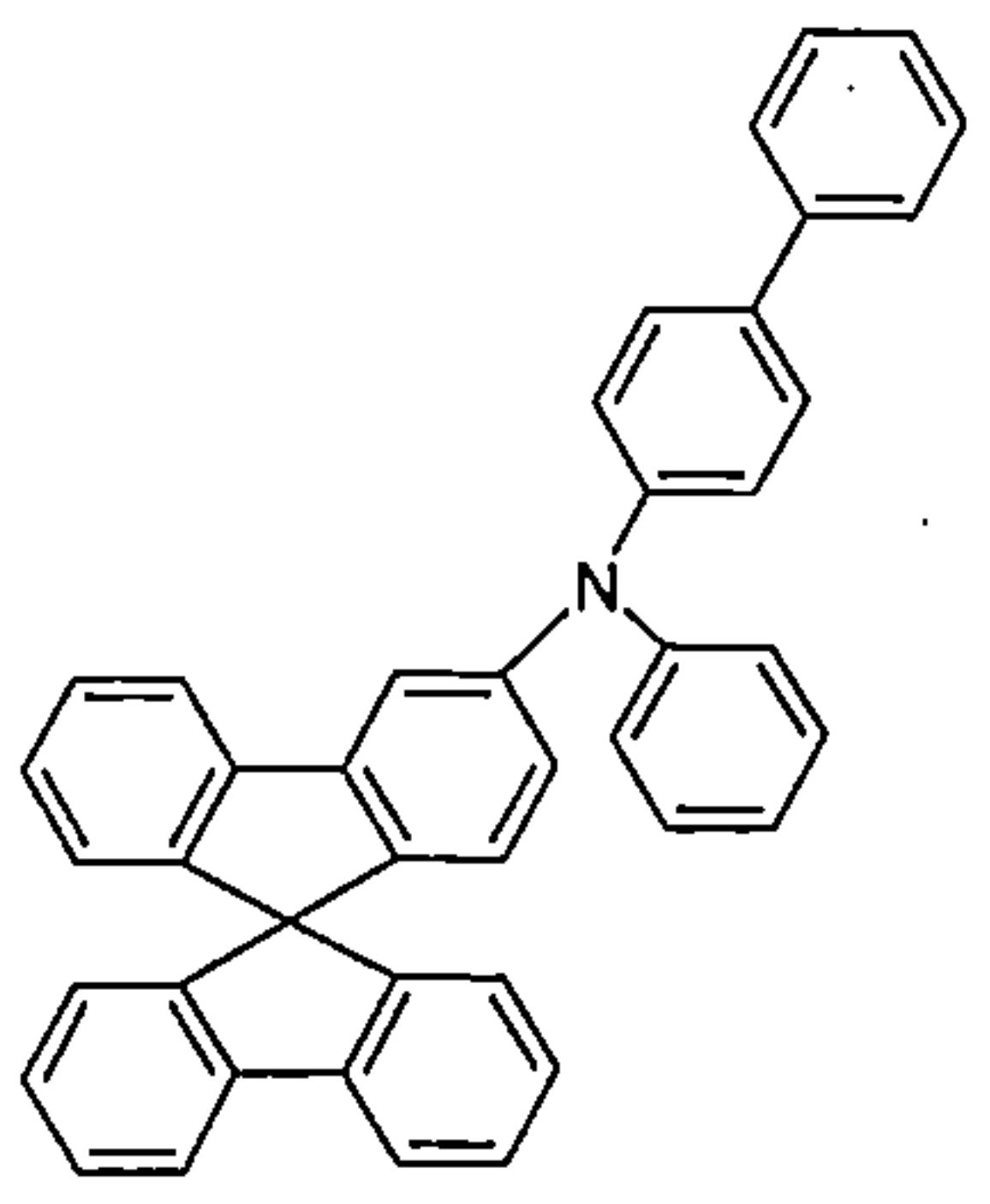
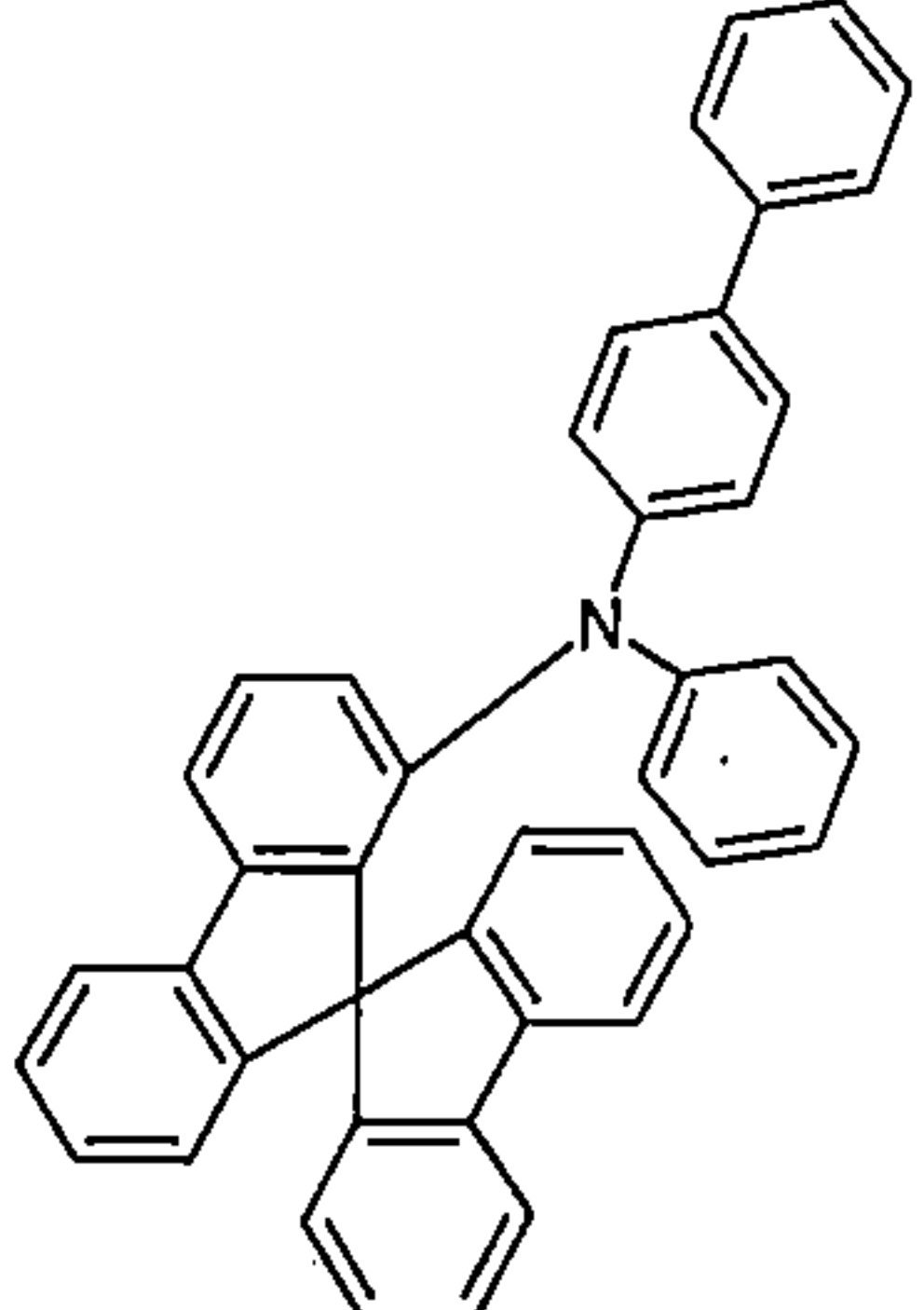
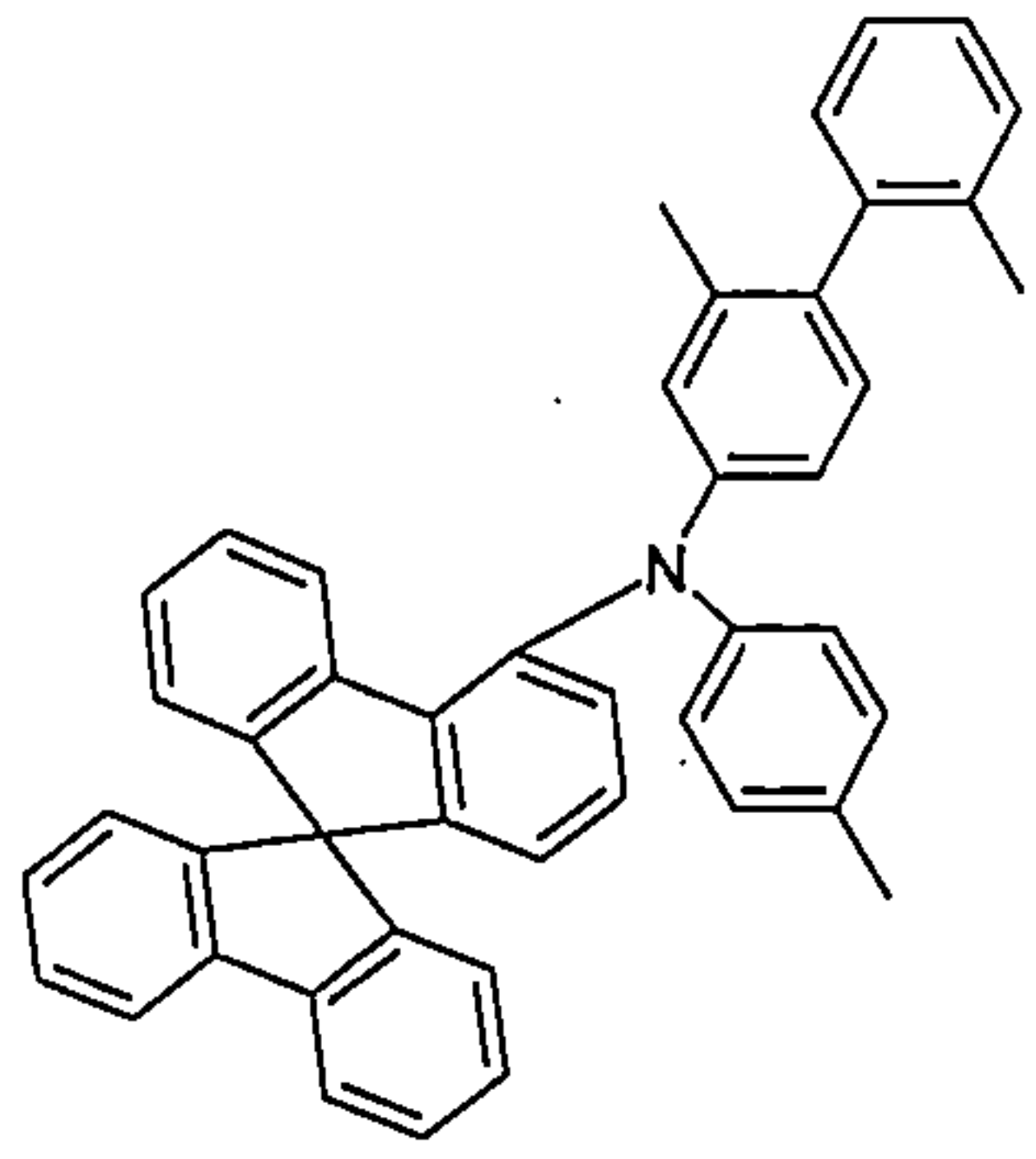
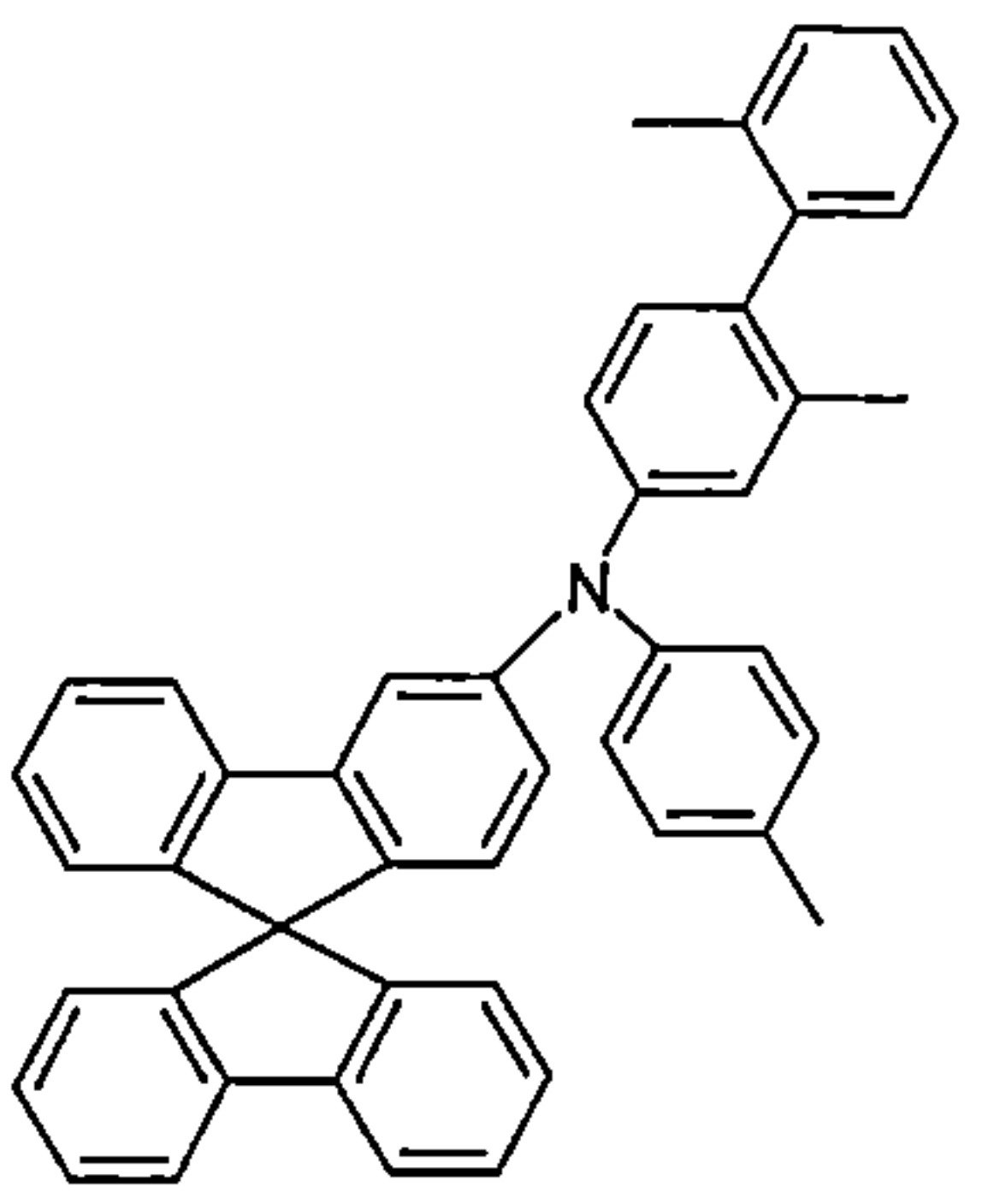
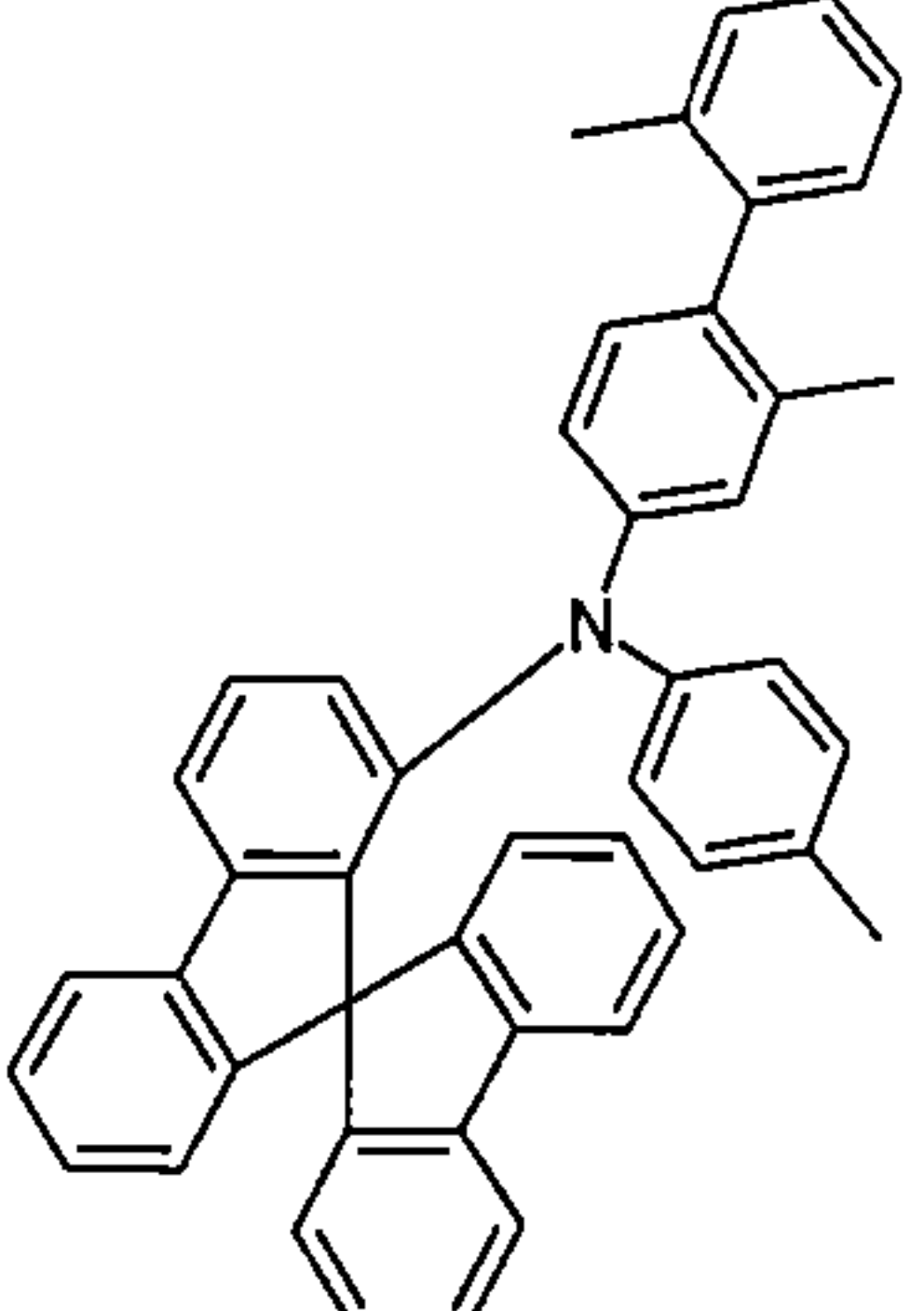
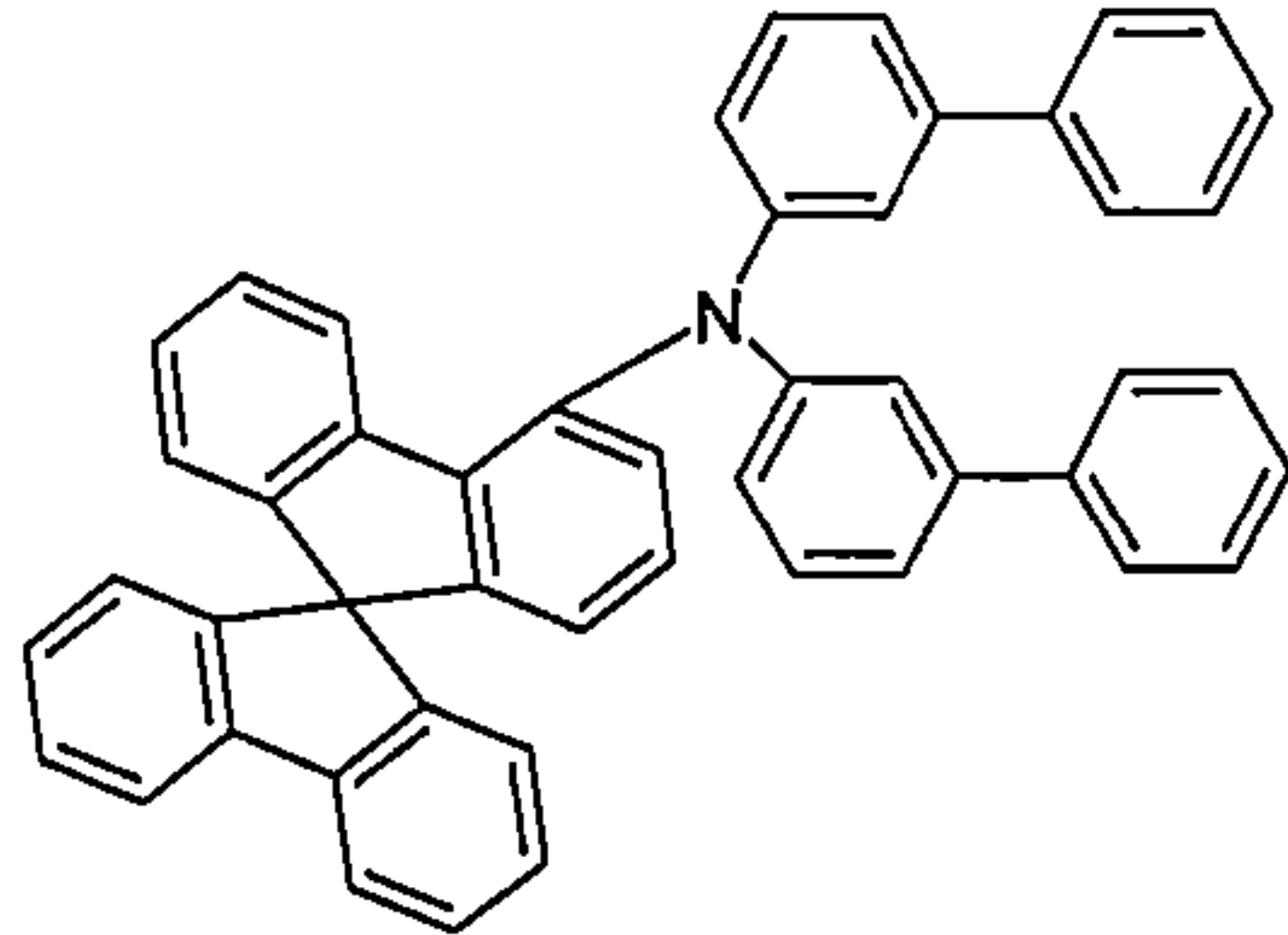
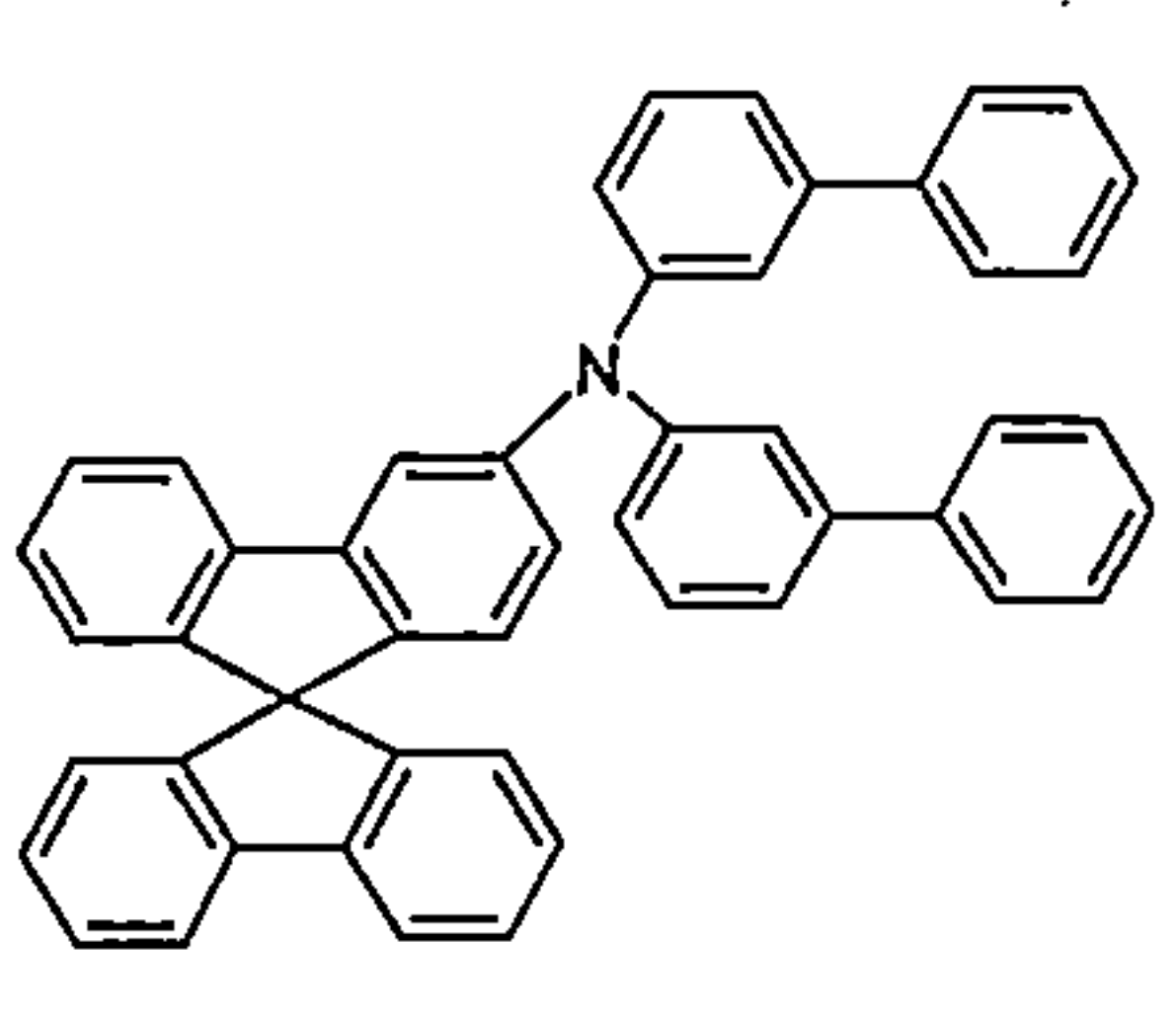
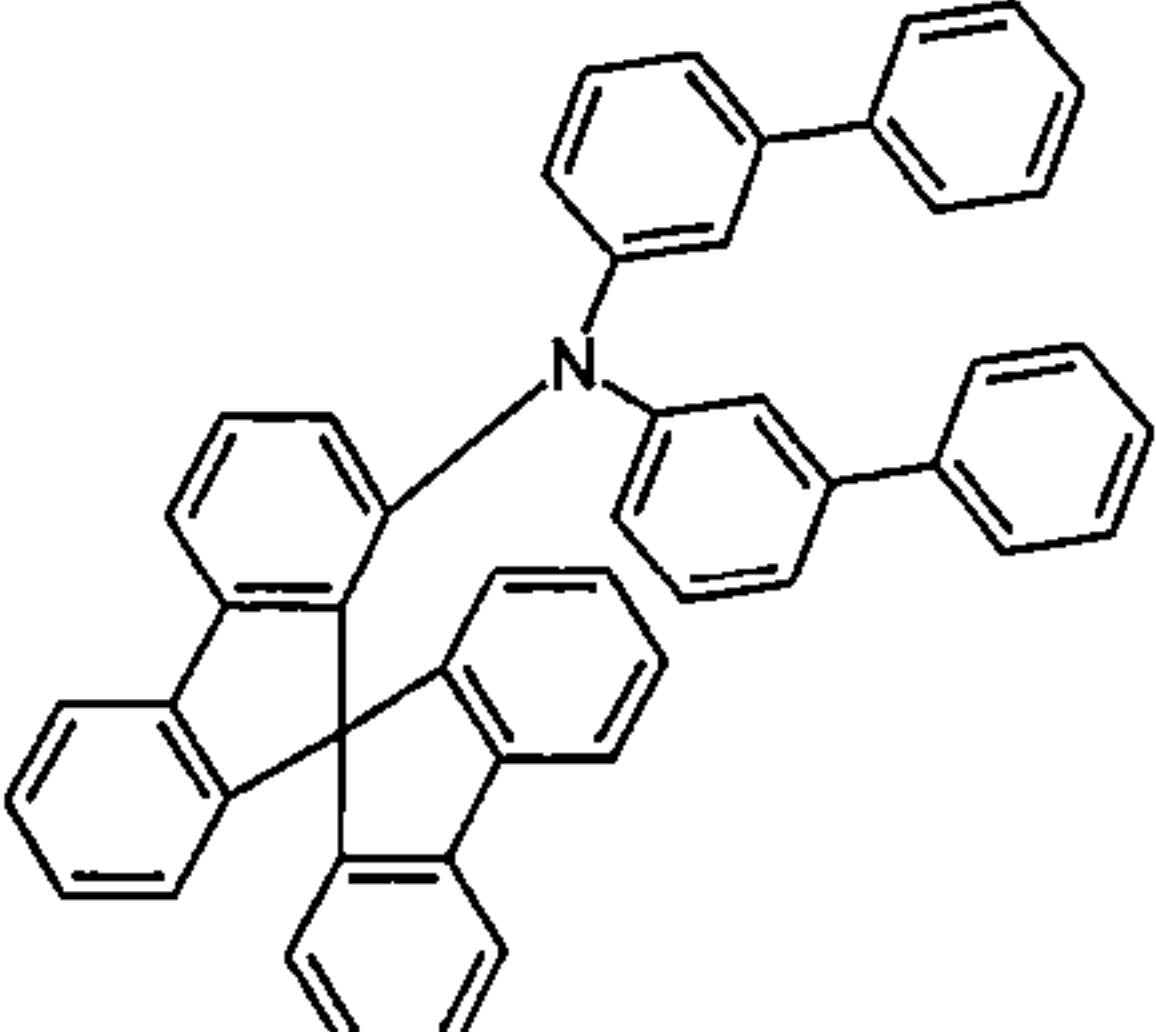
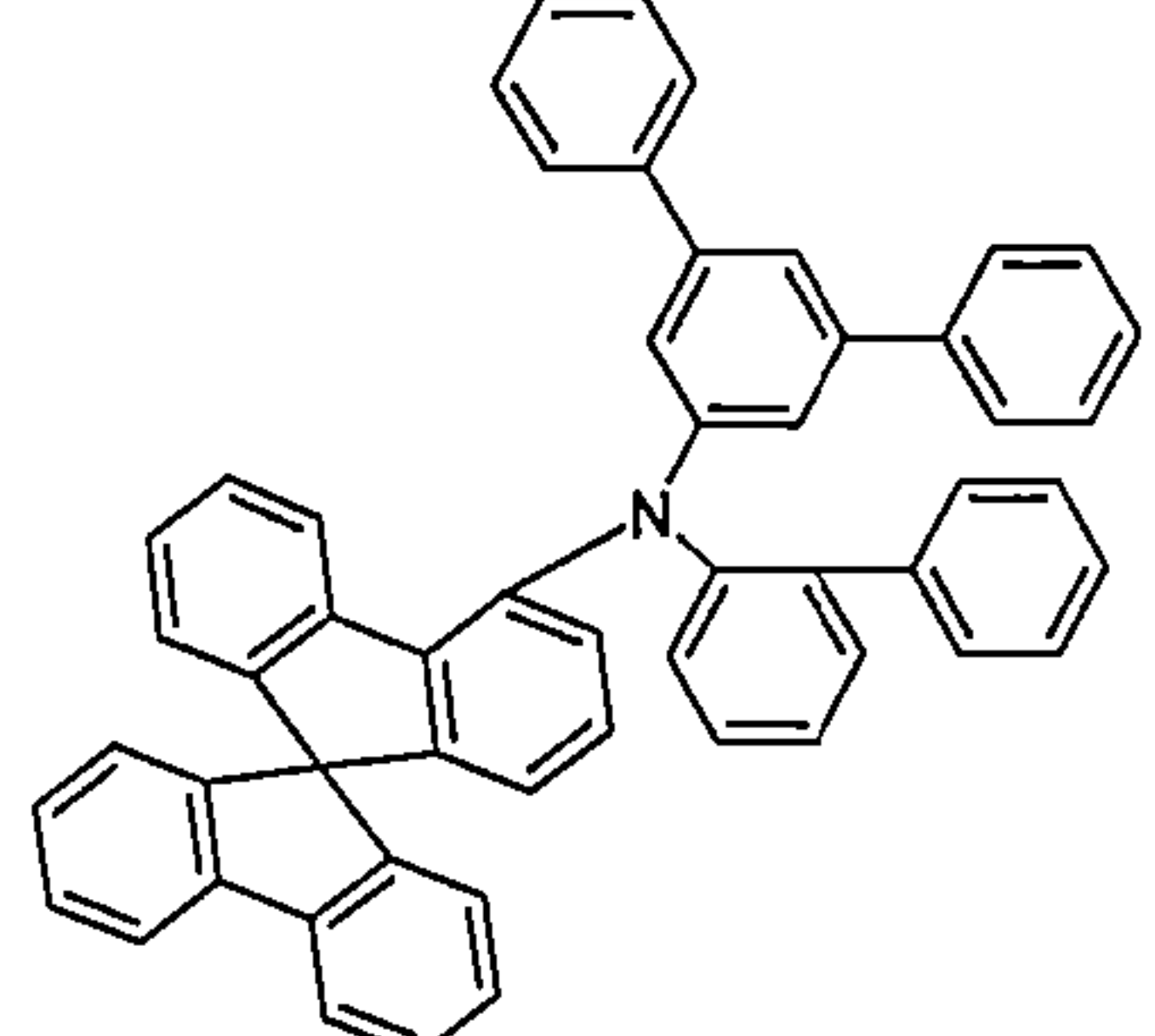
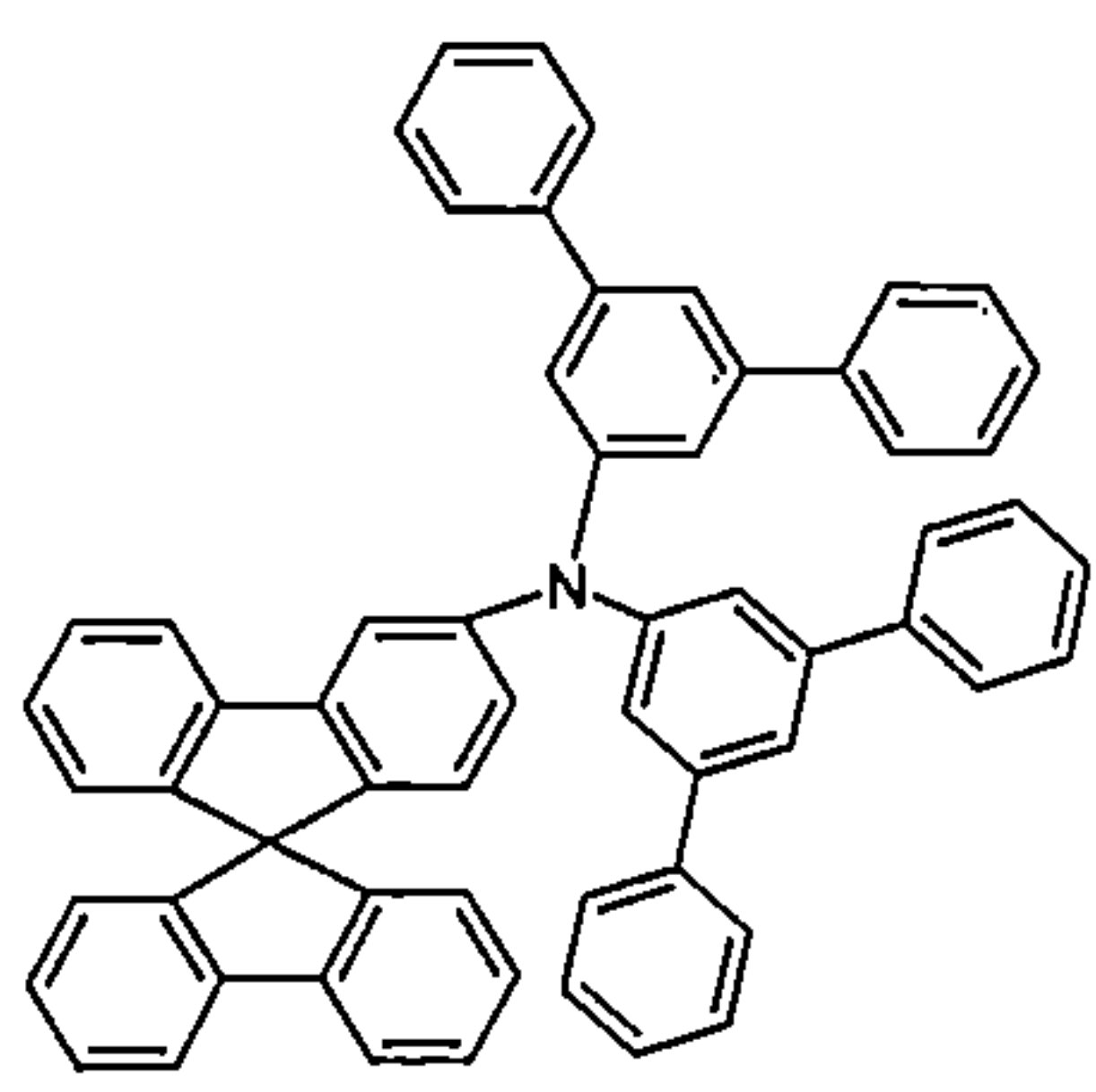
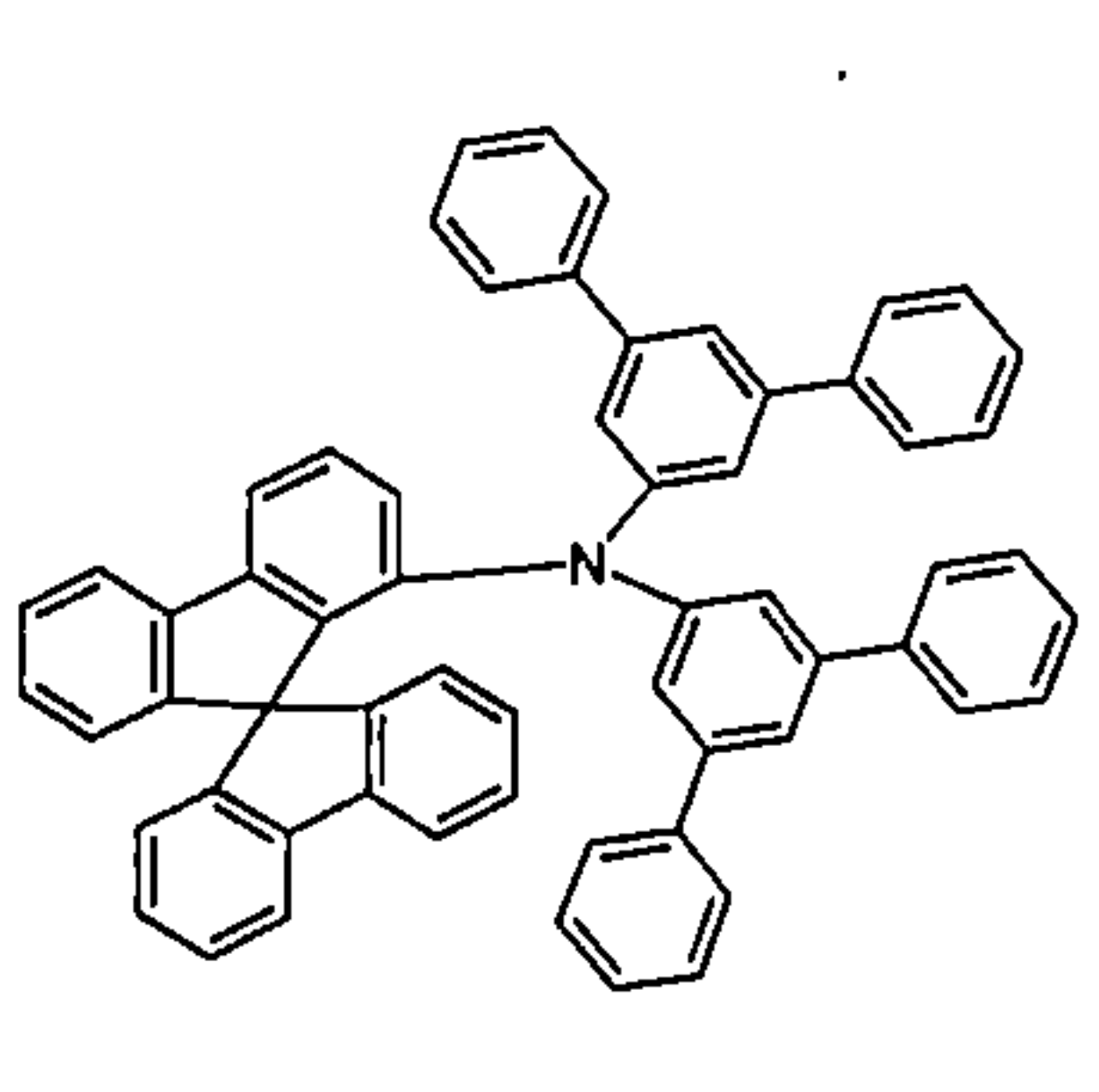
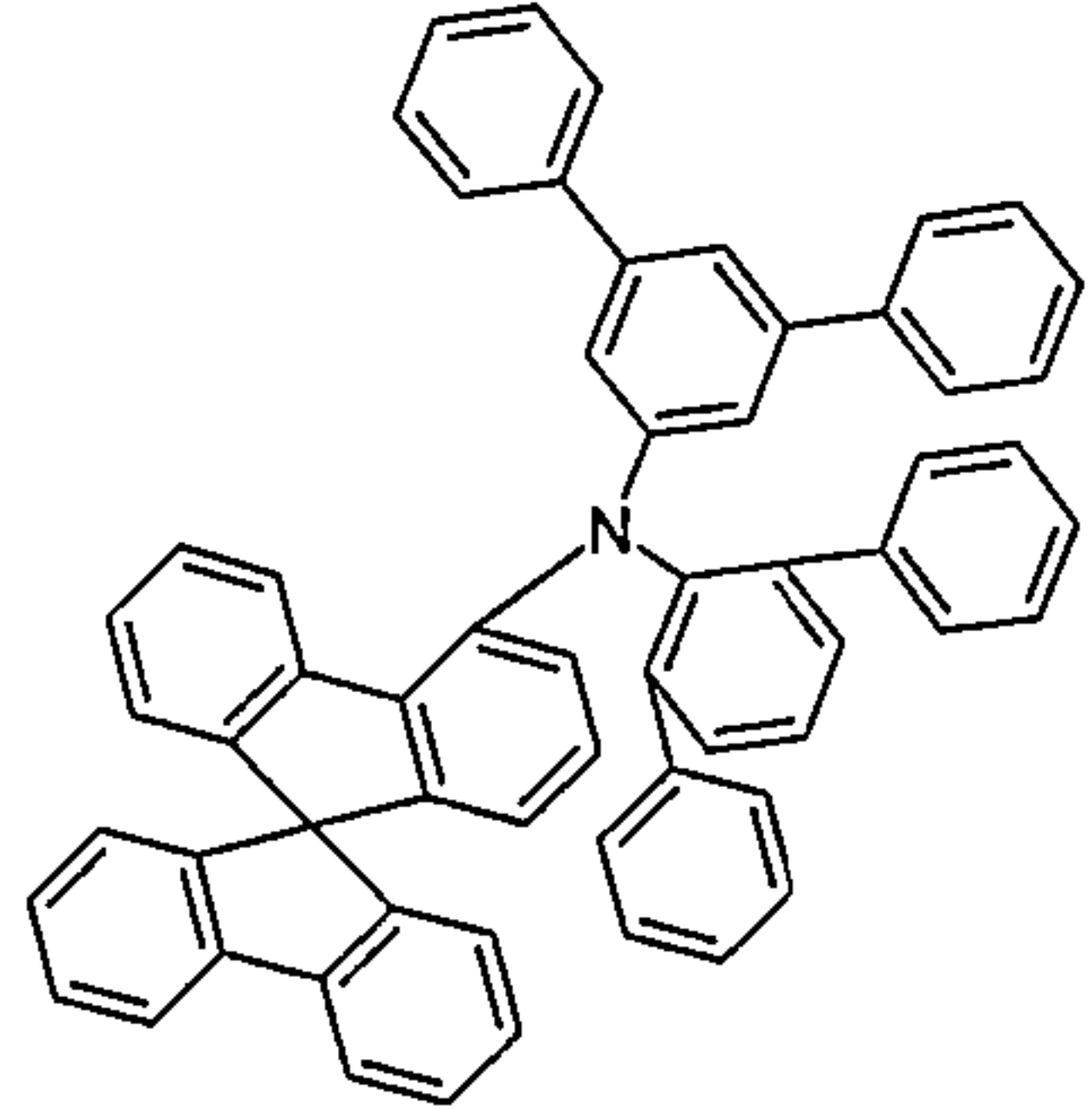
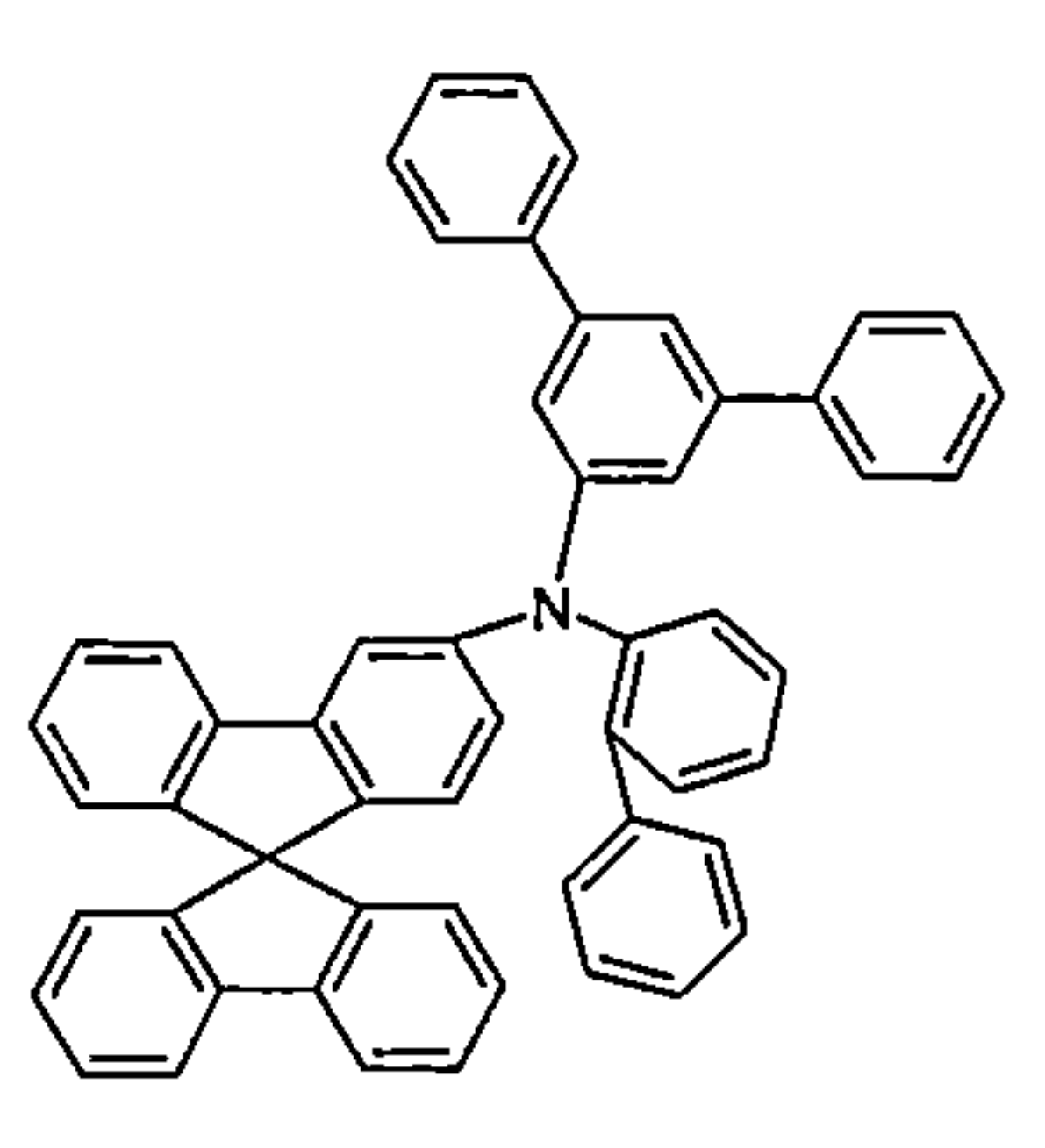
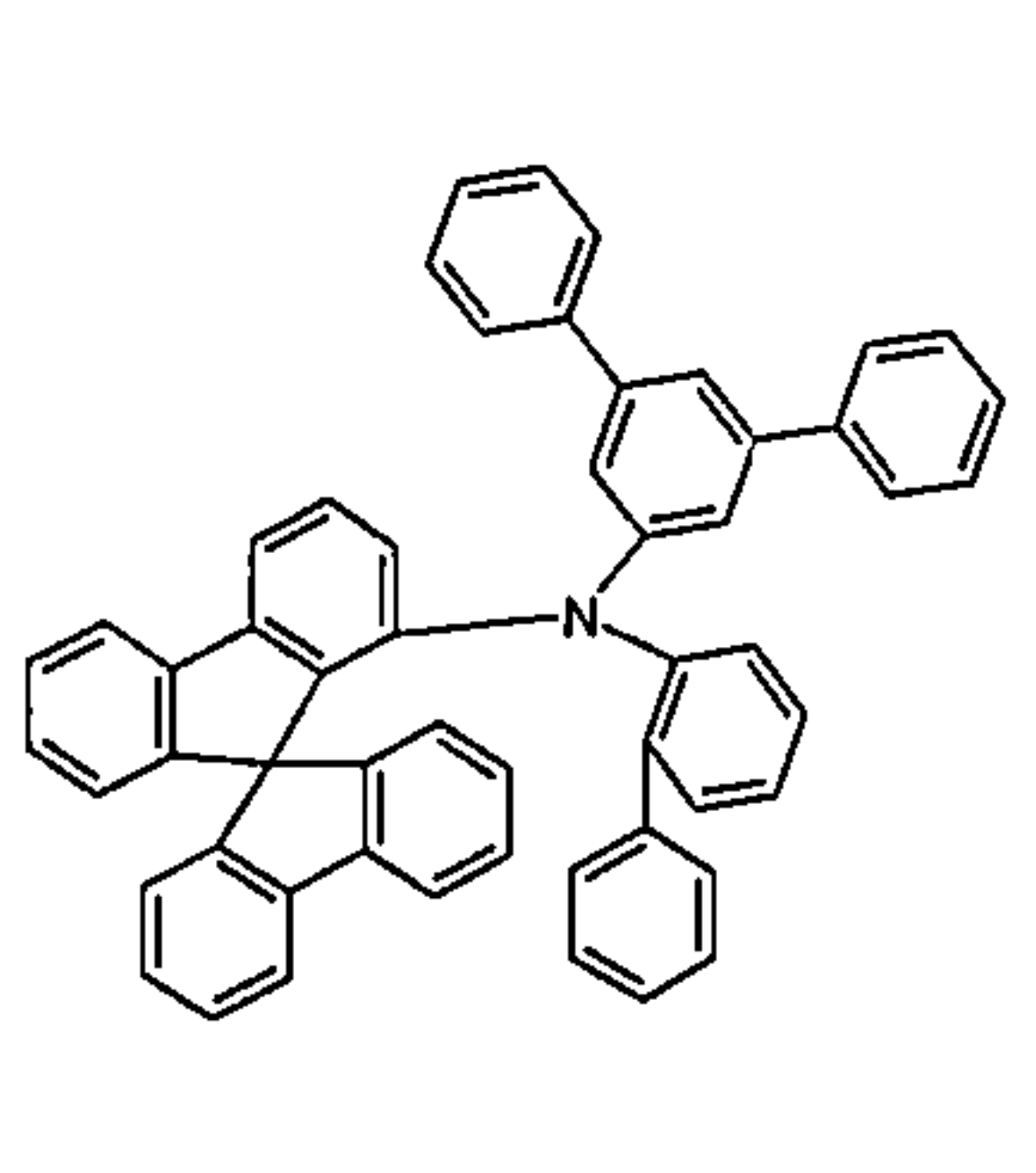
		
		
		
		
		

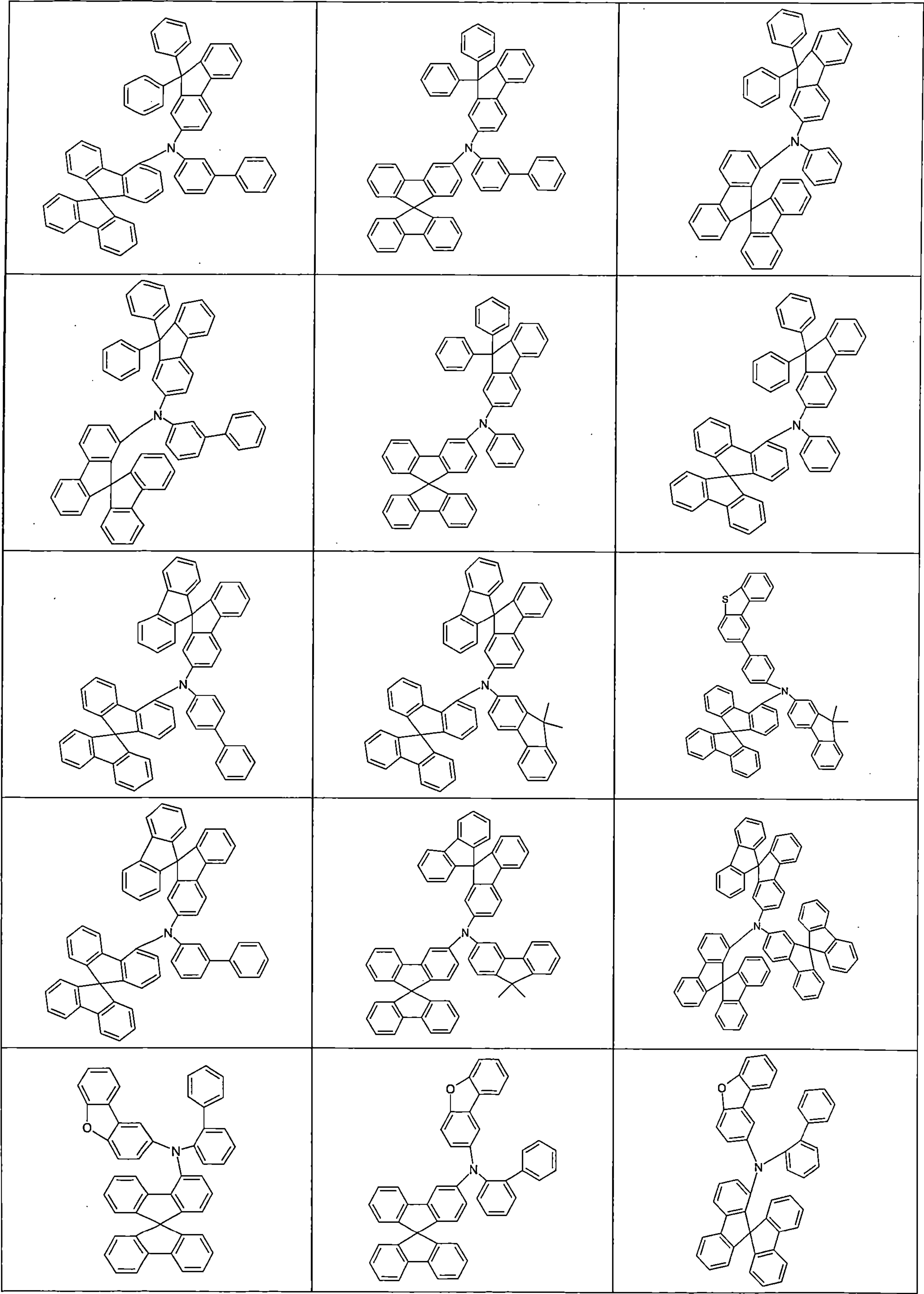
		
		
		
		
		

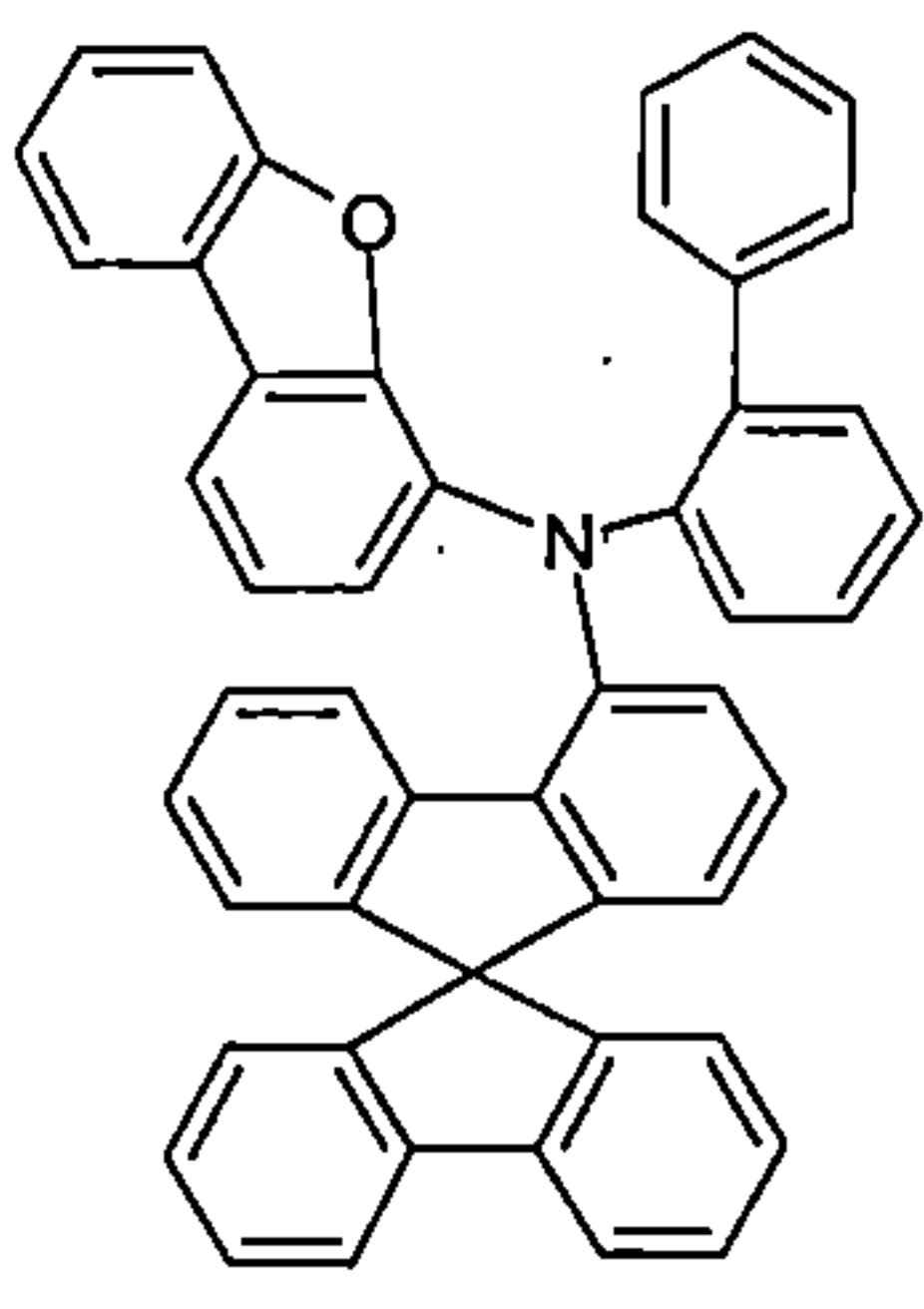
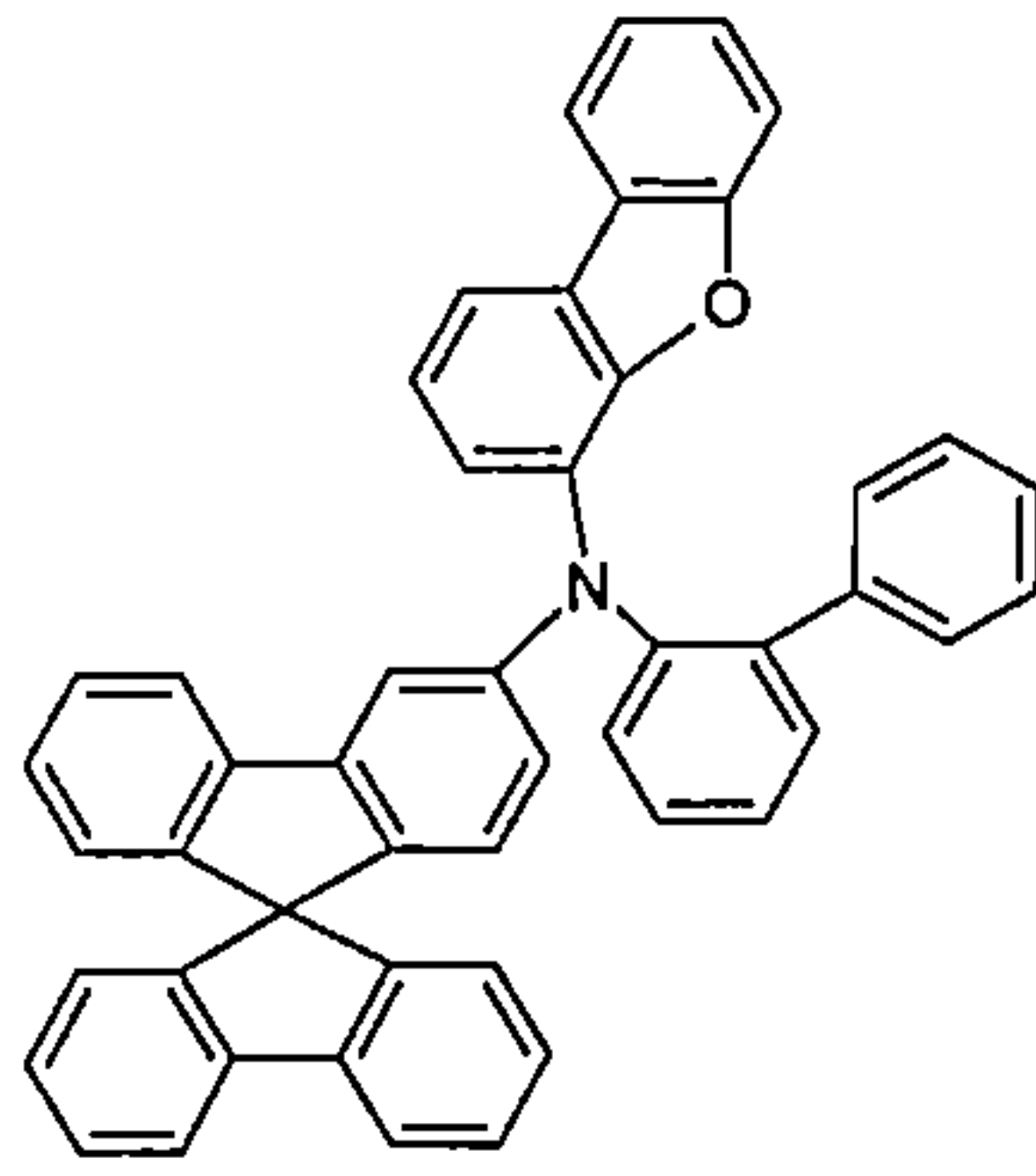
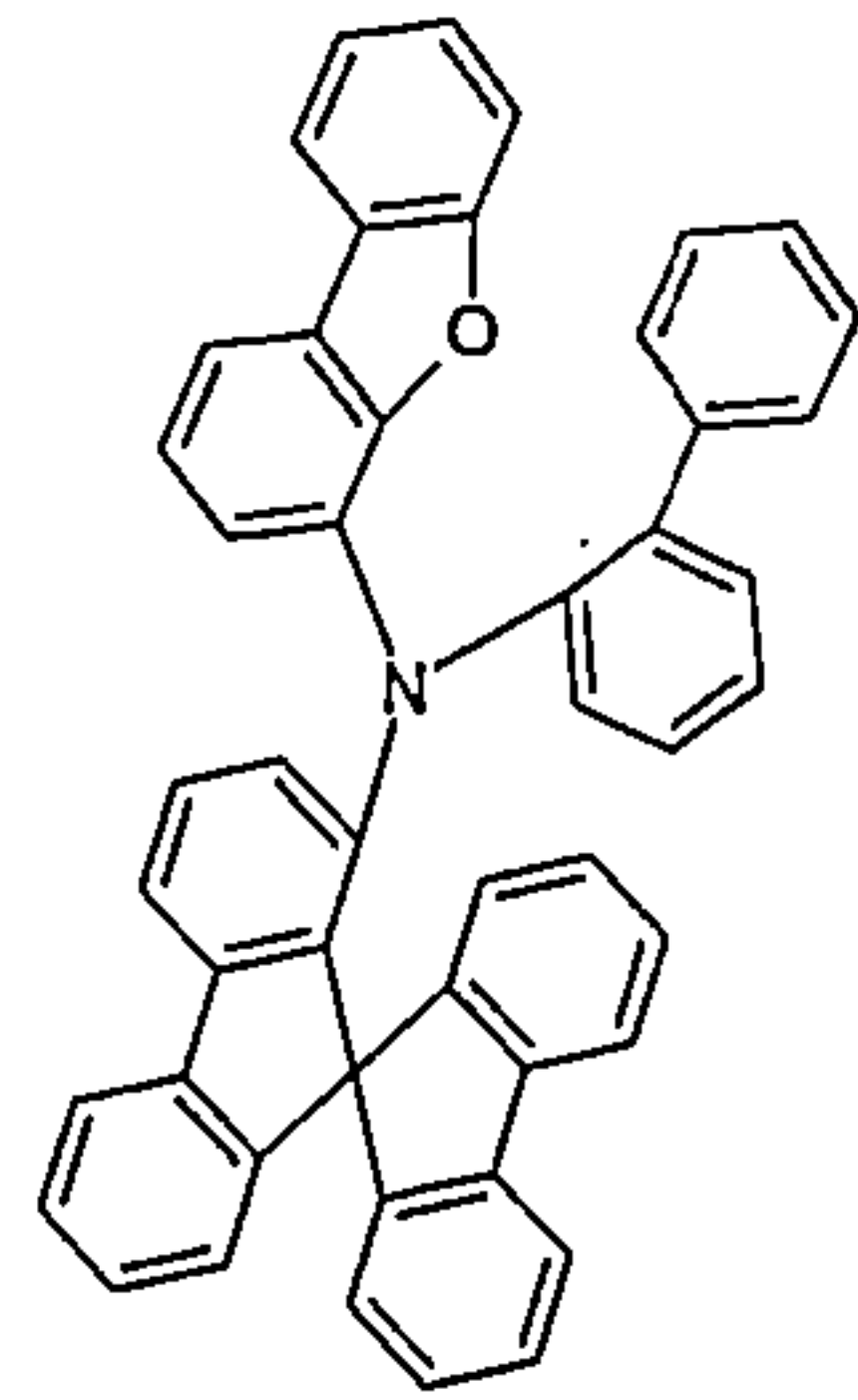
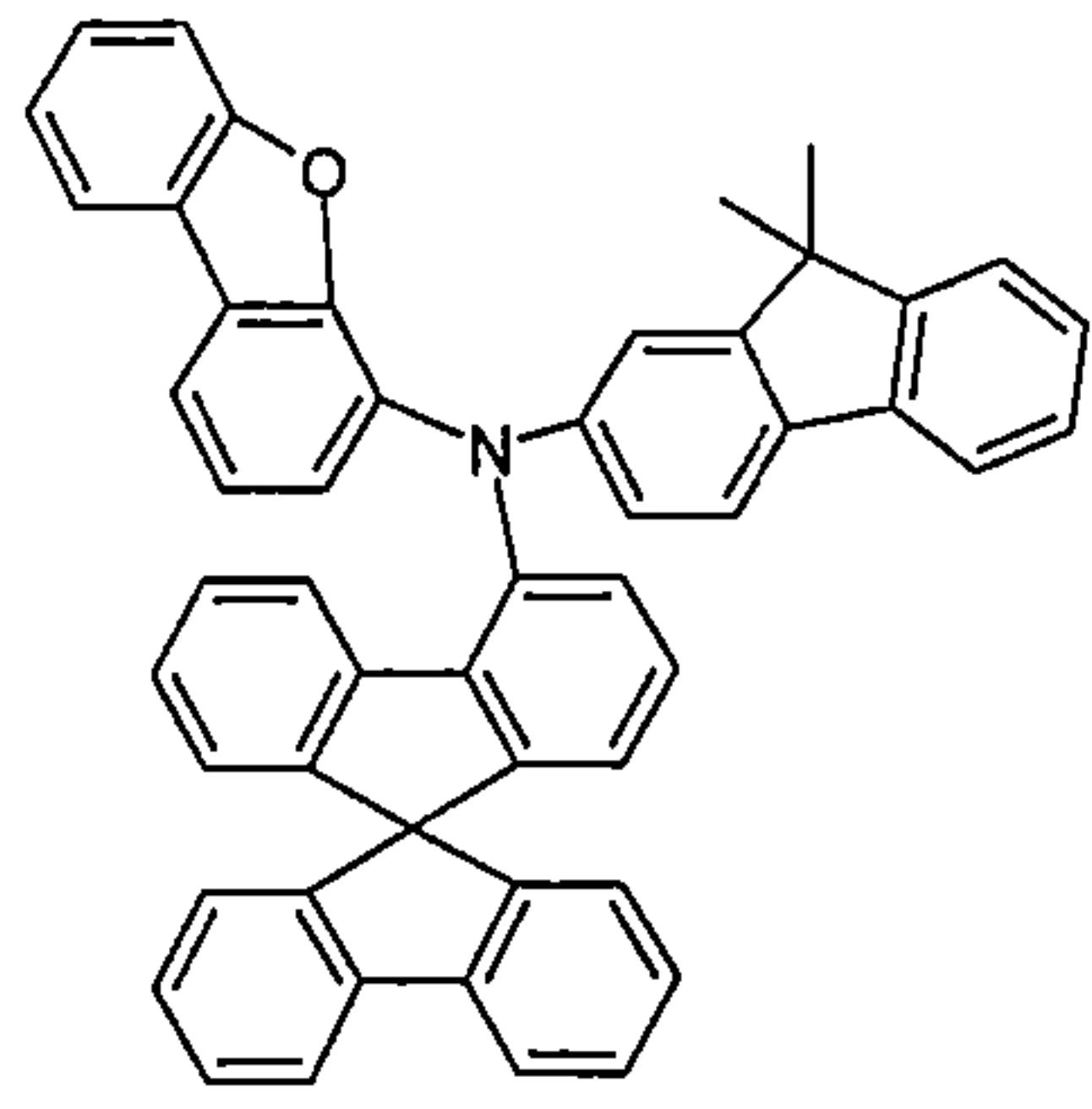
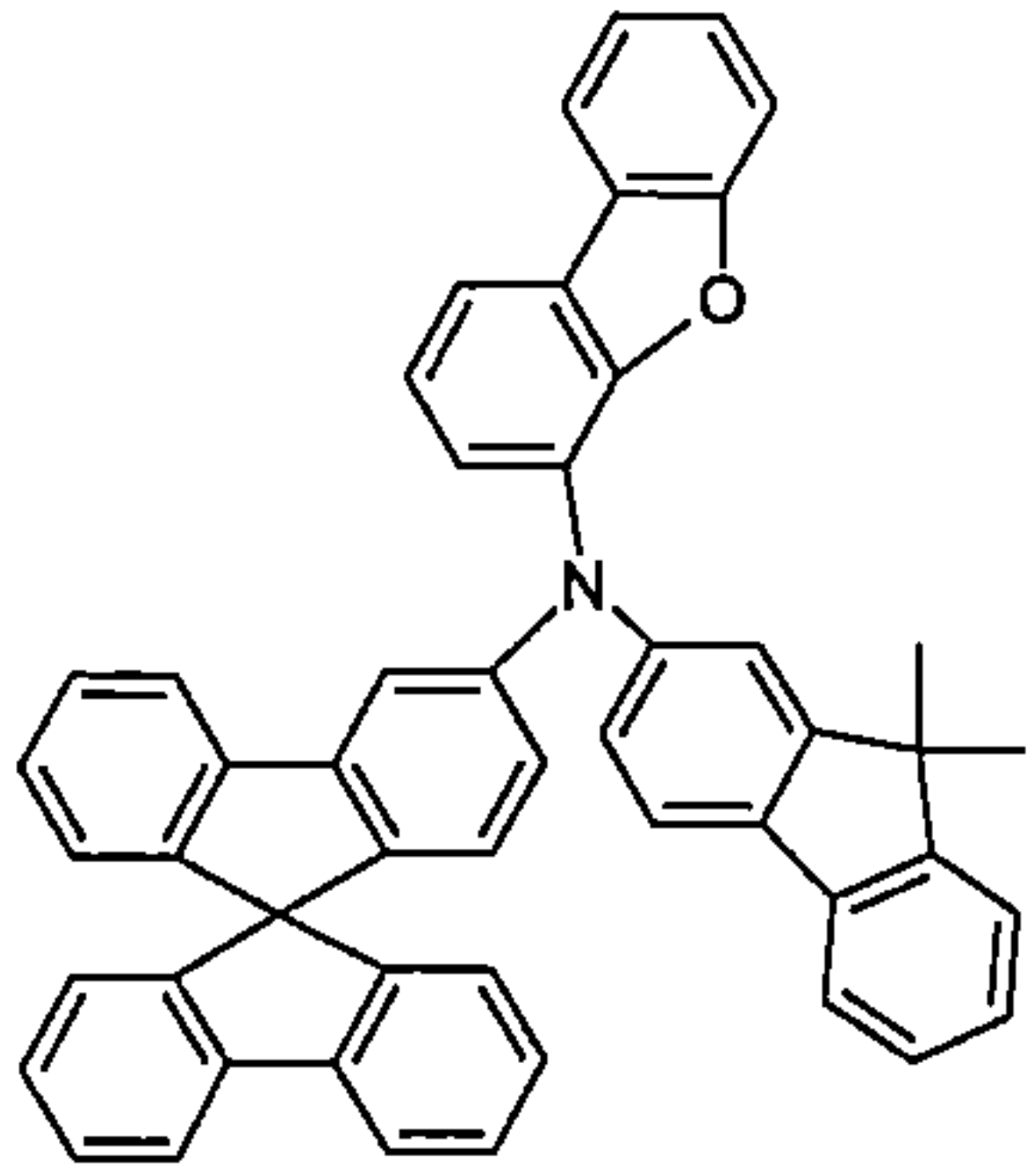
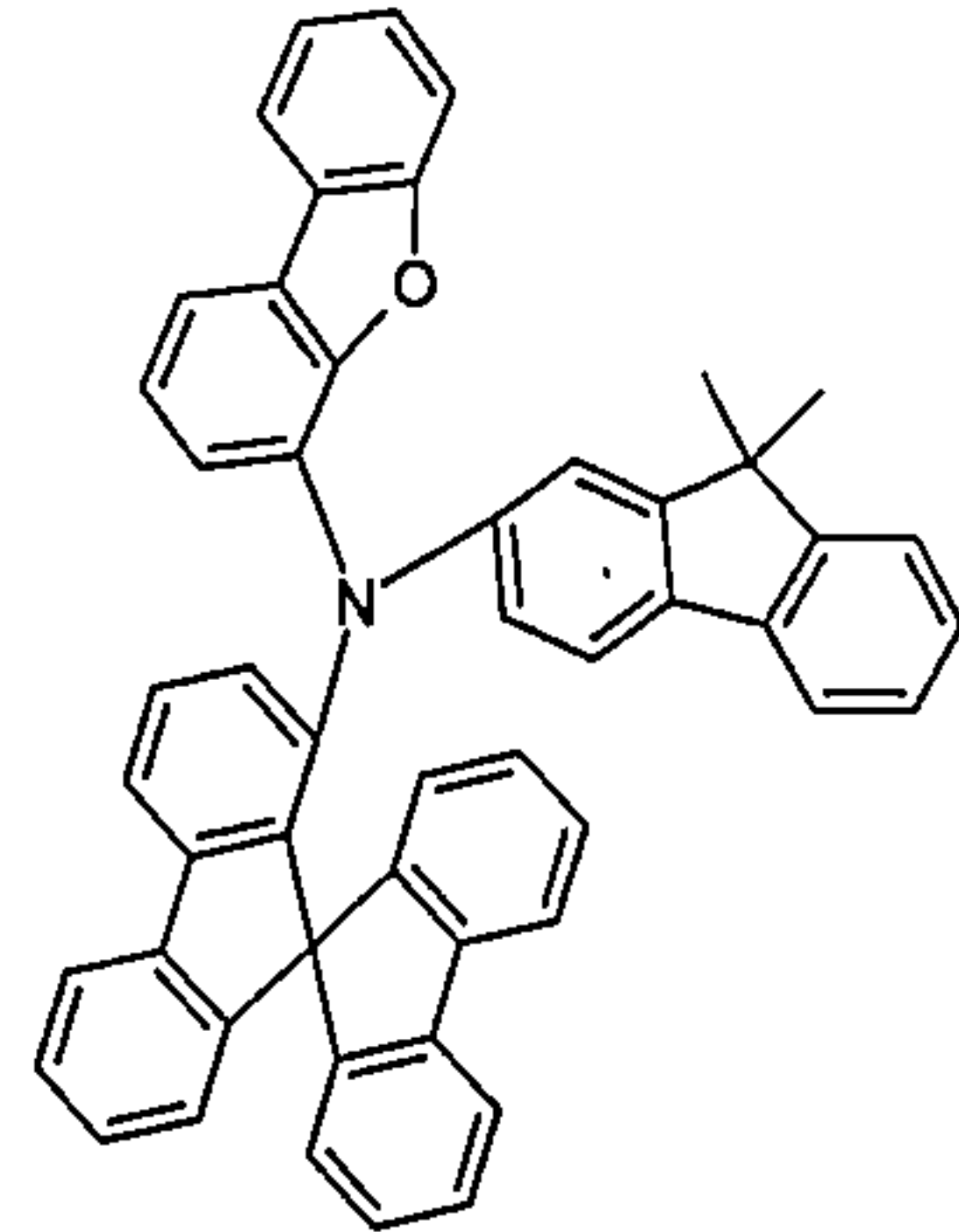
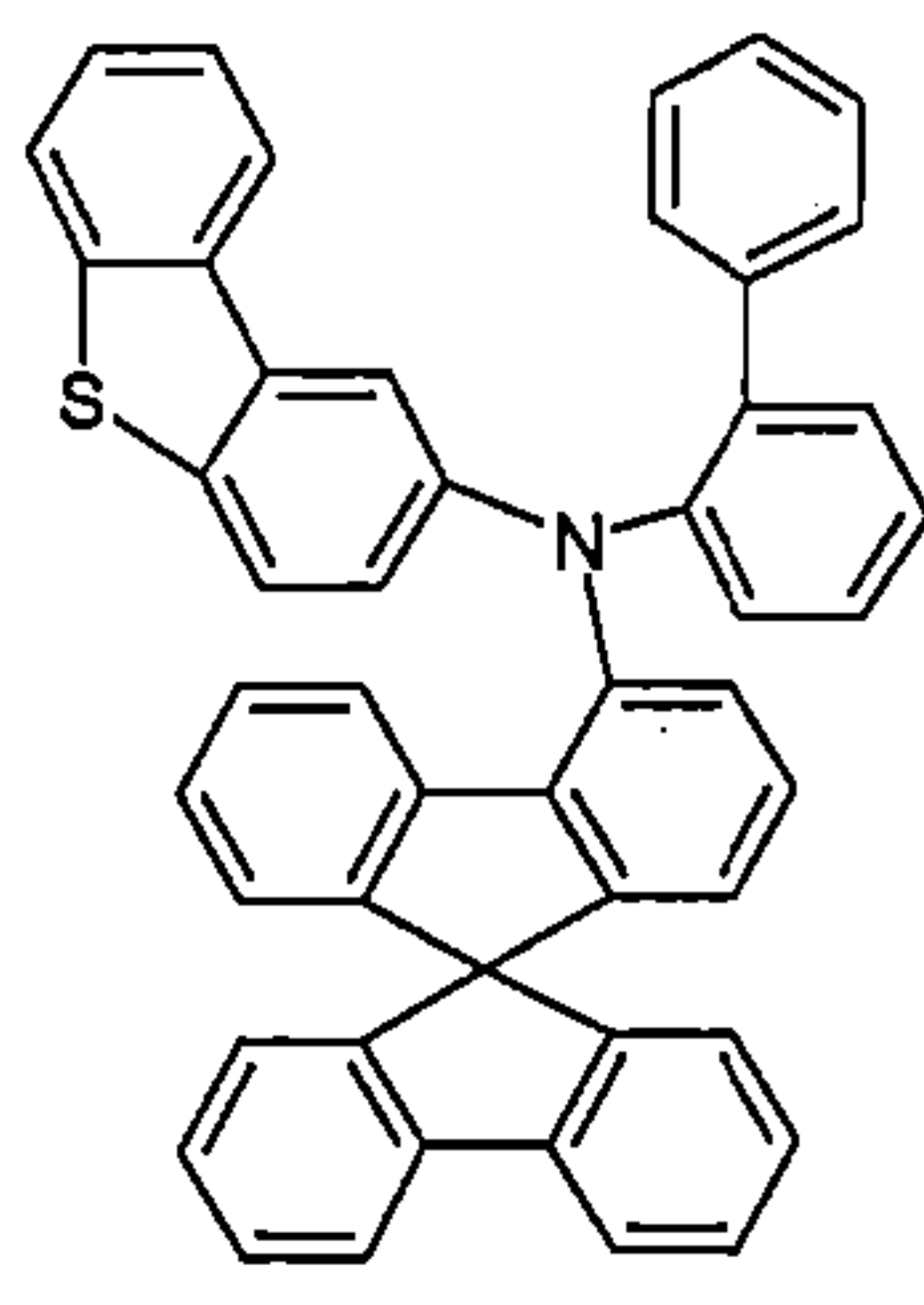
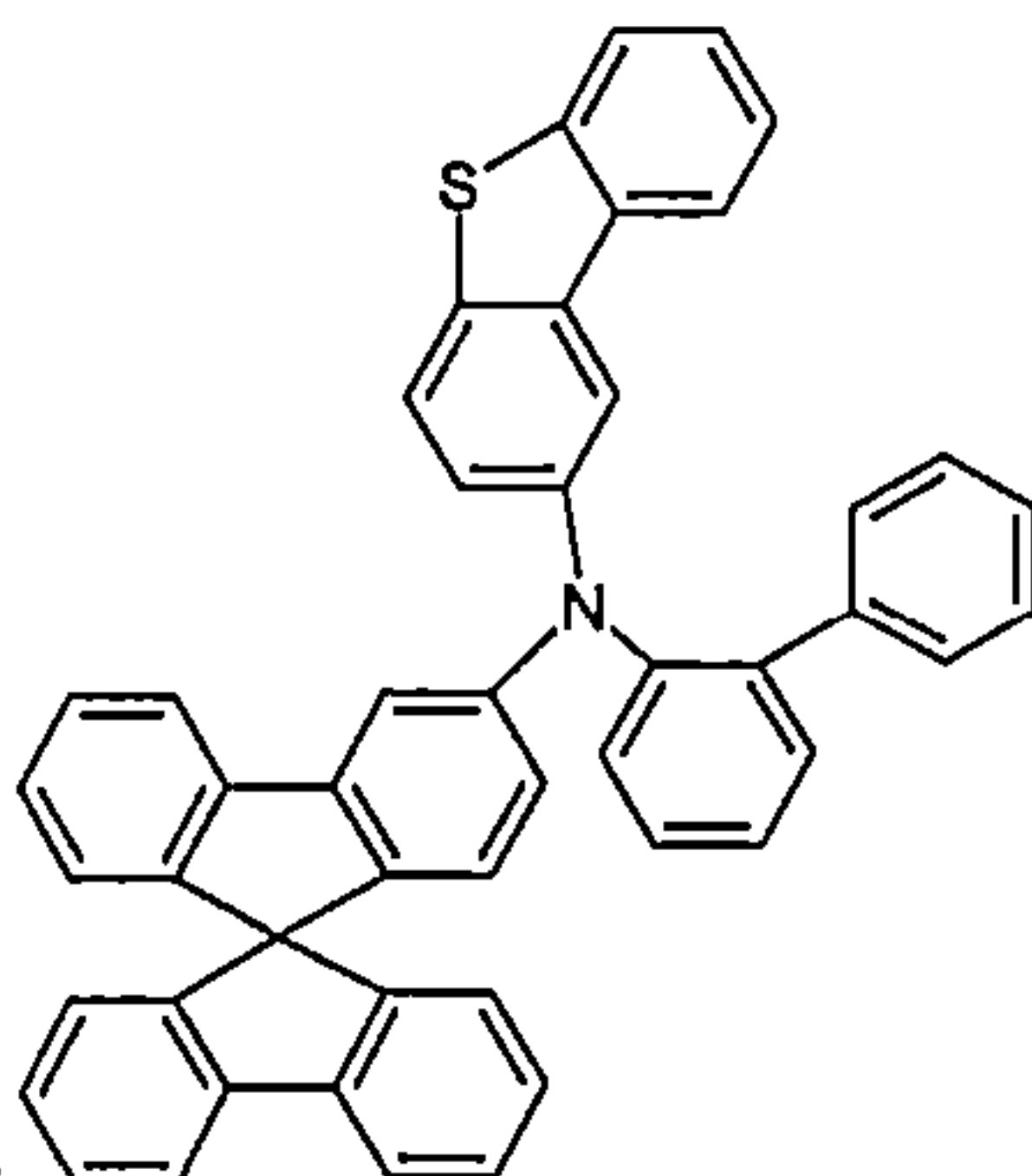
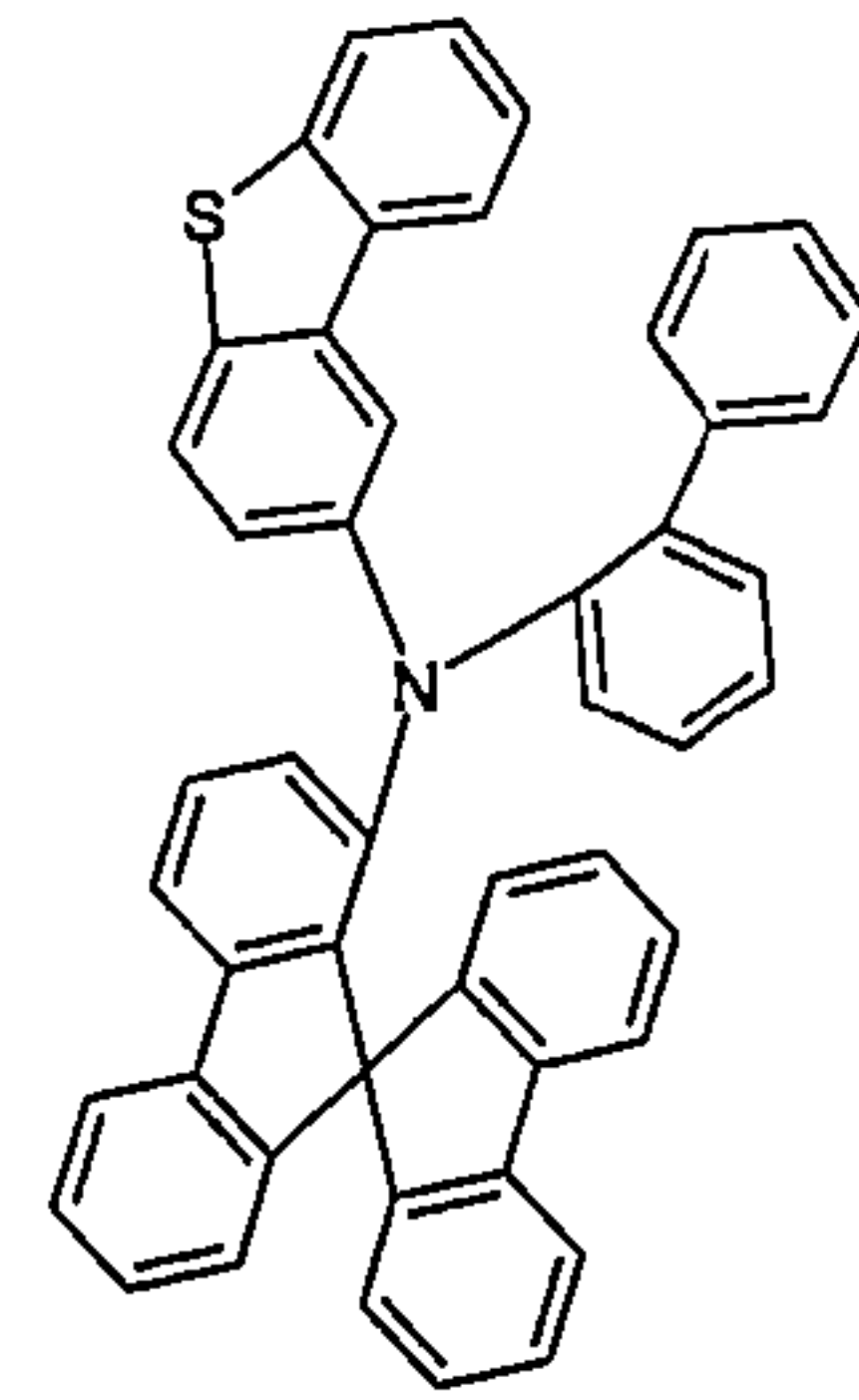
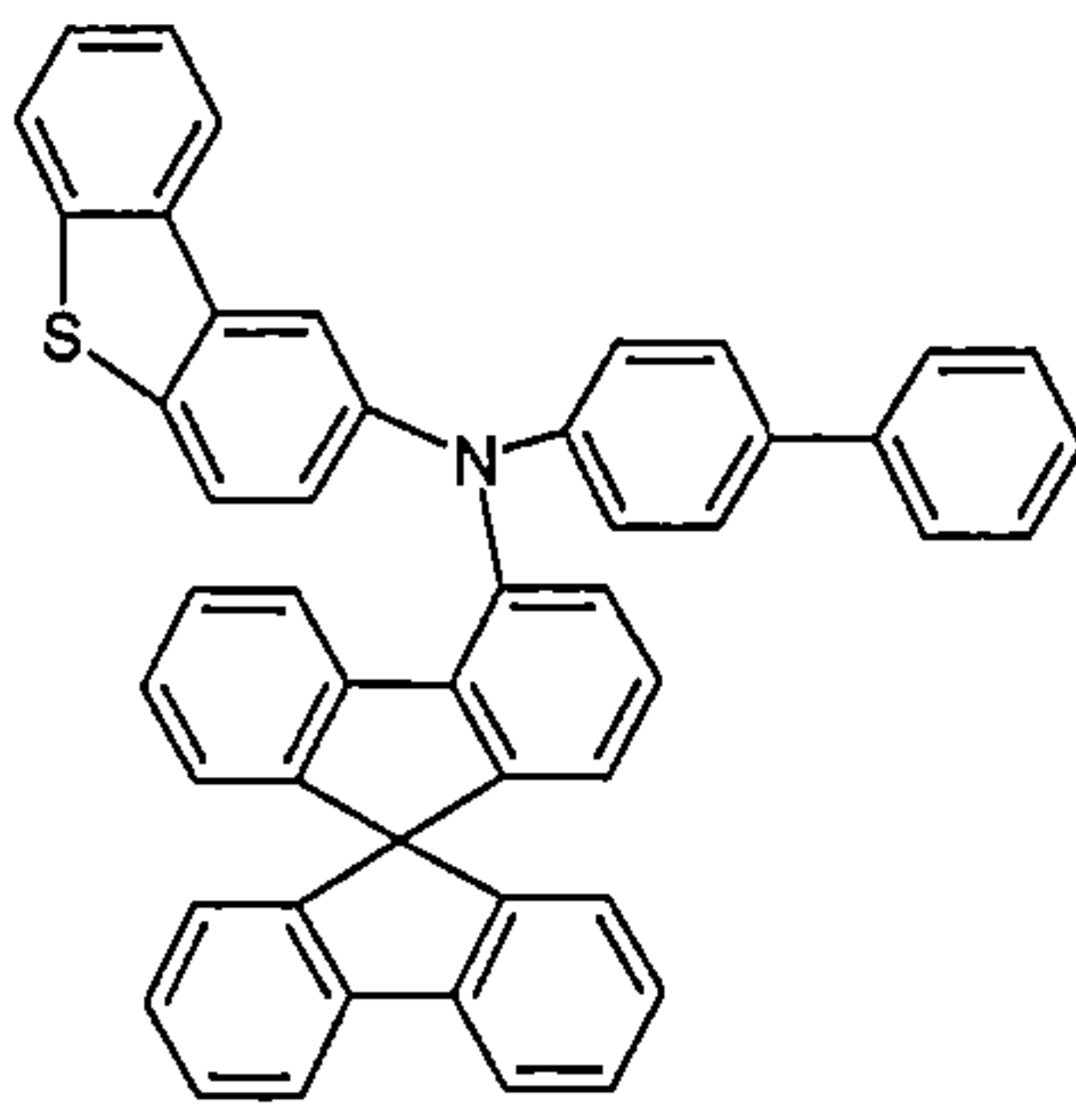
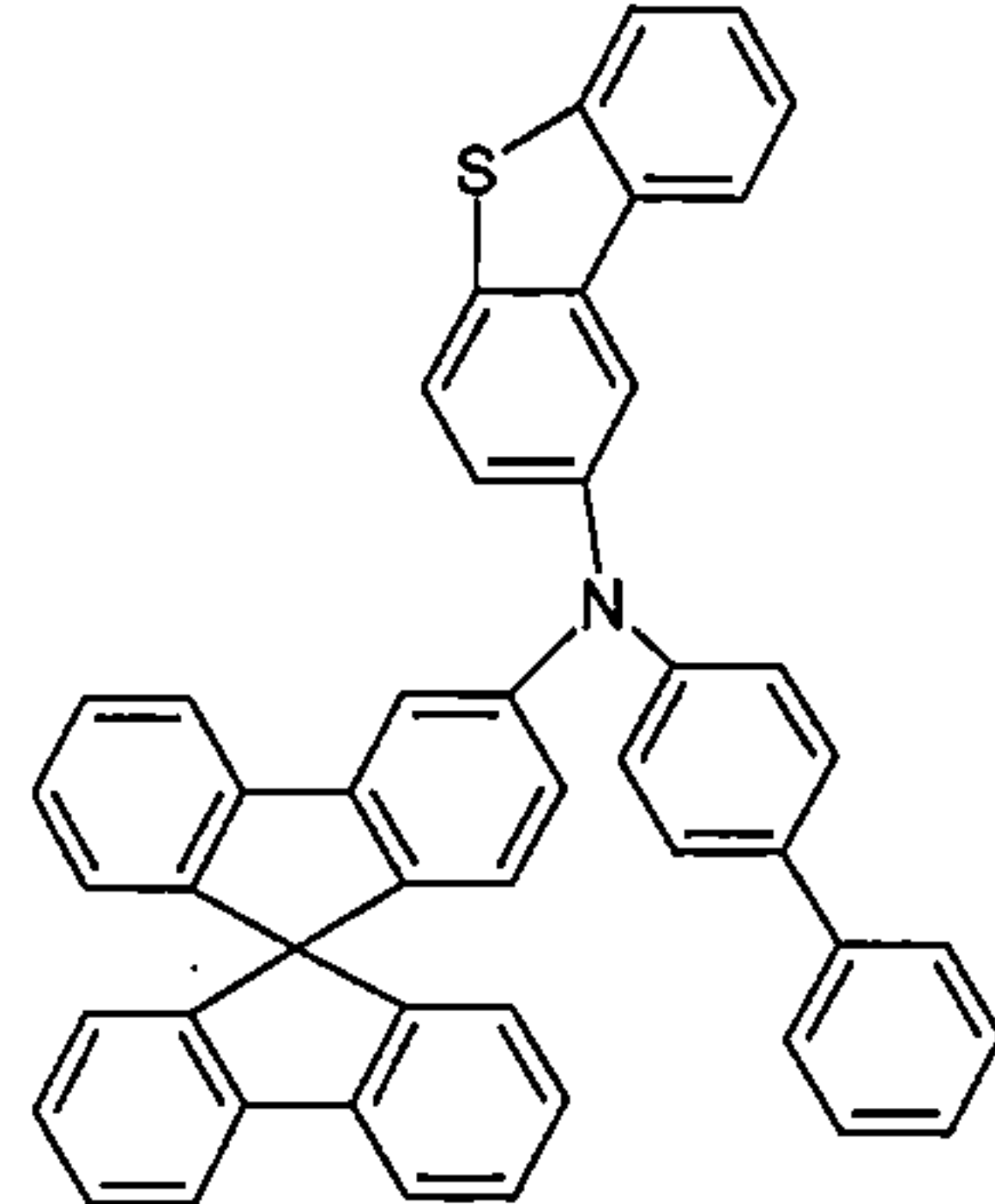
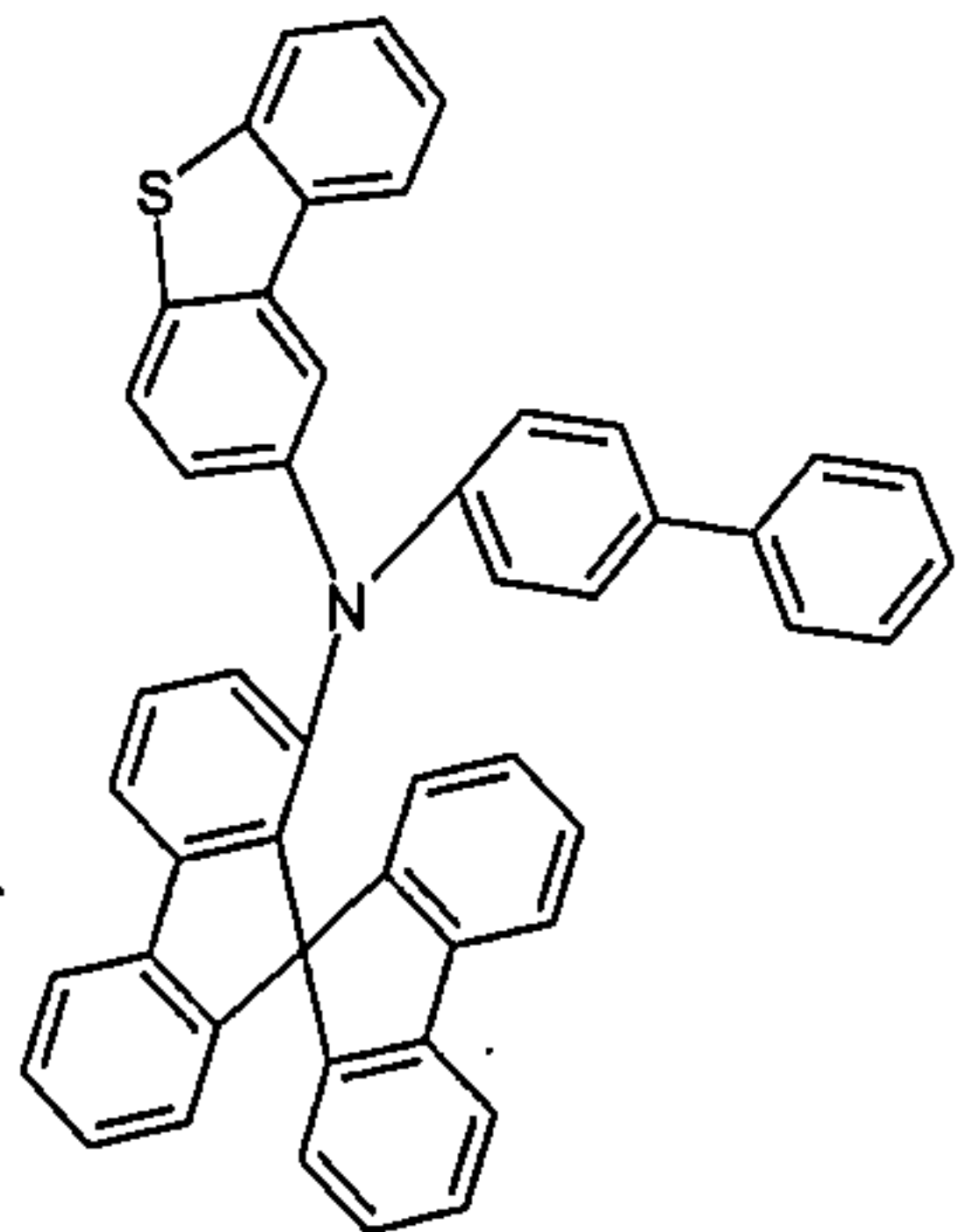
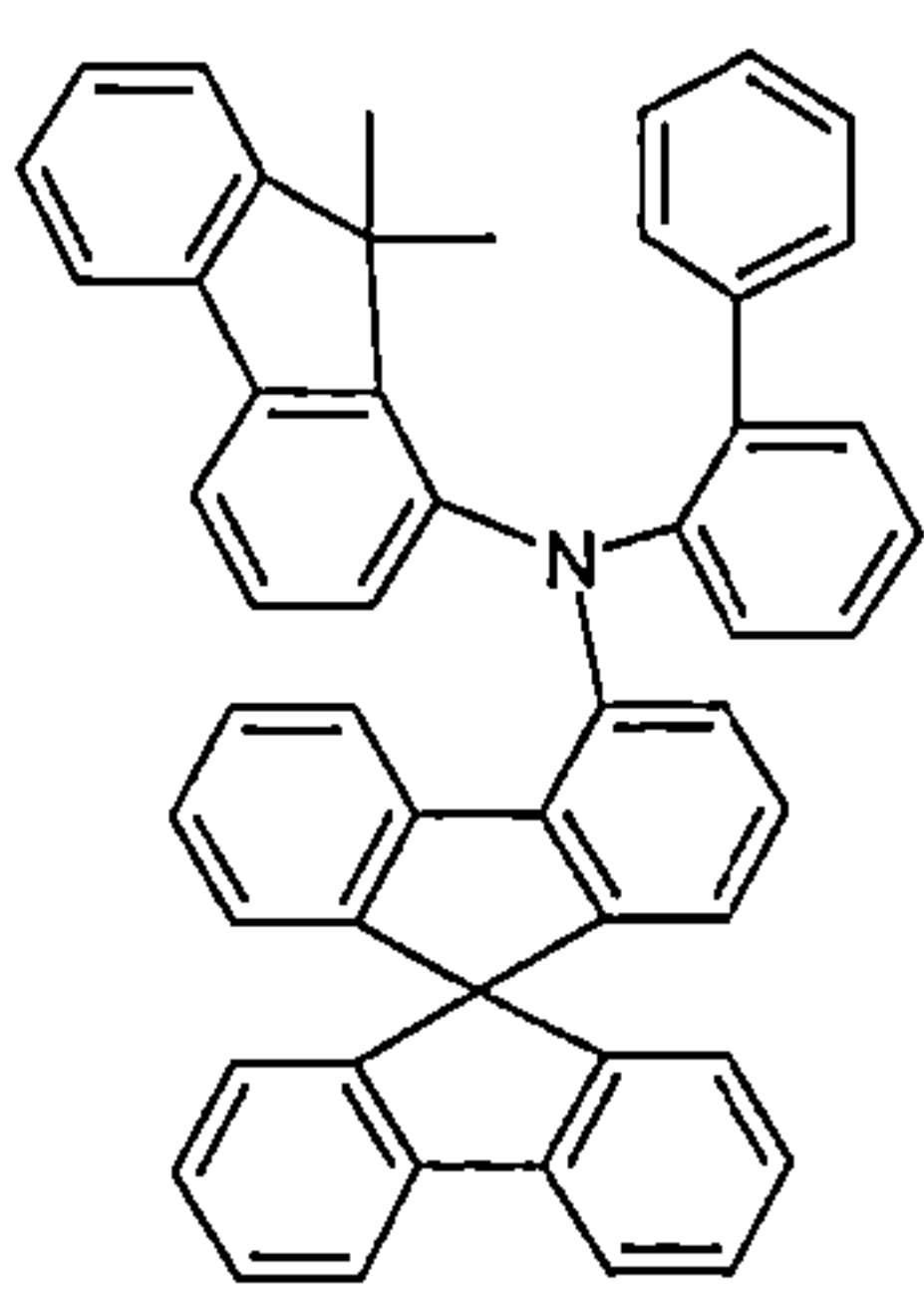
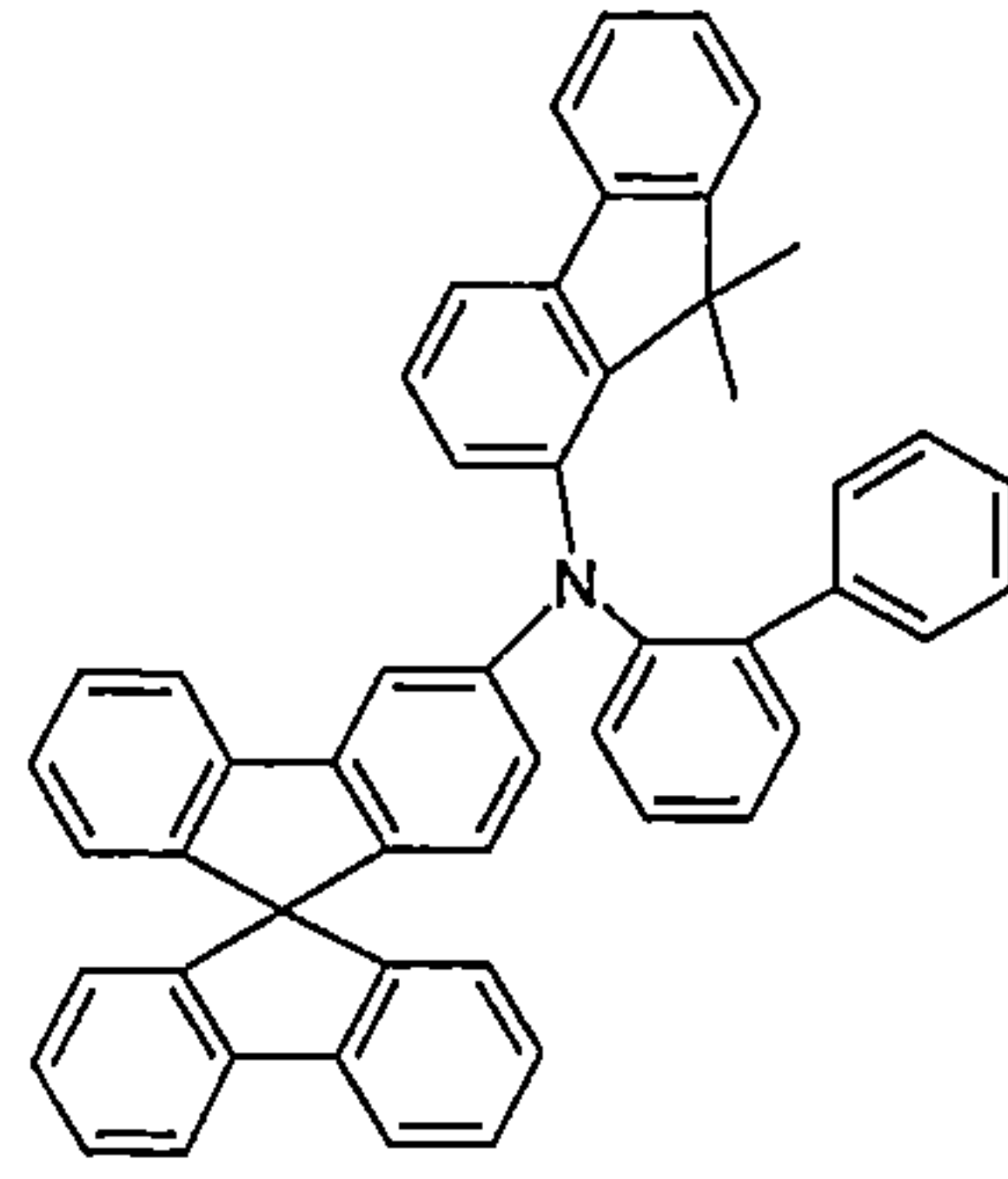
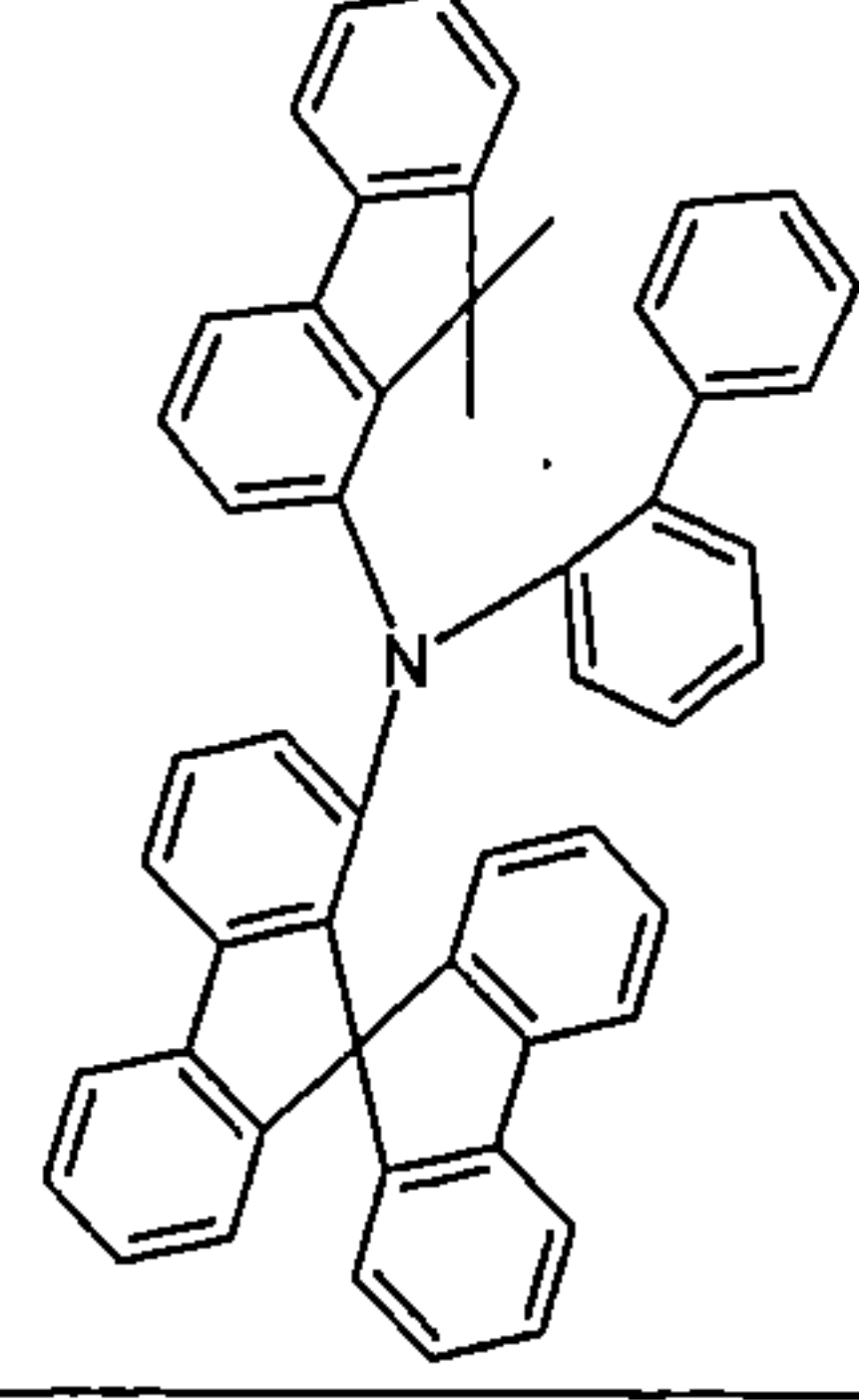
		
		
		
		
		

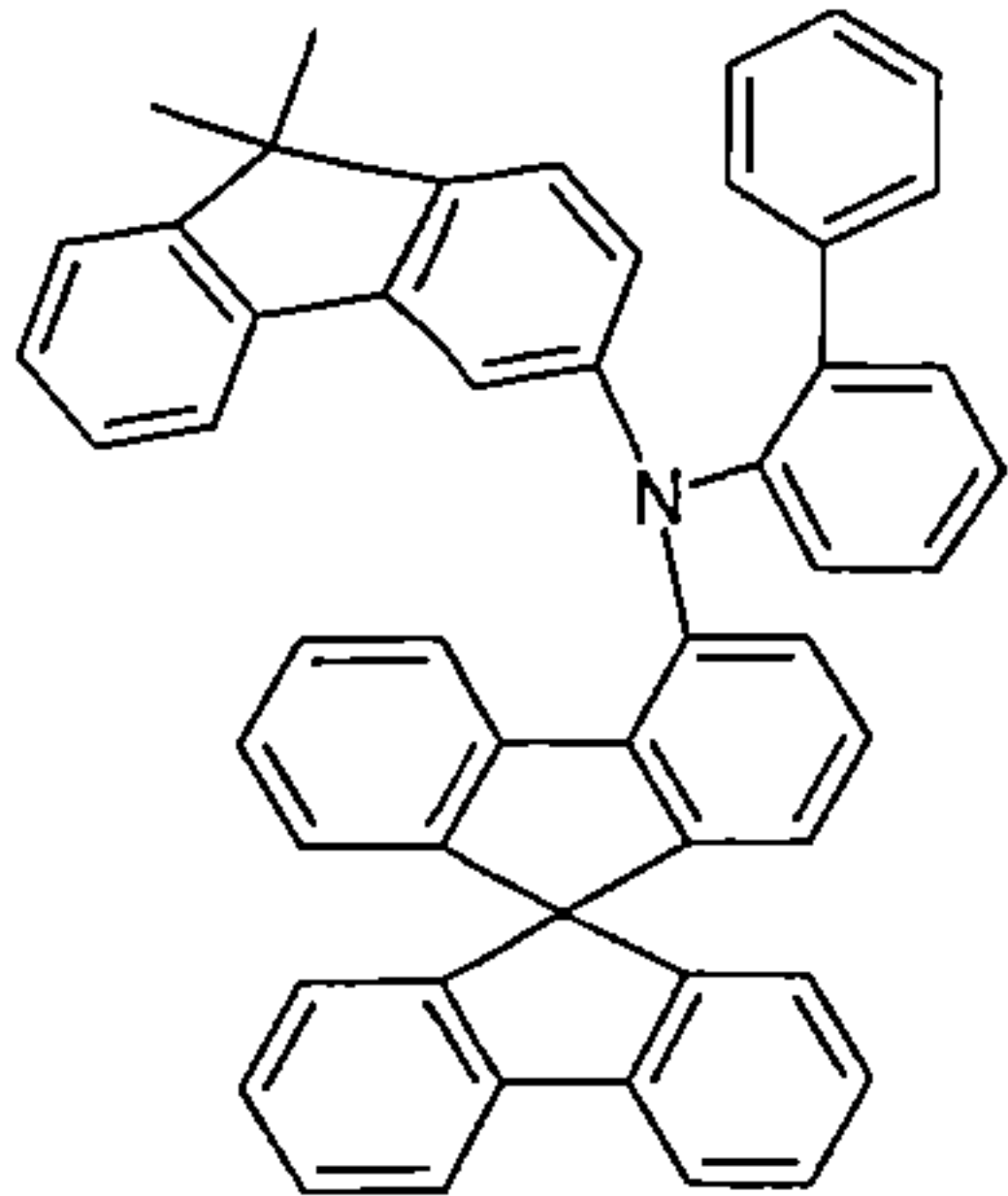
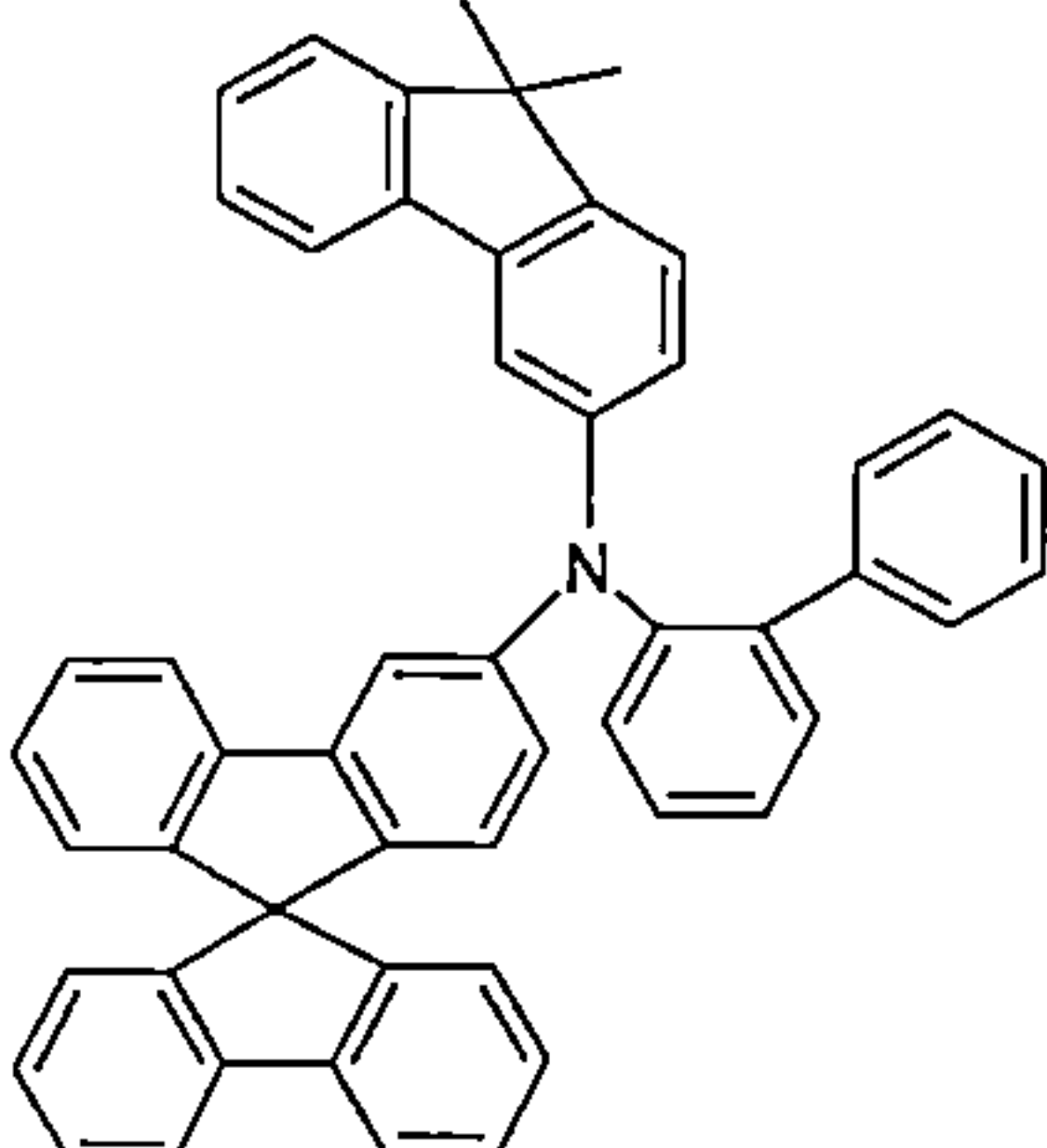
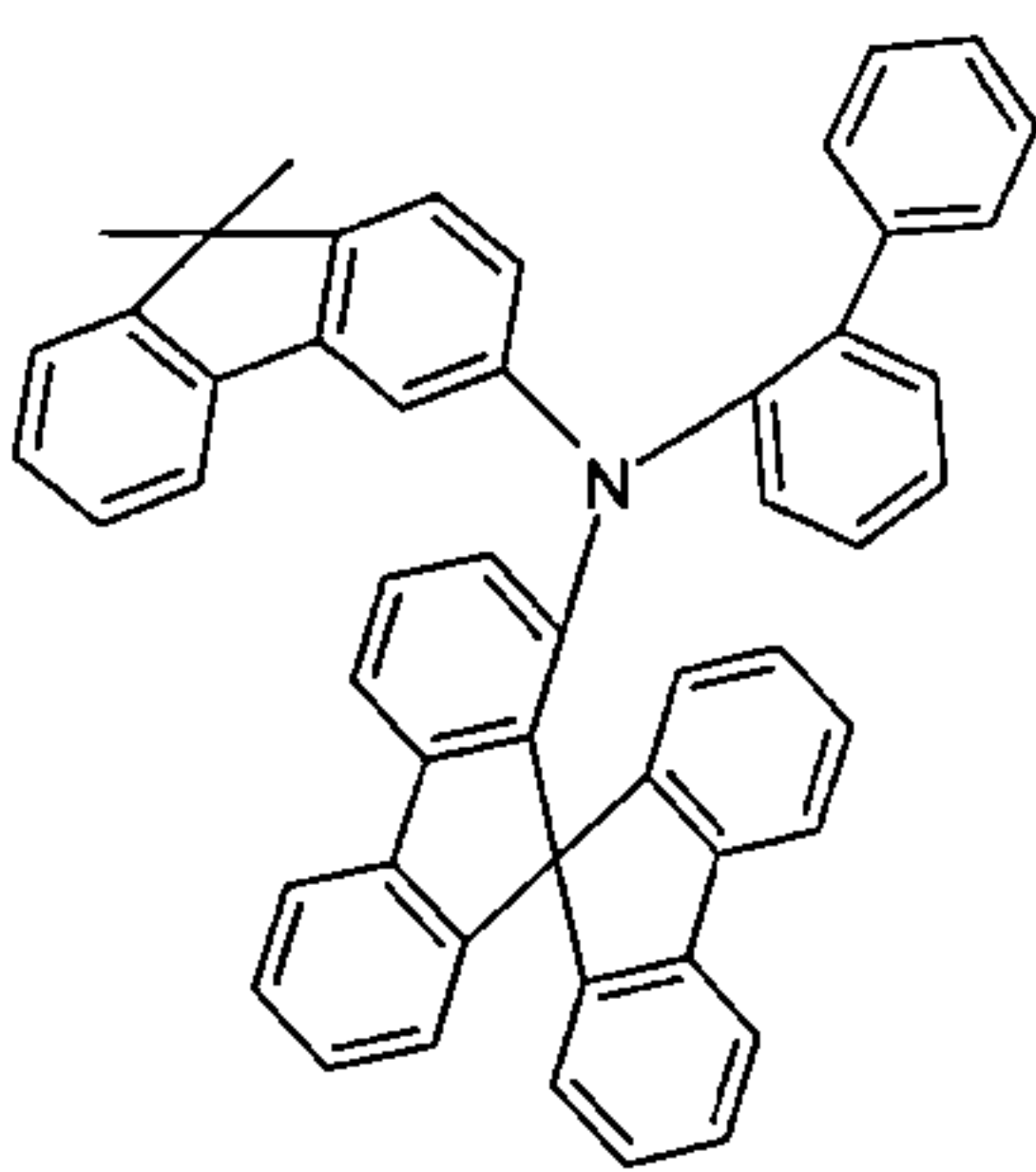
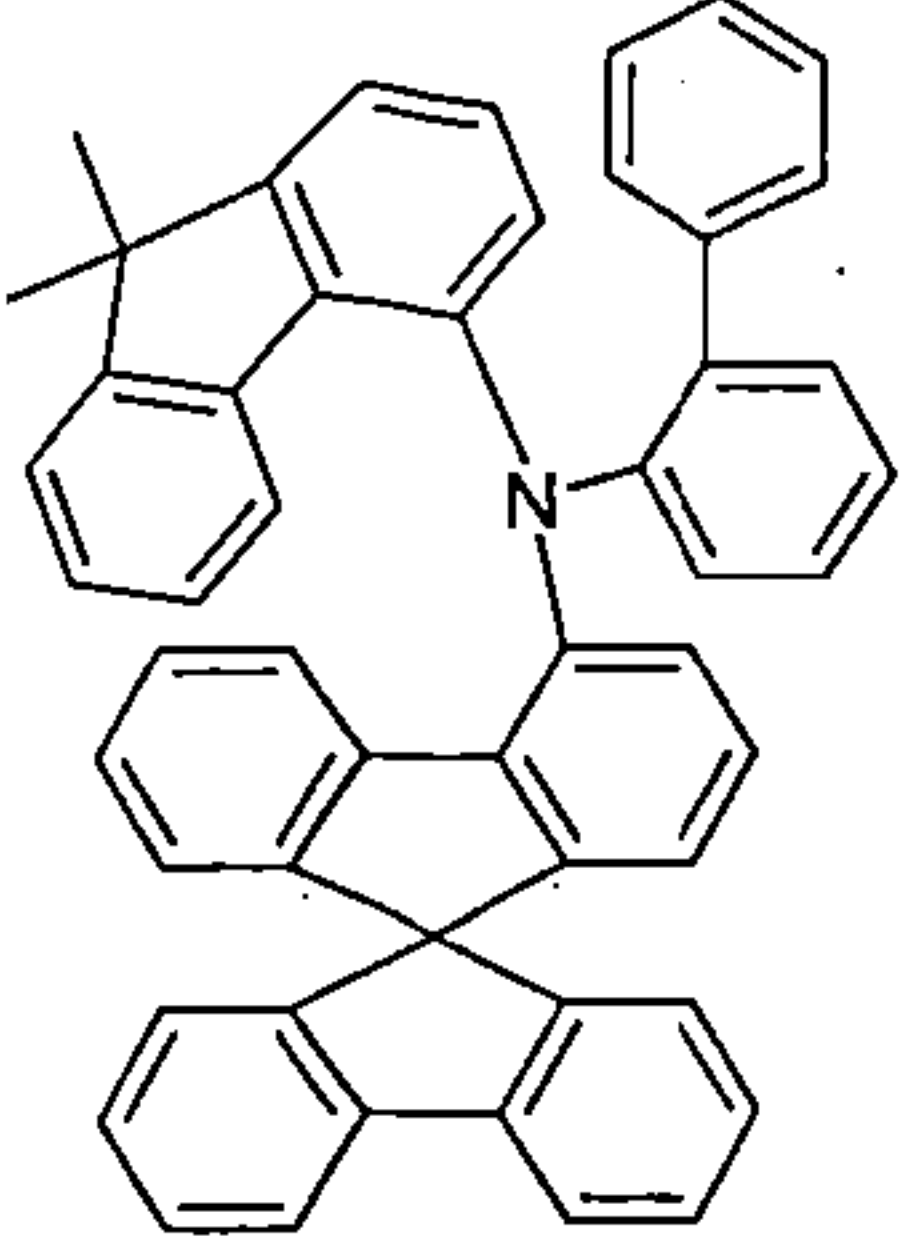
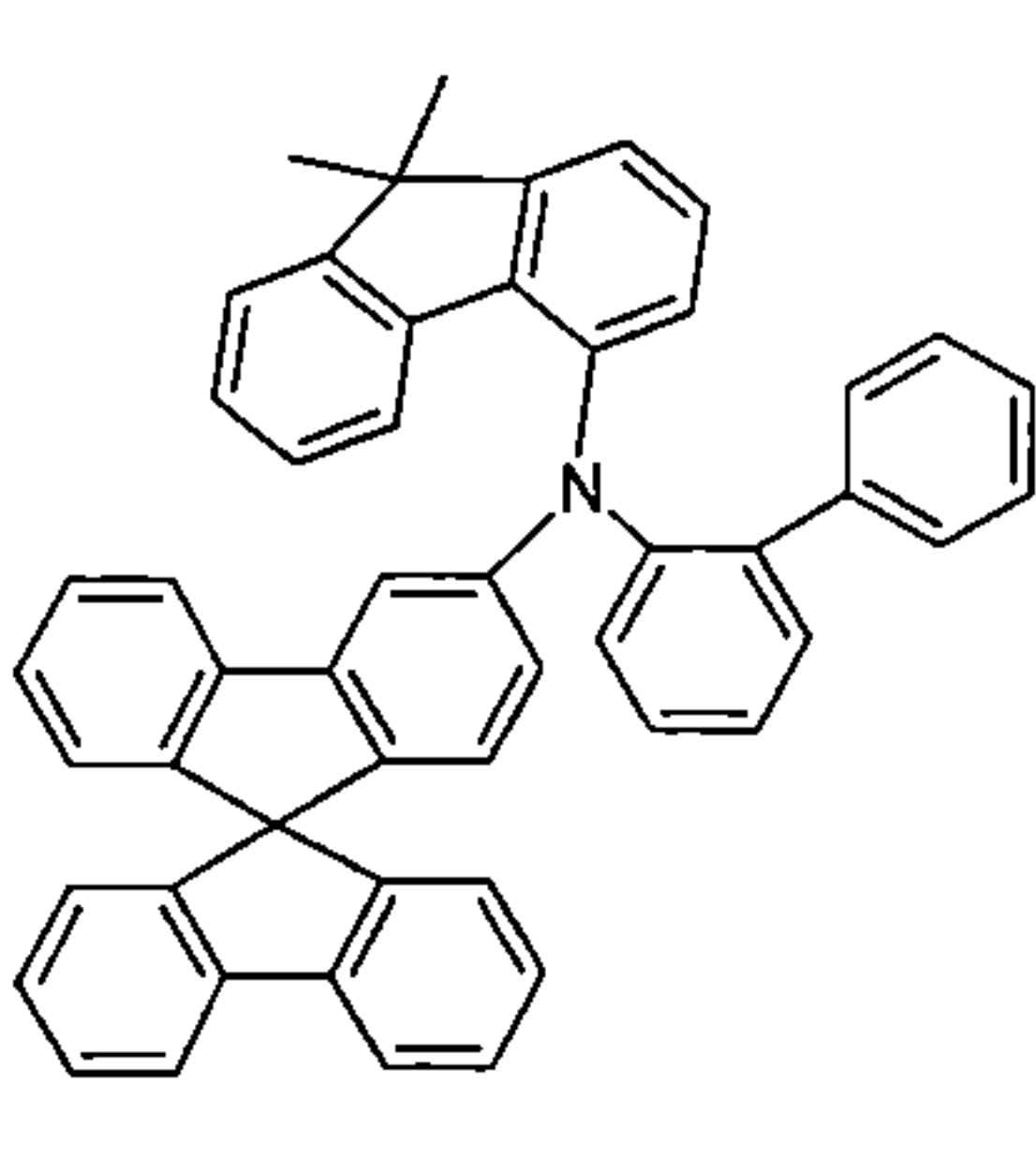
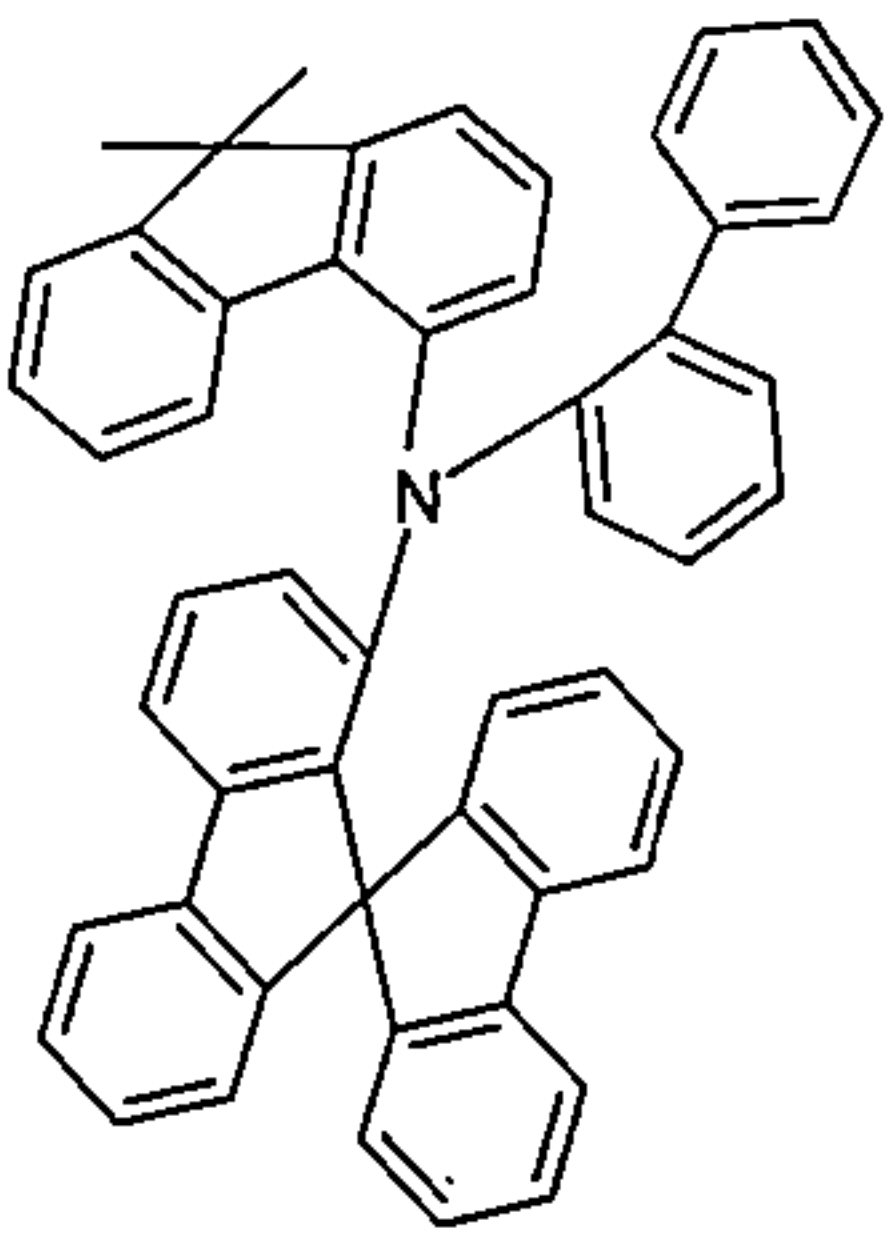
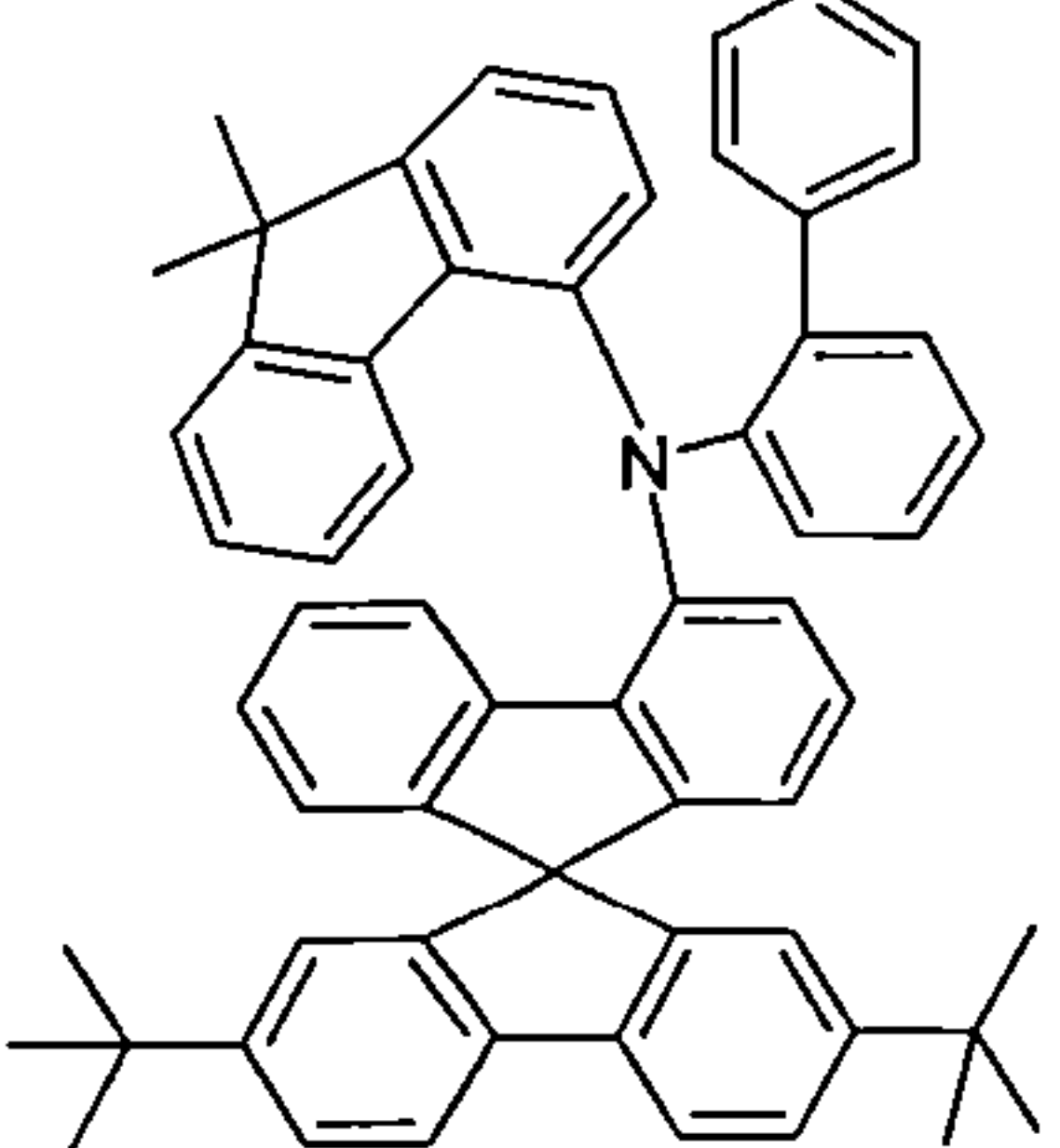
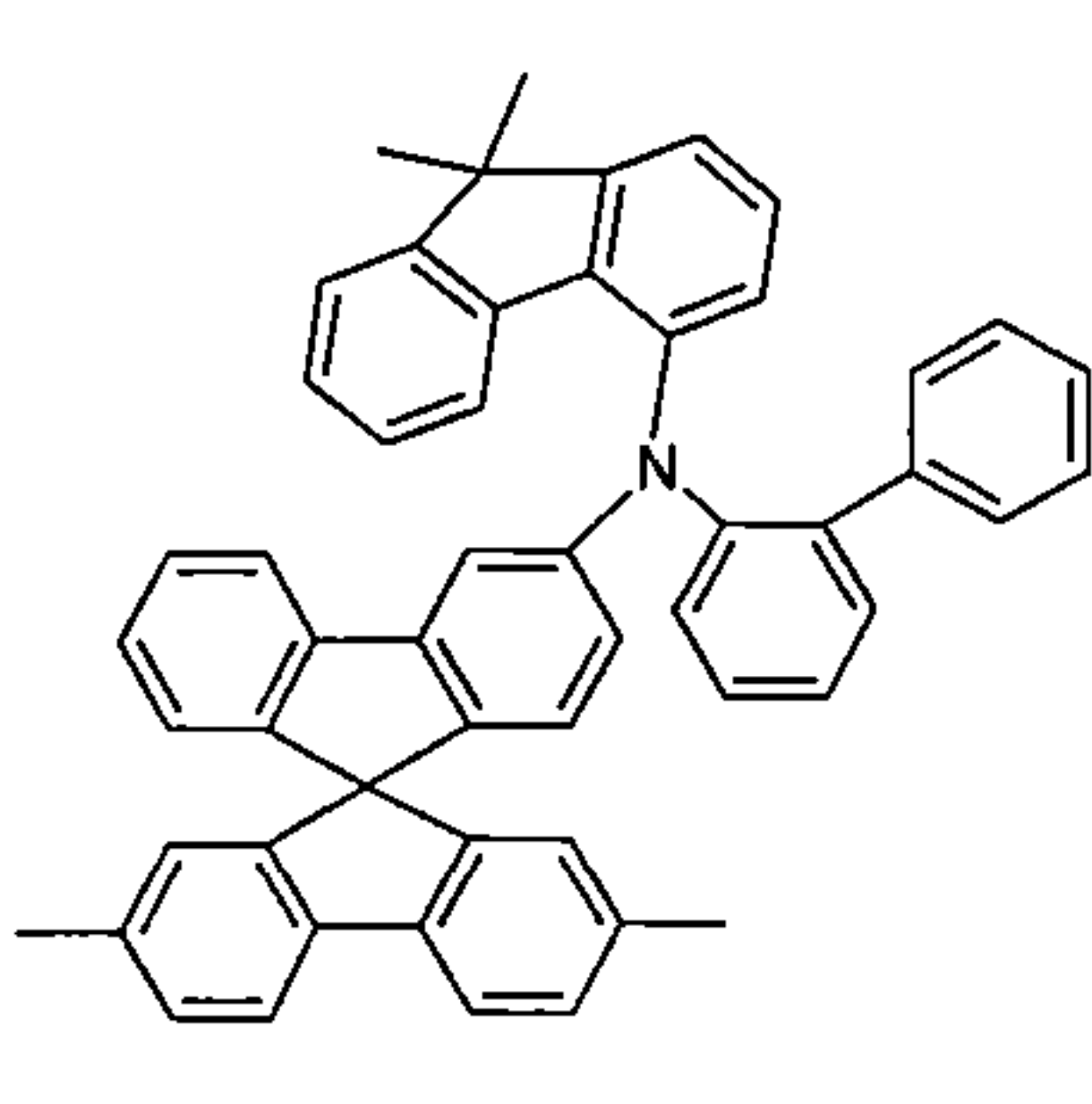
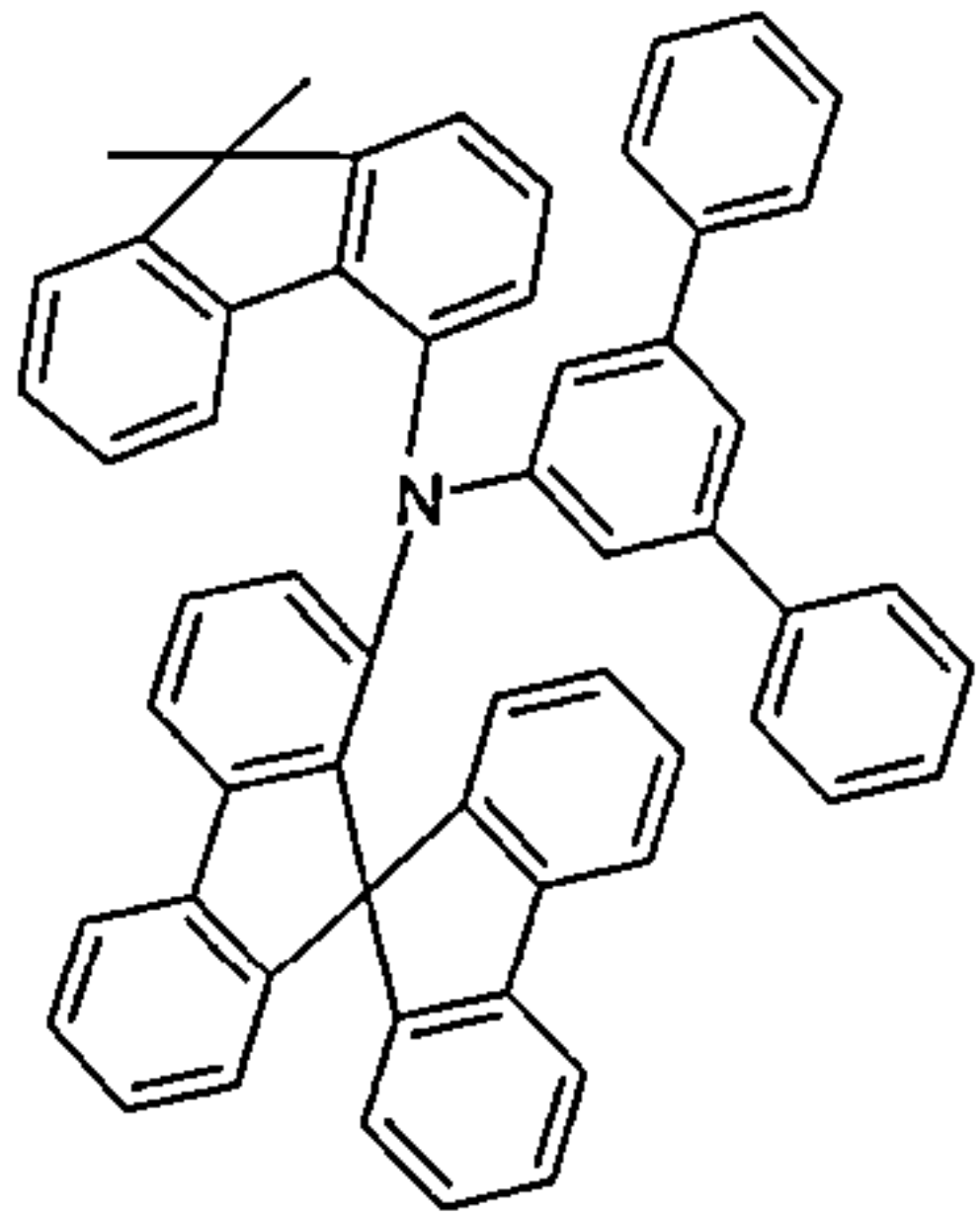
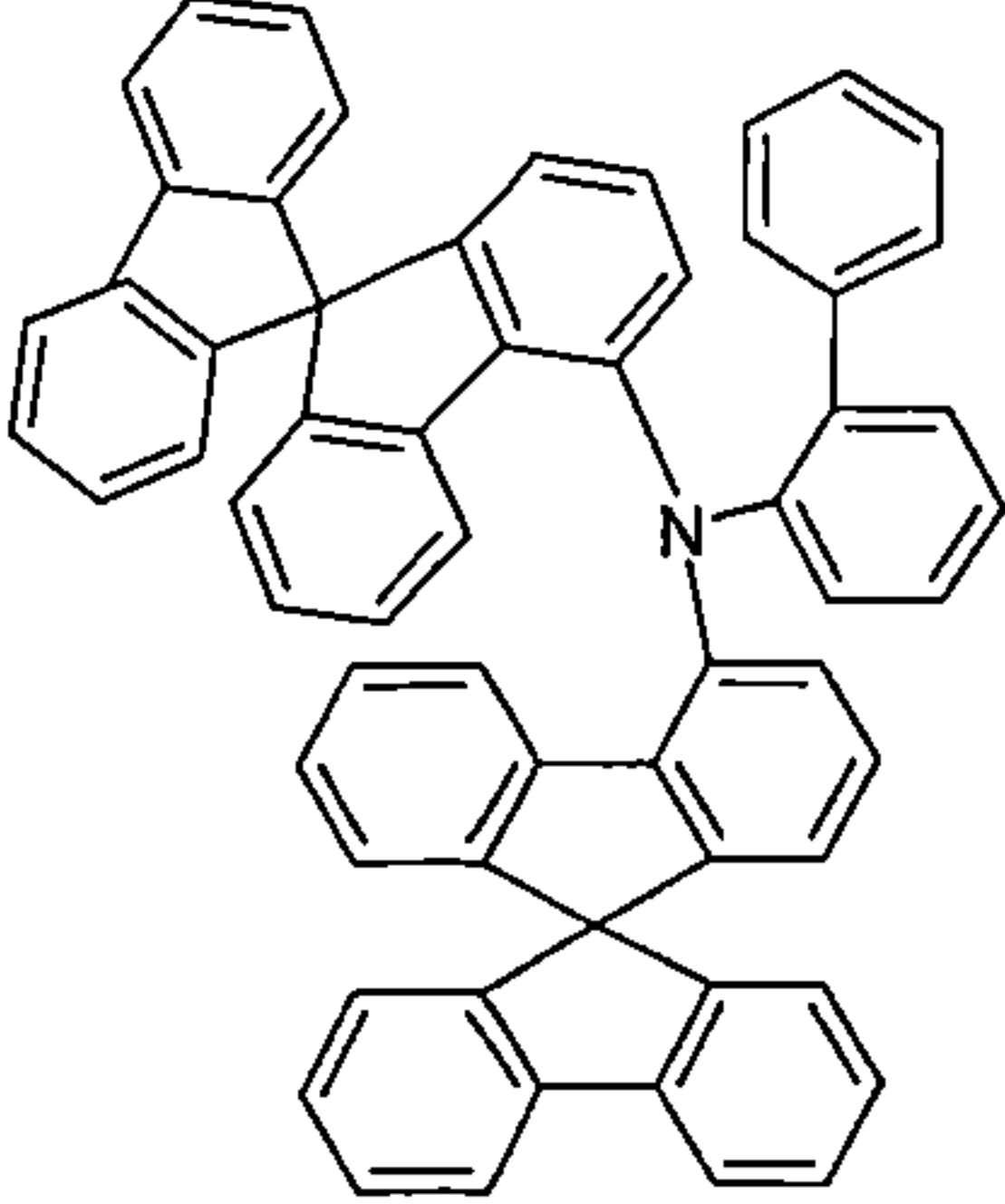
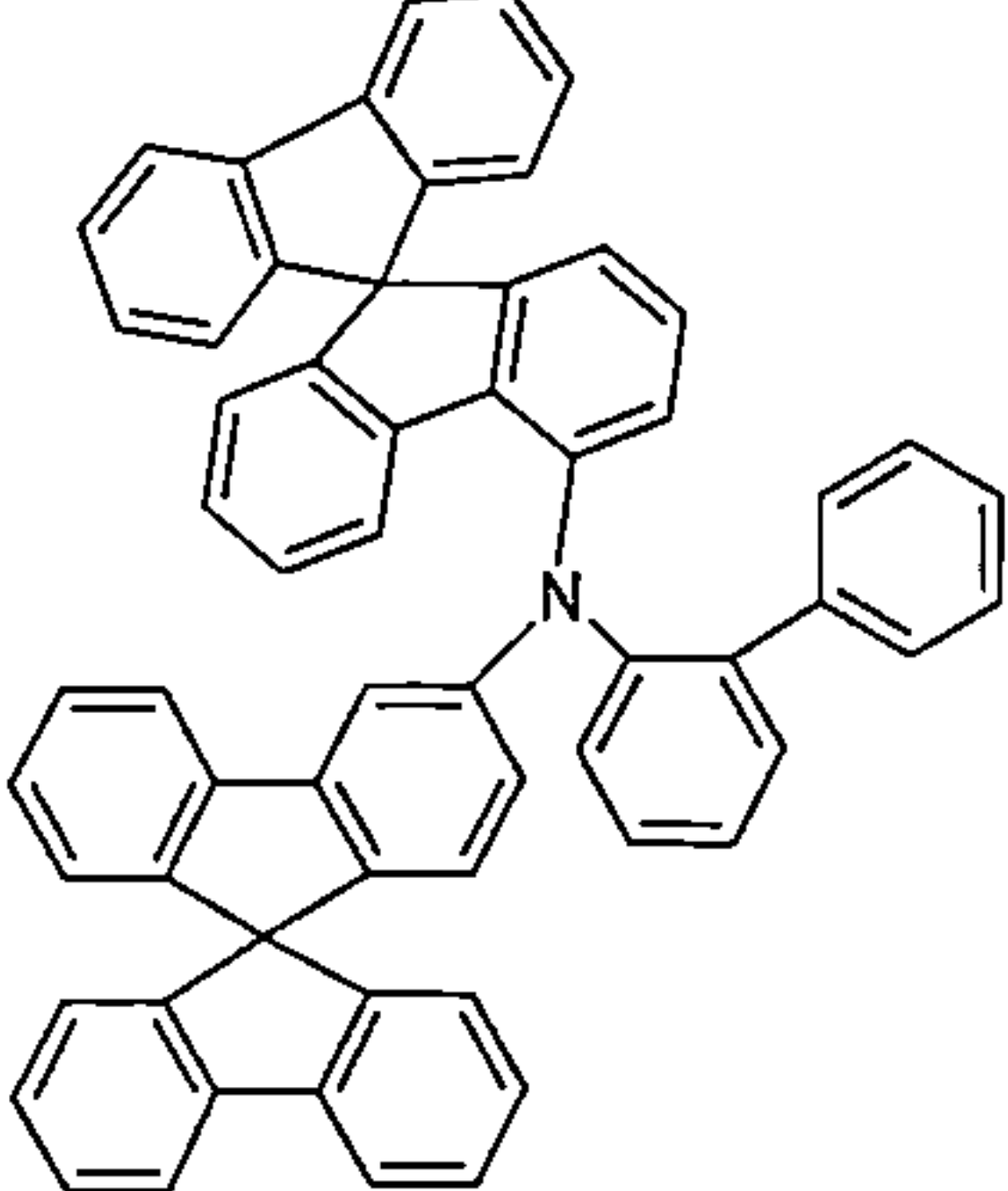
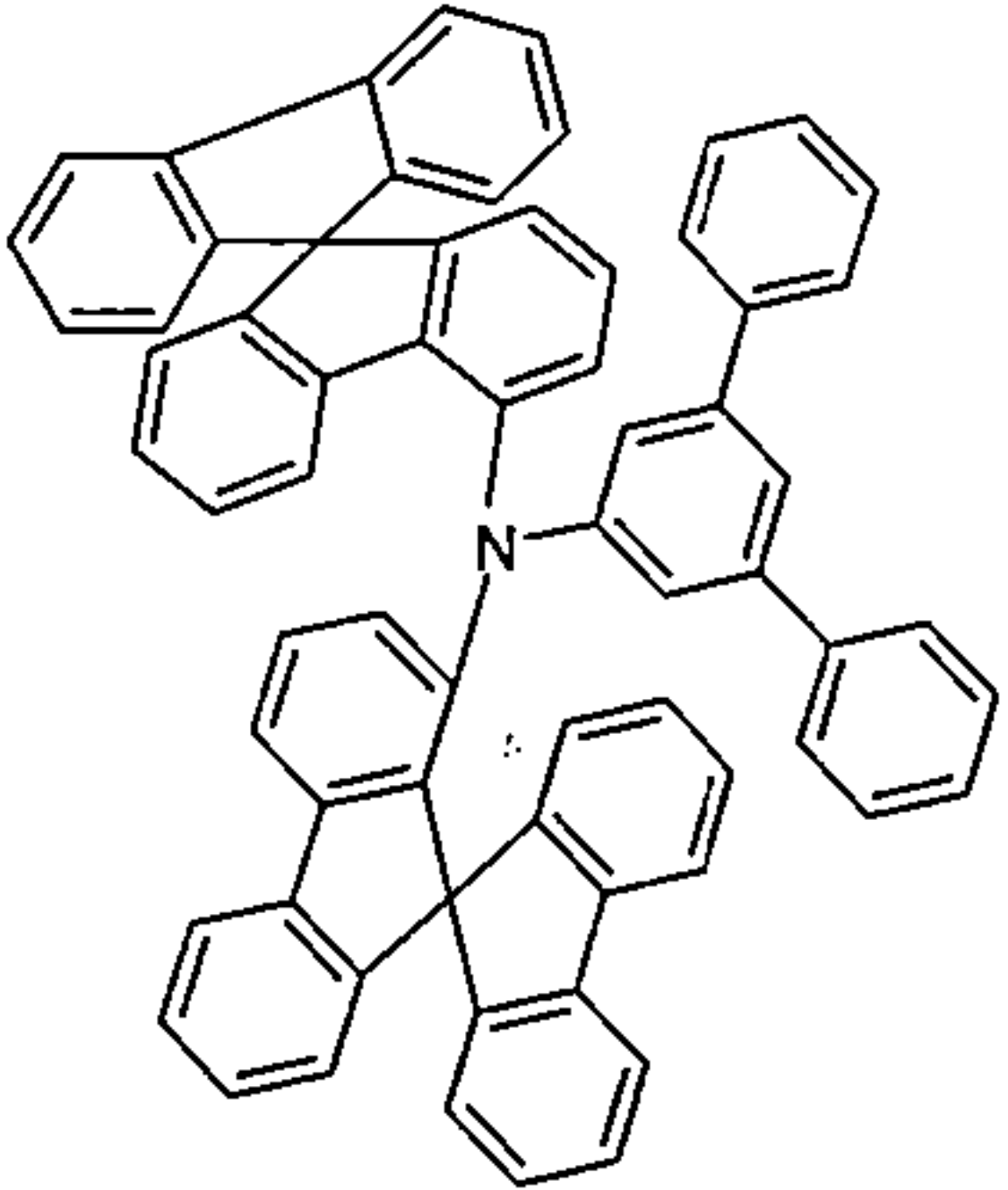
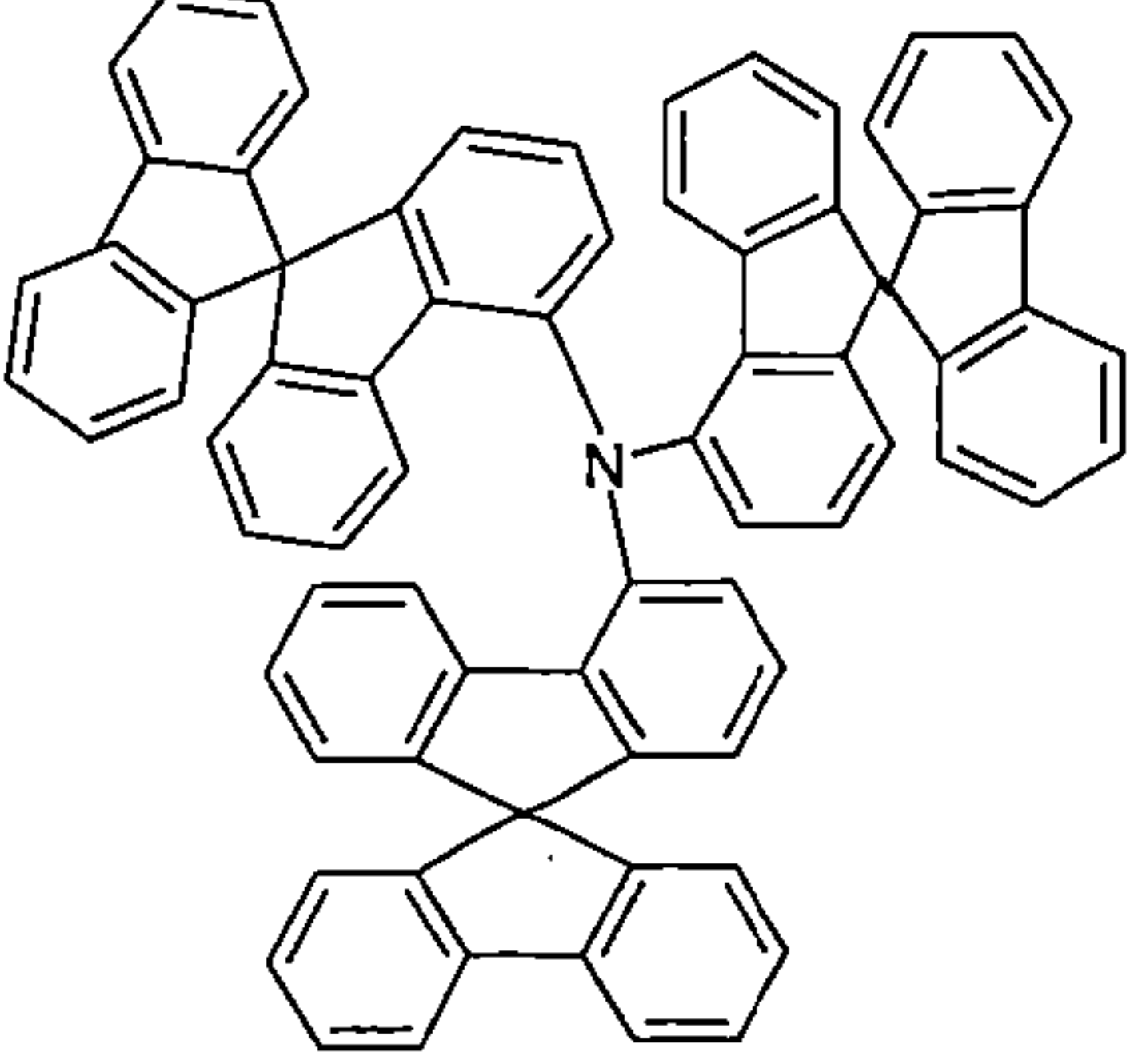
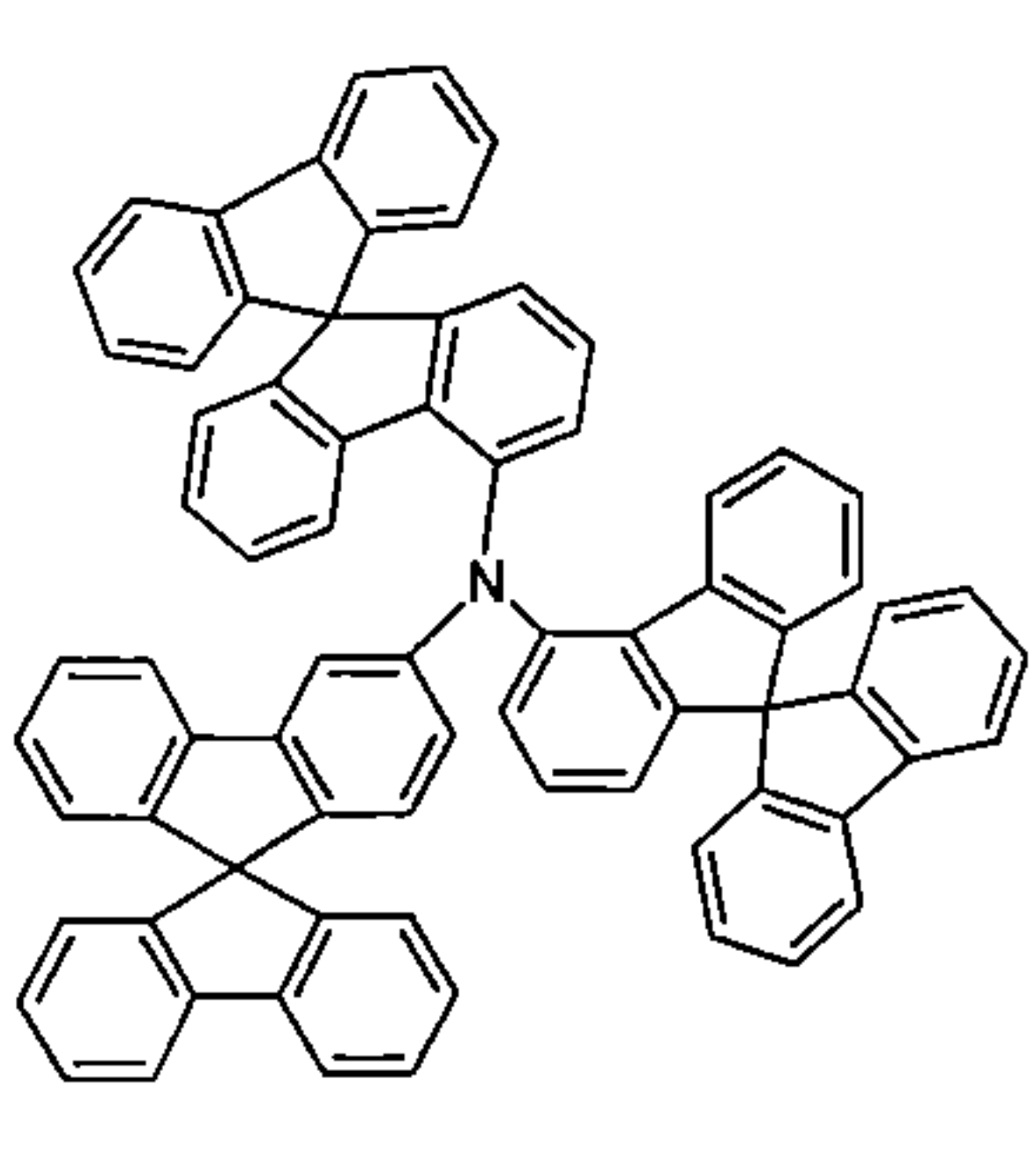
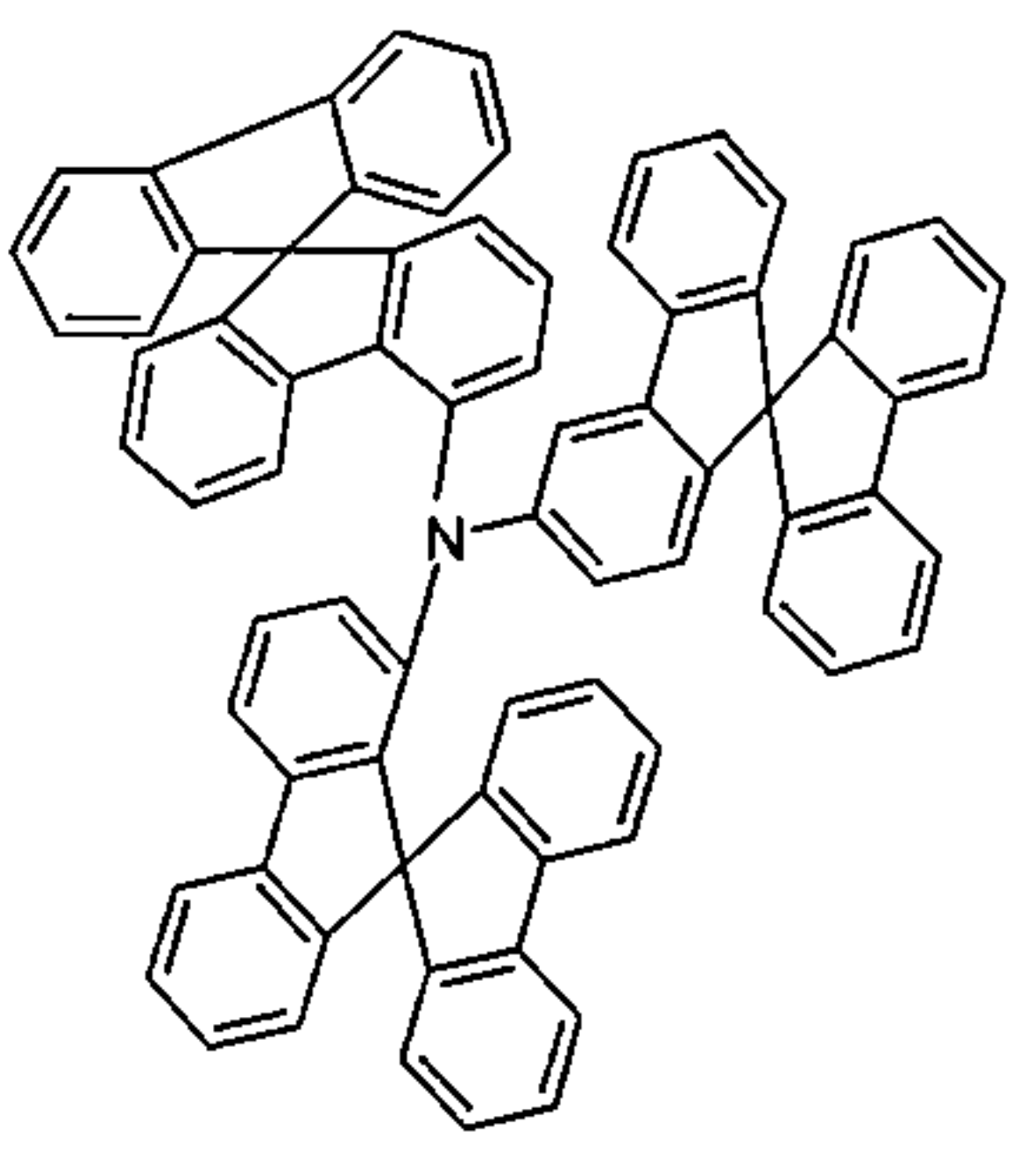
		
		
		
		
		

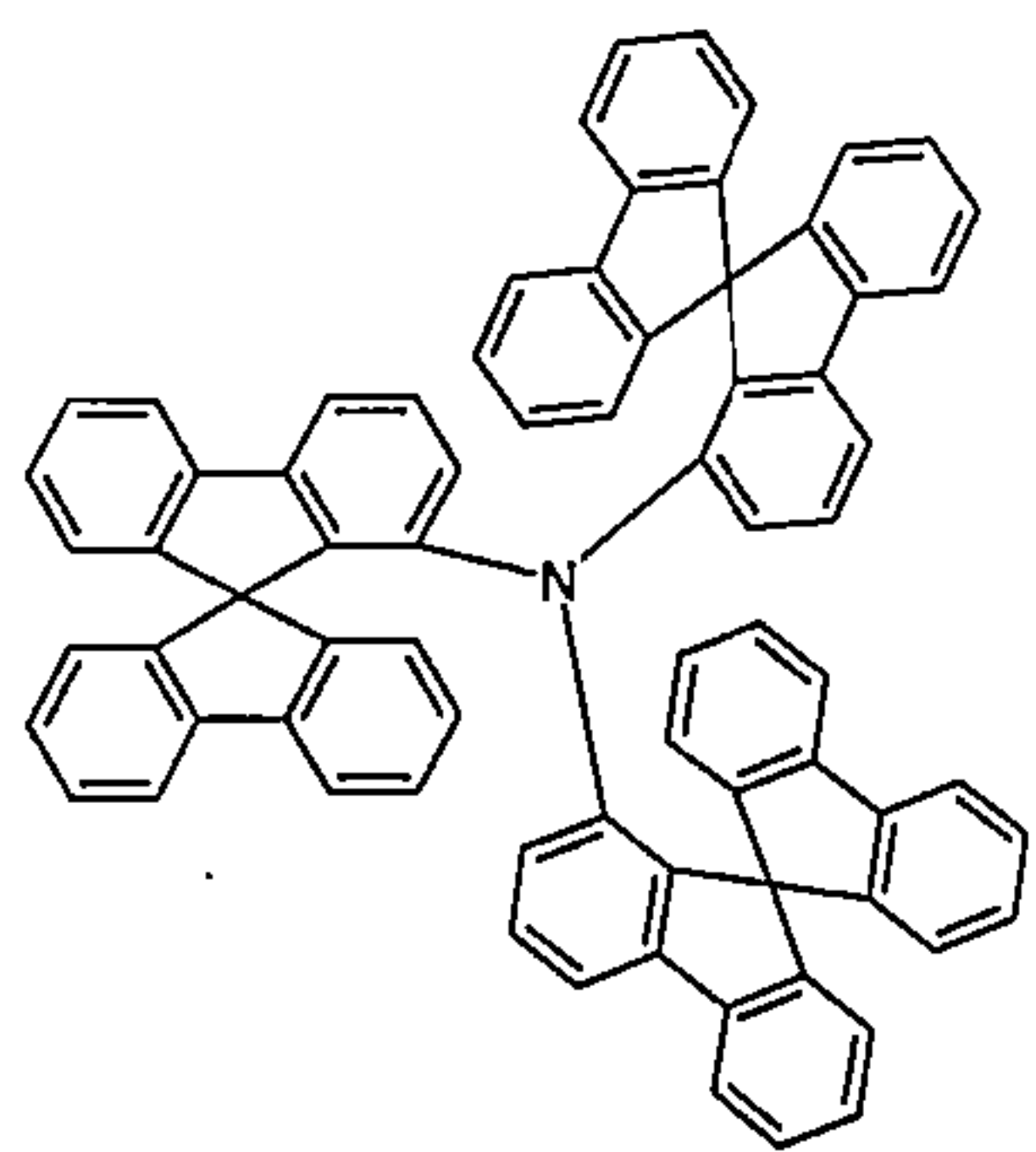
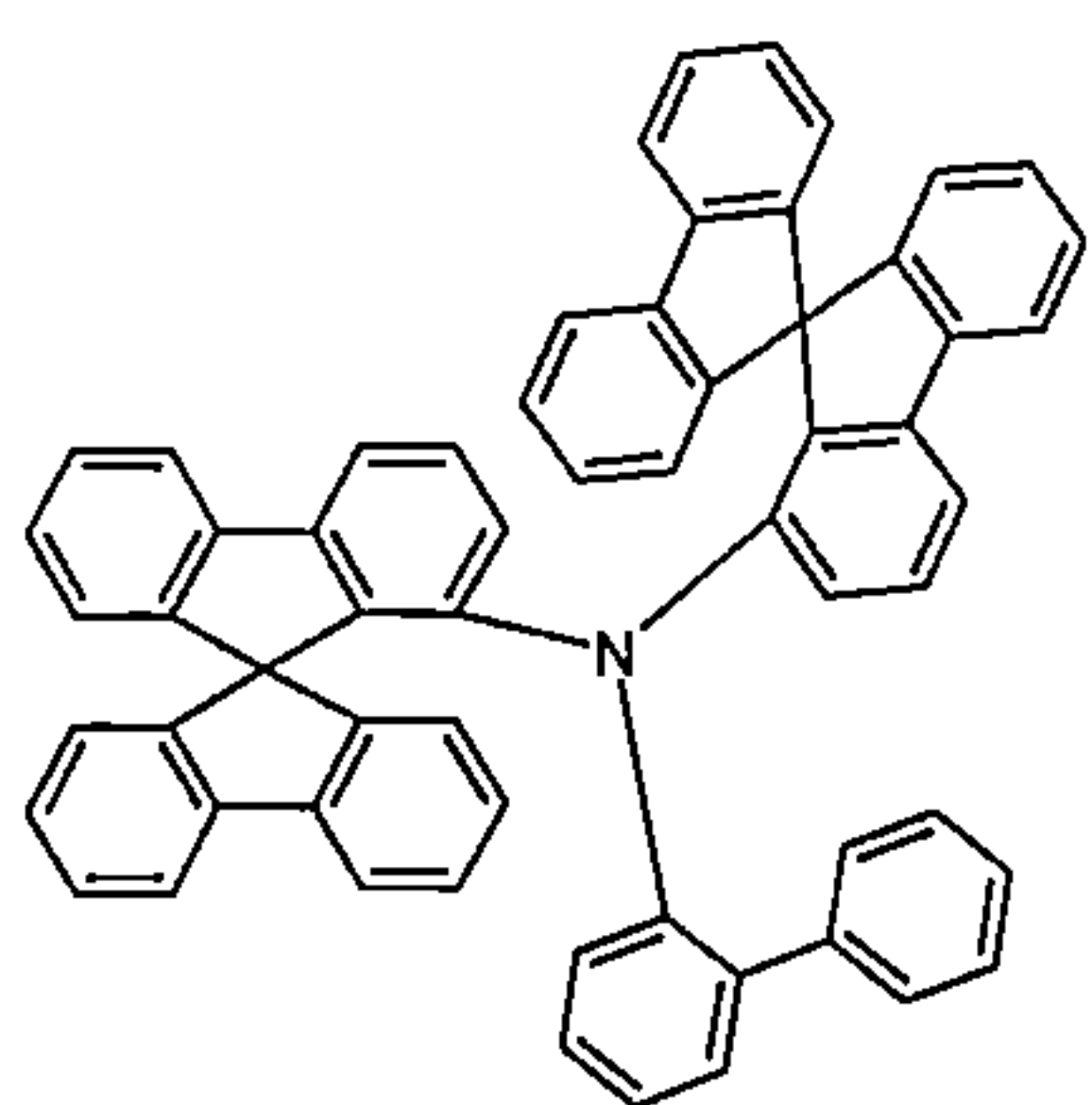
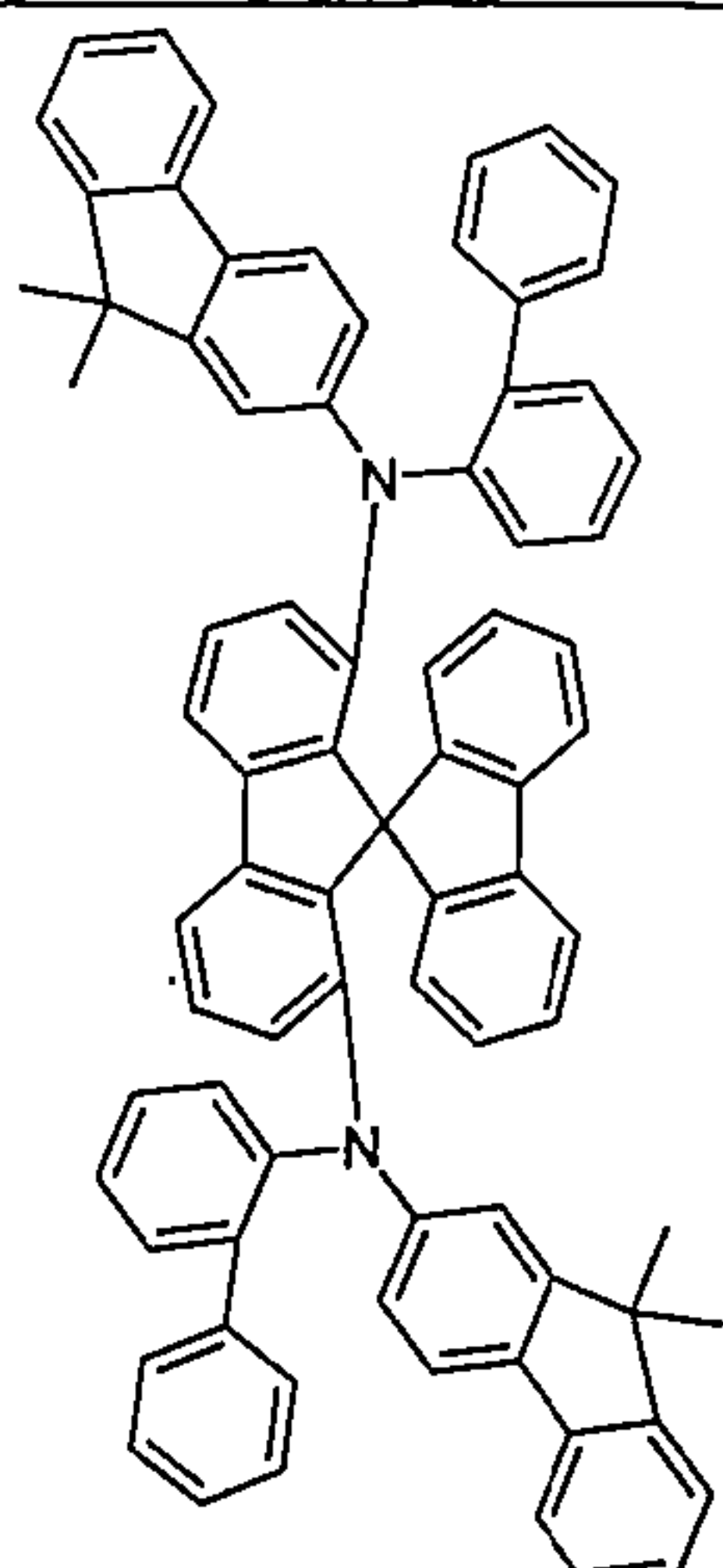
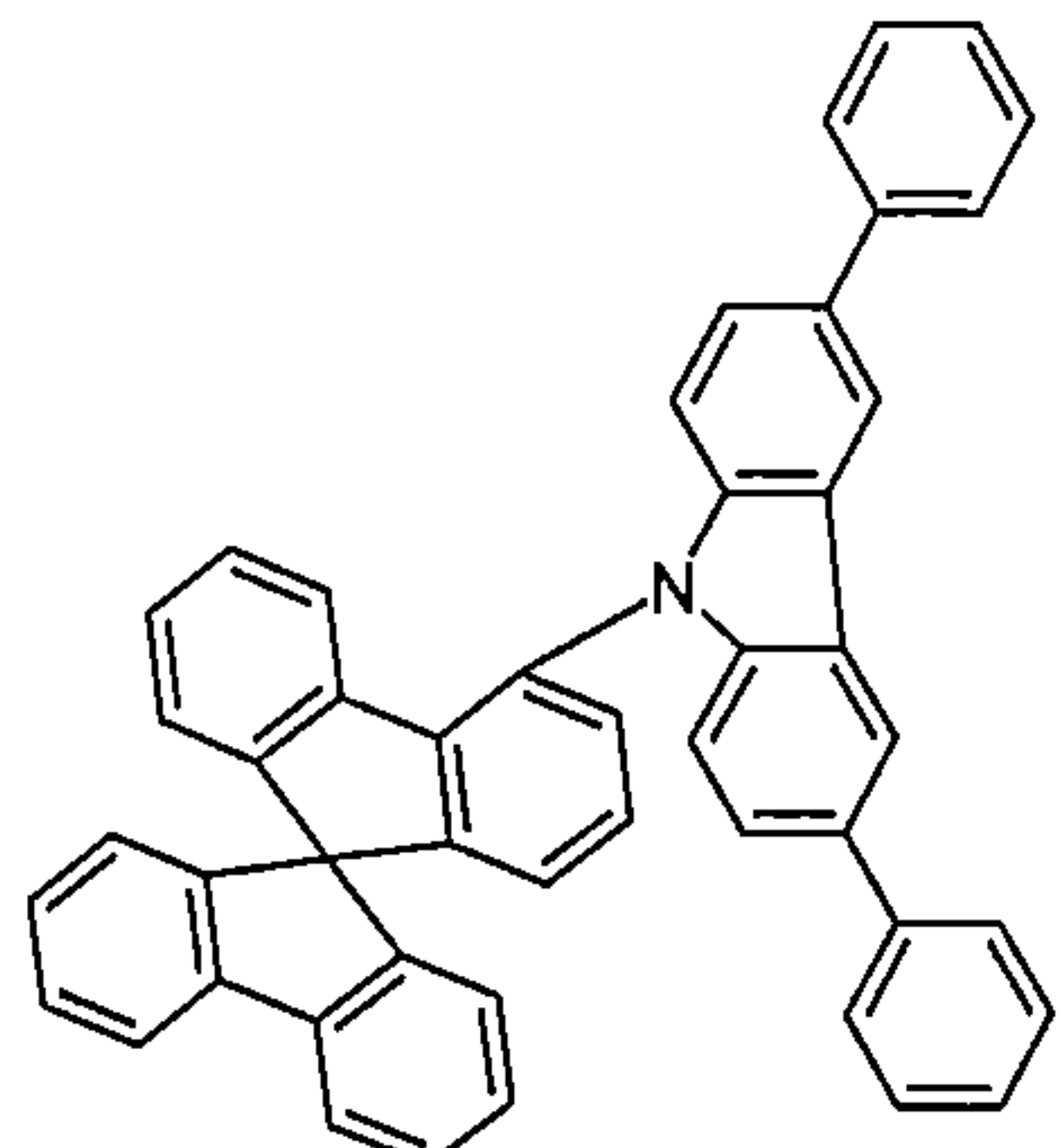
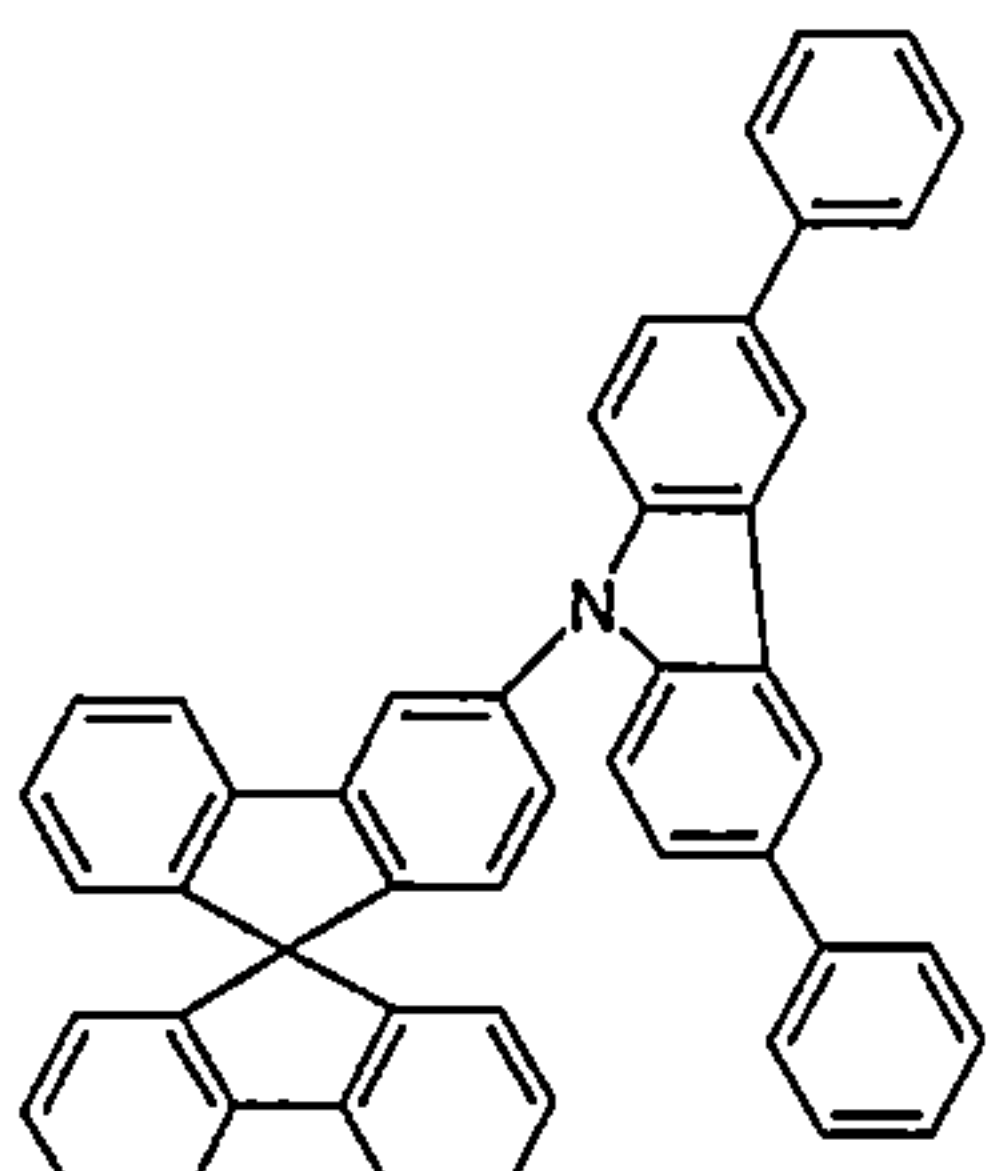
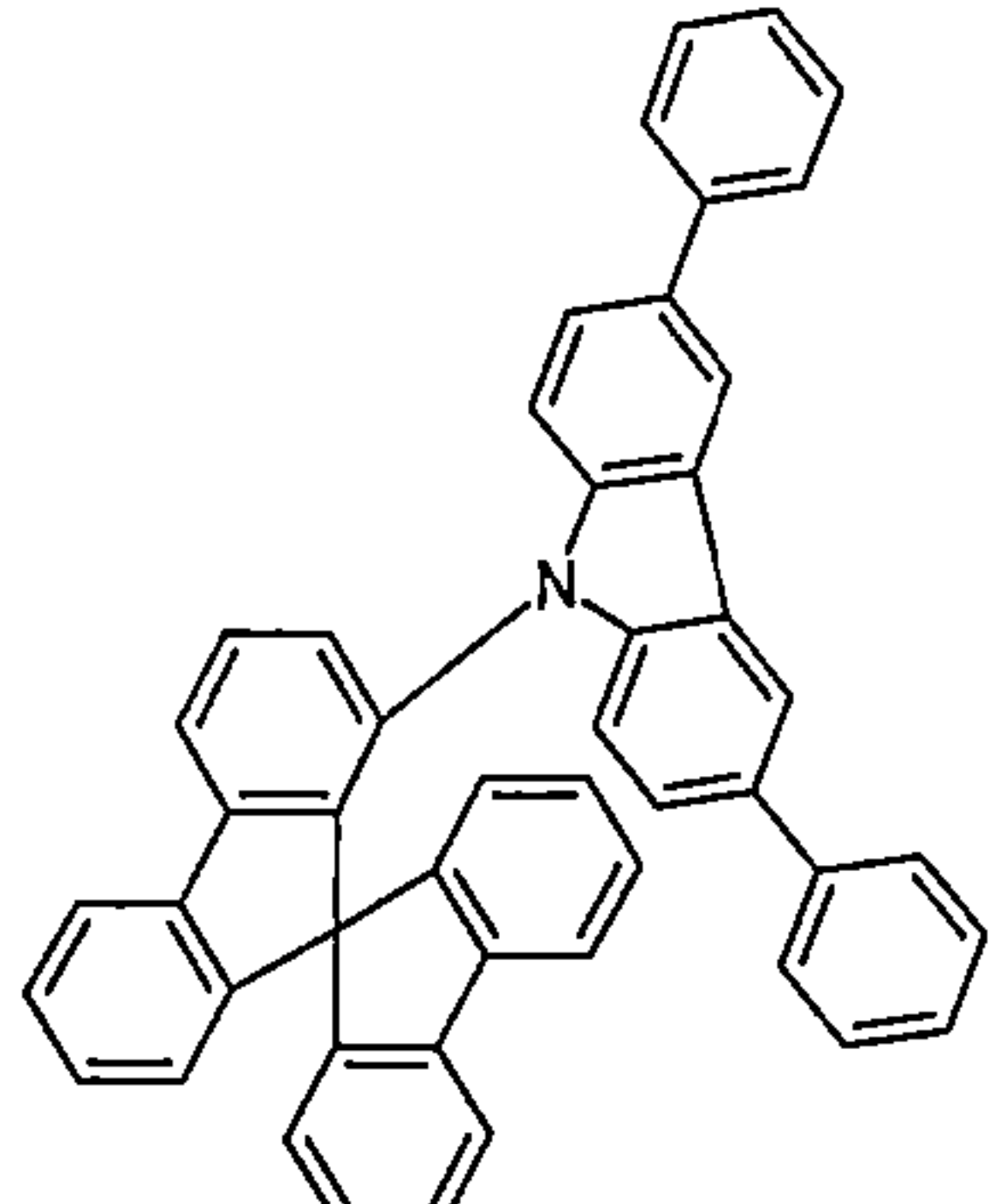
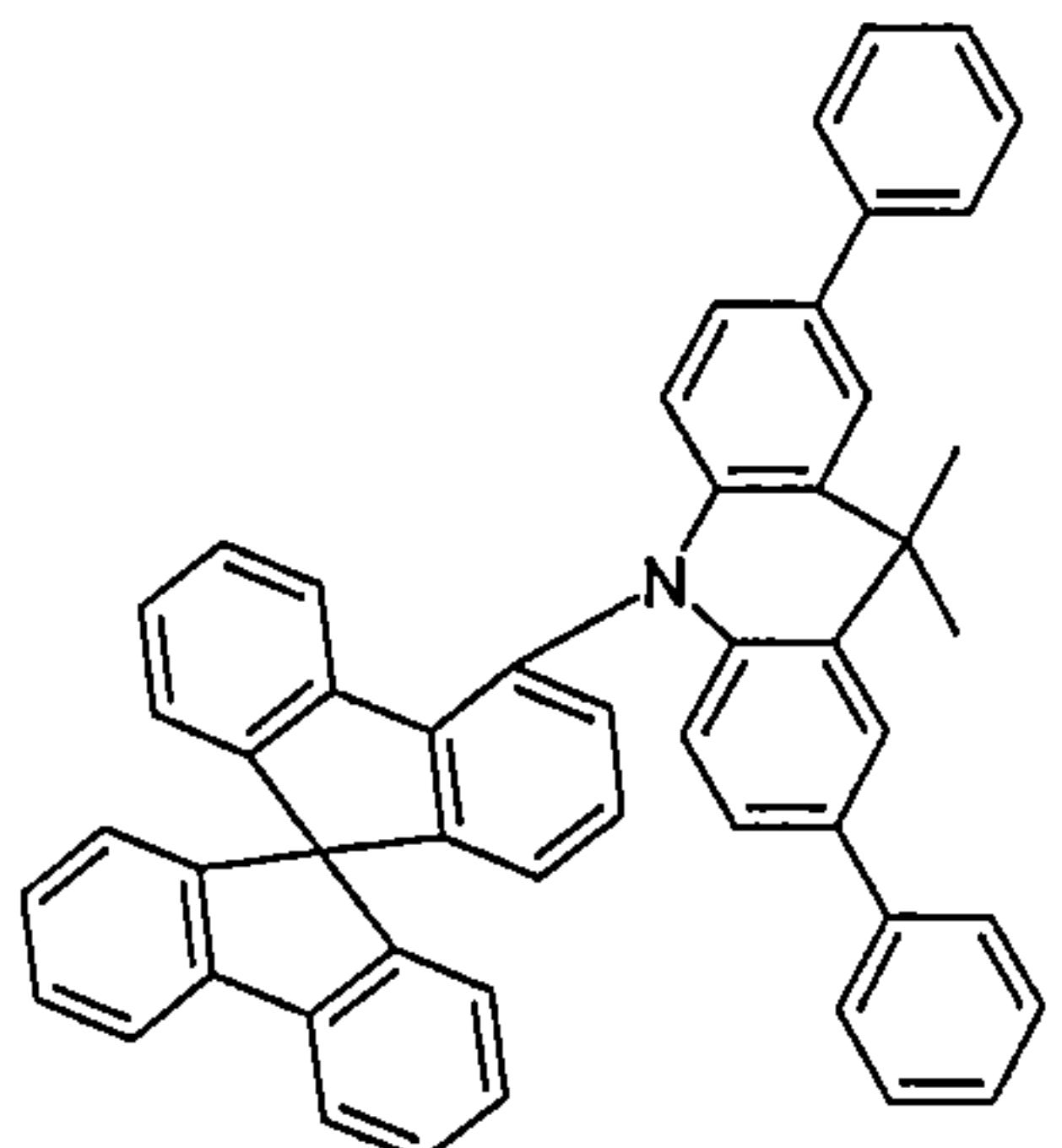
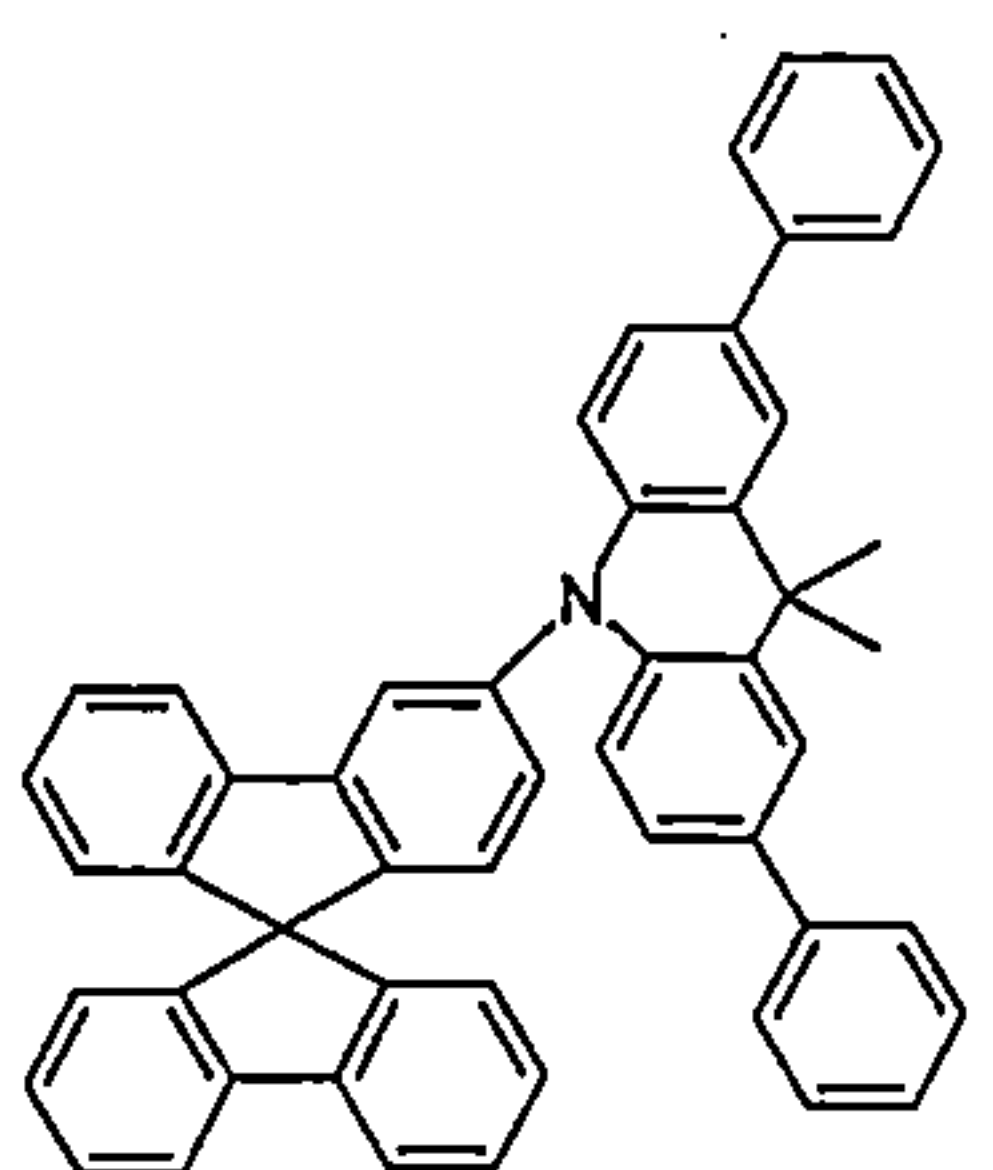
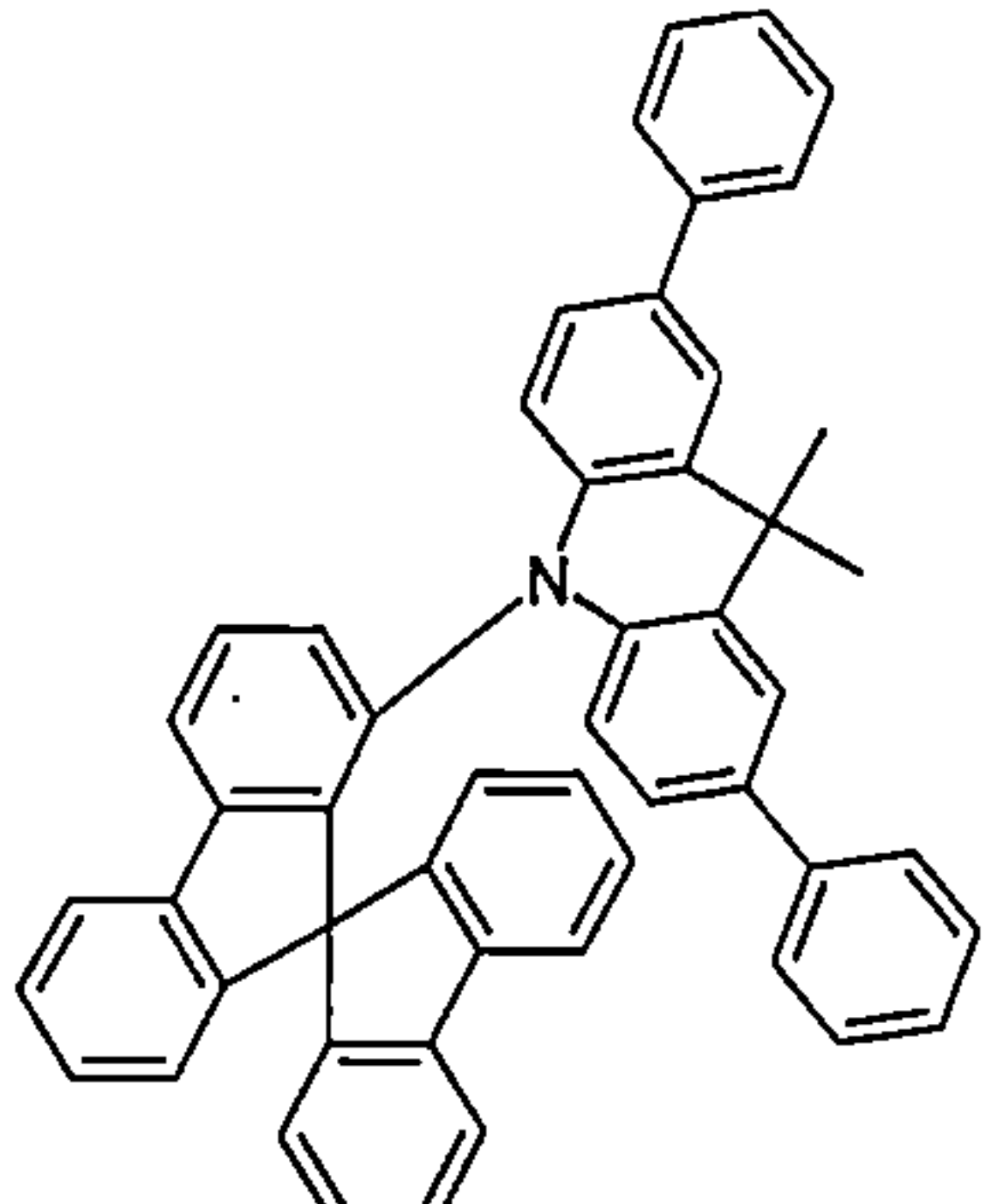
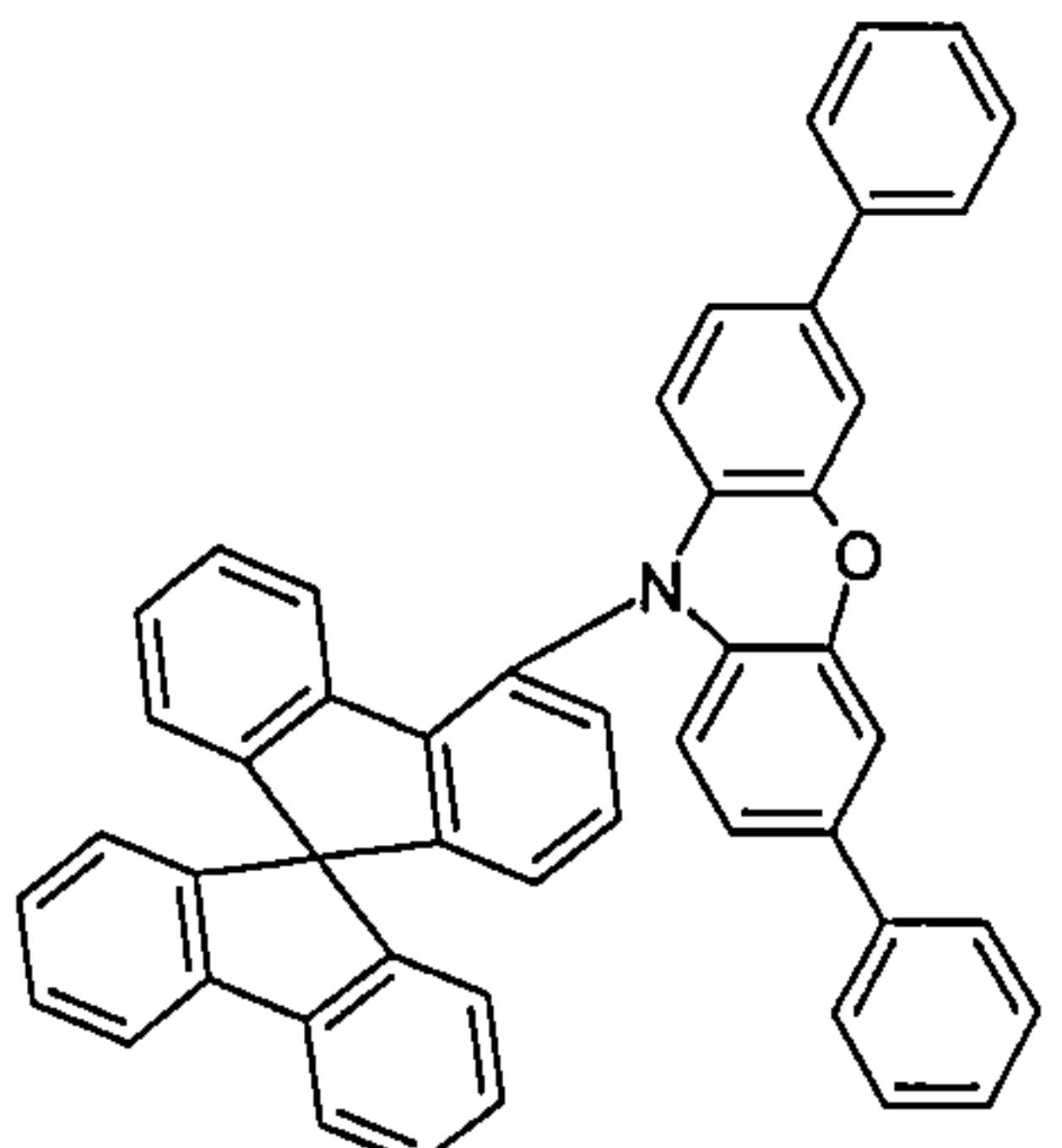
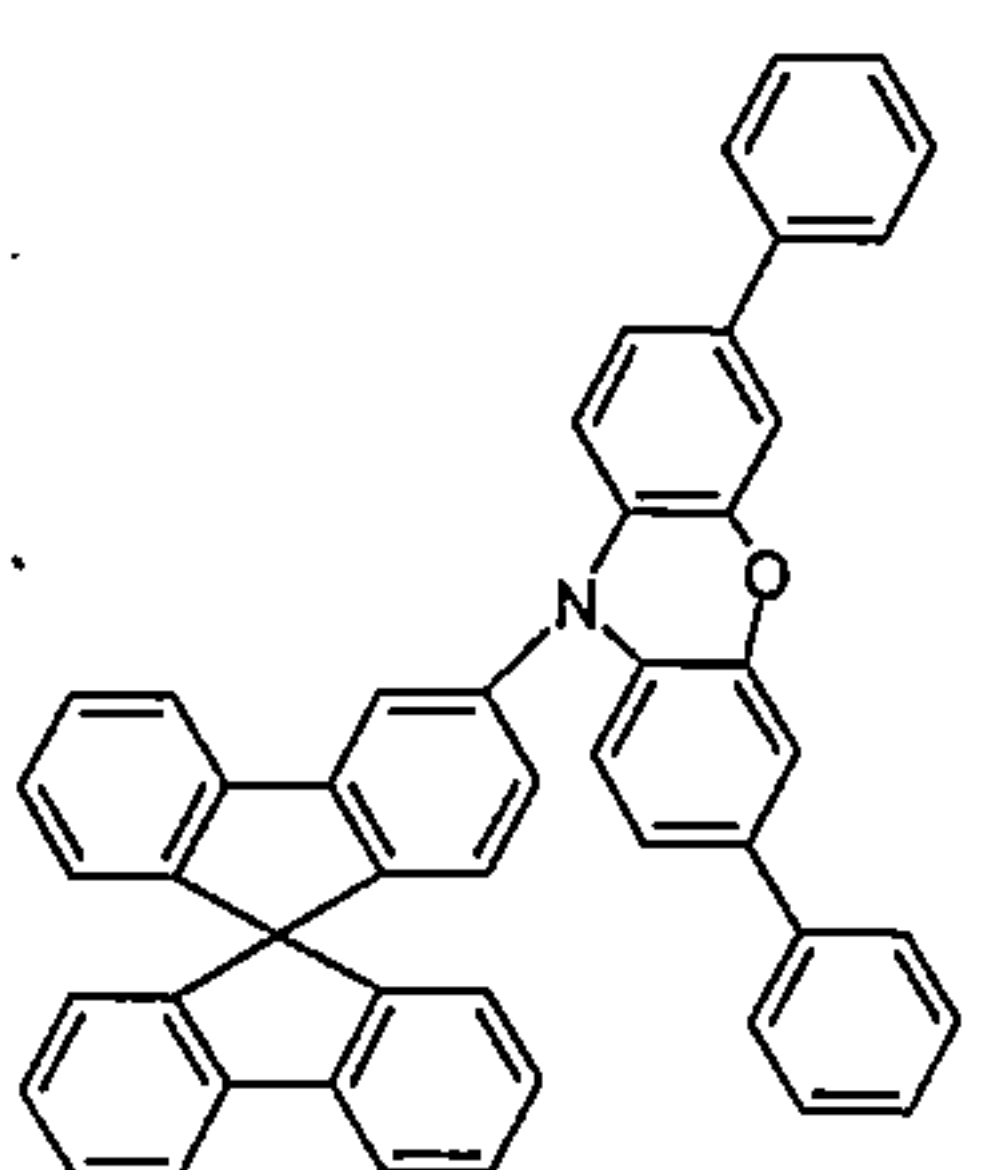
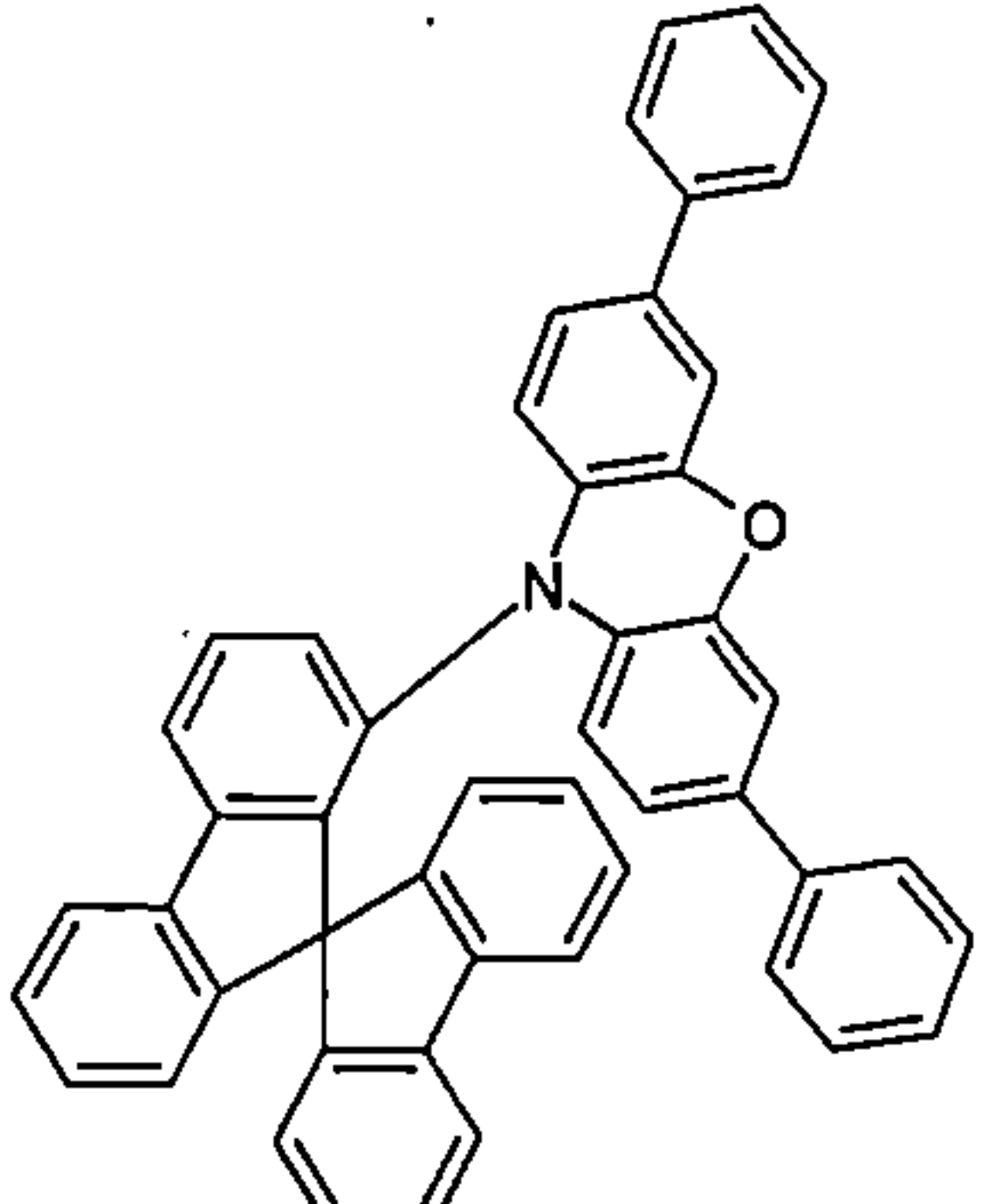
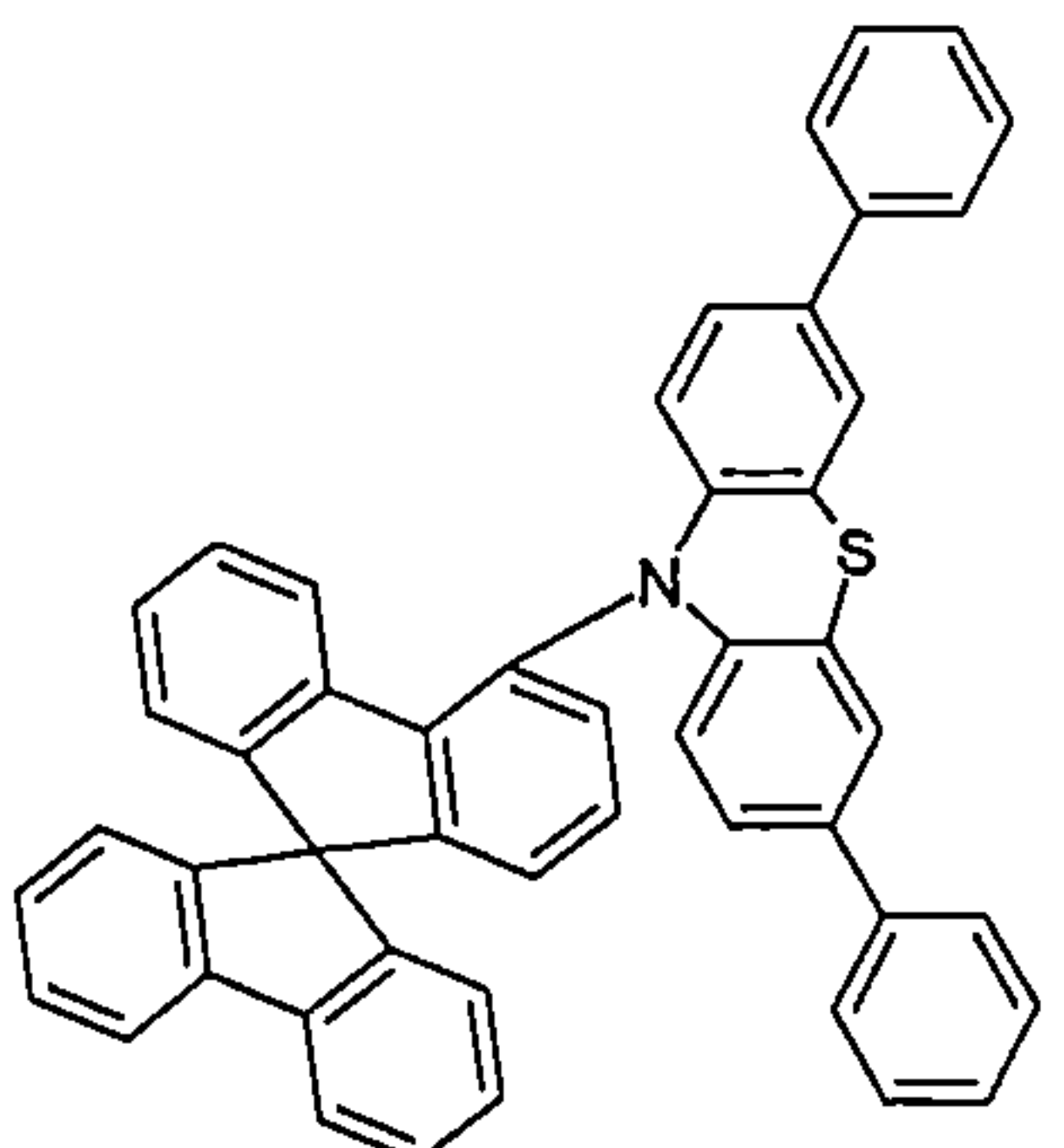
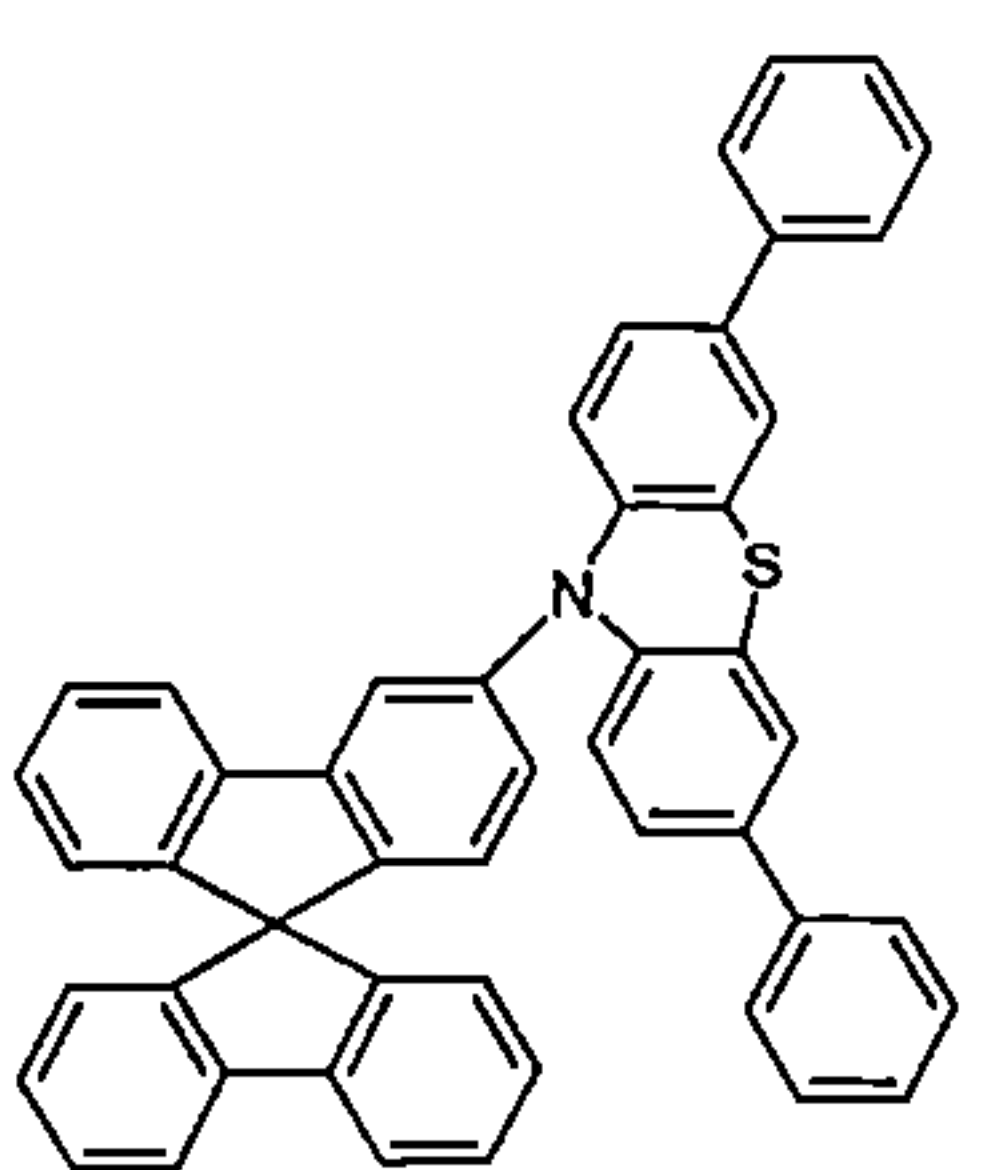
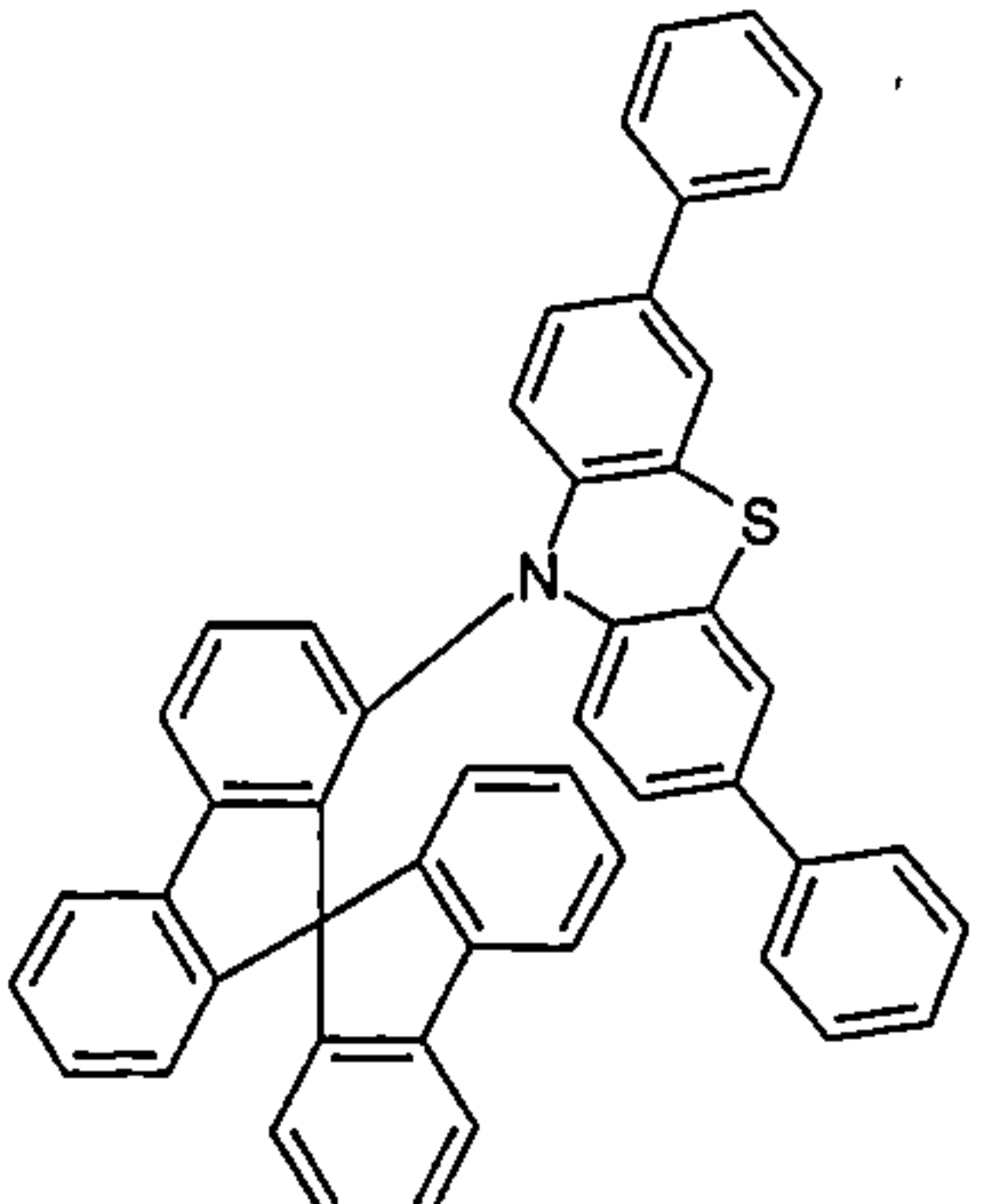
		
		
		
		
		

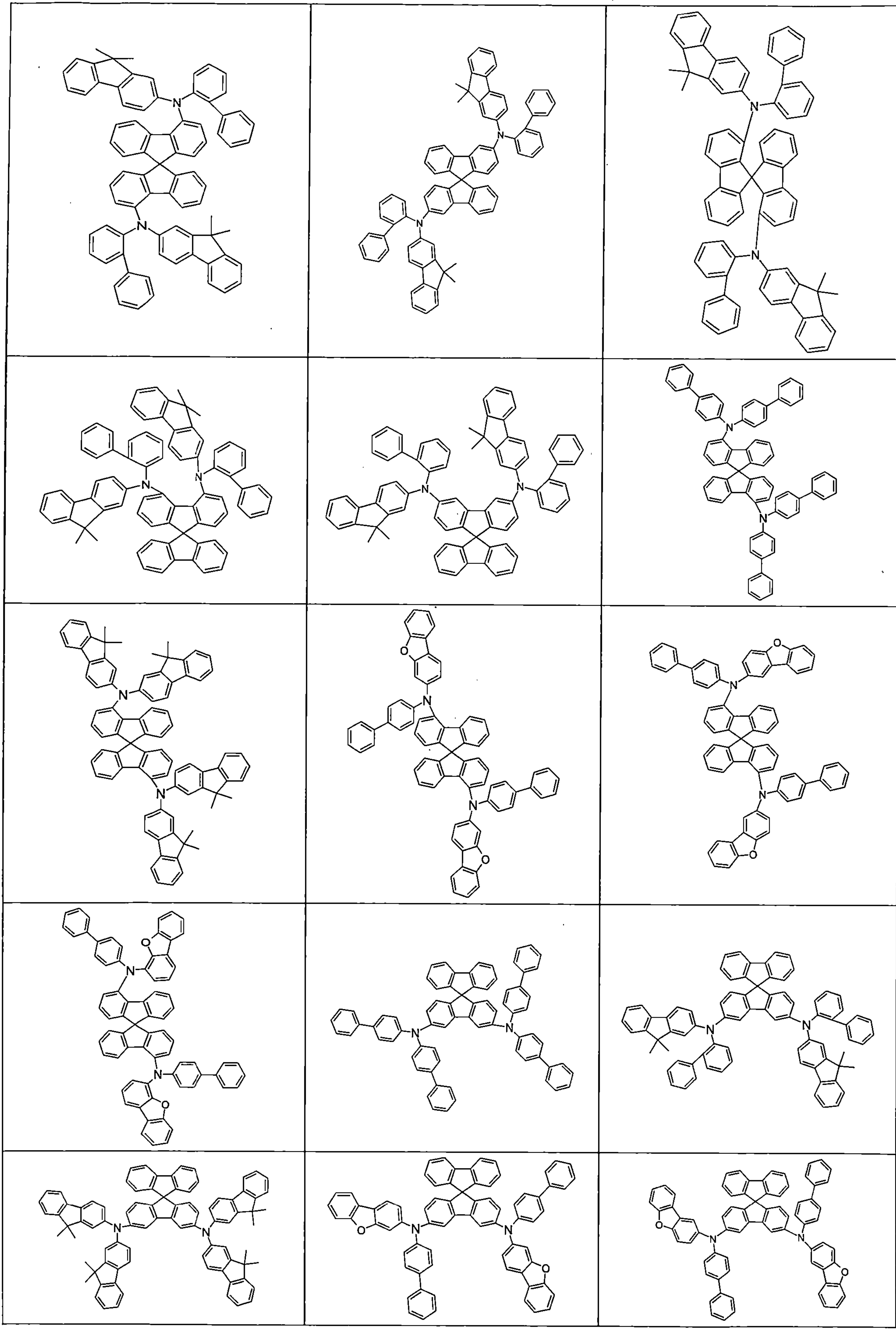
		
		
		
		
		

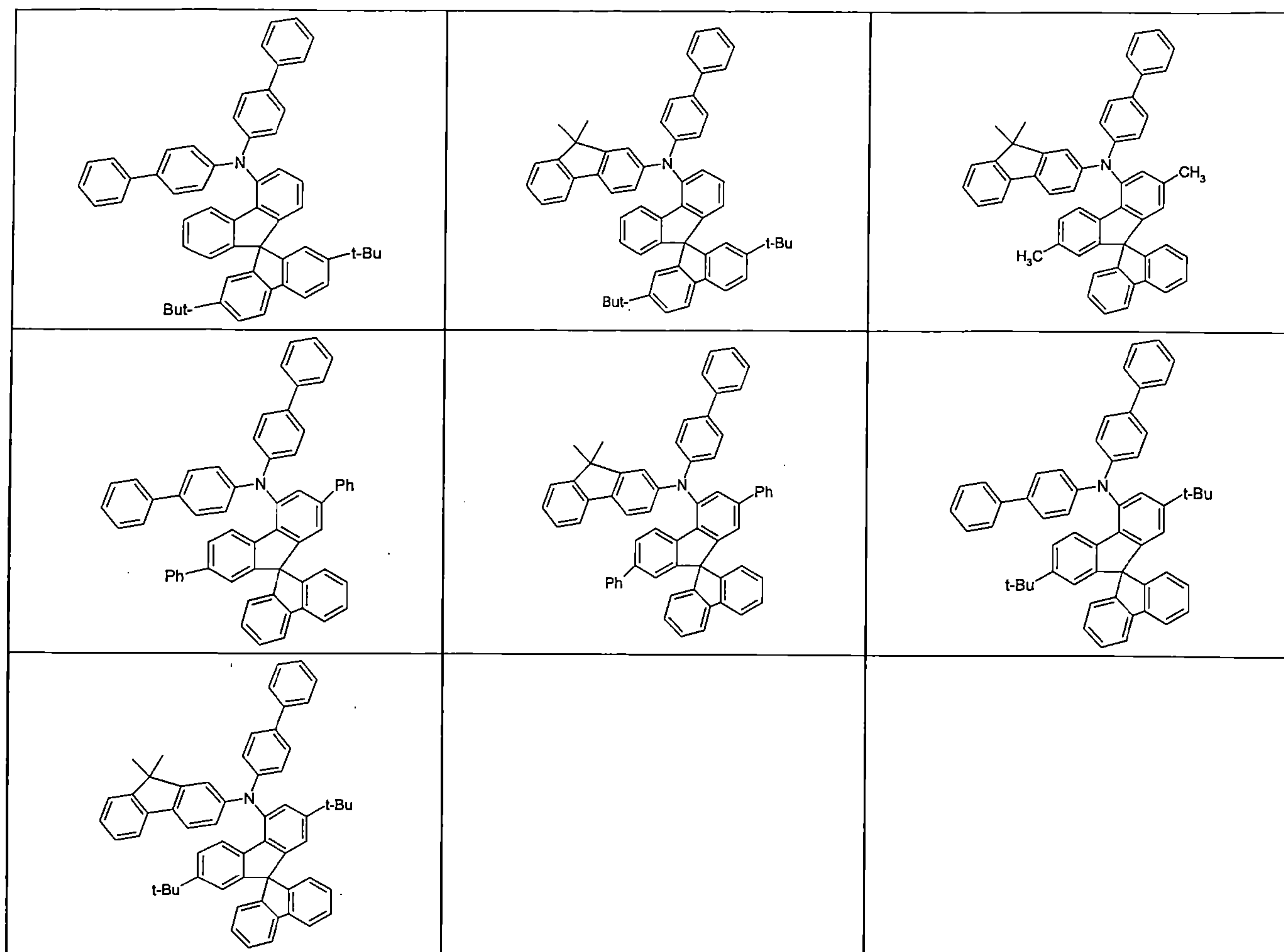




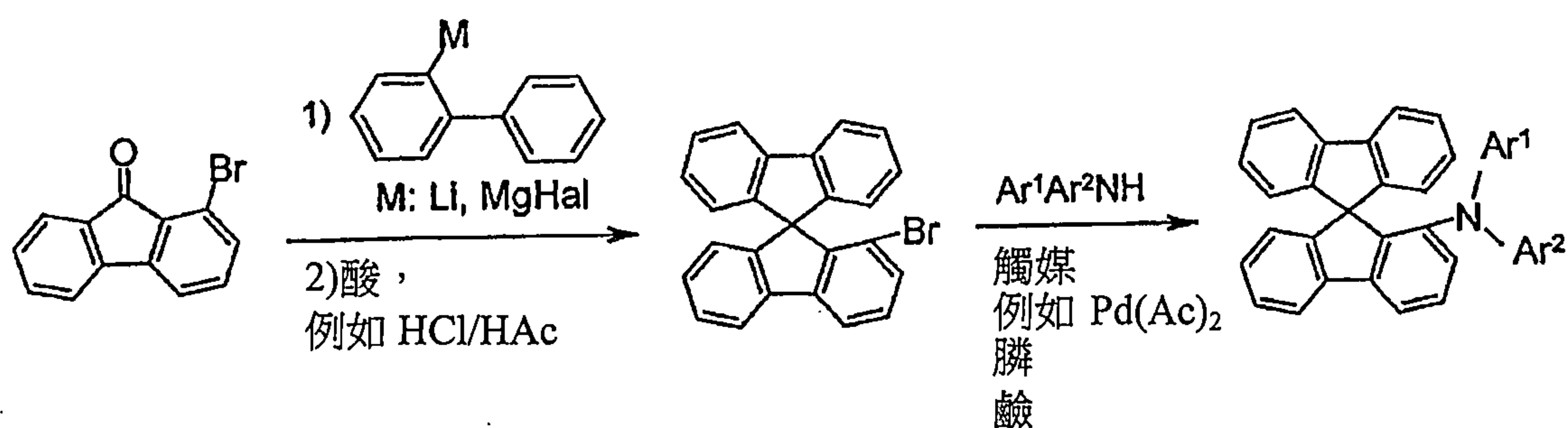


本發明化合物可藉由熟習此項技術者已知之合成步驟(例如，溴化、Ullmann芳基化、Hartwig-Buchwald偶合等)來製備。

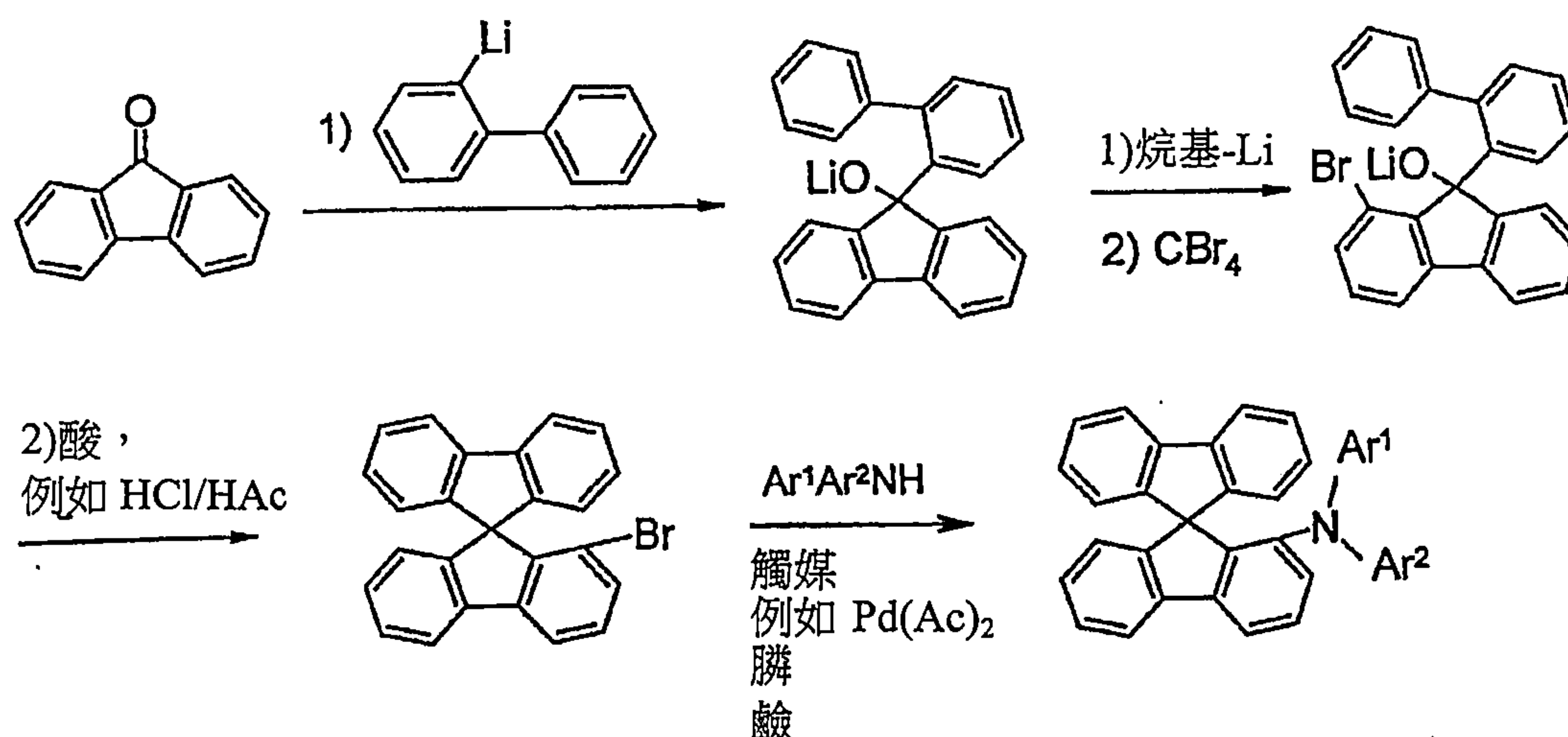
合成通常自1-、3-或4-鹵化、具體而言溴化之螺二萜衍生物開始，隨後實施C-N偶合反應(例如Hartwig-Buchwald偶合或Ullmann偶合)以引入二芳基胺基。類似地，可使用另一適宜離去基團(例如甲苯磺酸酯基或三氟甲烷磺酯基)代替鹵素。1-二芳基胺基螺二萜之合成顯示於反應圖1中，其中顯示溴化起始化合物之兩種不同獲取途徑。

反應圖1：

a)經典螺環合成：



b)萸醇之定向鋰化：



與上文所顯示之經典螺環合成類似，相應在3-或4位鹵化之螺二萸衍生物可藉由使用相應3-或4-鹵素取代之萸酮作為起始材料來合成。同樣，相應取代結構亦可完全類似地合成。

在反應圖1a所顯示之方法改進中，同樣可在第一步驟中對萸酮實施Buchwald偶合，且然後實施金屬化聯苯之加成，且隨後對螺二萸實施環閉合。該合成方法之其他細節係顯示於工作實例中。

螺二萸-吡啶化合物可藉由吡啶與經鹵素取代之螺二萸之Buchwald偶合來合成，如在工作實例中所顯示。

因此，本發明進一步係關於製備式(1)化合物之方法，其特徵在於二芳基胺基係藉由1-或3-或4-鹵化之螺二萸與二芳基胺之間之C-N偶合反應來引入。

上文所述之本發明化合物(具體而言經反應性離去基團(例如溴、碘、醯氨基或醯酸酯基)取代之化合物)可用作用於製備相應寡聚物、樹枝狀聚合物或聚合物之單體。此處之寡聚或聚合較佳係經由鹵素官能基或醯酸官能基來實施。

因此，本發明進一步係關於包含一或多種式(1)化合物之寡聚物、聚合物或樹枝狀聚合物，其中連接至聚合物、寡聚物或樹枝狀聚合物之鍵結可位於經 R^1 至 R^5 取代之式(1)中之任何期望位置處。端視式(1)化合物之連接，該化合物係寡聚物或聚合物之側鏈之一部分或主鏈之一部分。在本發明意義上，寡聚物意指自至少3個單體單元建構之化合物。在本發明意義上，聚合物意指自至少10個單體單元建構之化合物。本發明之聚合物、寡聚物或樹枝狀聚合物可為共軛、部分共軛或非共軛。本發明之寡聚物或聚合物可為直鏈、具支鏈或樹枝狀。在以直鏈方式連接之結構中，式(1)單元可彼此直接連接或經由二價基團(例如經由經取代或未經取代之伸烷基、經由雜原子或經由二價芳族或雜芳族基團)彼此連接。在具支鏈及樹枝狀結構中，三個或更多個式(1)之單元可(例如)經由三價或多價基團(例如經由三價或多價芳族或雜芳族基團)連接，得到具支鏈或樹枝狀寡聚物或聚合物。與上文針對式(1)化合物所述相同之較佳者適用於寡聚物、樹枝狀聚合物及聚合物中之式(1)之重複單元。

使本發明單體與其他單體均聚或共聚來製備該等寡聚物或聚合物。適宜且較佳之共單體係選自萘(例如根據EP 842208或WO 00/22026)、螺二萘(例如根據EP 707020、EP 894107或WO 06/061181)、對-伸苯基(例如根據WO 92/18552)、呋啶(例如根據WO 04/070772或WO 04/113468)、噻吩(例如根據EP 1028136)、二氫菲(例如根據WO 05/014689或WO 07/006383)、順式及反式-茛并萘(例如根據WO 04/041901或WO 04/113412)、酮(例如根據WO 05/040302)、菲

(例如根據WO 05/104264或WO 07/017066)亦或複數個該等單元。該等聚合物、寡聚物及樹枝狀聚合物通常亦含有其他單元，例如發射(螢光或磷光)單元，例如，乙烯基三芳基胺(例如根據WO 07/068325)或磷光金屬錯合物(例如根據WO 06/003000)、及/或電荷傳輸單元(具體而言彼等基於三芳基胺者)。

本發明之聚合物、寡聚物及樹枝狀聚合物具有有利性質，具體而言長壽命、高效率及良好的色坐標。

本發明之聚合物及寡聚物通常係藉由聚合一或多種類型之單體來製備，其中至少一種單體產生聚合物中之式(1)之重複單元。適宜聚合反應為熟習此項技術者已知且闡述於文獻中。產生C-C或C-N鍵之尤其適宜且較佳之聚合反應係以下：

- (A) SUZUKI聚合；
- (B) YAMAMOTO聚合；
- (C) STILLE聚合；及
- (D) HARTWIG-BUCHWALD聚合。

可藉由該等方法實施聚合之方式及然後可自反應介質分離出聚合物並純化之方式為熟習此項技術者已知且詳細闡述於文獻(例如WO 2003/048225、WO 2004/037887及WO 2004/037887)中。

因此，本發明亦係關於製備本發明之聚合物、寡聚物及樹枝狀聚合物之方法，其特徵在於該等聚合物、寡聚物及樹枝狀聚合物係藉由SUZUKI聚合、YAMAMOTO聚合、STILLE聚合或HARTWIG-BUCHWALD聚合來製備。本發明之樹枝狀聚合物可藉由熟習此項技術者已知之方法或與其類似之方法來製備。適宜方法係闡述於諸如以下文獻中：Frechet, Jean M. J.; Hawker, Craig J., 「Hyperbranched polyphenylene and hyperbranched polyesters: new soluble, three-dimensional, reactive polymers」, Reactive & Functional Polymers

(1995), 26(1-3), 127 - 36 ; Janssen, H. M.; Meijer, E. W., 「 The synthesis and characterization of dendritic molecules 」 , Materials Science and Technology (1999), 20 (Synthesis of Polymers), 403 - 458 ; Tomalia 、 Donald A. , 「 Dendrimer molecules 」 , Scientific American (1995), 272(5), 62 - 6 ; WO 02/067343 A1及WO 2005/026144 A1 。

本發明化合物適合用於電子裝置。此處電子裝置意指包含至少一個包含至少一種有機化合物之層之裝置。然而，此處組份亦可包含無機材料亦或完全自無機材料建構之層。

因此，本發明此外係關於本發明化合物在電子裝置中、具體而言在有機電致發光裝置中之用途。

本發明此外亦係關於包含至少一種本發明化合物之電子裝置。上文所述之較佳者亦適用於該等電子裝置。

電子裝置較佳選自由下列組成之群：有機電致發光裝置(有機發光二極體，OLED)、有機積體電路(O-IC)、有機場效電晶體(O-FET)、有機薄膜電晶體(O-TFT)、有機發光電晶體(O-LET)、有機太陽能電池(O-SC)、有機染料敏化太陽能電池(ODSSC)、有機光學偵測器、有機光感受器、有機場致猝滅裝置(O-FQD)、發光電化學電池(LEC)、有機雷射二極體(O-雷射)及有機電漿子發射裝置(D. M. Koller 等人，*Nature Photonics* **2008**, 1 - 4)，但較佳係有機電致發光裝置(OLED)，尤佳係磷光OLED。

有機電致發光裝置及發光電化學電池可用於多種應用，例如單色或多色顯示器、照明應用或醫療及/或美容應用(例如在光電治療術中)。

該有機電致發光裝置包含陰極、陽極及至少一個發射層。除該等層以外，其亦可包含其他層，舉例而言，在每一情形下，一或多個

電洞注入層、電洞傳輸層、電洞阻擋層、電子傳輸層、電子注入層、激子阻擋層、電子阻擋層及/或電荷產生層。亦可在兩個發射層之間引入具有(例如)激子阻擋功能之中間層。然而，應指出，該等層中之每一者並不一定必須存在。

此處有機電致發光裝置可包含一個發射層或複數個發射層。若存在複數個發射層，則該等發射層之複數個發射最大值較佳總計介於380 nm與750 nm之間以便整體產生白色發射，即在發射層中使用多種能夠發出螢光或磷光之發射化合物。尤佳者係具有三個發射層之系統，其中該三個層展示藍色、綠色及橙色或紅色發射(對於該等基本結構，例如參見WO 2005/011013)。此處可能的是，所有發射層係螢光的或所有發射層係磷光的，或一或多個發射層係螢光的且一或多個其他層係磷光的。

此處上文所指示之實施例之本發明化合物可用於不同層中，此端視精確結構而定。較佳者係包含式(1)化合物或較佳實施例作為電洞傳輸層或電洞注入層或激子阻擋層或電子阻擋層中之電洞傳輸材料或作為發射層中之螢光或磷光發射體、具體而言磷光發射體之基質材料的有機電致發光裝置。上文所指示之較佳實施例亦適用於該等材料在有機電子裝置中之用途。

在本發明之較佳實施例中，式(1)化合物或較佳實施例用作電洞傳輸層或電洞注入層中之電洞傳輸材料或電洞注入材料。此處發射層可係螢光的或磷光的。在本發明意義上，電洞注入層係直接毗鄰陽極之層。在本發明意義上，電洞傳輸層係位於電洞注入層與發射層之間之層。

在本發明之再一較佳實施例中，式(1)化合物或較佳實施例用於激子阻擋層中。激子阻擋層意指直接毗鄰陽極側上之發射層之層。

式(1)之化合物或較佳實施例尤佳用於電洞傳輸層或激子阻擋層

中。

在本發明之一實施例中，式(1)化合物或較佳實施例與包含六氮雜三伸苯基衍生物、具體而言六氰基六氮雜三伸苯基之層組合用於電洞傳輸層或電洞注入層中(例如根據EP 1175470)。因此，舉例而言，較佳者係如下所示之組合：陽極-六氮雜三伸苯基衍生物-電洞傳輸層，其中電洞傳輸層包含一或多種式(1)化合物或較佳實施例。亦可在此結構中使用複數個連續電洞傳輸層，其中至少一個電洞傳輸層包含至少一種式(1)化合物或較佳實施例。另一較佳組合如下所示：陽極-電洞傳輸層-六氮雜三伸苯基衍生物-電洞傳輸層，其中該兩個電洞傳輸層中之至少一者包含一或多種式(1)化合物或較佳實施例。亦可在此結構中使用複數個連續電洞傳輸層代替一個電洞傳輸層，其中至少一個電洞傳輸層包含至少一種式(1)化合物或較佳實施例。

若式(1)化合物用作電洞傳輸層、電洞注入層、激子阻擋層或電子阻擋層中之電洞傳輸材料，則該化合物可作為純材料(即在該層中以100%比例)使用，或其可與一或多種其他材料組合使用。根據較佳實施例，在此情形下，與式(1)化合物組合使用之一種或其他化合物係p型摻雜劑。欲使用之較佳p型摻雜劑係電子受體化合物，較佳例如可氧化該混合物中之一或多種其他化合物之電子受體化合物。

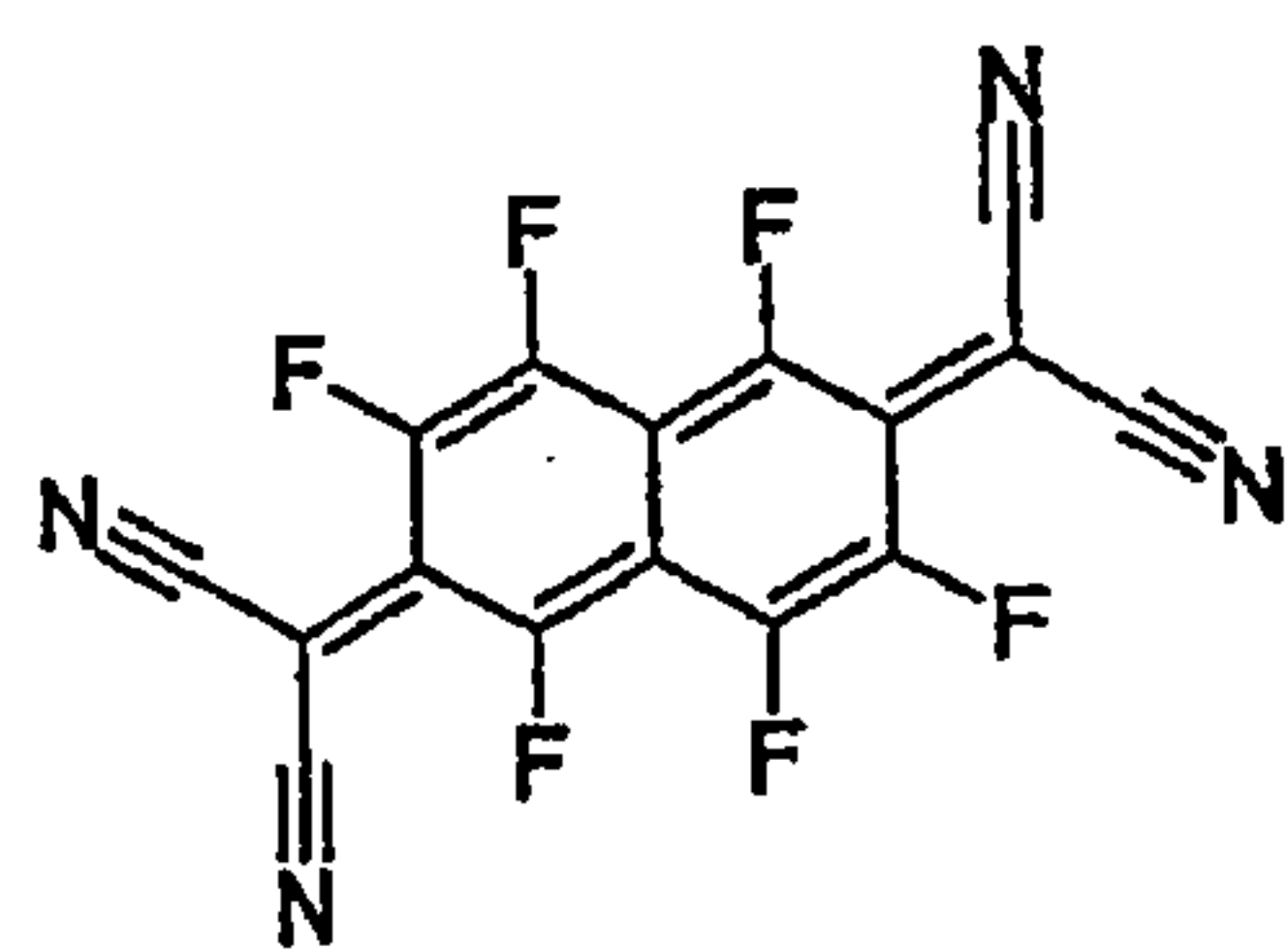
p型摻雜劑較佳係以0.1體積%至20體積%、較佳0.5體積%至12體積%、更佳1體積%至8體積%且最佳2體積%至6體積%之濃度存於包含本發明化合物之層中。

欲與本發明化合物組合使用之尤佳p型摻雜劑係揭示於以下文件中之之一或多者中之化合物：WO 2011/073149、EP 1968131、EP 2276085、EP 2213662、EP 1722602、EP 2045848、DE 102007031220、US 8044390、US 8057712、WO 2009/003455、WO 2010/094378、WO 2011/120709、US 2010/0096600 及 WO

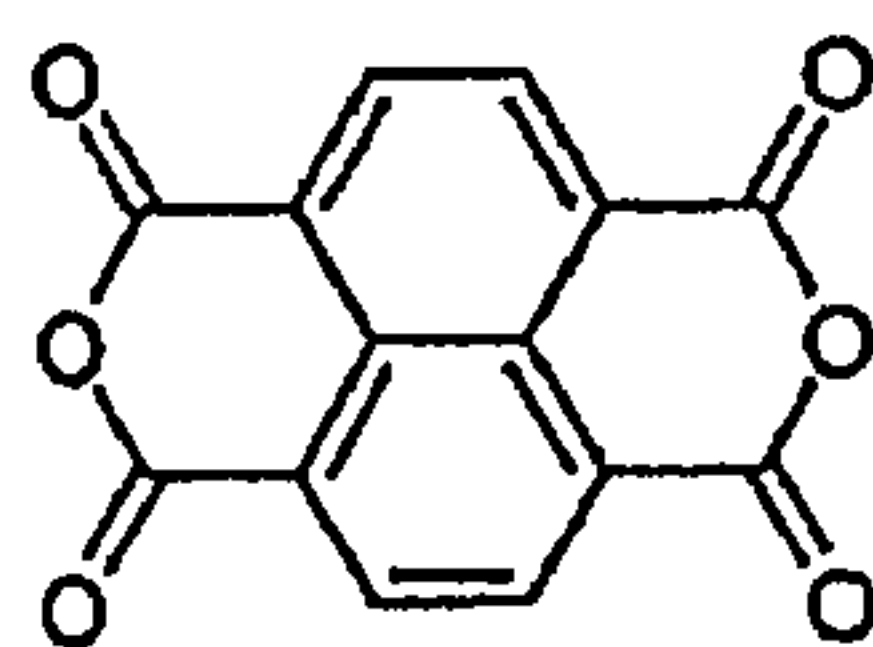
2012/095143。

欲用於本發明裝置之極佳p型摻雜劑係醯二甲烷、氮雜茛苈第二酮、氮雜萘、氮雜三伸苯基、 I_2 、金屬鹵化物(較佳過渡金屬鹵化物)、金屬氧化物(較佳過渡金屬氧化物或包含至少一種第三主族金屬之金屬氧化物)及過渡金屬錯合物(較佳Cu、Co、Ni、Pd或Pt與具有至少一個結合氧原子之配體之錯合物)。此外，較佳者係過渡金屬氧化物，例如氧化銻、氧化鉬及氧化鎢，更佳係 Re_2O_7 、 MoO_3 、 WO_3 及 ReO_3 。

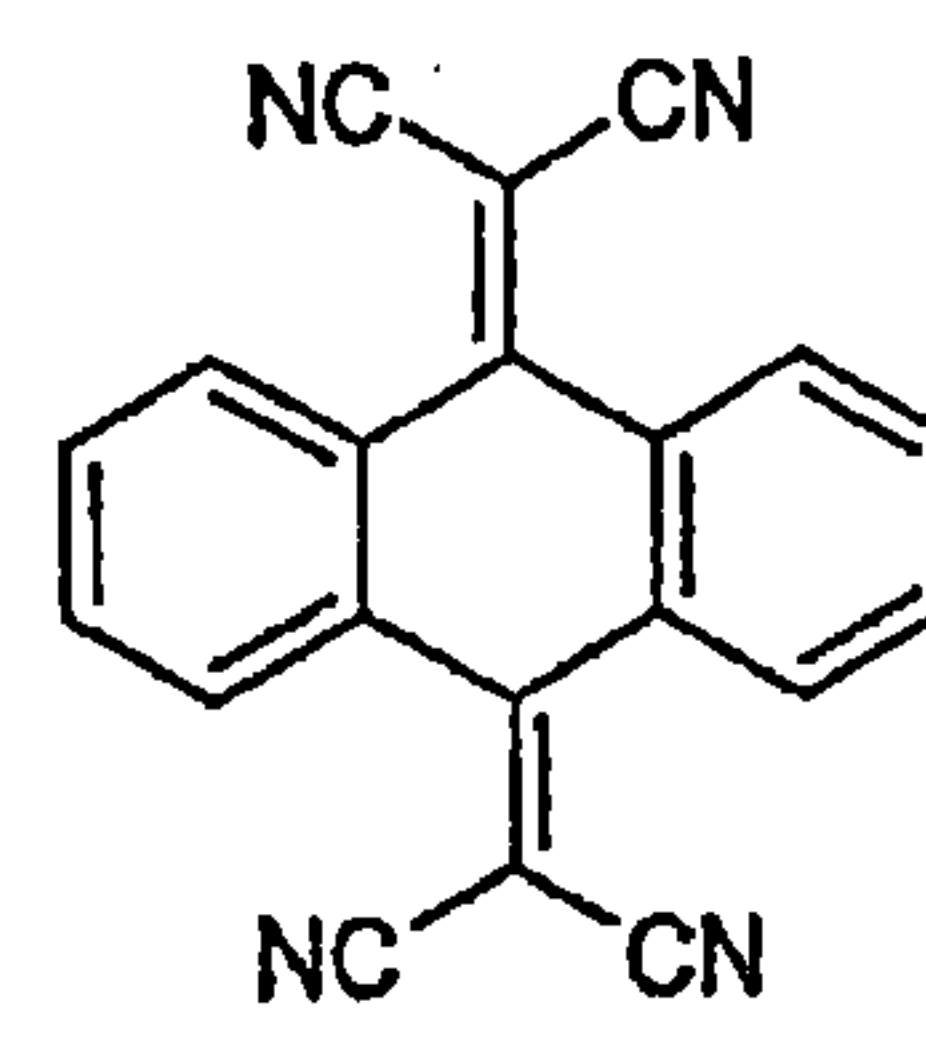
此外，較佳p型摻雜劑係以下化合物：



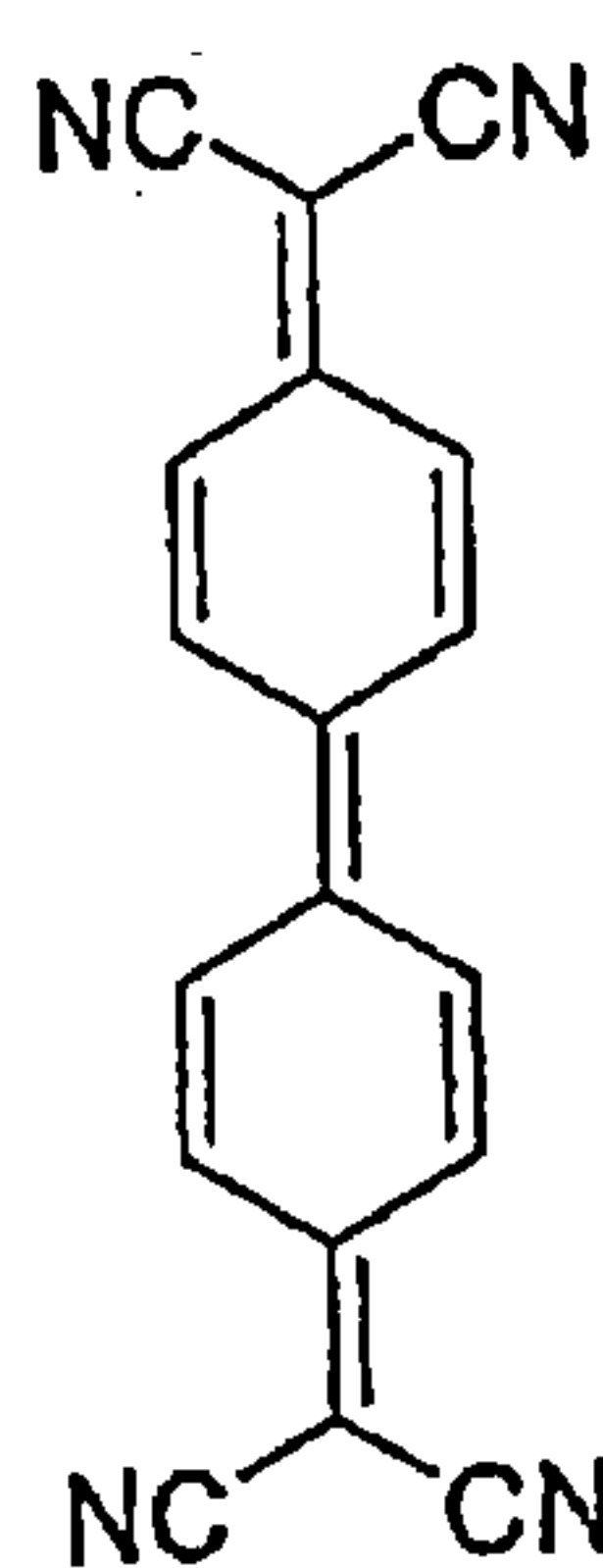
(D-1)



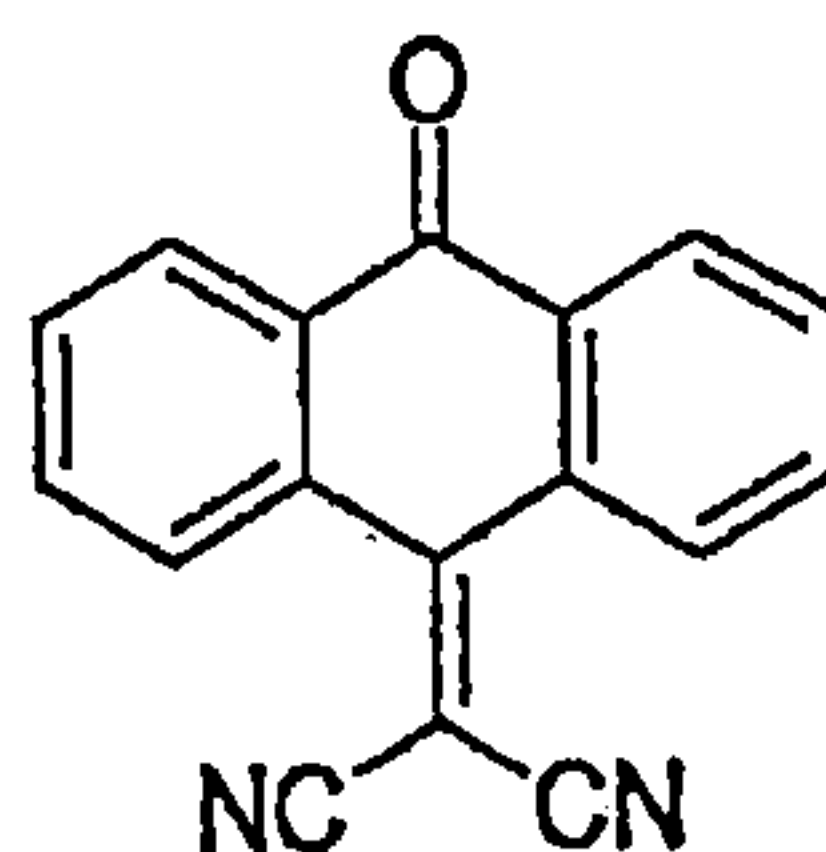
(D-2)



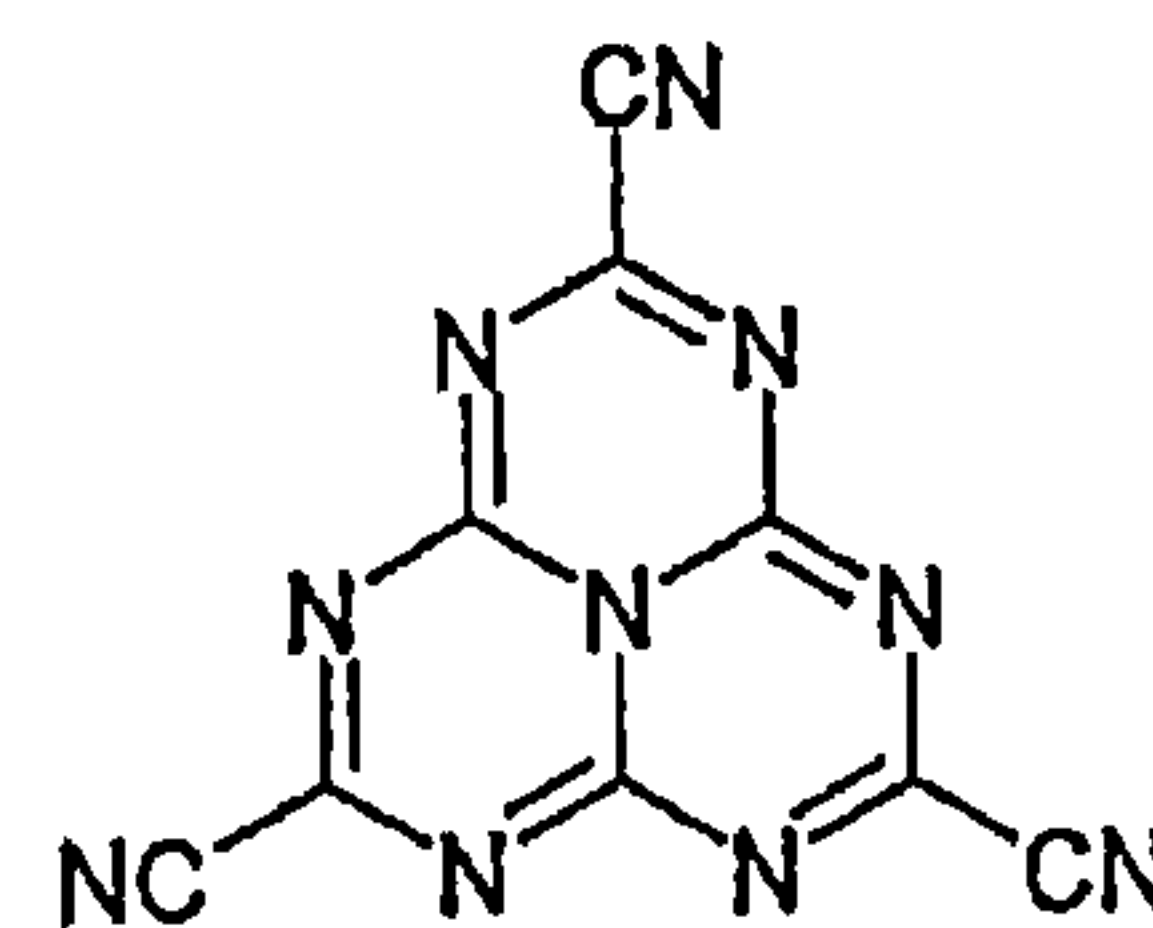
(D-3)



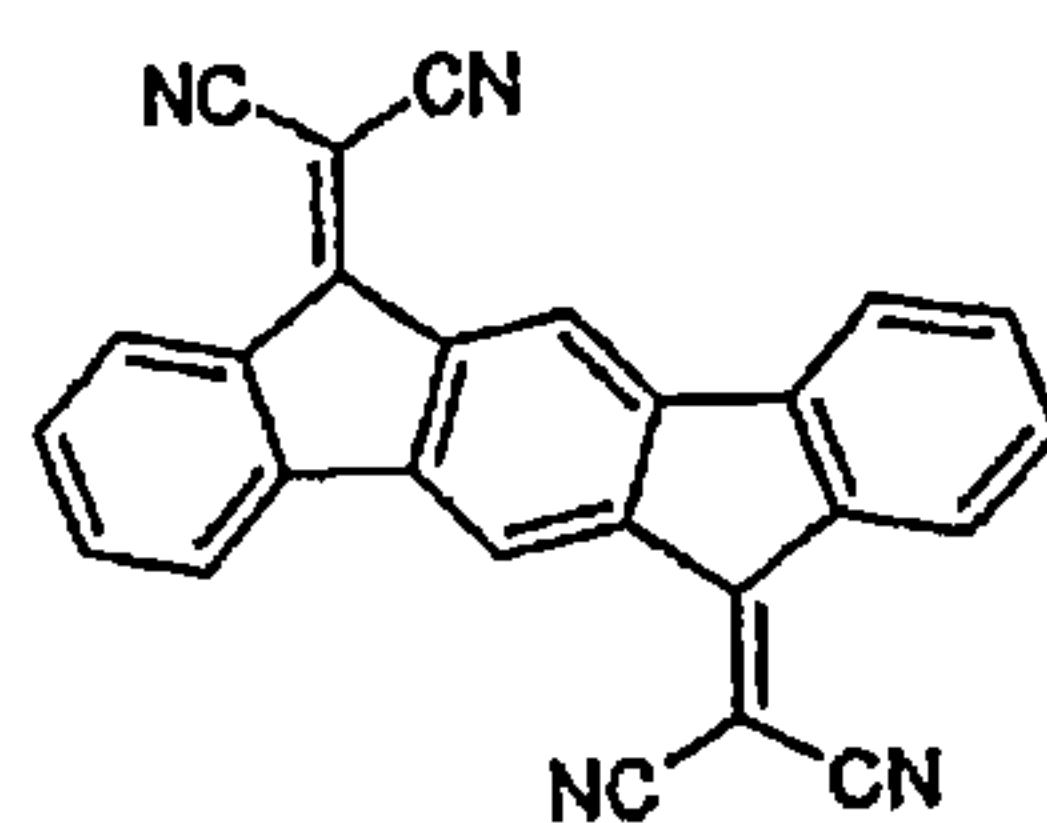
(D-4)



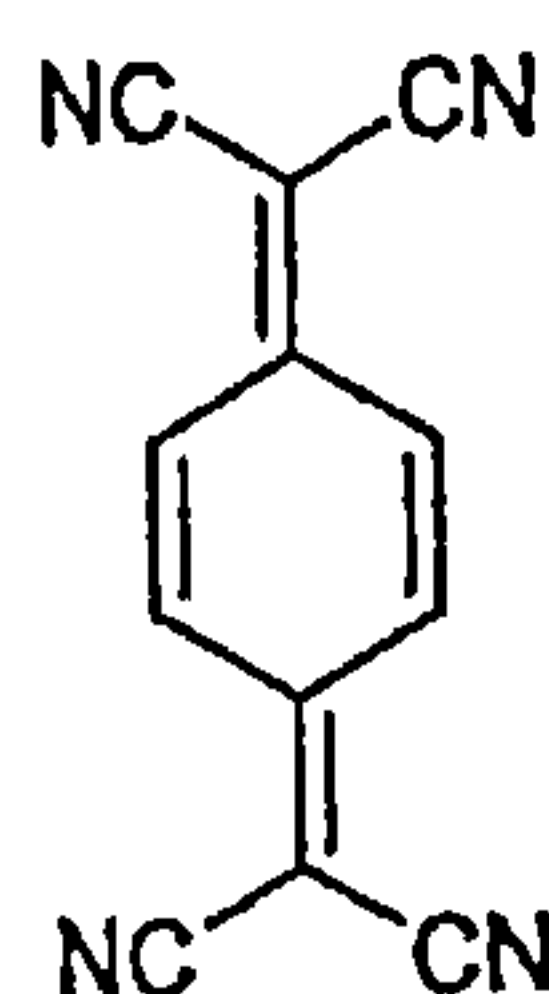
(D-5)



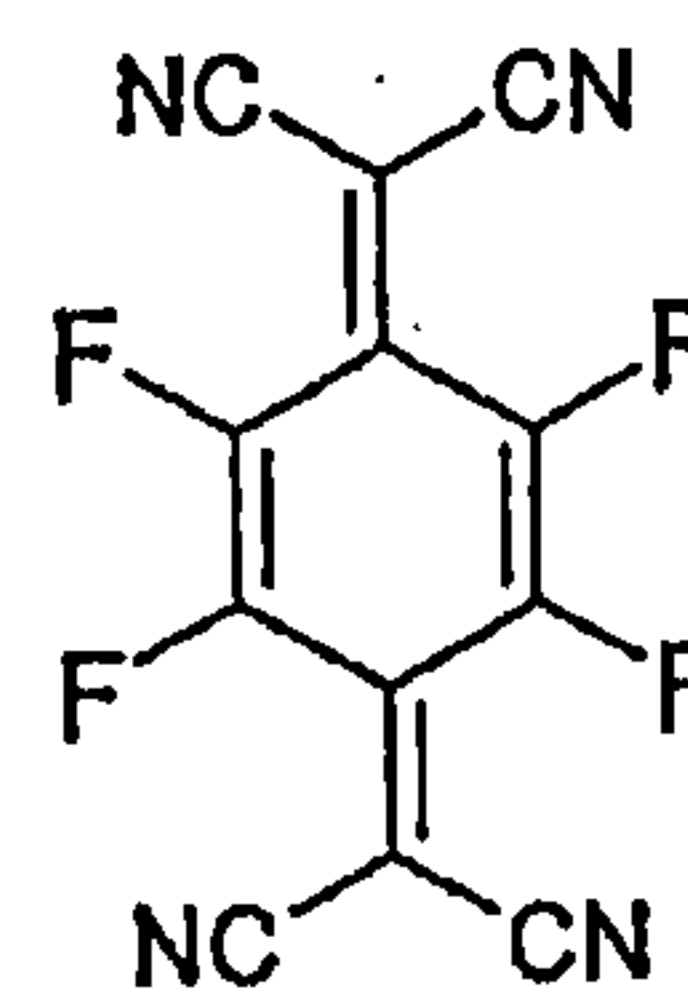
(D-6)



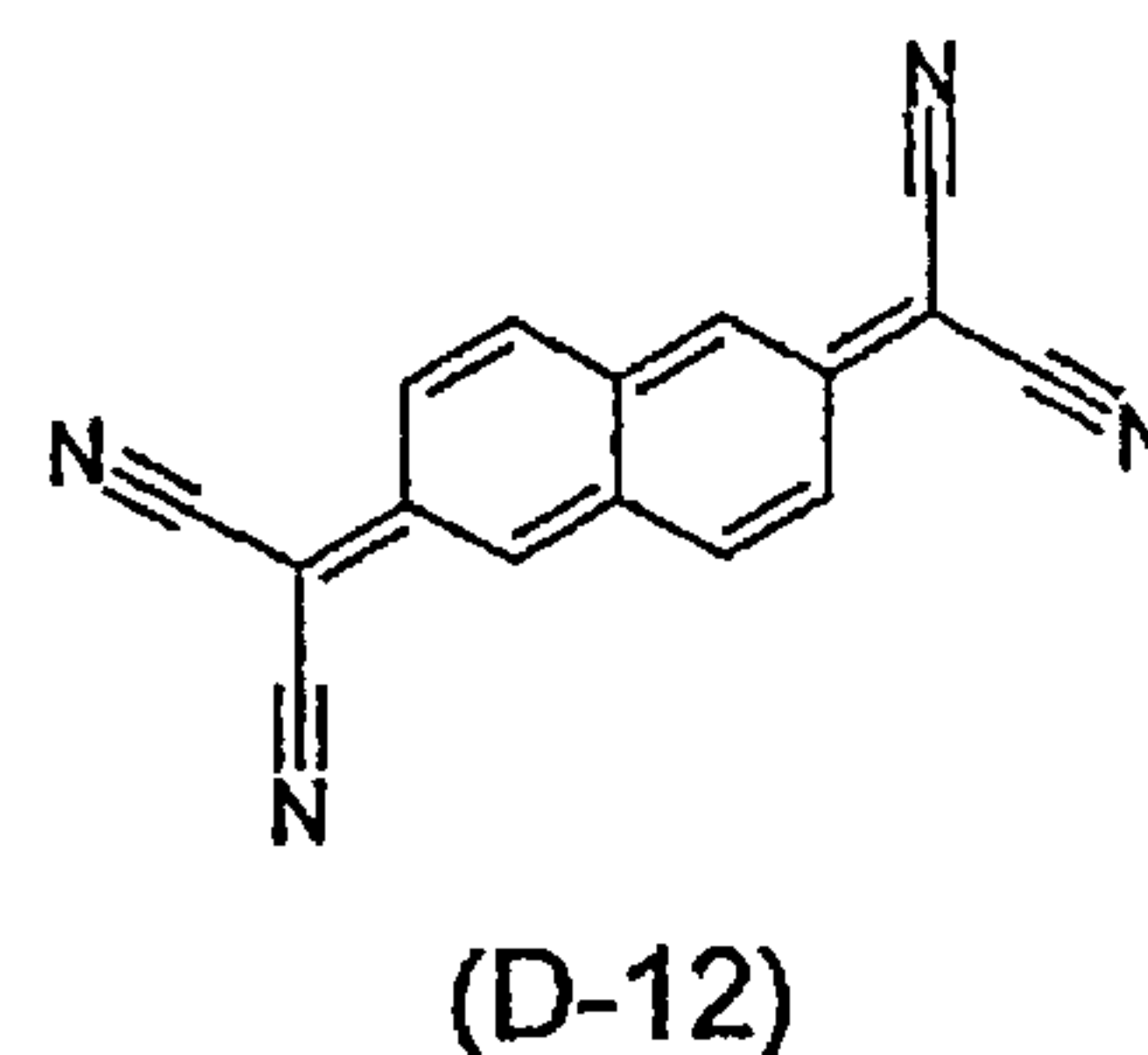
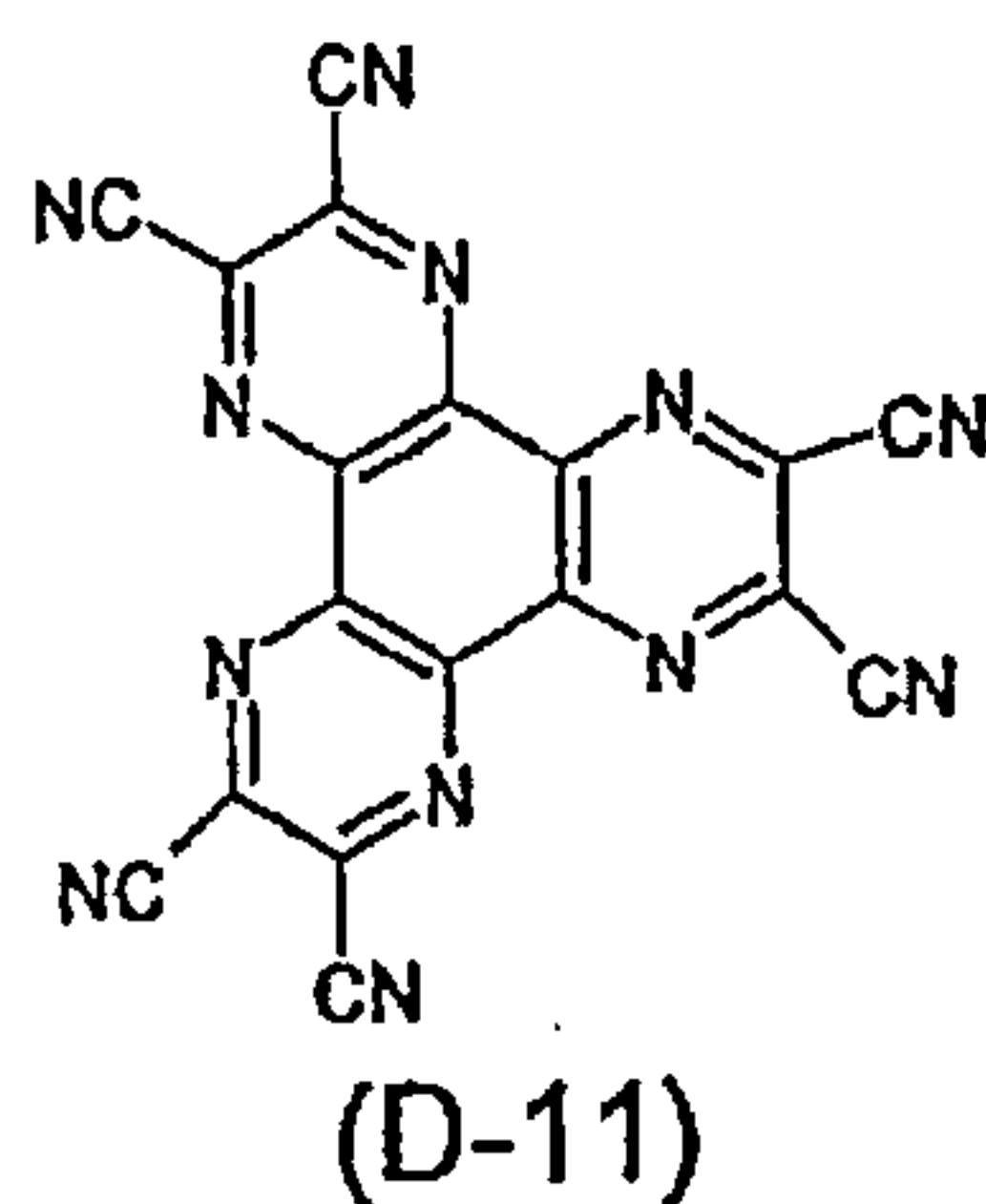
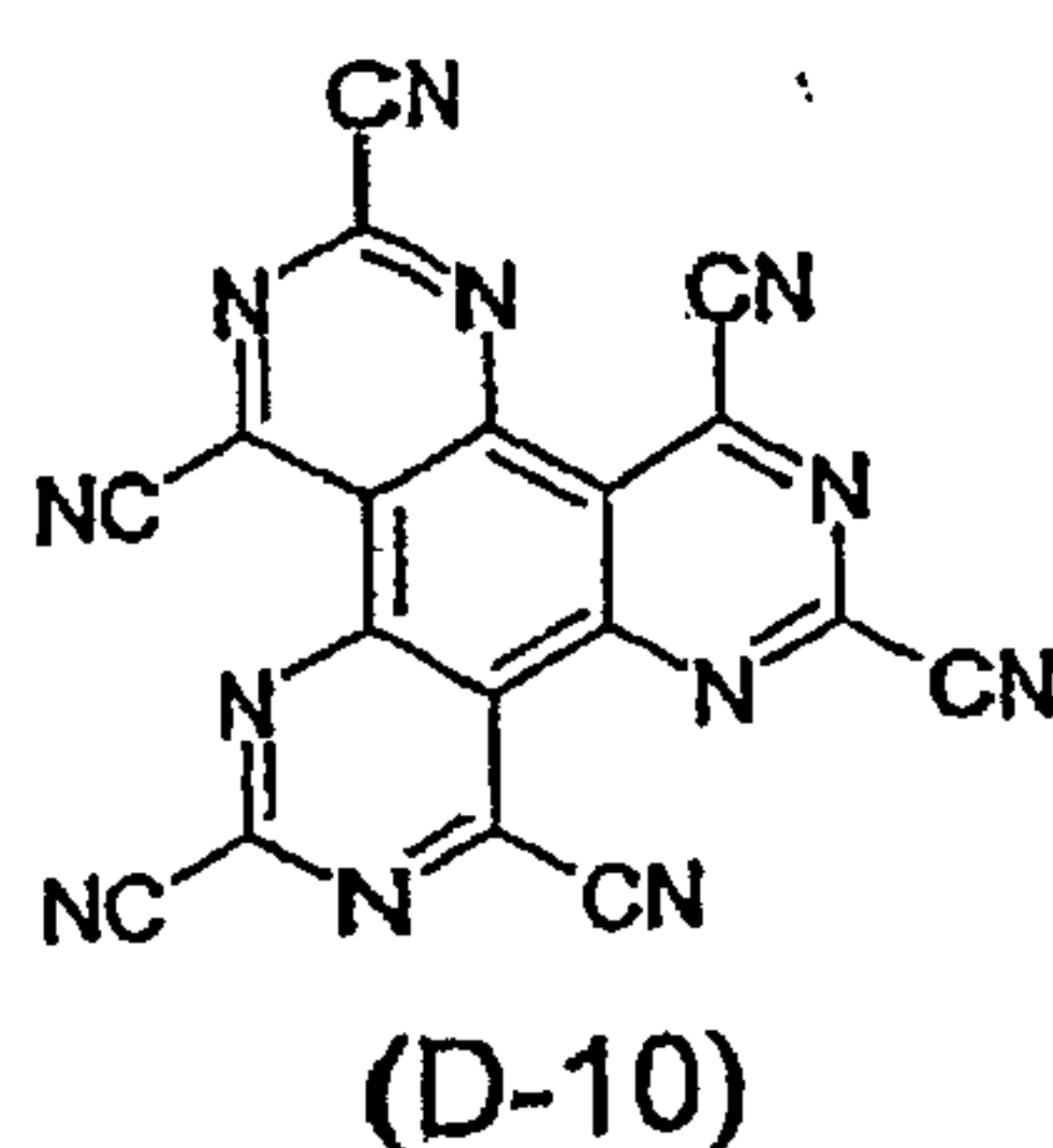
(D-7)



(D-8)



(D-9)



在本發明之另一較佳實施例中，式(1)化合物或較佳實施例係用作發射層中之螢光或磷光化合物、具體而言磷光化合物之基質材料。此處有機電致發光裝置可包含一個發射層或複數個發射層，其中至少一個發射層包含至少一種本發明化合物作為基質材料。

若式(1)化合物或較佳實施例用作發射層中之發射化合物之基質材料，則其較佳與一或多種磷光材料(三重態發射體)組合使用。在本發明意義上，磷光意指來自自旋多重性 > 1 之激發態、具體而言來自激發三重態之發光。出於本申請案之目的，所有含有過渡金屬或鐳系元素之發光錯合物、具體而言所有發光銥、鉑及銅之錯合物均視為磷光化合物。

包含式(1)化合物或較佳實施例及發射化合物之混合物以包含發射體及基質材料之整個混合物計包含介於99.9重量%與1重量%之間、較佳介於99重量%與10重量%之間、尤佳介於97重量%與60重量%之間、具體而言介於95重量%與80重量%之間之式(1)化合物或較佳實施例。相應地，該混合物以包含發射體及基質材料之整個混合物計包含介於0.1重量%與99重量%之間、較佳介於1重量%與90重量%之間、尤佳介於3重量%與40重量%之間、具體而言介於5重量%與20重量%之間之發射體。具體而言，若該層係自溶液施加，則上文所指示之限制適用。若該層係藉由真空蒸發來施加，則在每一情形下相同數值適用，其中在此情形下百分比係以體積%指示。

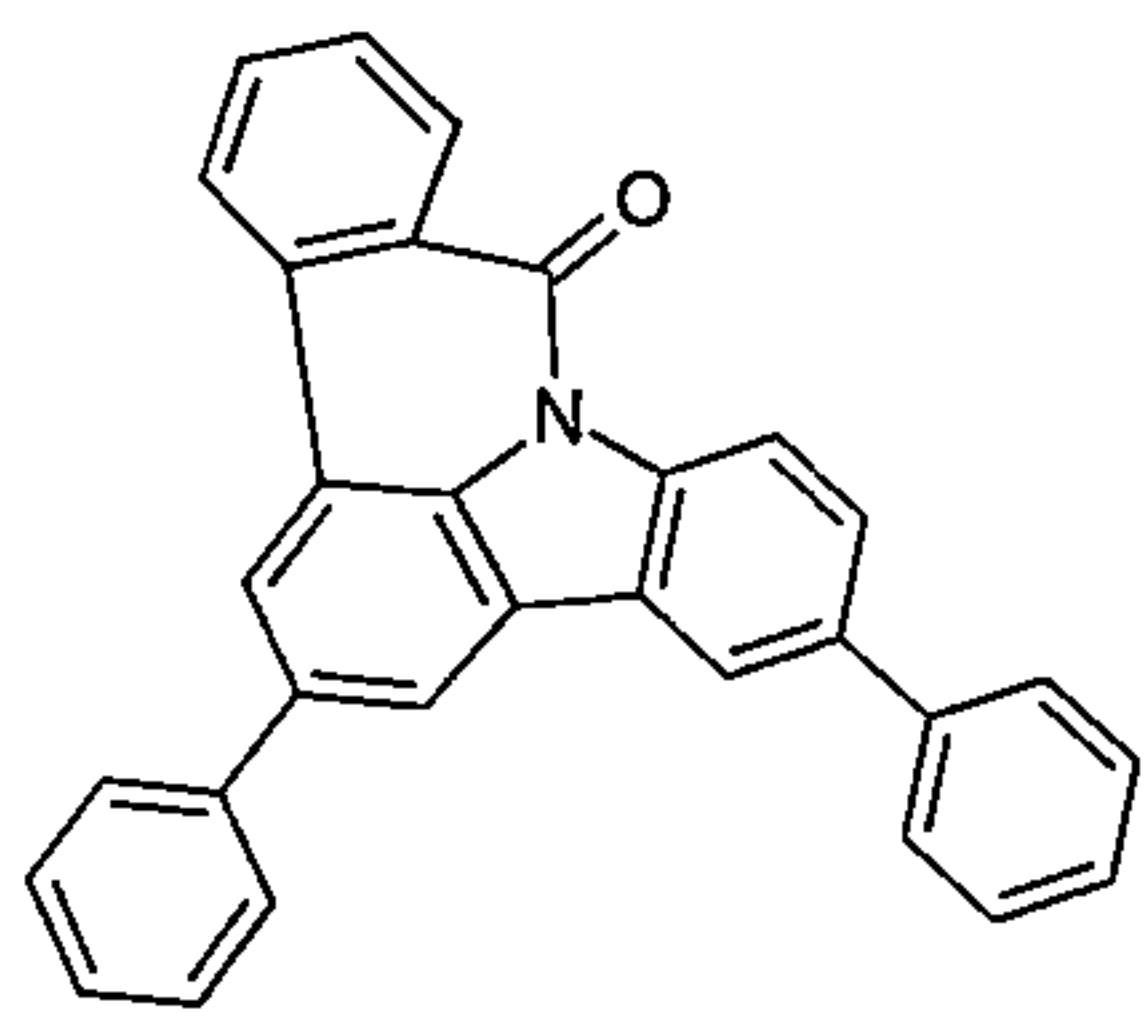
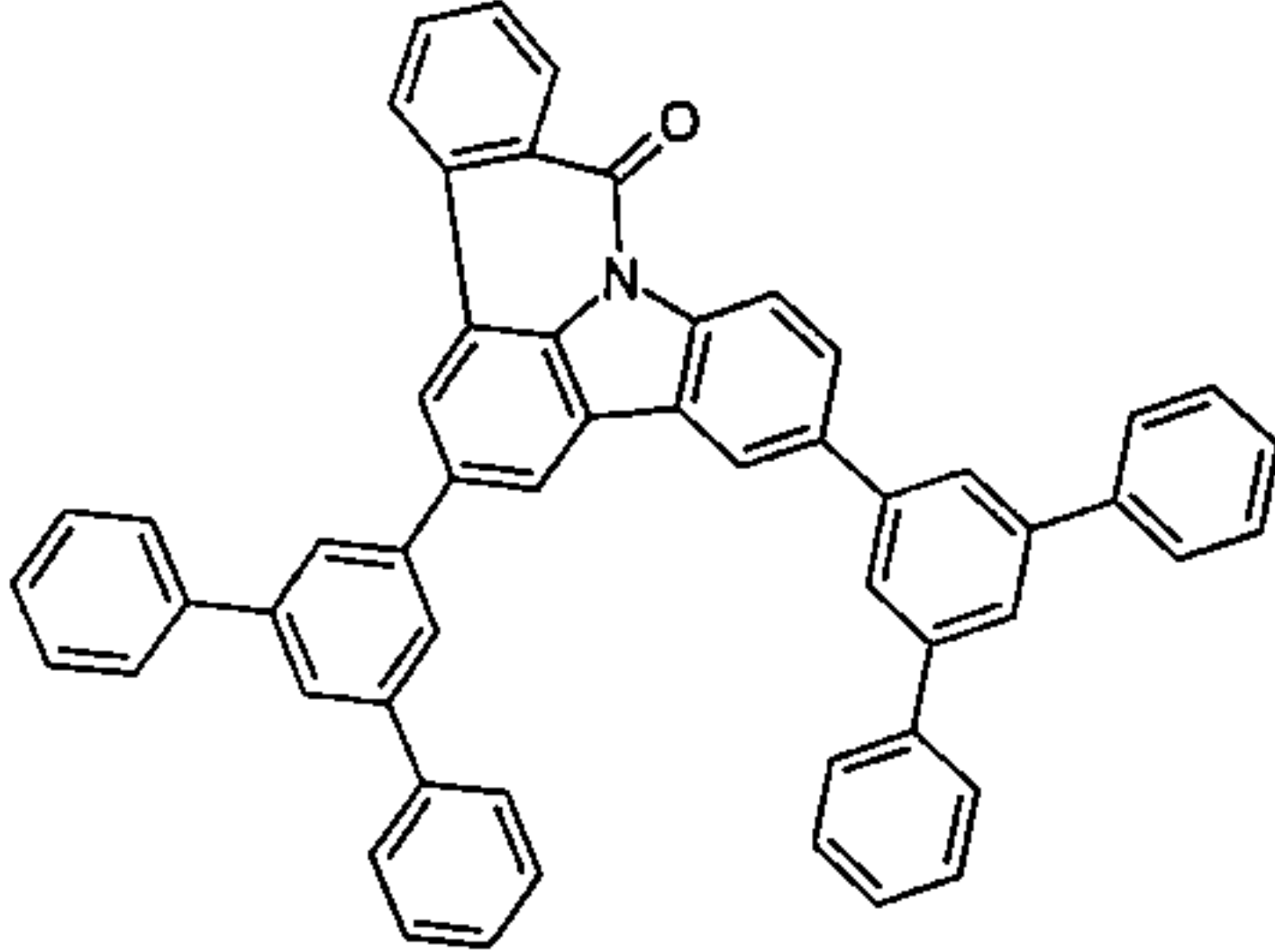
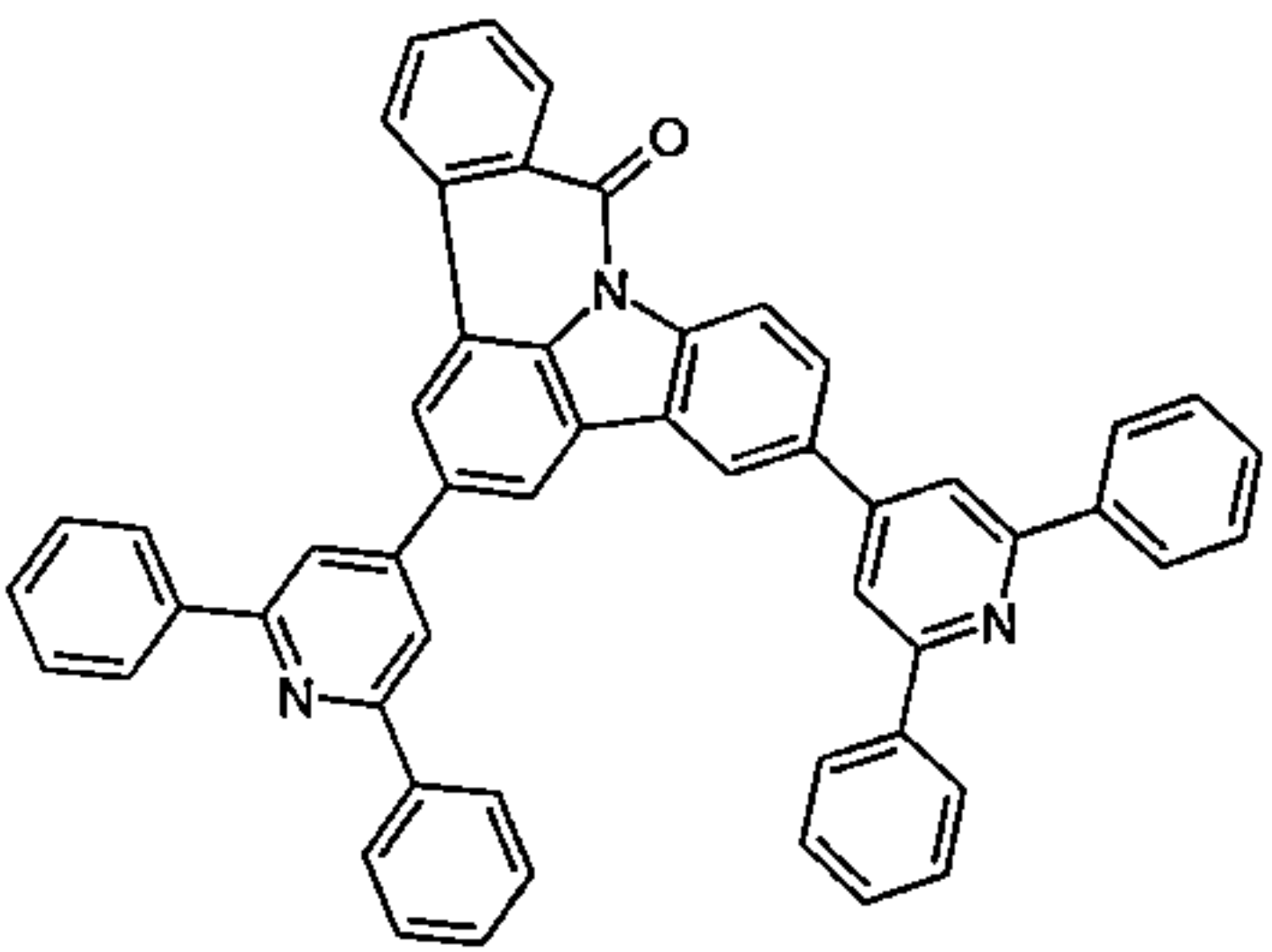
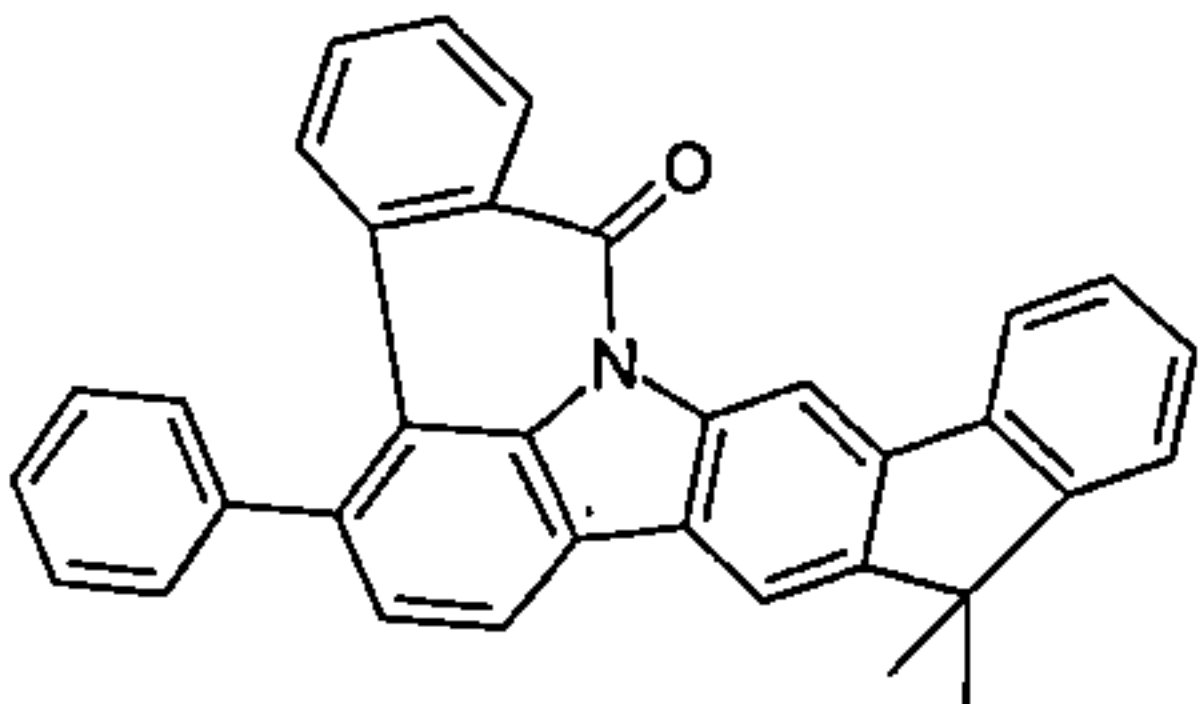
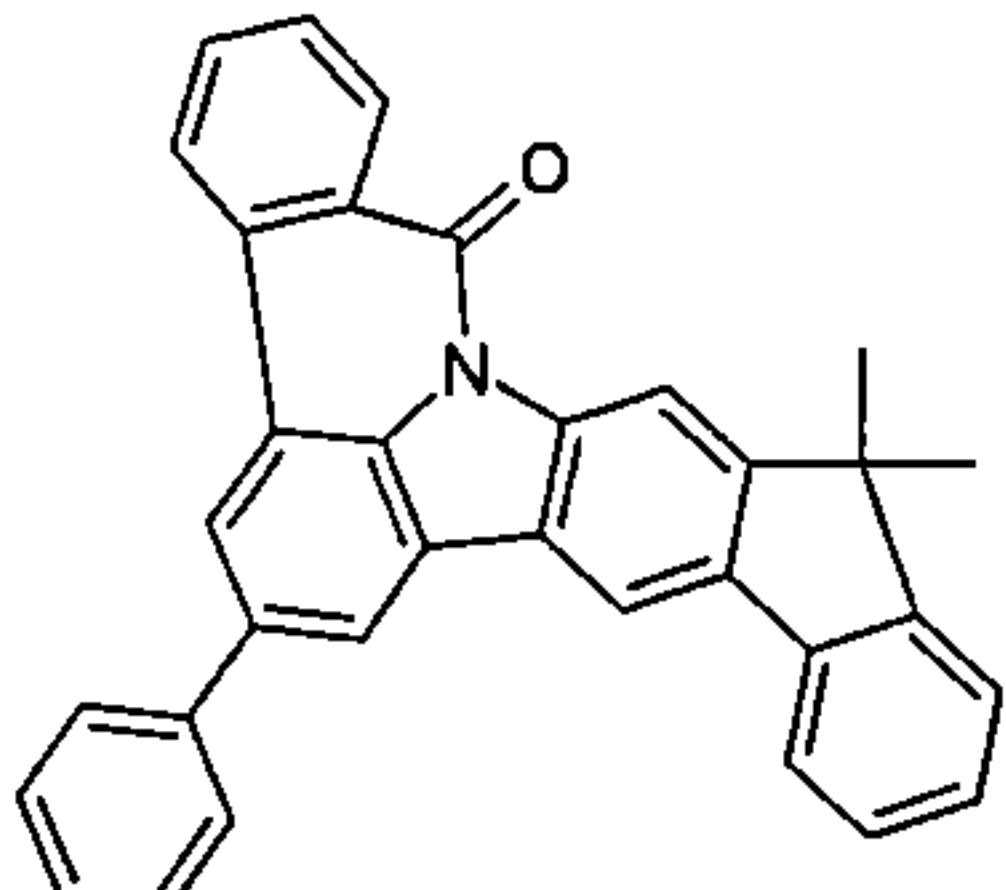
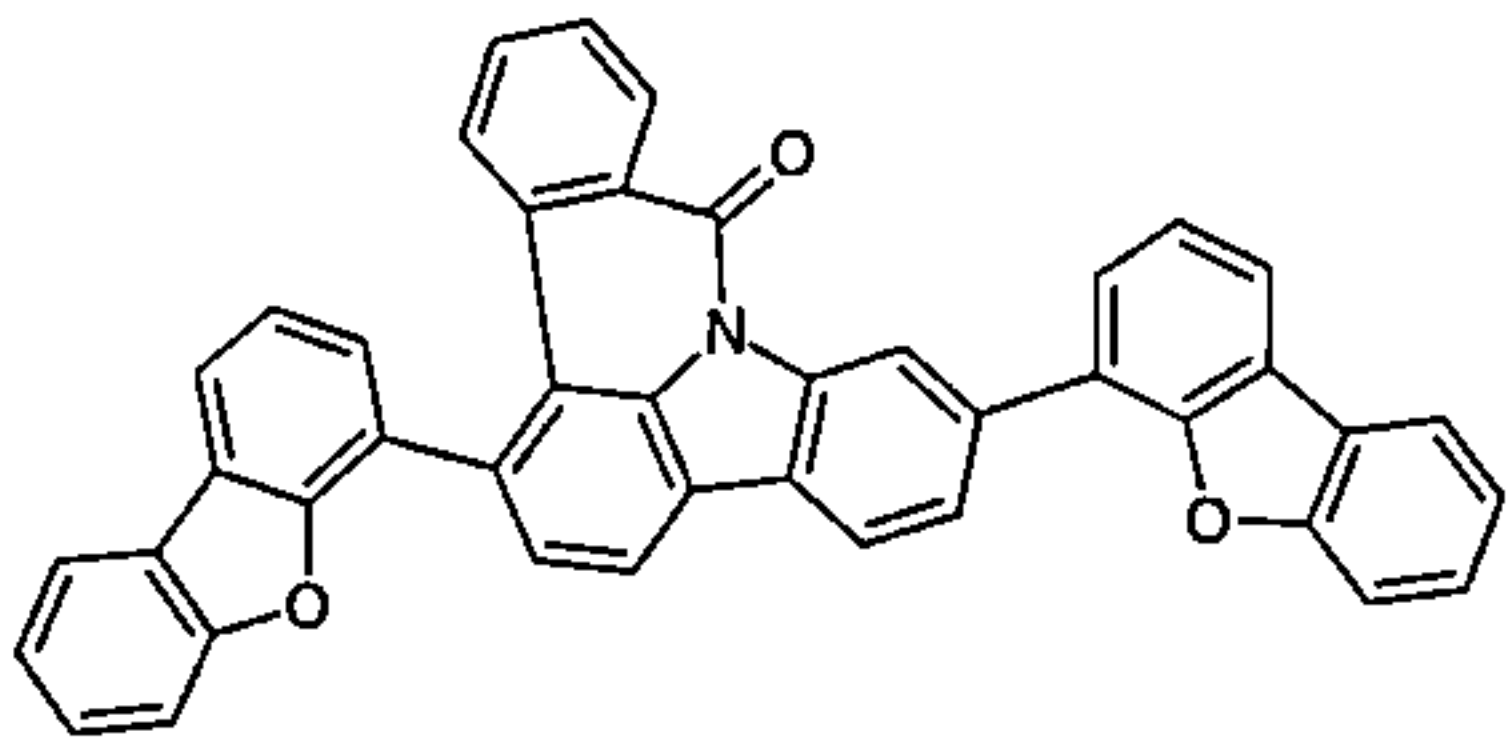
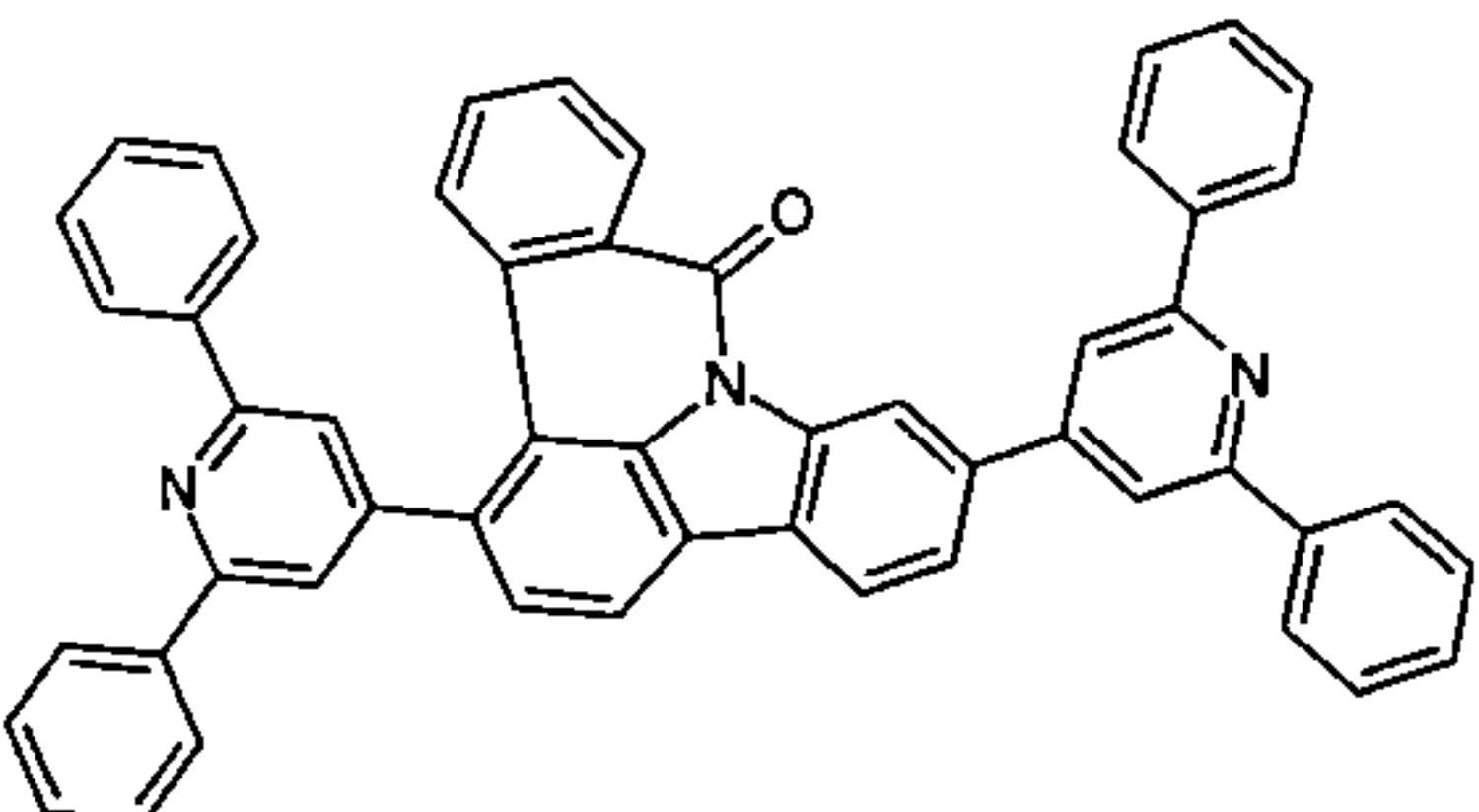
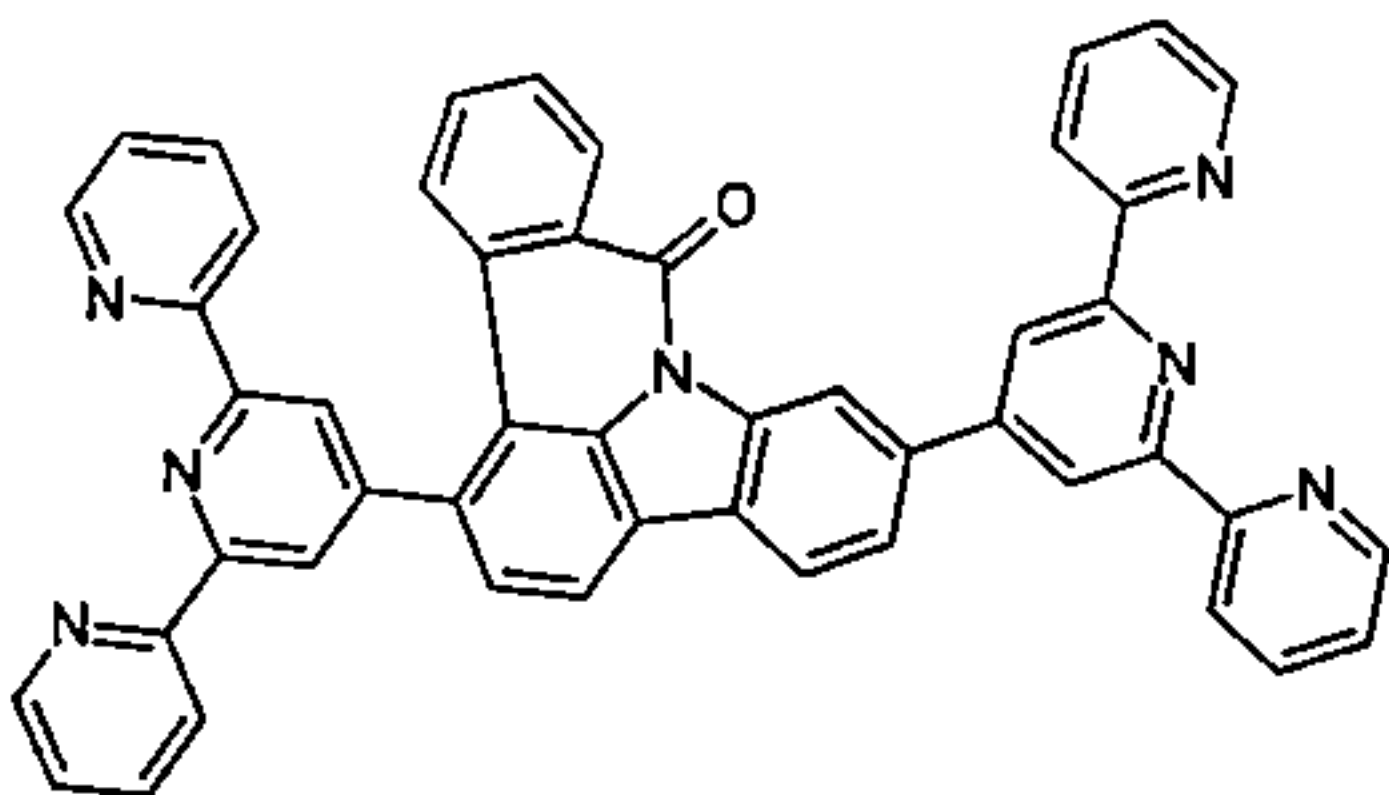
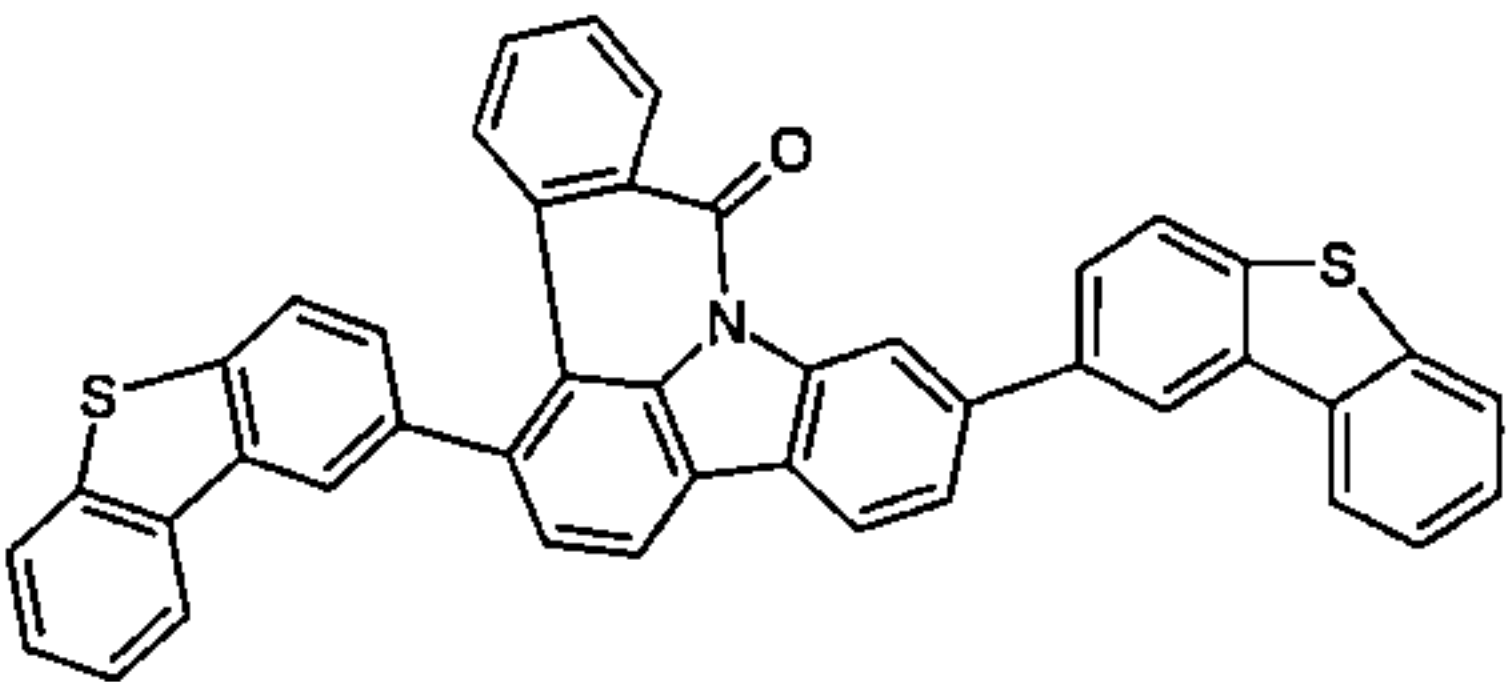
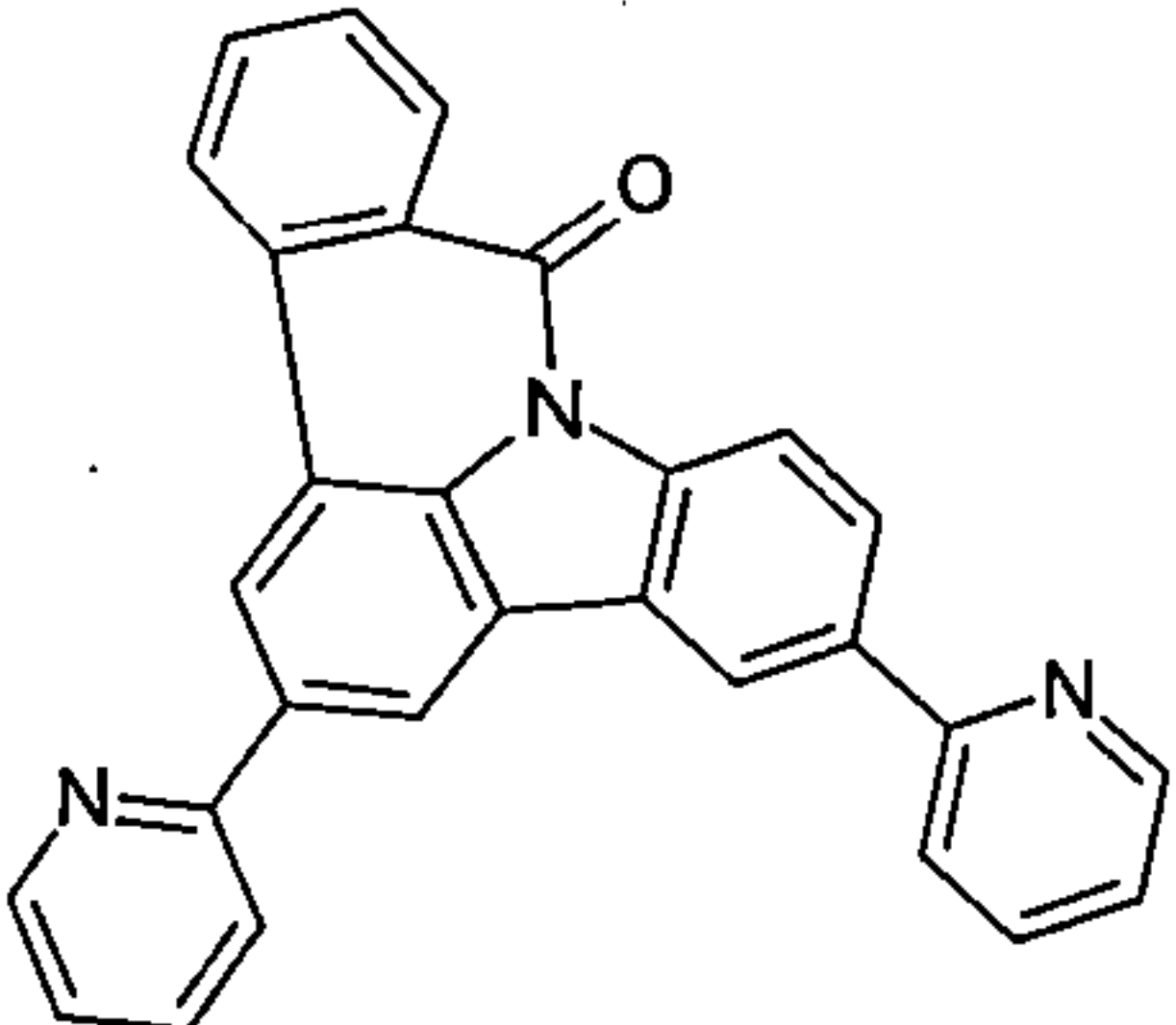
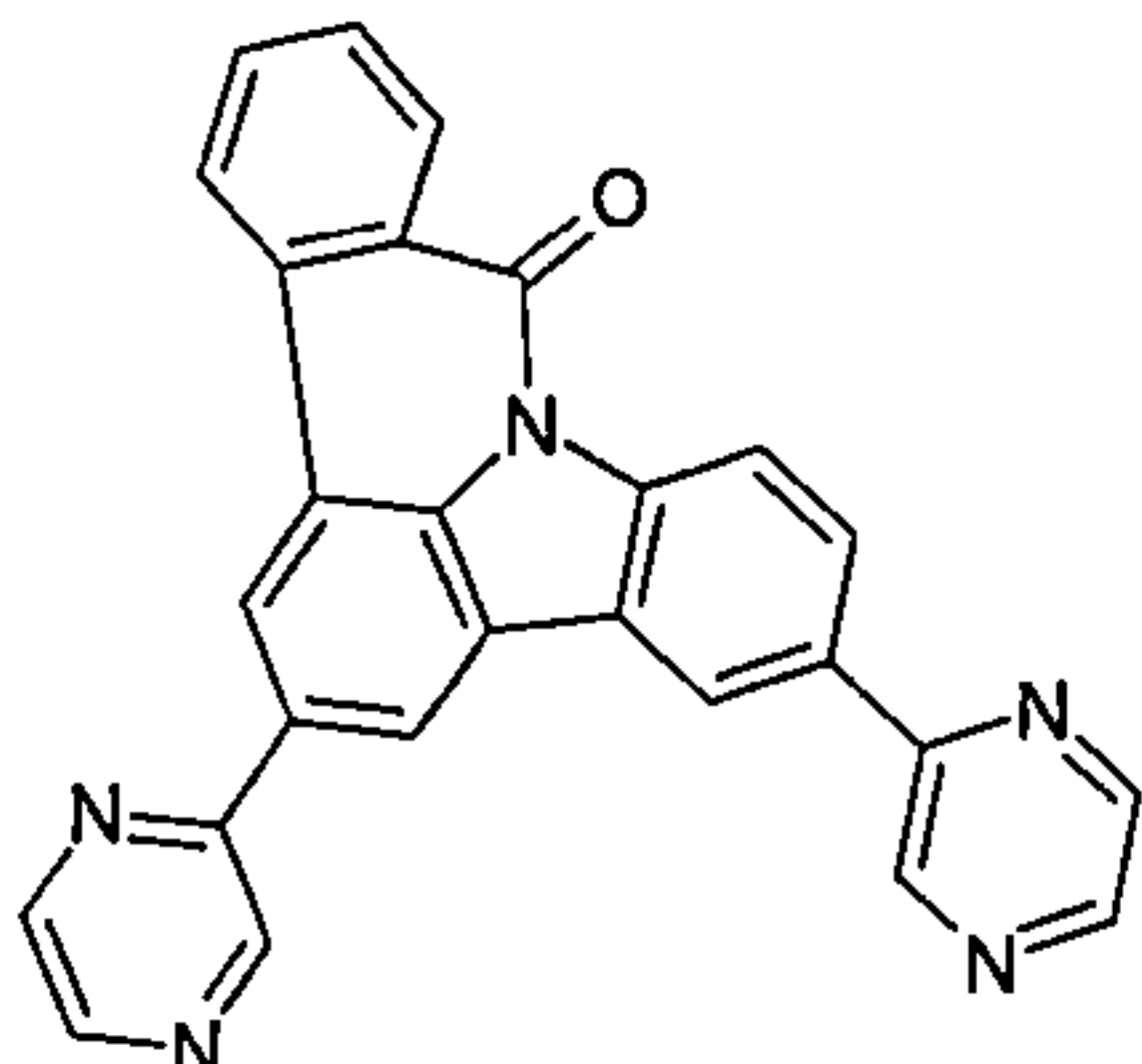
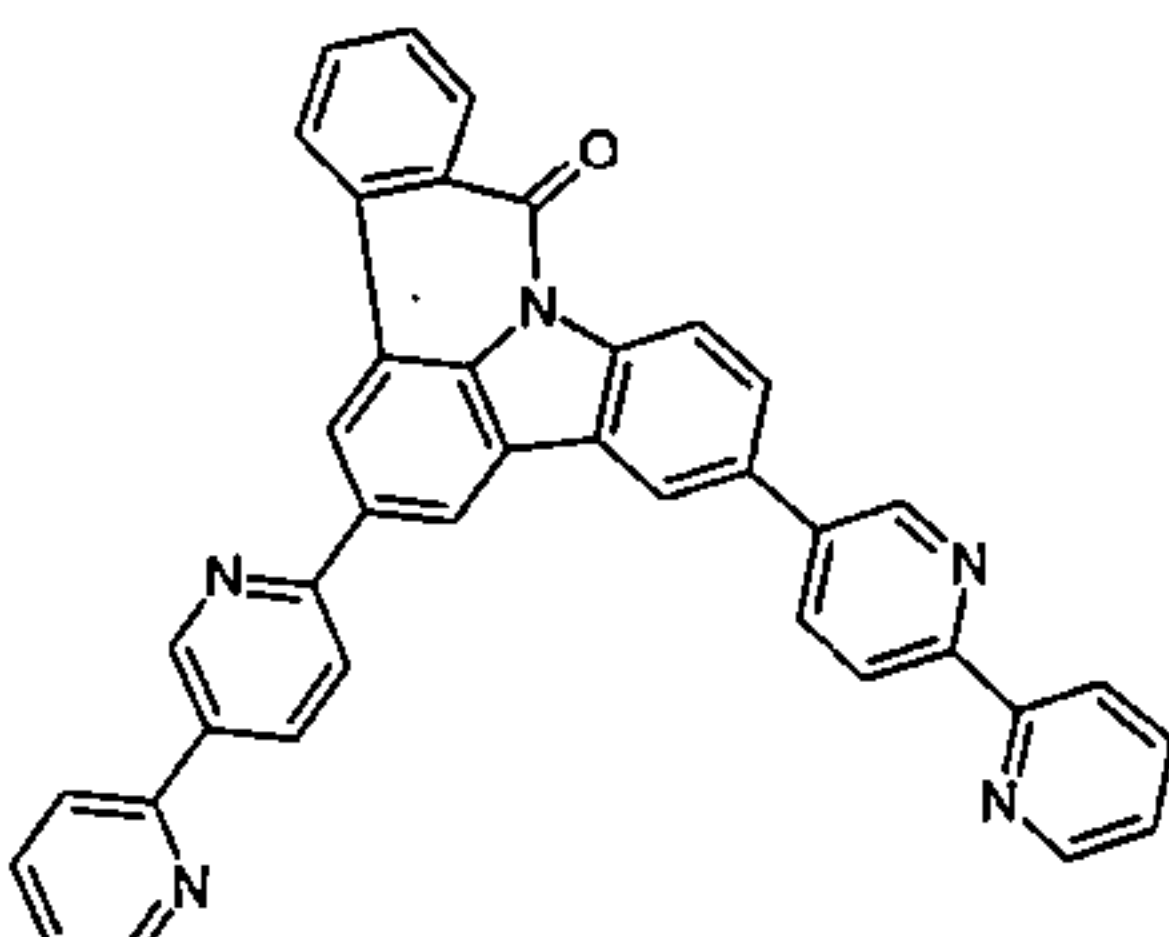
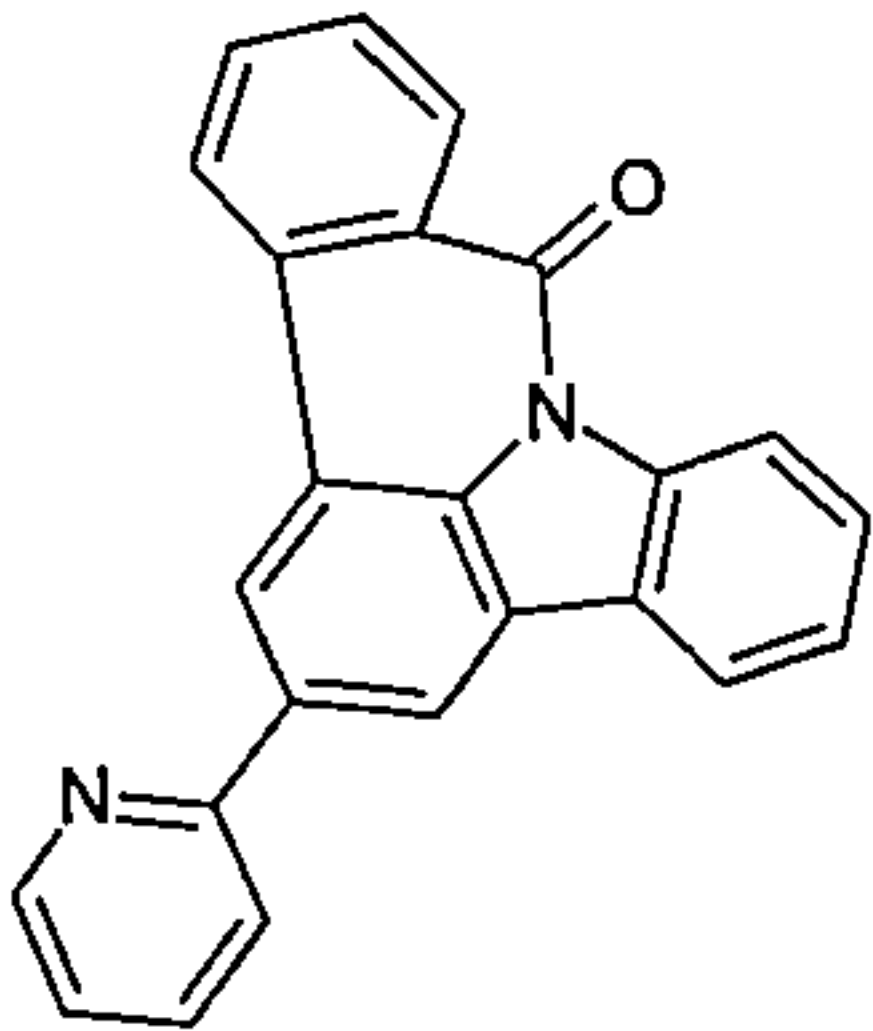
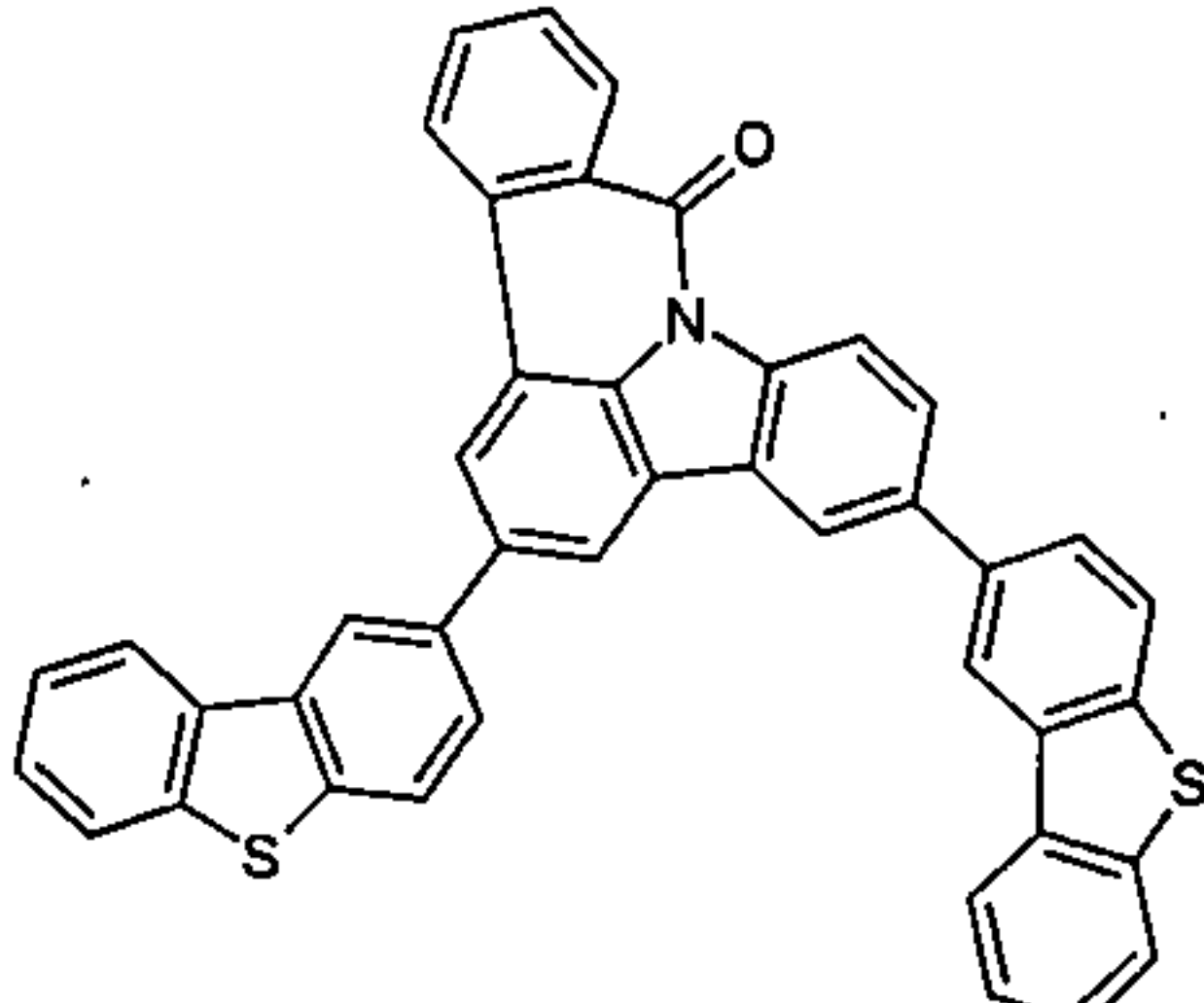
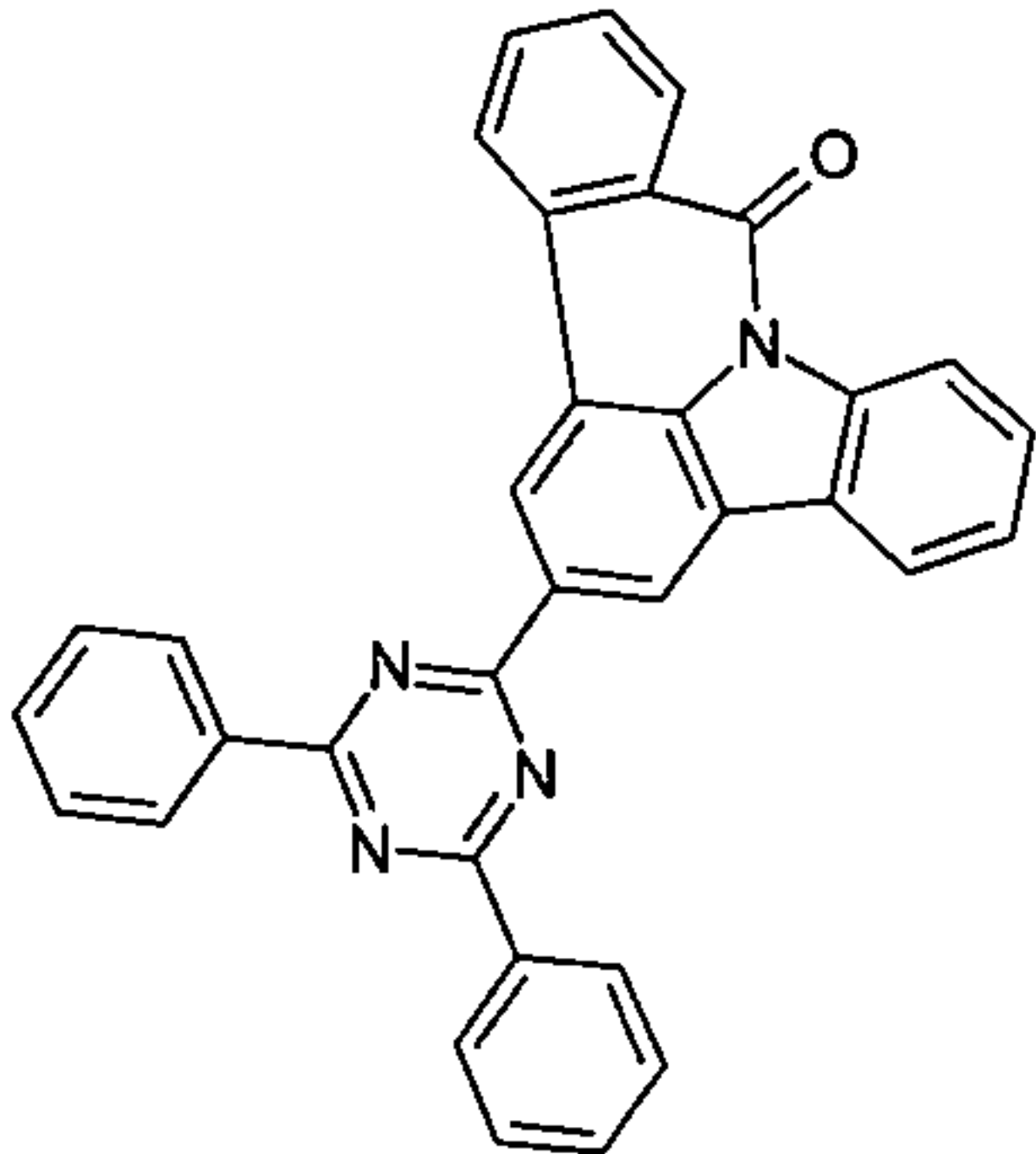
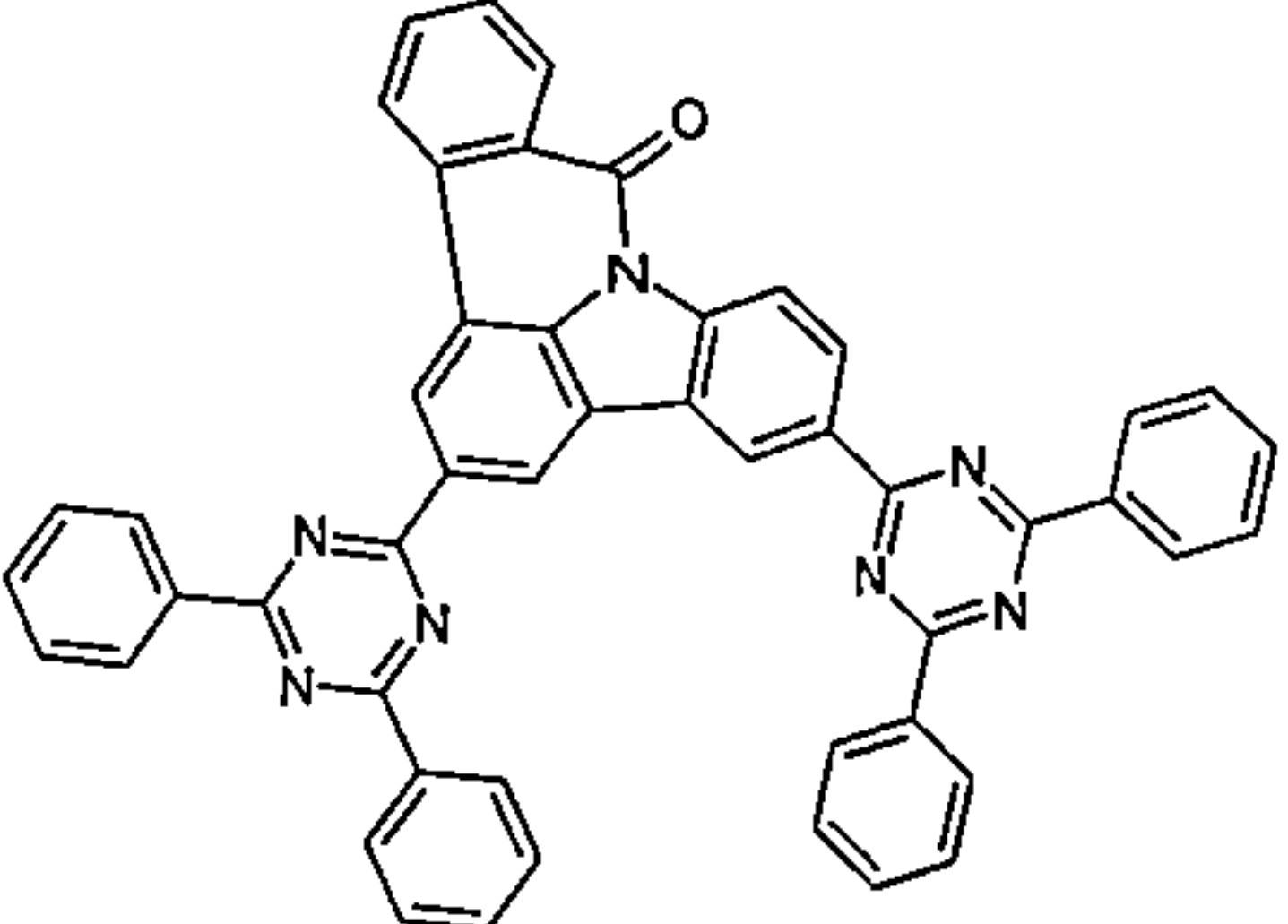
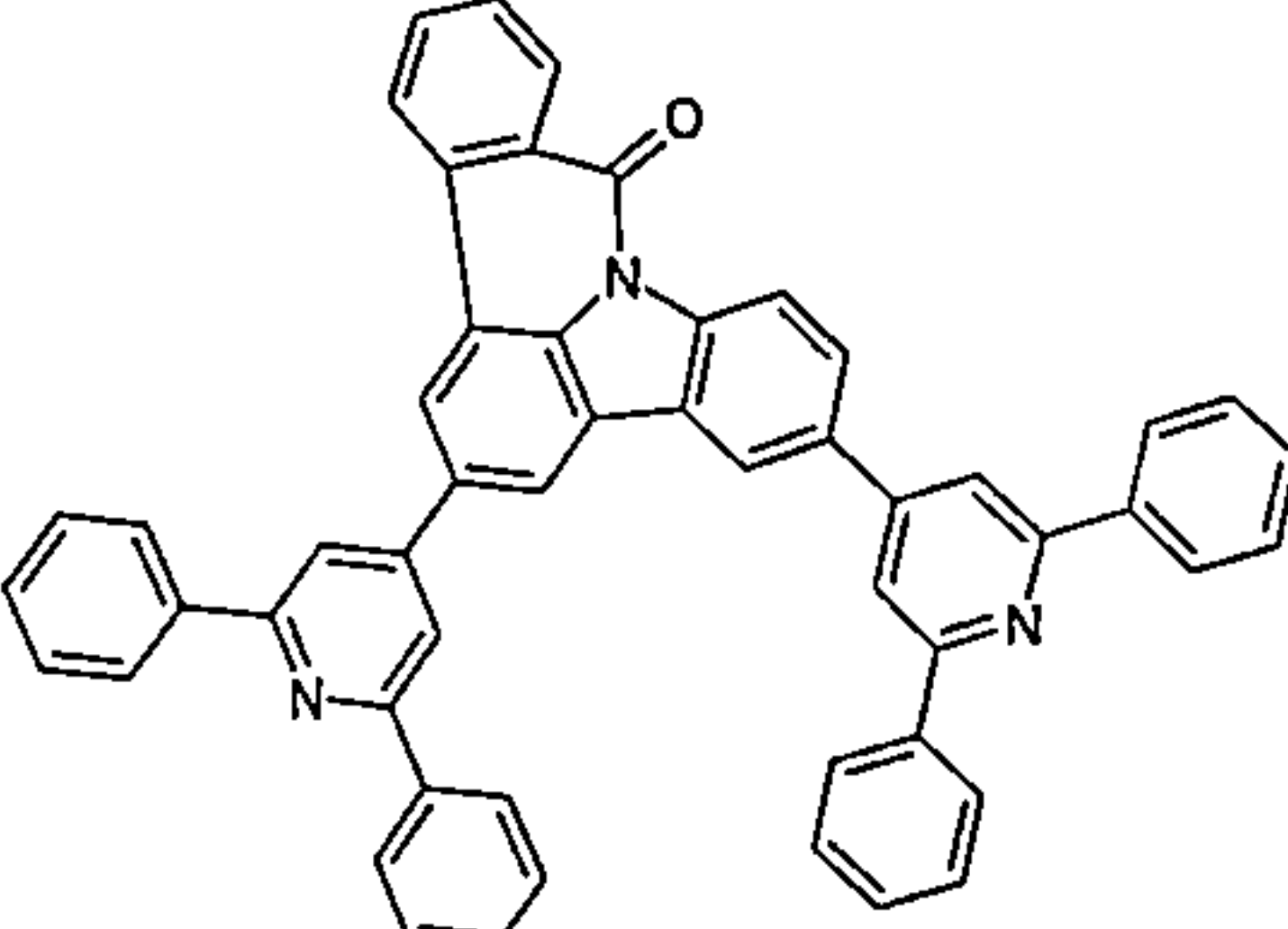
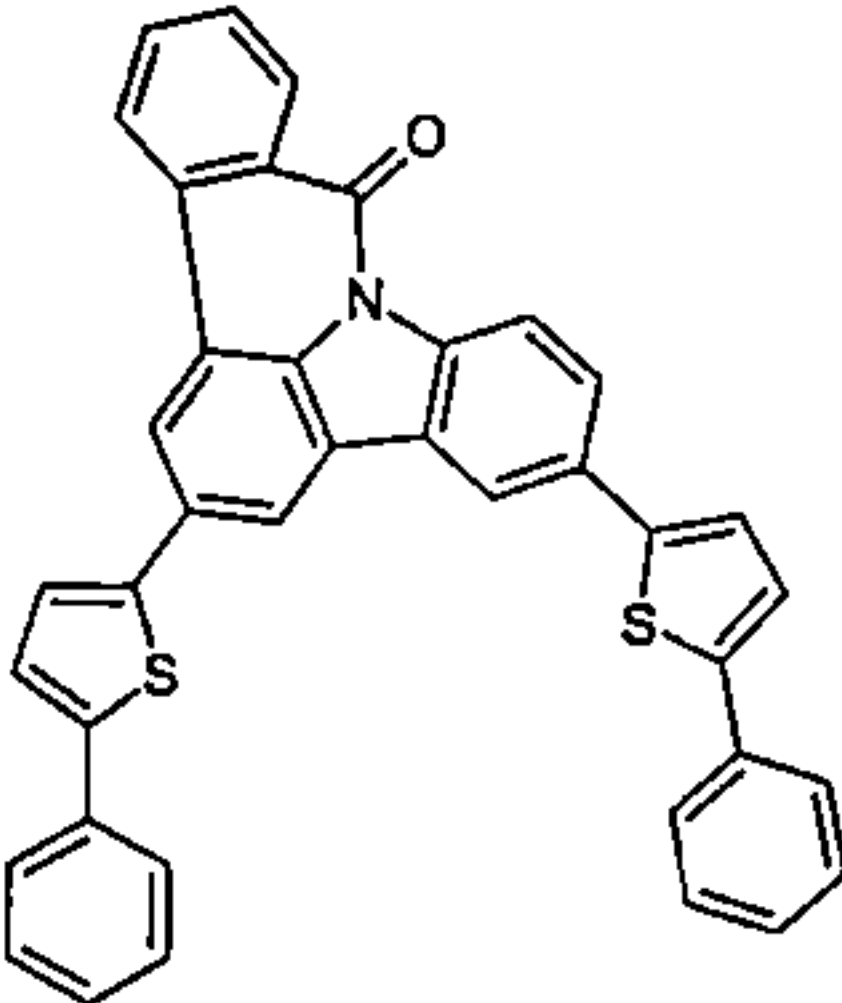
本發明之尤佳實施例係組合使用式(1)化合物或較佳實施例與另

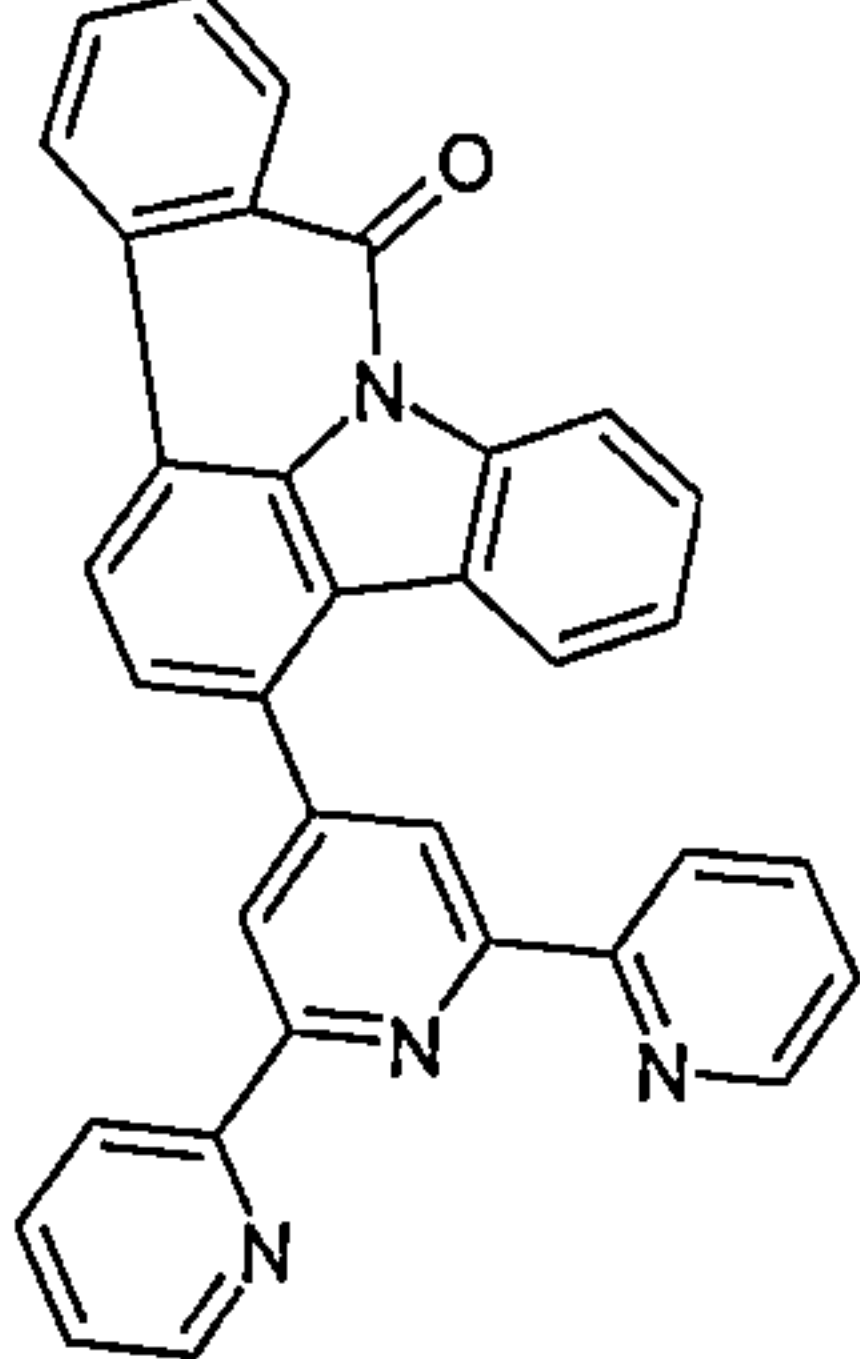
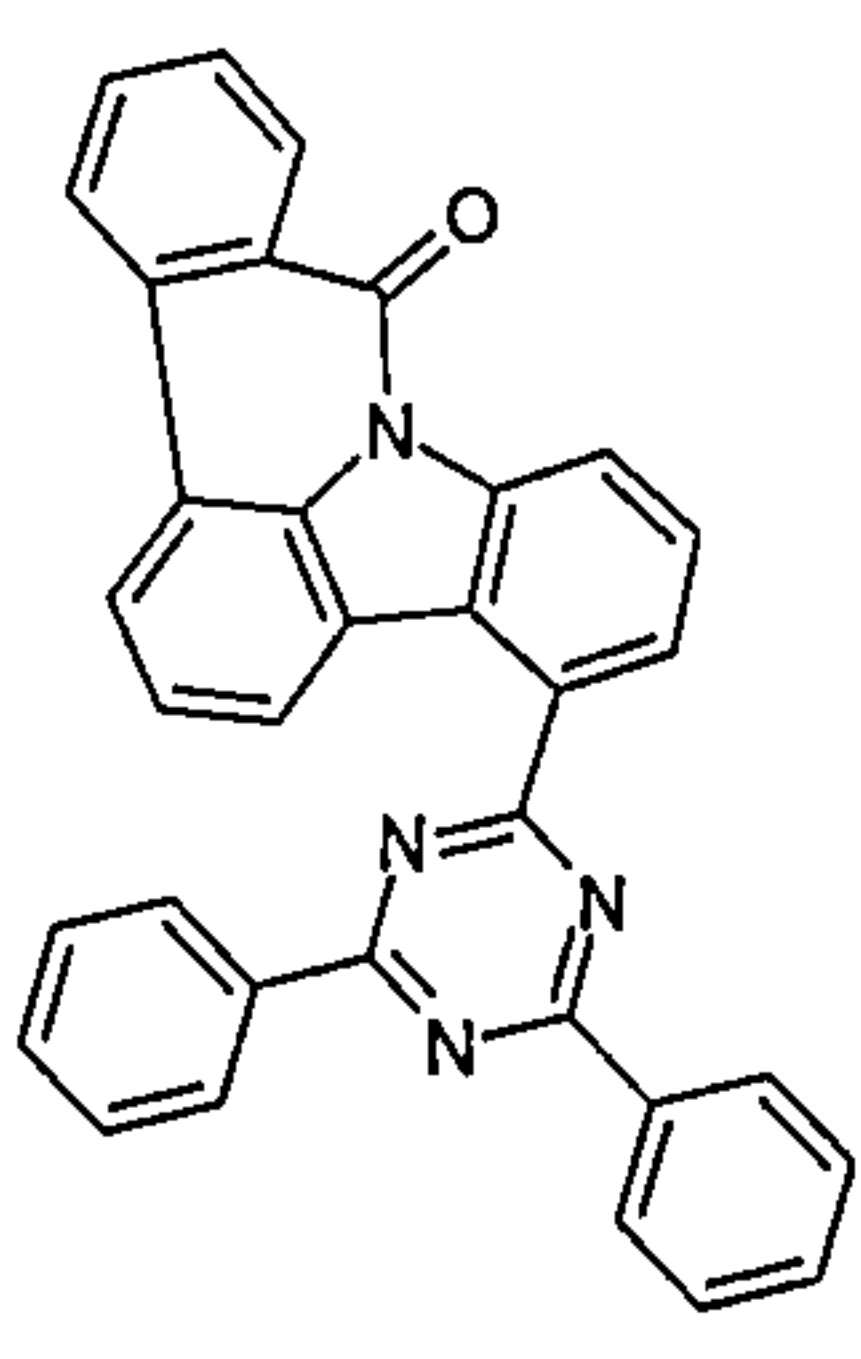
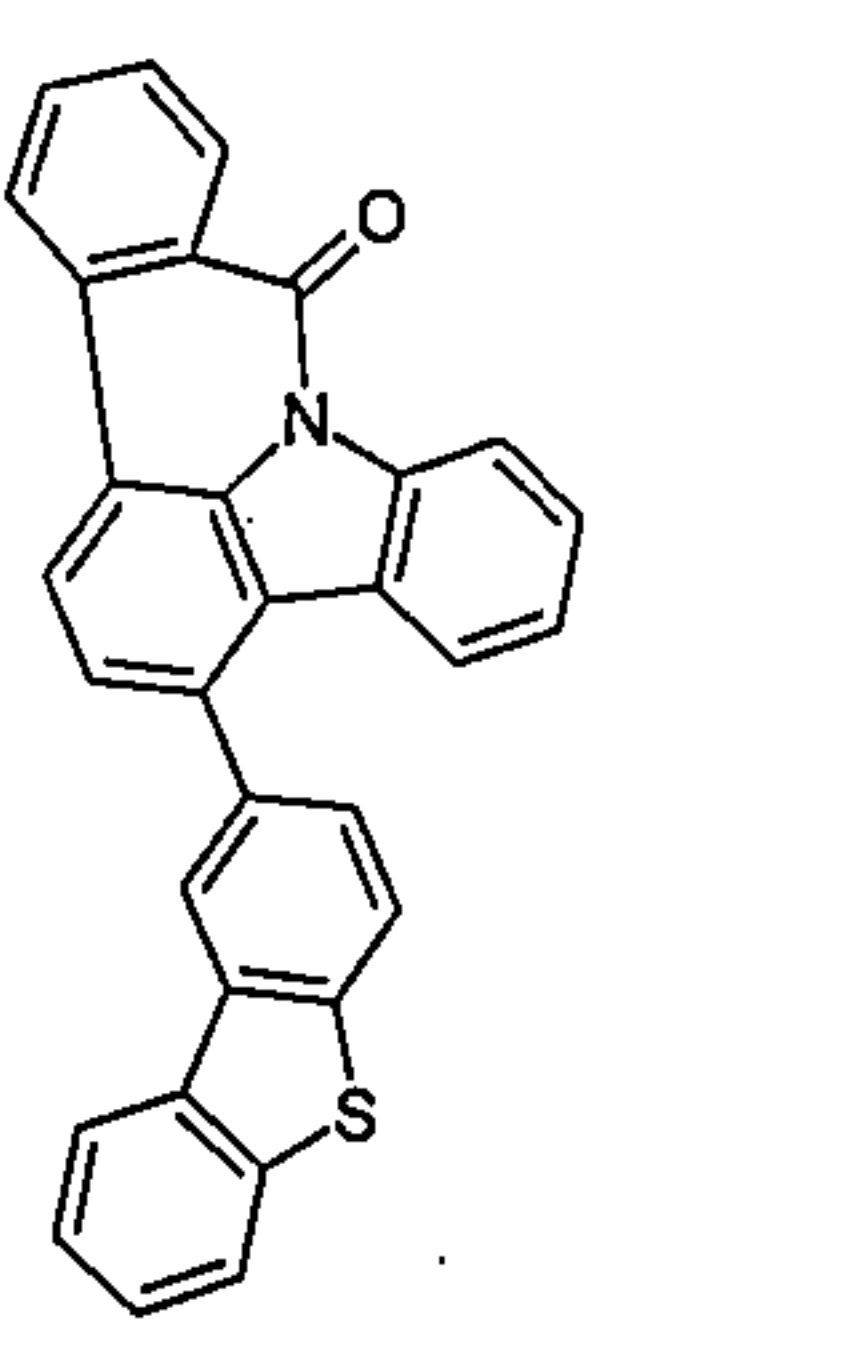
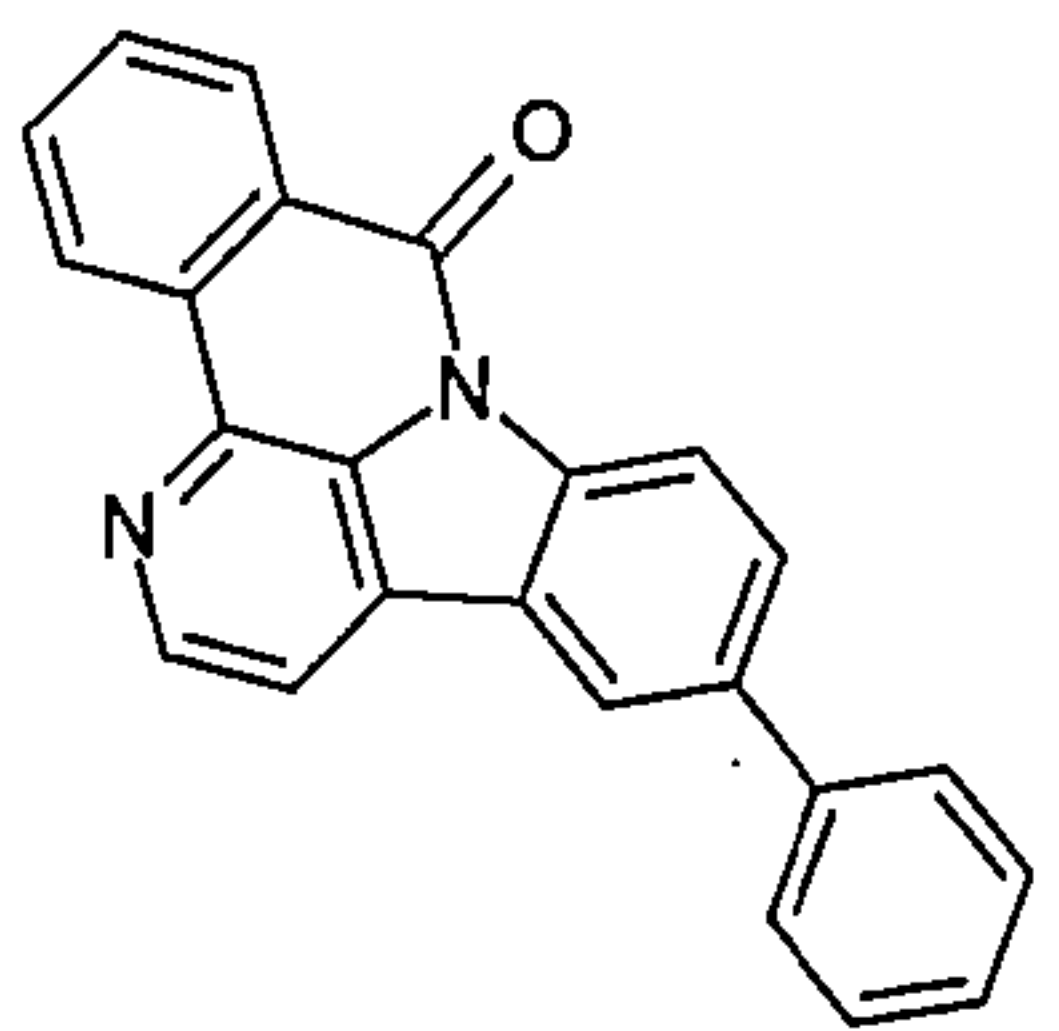
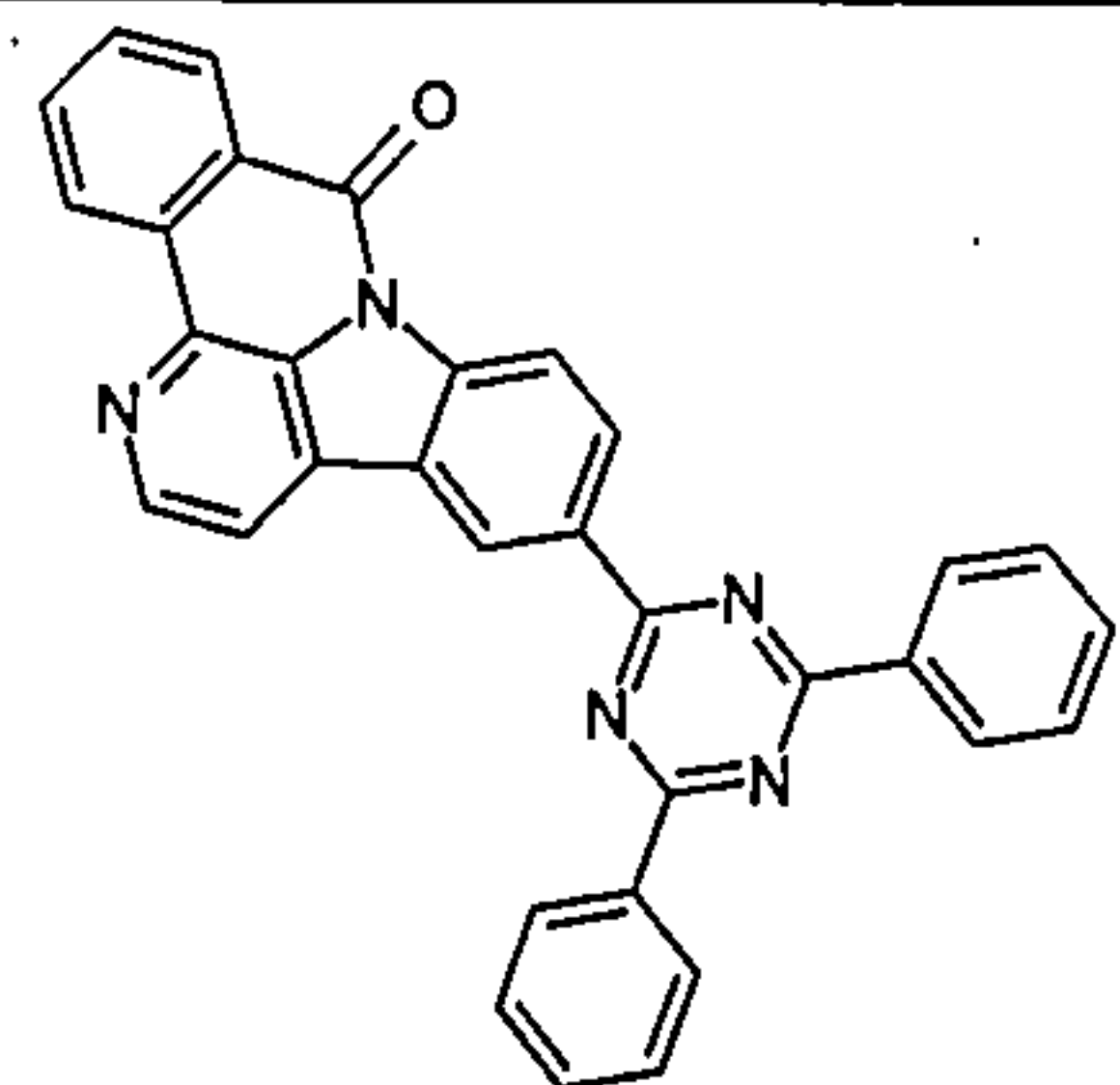
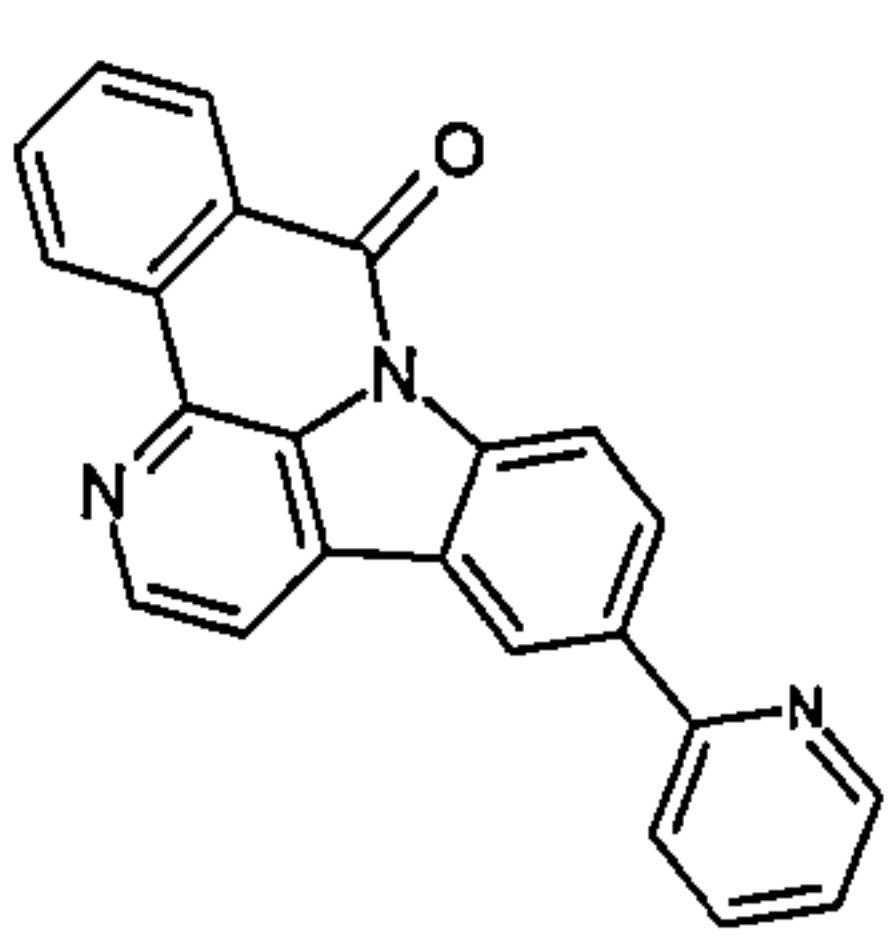
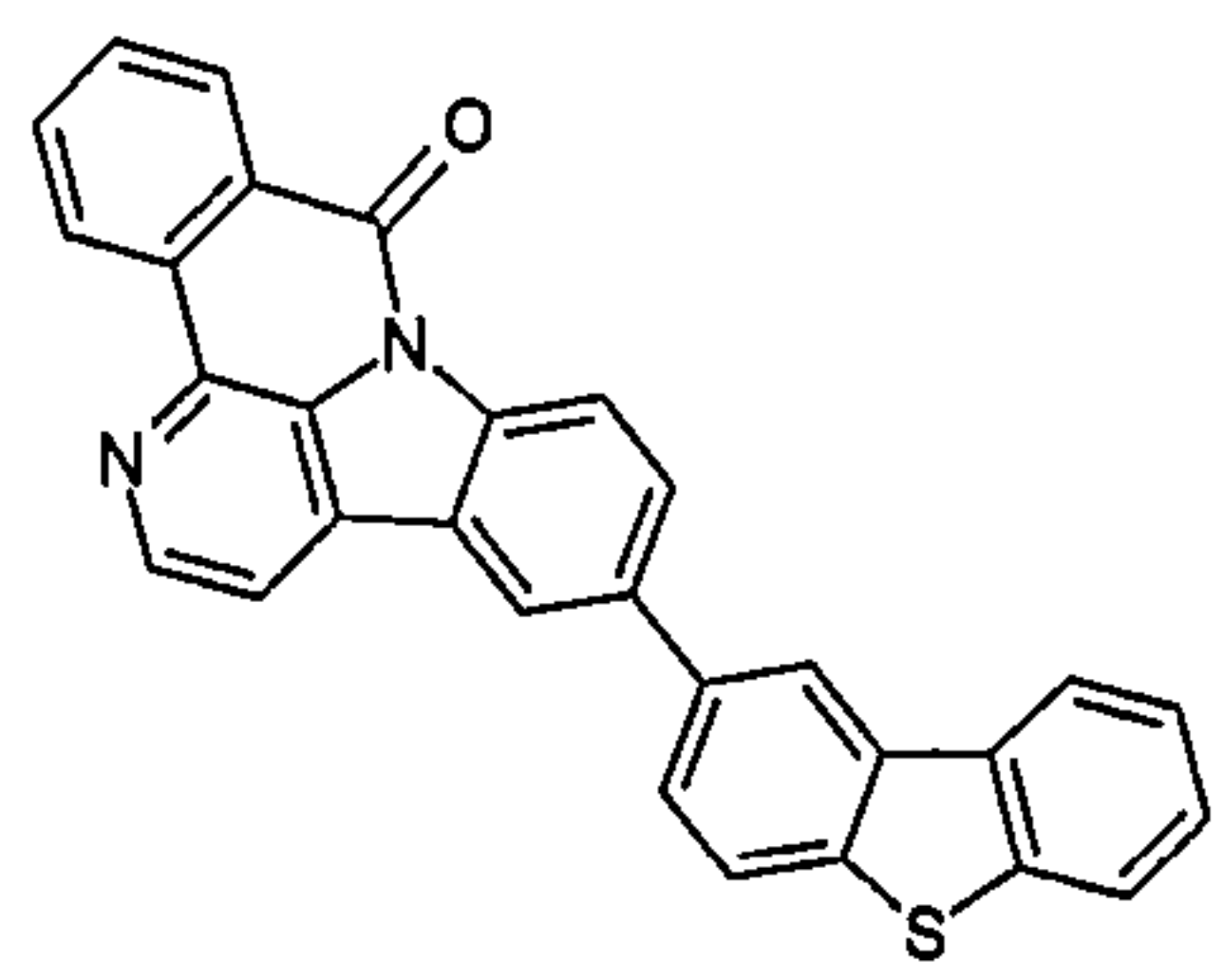
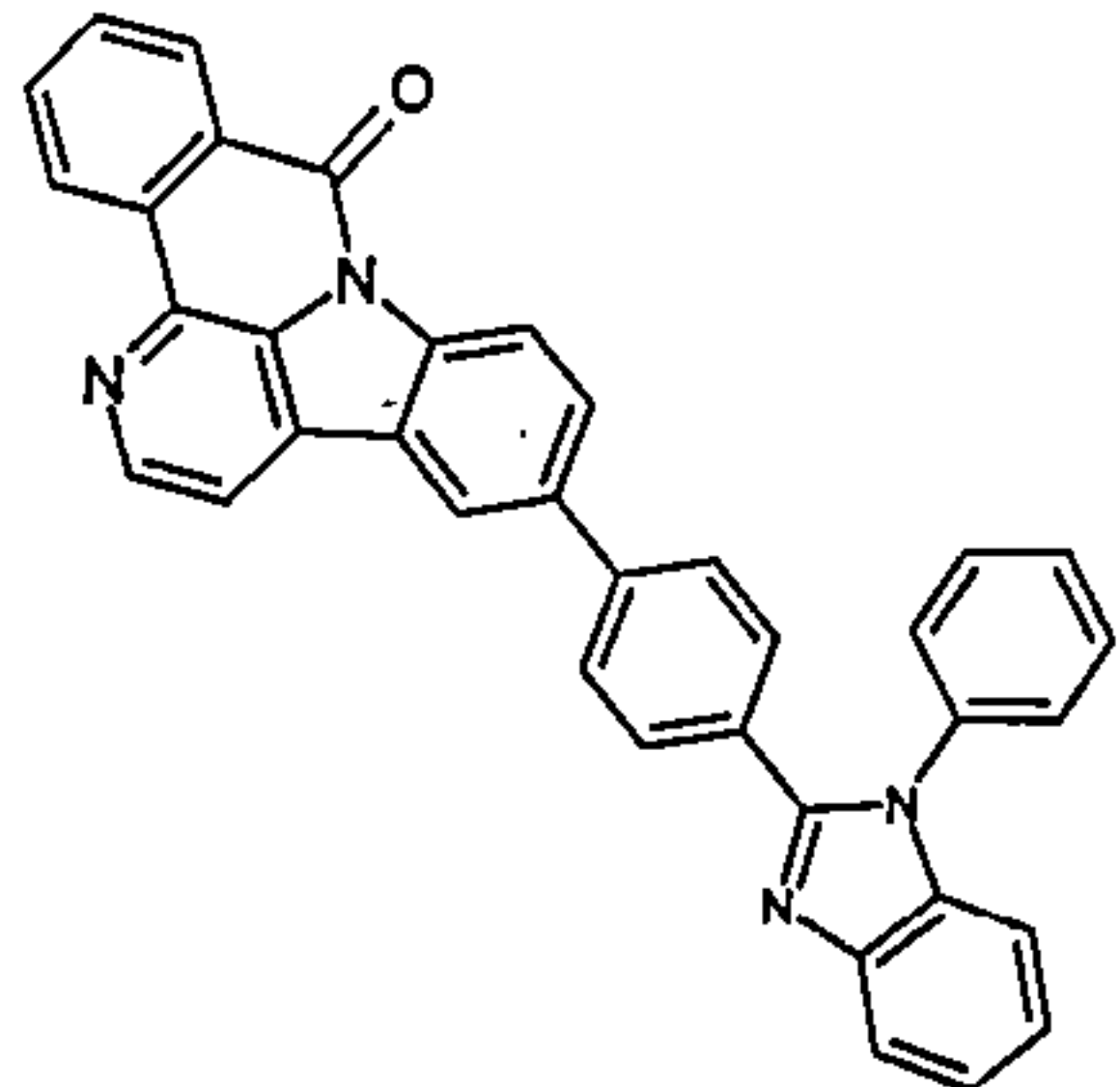
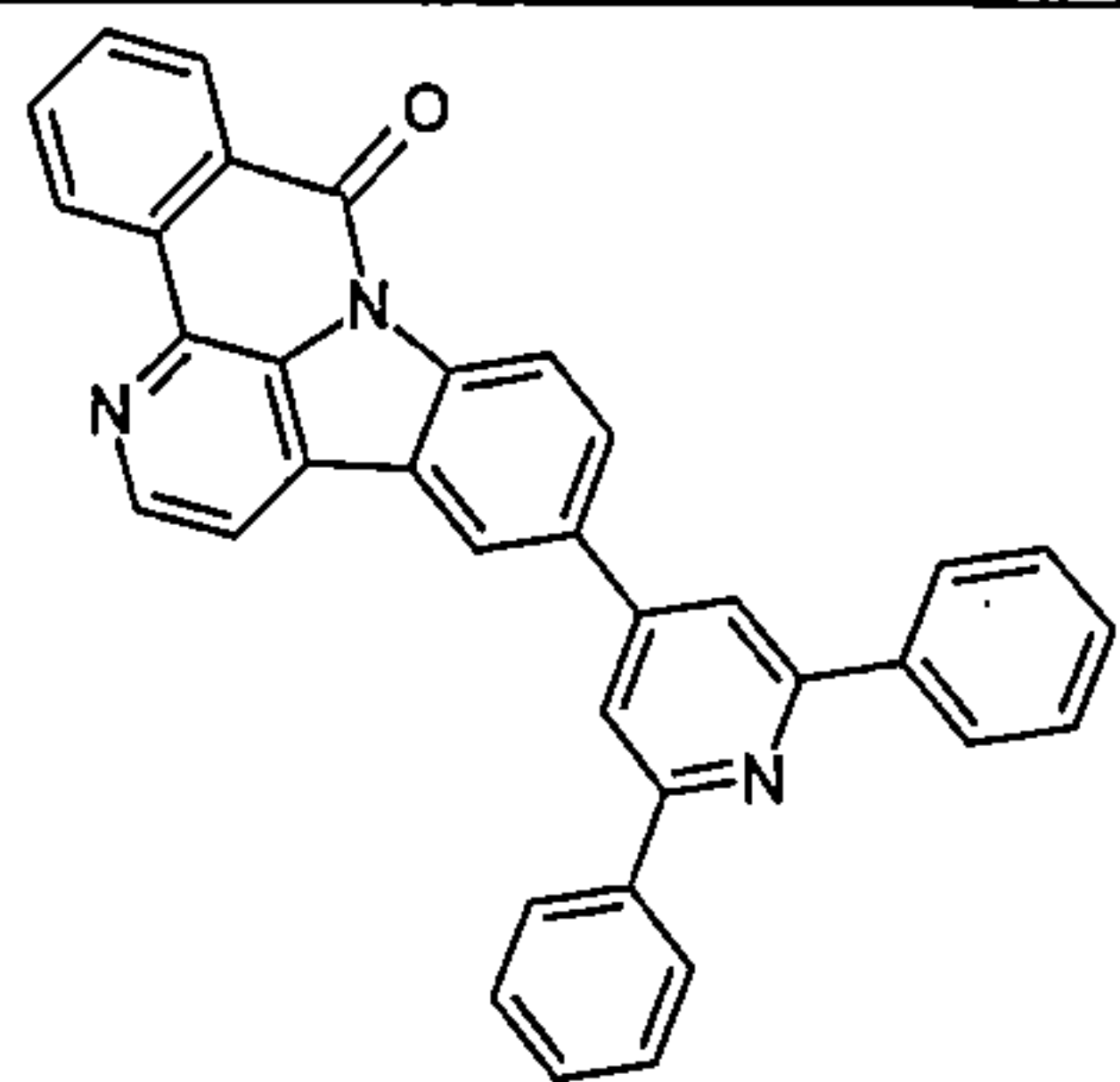
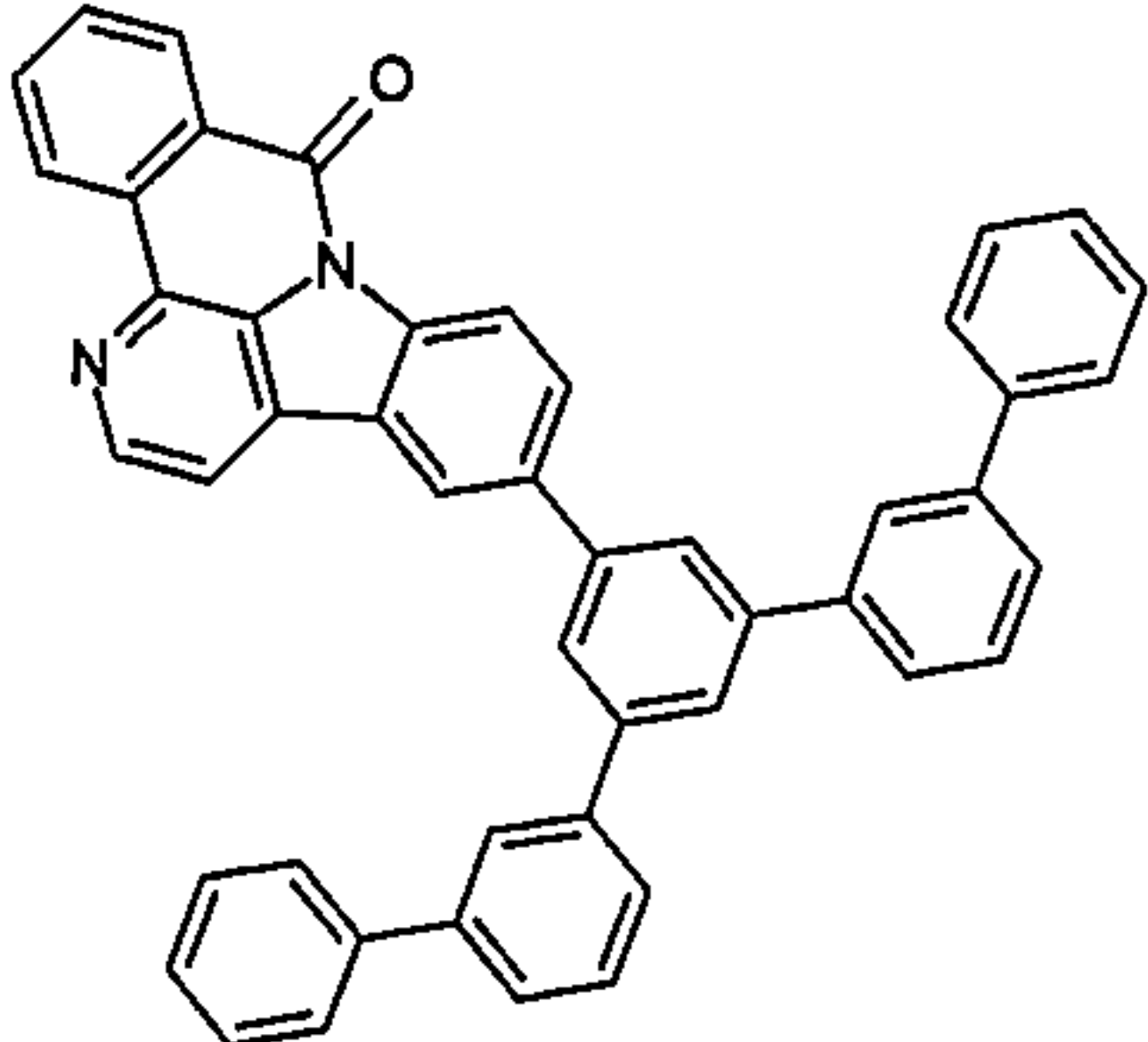
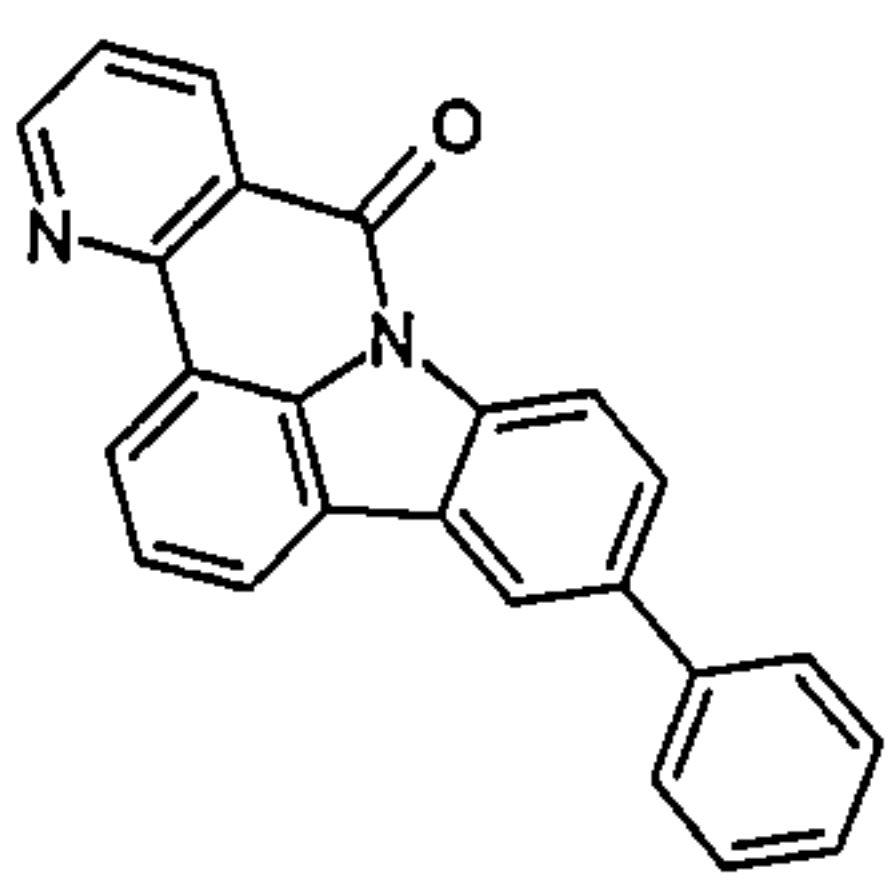
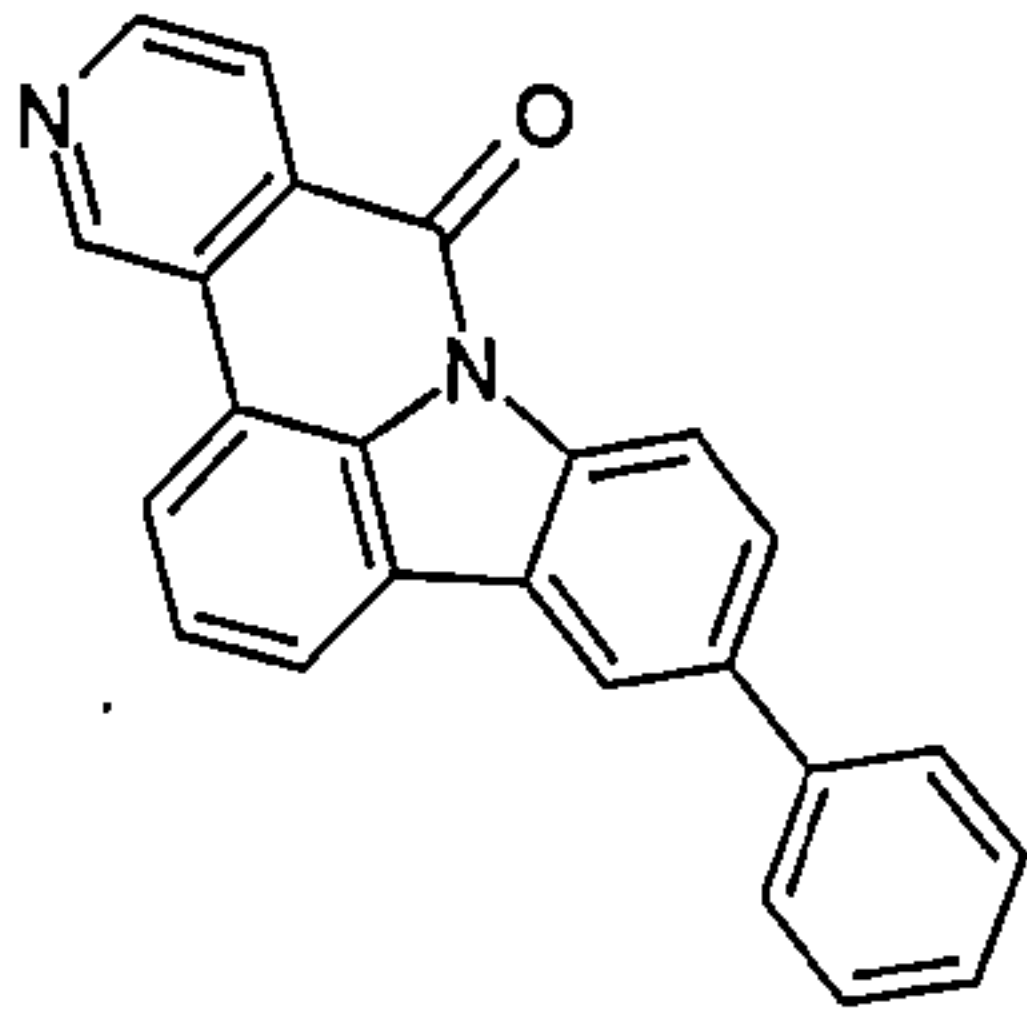
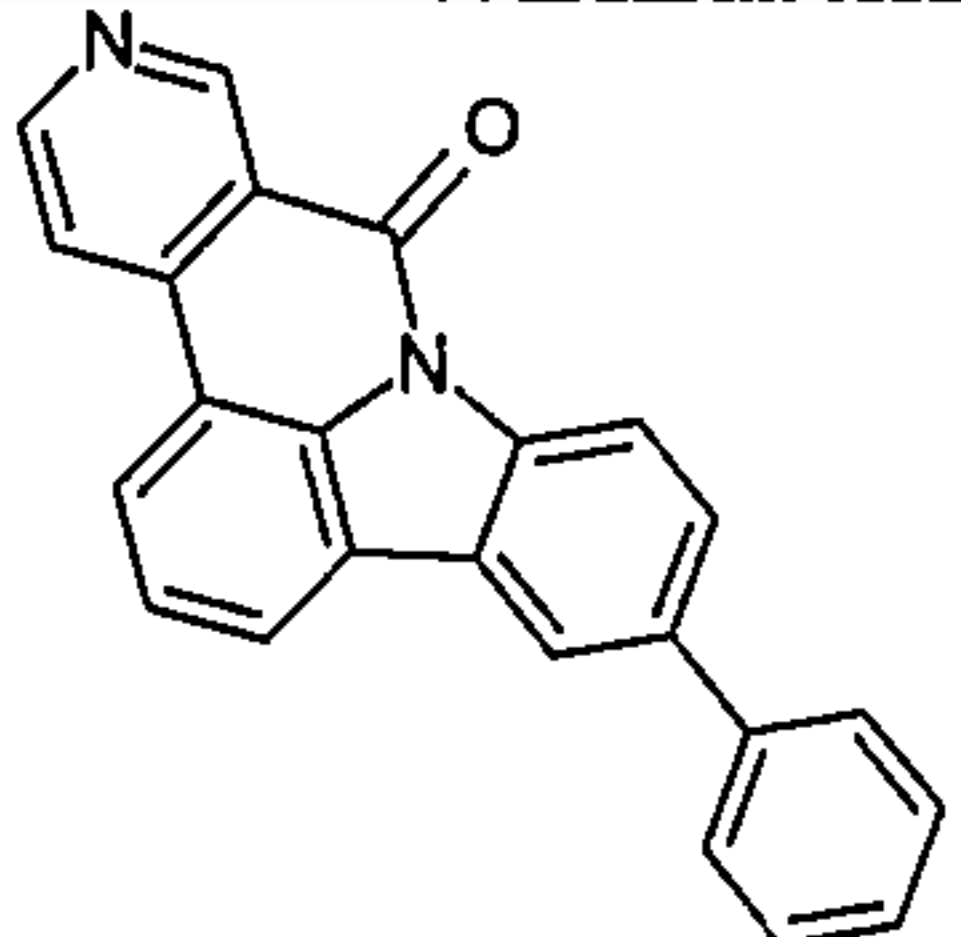
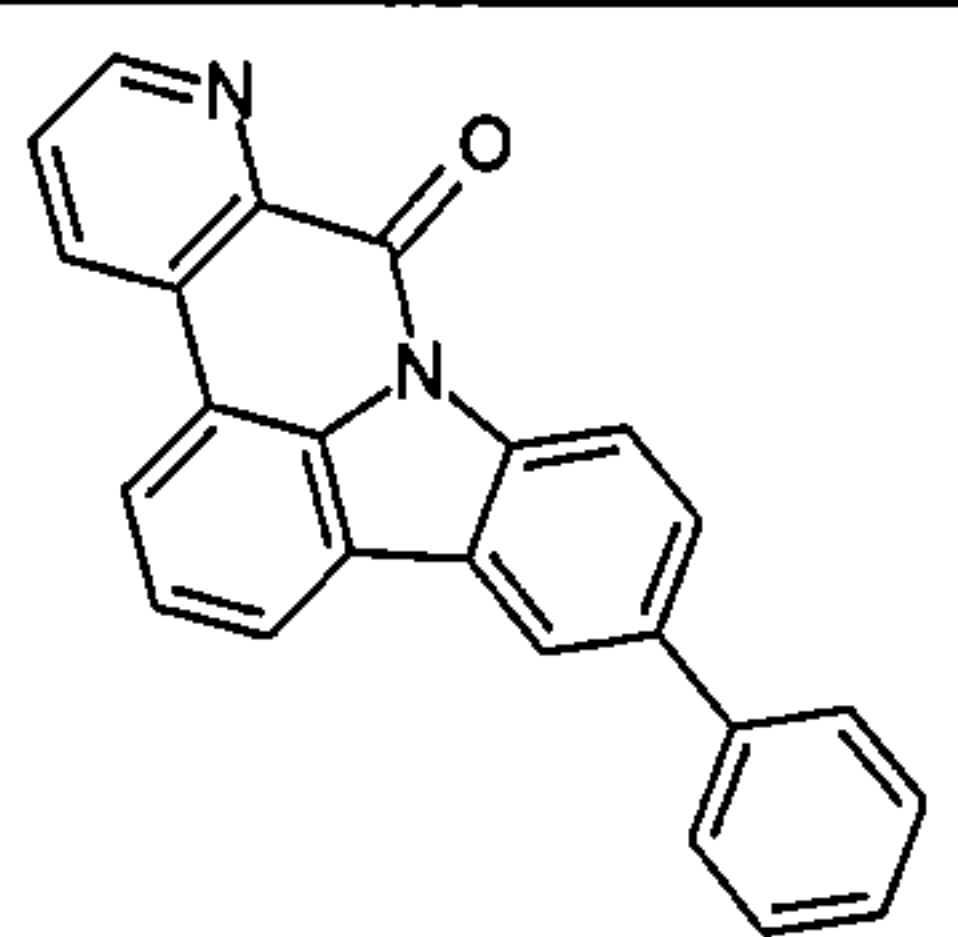
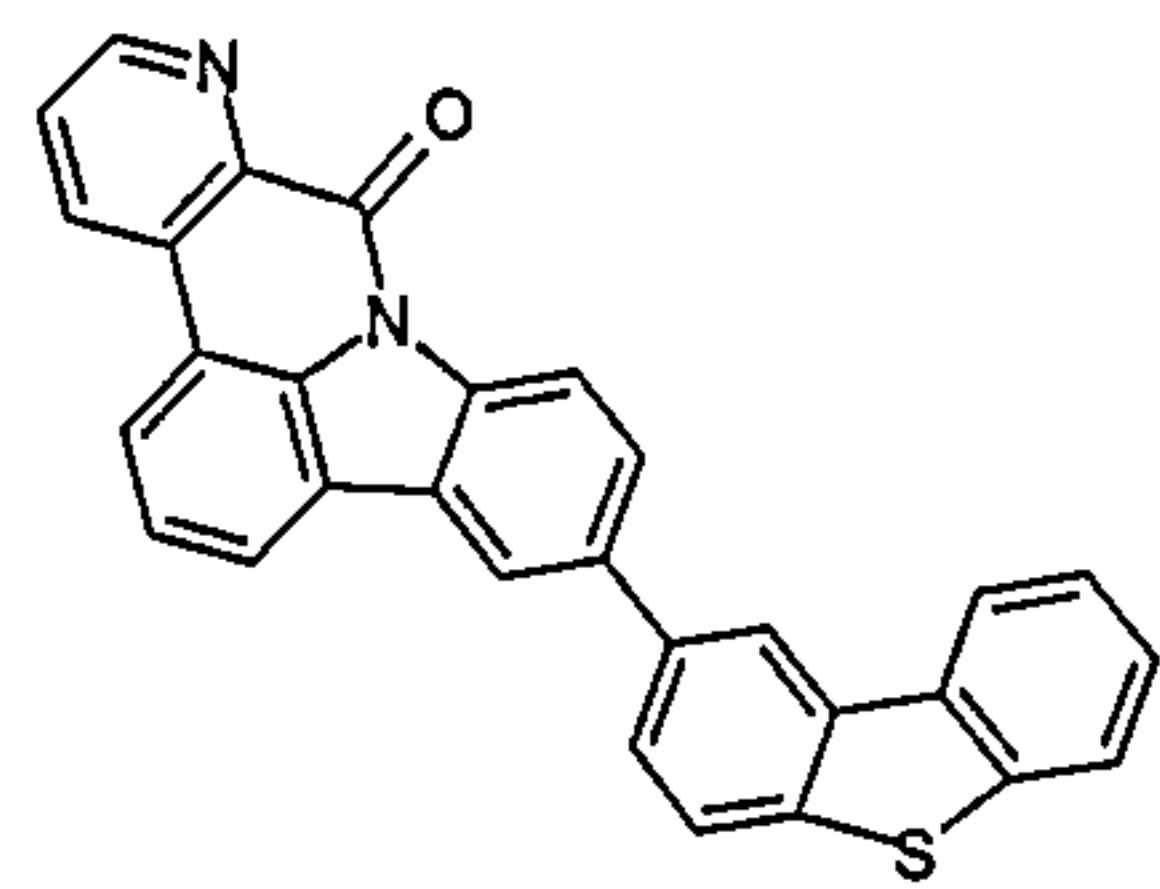
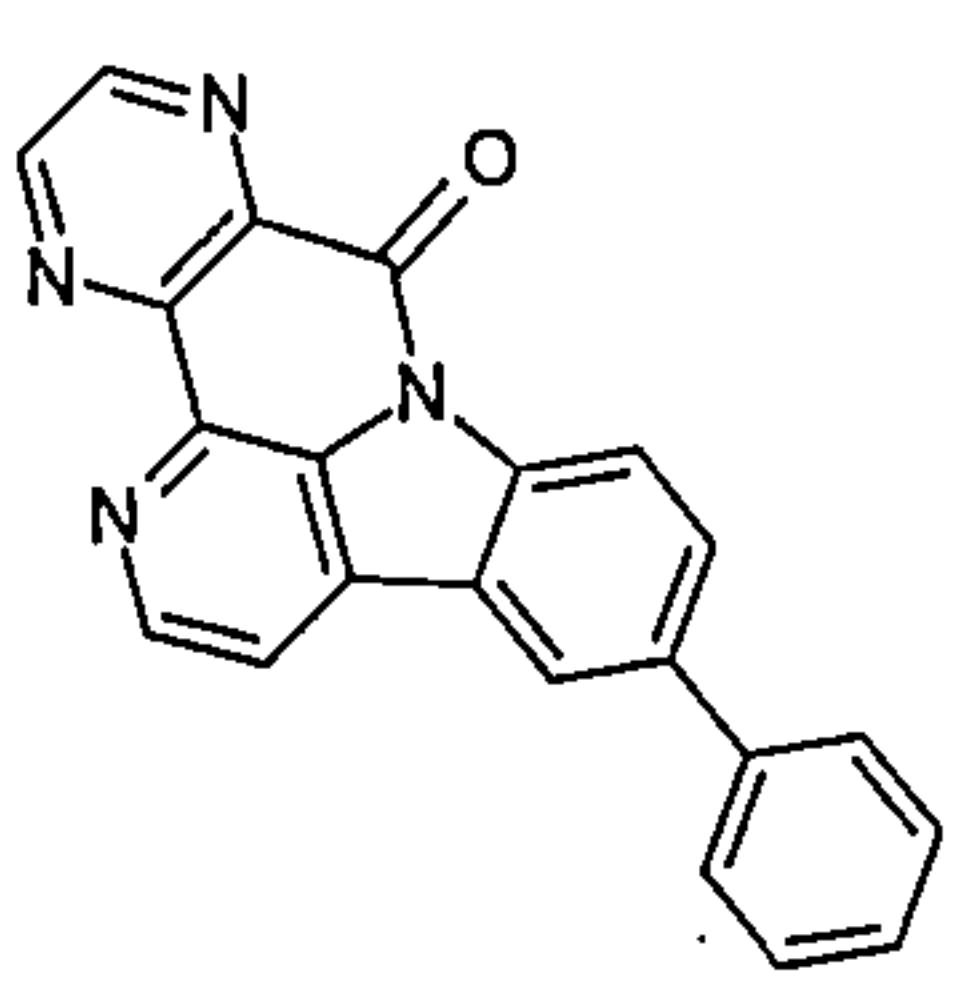
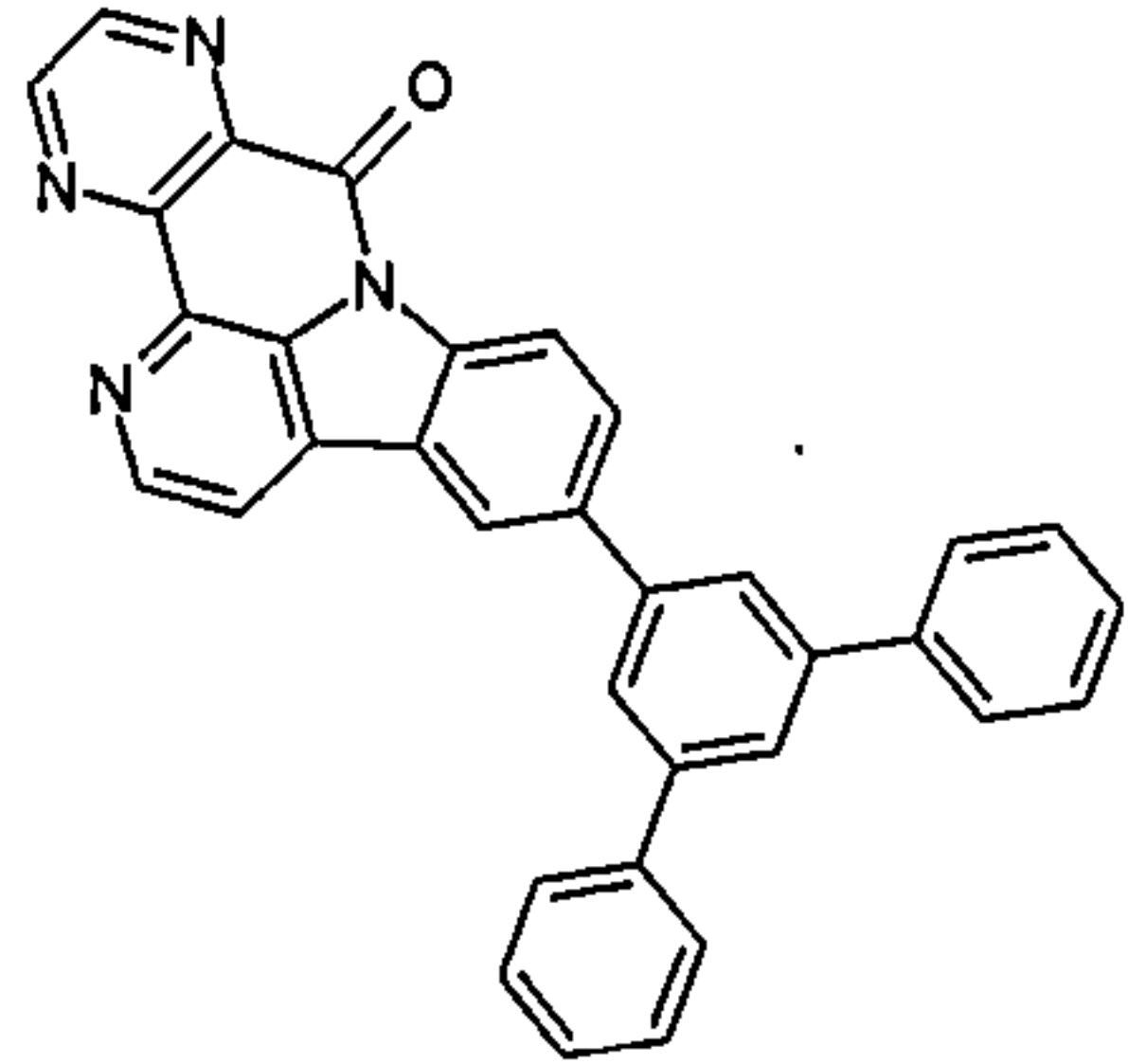
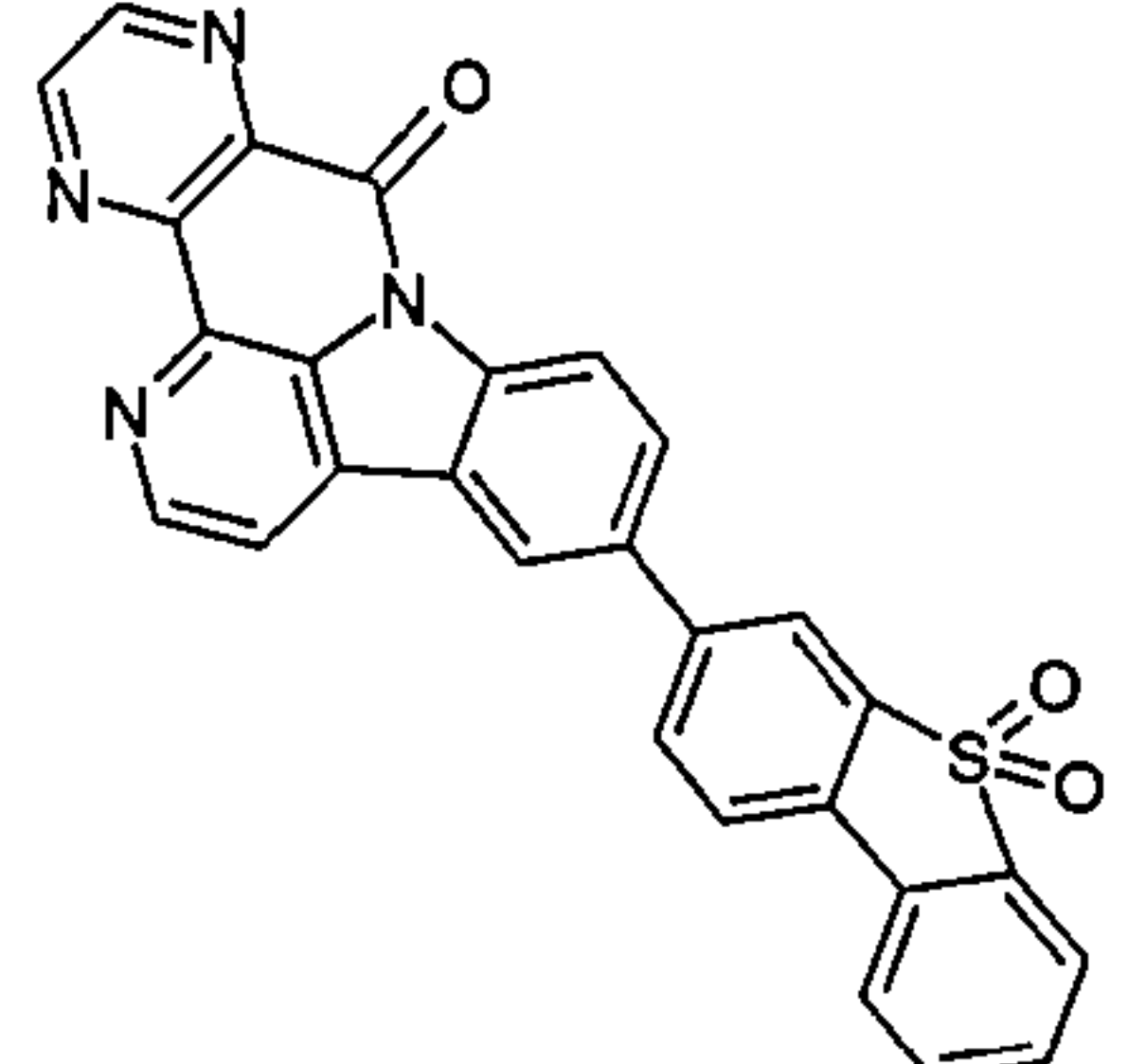
一基質材料作為磷光發射體之基質材料。可與式(1)化合物或較佳實施例組合使用之尤其適宜基質材料係芳族酮、芳族氧化膦或芳族亞砷或砷，例如根據 WO 2004/013080、WO 2004/093207、WO 2006/005627或WO 2010/006680；三芳基胺；咔唑衍生物，例如WO 2005/039246、US 2005/0069729、JP 2004/288381、EP 1205527或WO 2008/086851中所揭示之CBP (N,N-雙咔唑基聯苯)、間-CBP或咔唑衍生物；吡啶并咔唑衍生物，例如根據WO 2007/063754或WO 2008/056746；茚并咔唑衍生物，例如根據WO 2010/136109或WO 2011/000455；氮雜咔唑衍生物，例如根據EP 1617710、EP 1617711、EP 1731584、JP 2005/347160；雙極性基質材料，例如根據WO 2007/137725；矽烷，例如根據WO 2005/111172；氮雜硼雜環戊二烯或酮酸酯，例如根據WO 2006/117052；三嗪衍生物，例如根據WO 2010/015306，WO 2007/063754或WO 08/056746；鋅錯合物，例如根據EP 652273或WO 2009/062578；萸衍生物，例如根據WO 2009/124627；二氮雜矽雜環戊二烯或四氮雜矽雜環戊二烯衍生物，例如根據WO 2010/054729；二氮雜磷雜環戊二烯衍生物；例如根據WO 2010/054730；或橋接咔唑衍生物，例如根據US 2009/0136779、WO 2010/050778、WO 2011/042107或WO 2011/088877。此外，可使用既無電洞傳輸性質亦無電子傳輸性質之電中性共主體，如(例如)WO 2010/108579中所闡述。

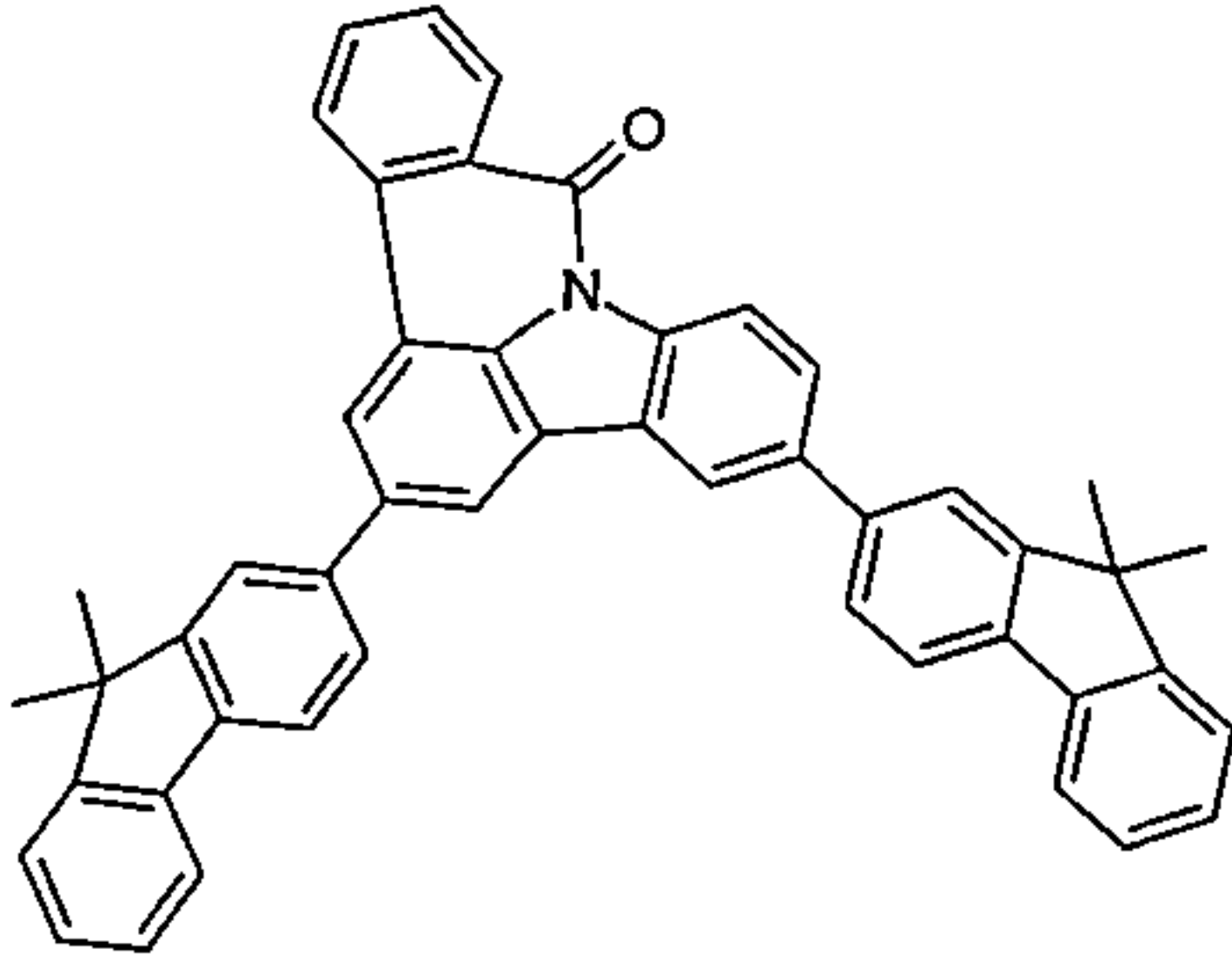
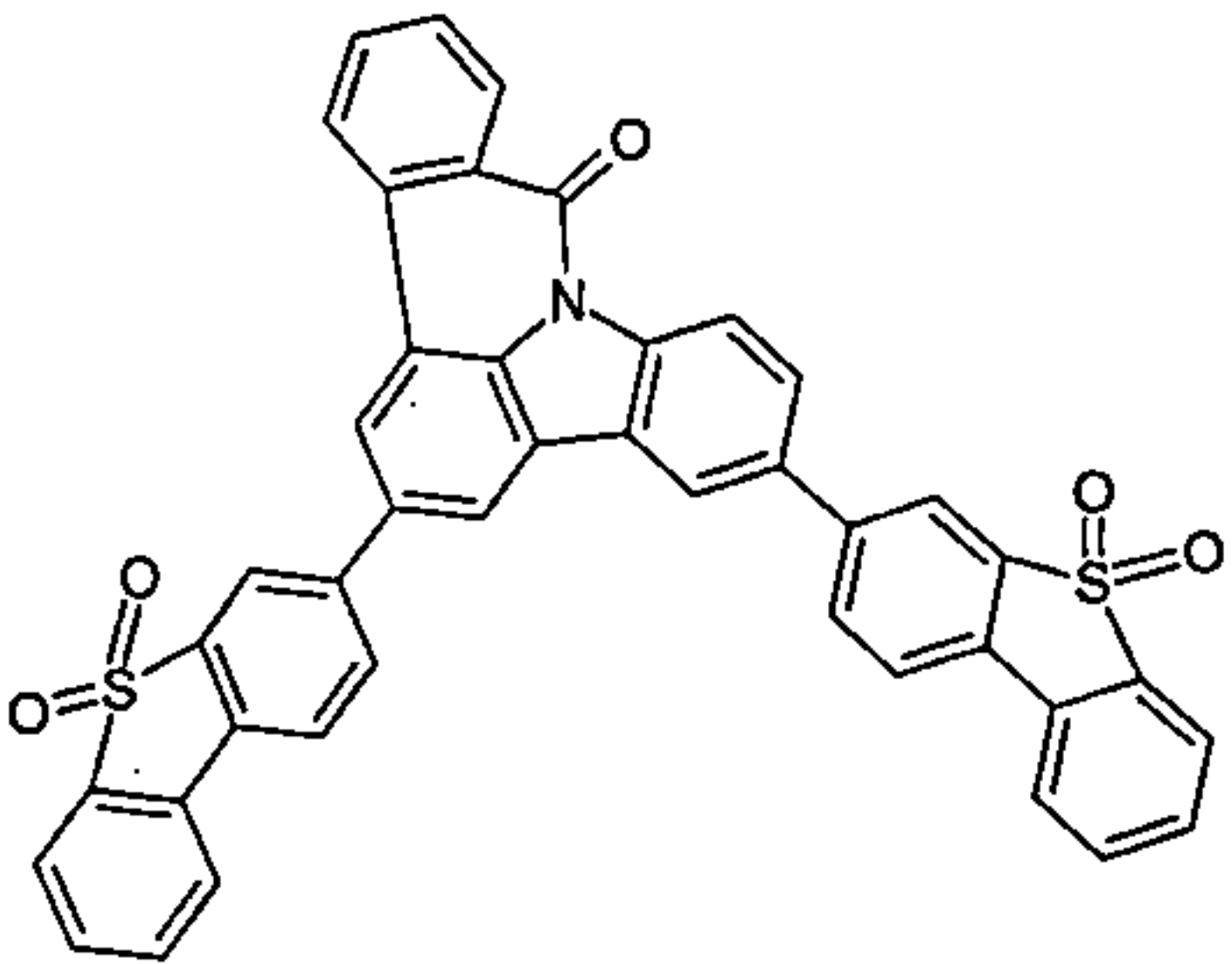
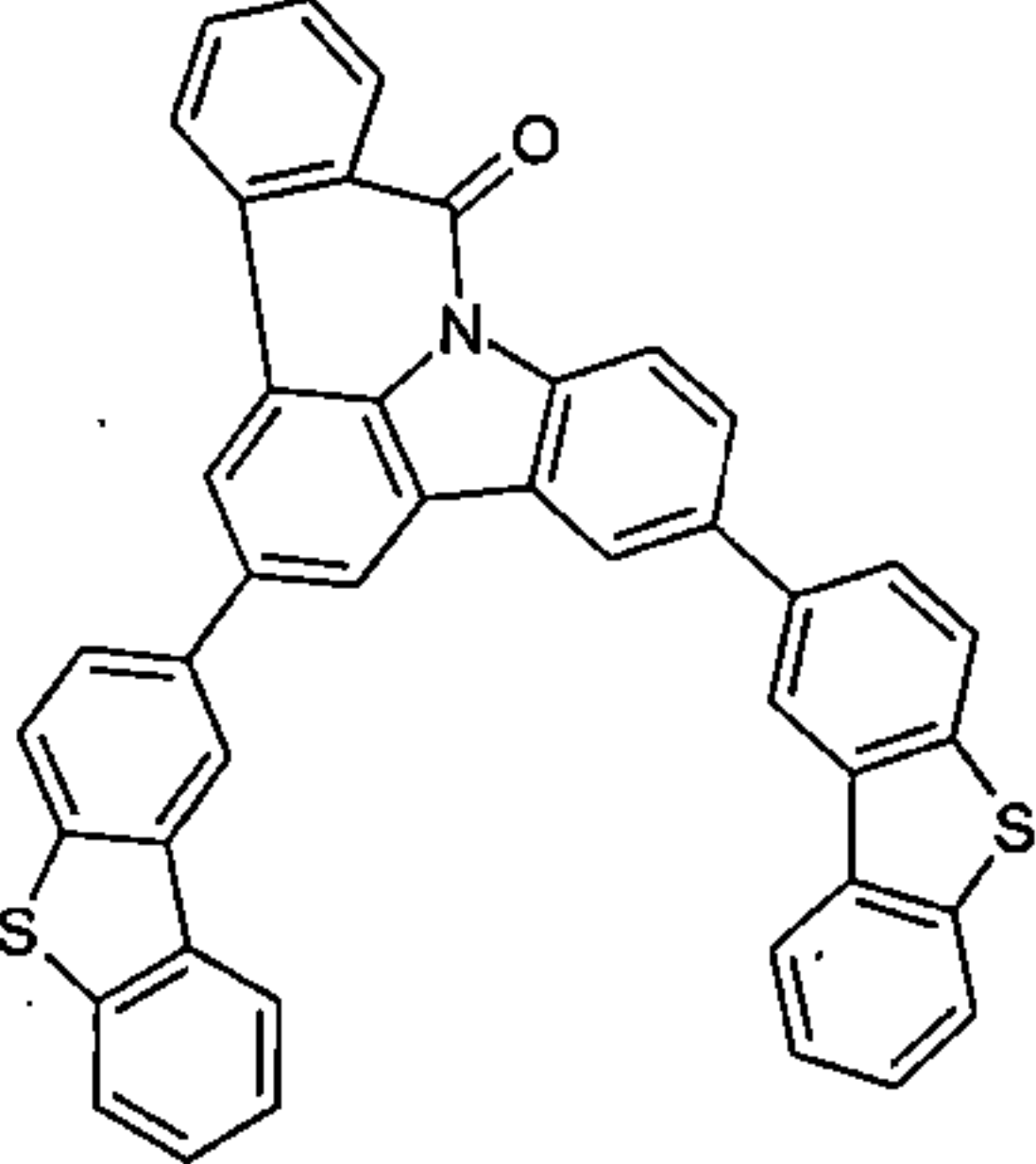
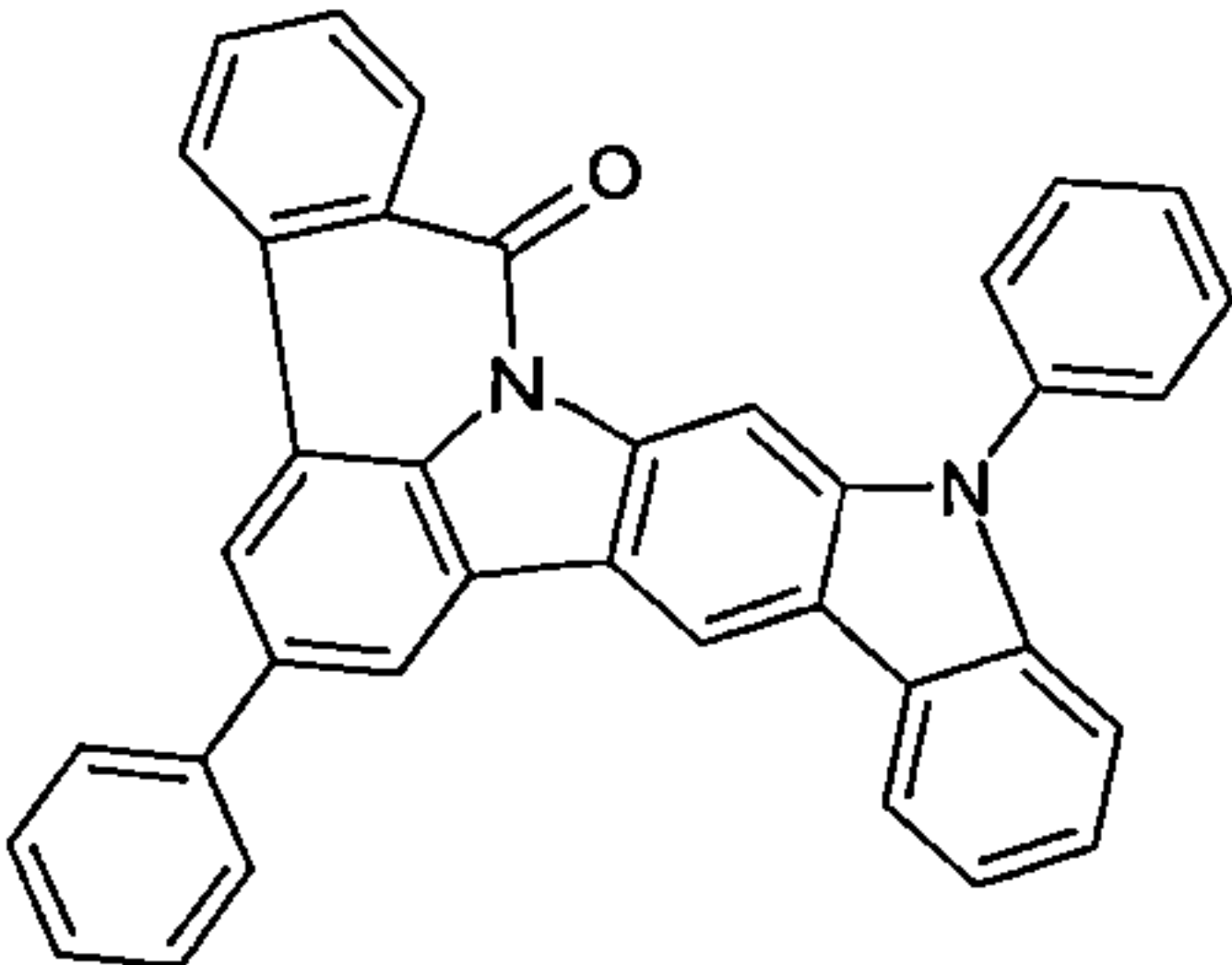
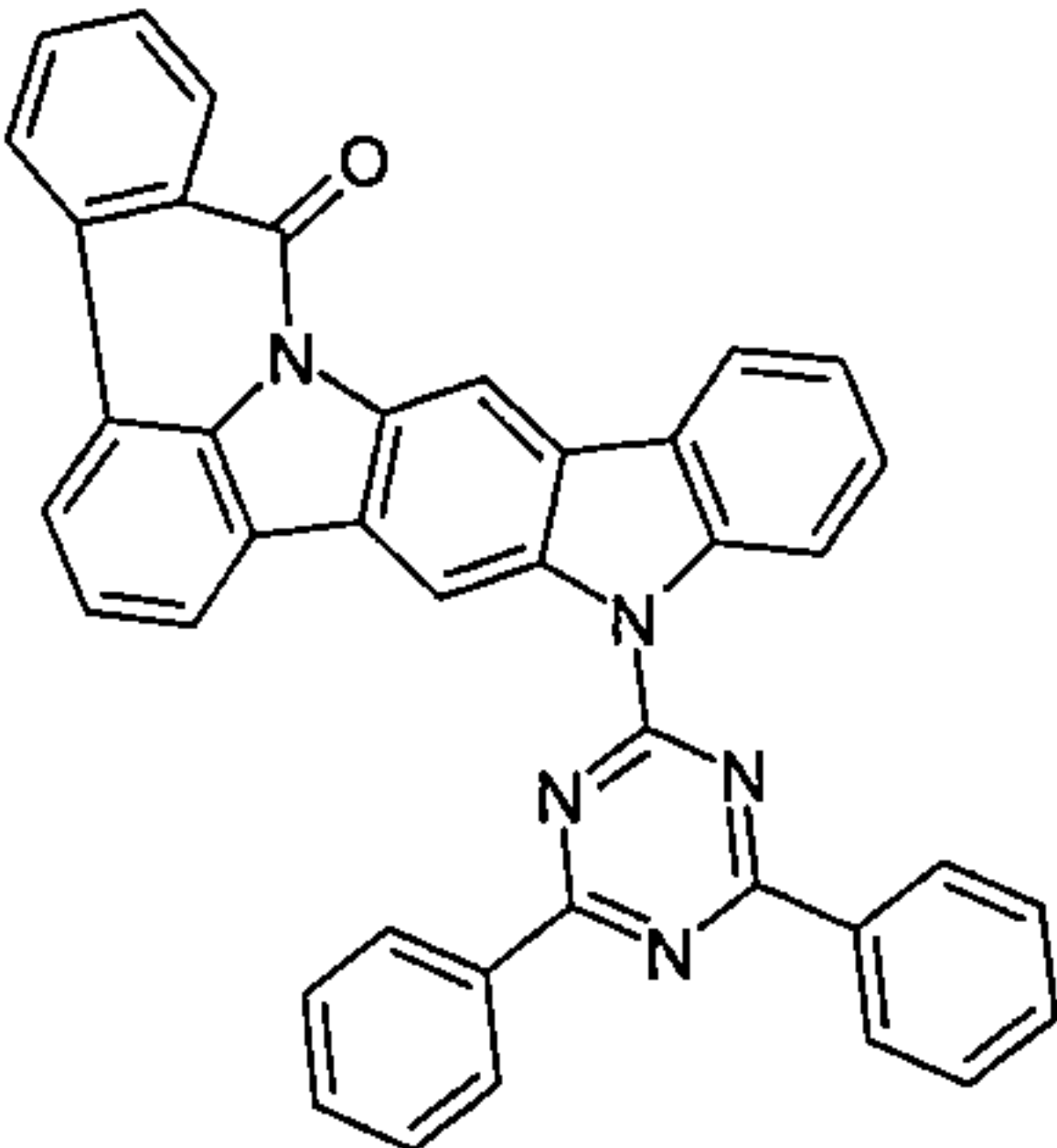
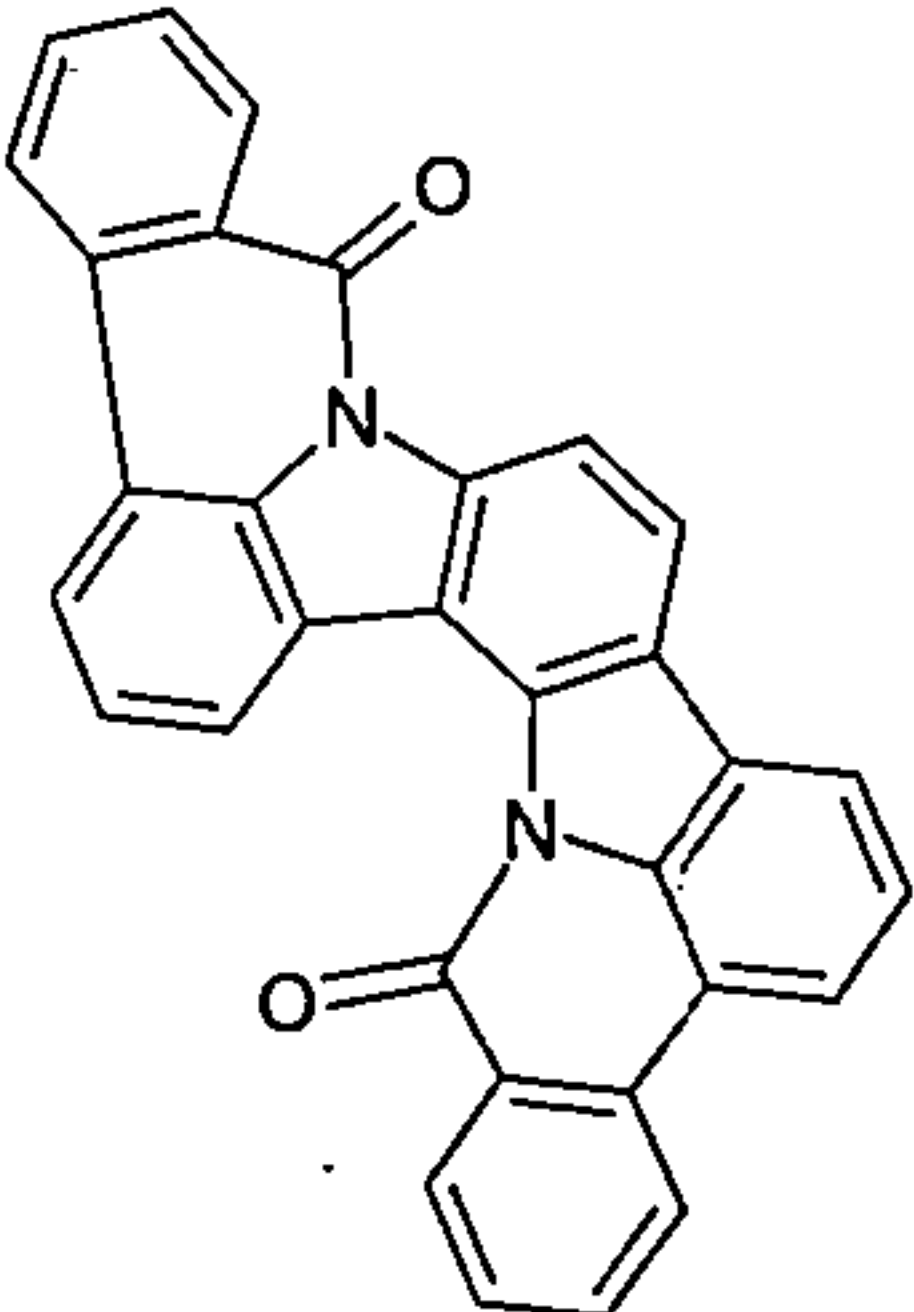
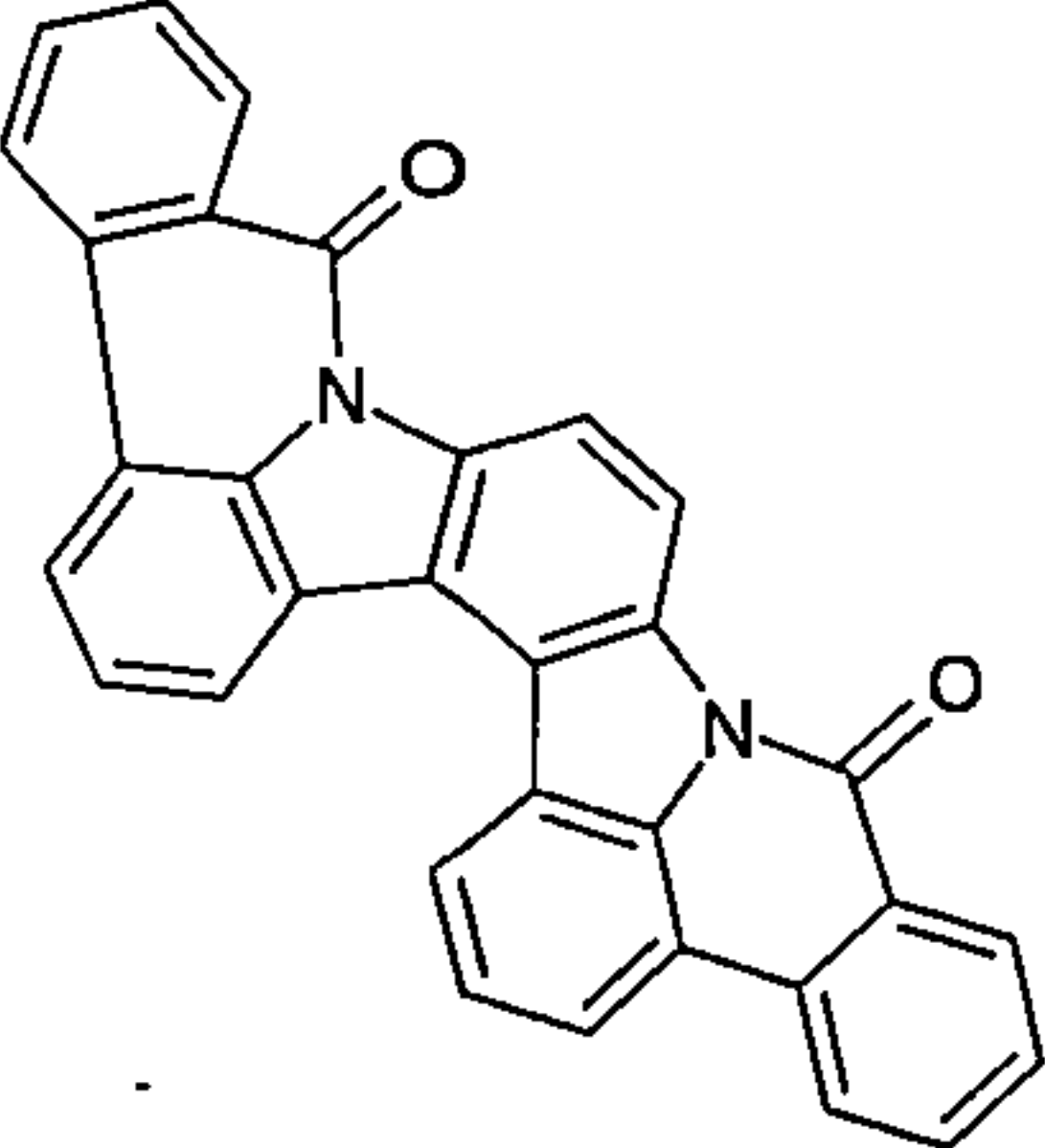
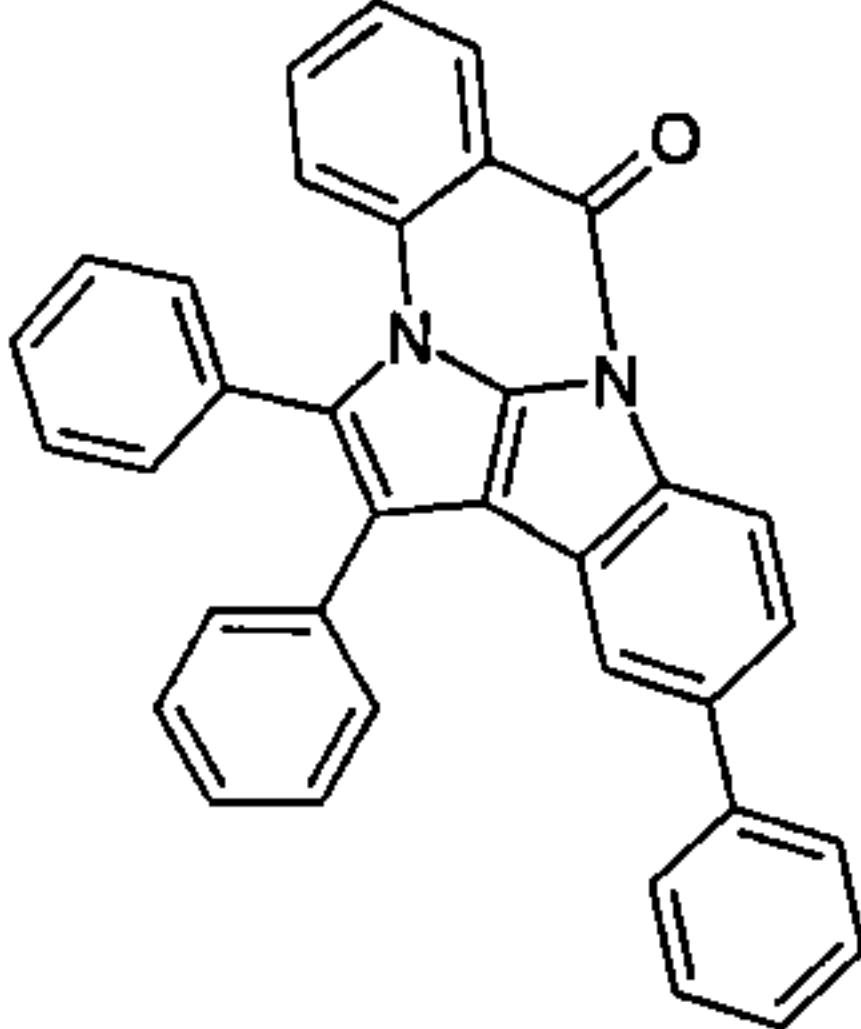
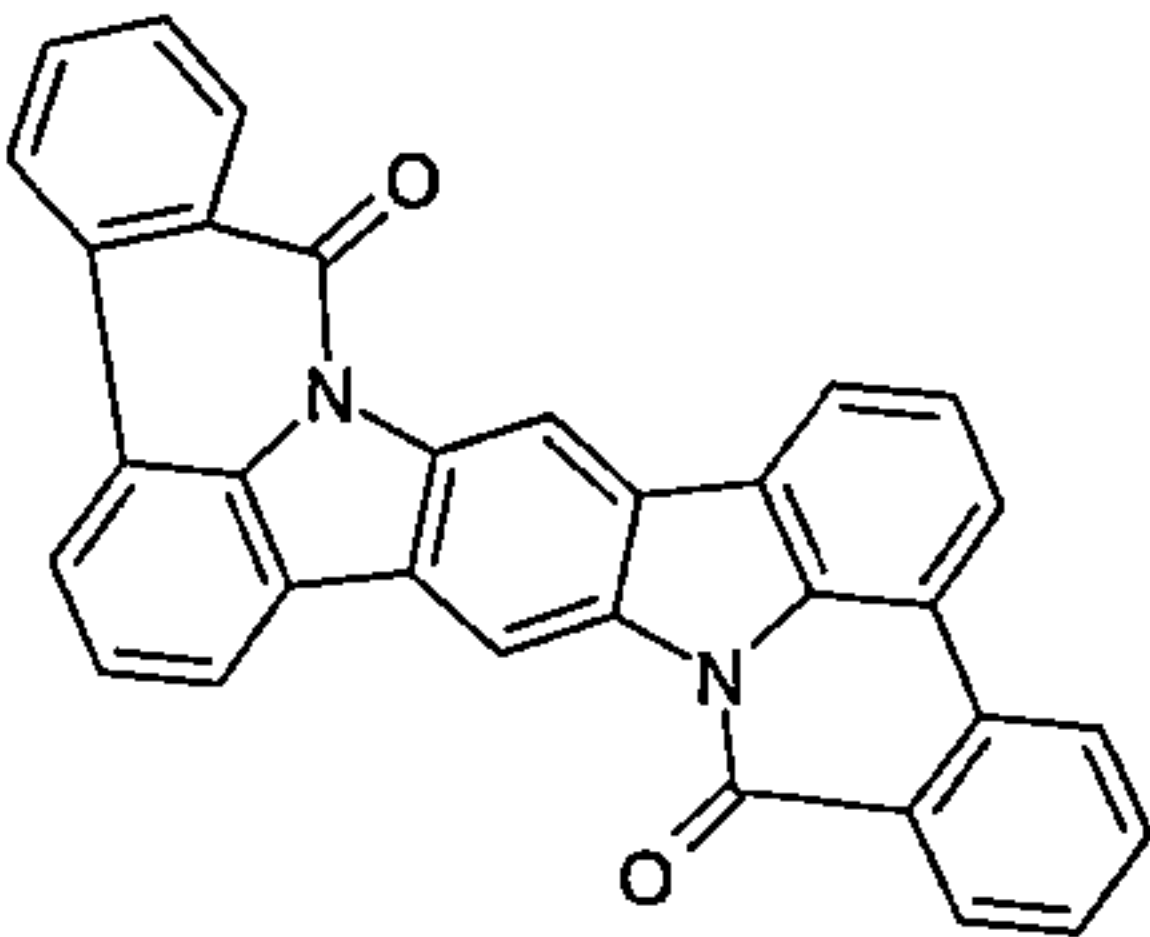
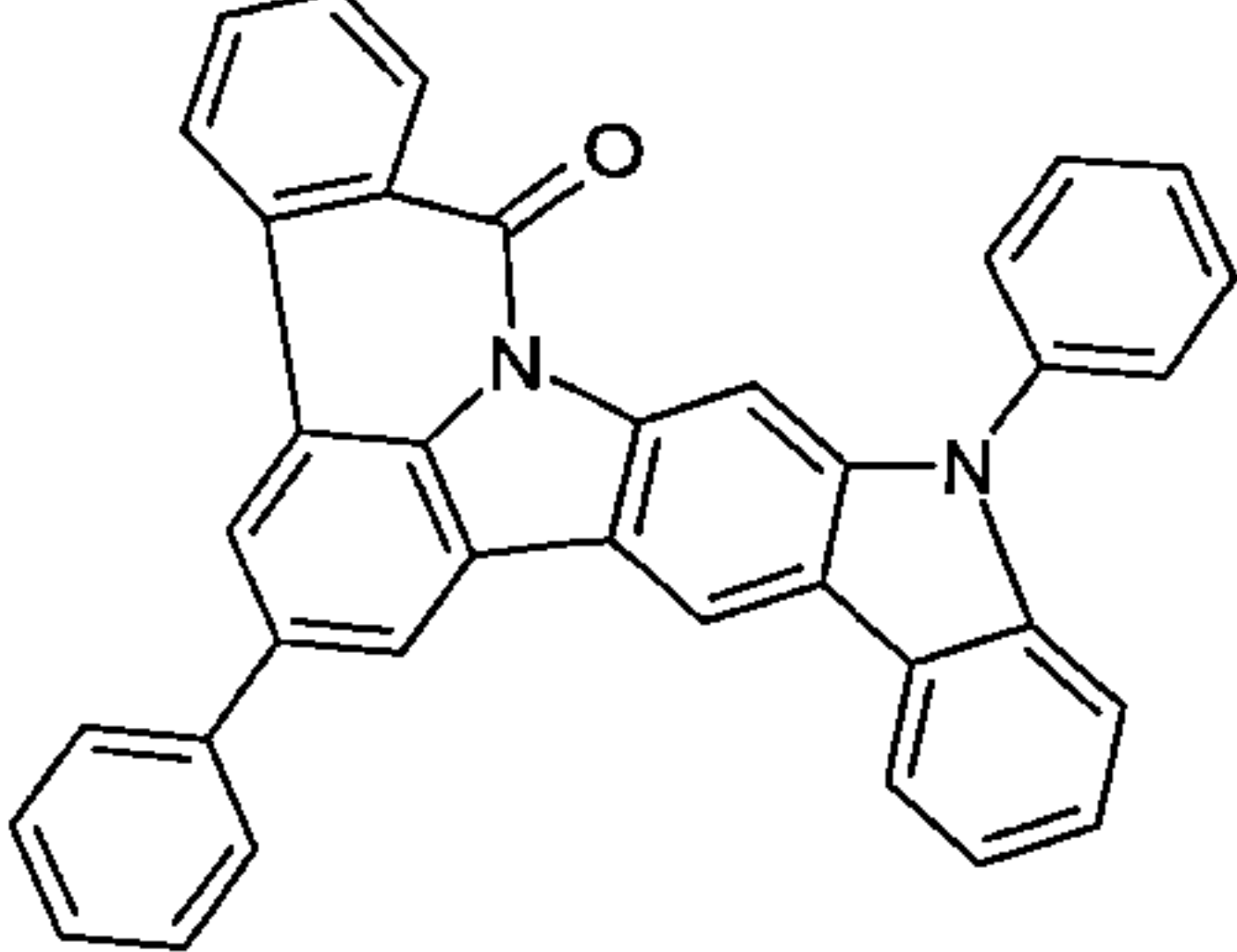
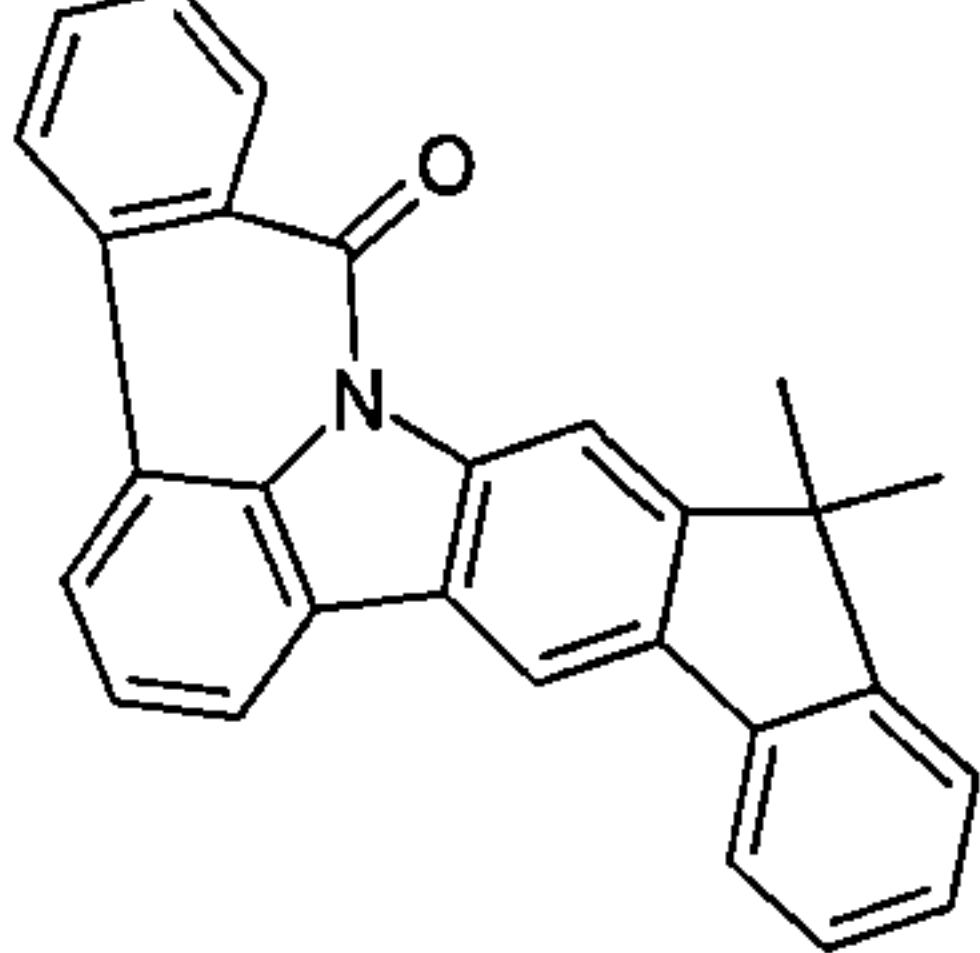
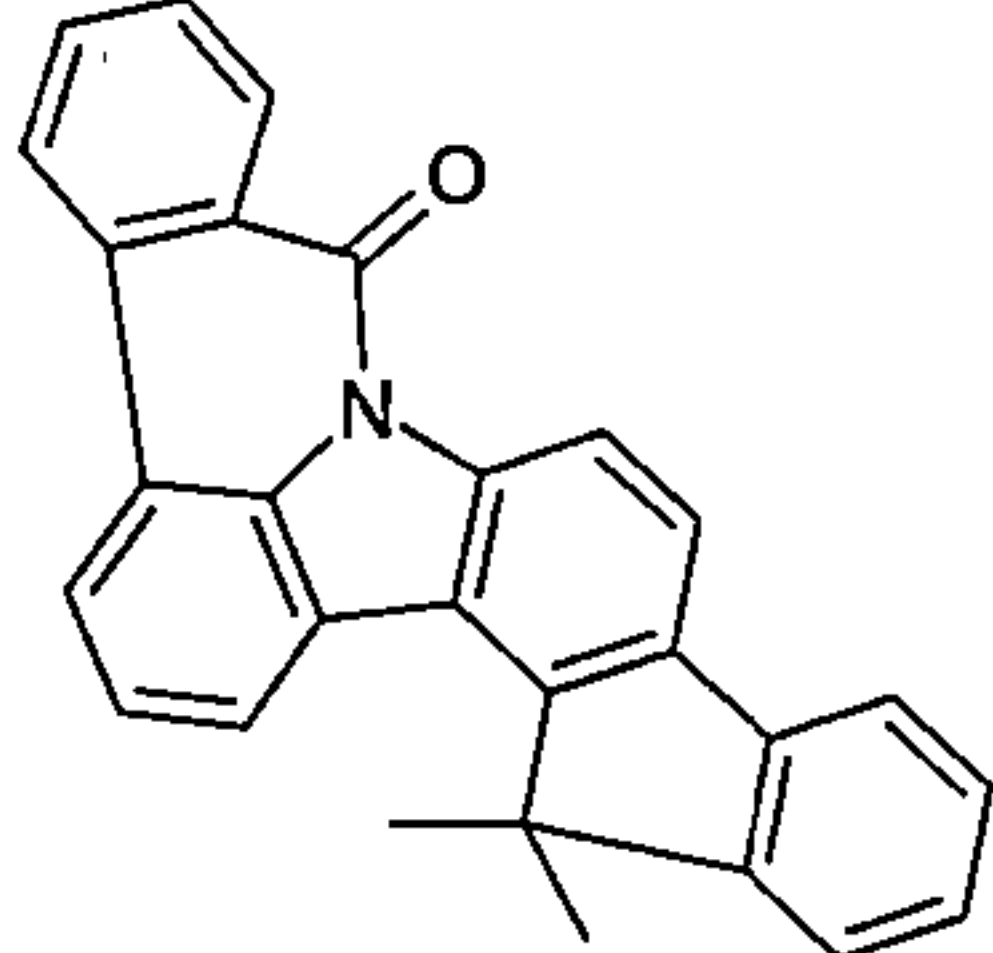
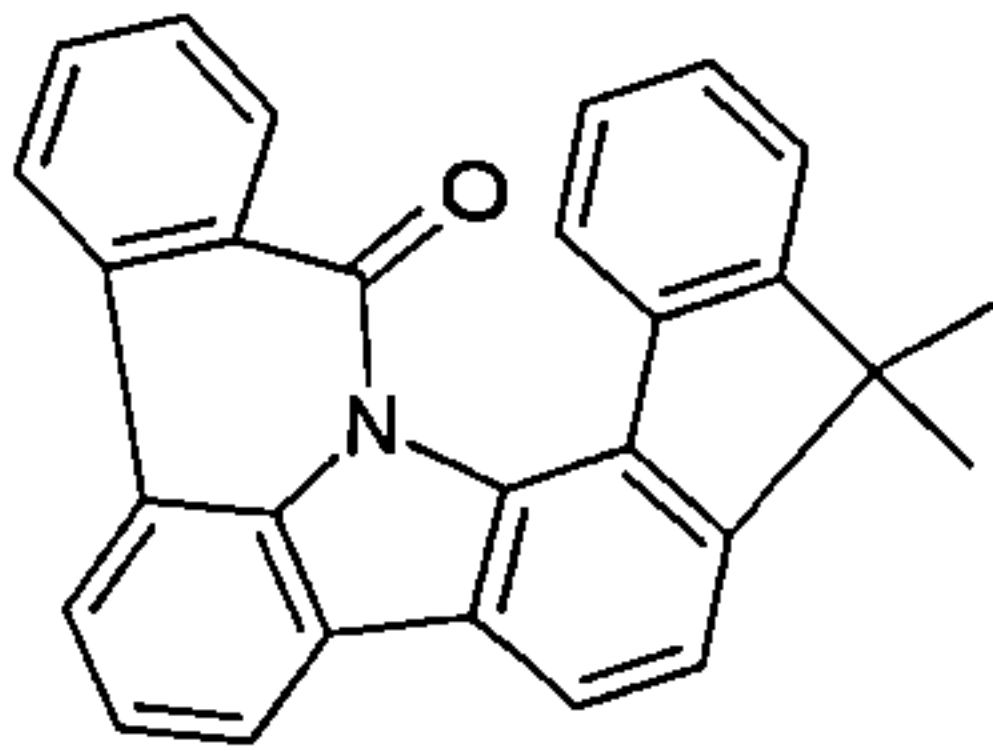
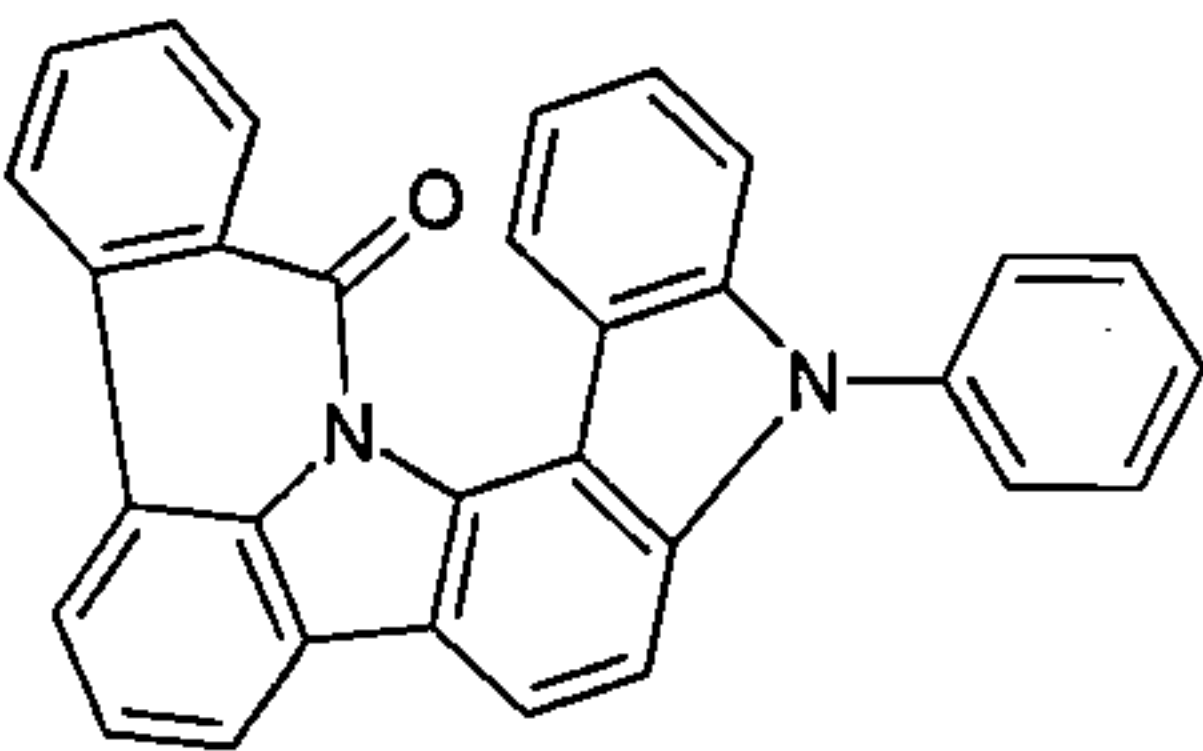
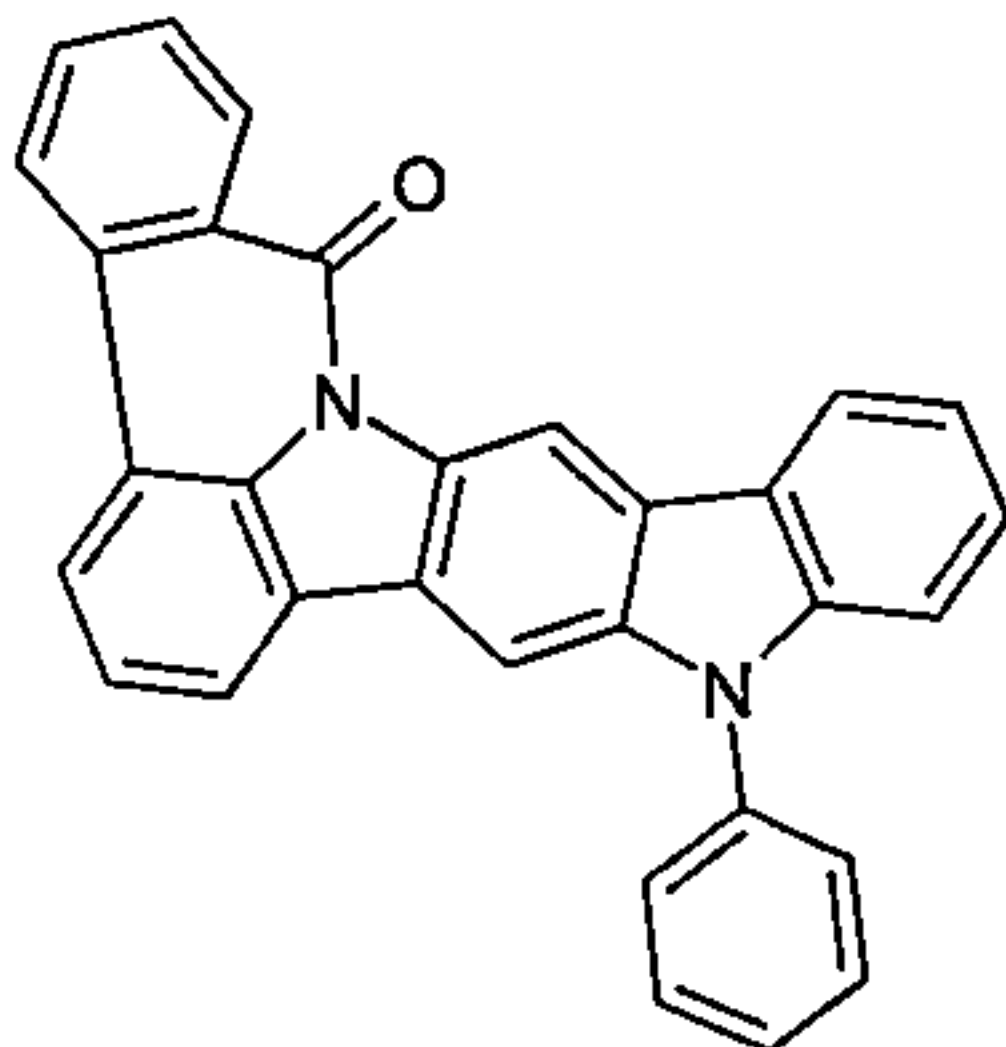
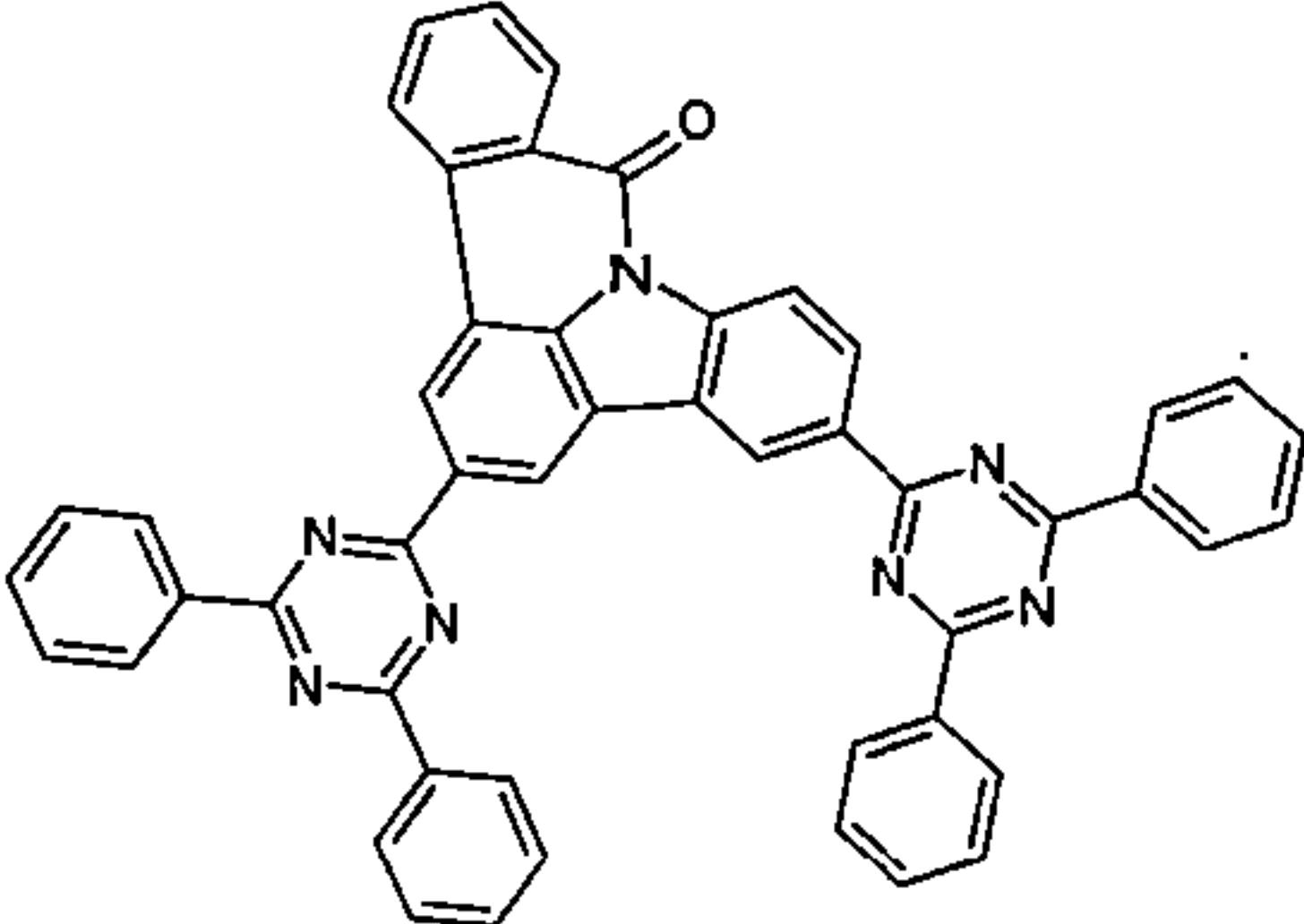
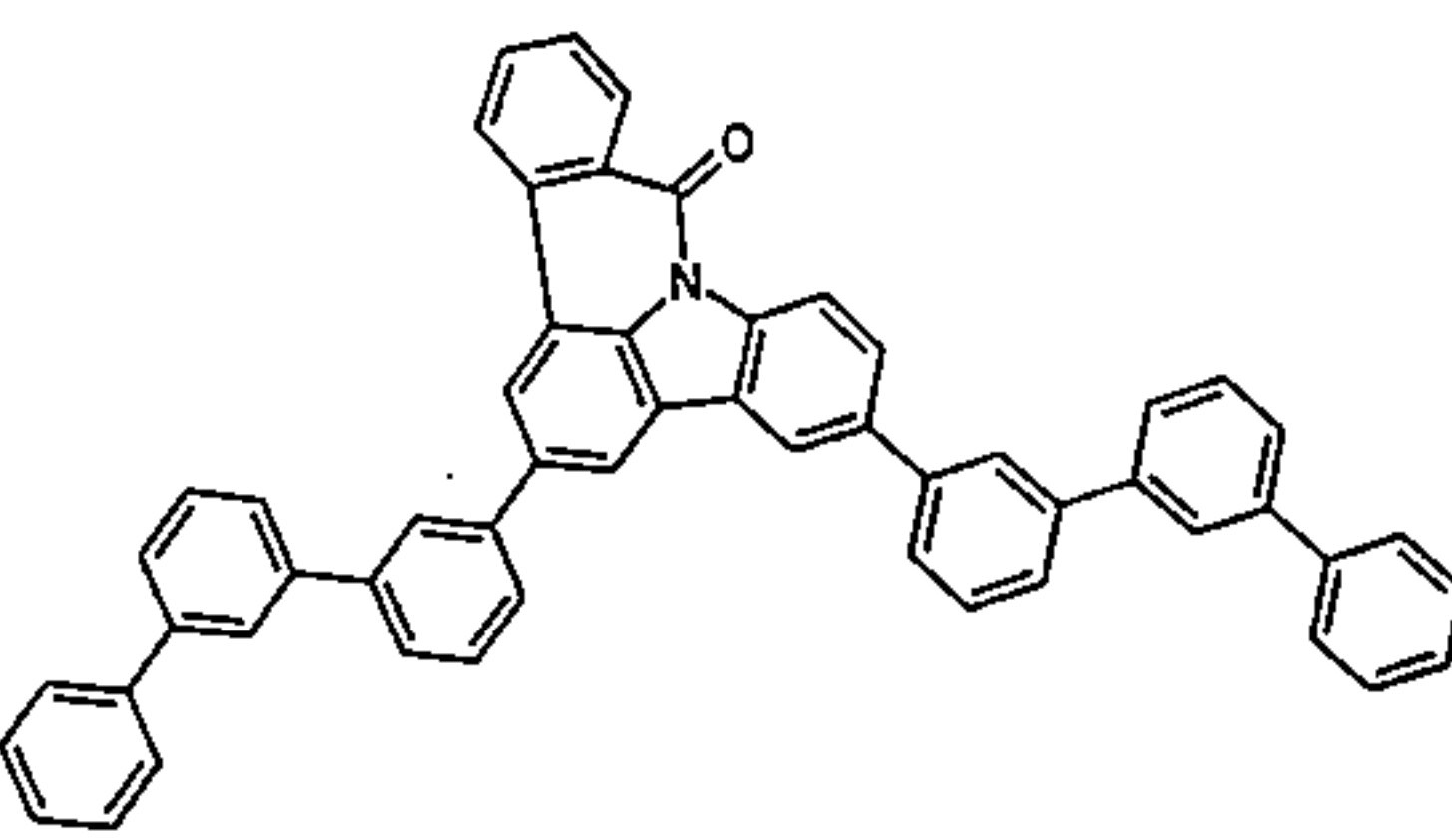
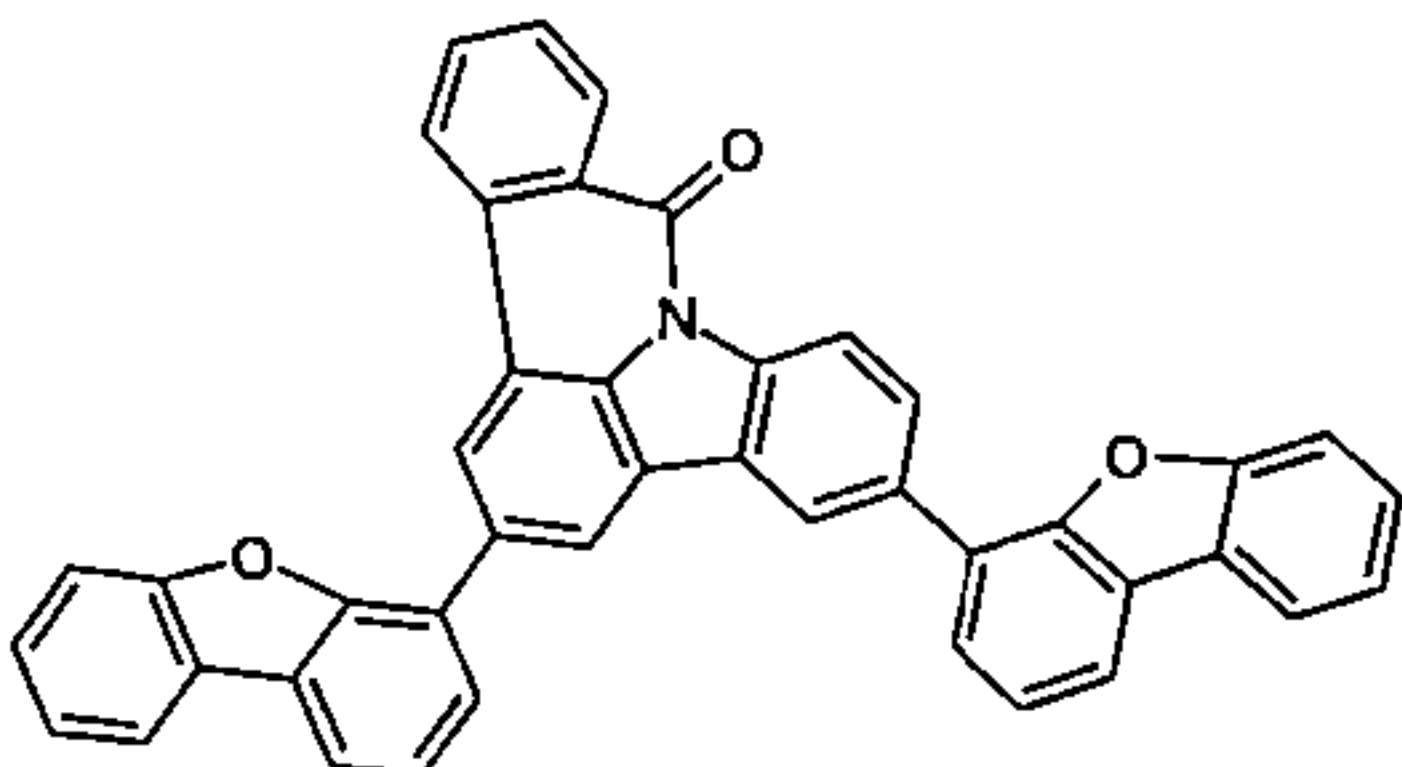
尤佳地，式(1)化合物係與選自內醯胺化合物之第二主體材料組合用作一或多種三重態發射體之基質材料。尤佳者係WO 2011/116865、WO 2011/137951、未公開EP 12007040.7及未公開EP 11008708.7中所揭示之內醯胺化合物。最佳者係以上申請案中之工作實例中所顯示之化合物。

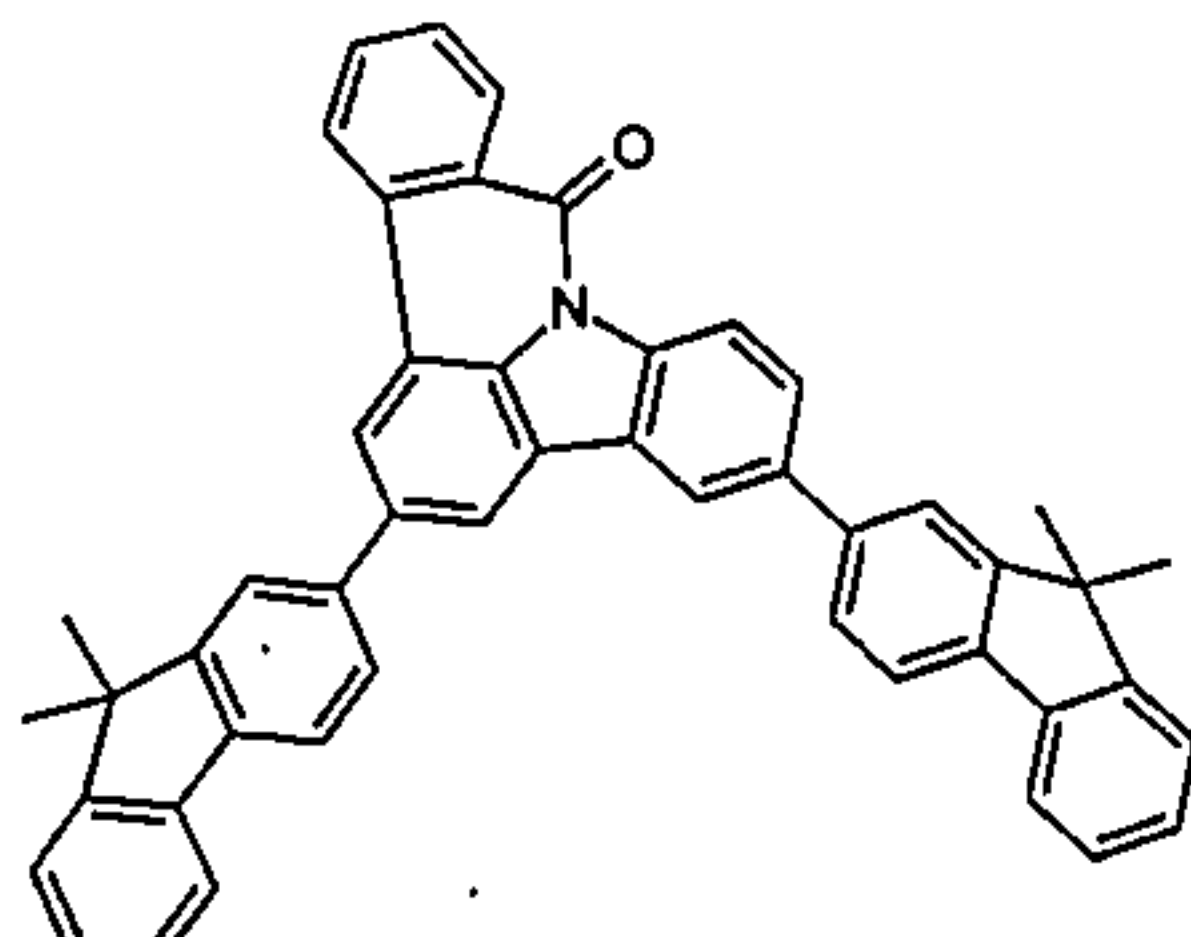
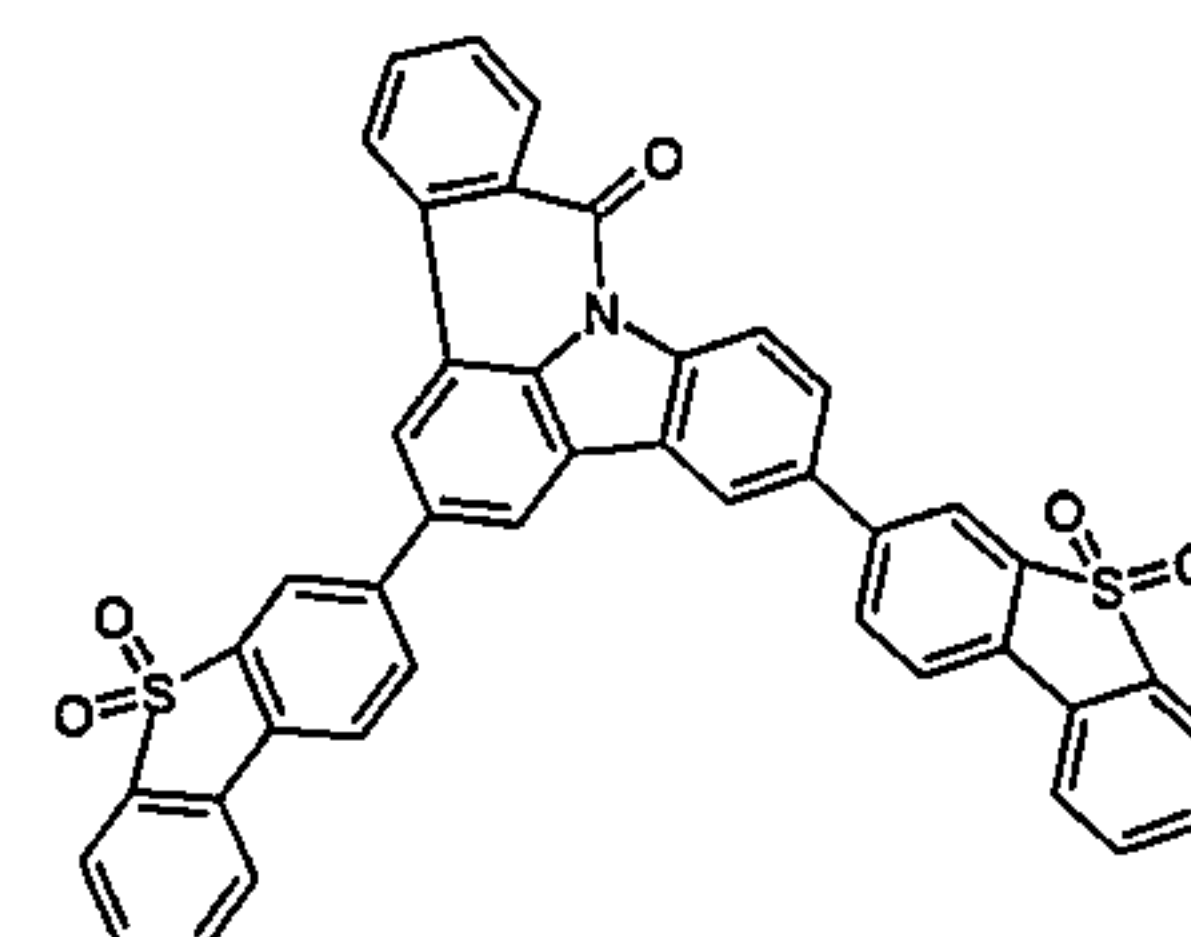
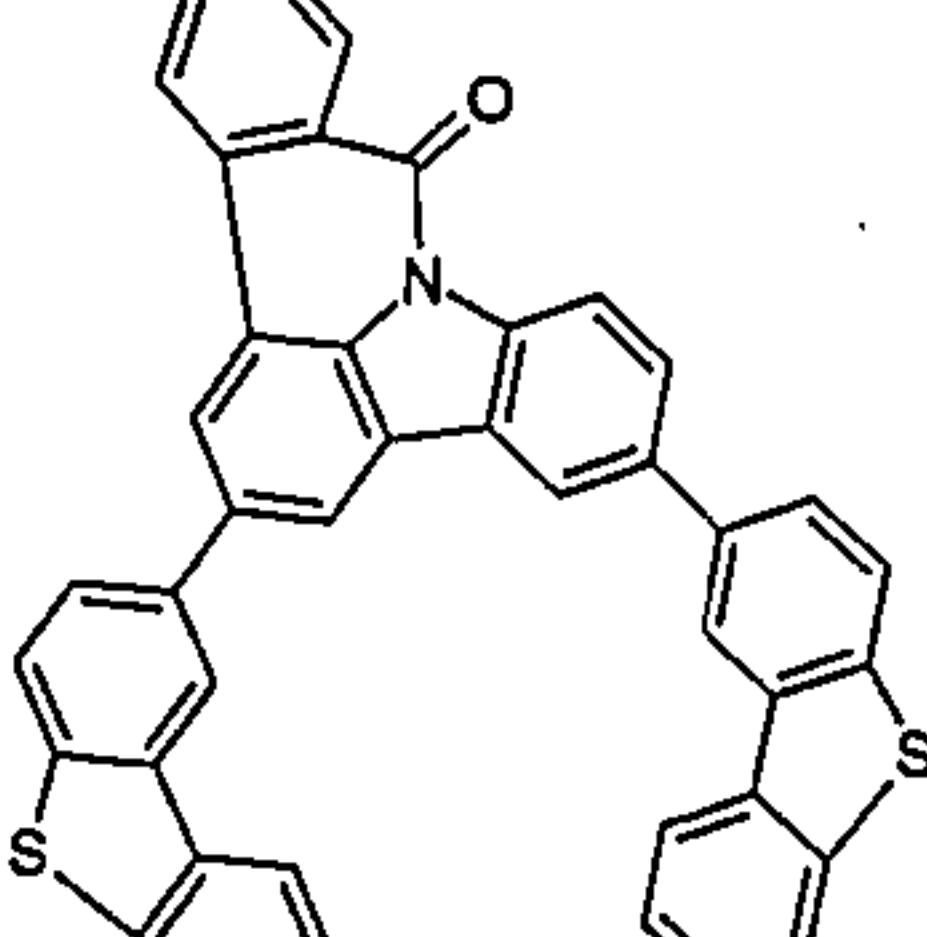
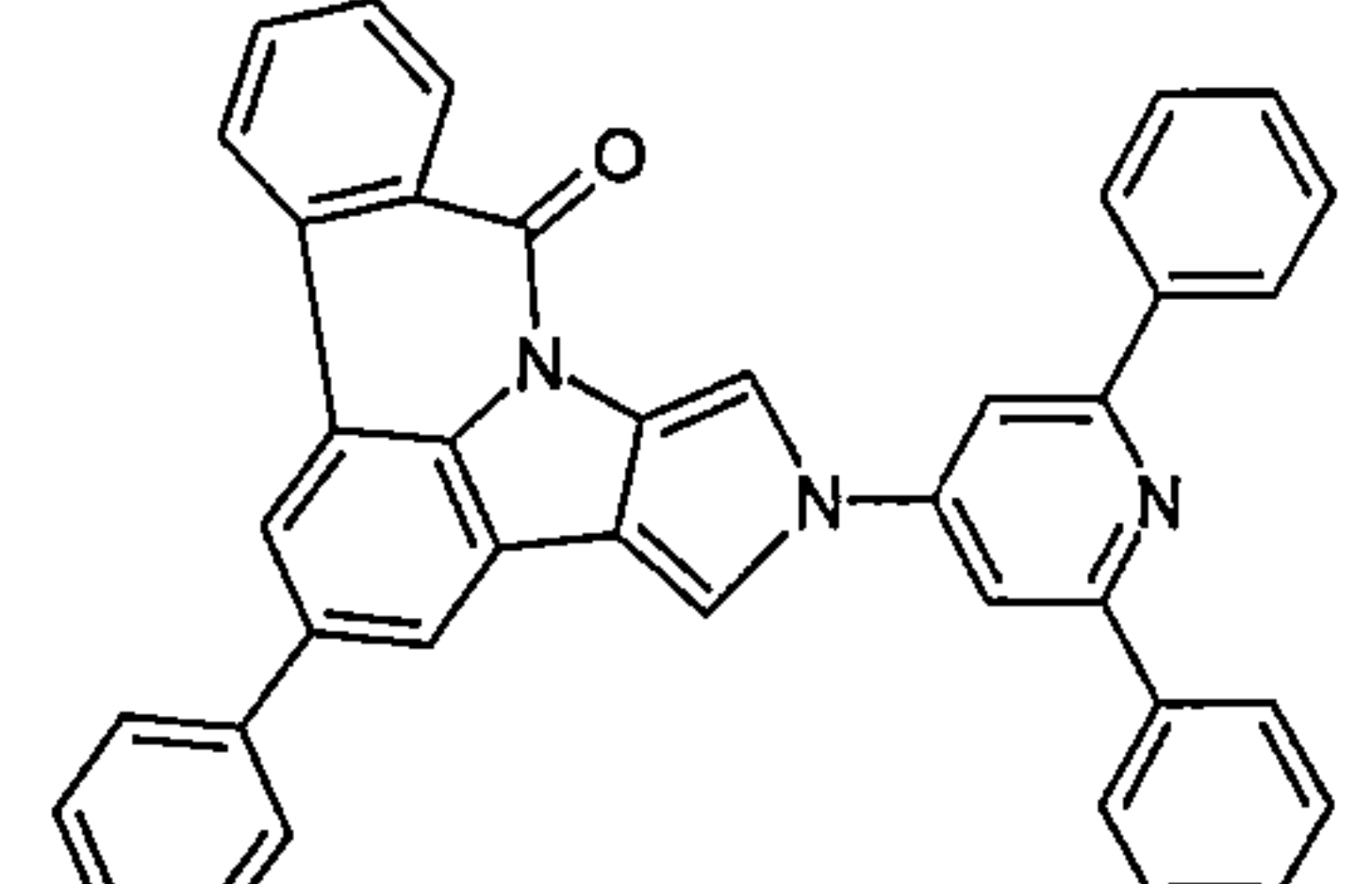
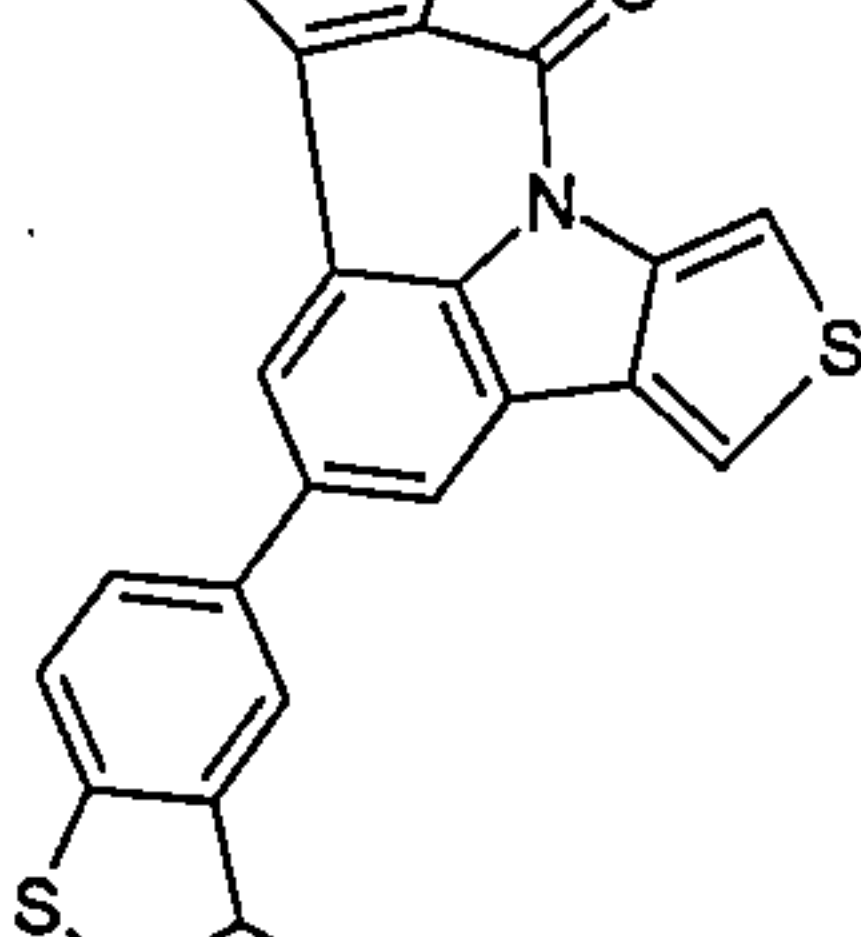
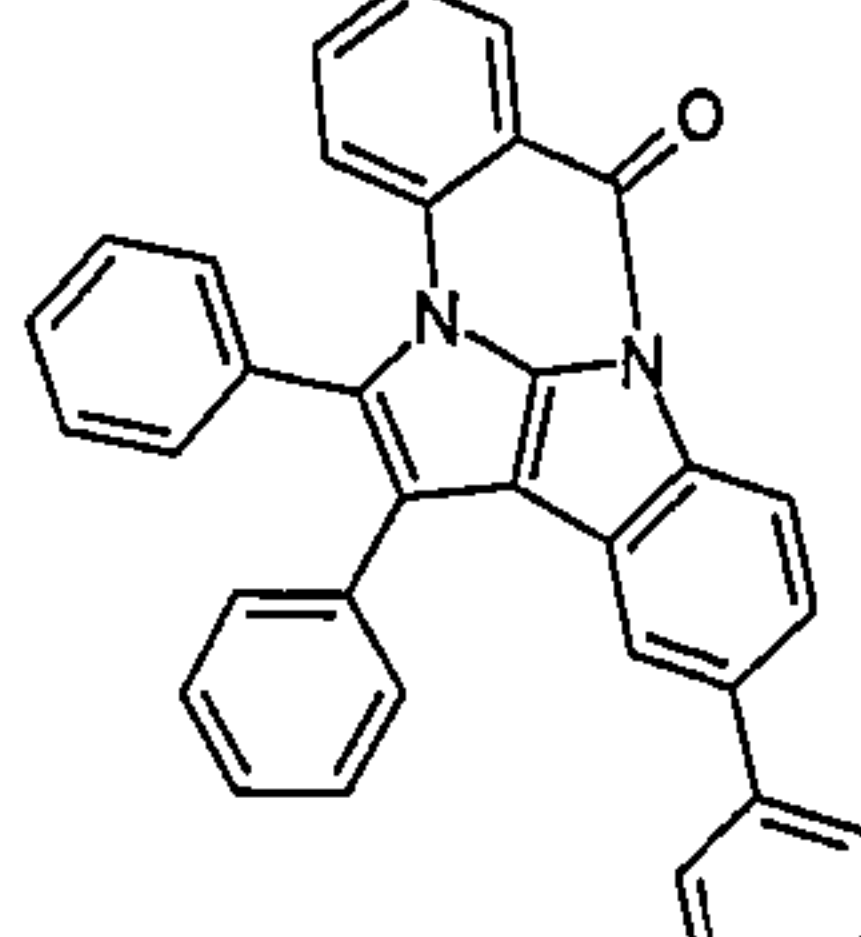
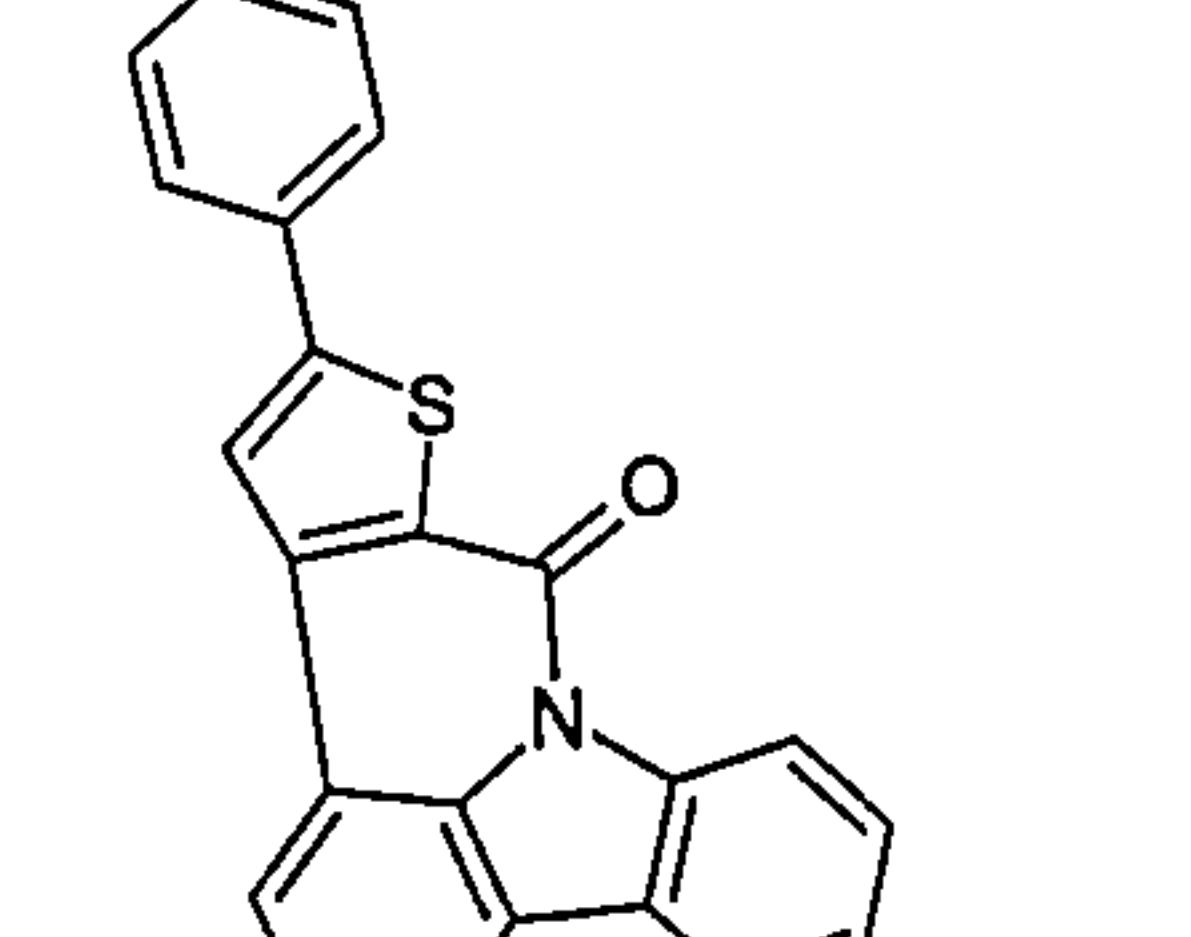
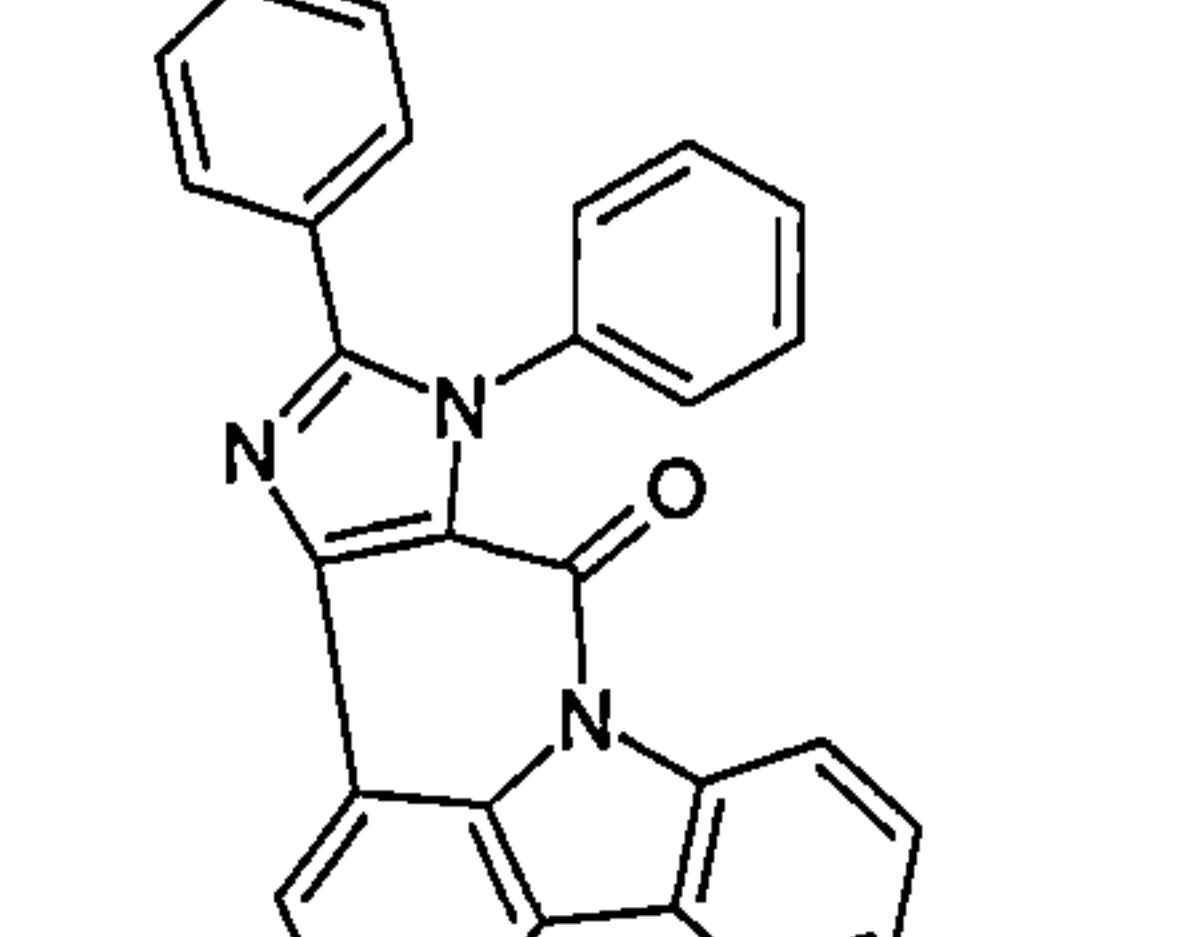
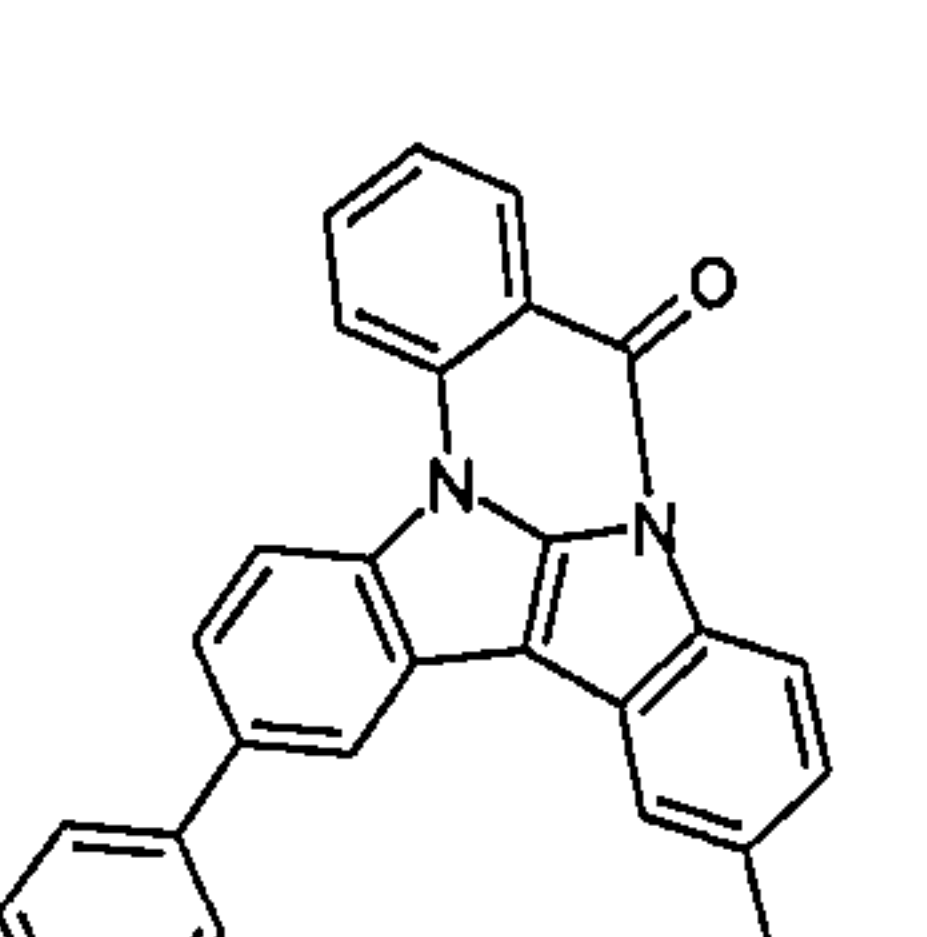
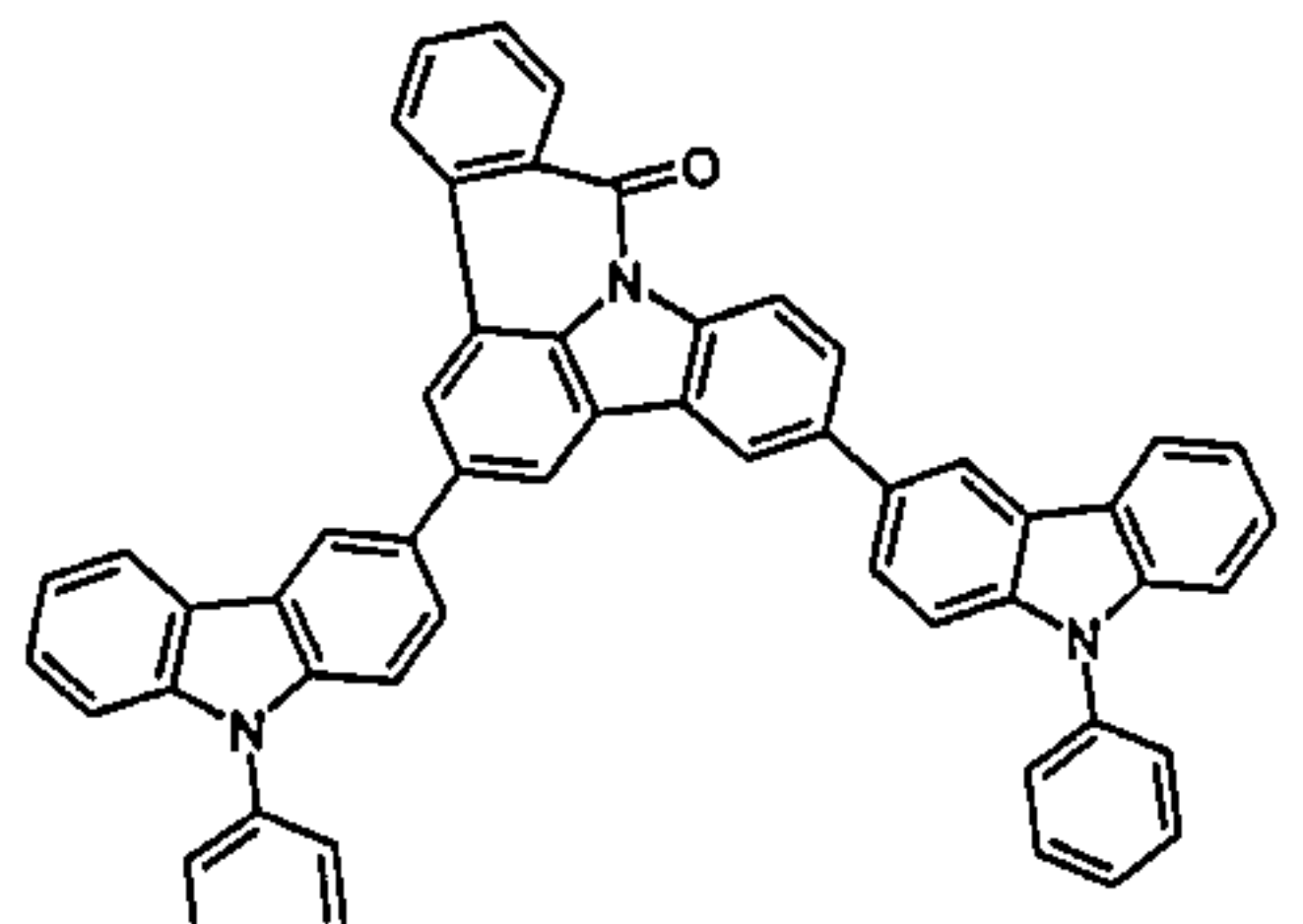
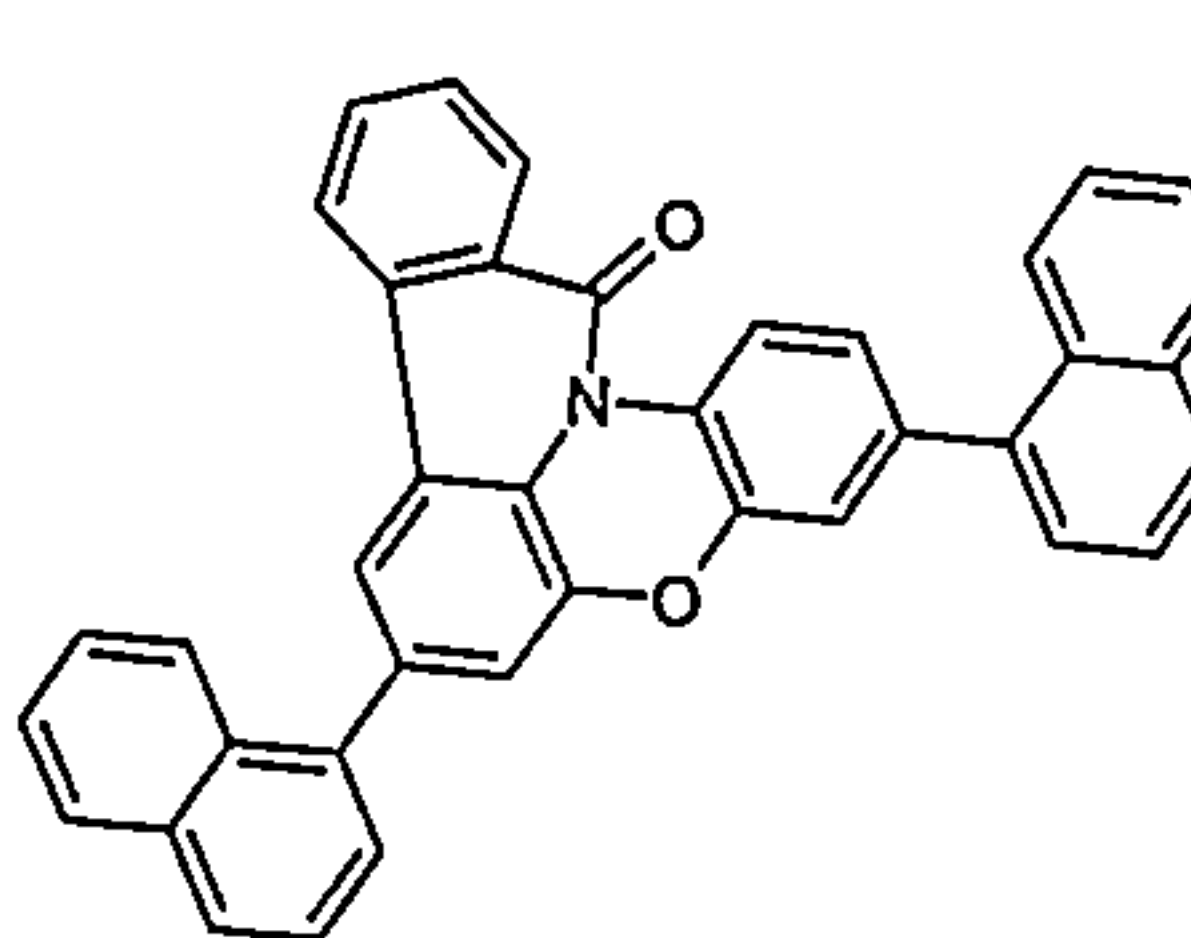
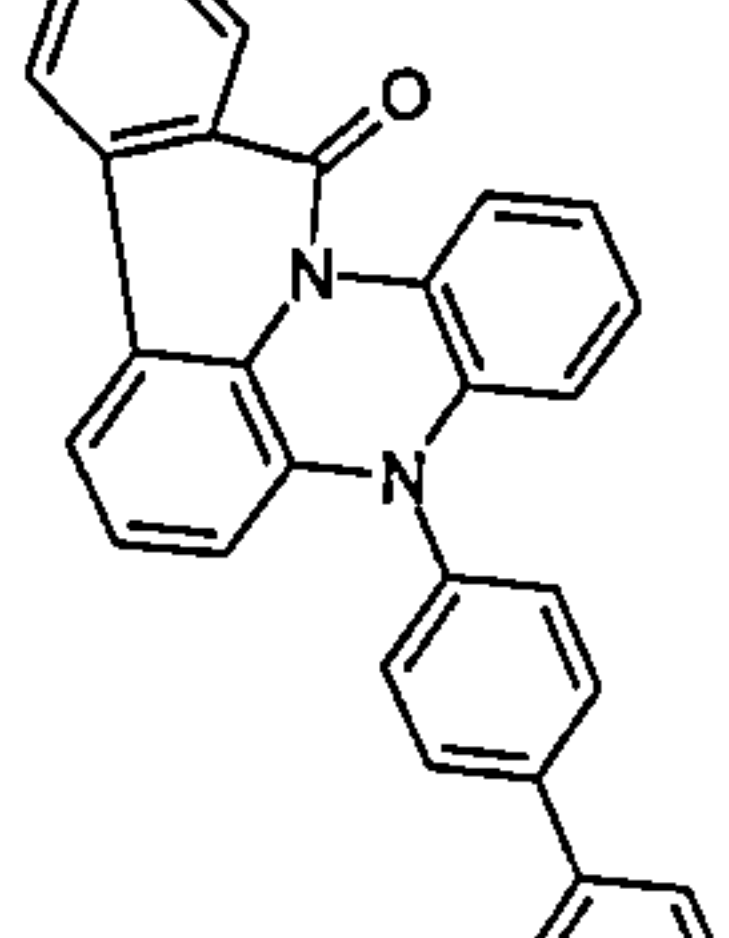
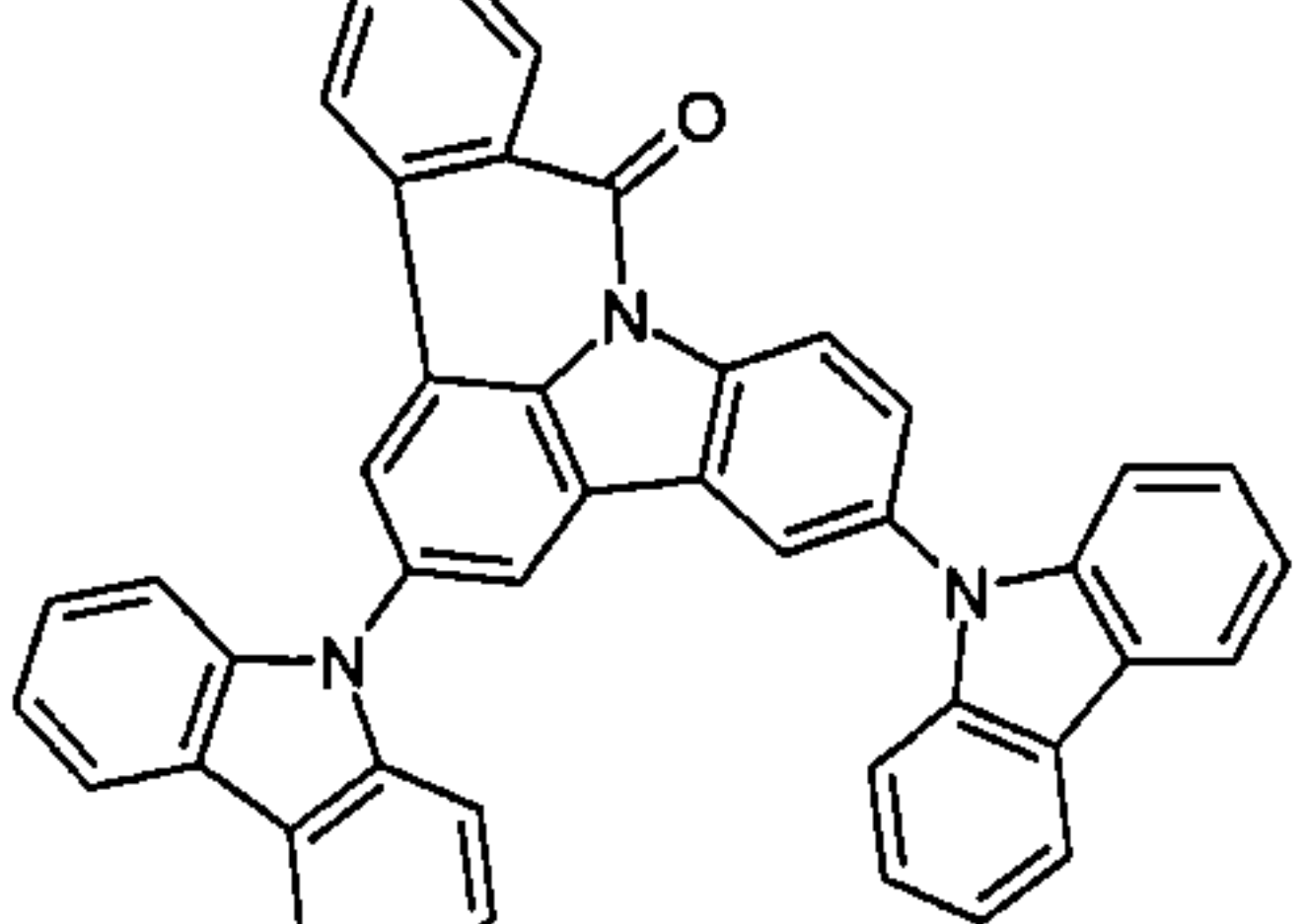
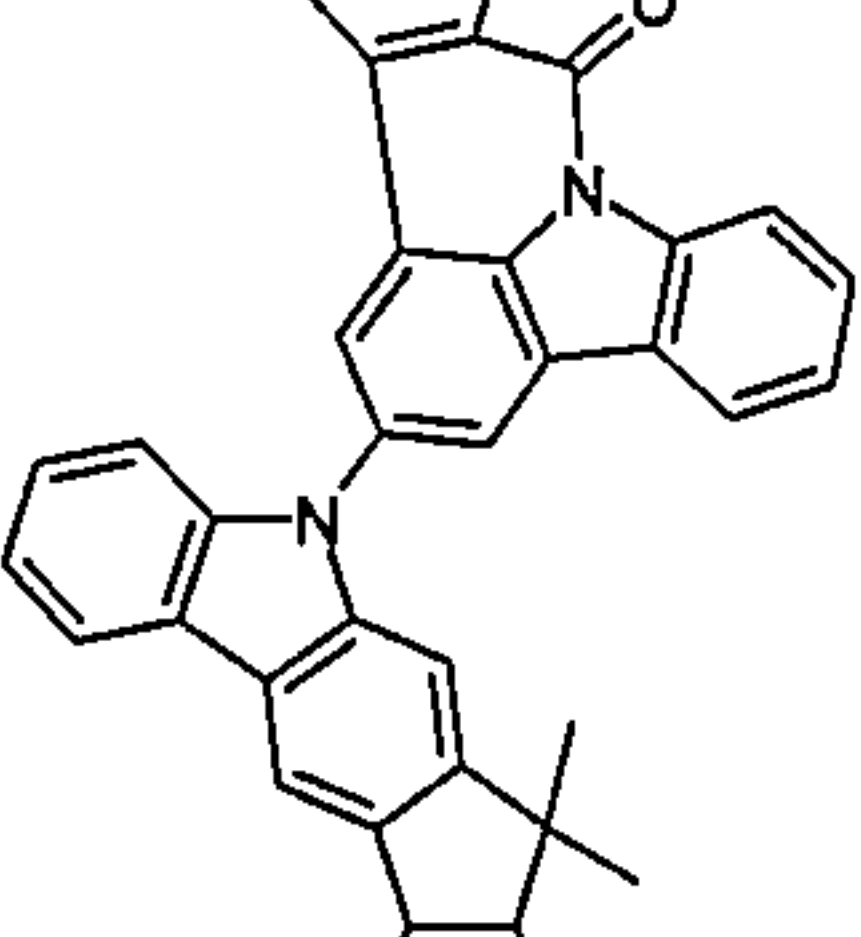
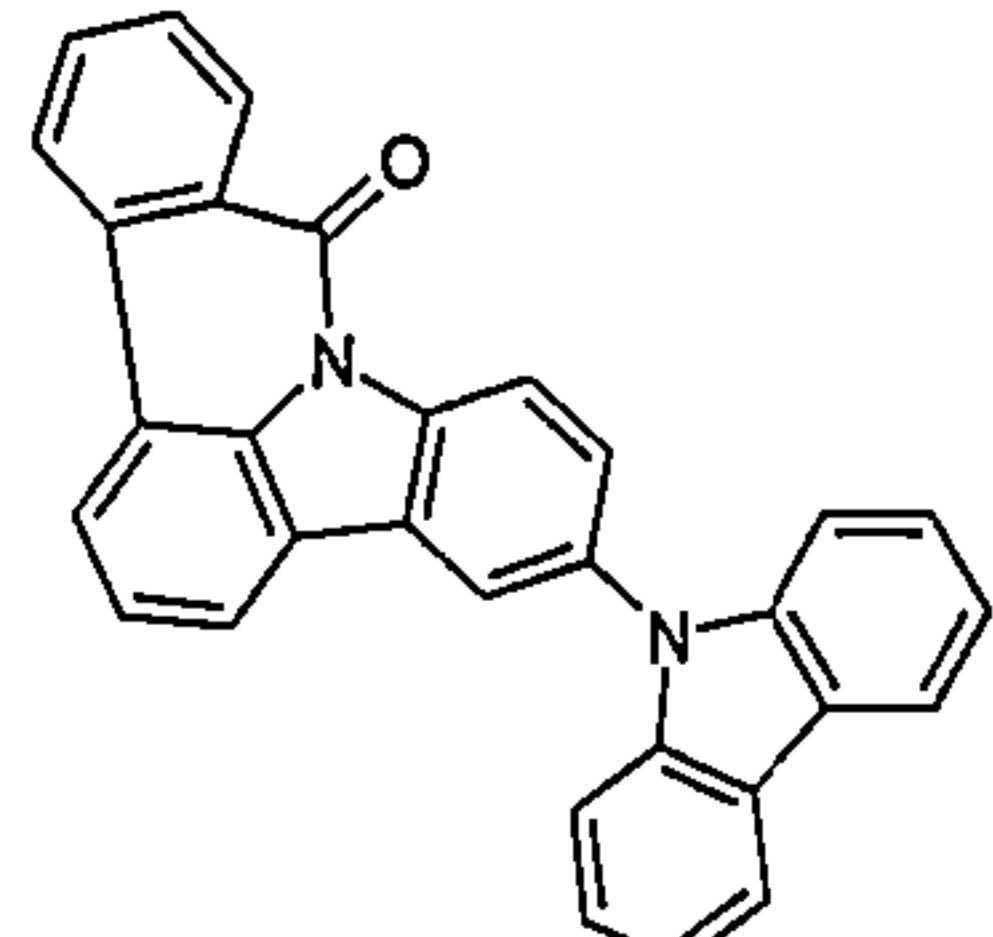
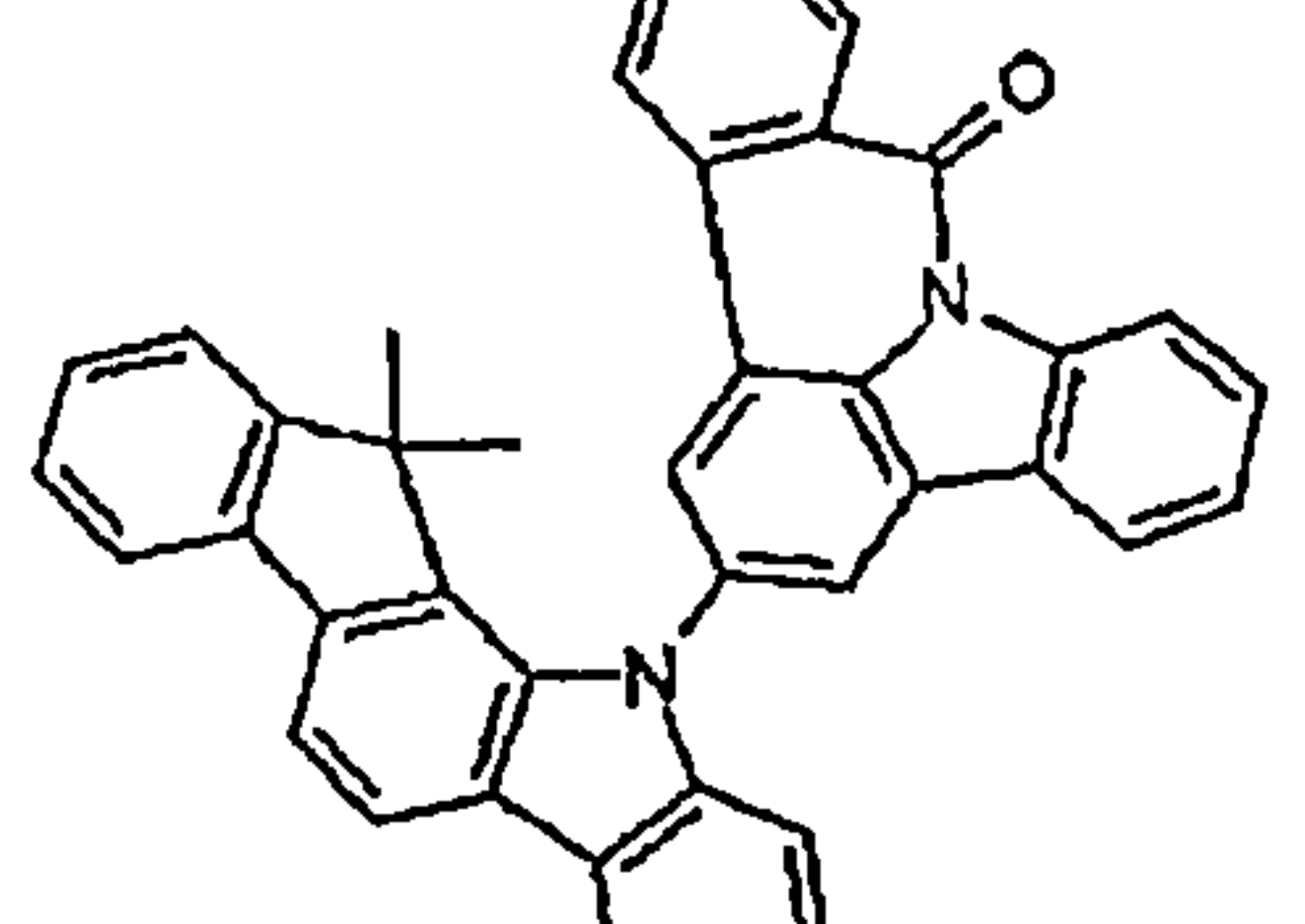
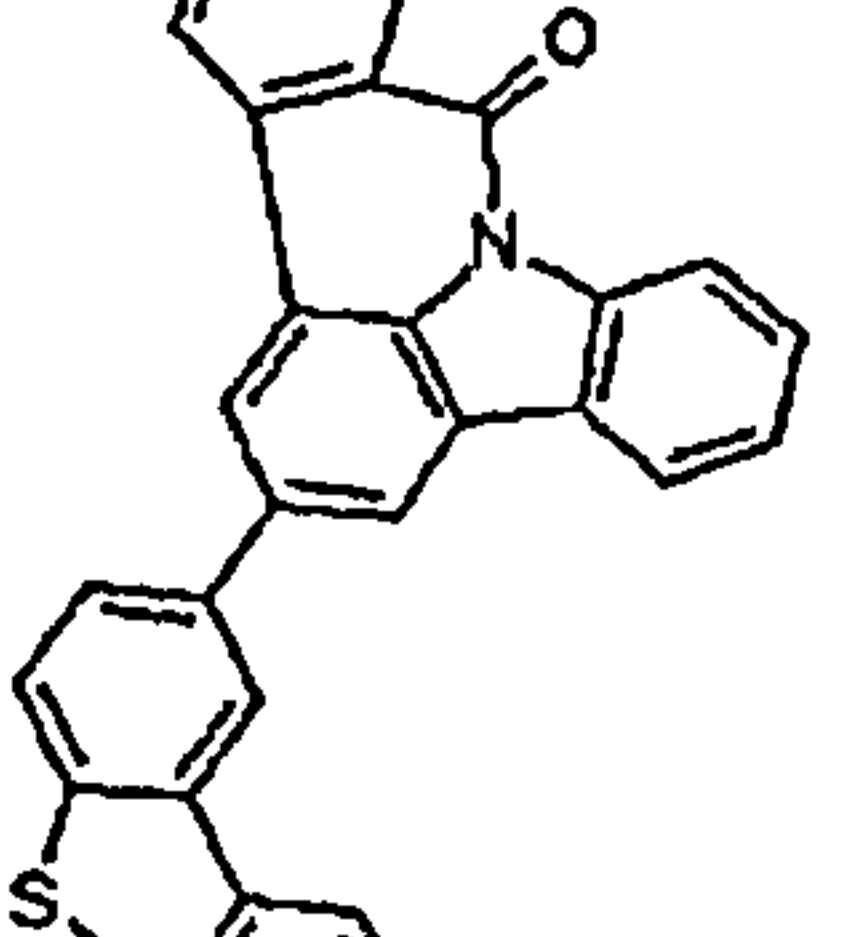
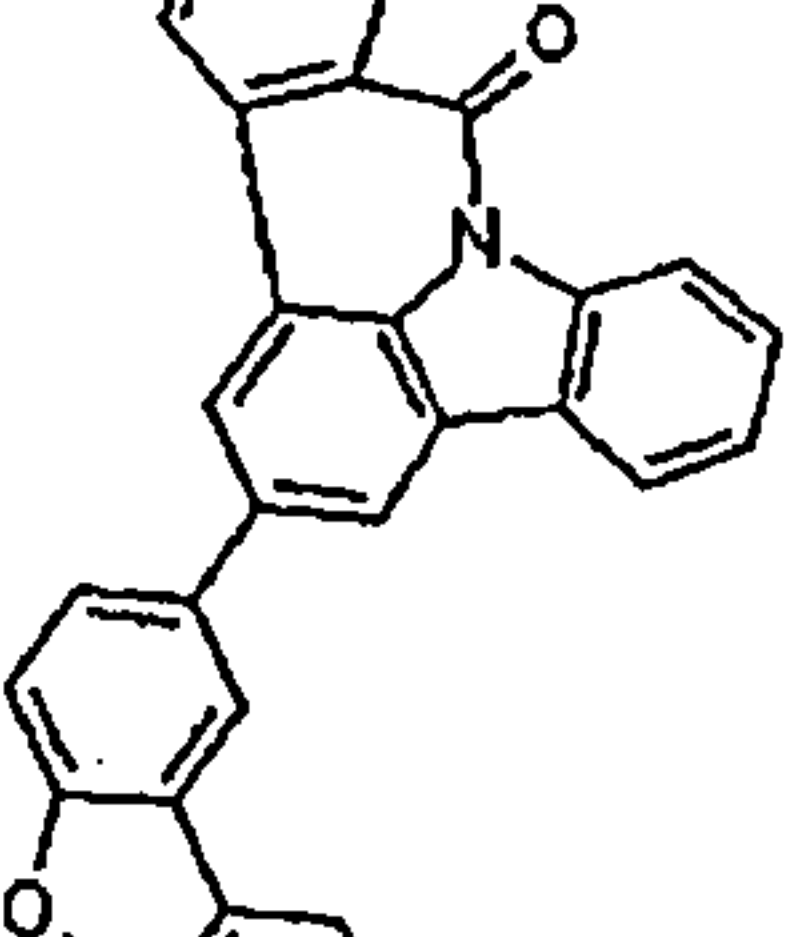
欲與式(1)材料組合用於發射層之較佳內醯胺化合物之實例顯示

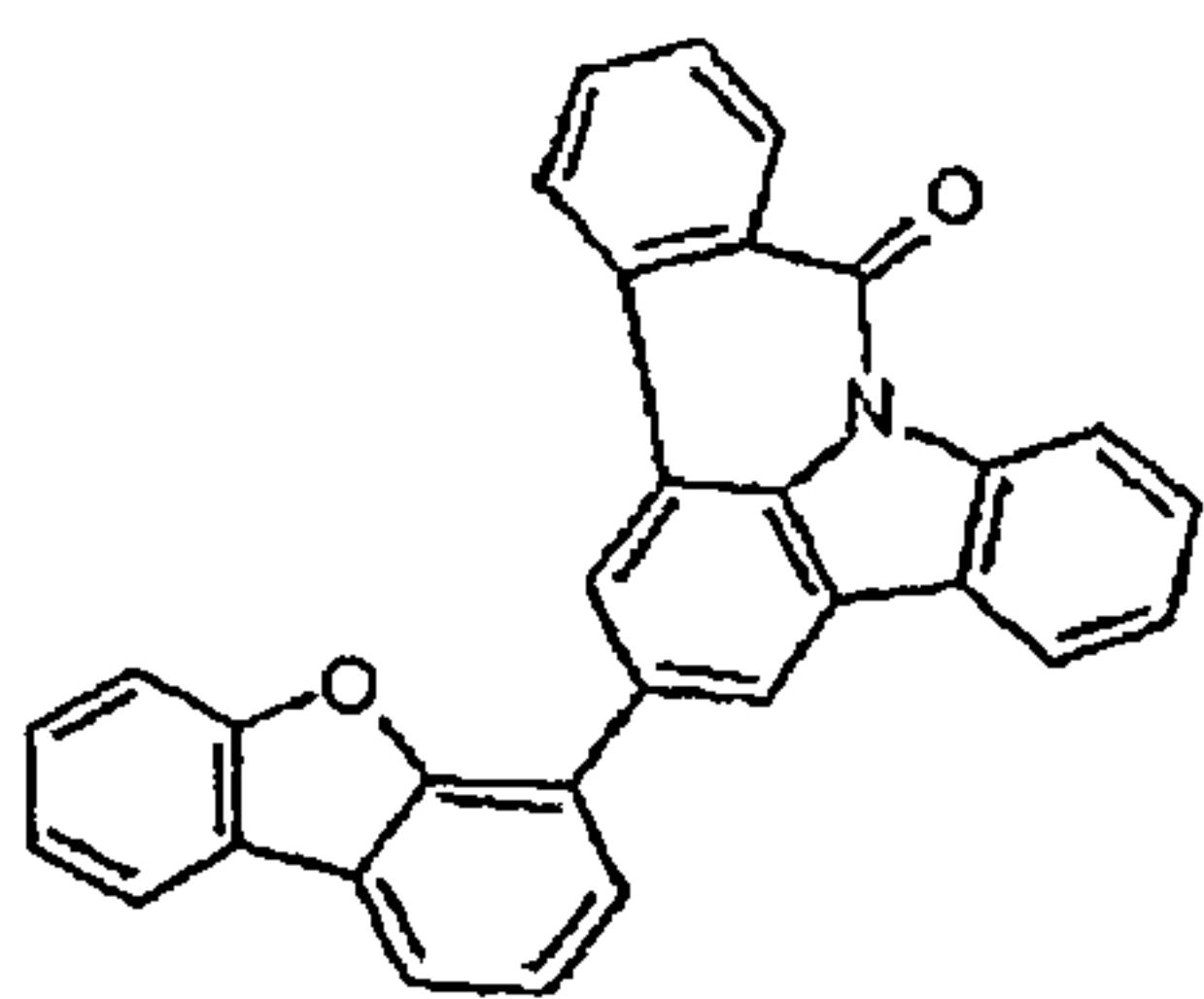
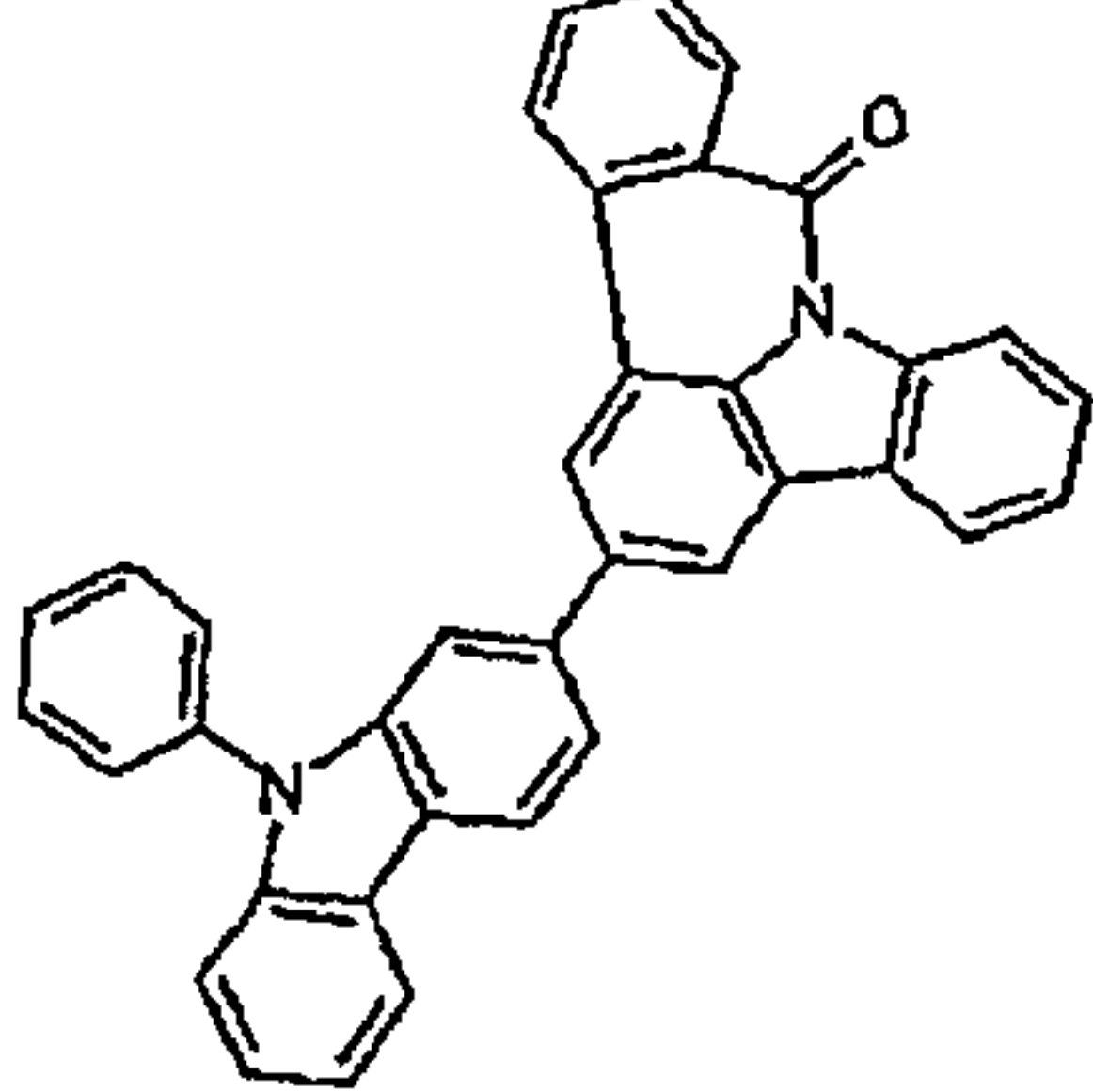
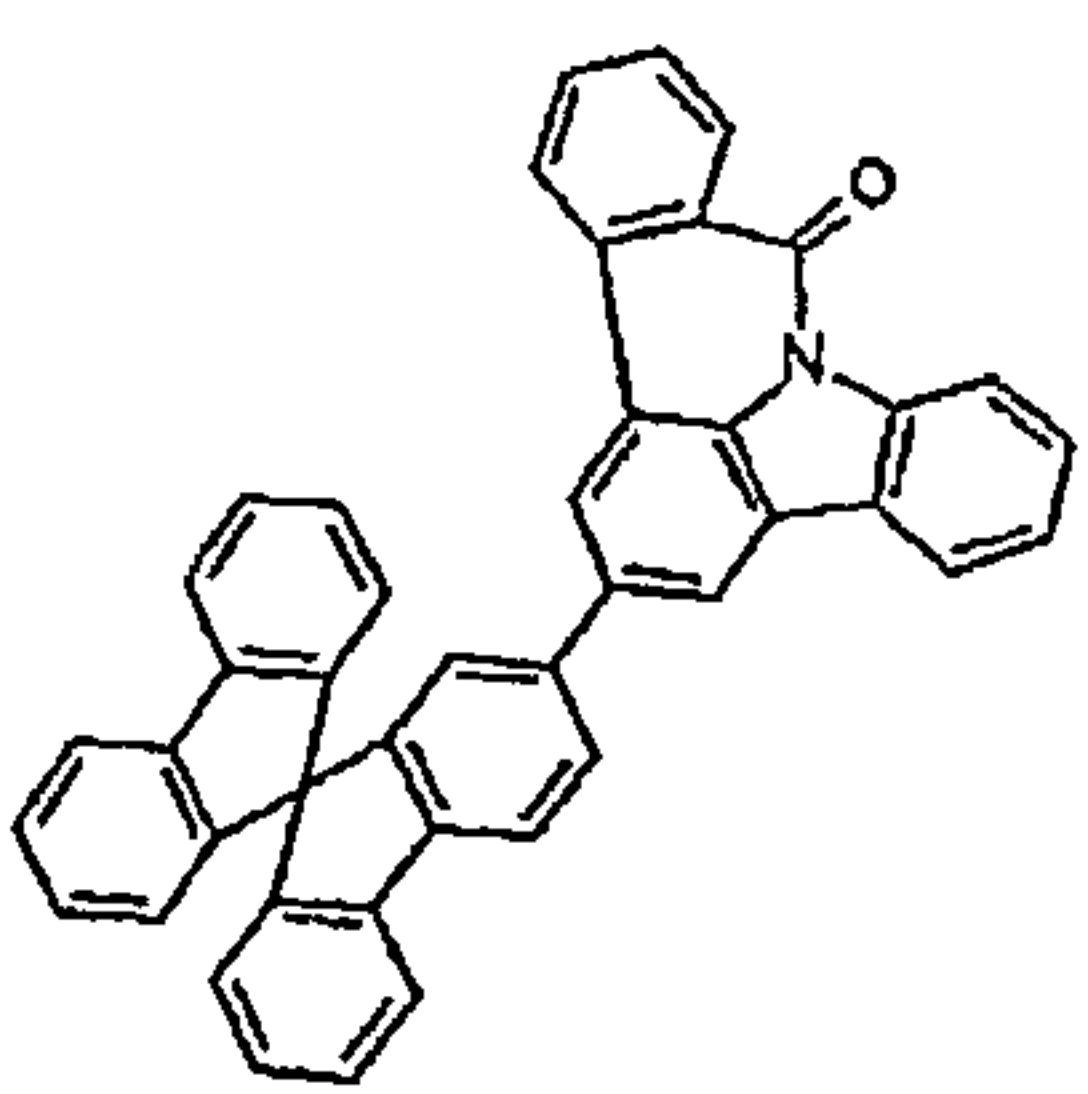
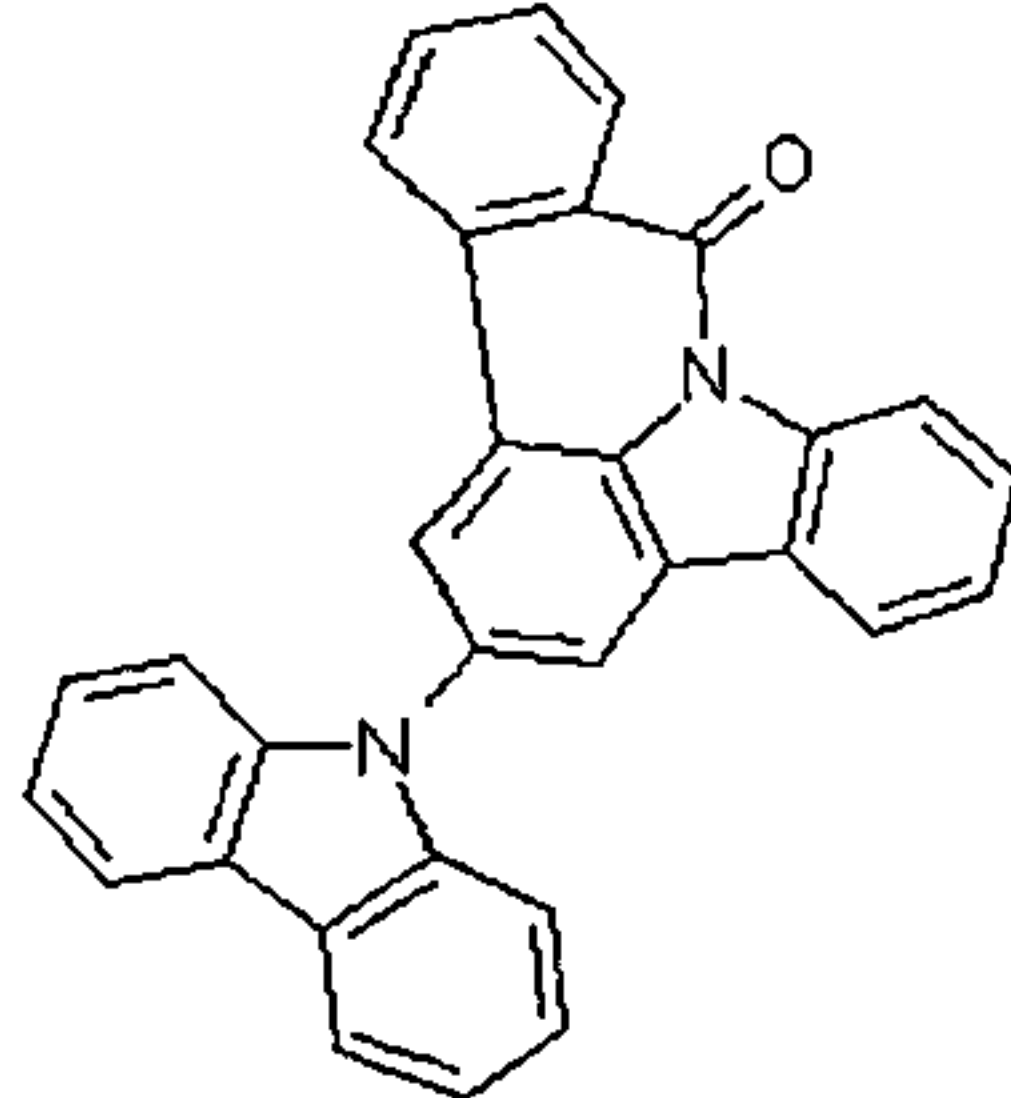
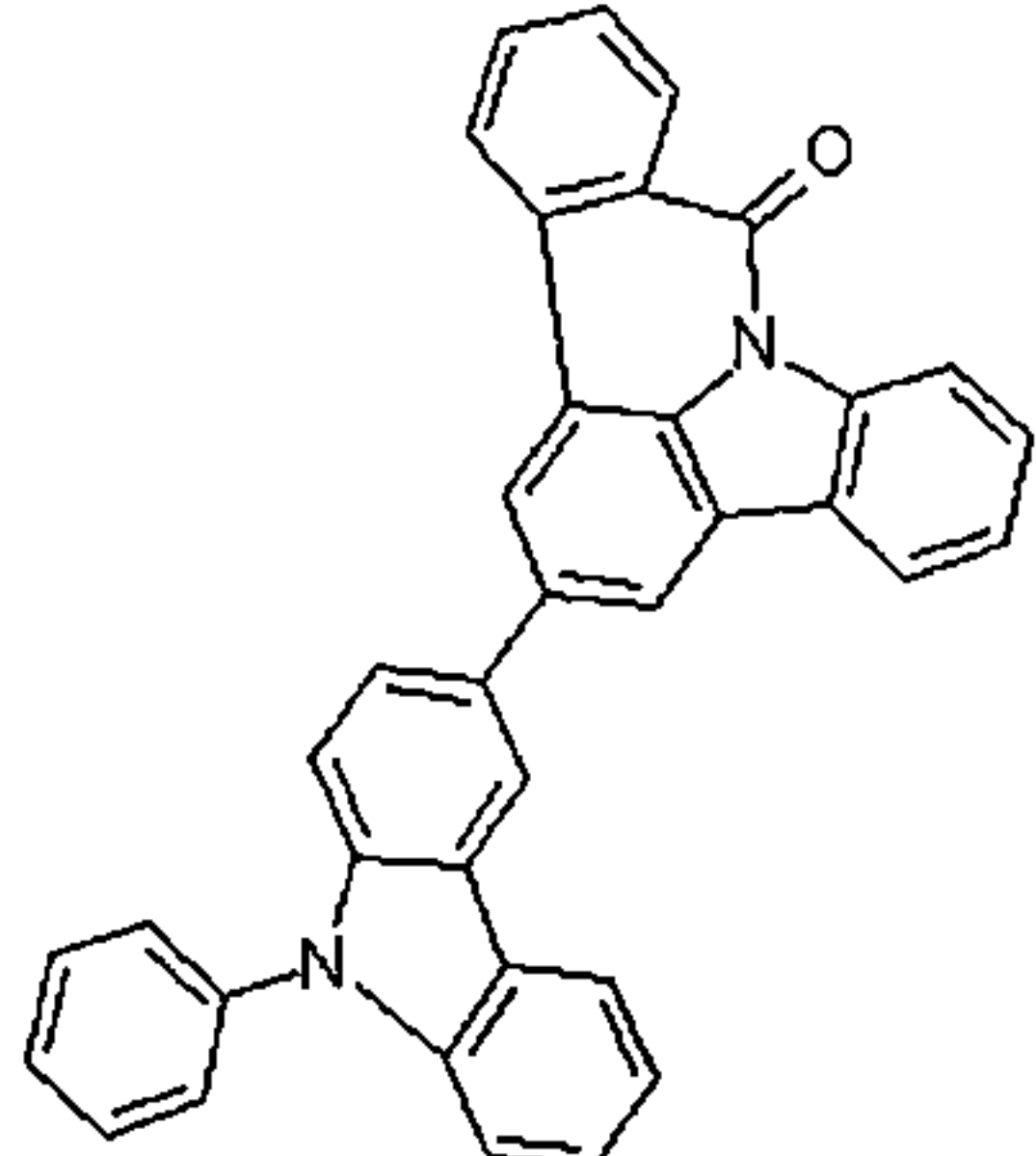
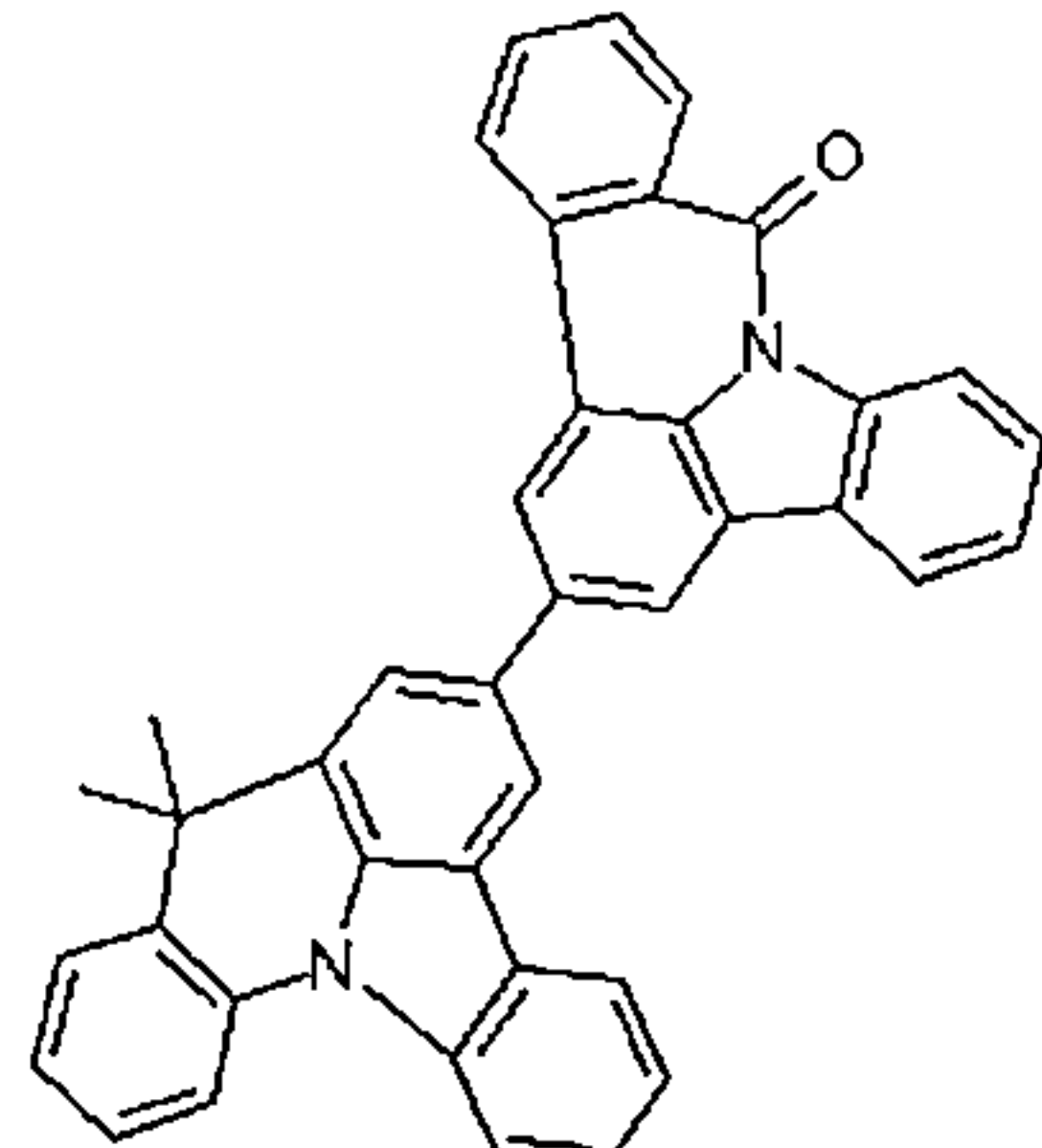
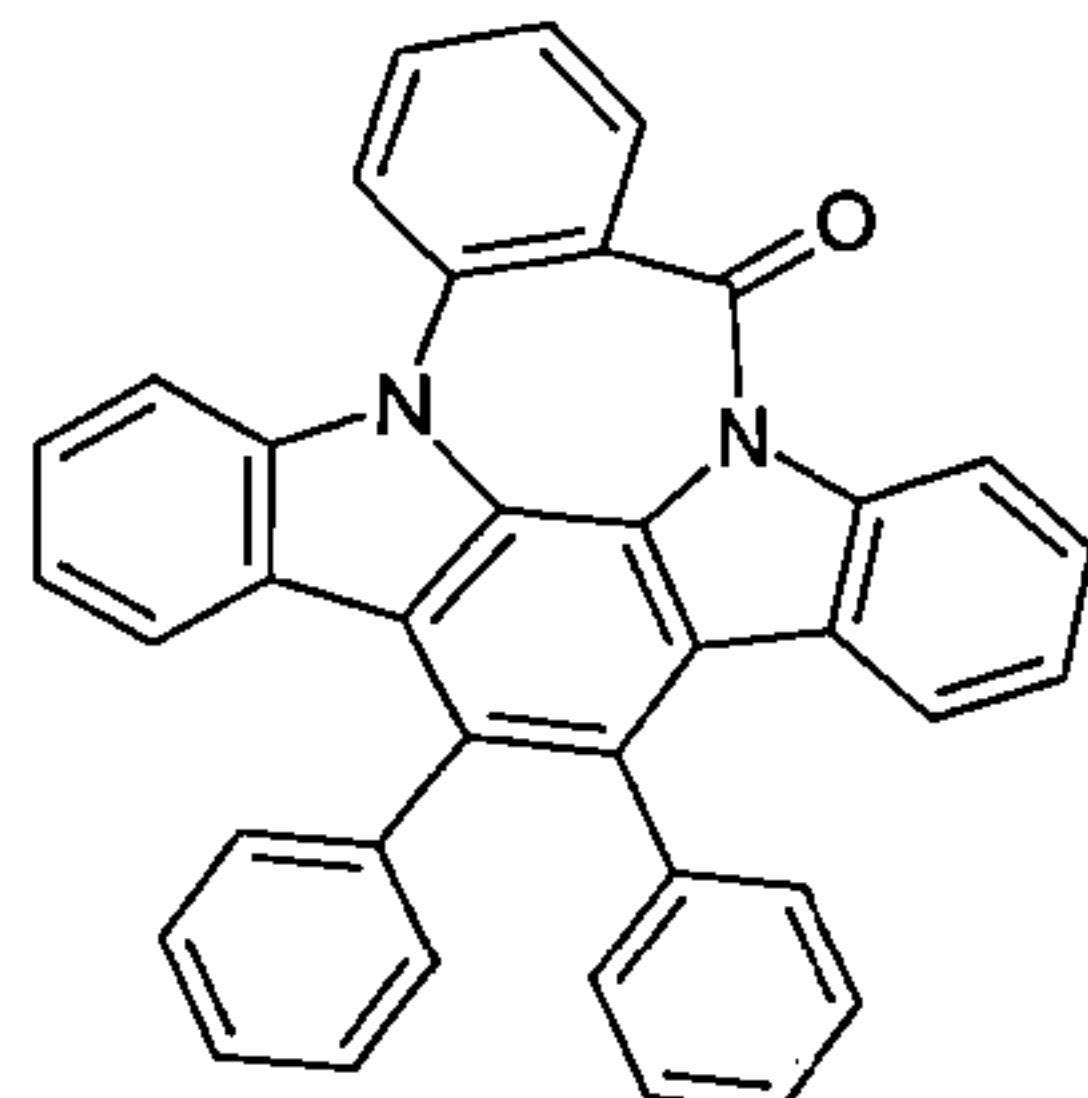
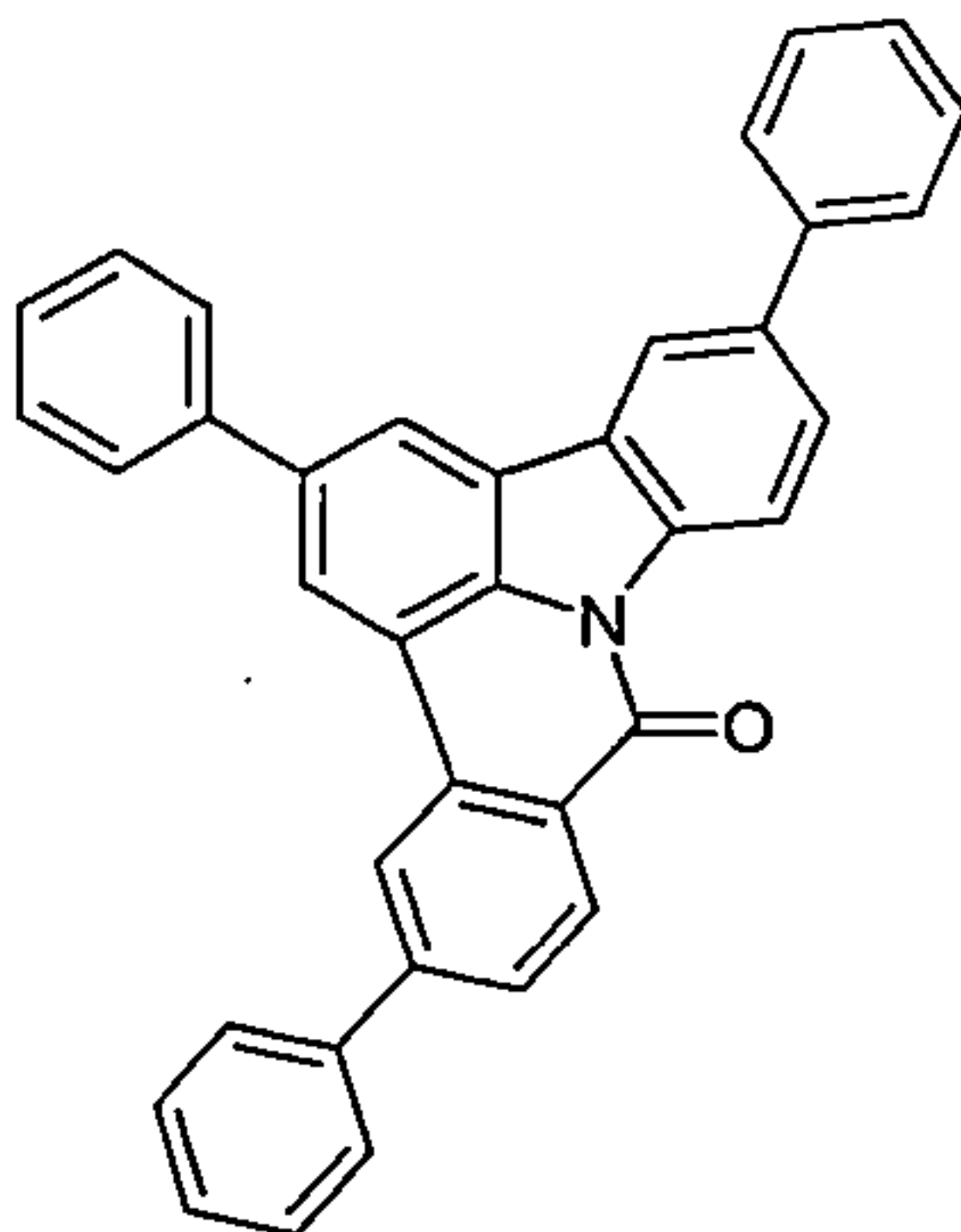
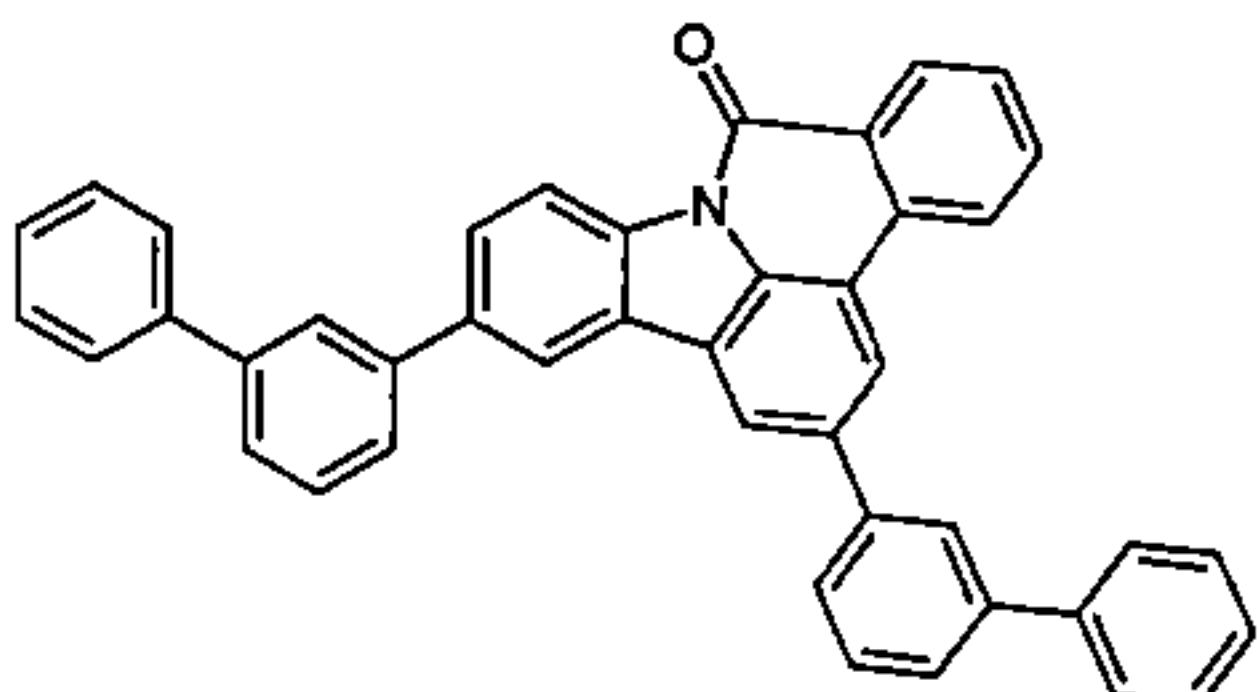
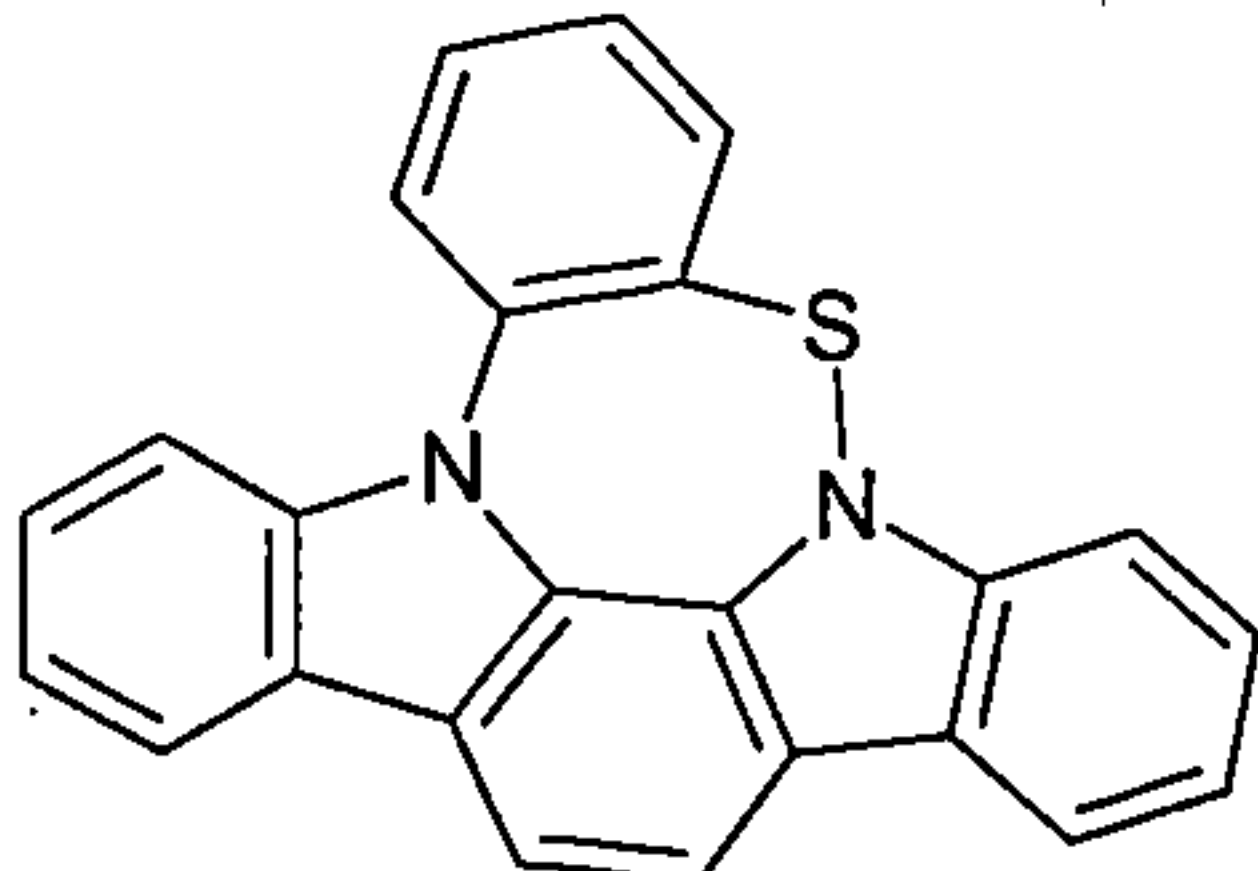
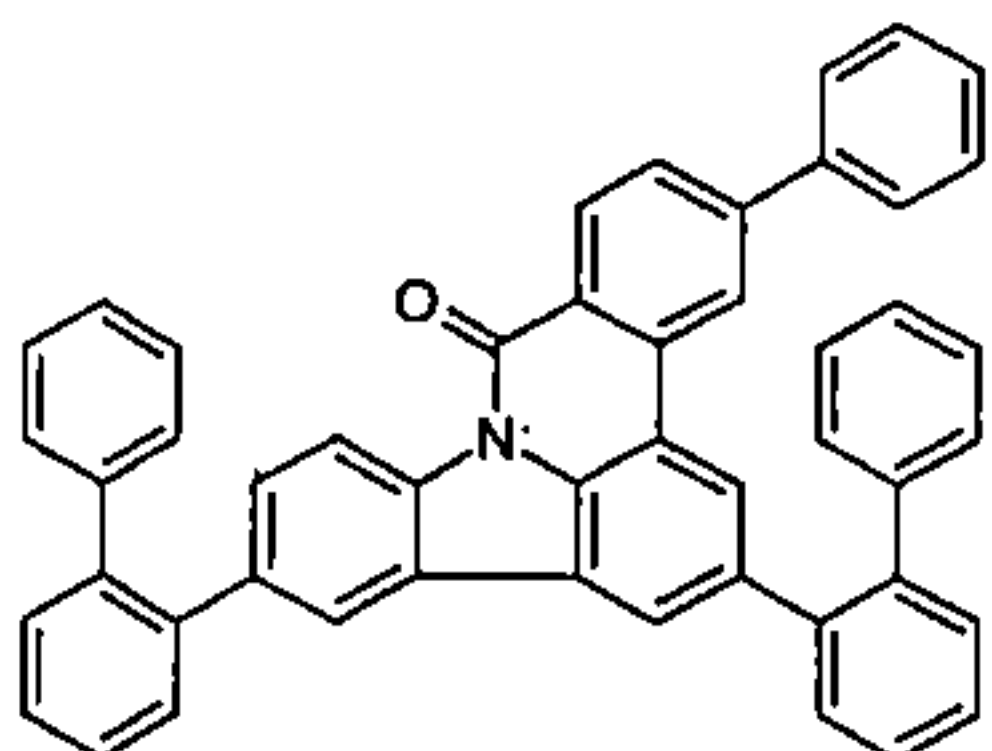
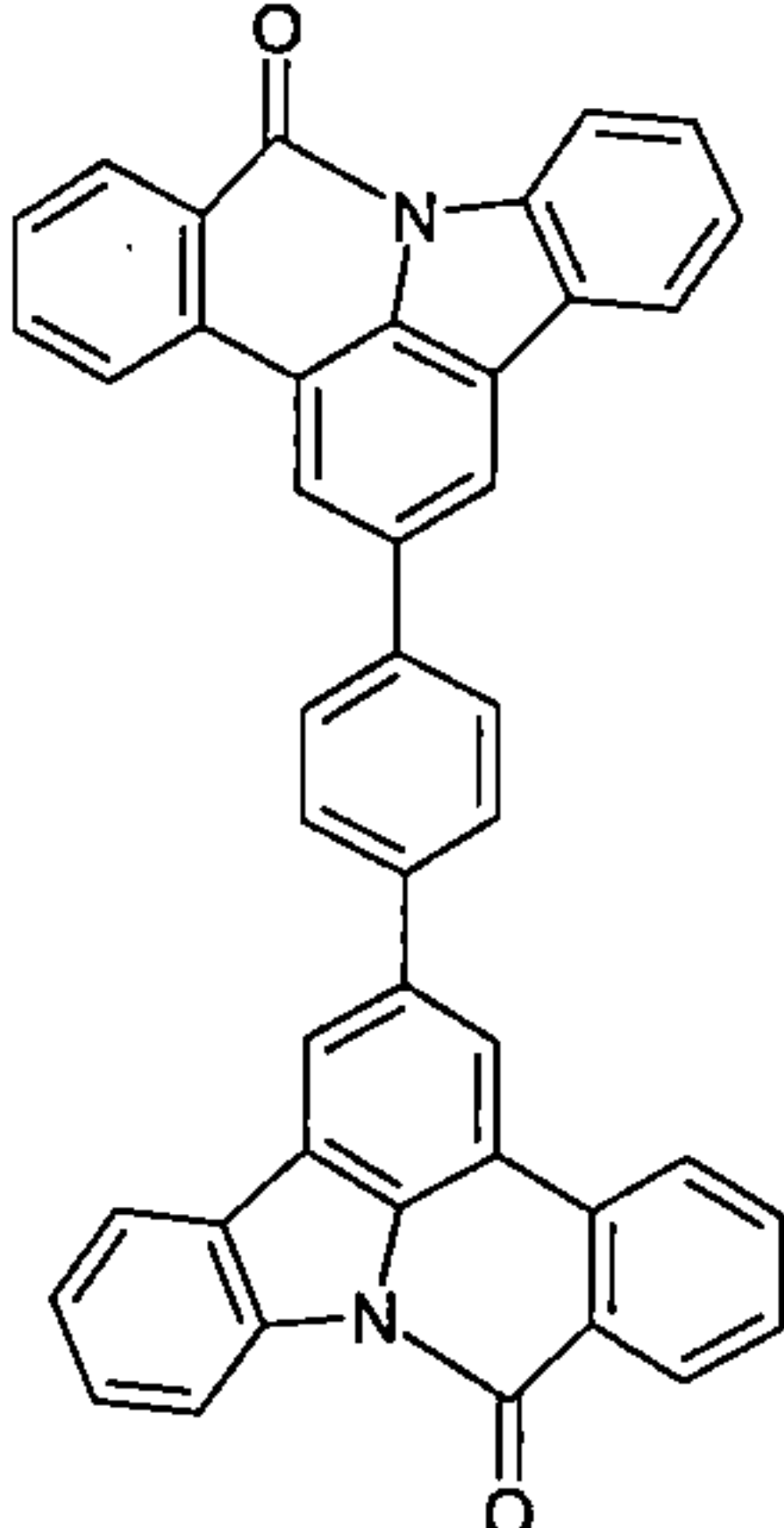
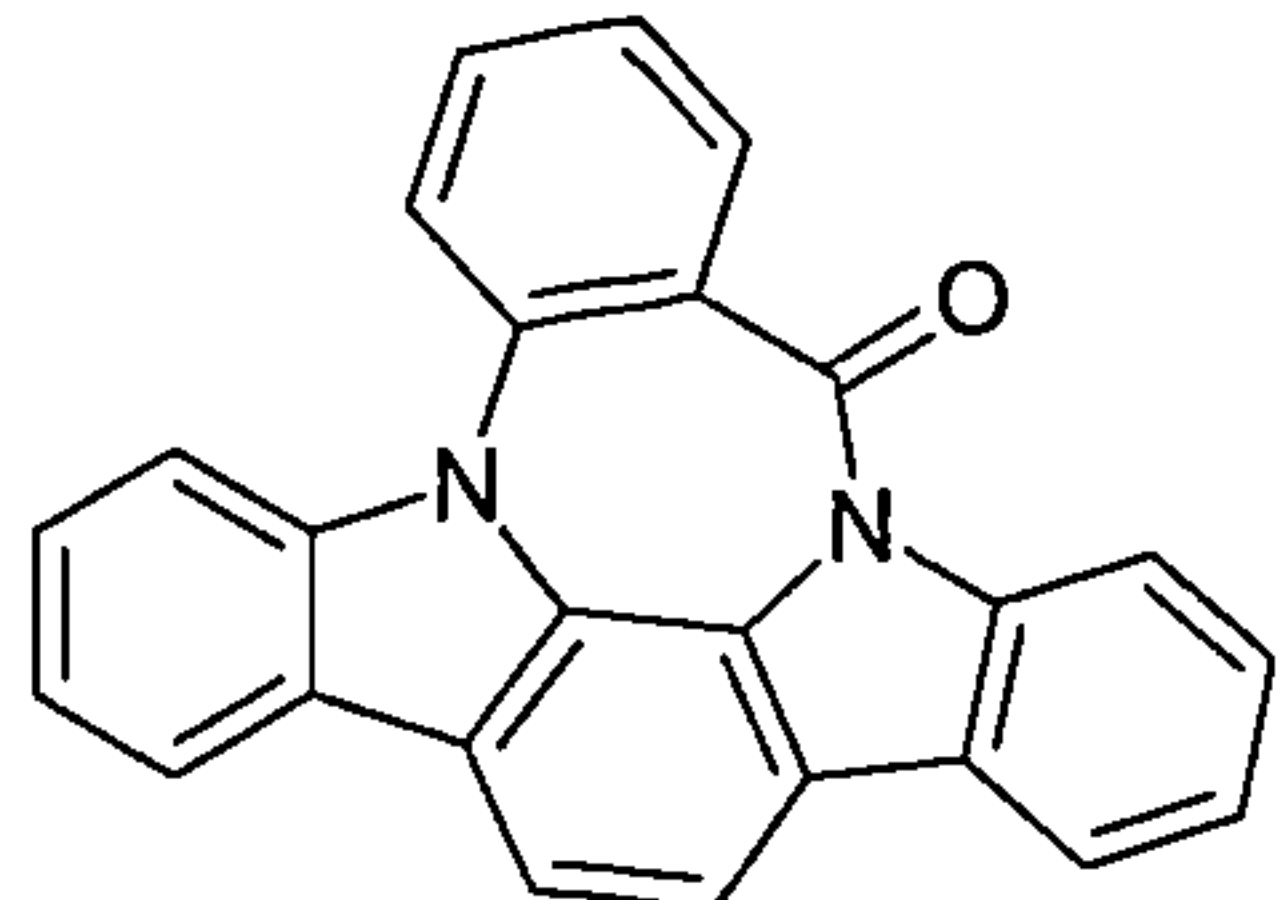
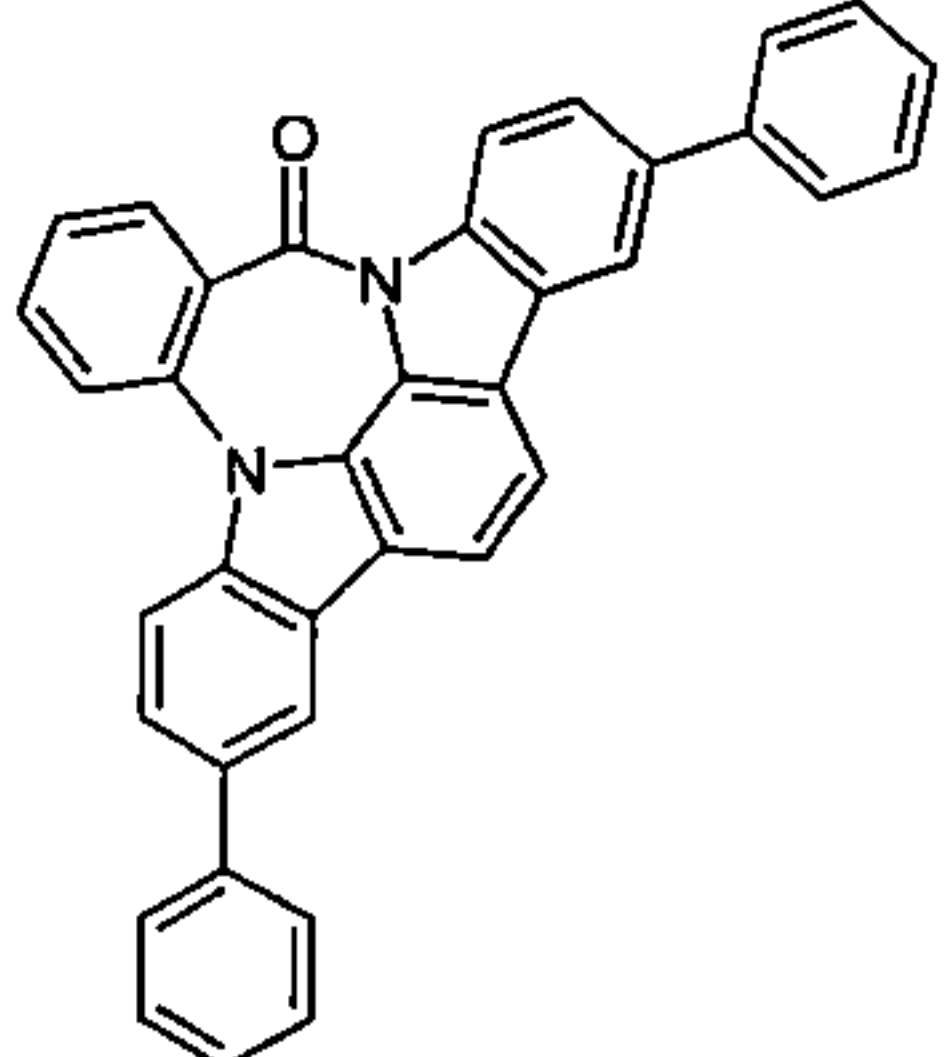
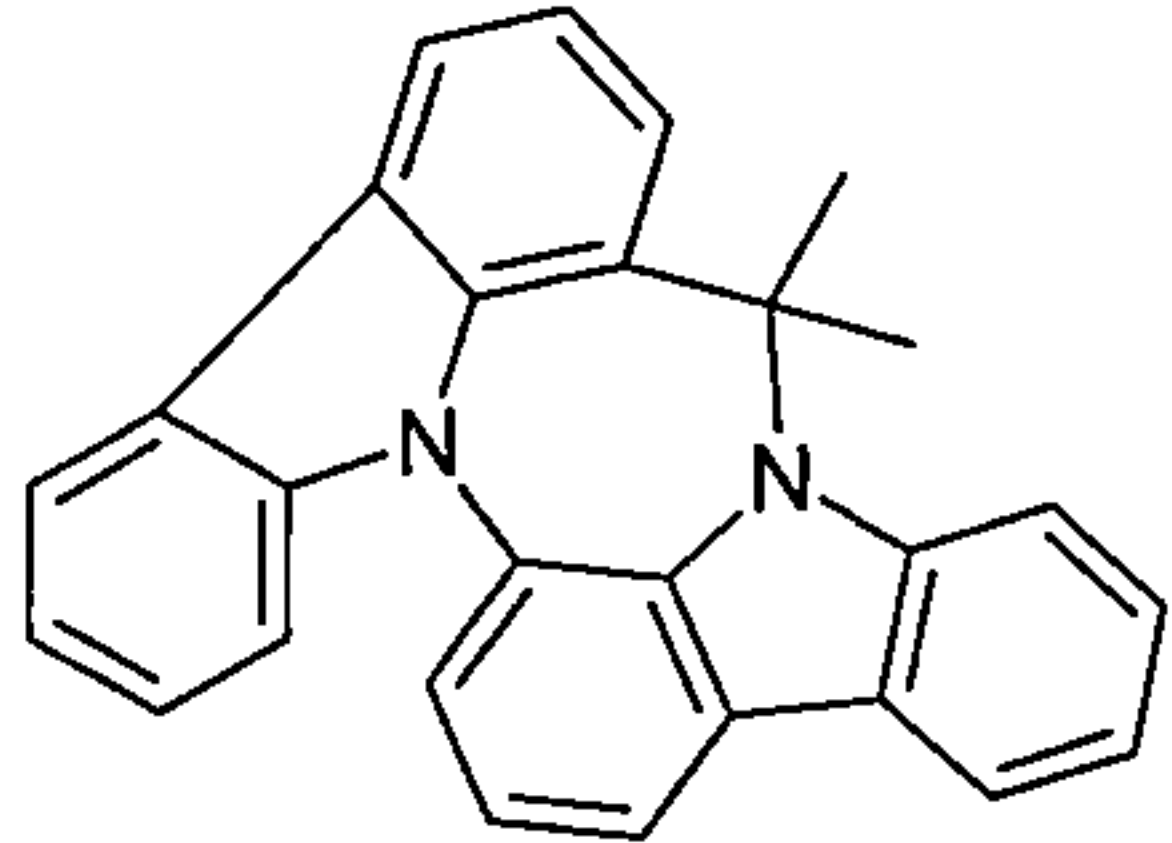
於下表中。

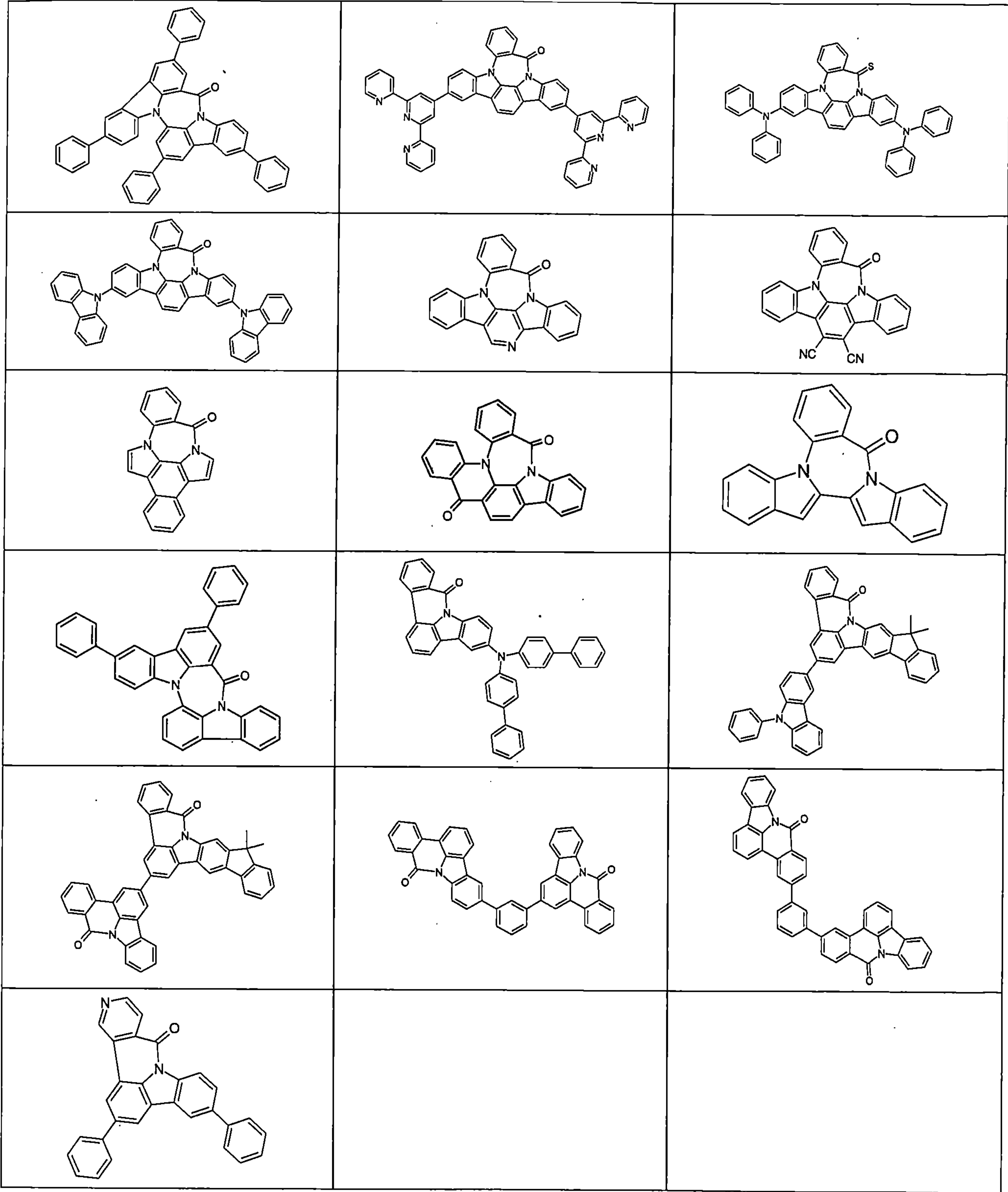
		
		
		
		
		
		



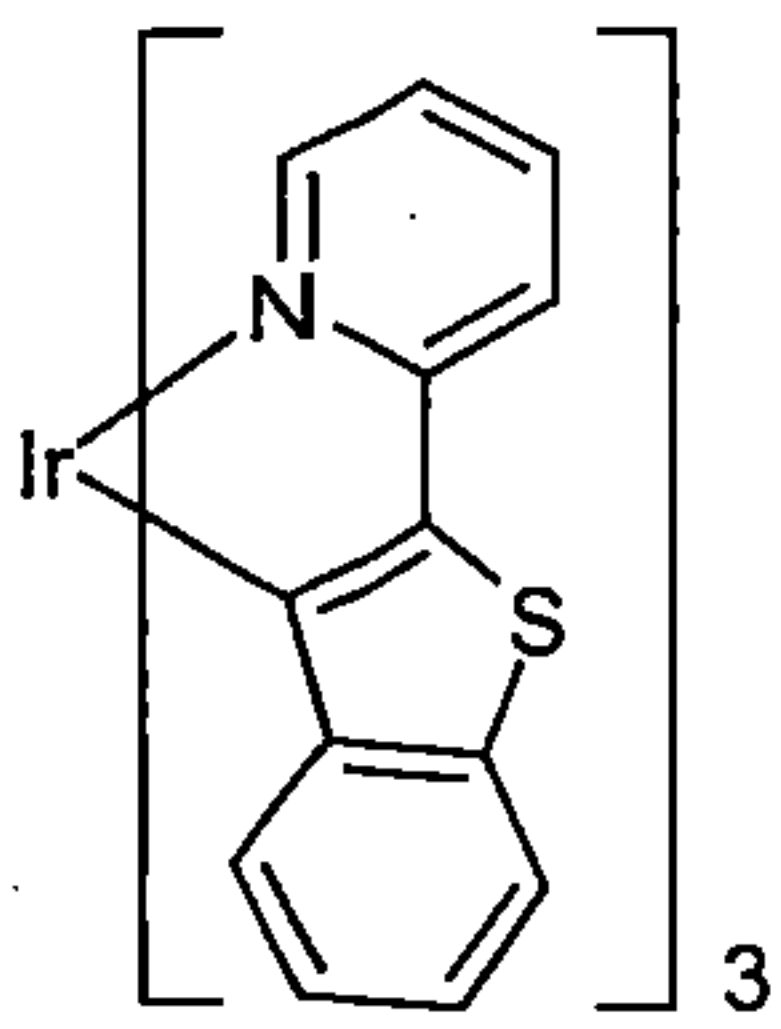
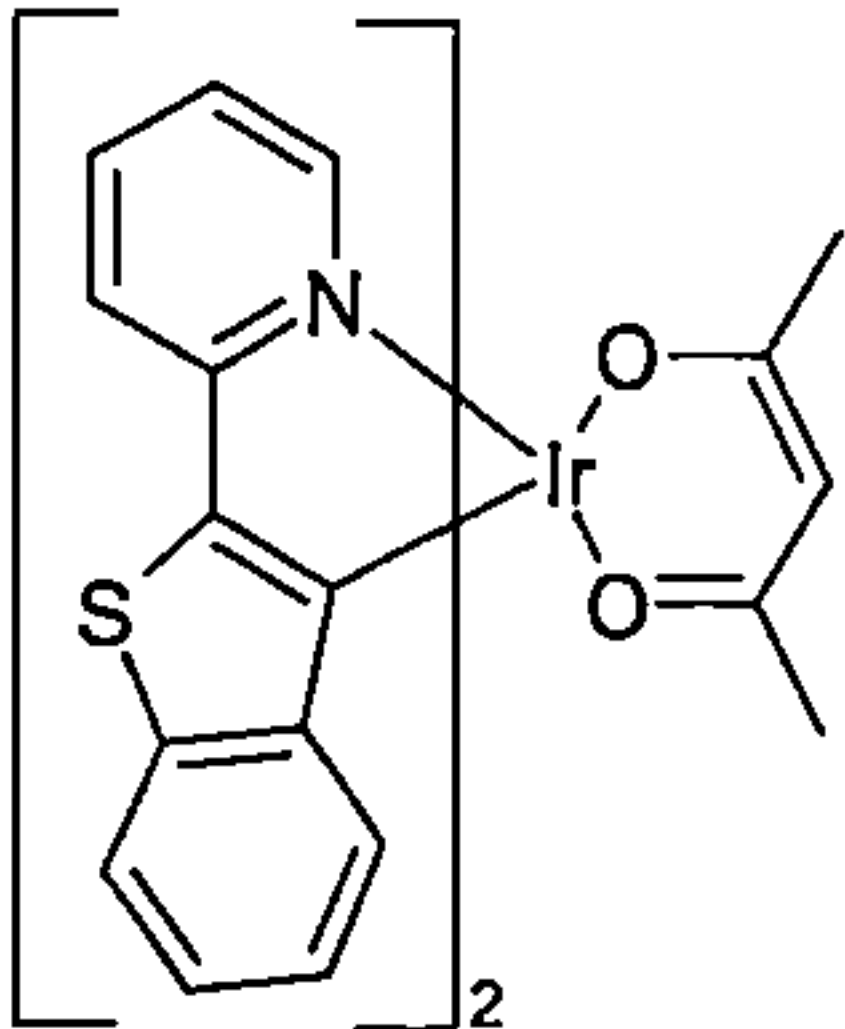
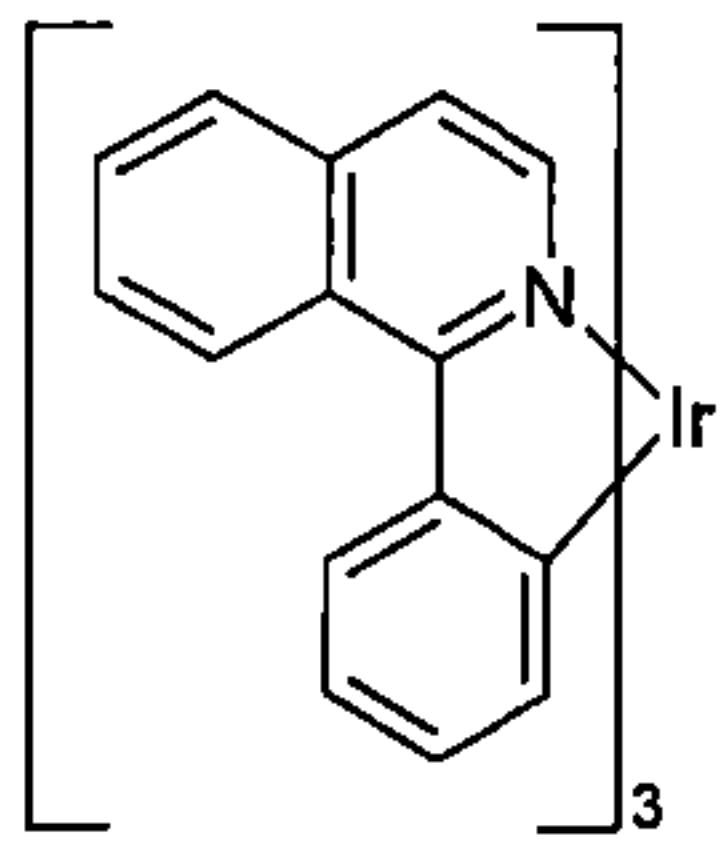
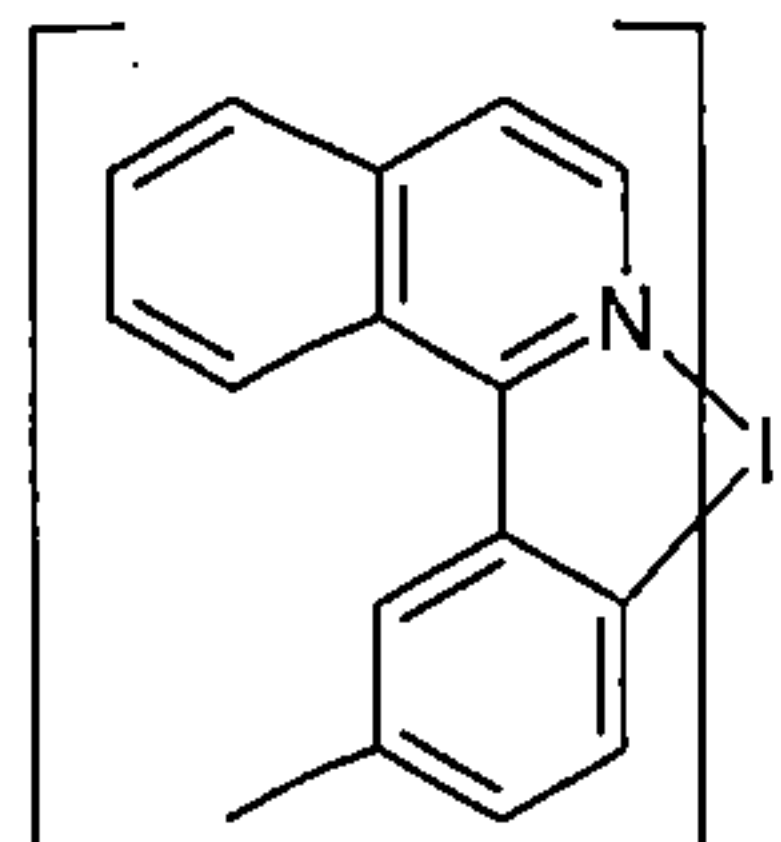
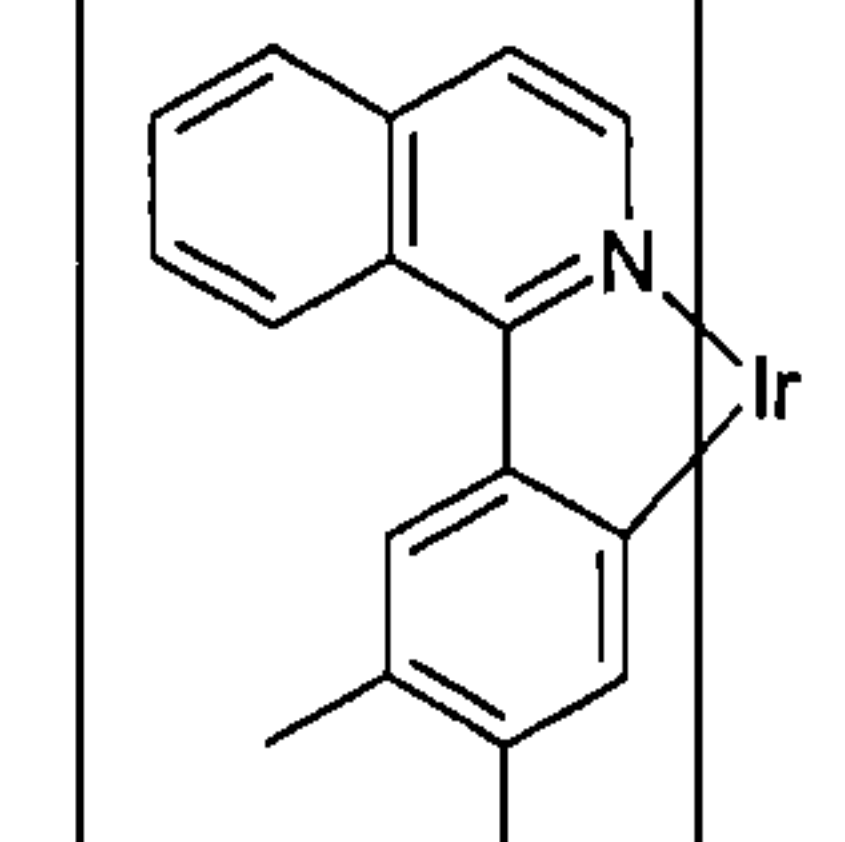
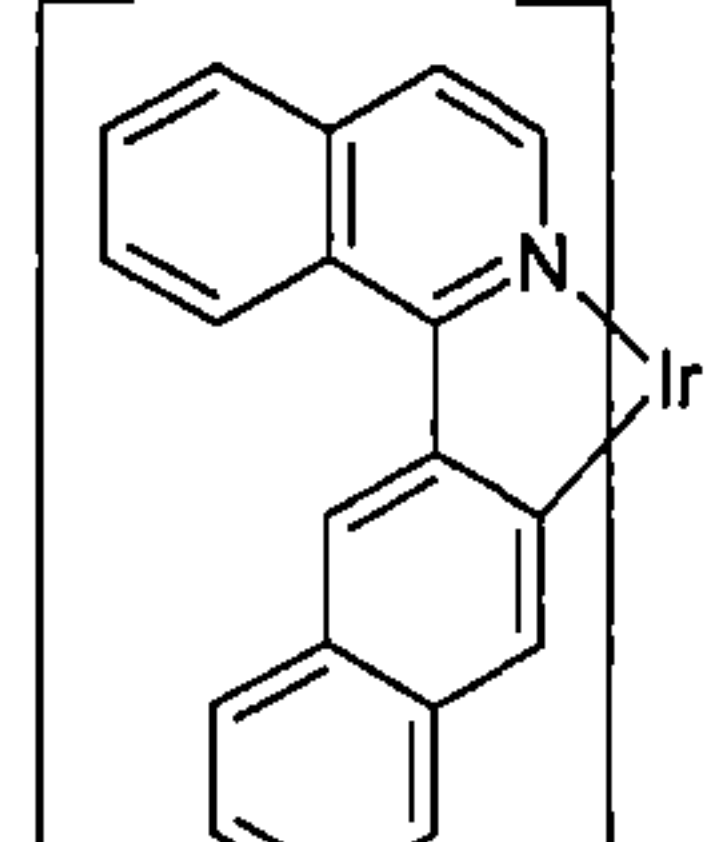
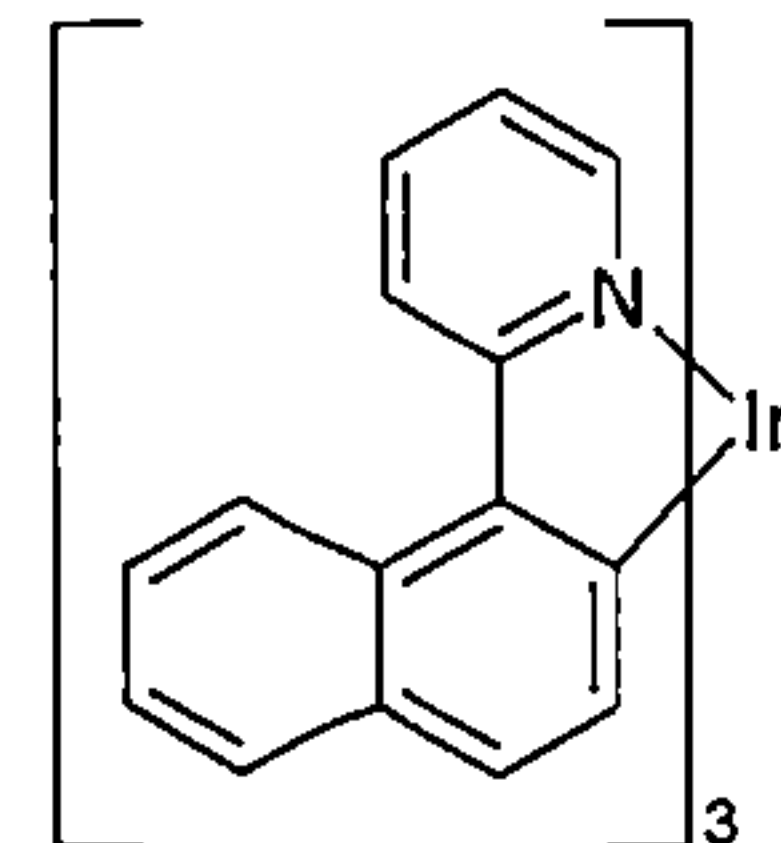
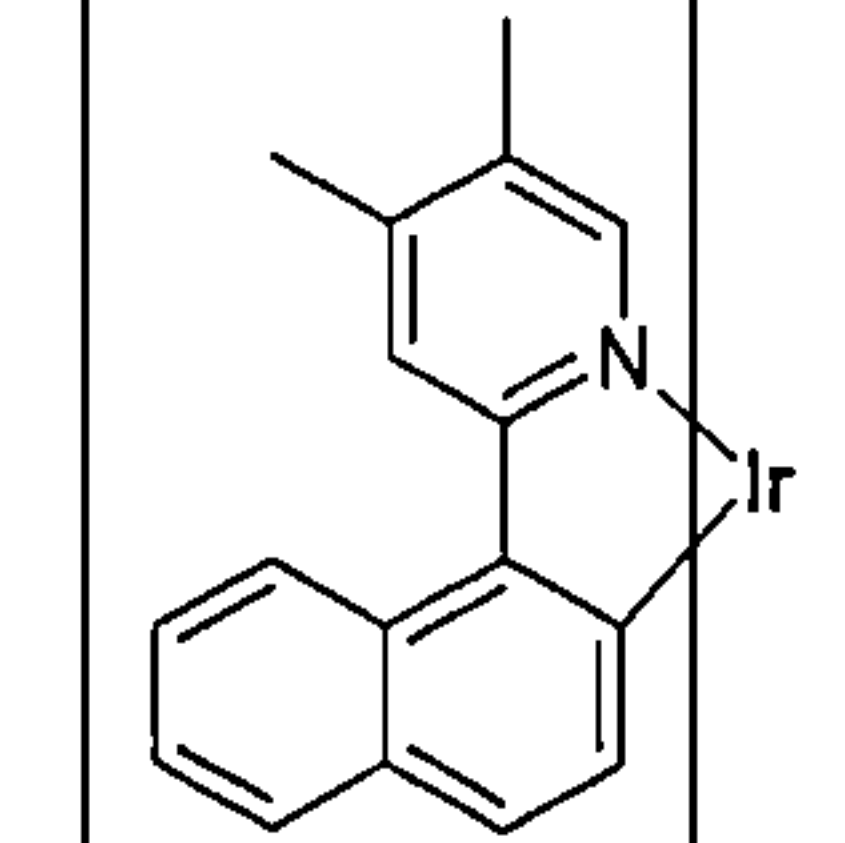
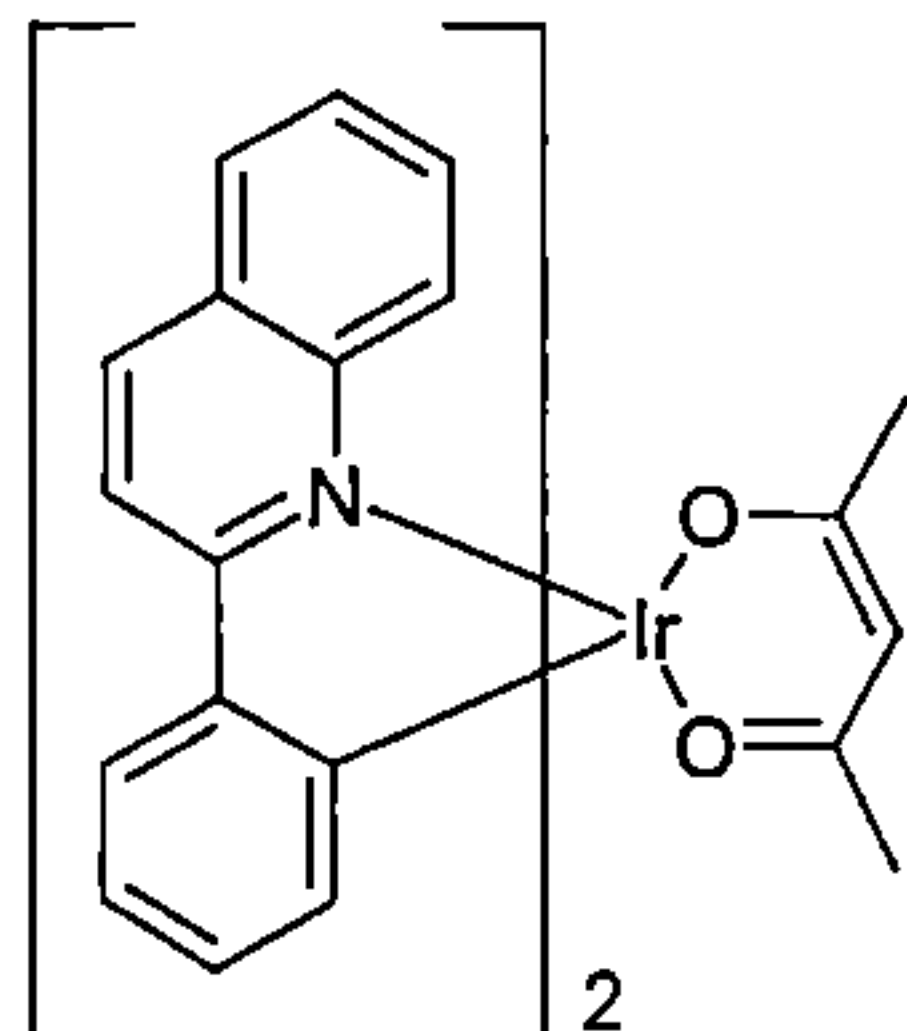
亦可在混合物中使用兩個或更多種磷光發射體。在此情形下，在較短波長下發射之發射體充當混合物中之共主體。

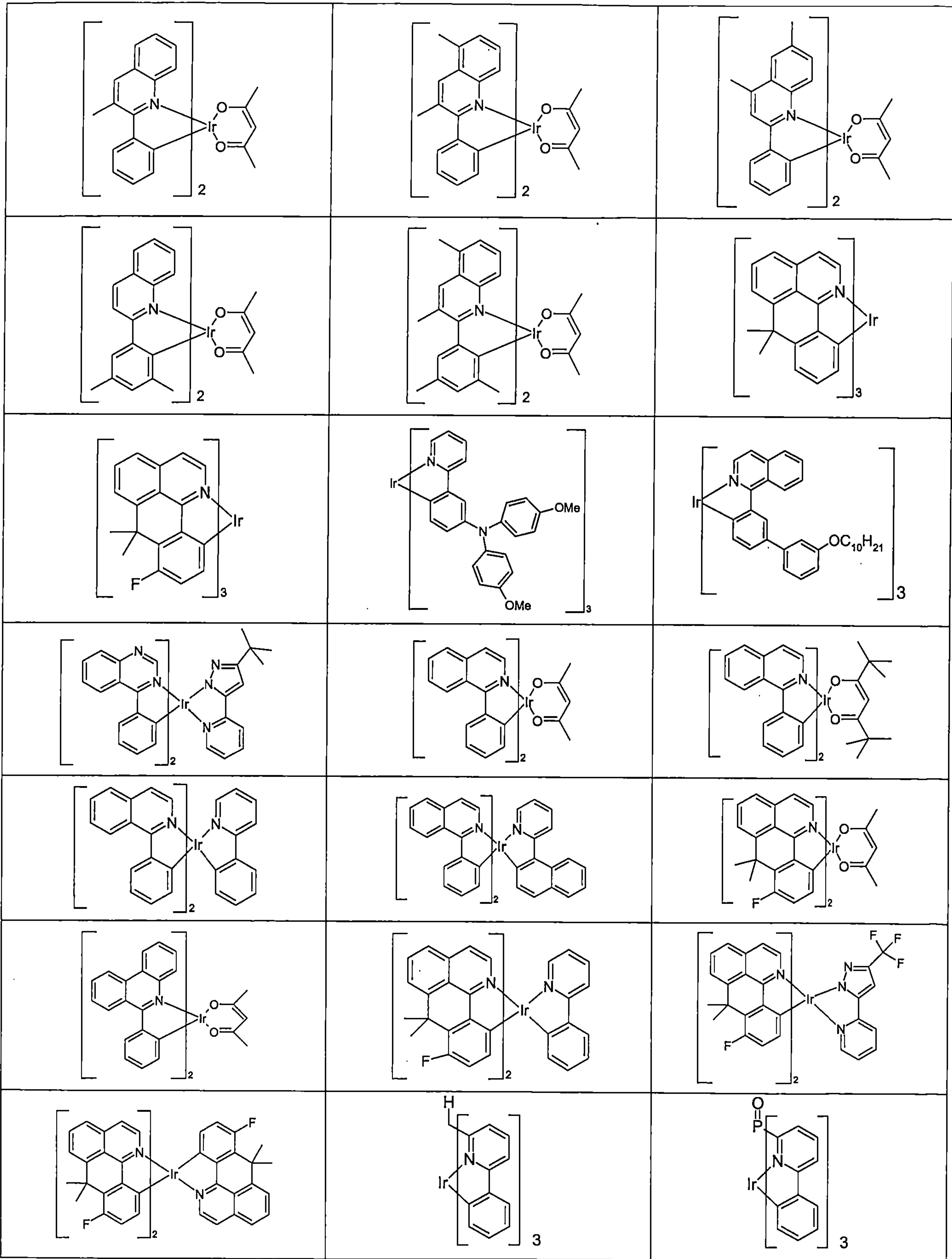
具體而言，適宜磷光化合物(=三重態發射體)係在適宜激發時發射光(較佳在可見區域內)且另外含有至少一個原子序數大於20、較佳大於38且小於84、尤佳大於56且小於80之原子(具體而言具有此原子

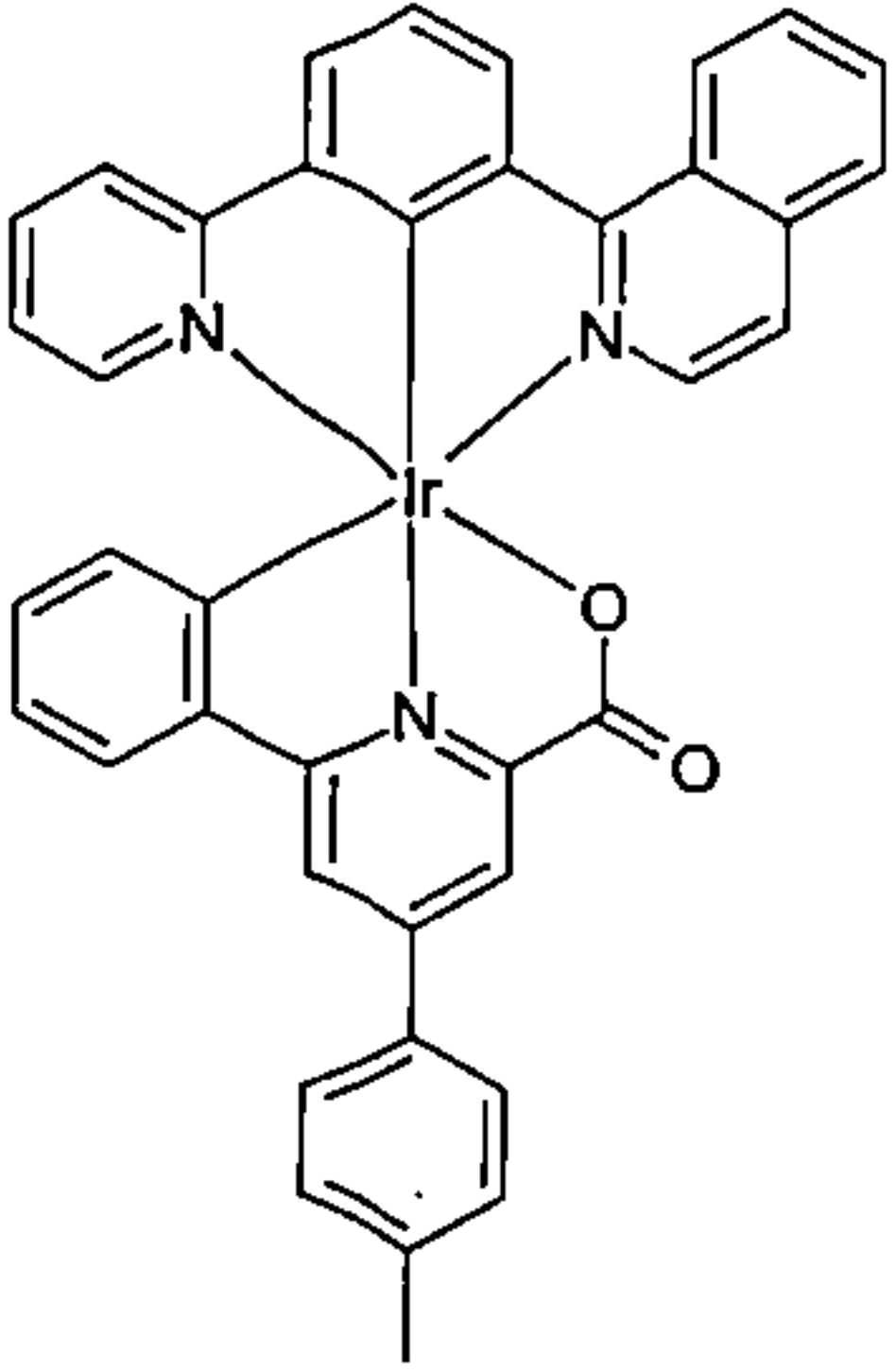
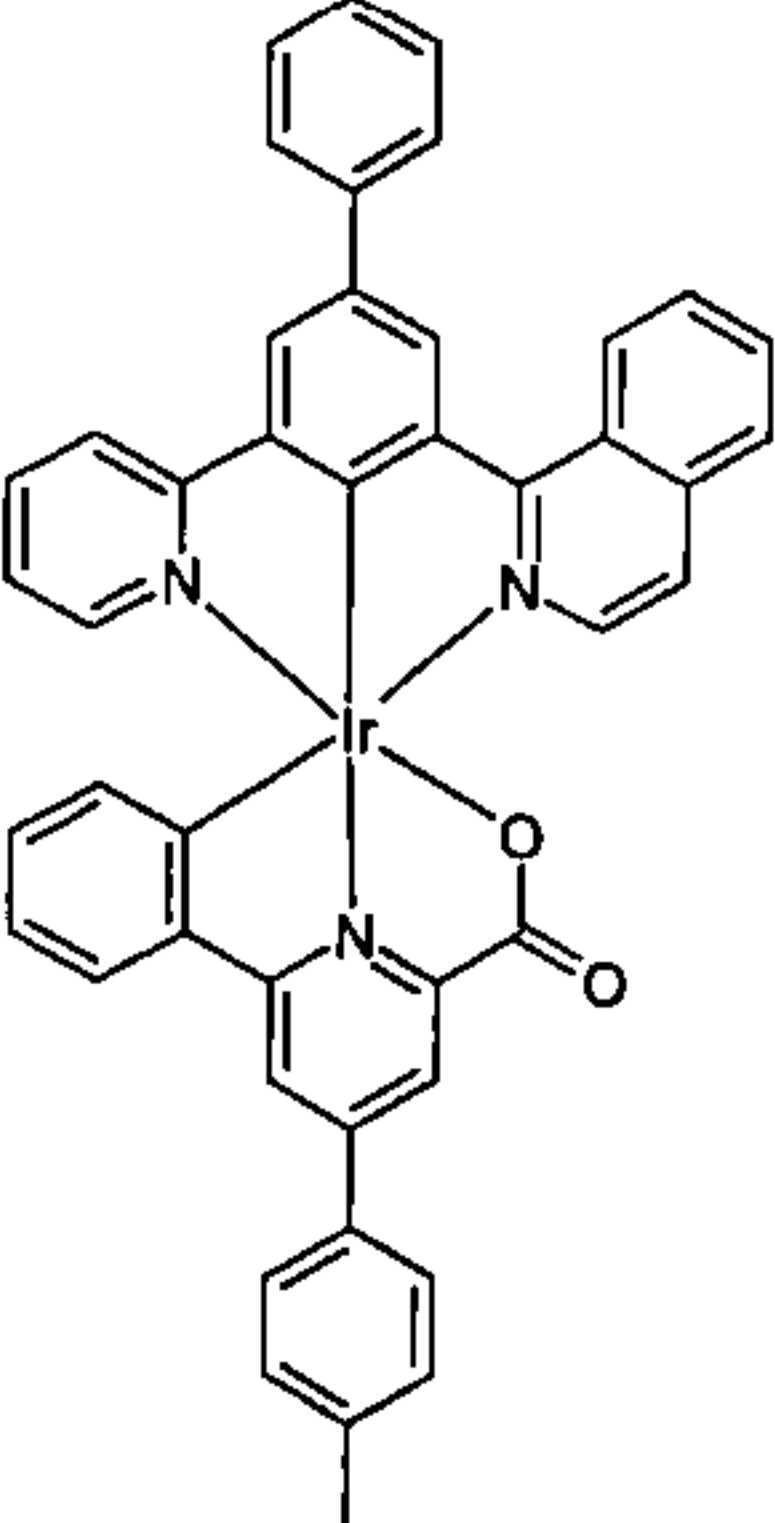
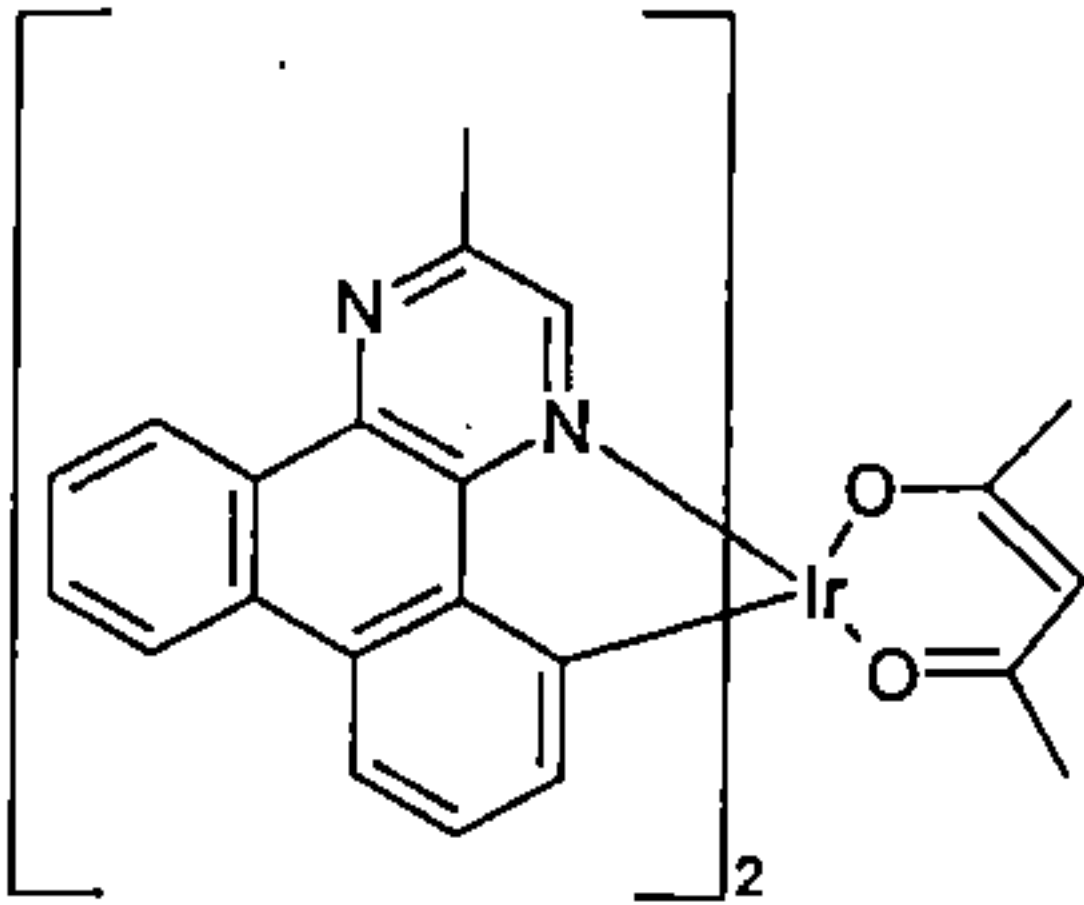
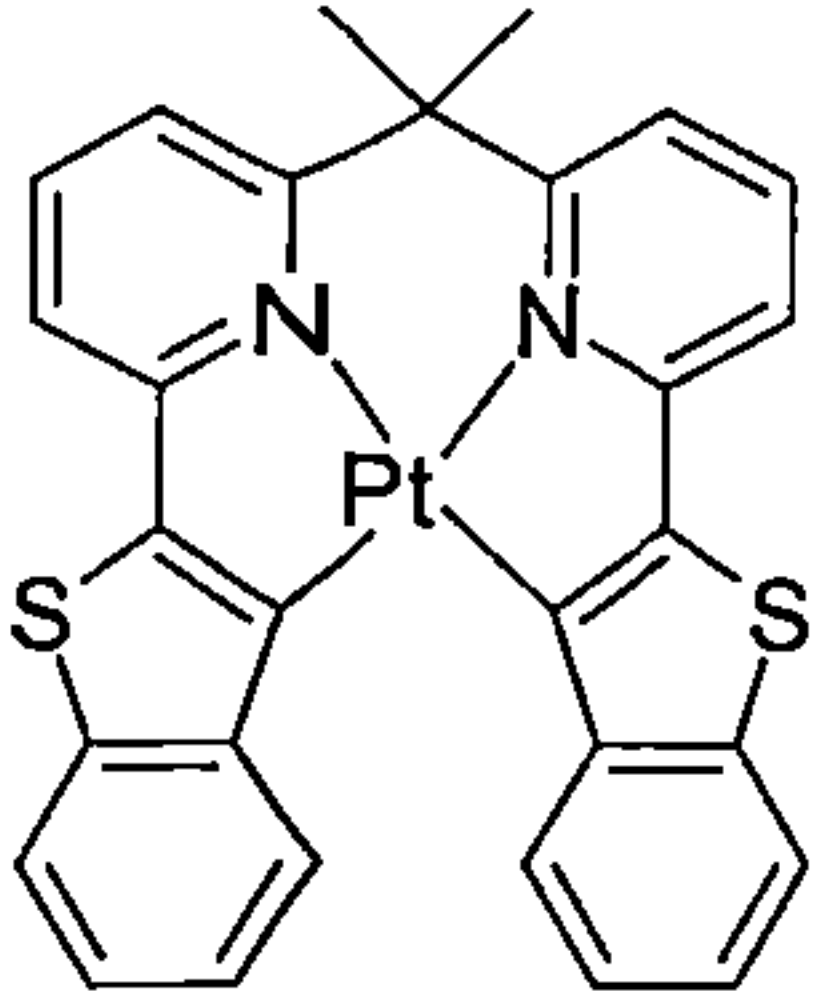
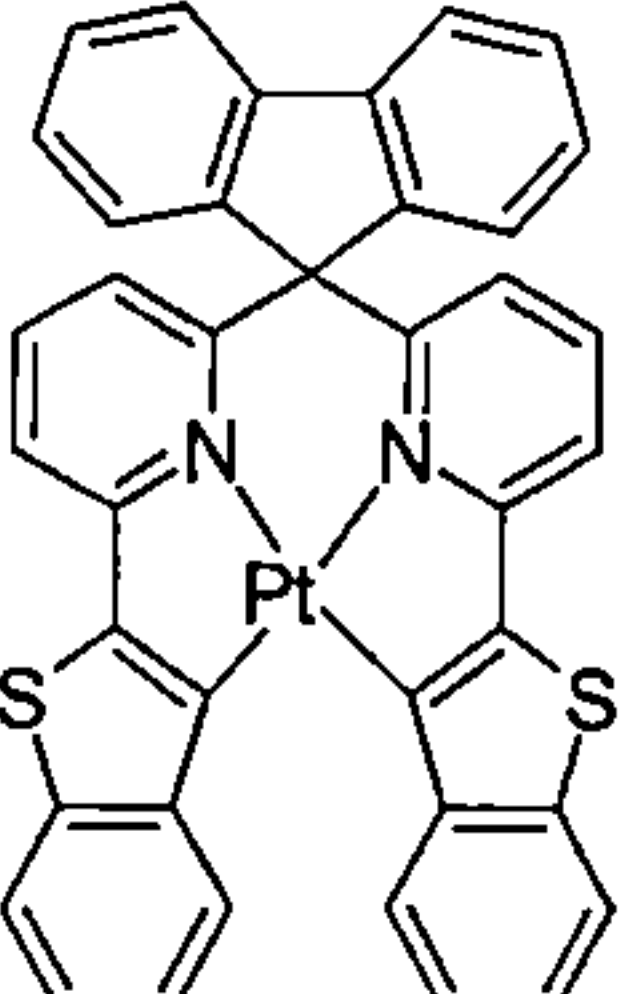
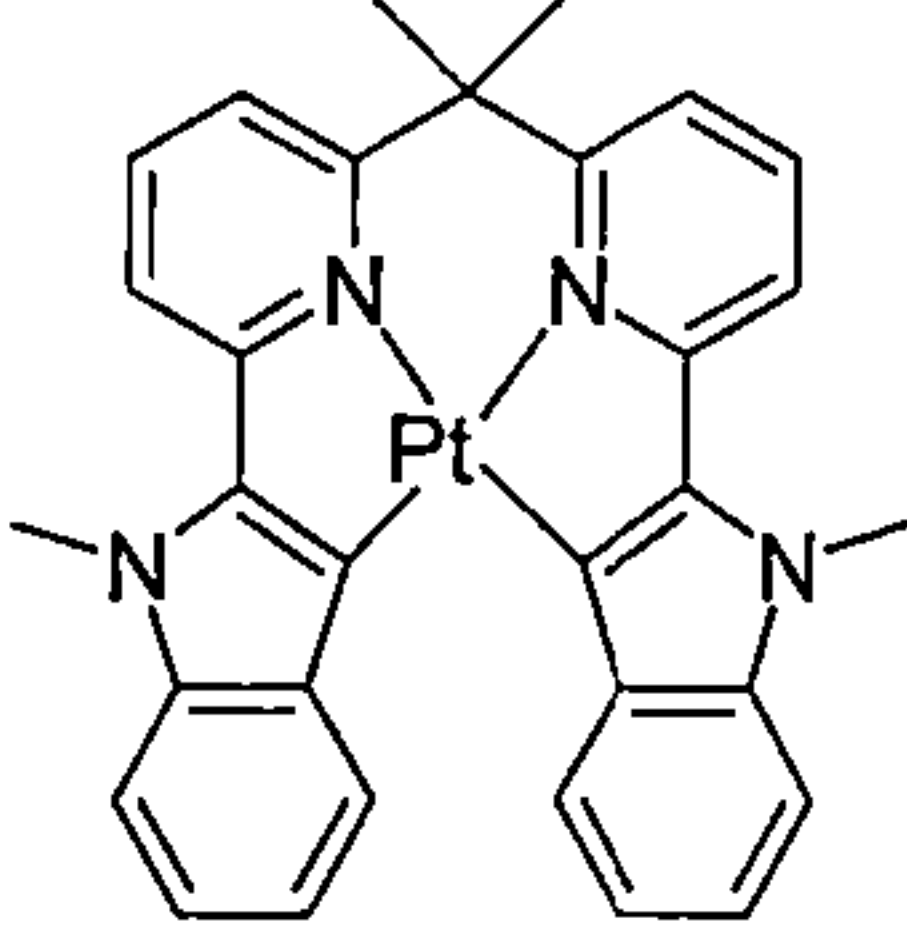
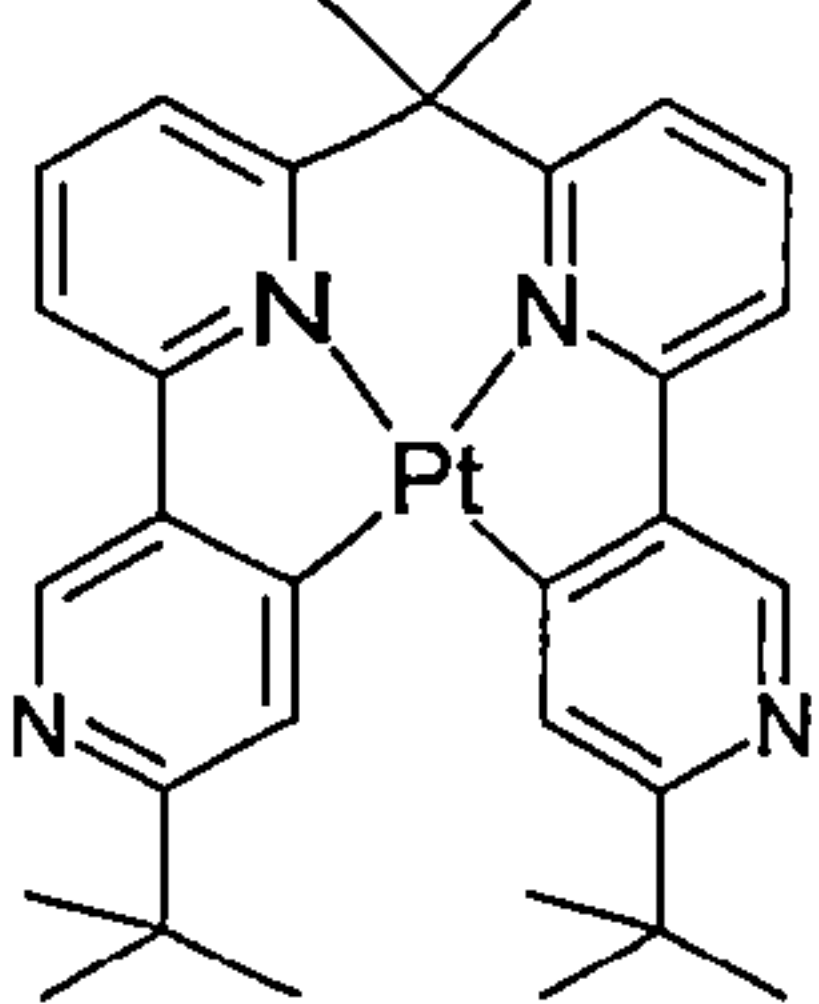
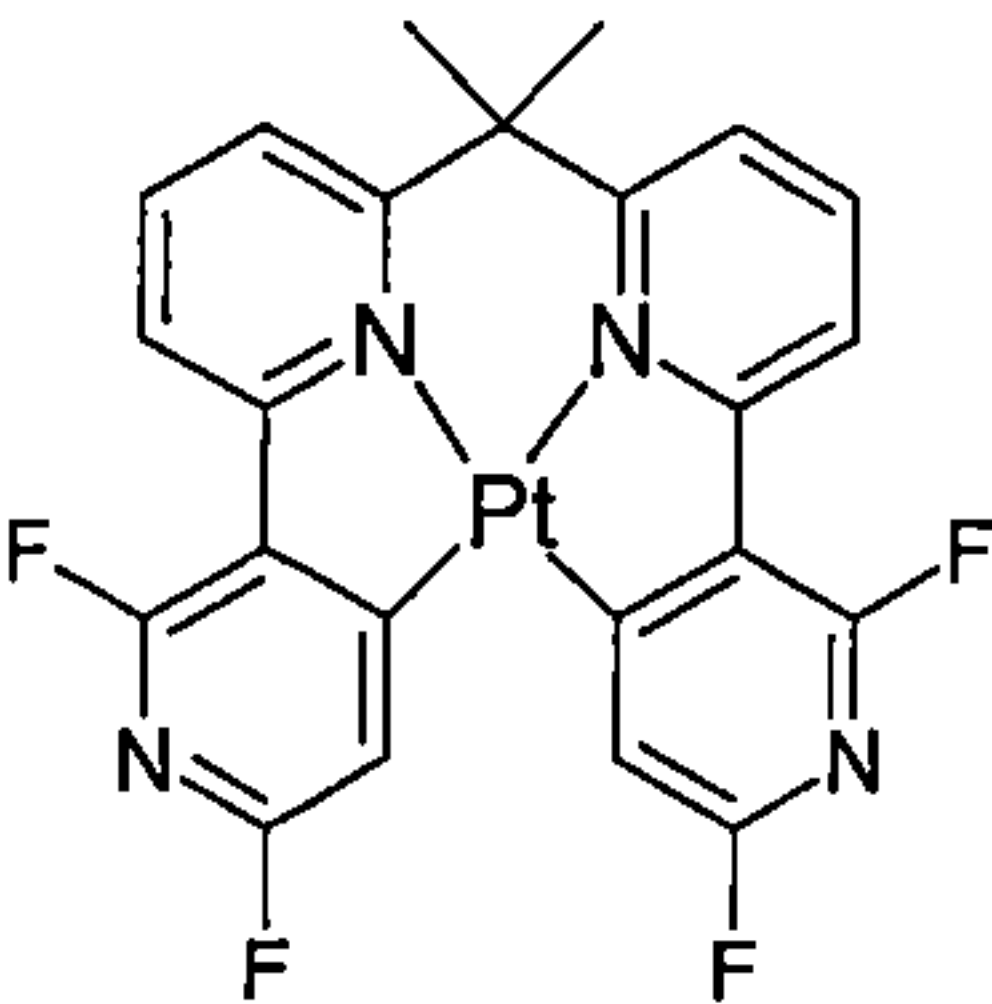
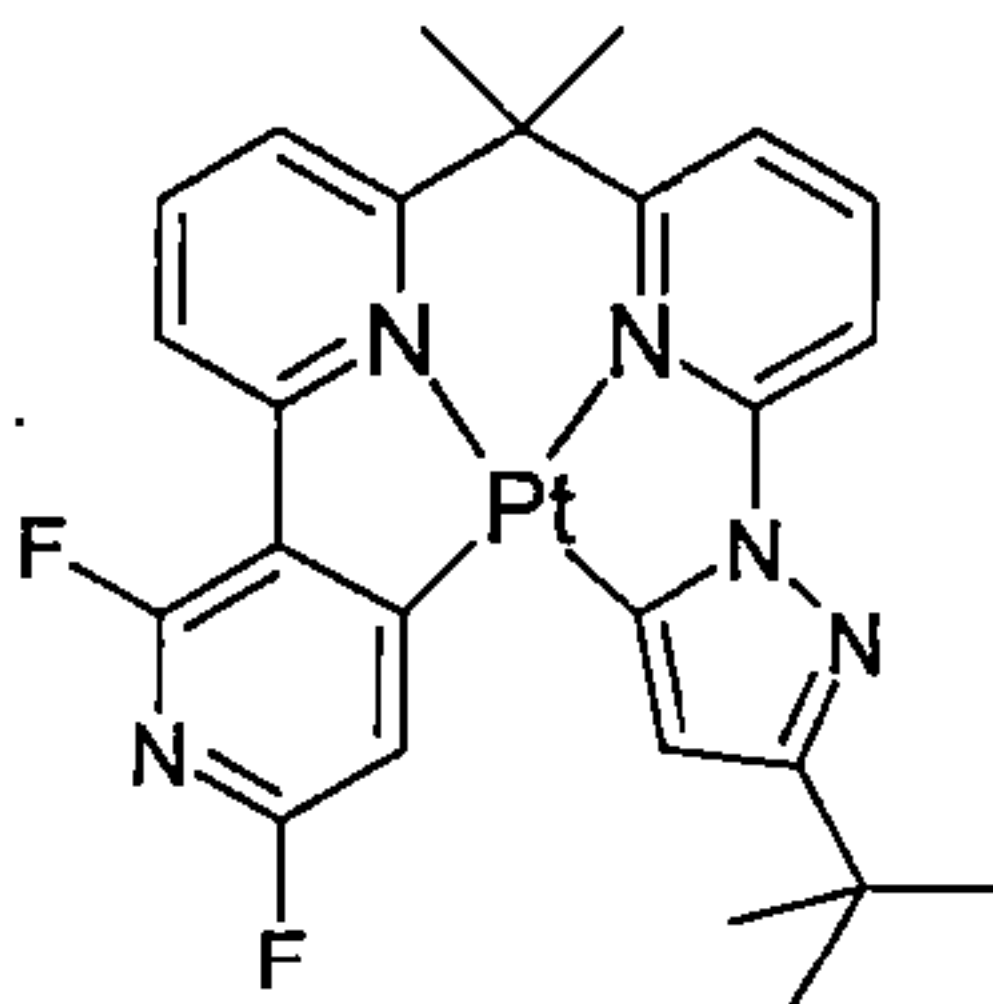
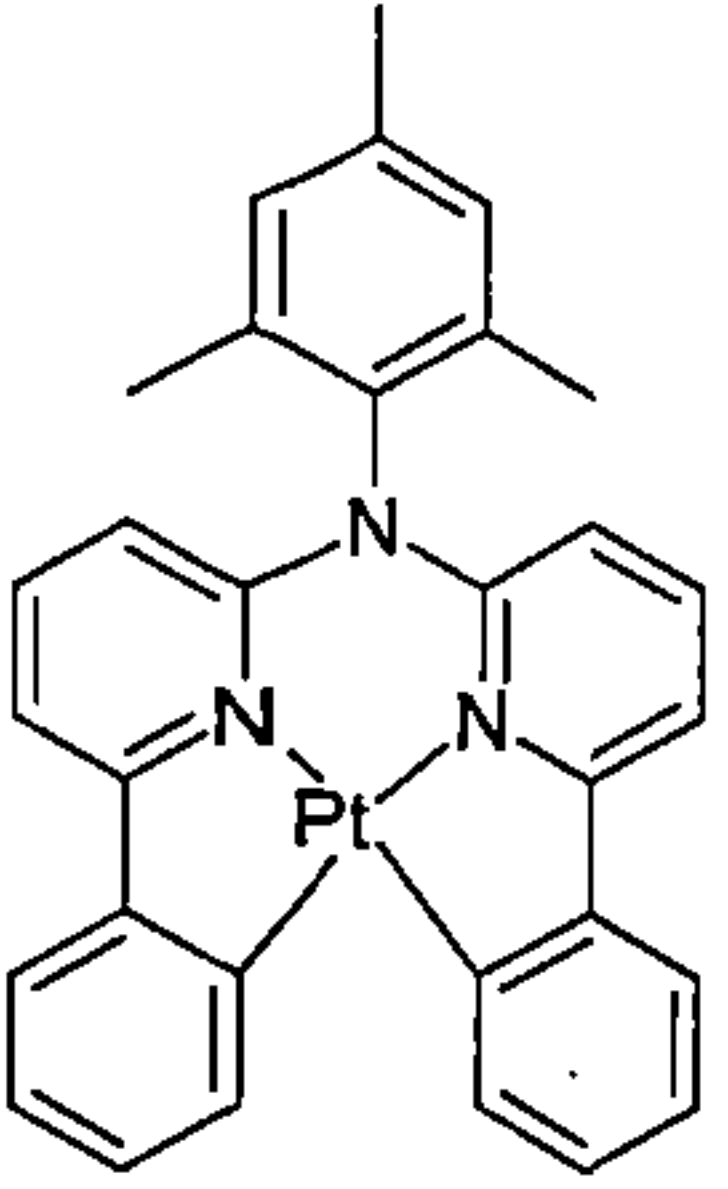
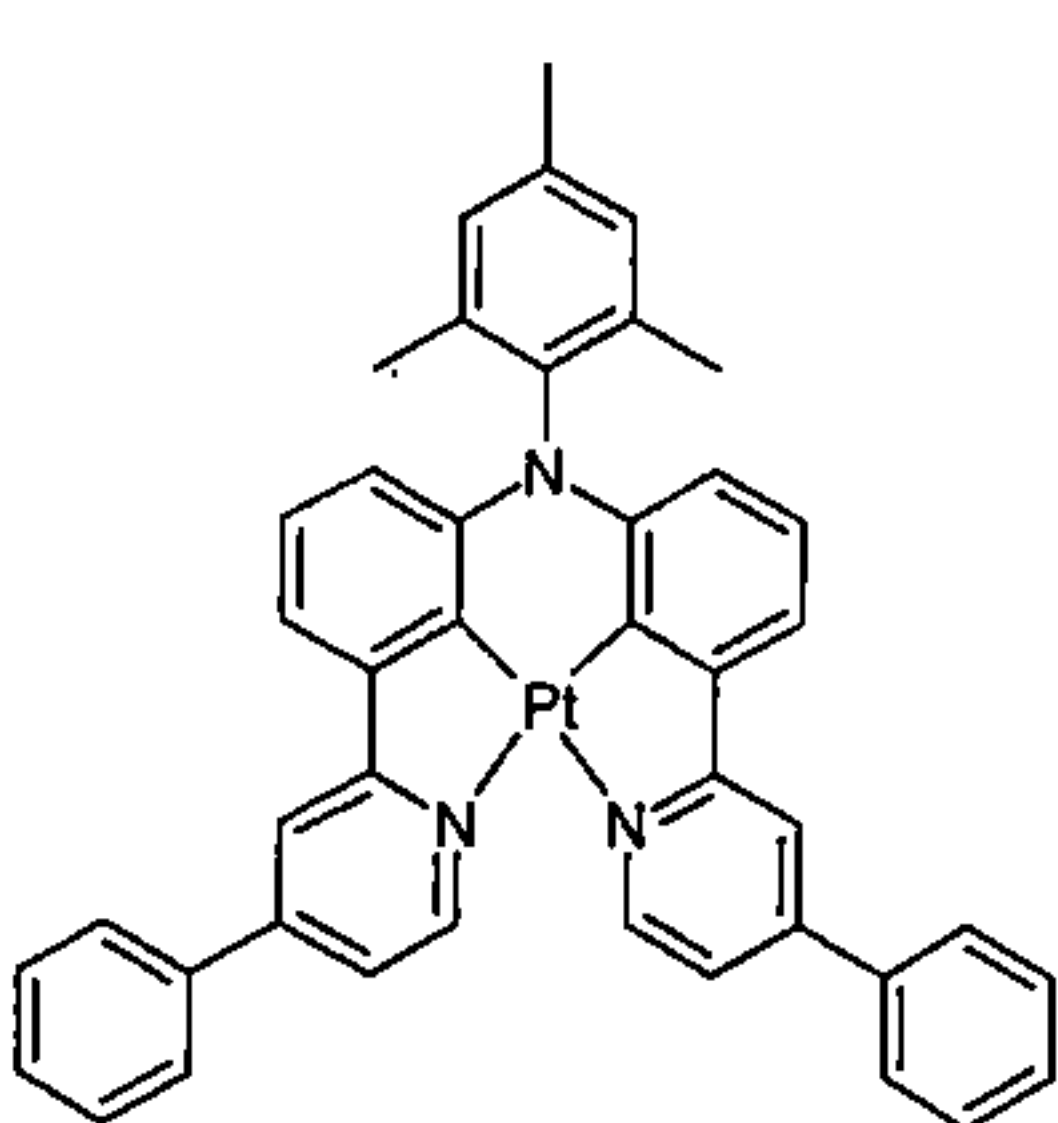
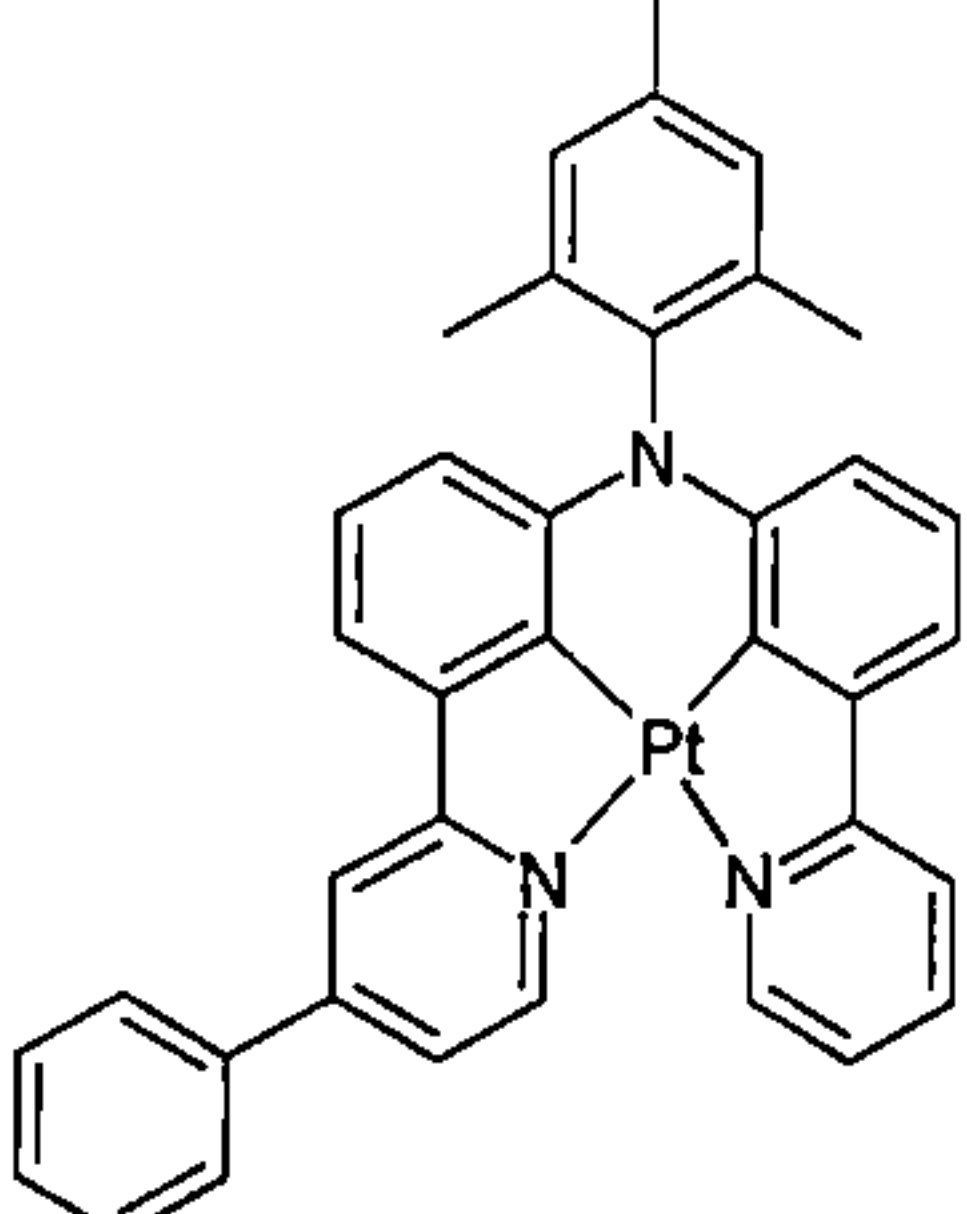
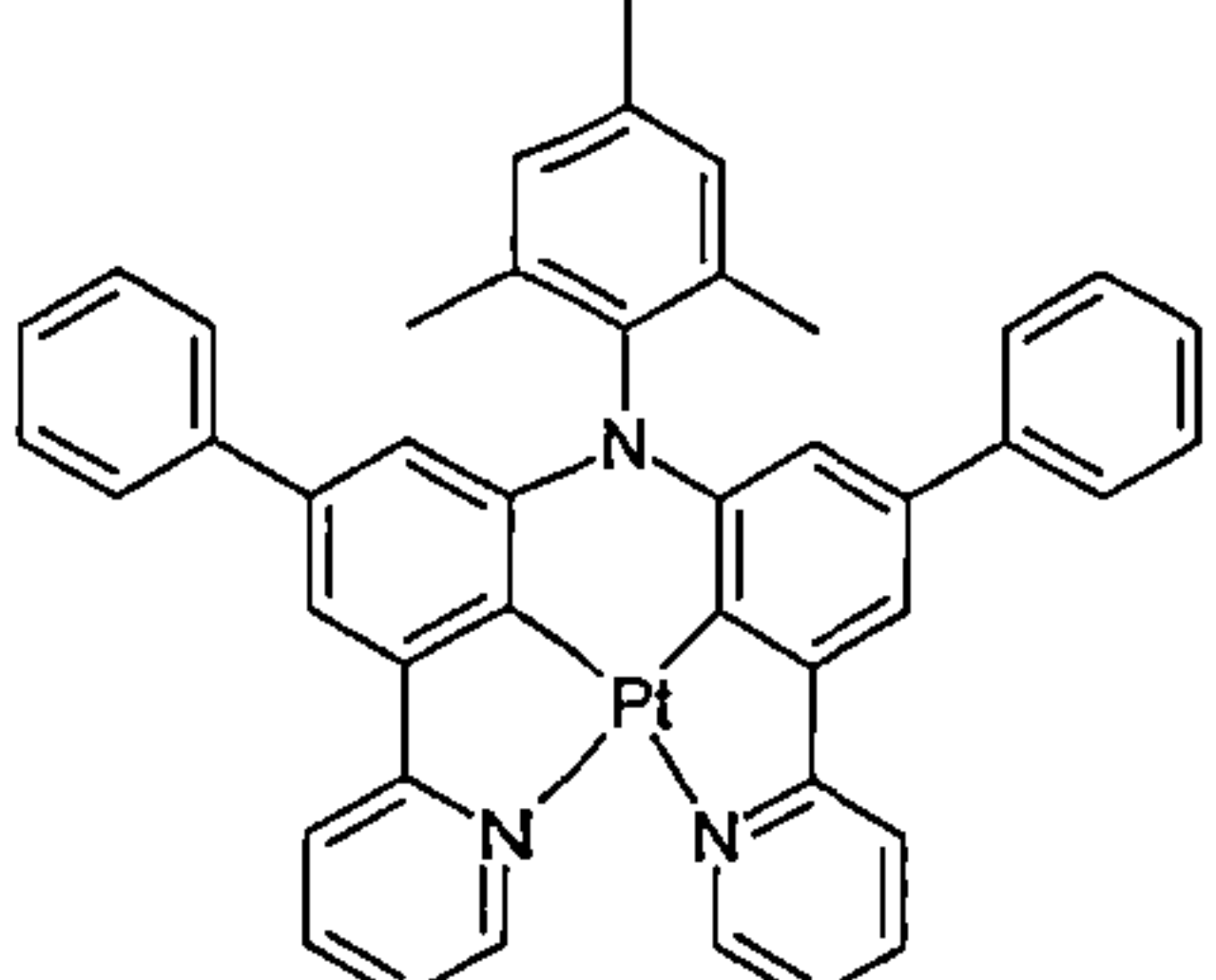
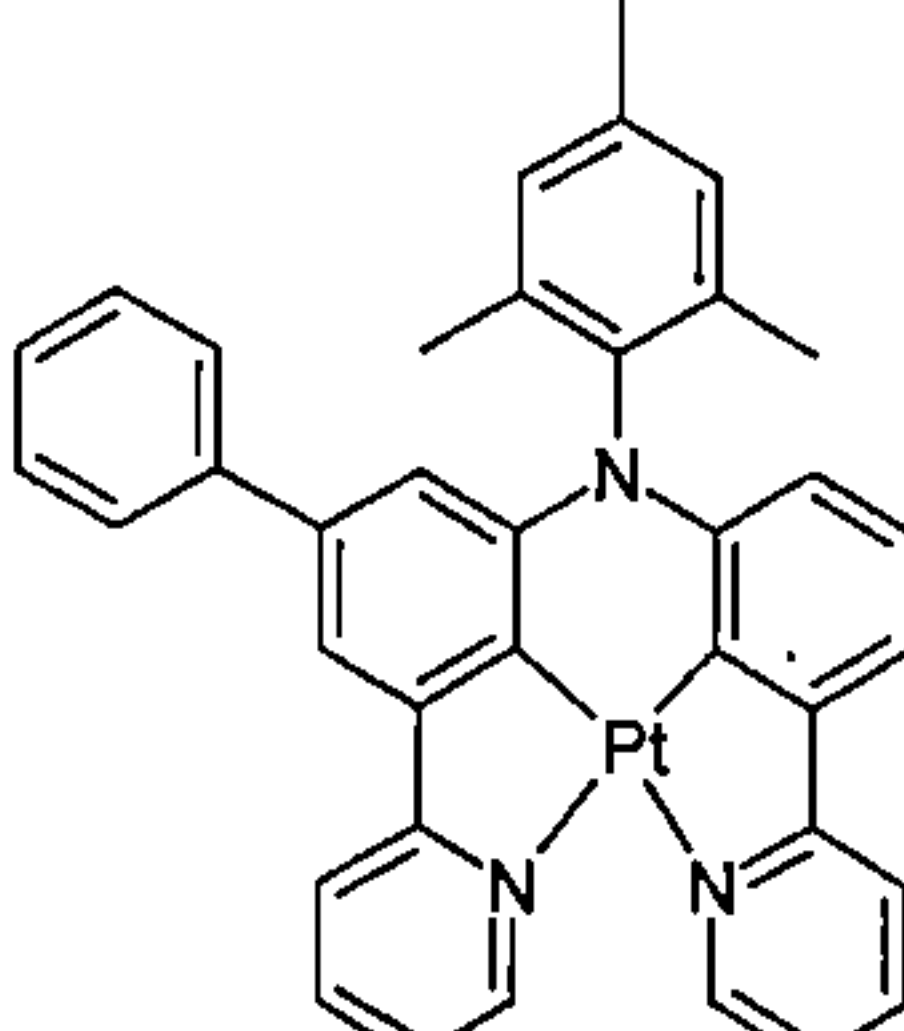
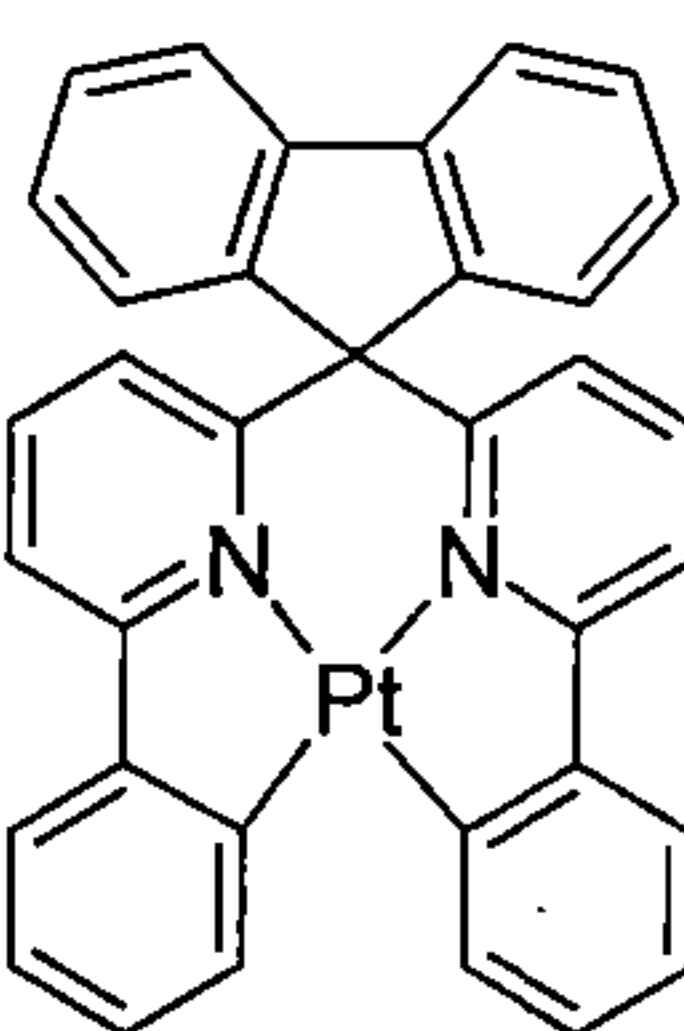
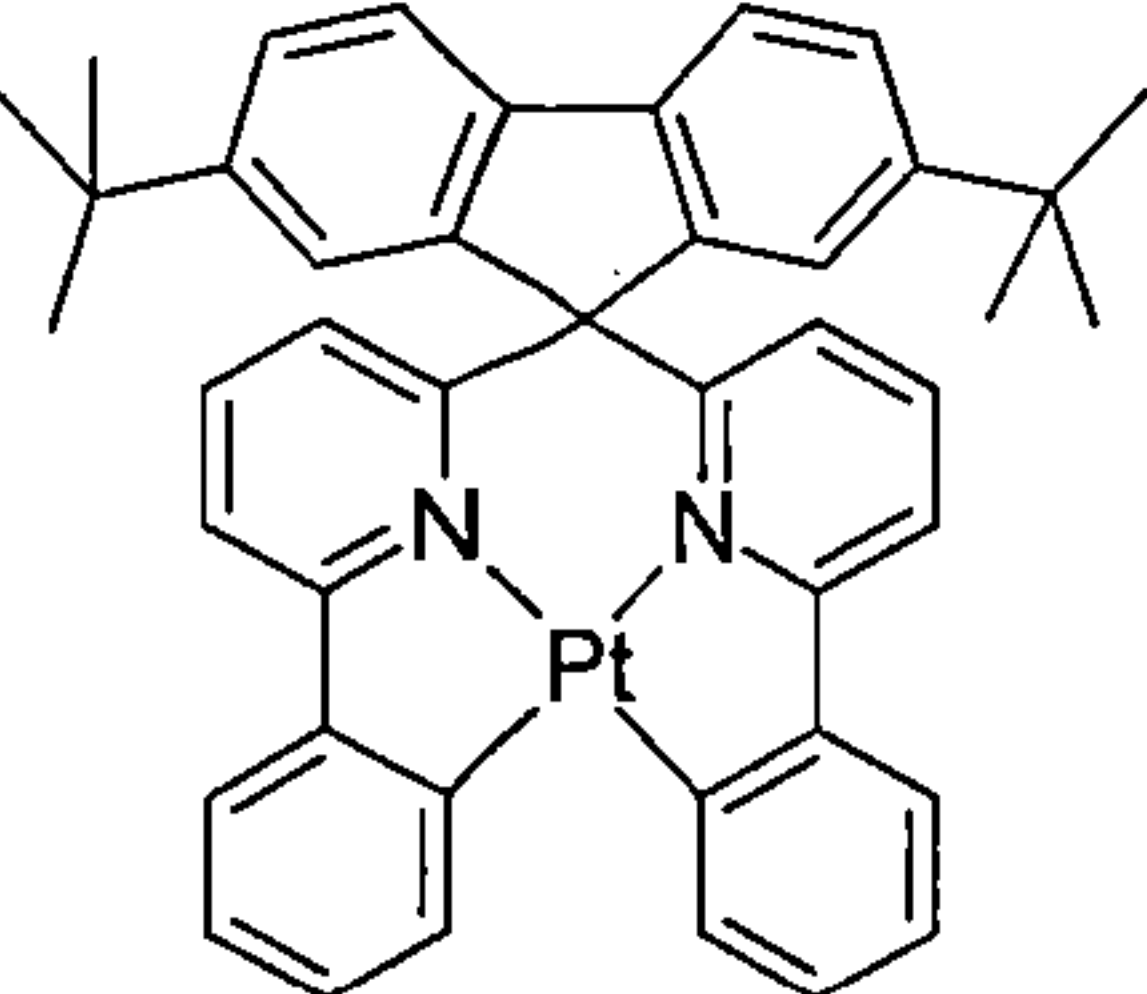
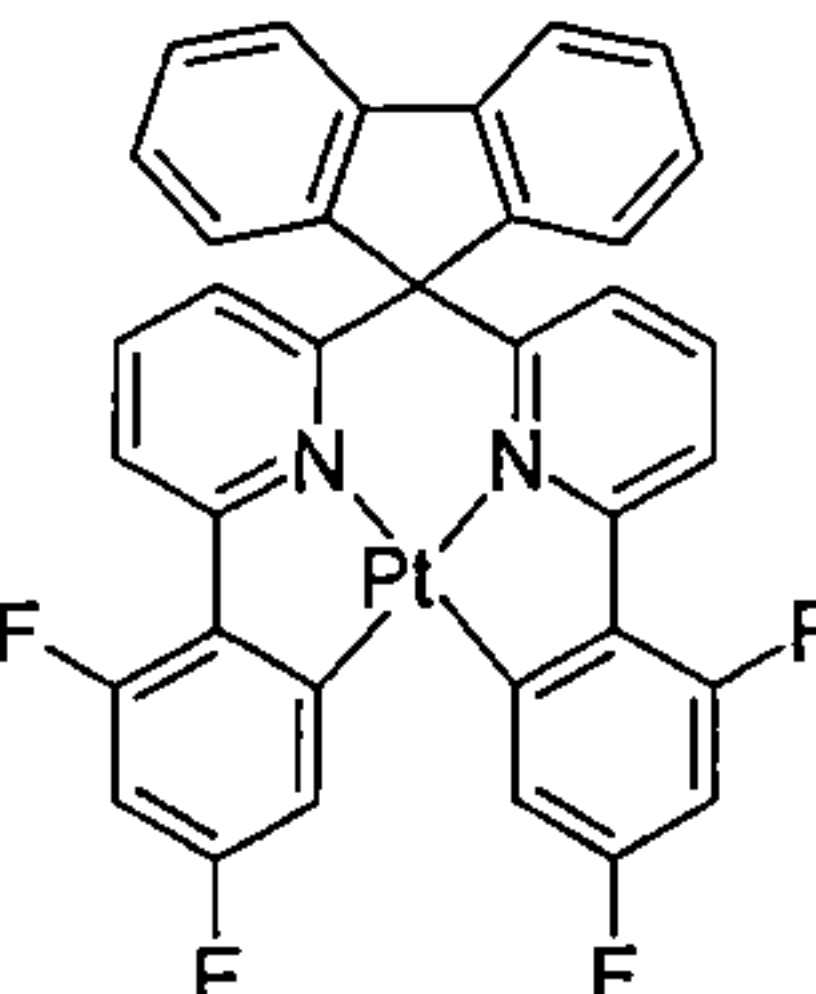
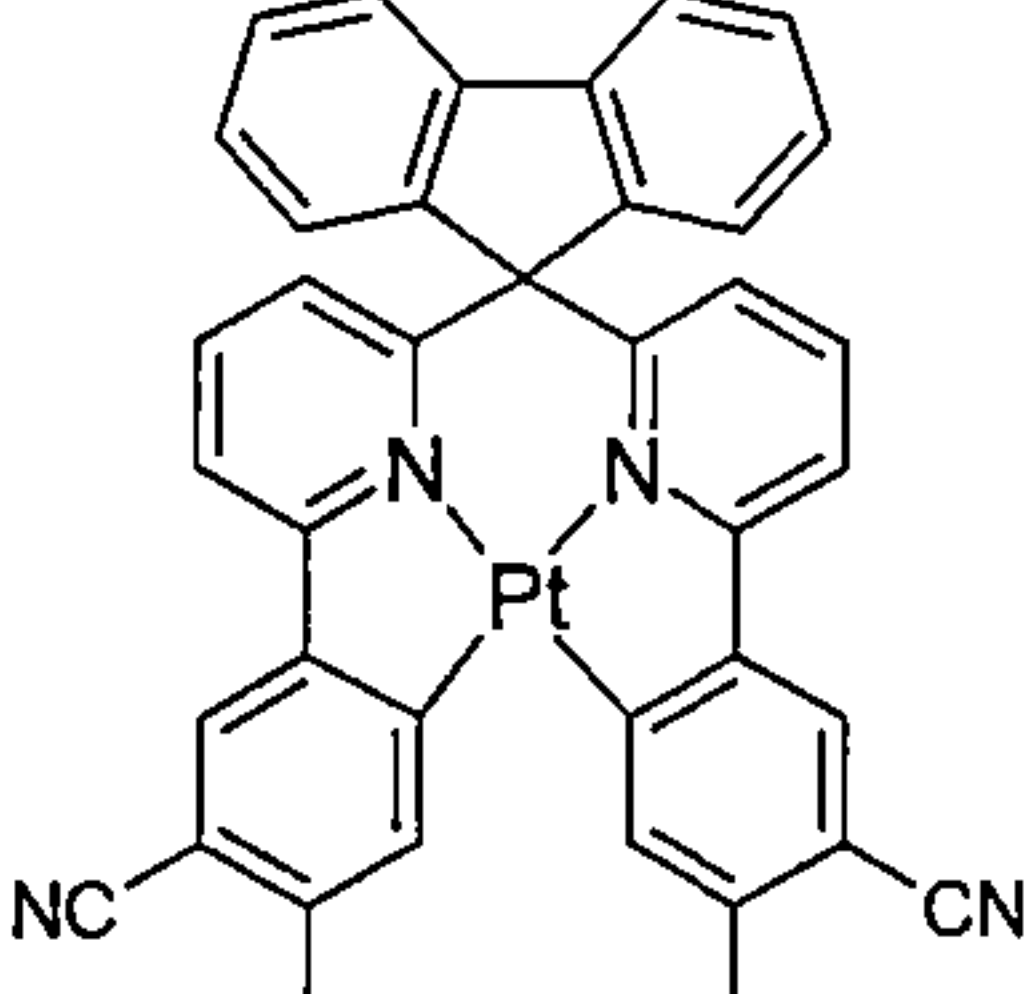
序數之金屬)的化合物。所用磷光發射體較佳係含有銅、鋁、鎢、銻、釷、鐵、銻、銻、鈮、鉑、銀、金或鎢之化合物，具體而言含有銻、鉑或銅之化合物。

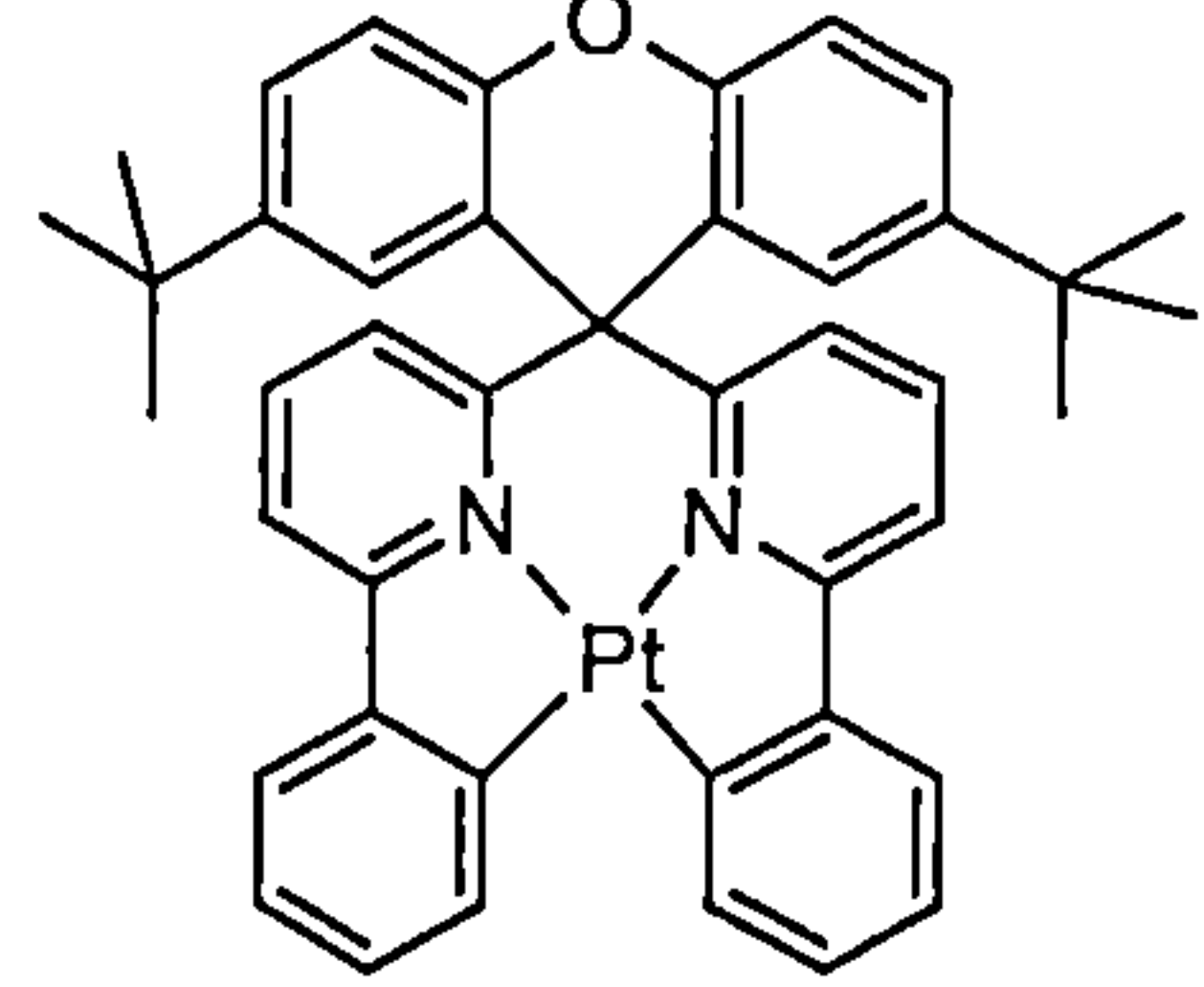
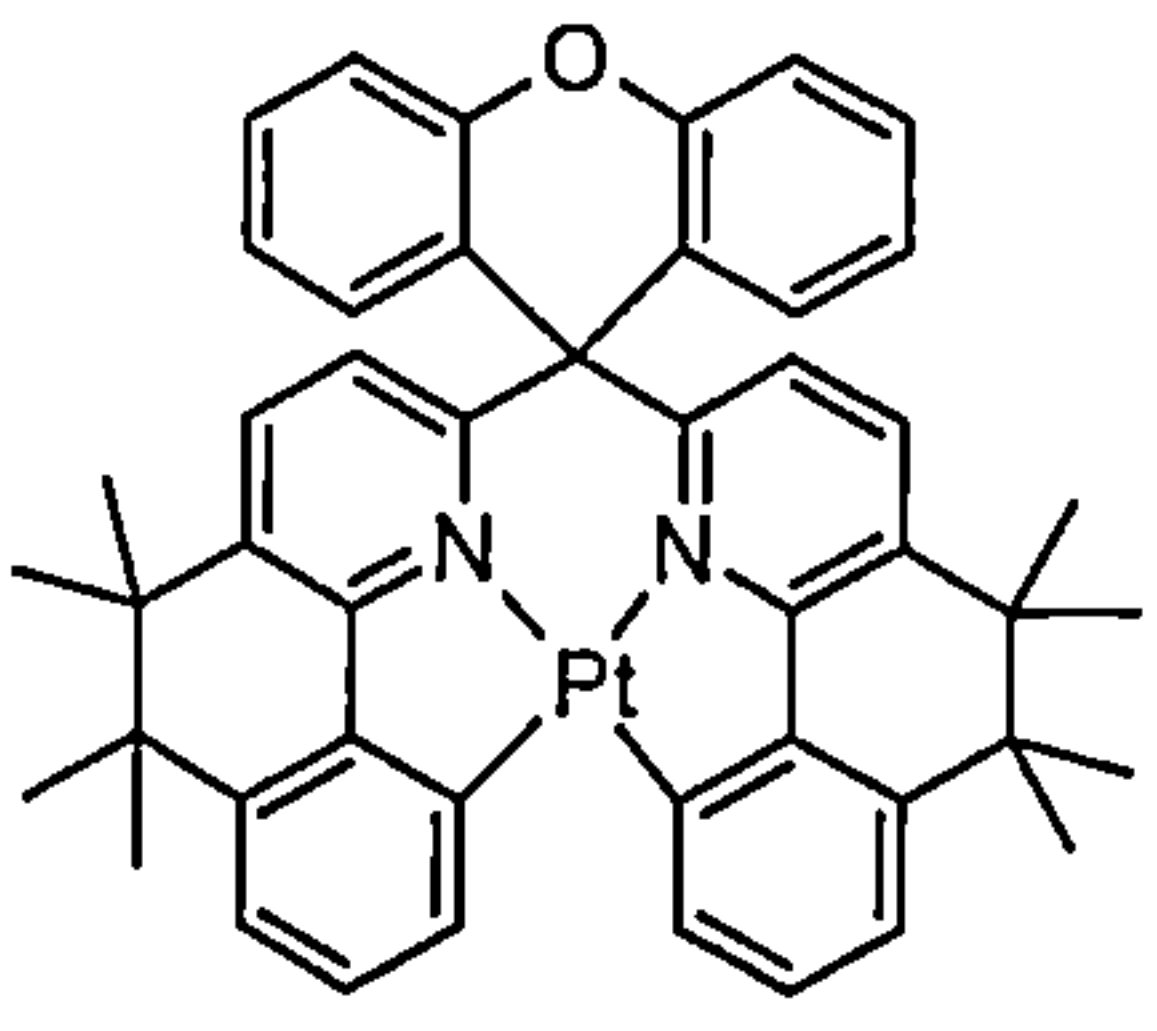
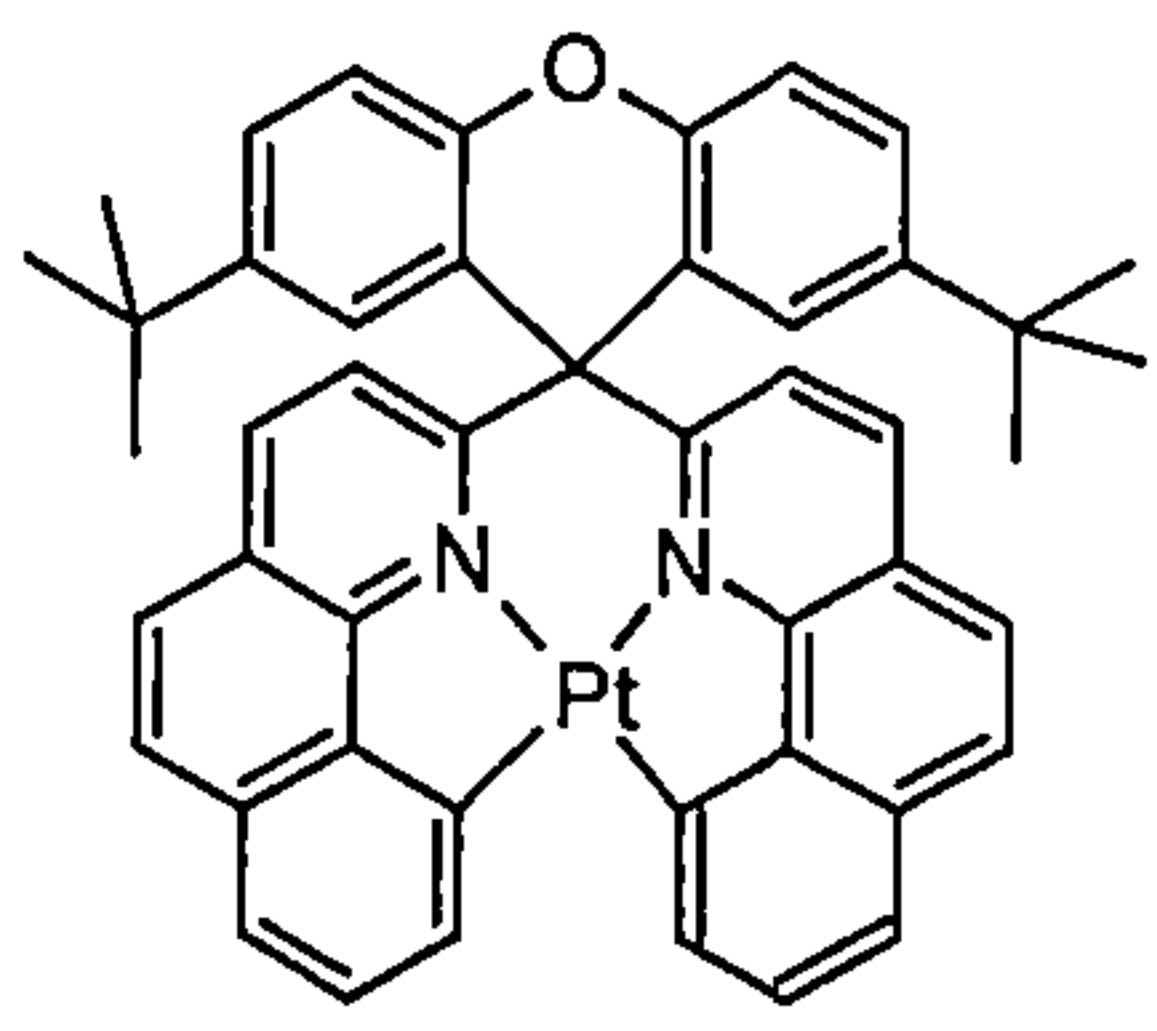
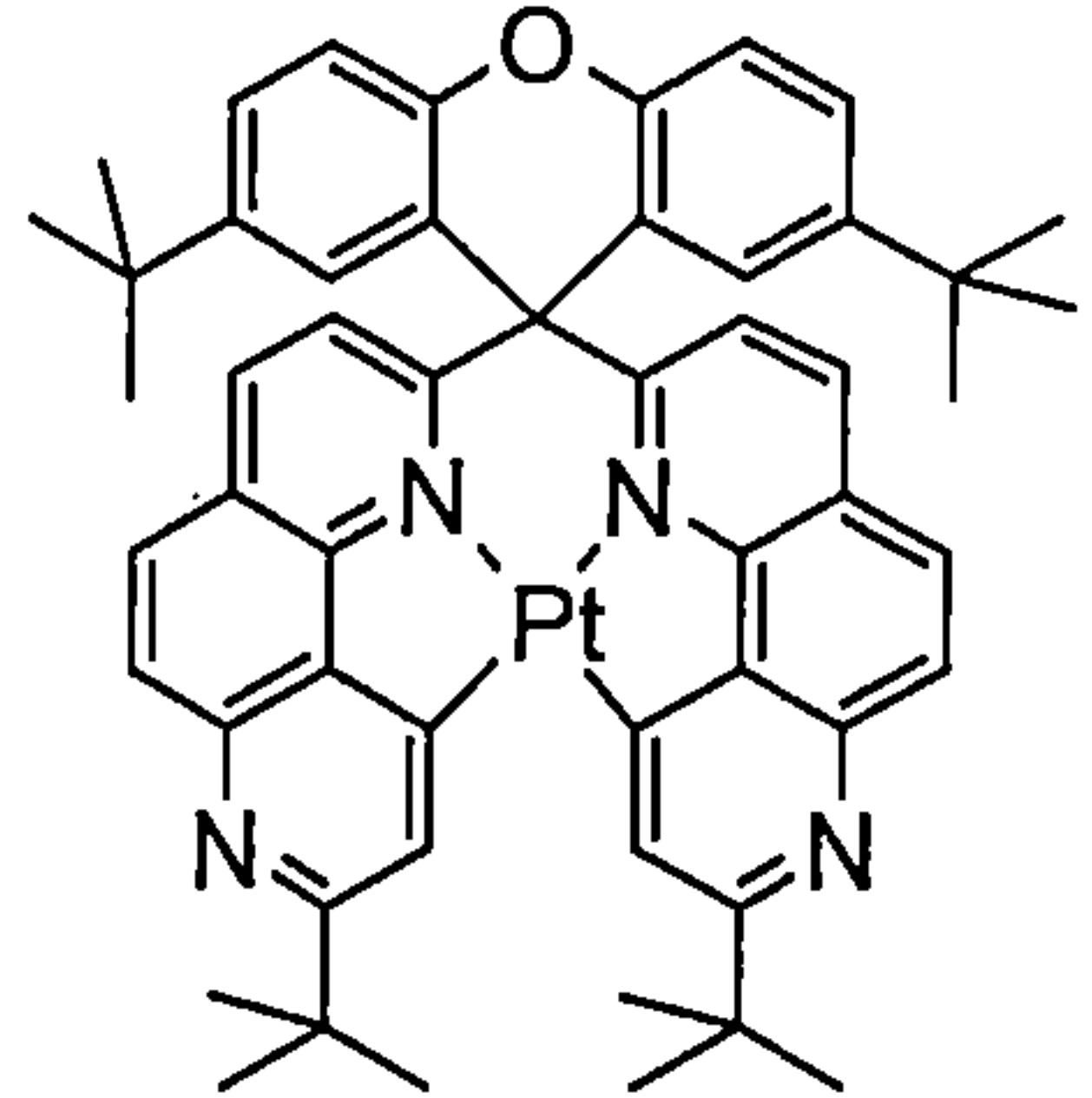
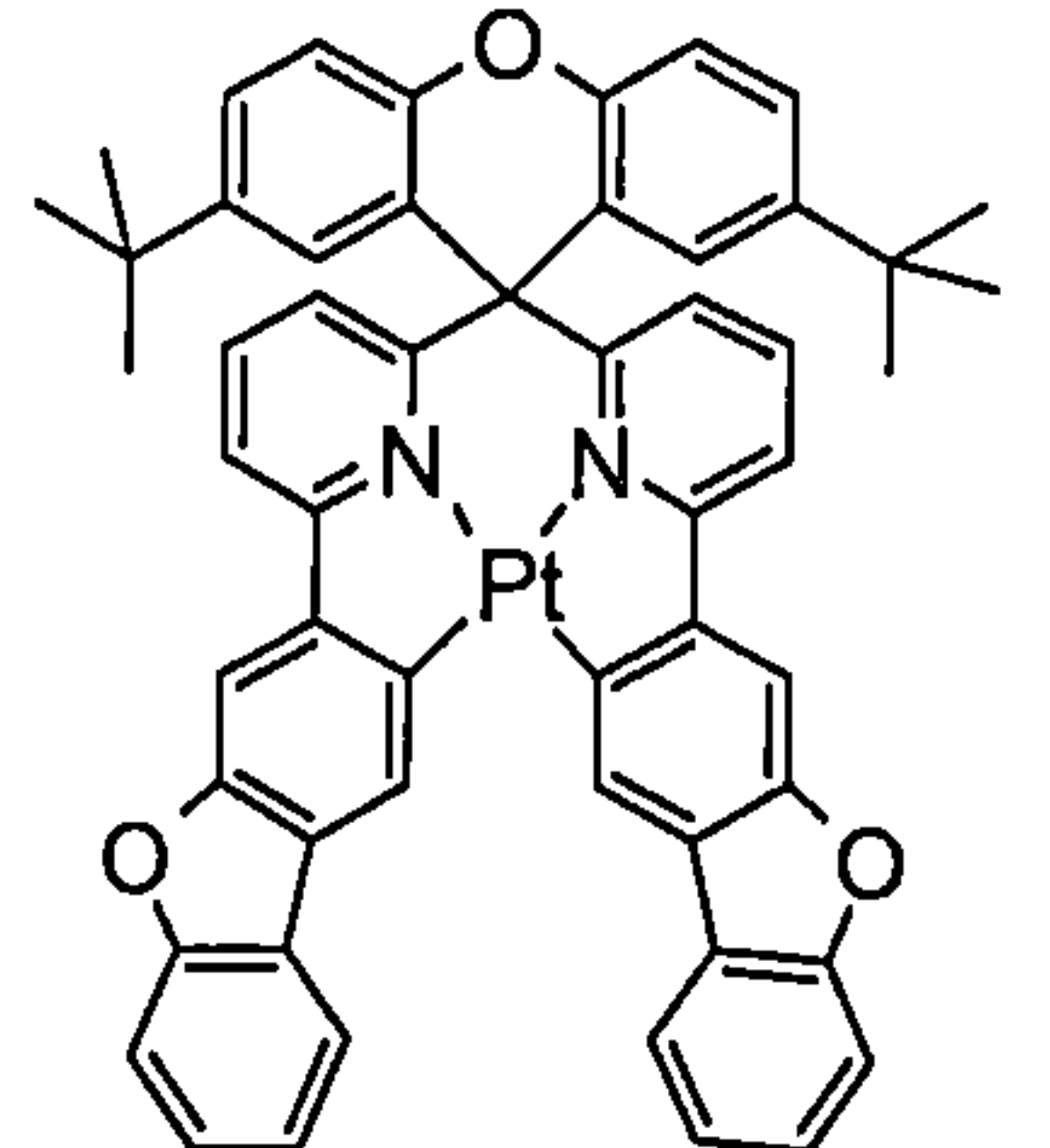
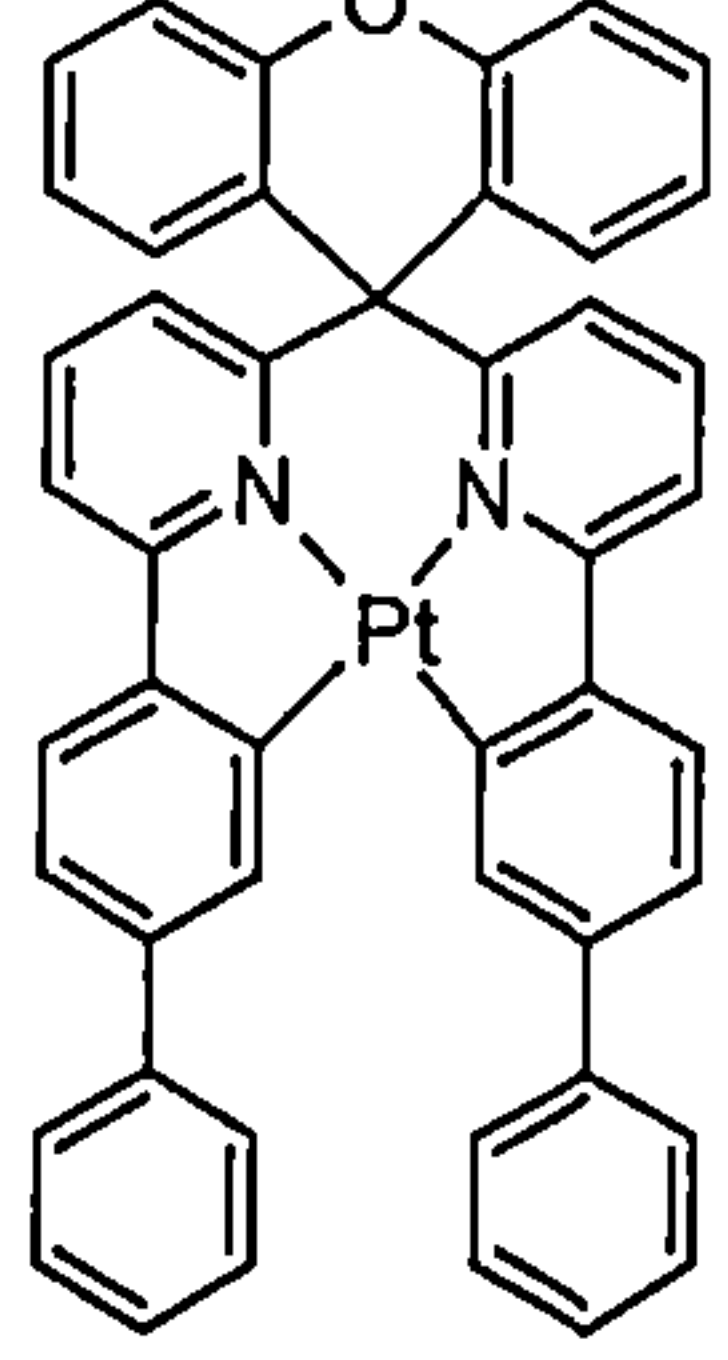
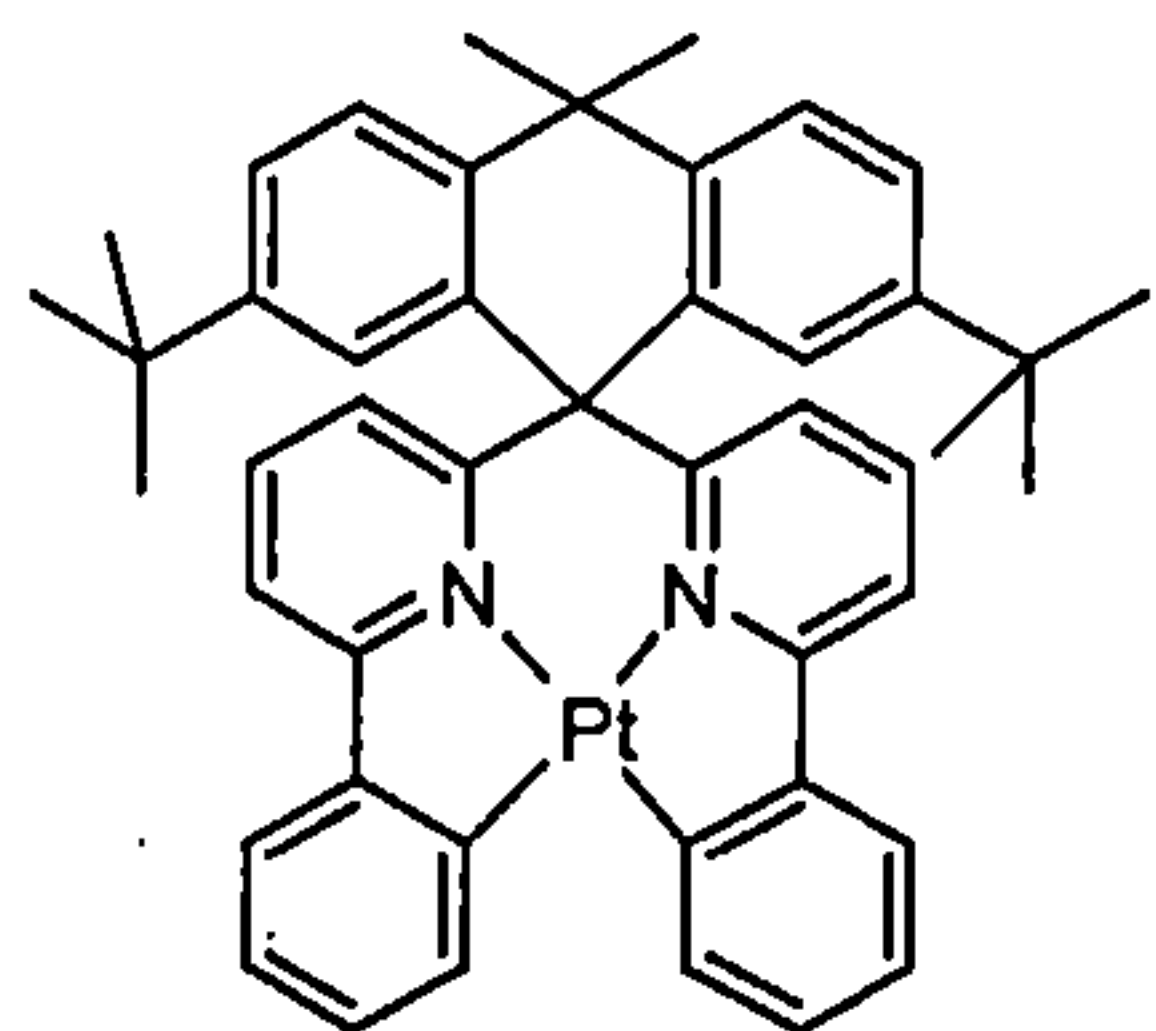
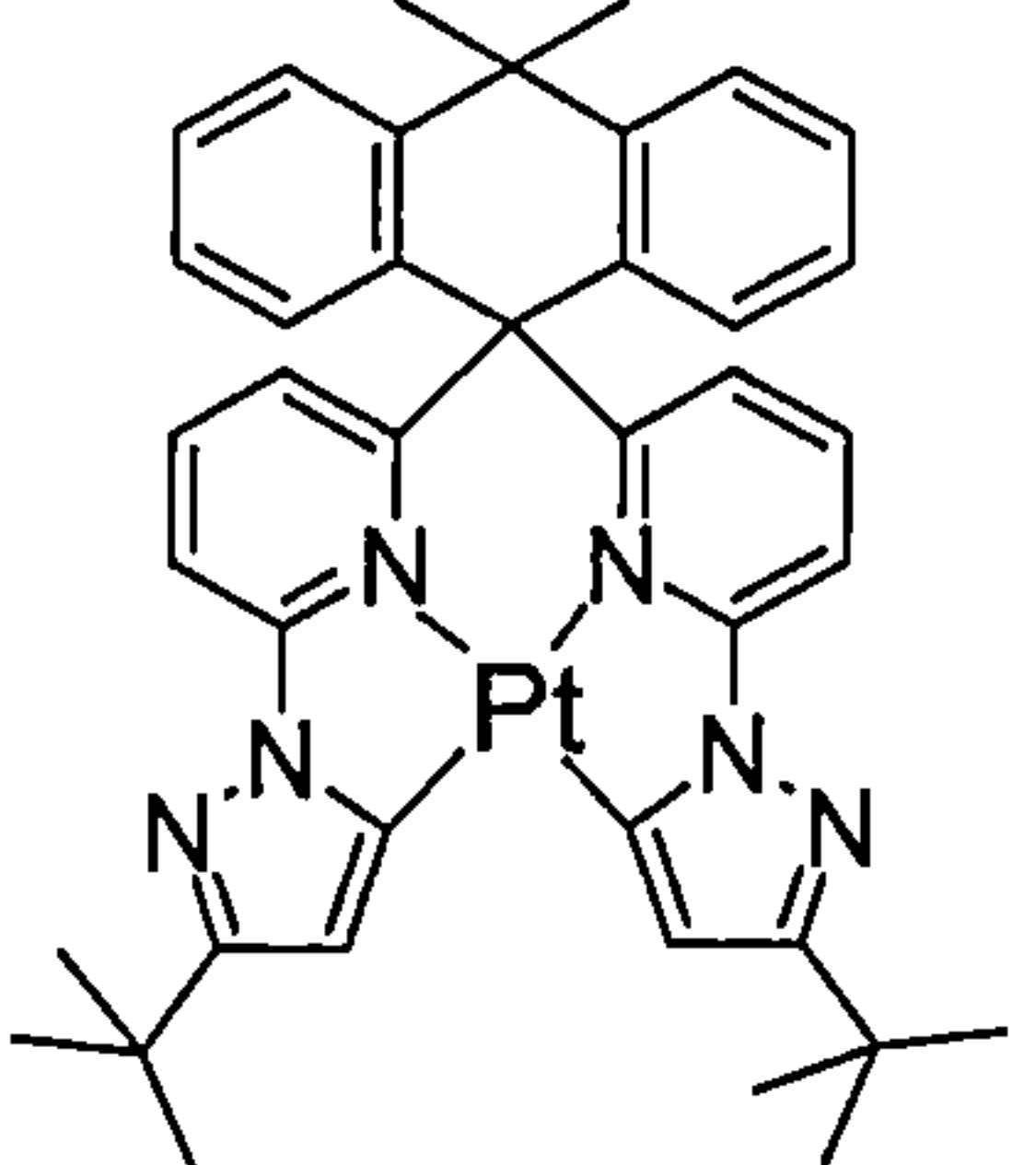
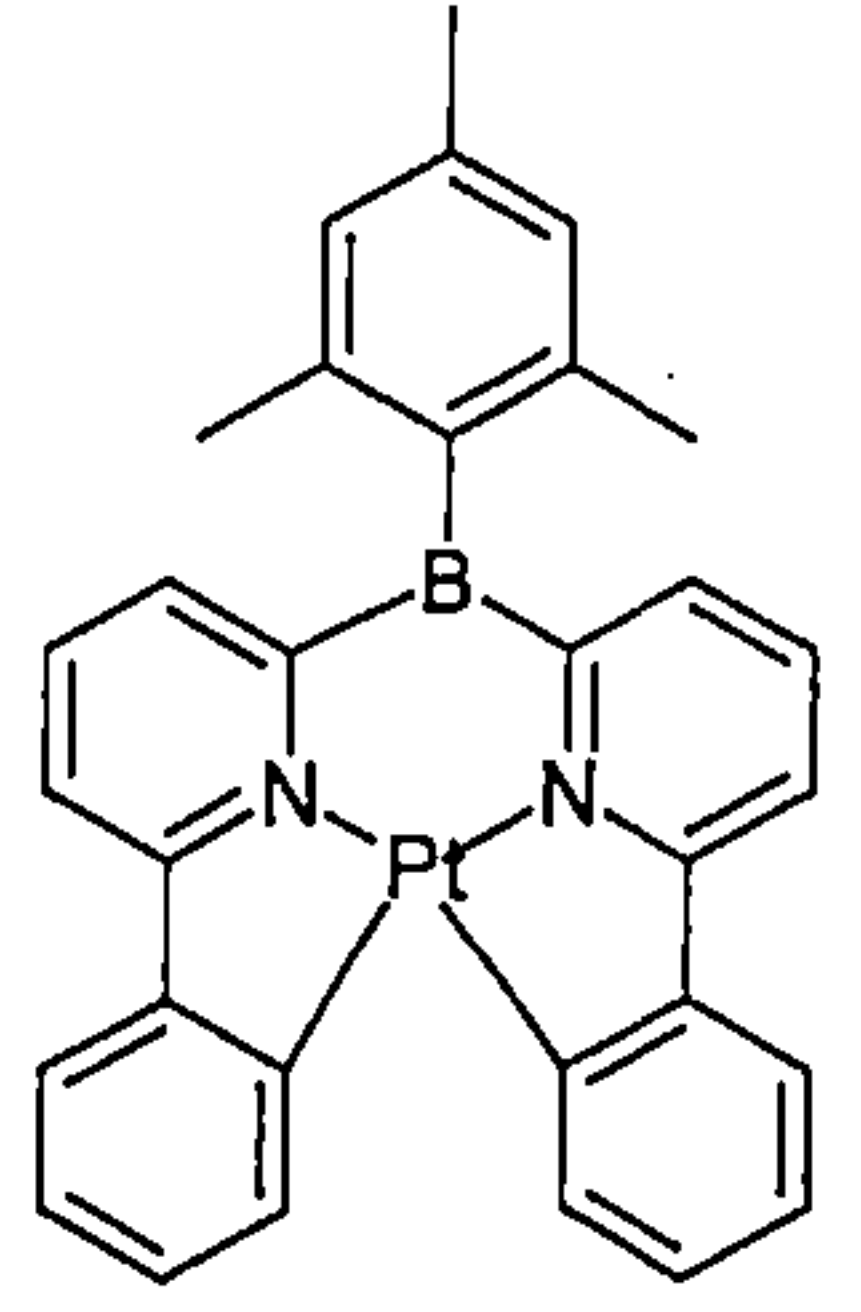
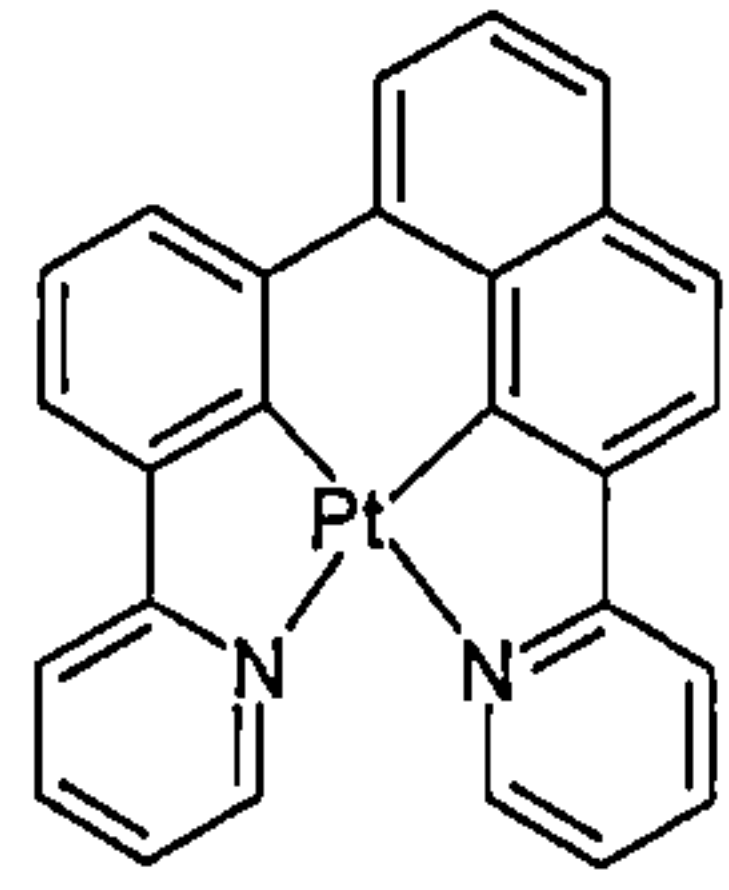
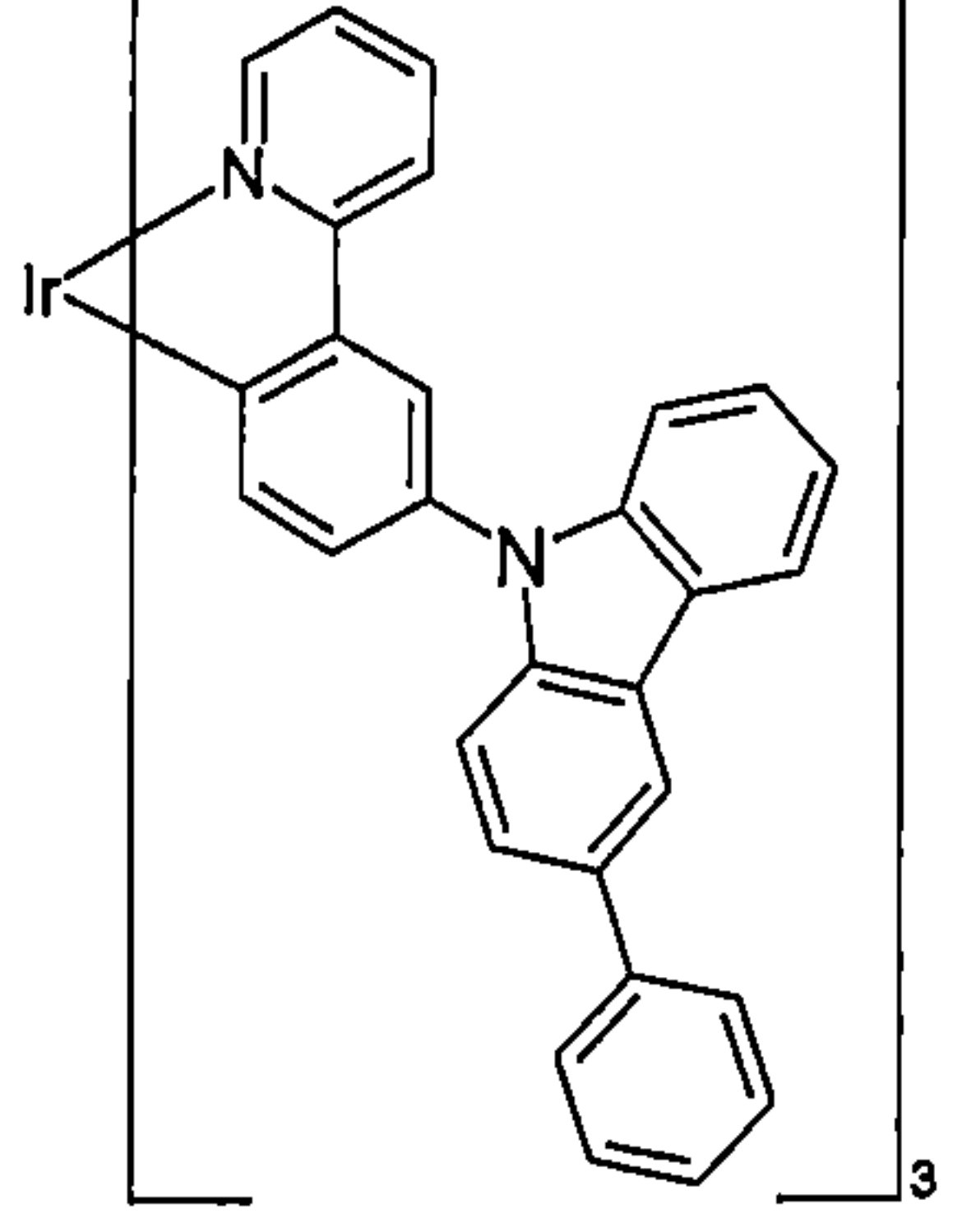
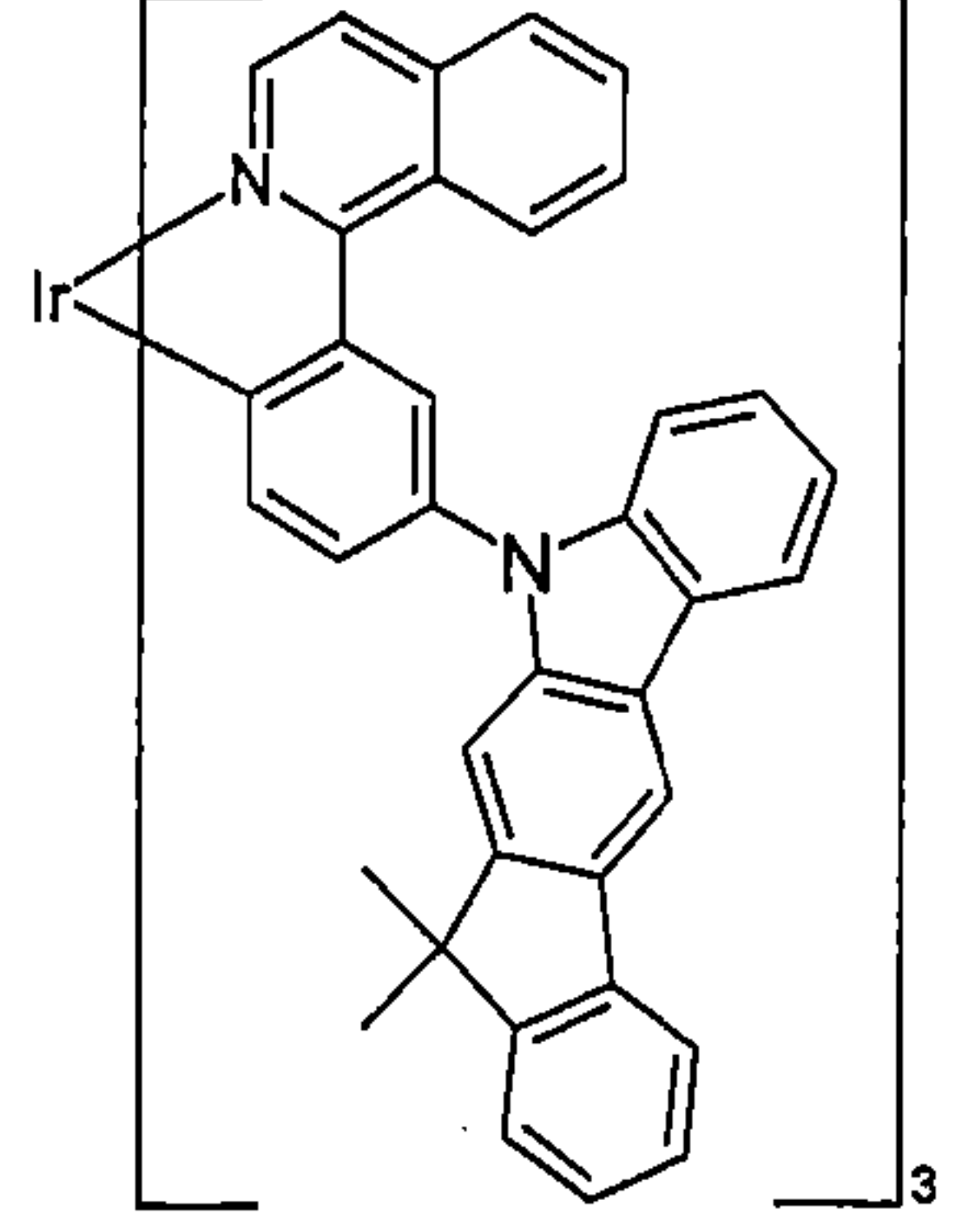
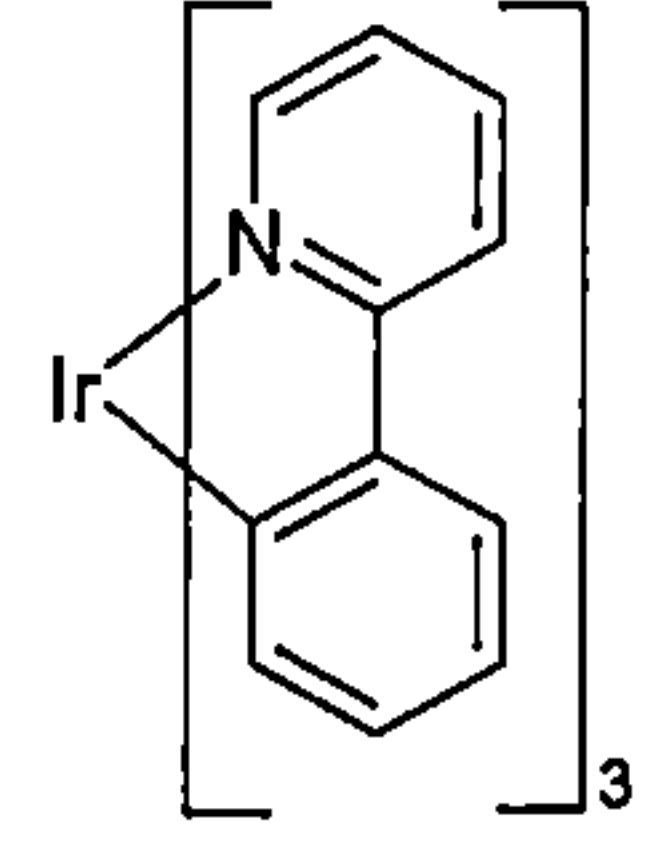
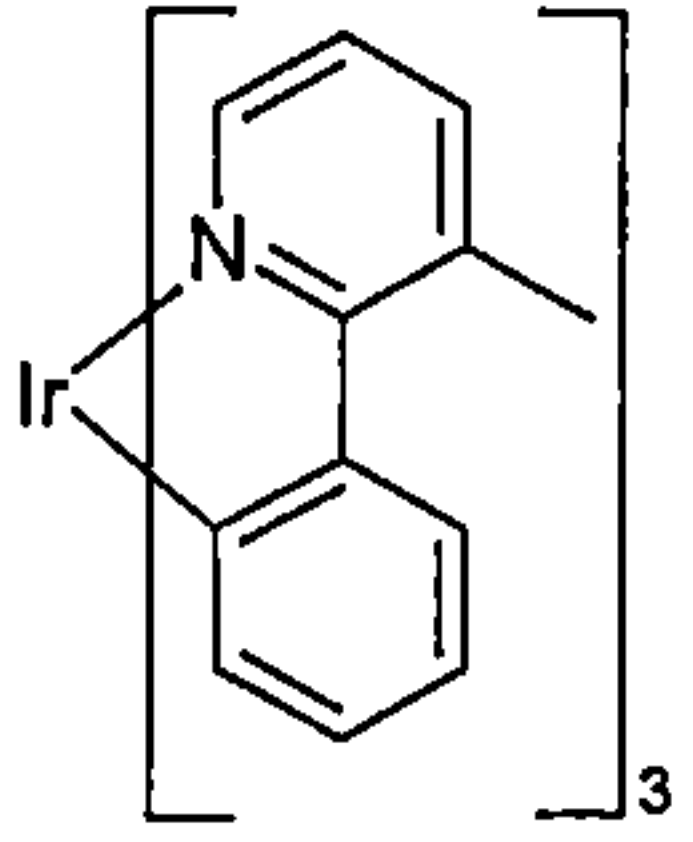
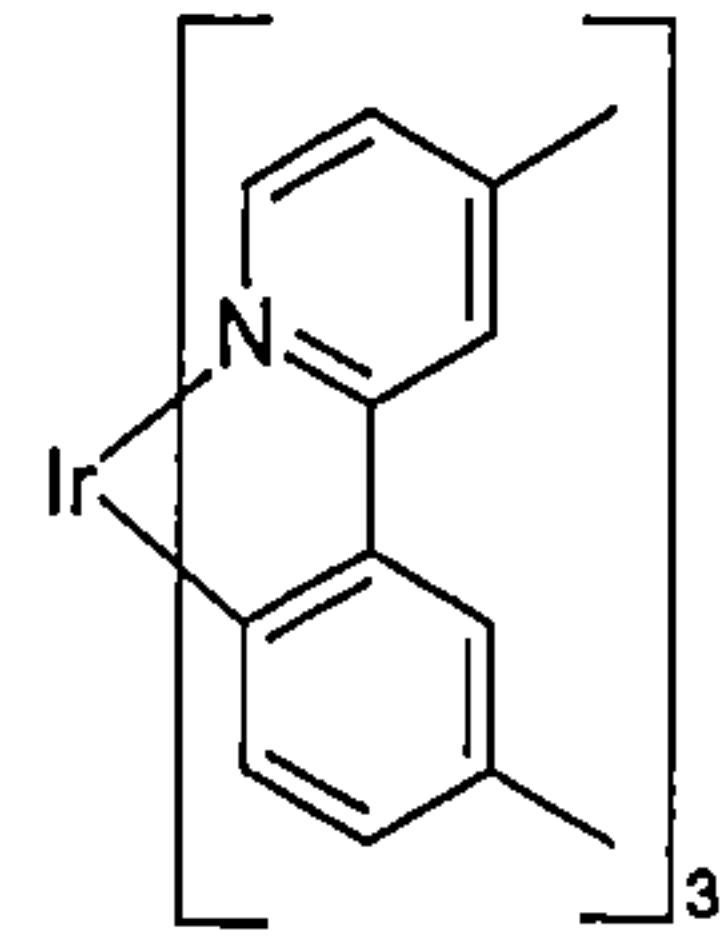
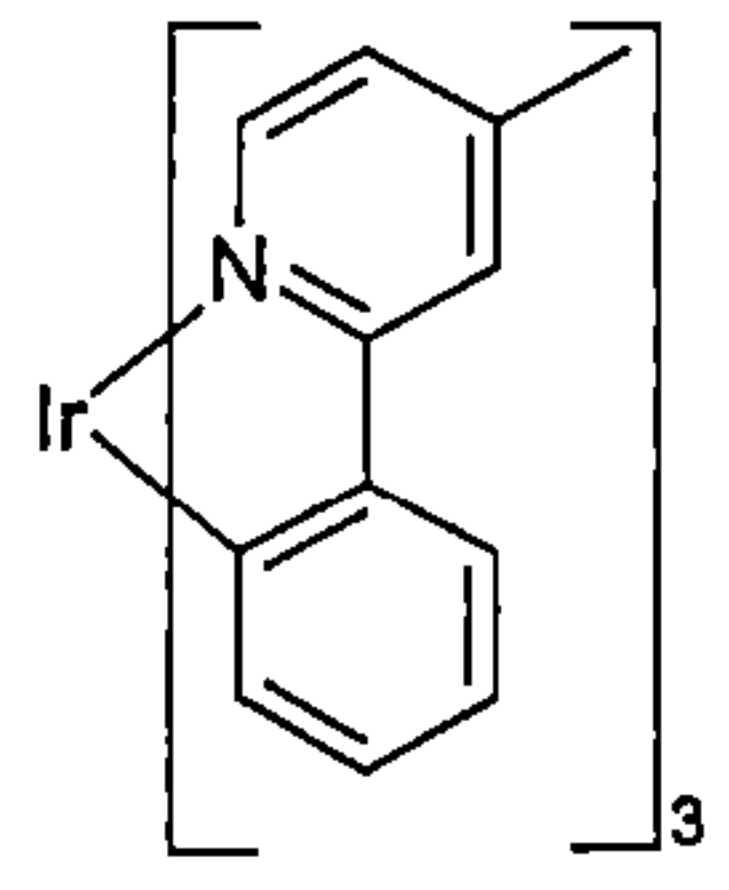
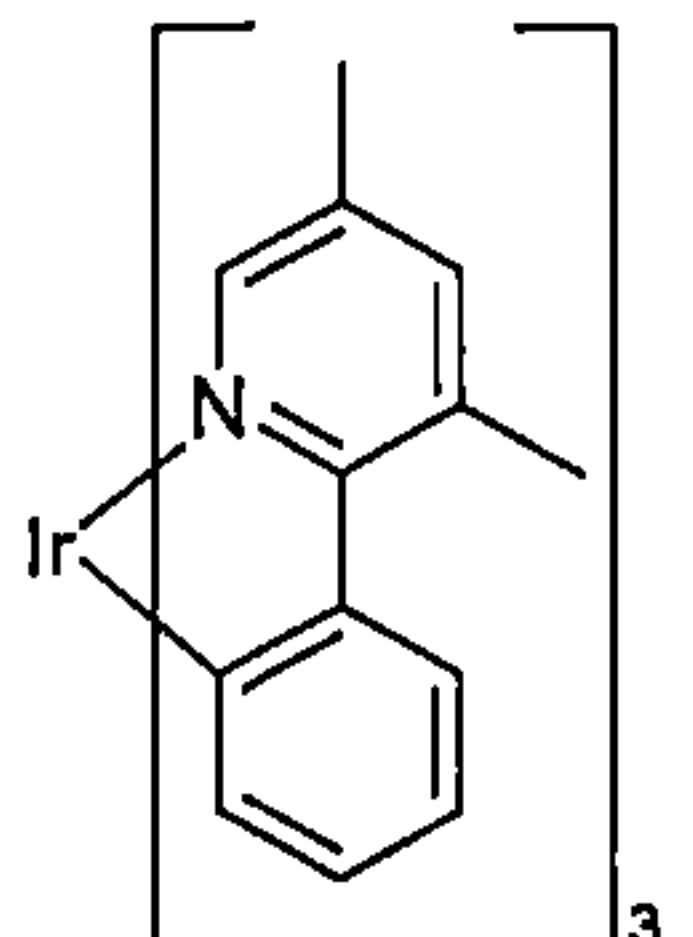
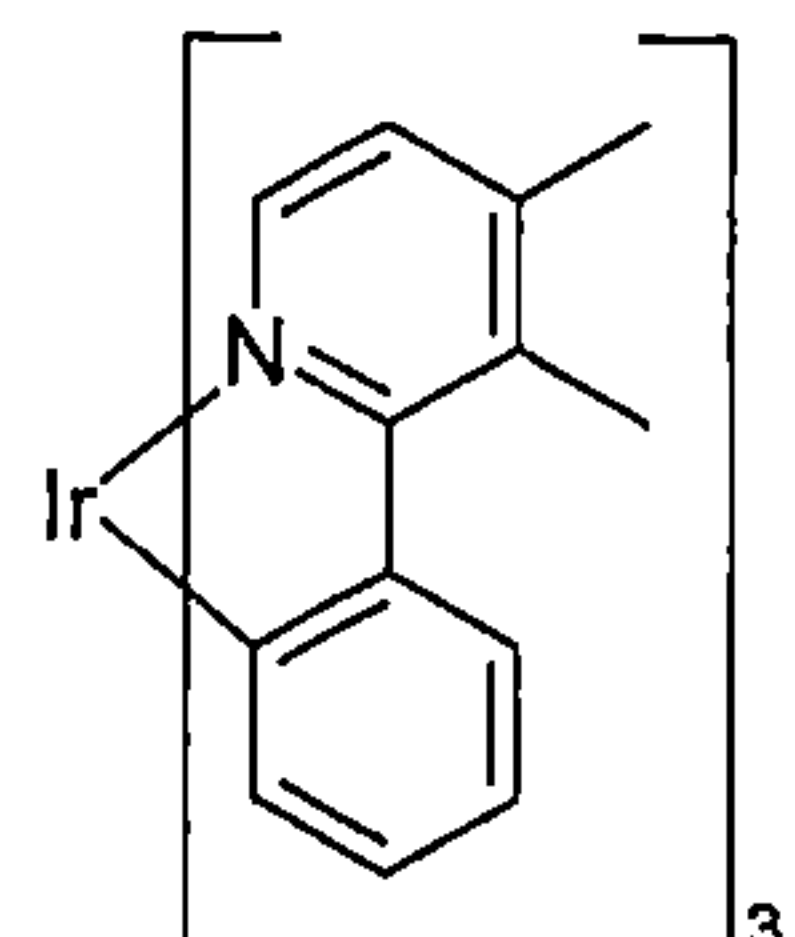
上文所述發射體之實例係藉由以下揭示：申請案 WO 2000/70655、WO 2001/41512、WO 2002/02714、WO 2002/15645、EP 1191613、EP 1191612、EP 1191614、WO 2005/033244、WO 2005/019373、US 2005/0258742、WO 2009/146770、WO 2010/015307、WO 2010/031485、WO 2010/054731、WO 2010/054728、WO 2010/086089、WO 2010/099852、WO 2010/102709、WO 2011/157339或WO 2012/007086。一般而言，如根據先前技術用於磷光OLED及如有機電致發光領域內之技術人員已知之所有磷光錯合物均係適宜的，且熟習此項技術者將能夠在無發明性步驟之情況下使用其他磷光錯合物。

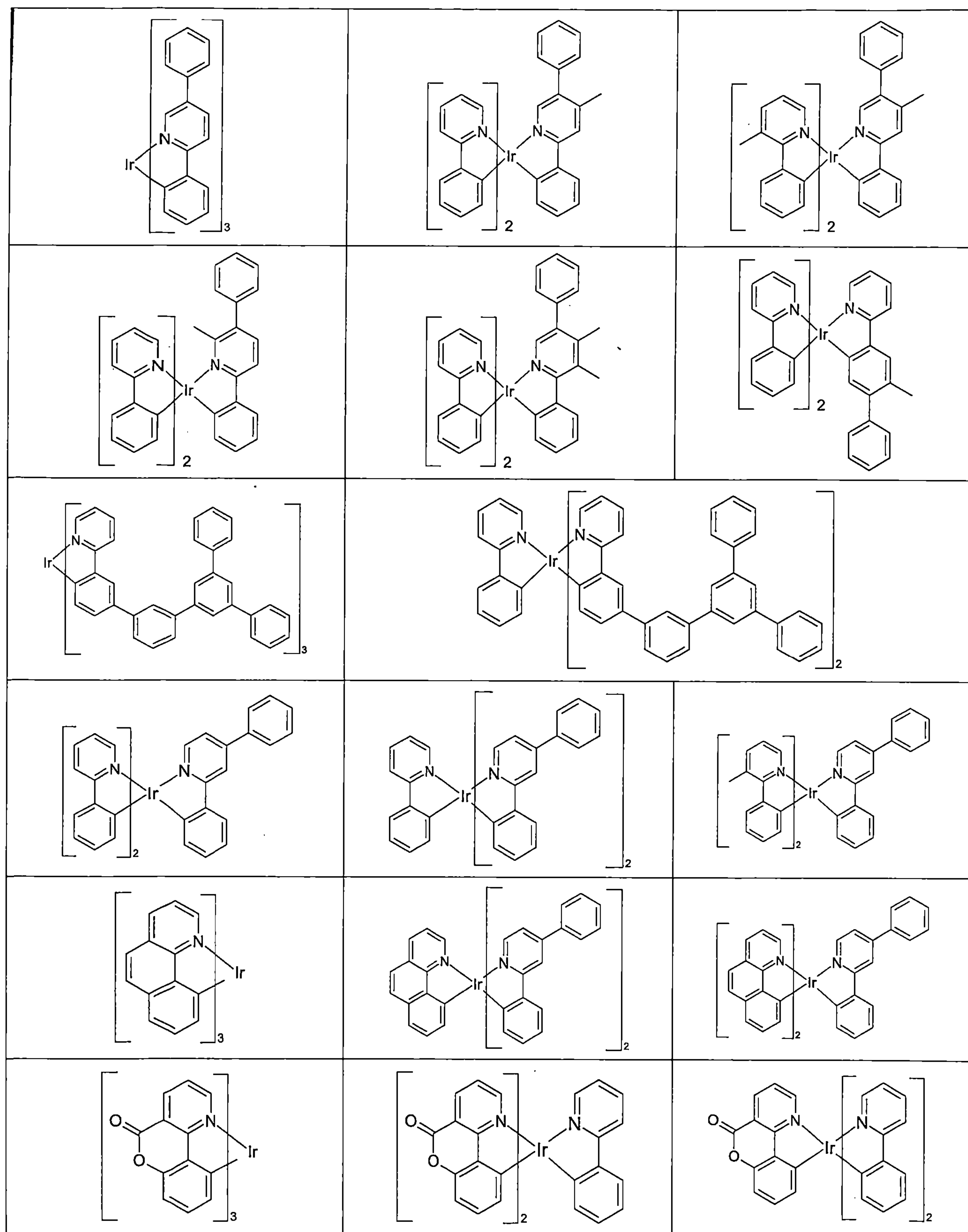
欲用於本發明申請案之裝置中之三重態發射體之實例顯示於下表中。

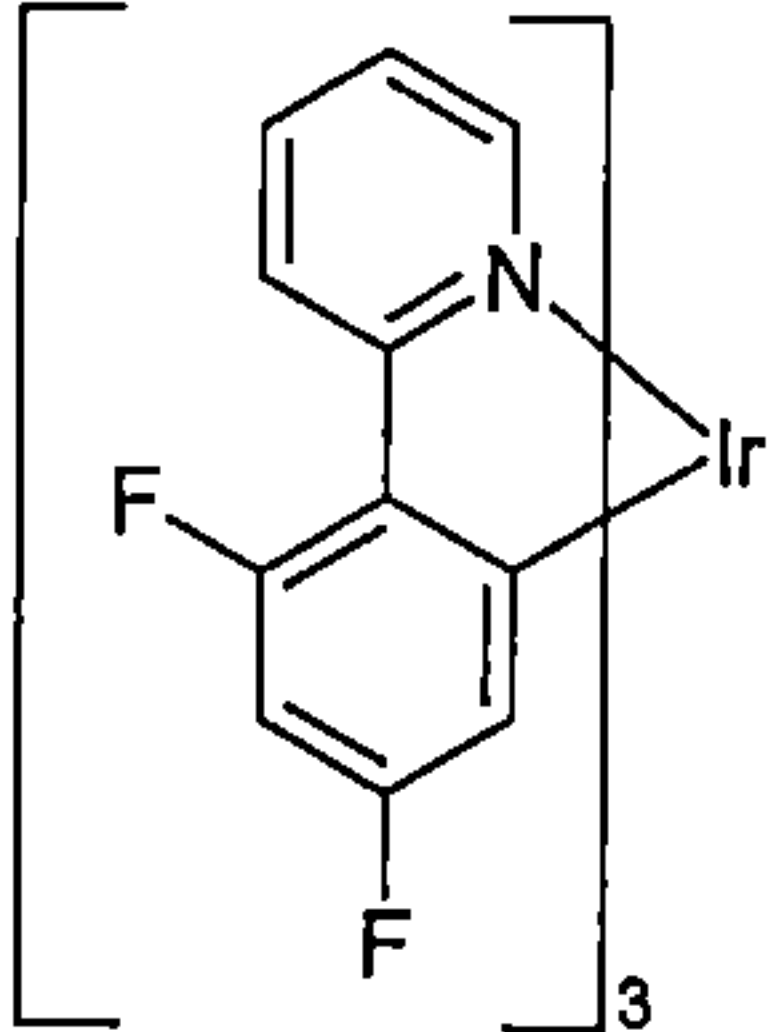
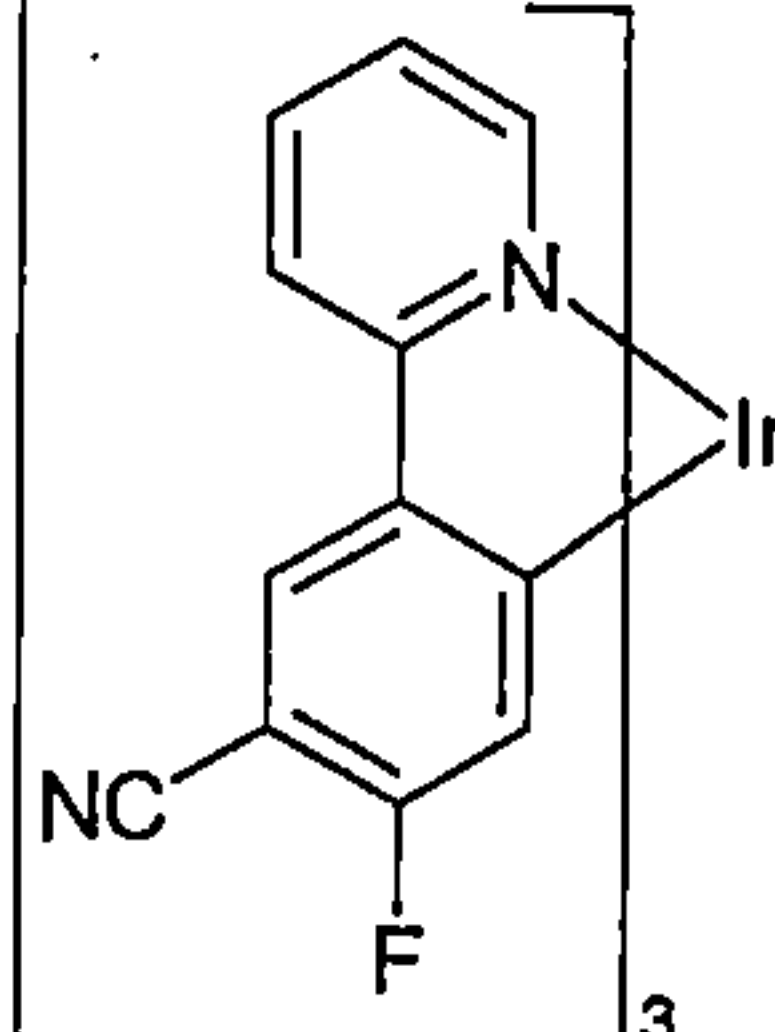
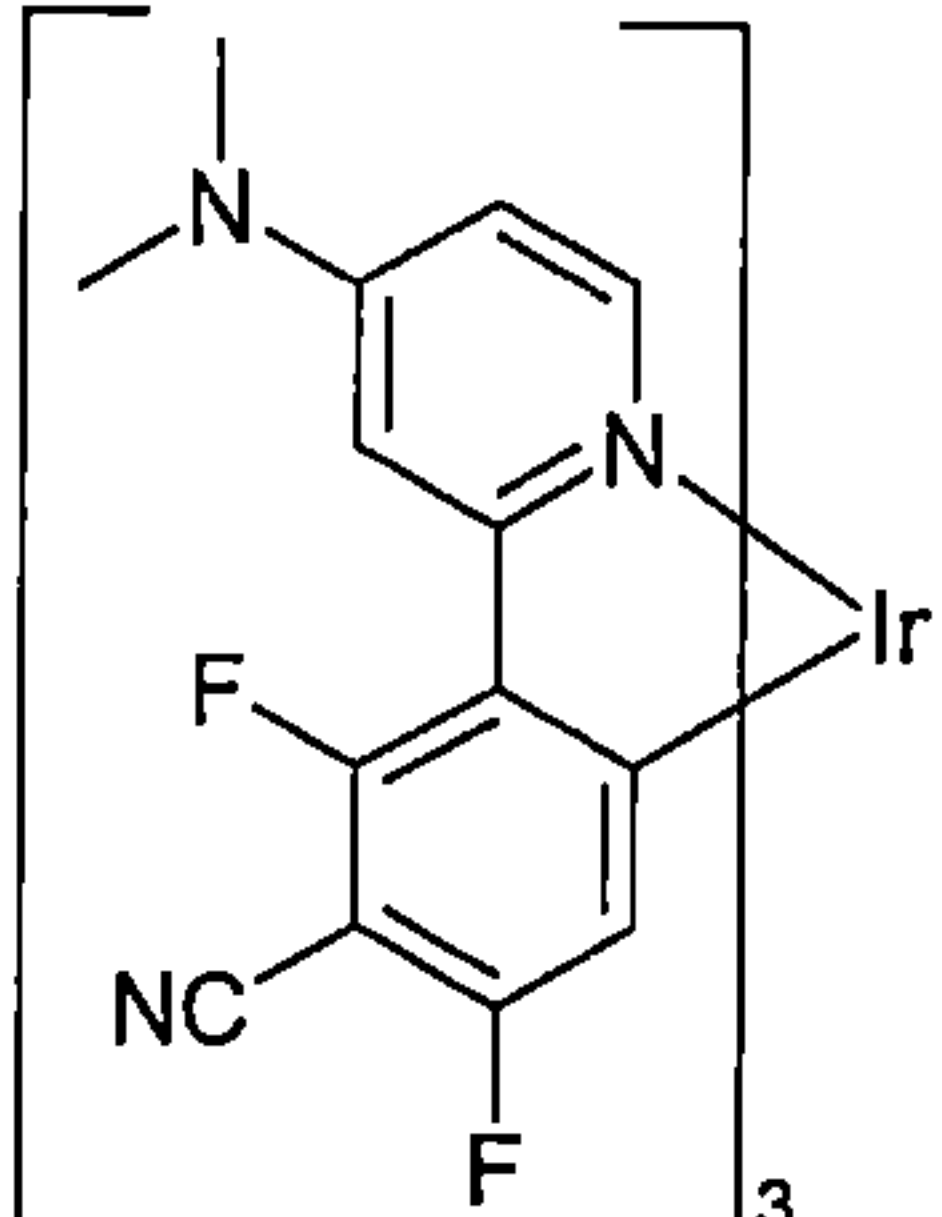
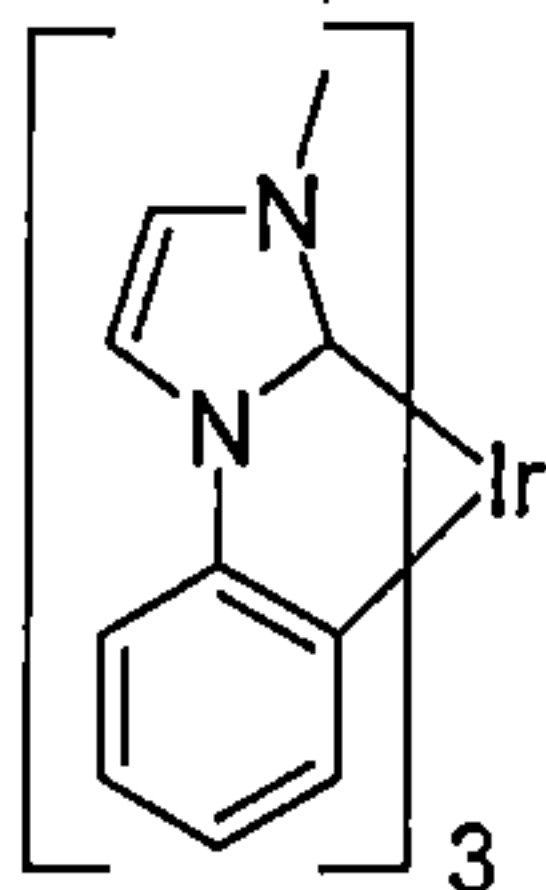
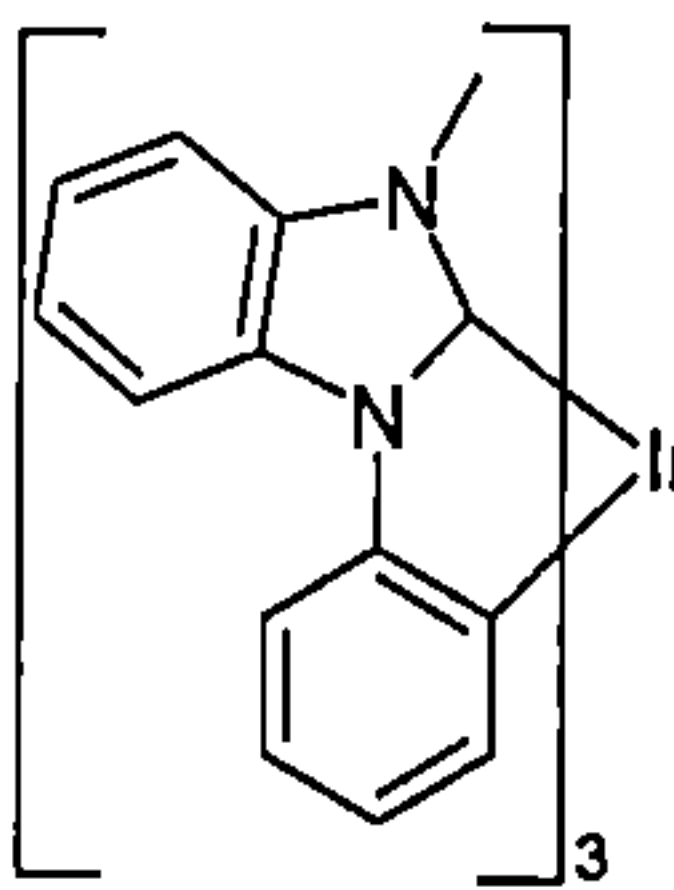
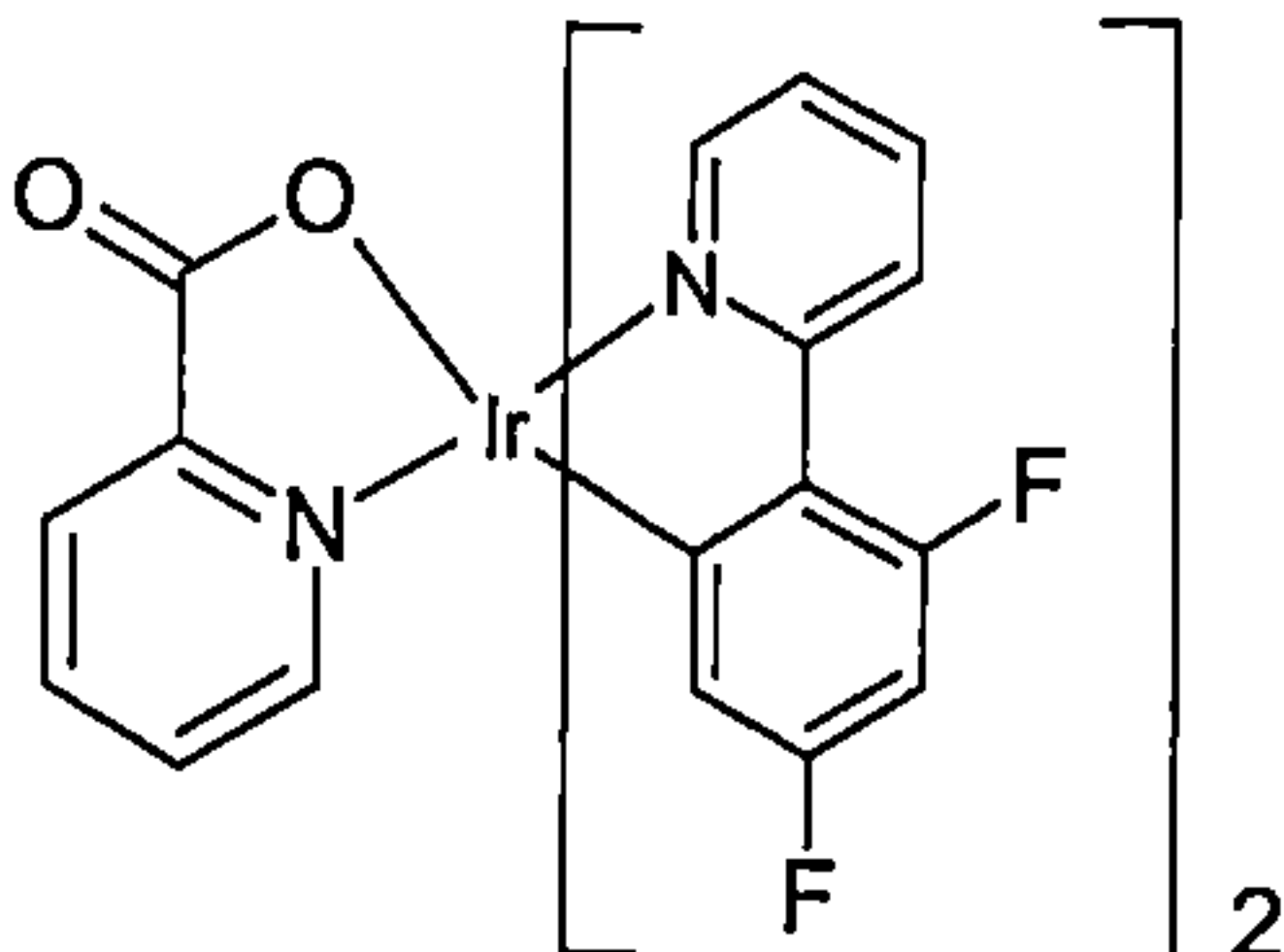
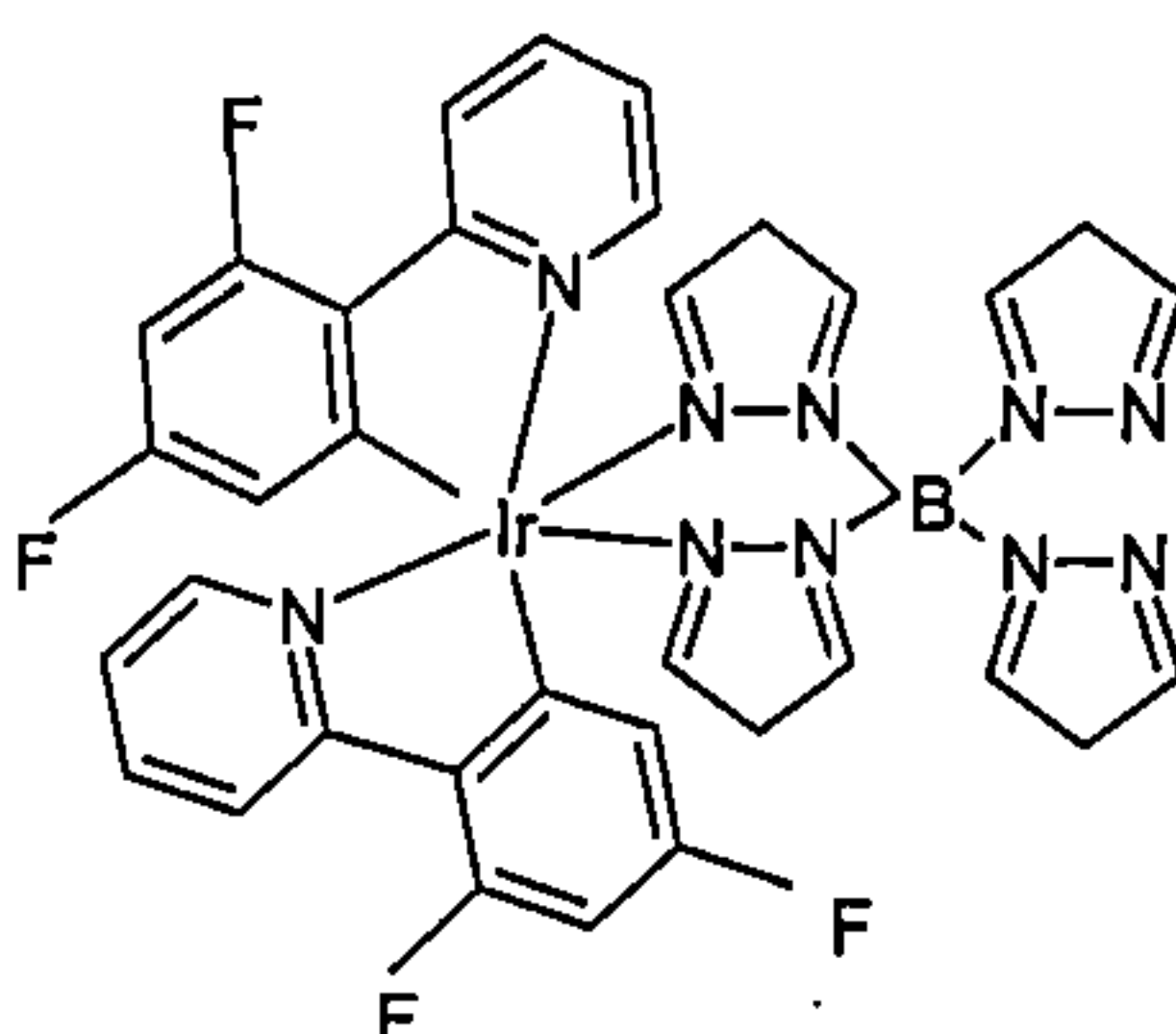
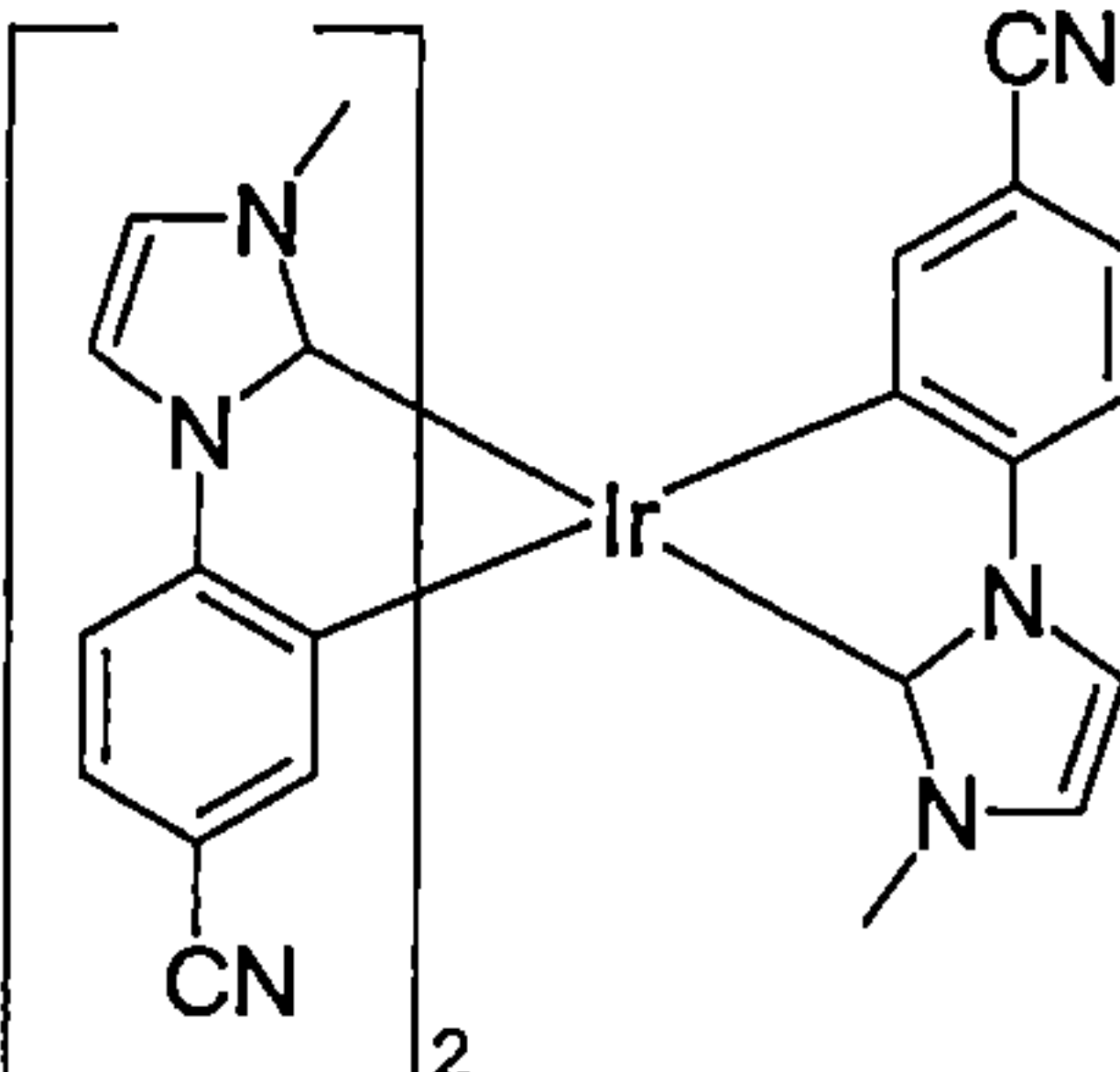
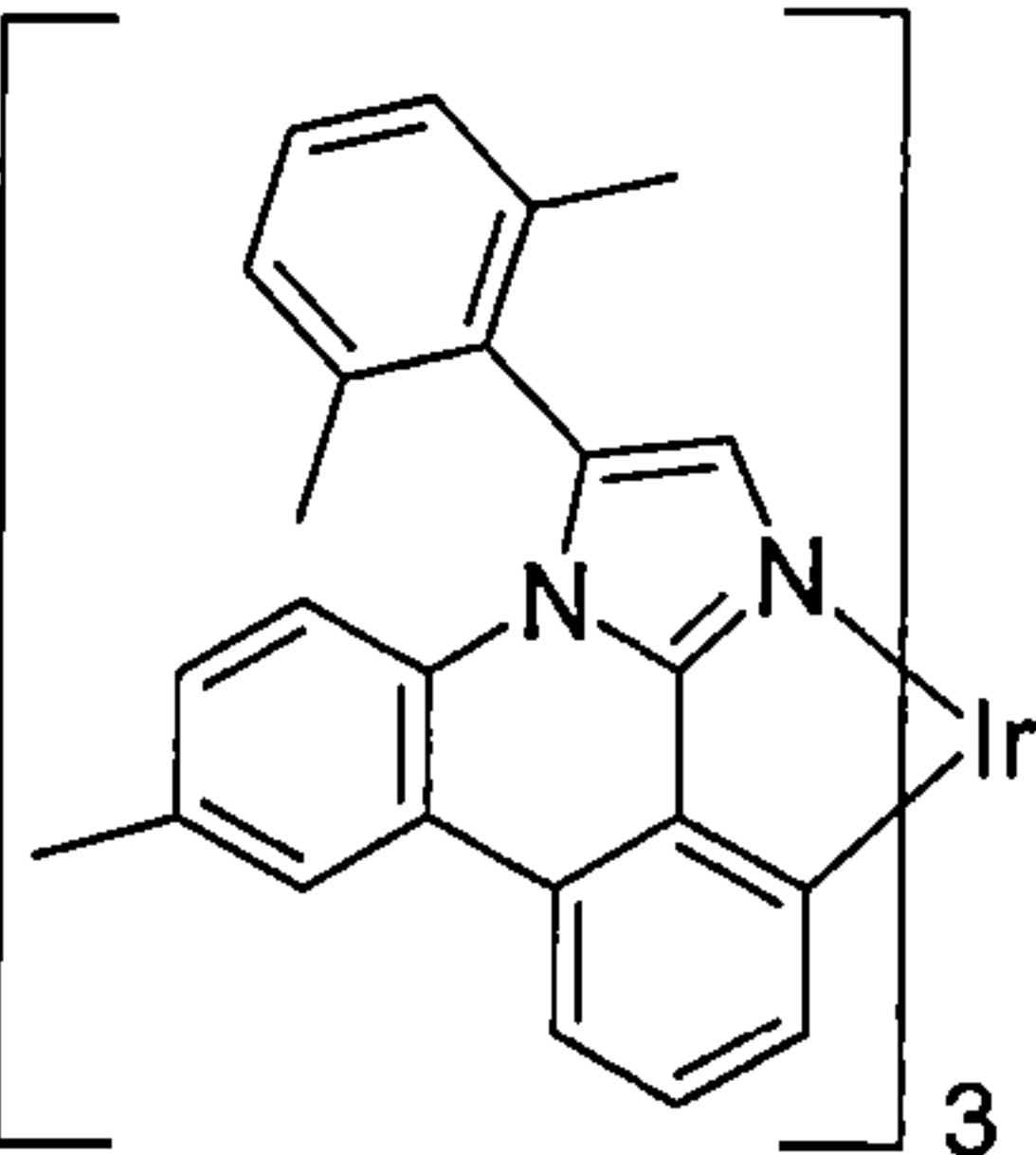
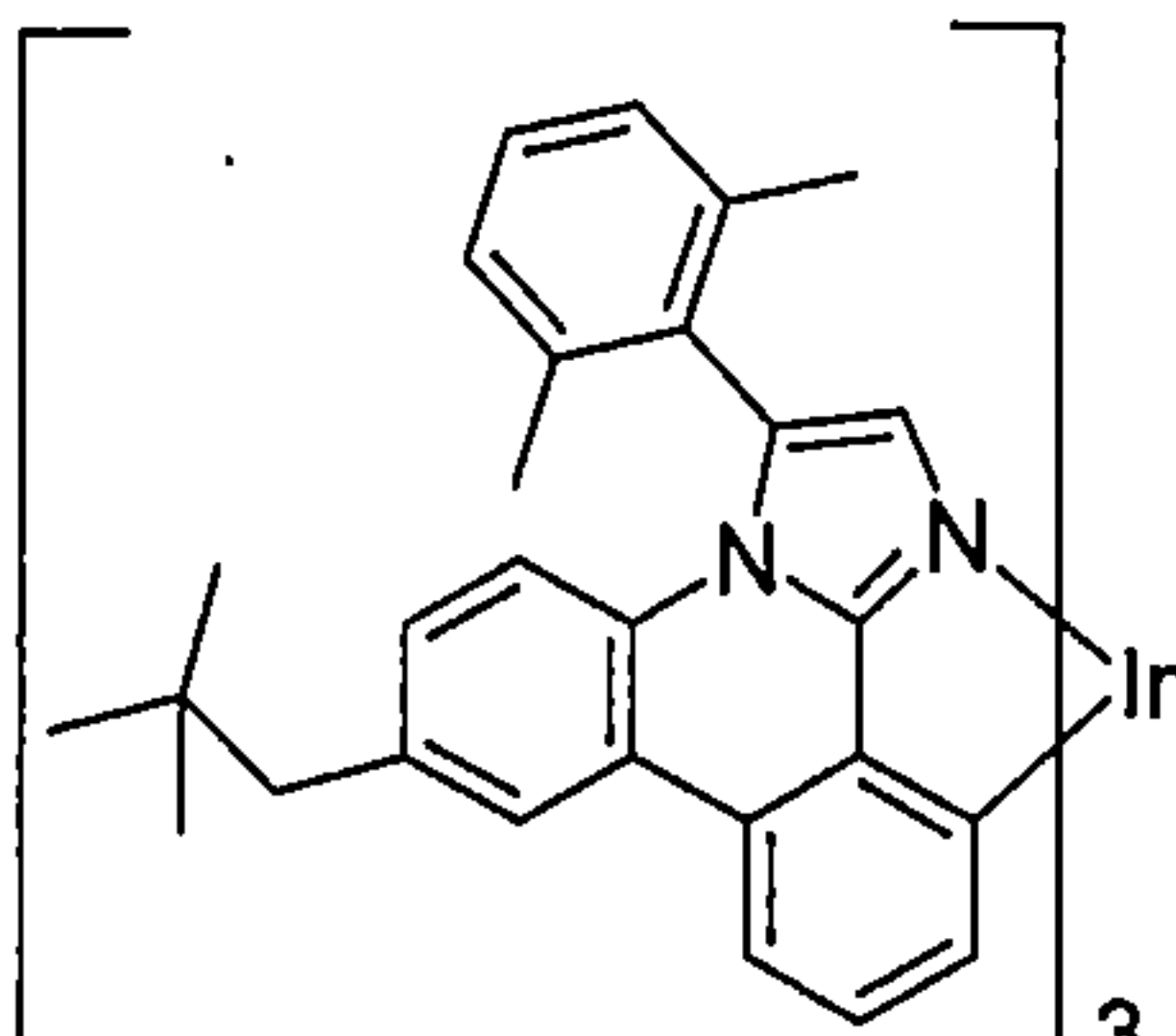
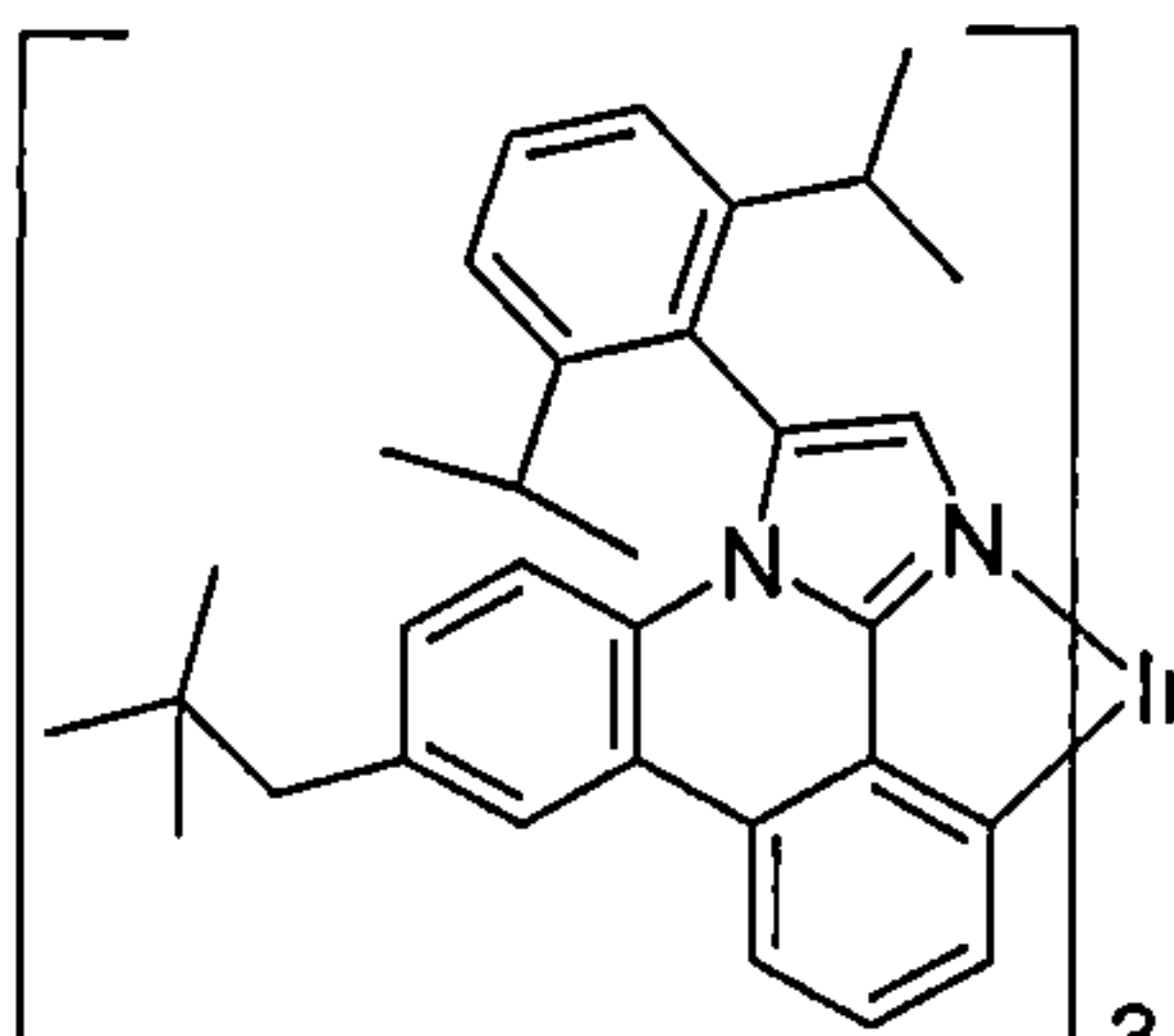
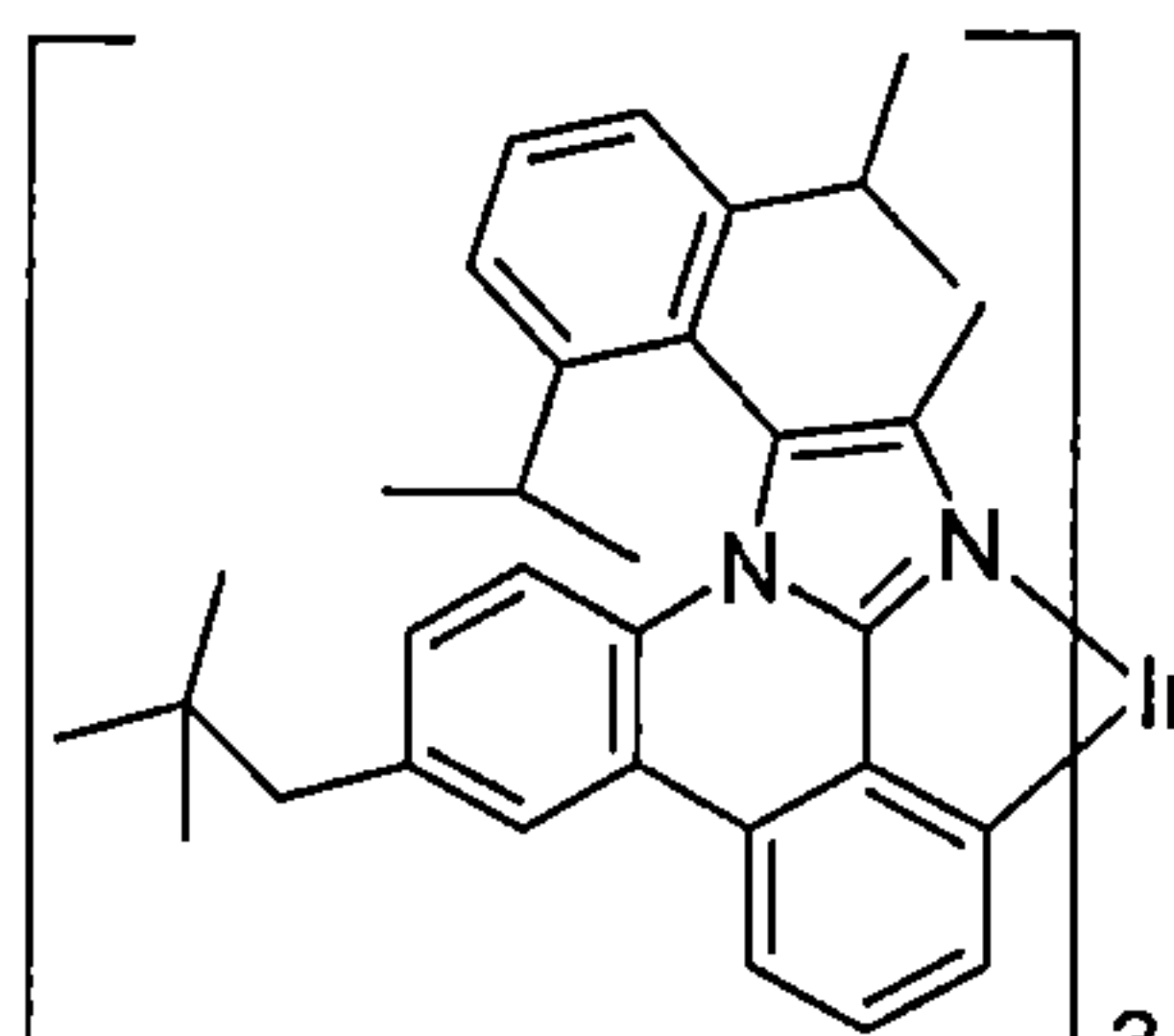
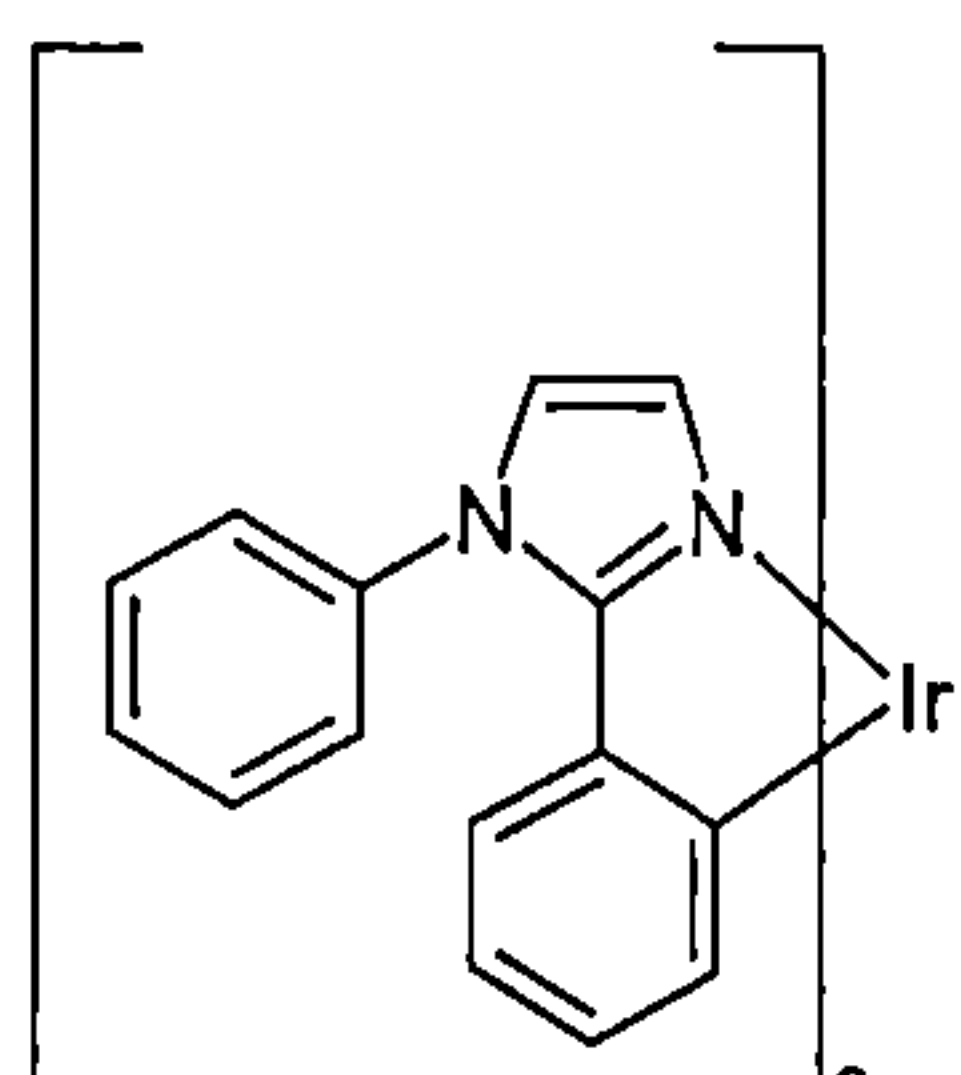
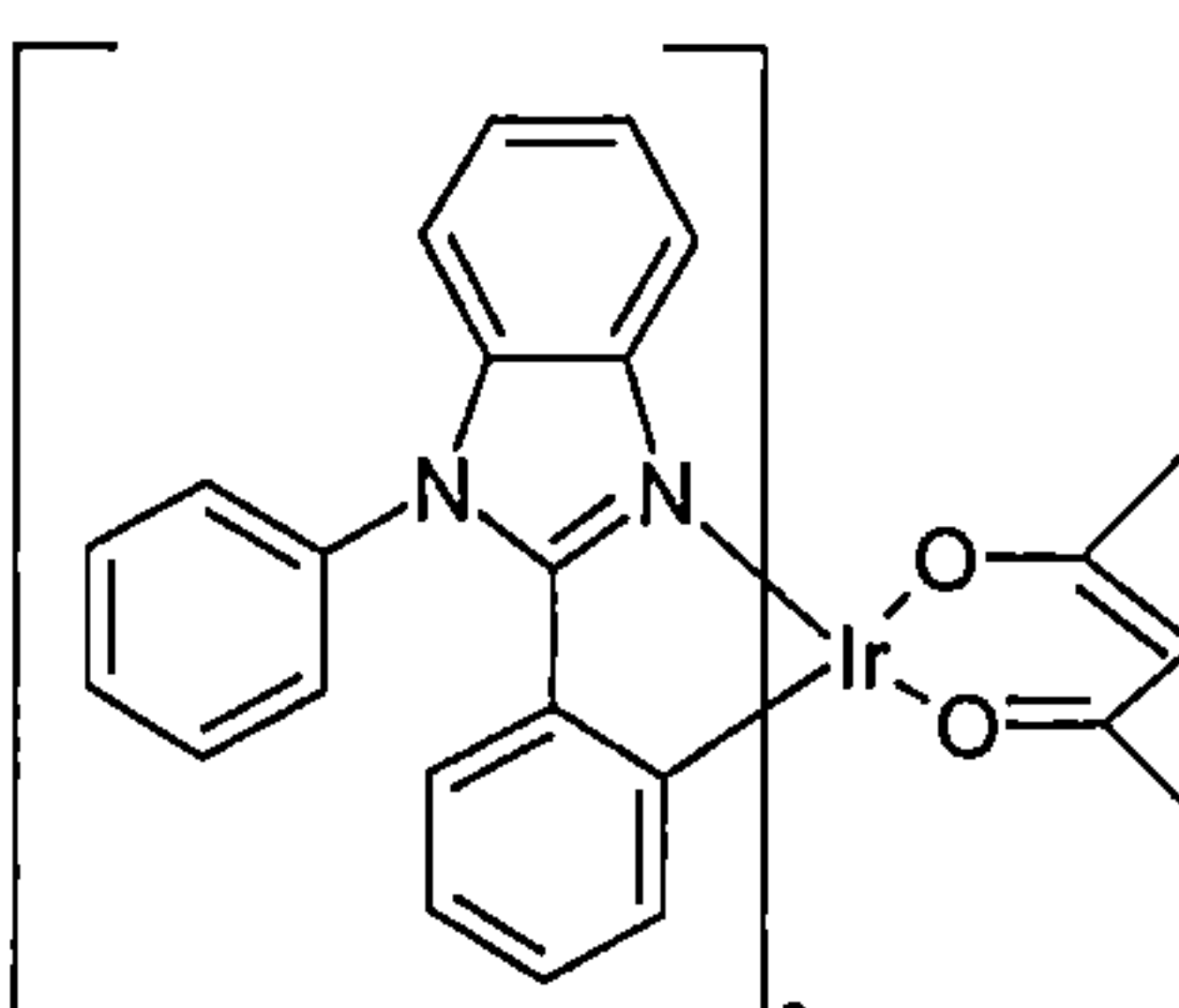
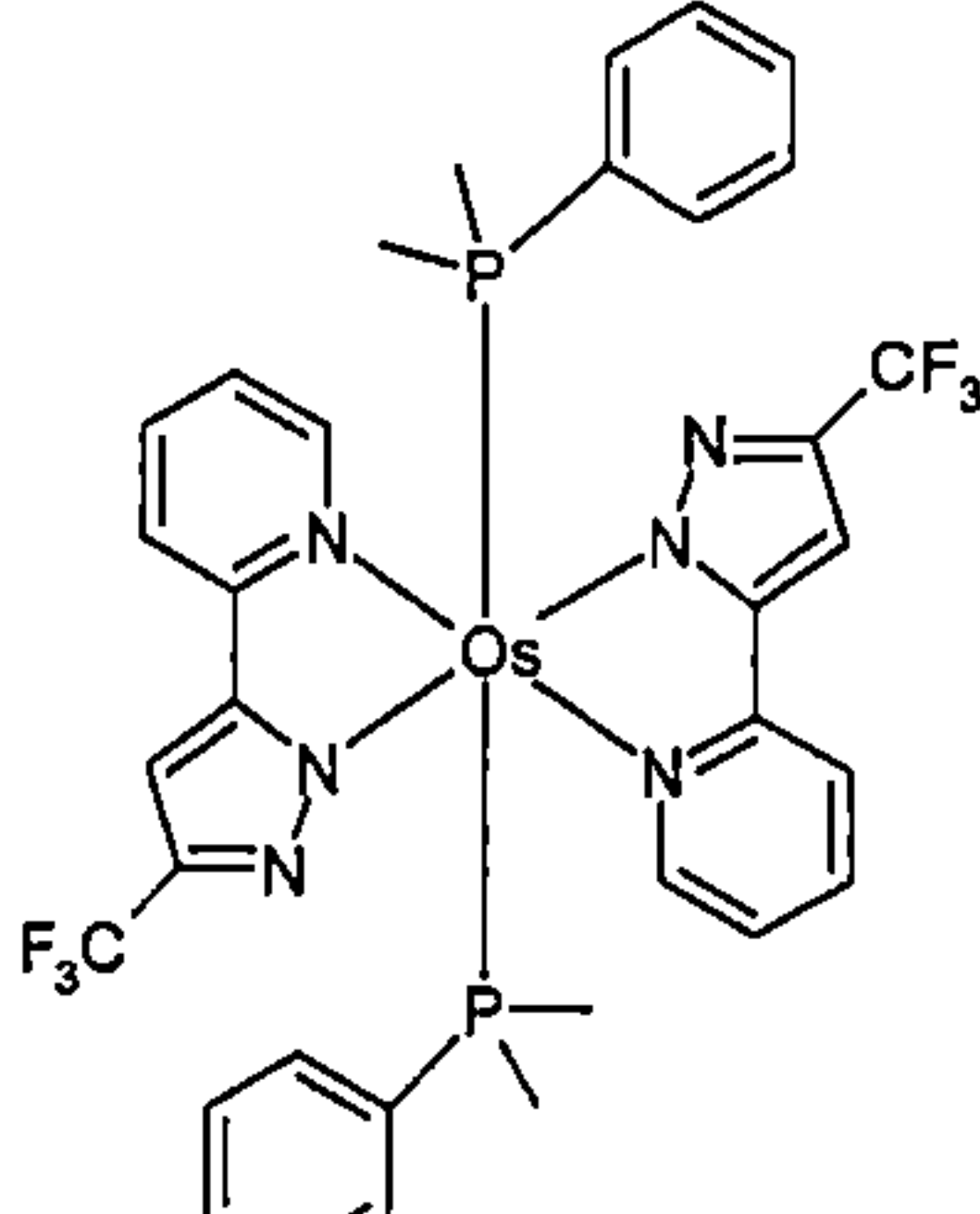
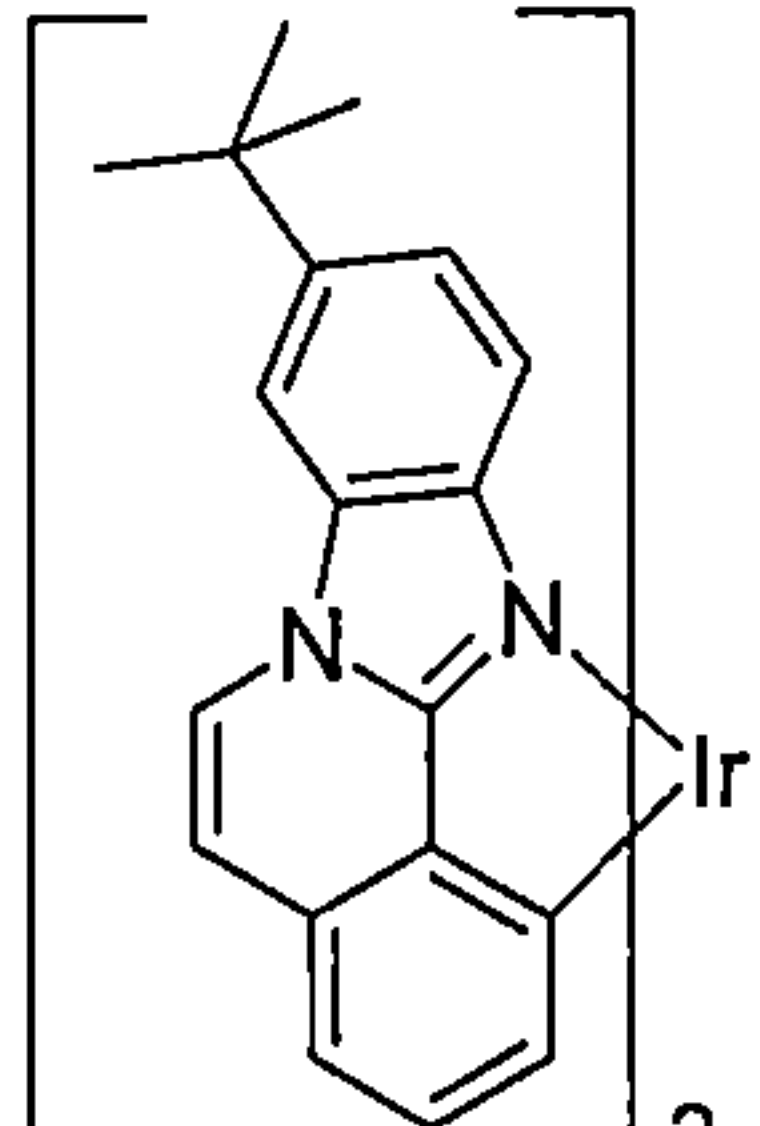
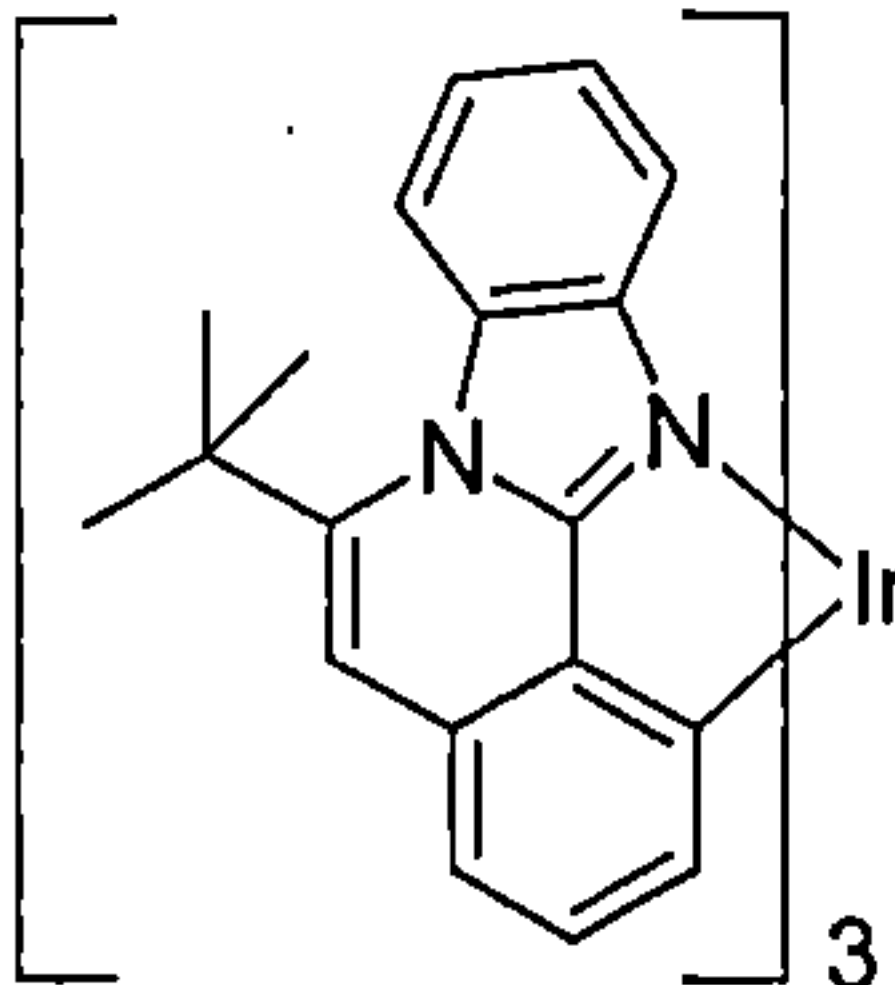
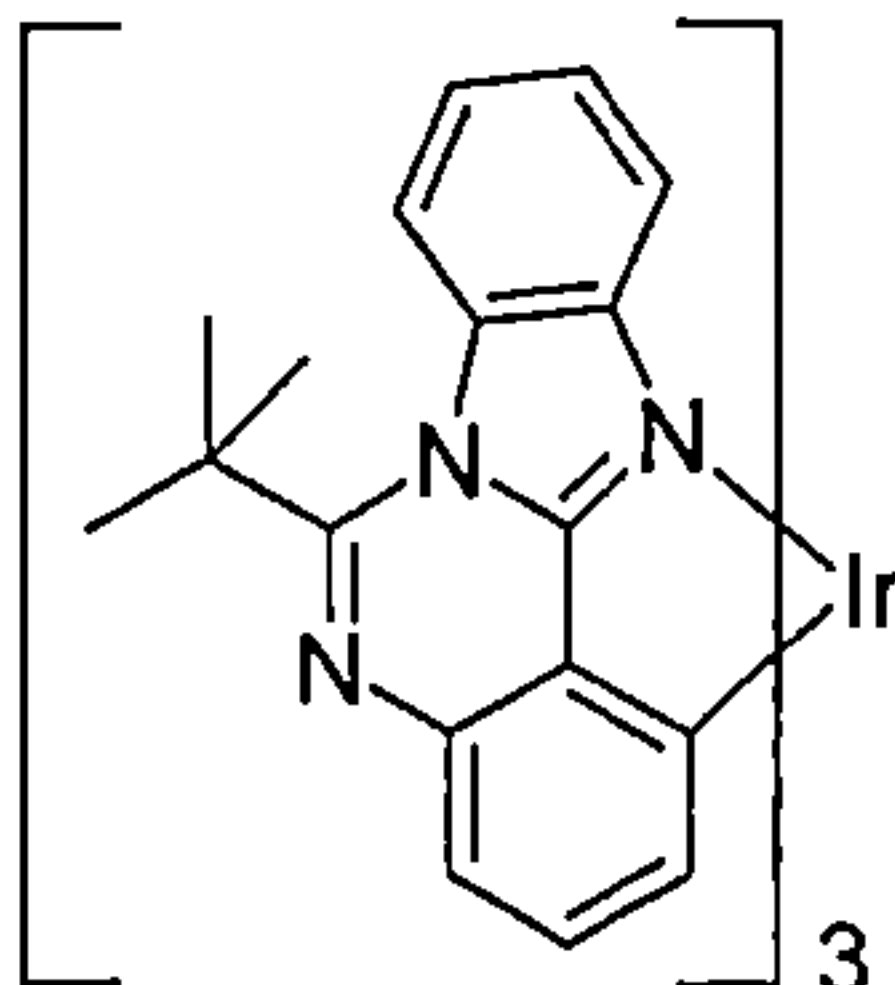
		
		
		

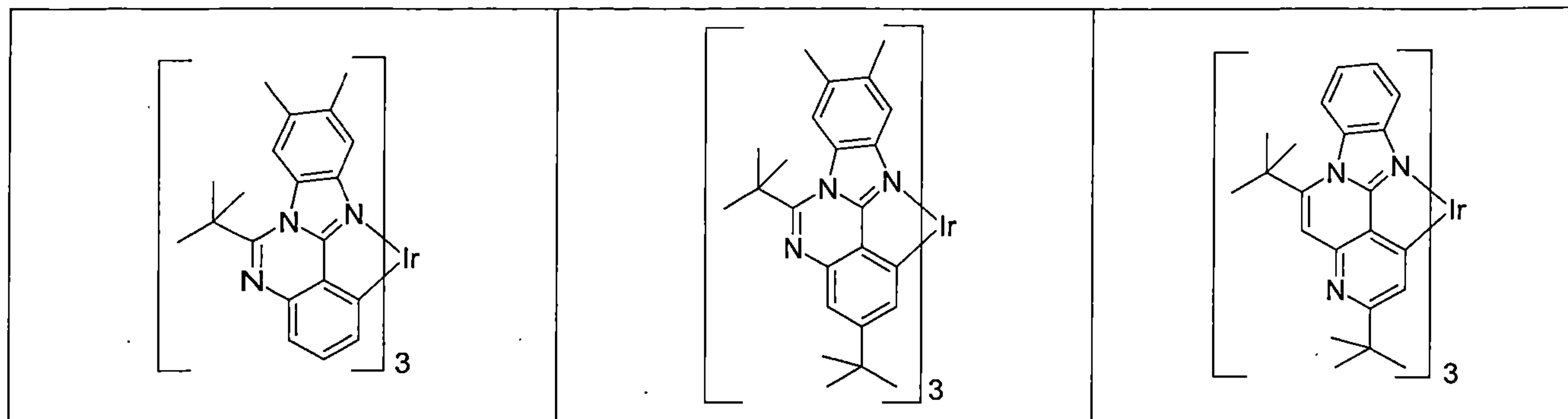






在本發明之另一實施例中，本發明有機電致發光裝置不含單獨電洞注入層及/或電洞傳輸層及/或電洞阻擋層及/或電子傳輸層，即發射層直接毗鄰電洞注入層或陽極及/或發射層直接毗鄰電子傳輸層或電子注入層或陰極，如(例如)WO 2005/053051中所述。此外，可使用與在發射層中之金屬錯合物相同或類似的金屬錯合物作為電洞傳輸或電洞注入材料直接毗鄰發射層，如(例如) WO 2009/030981中所述。

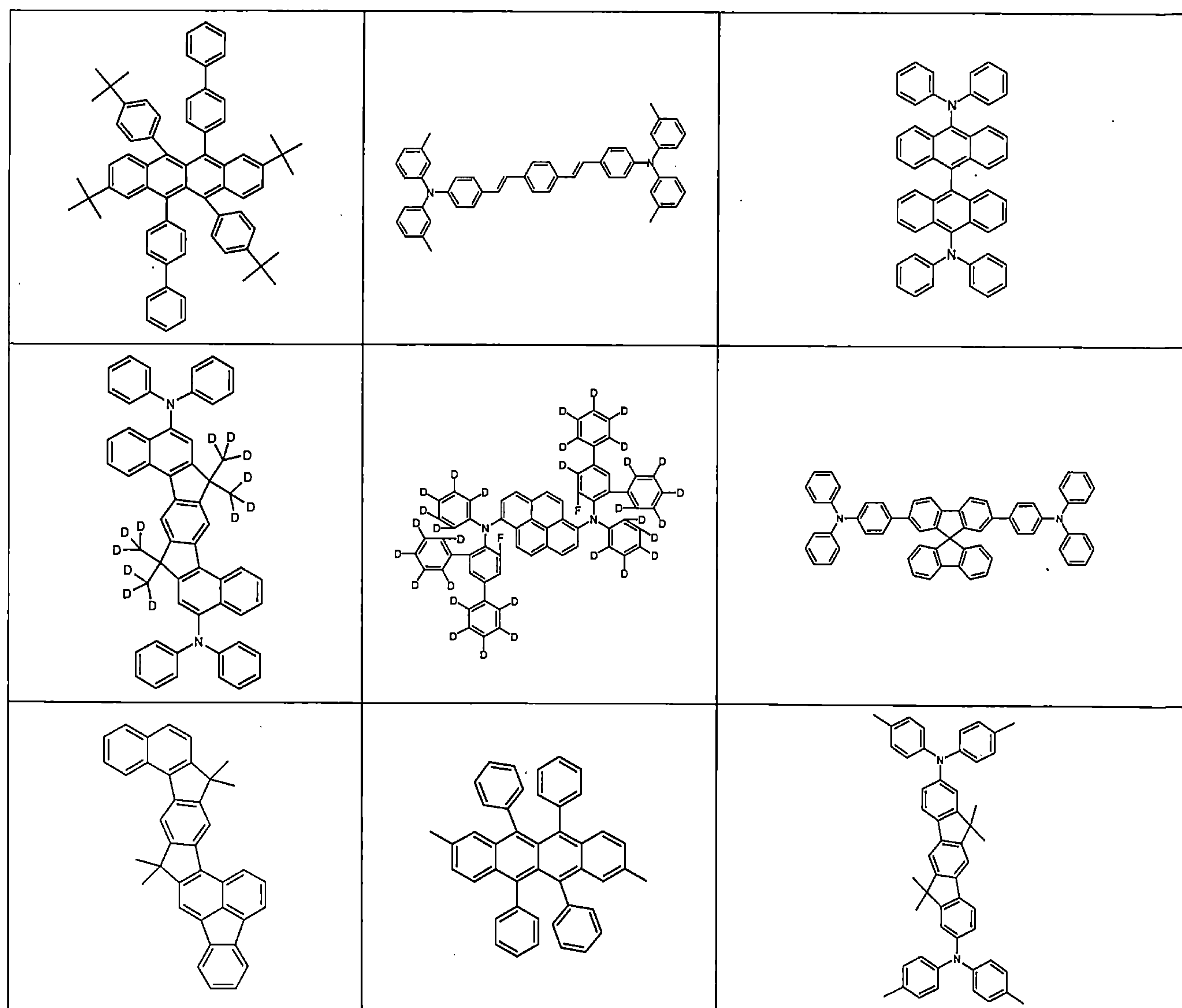
此外，可將式(1)化合物或較佳實施例用於電洞傳輸層或激子阻擋層二者中並用作發射層中之基質。

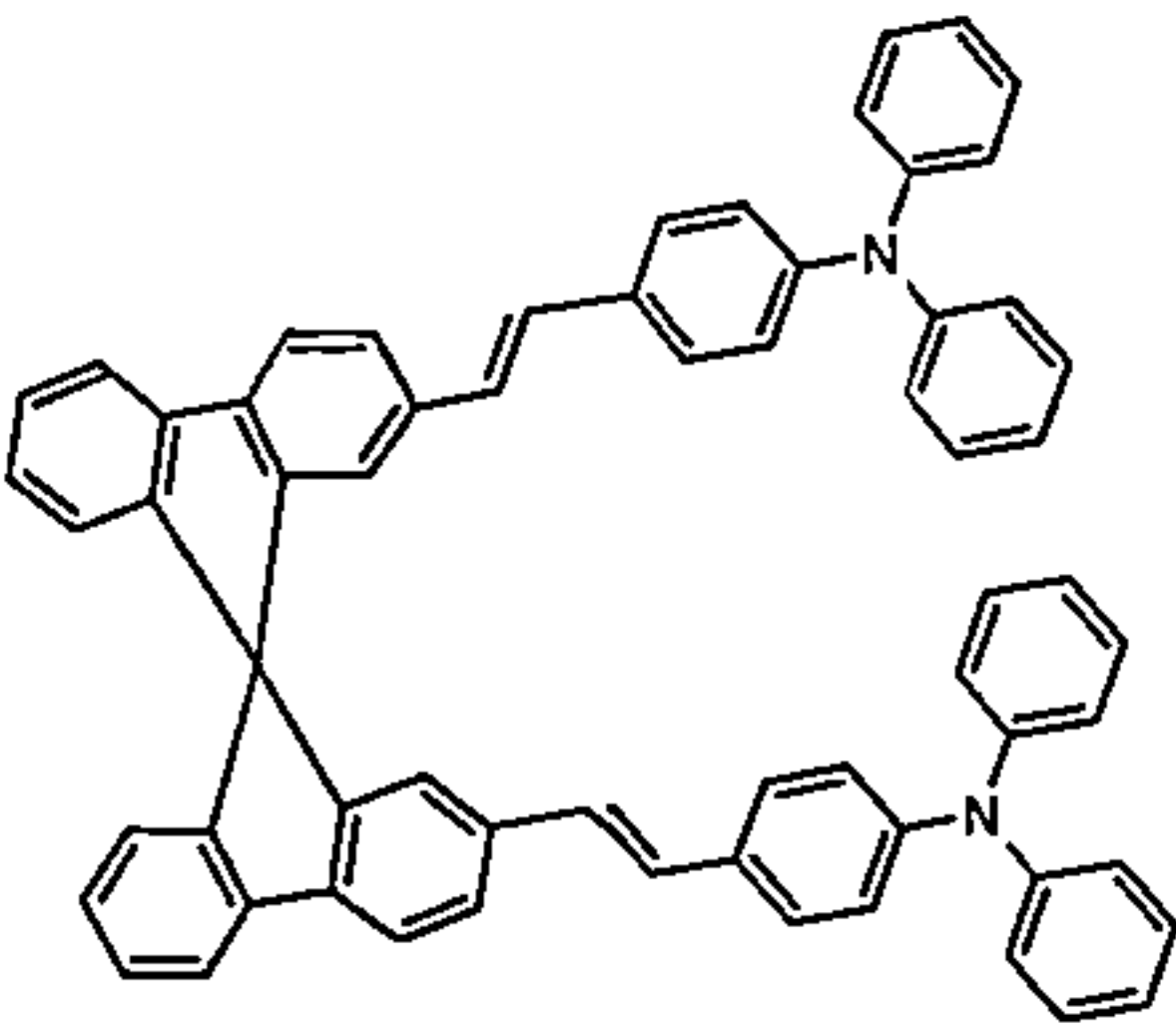
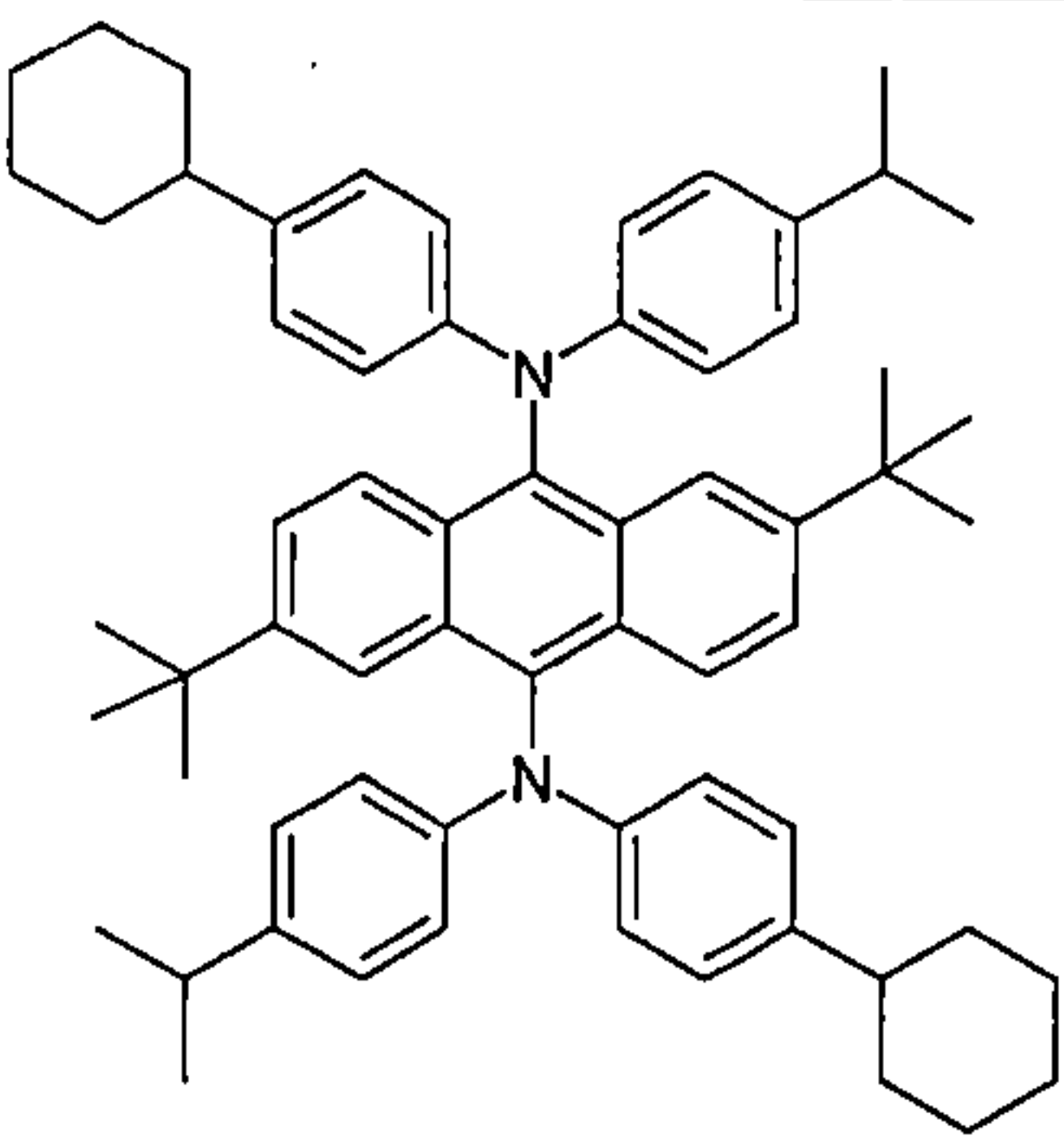
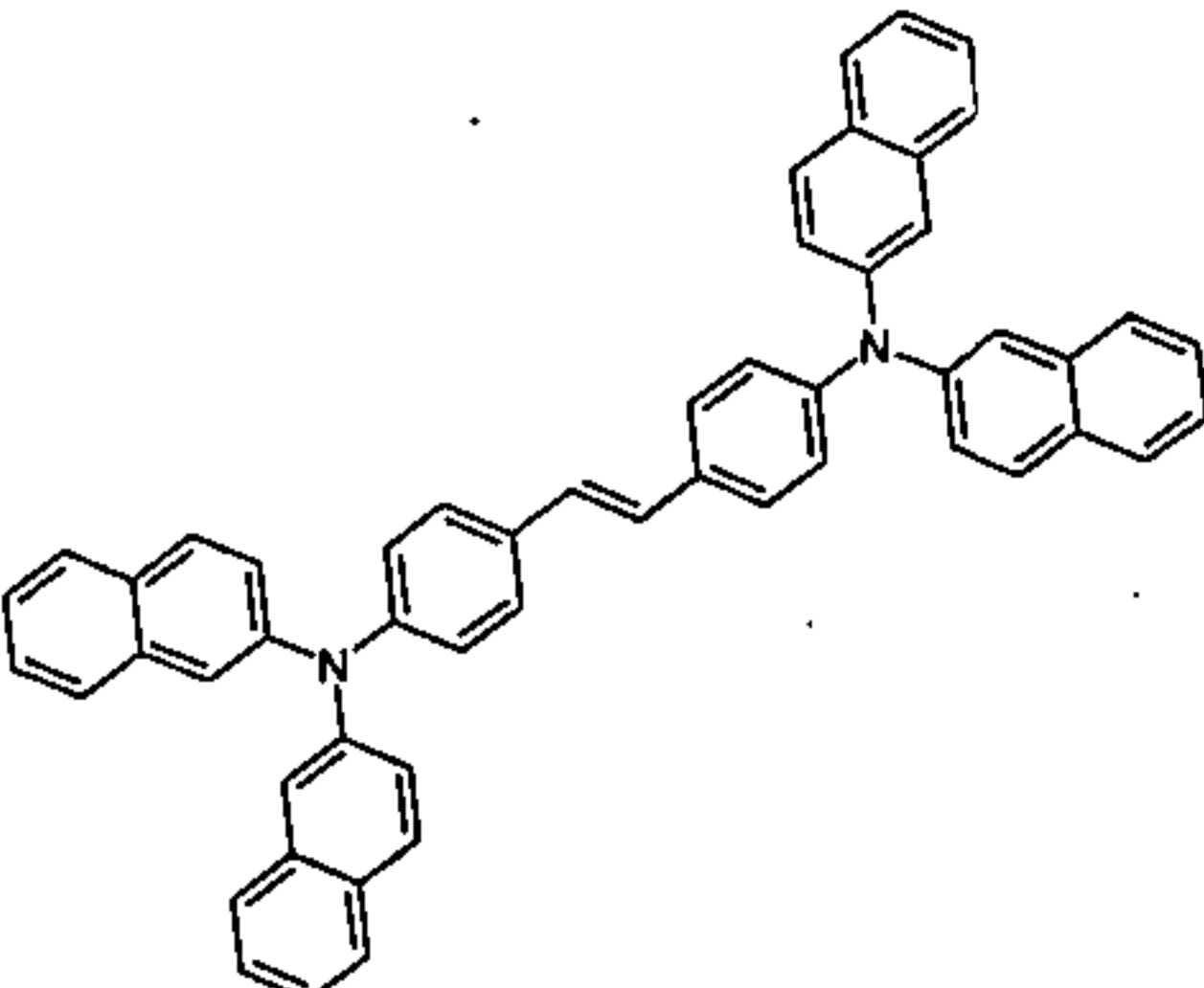
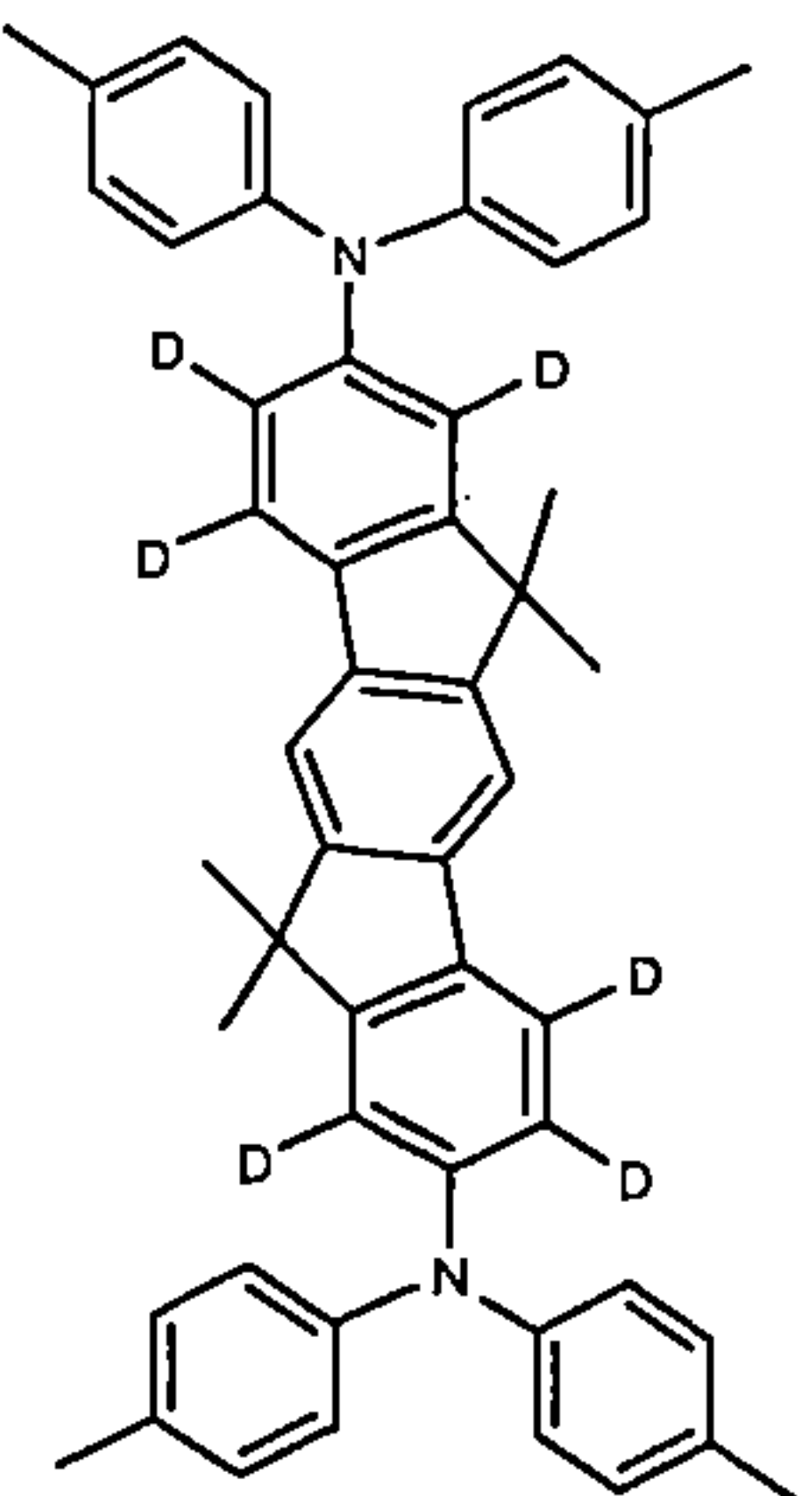
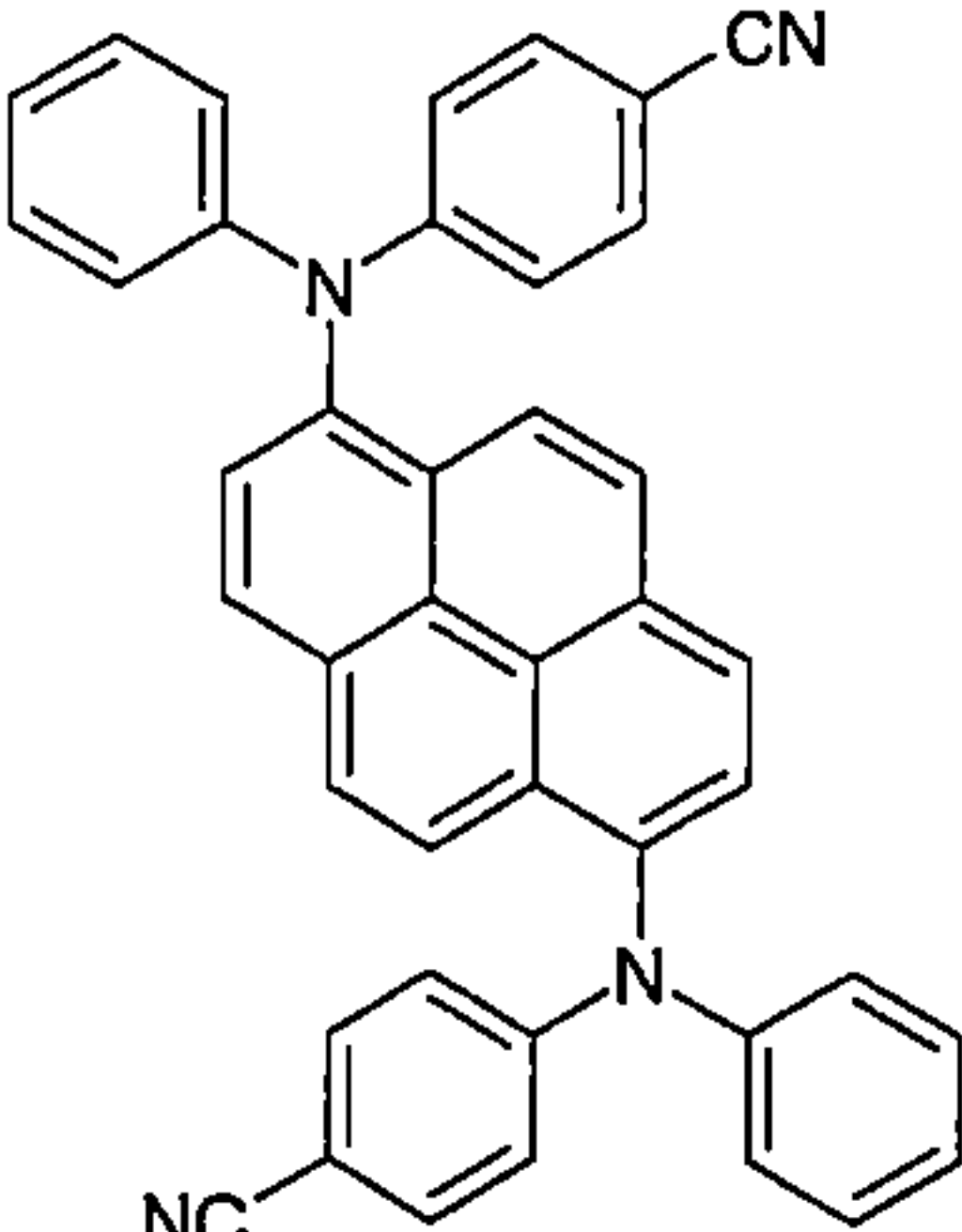
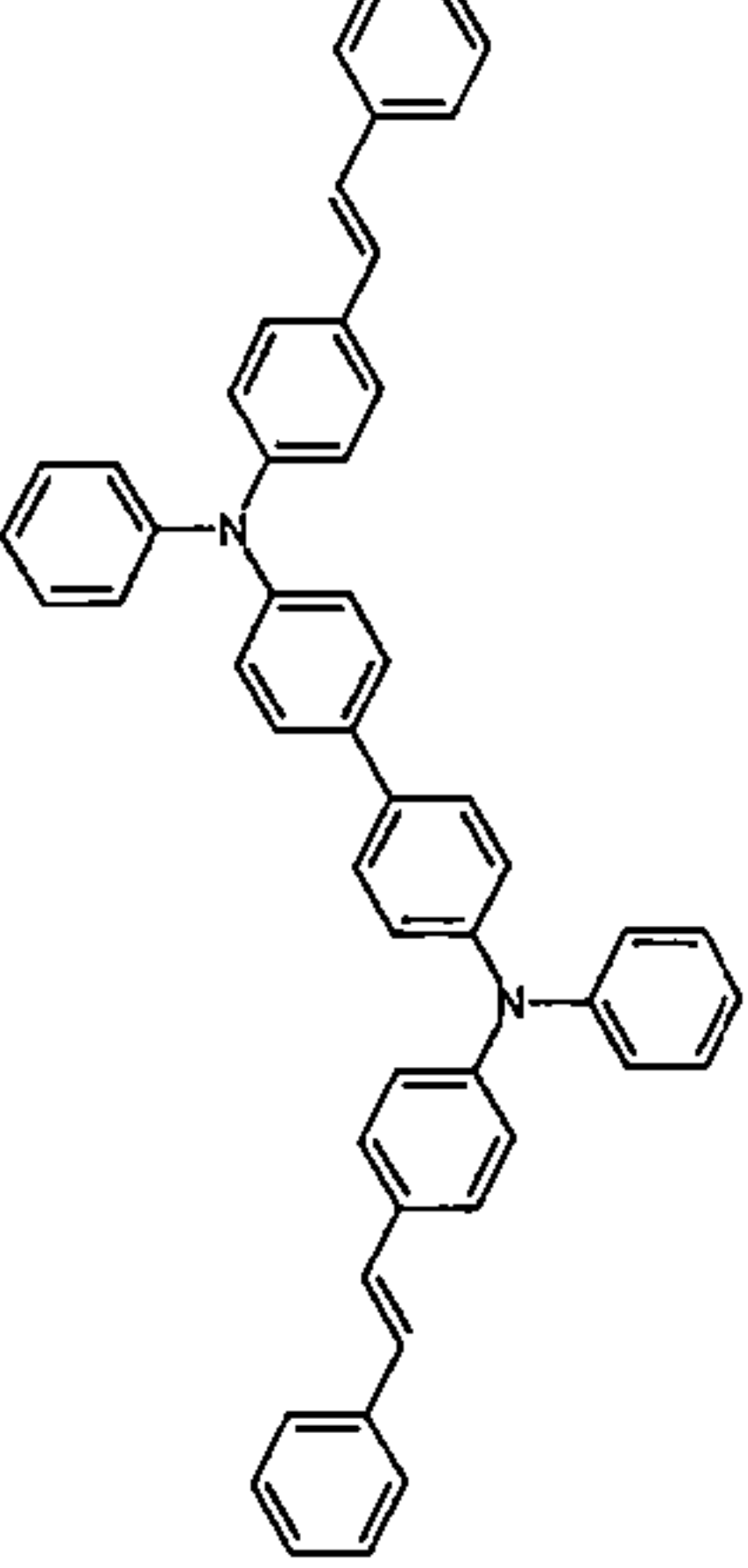
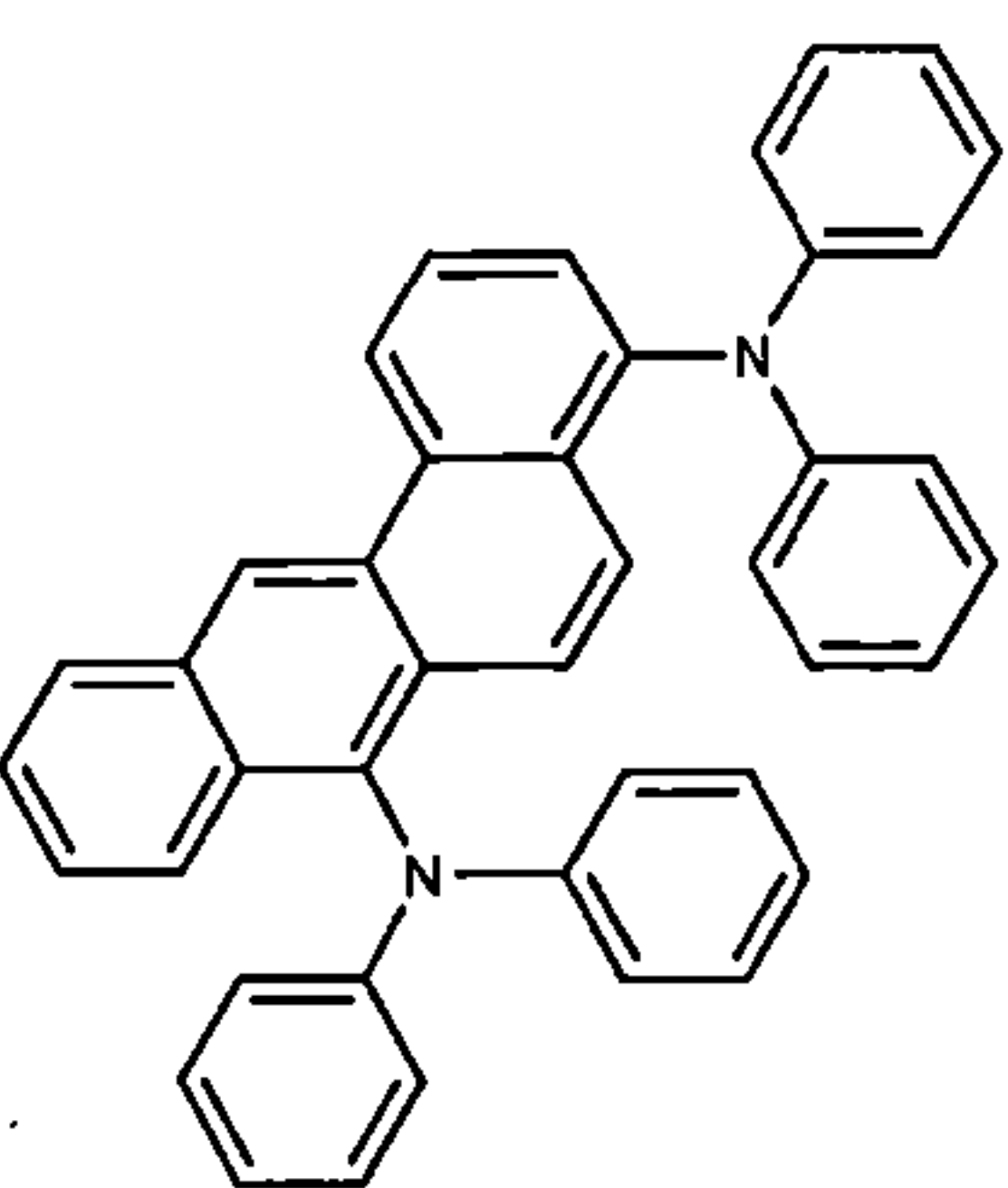
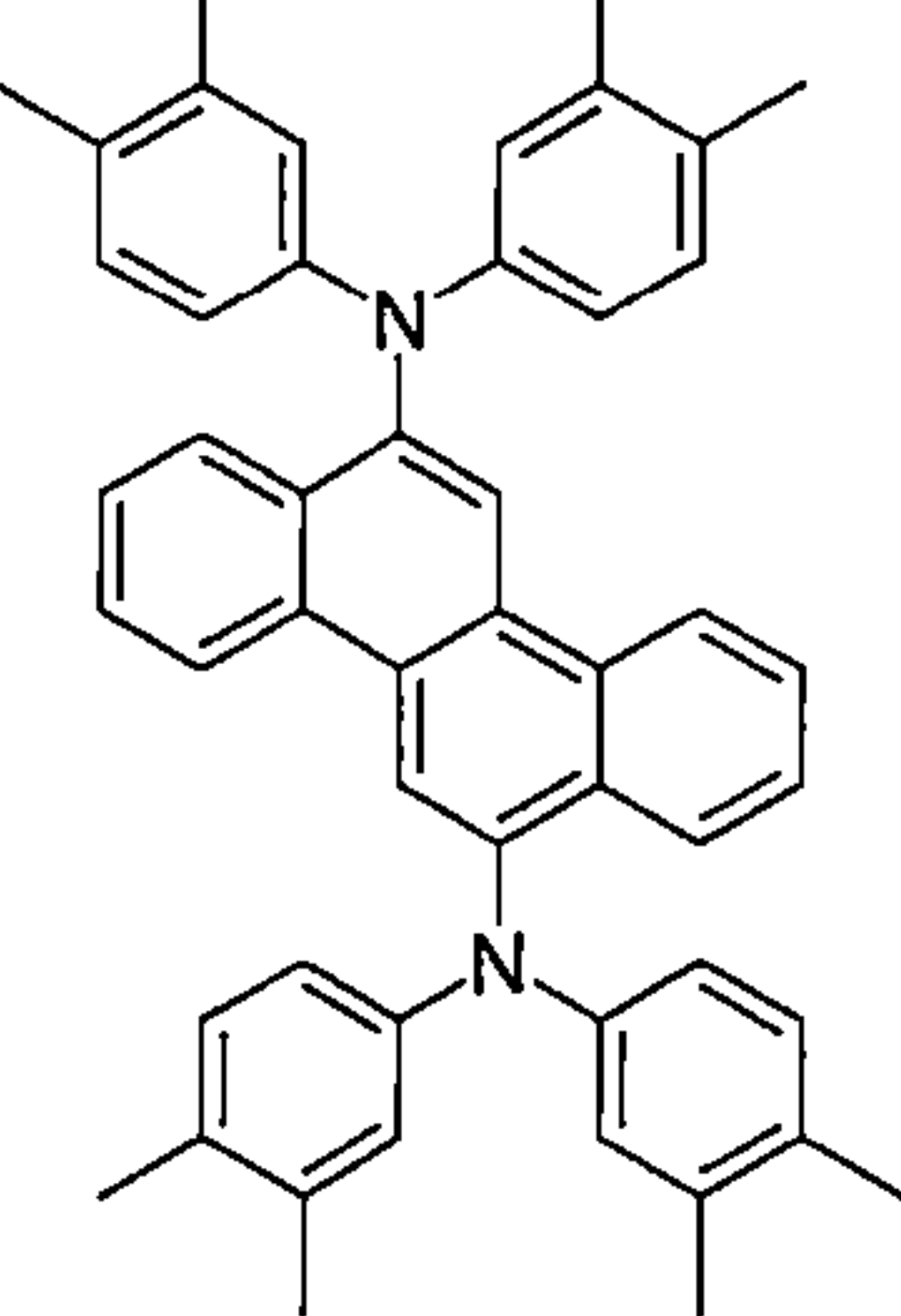
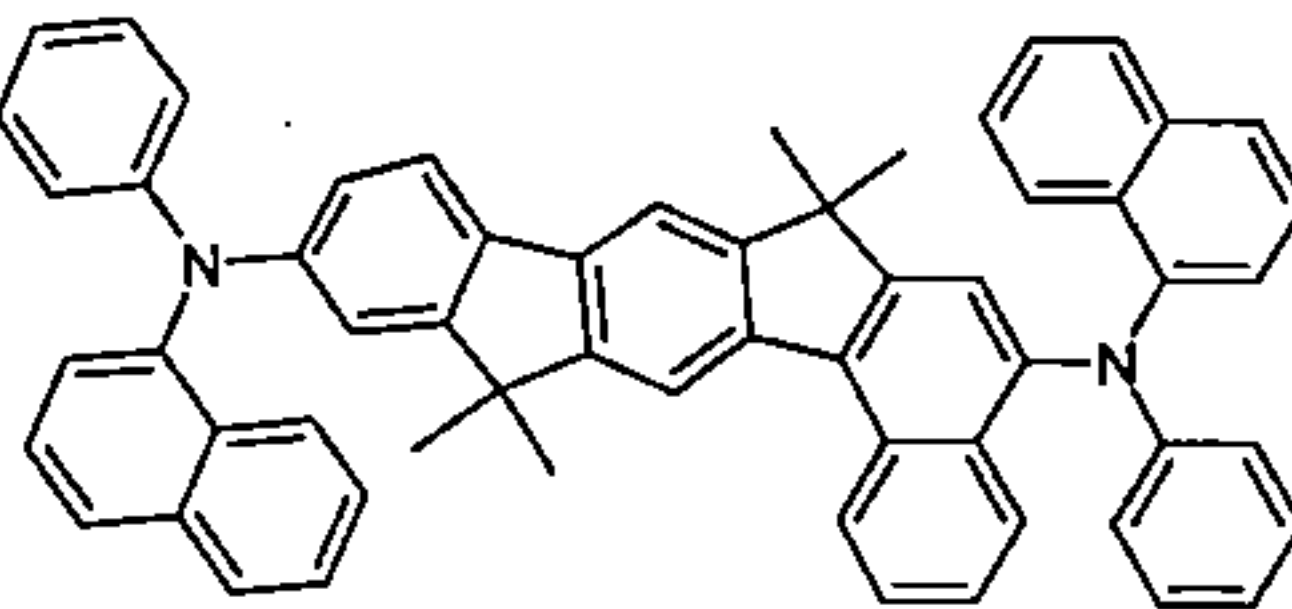
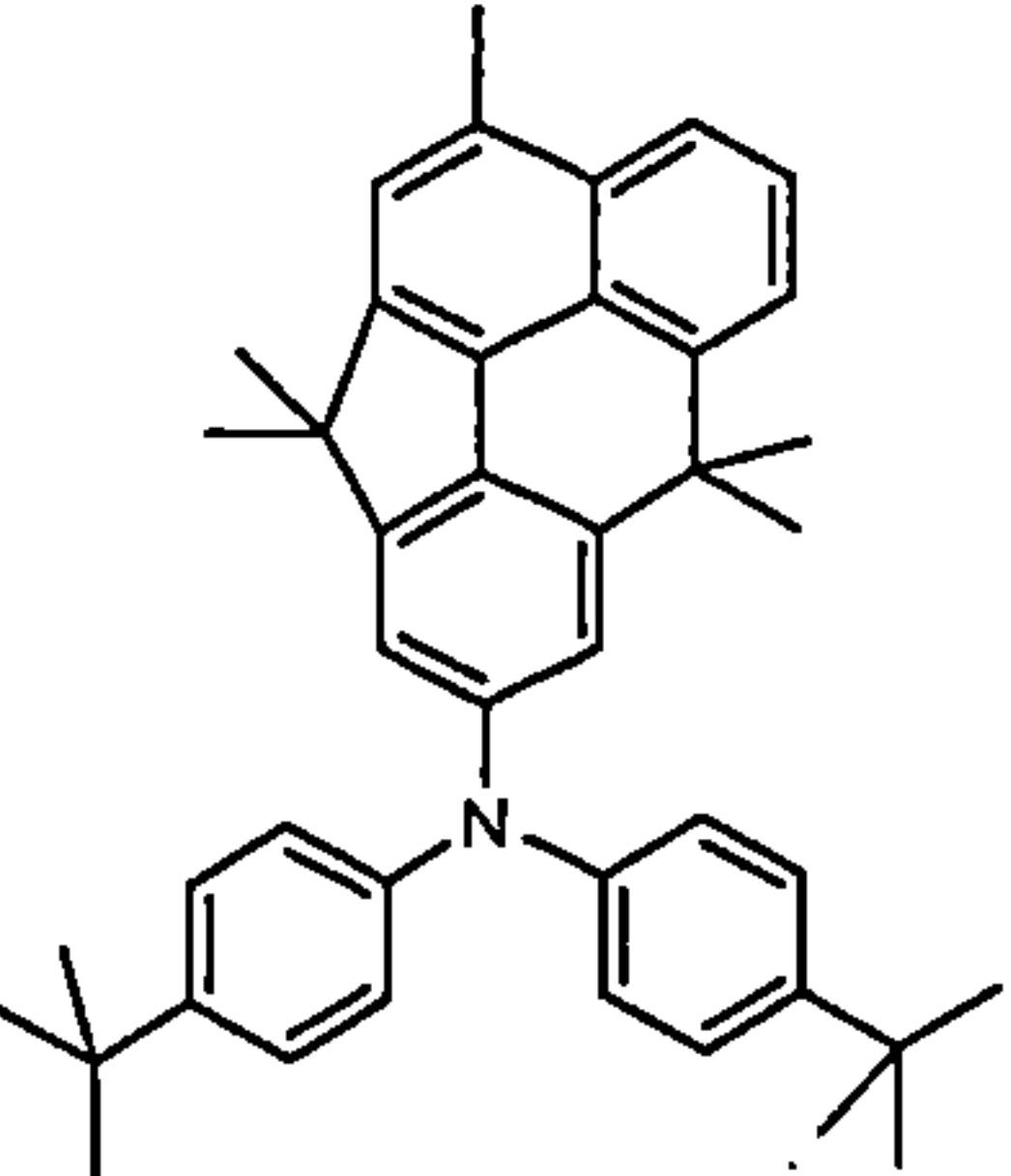
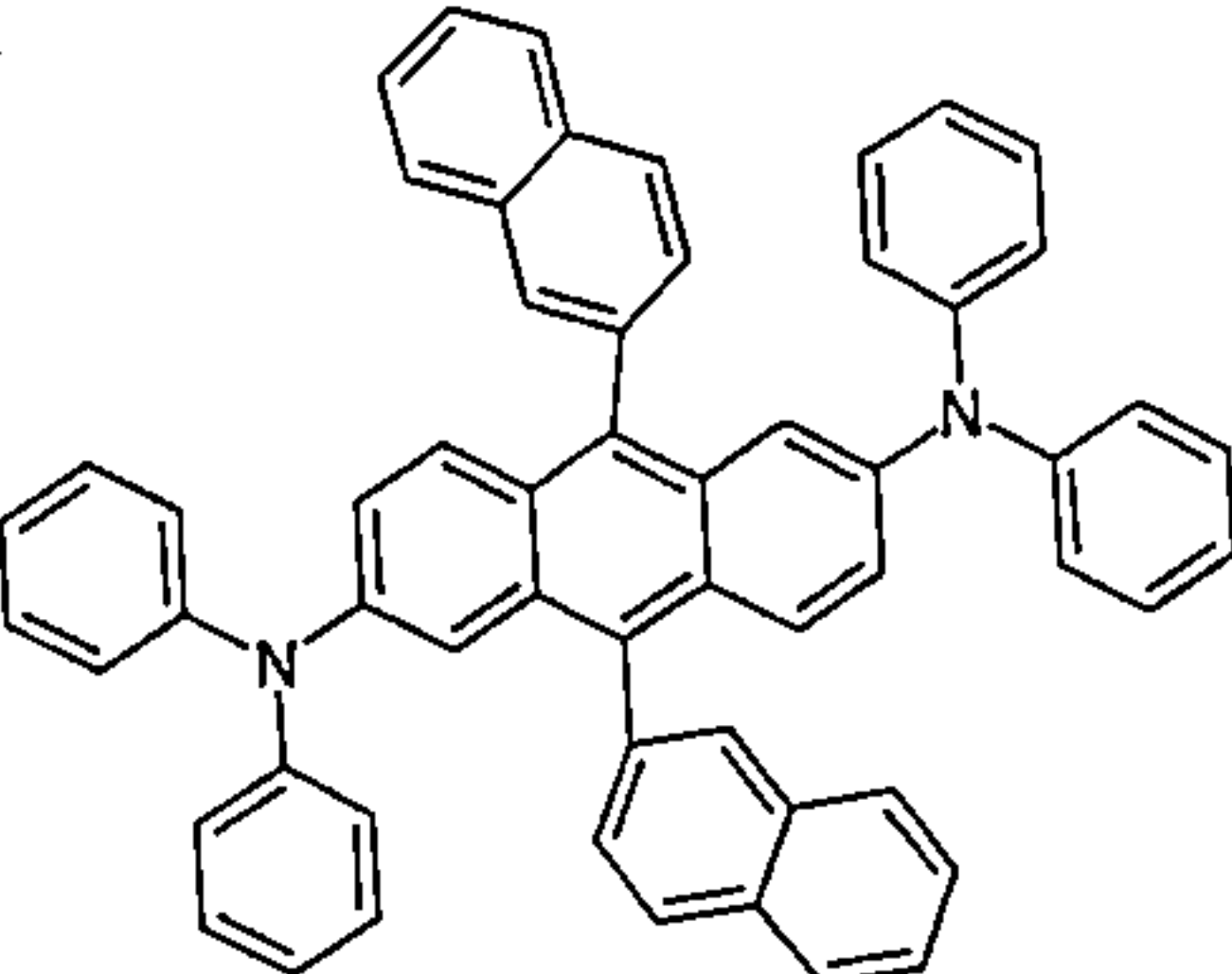
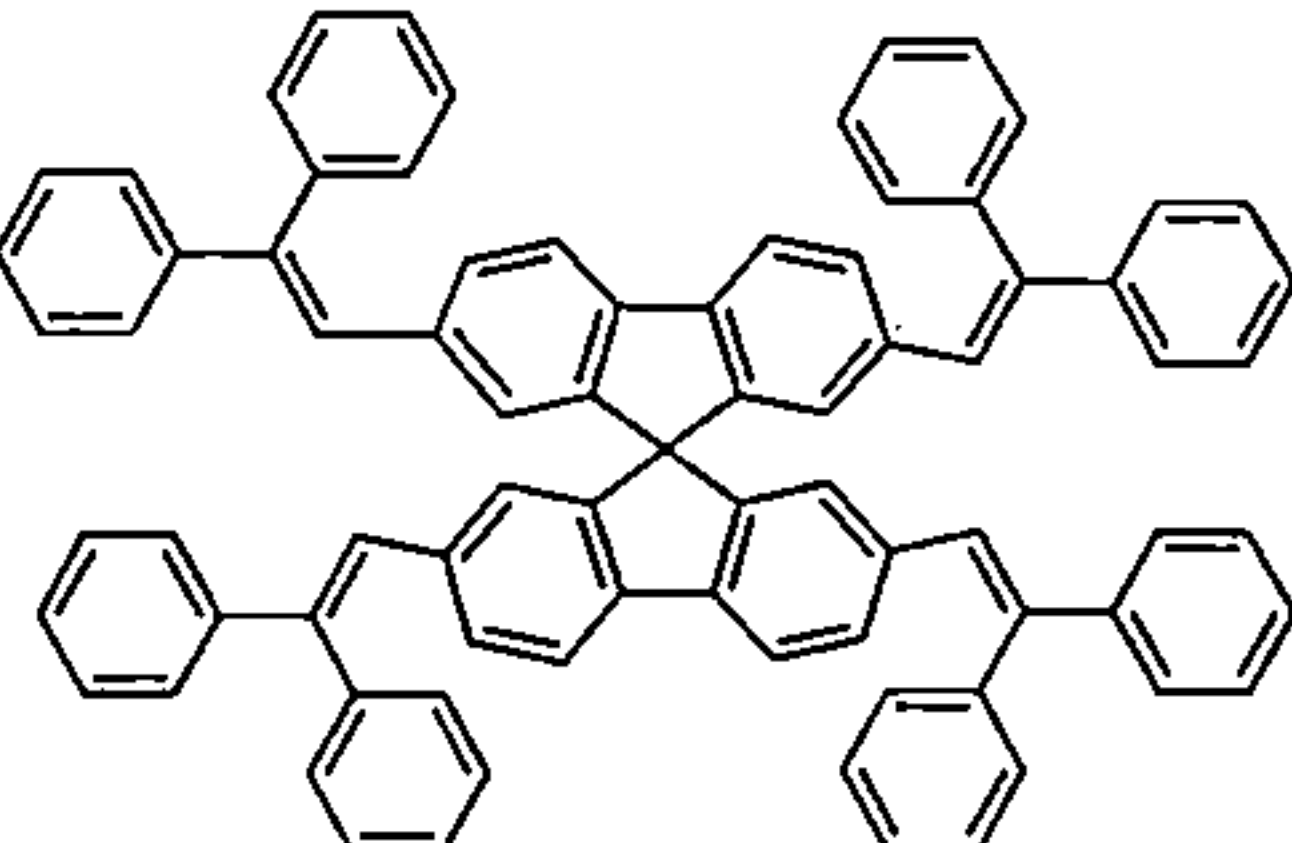
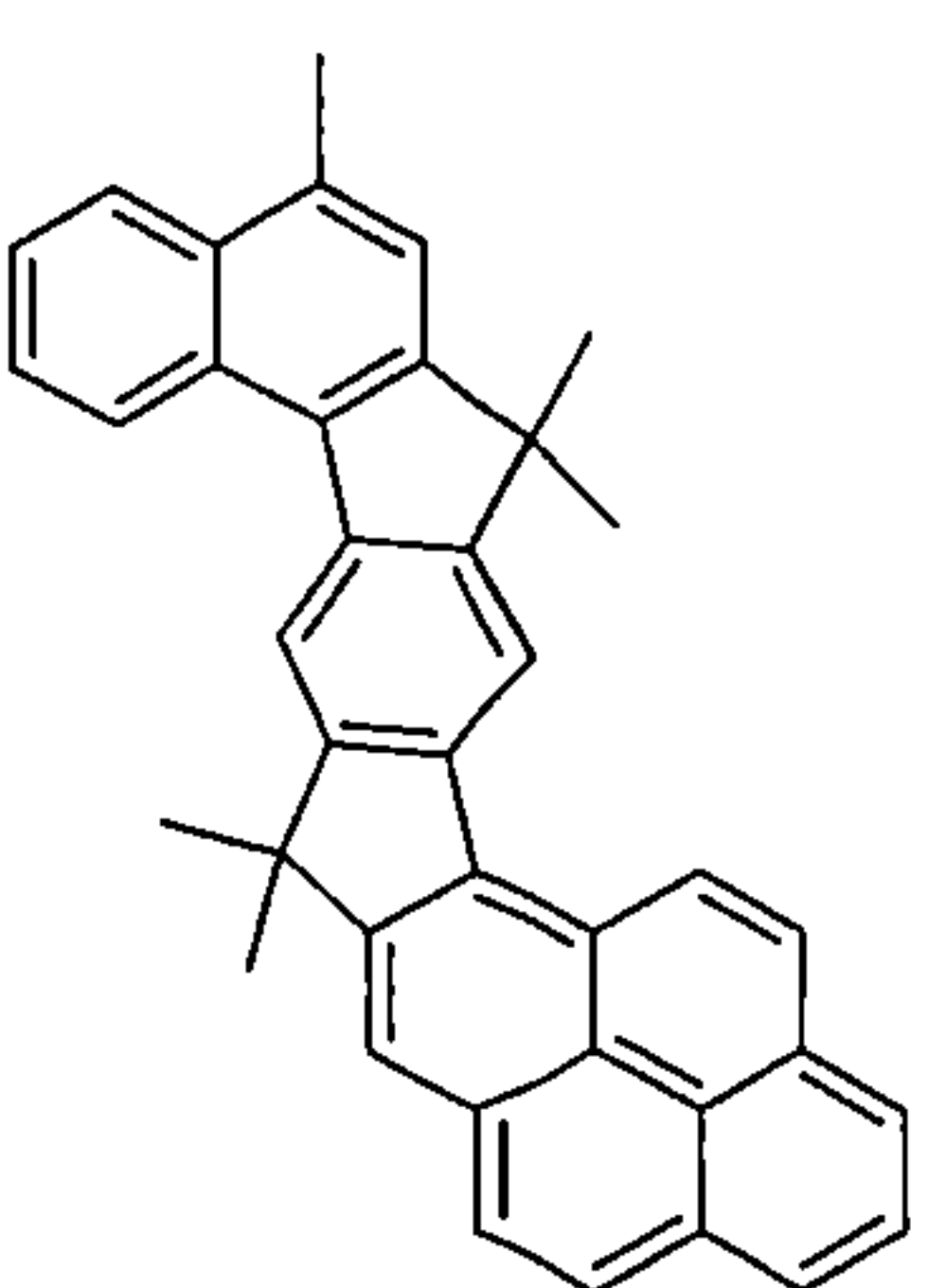
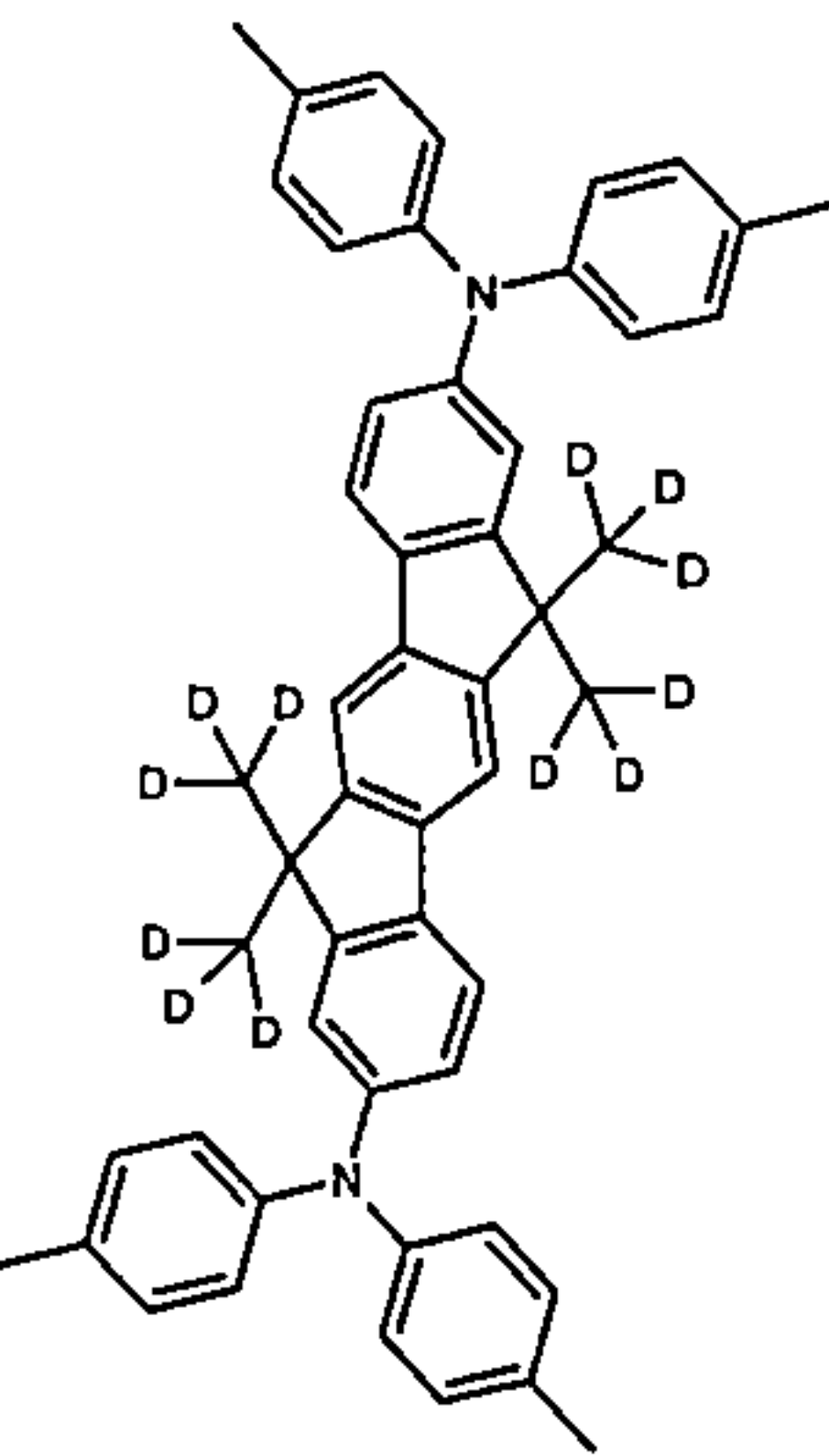
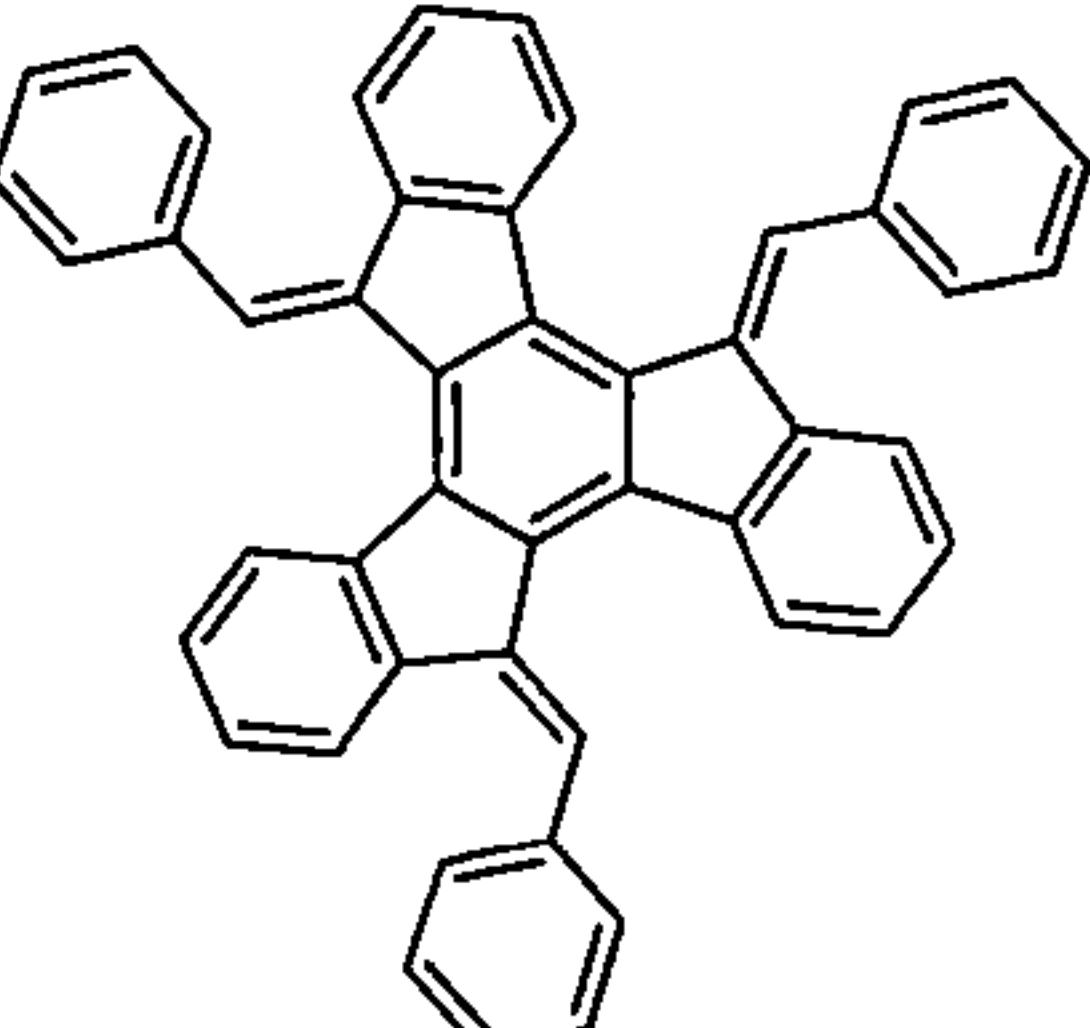
在本發明有機電致發光裝置之其他層中，可使用根據先前技術通常使用之所有材料。因此，熟習此項技術者將能夠在無發明性步驟之情況下組合使用所有已知用於有機電致發光裝置之材料與本發明式(1)化合物或較佳實施例。

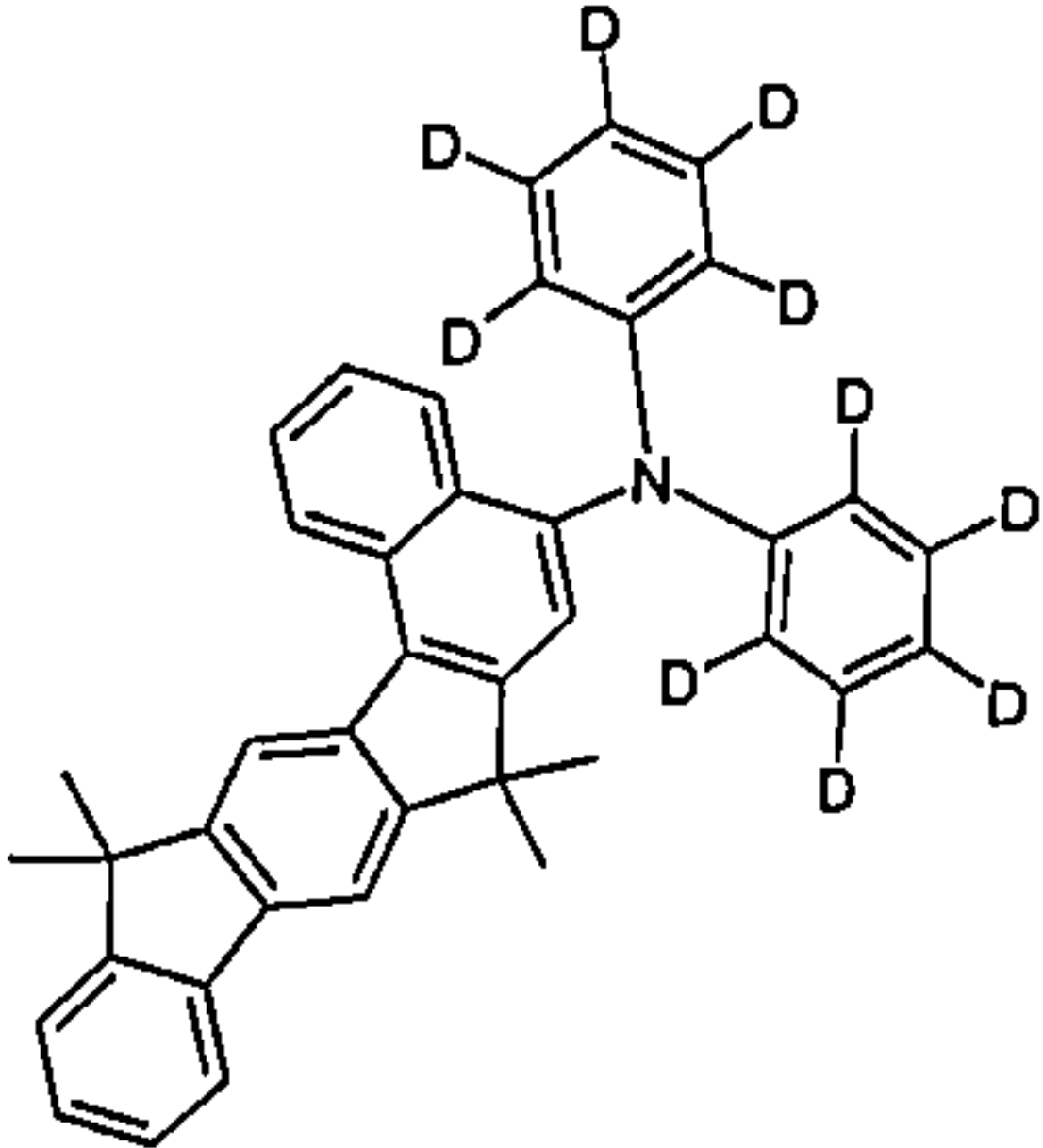
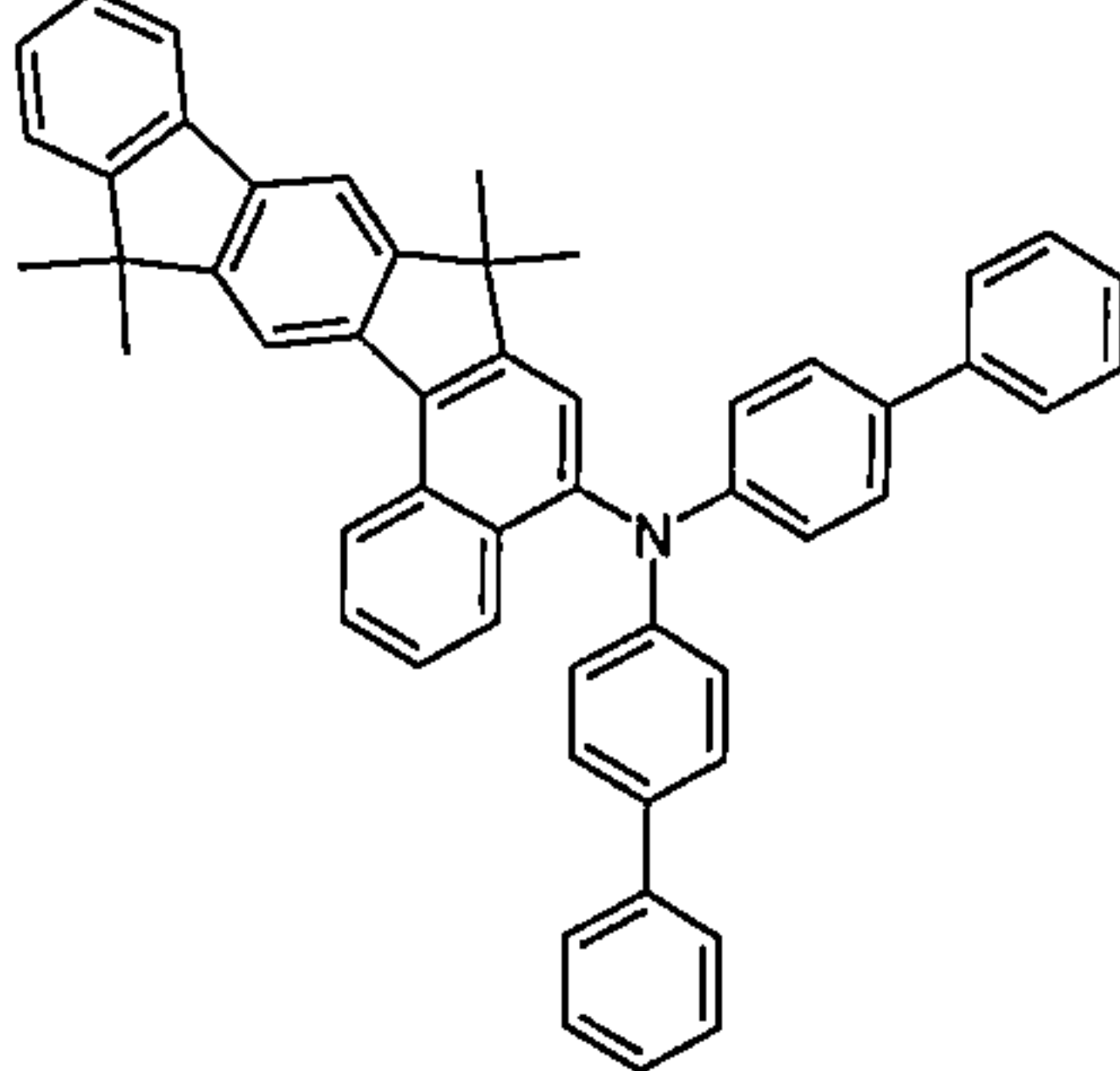
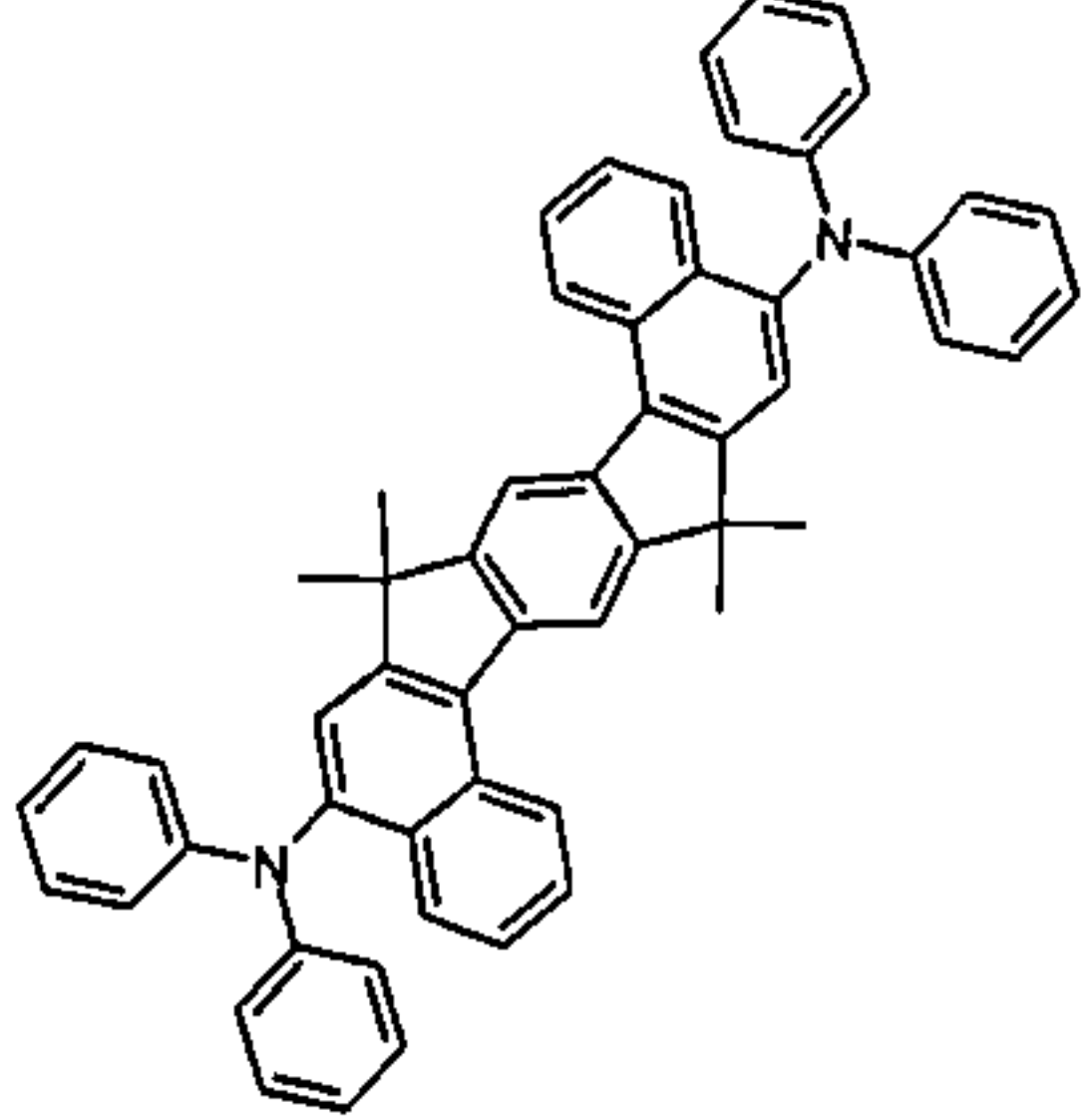
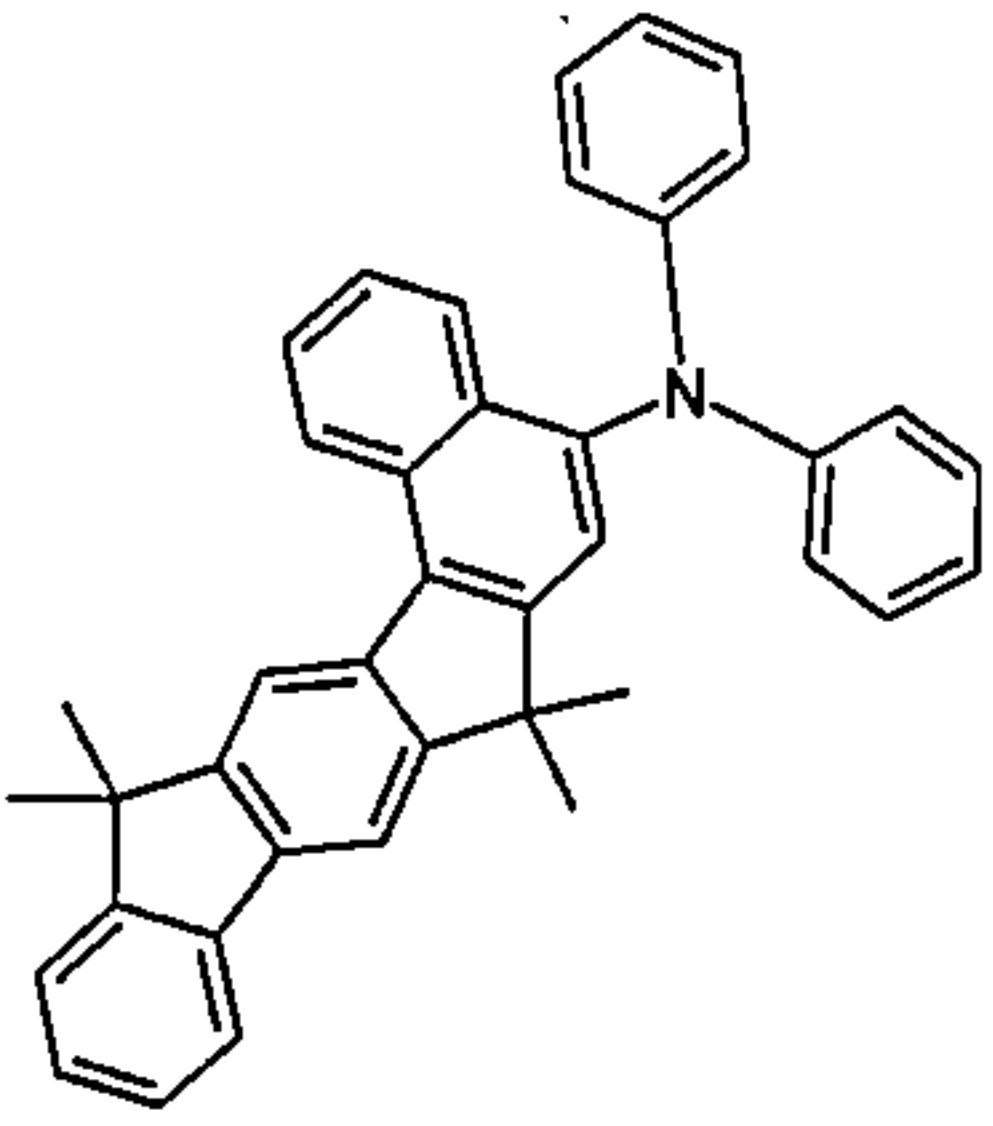
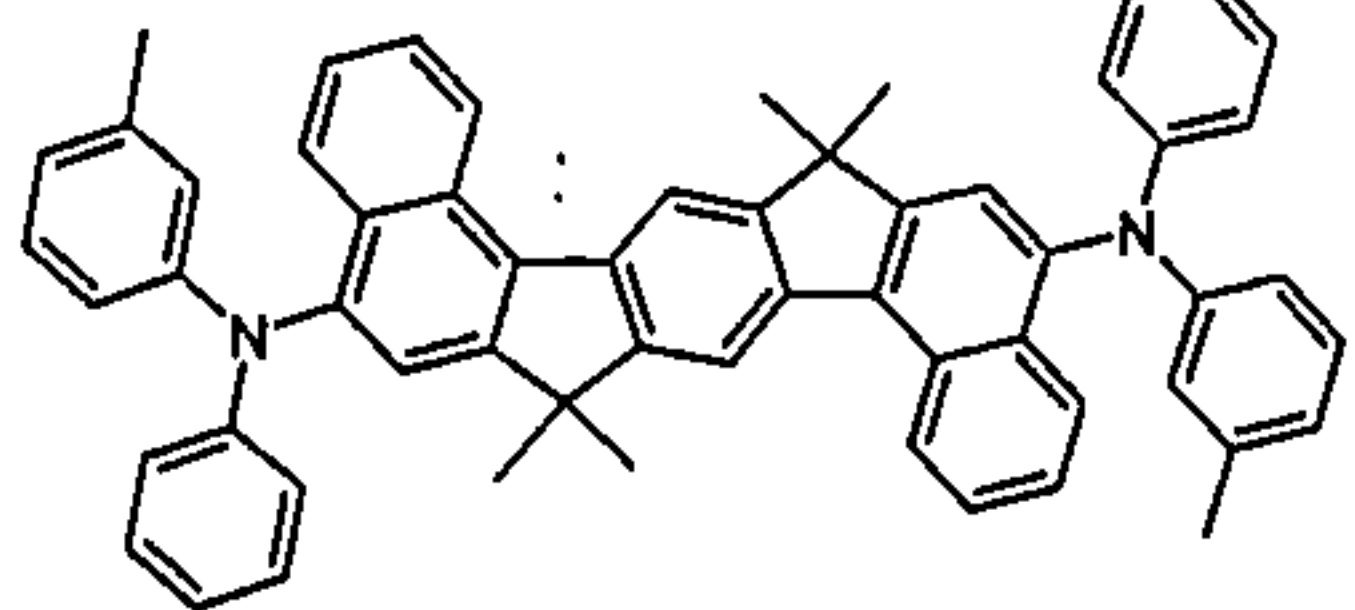
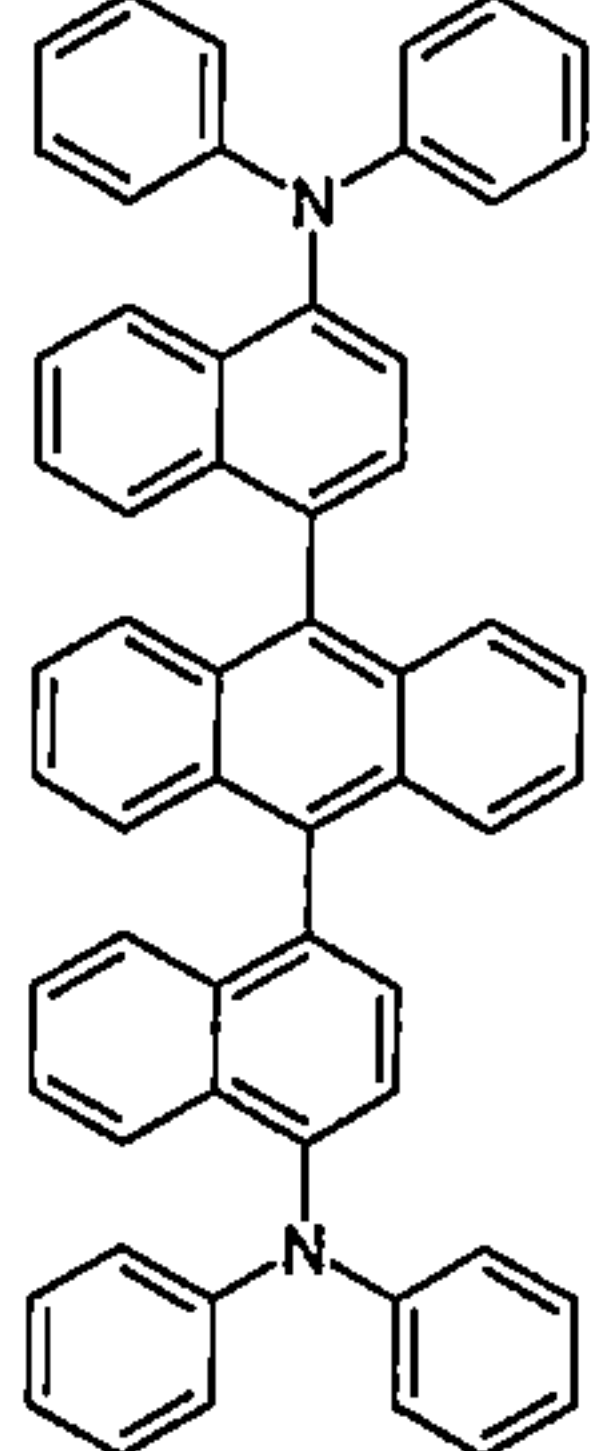
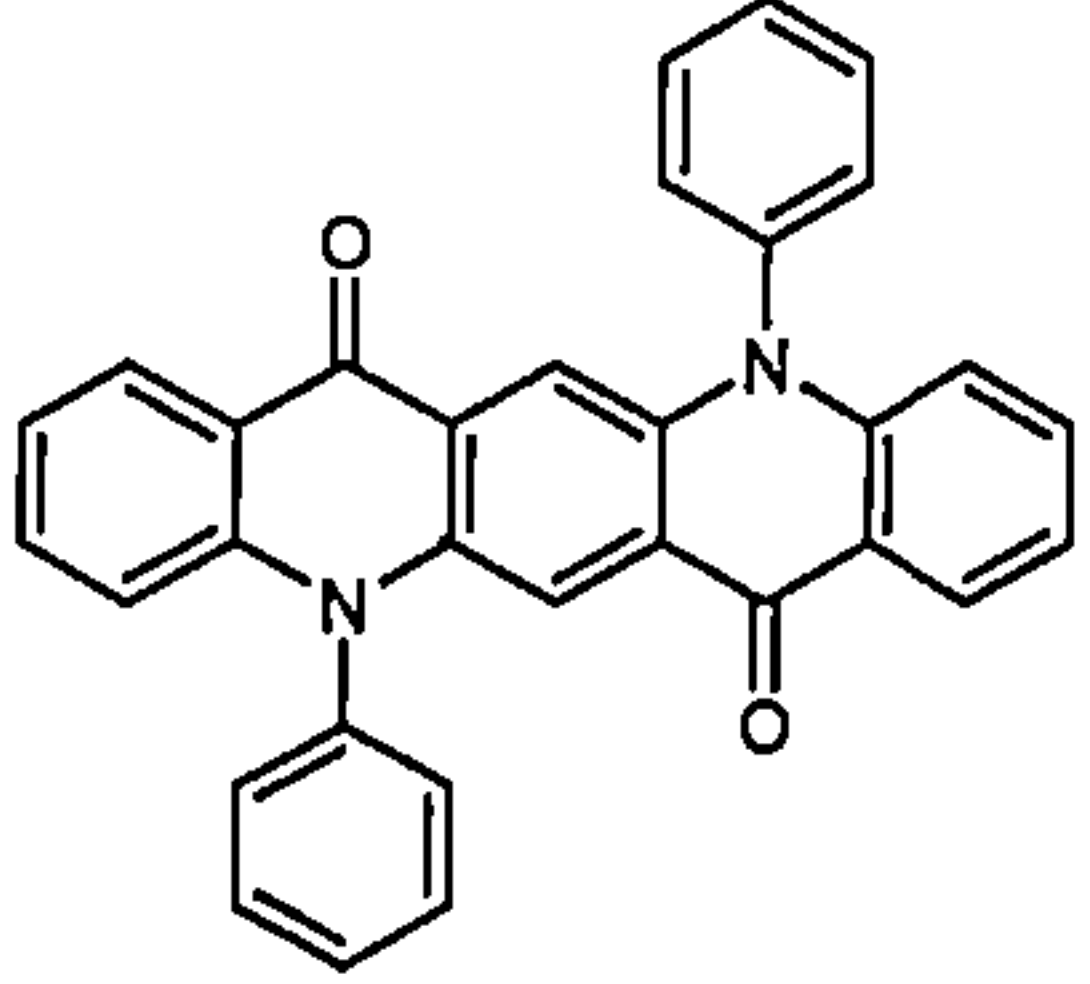
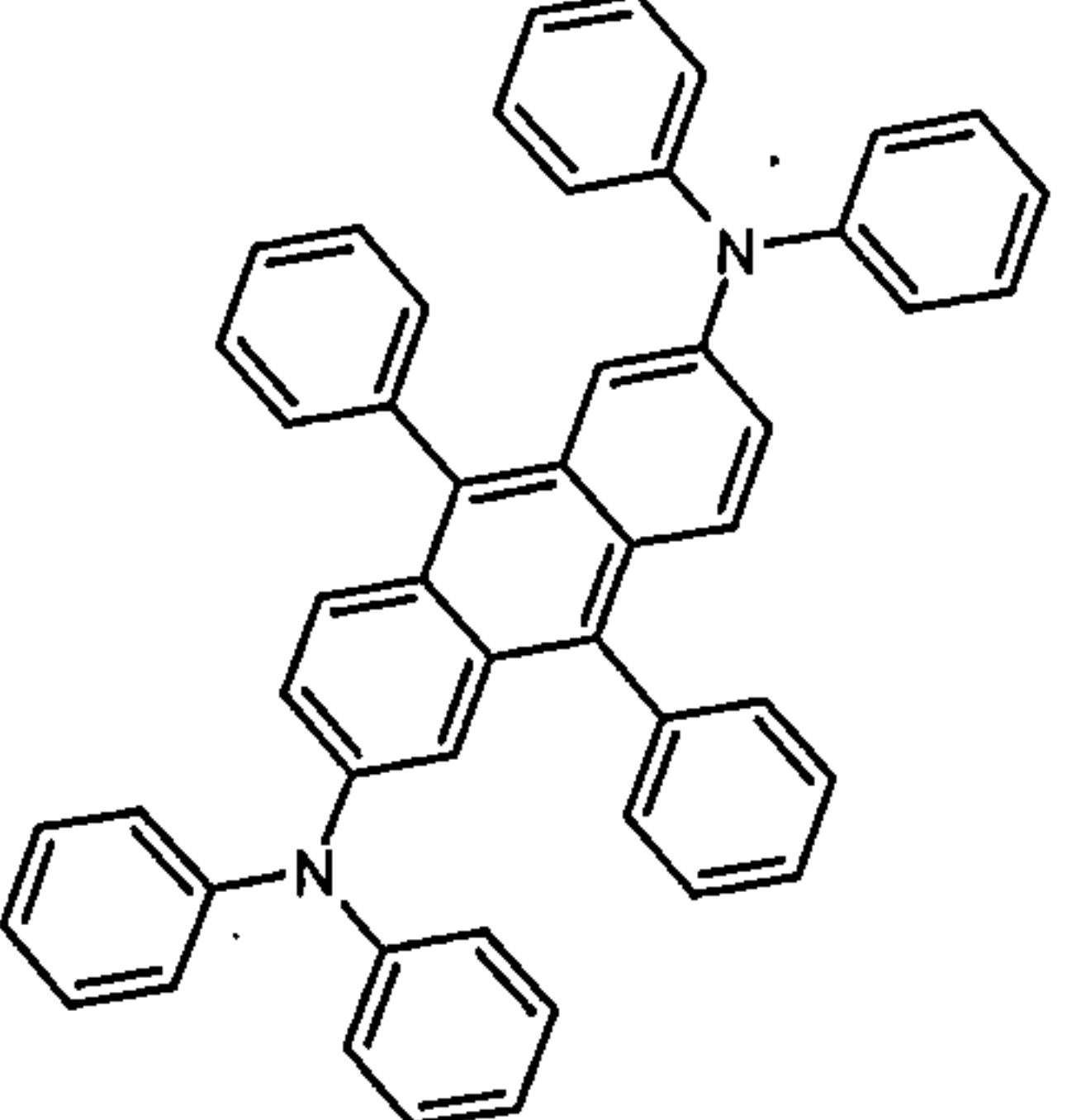
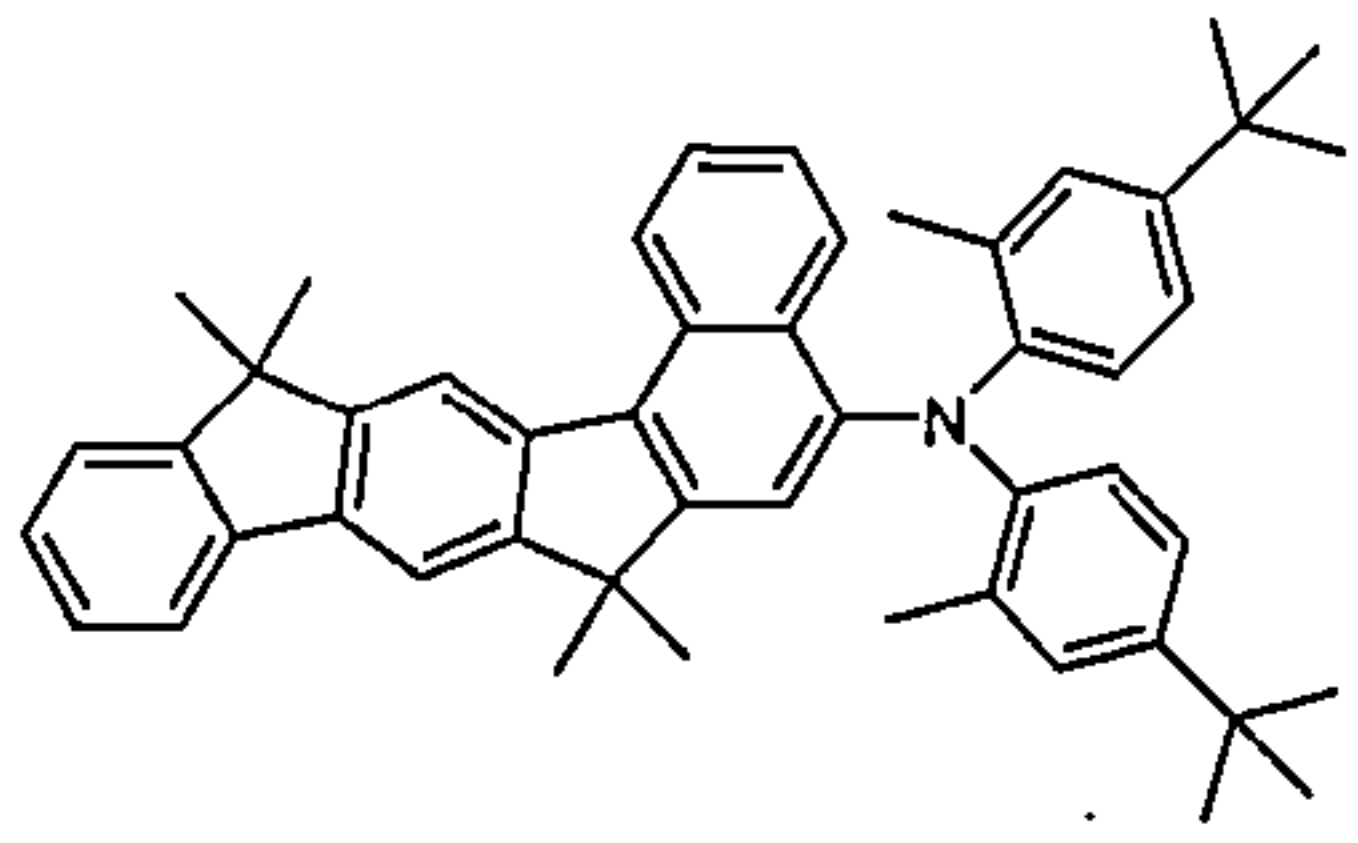
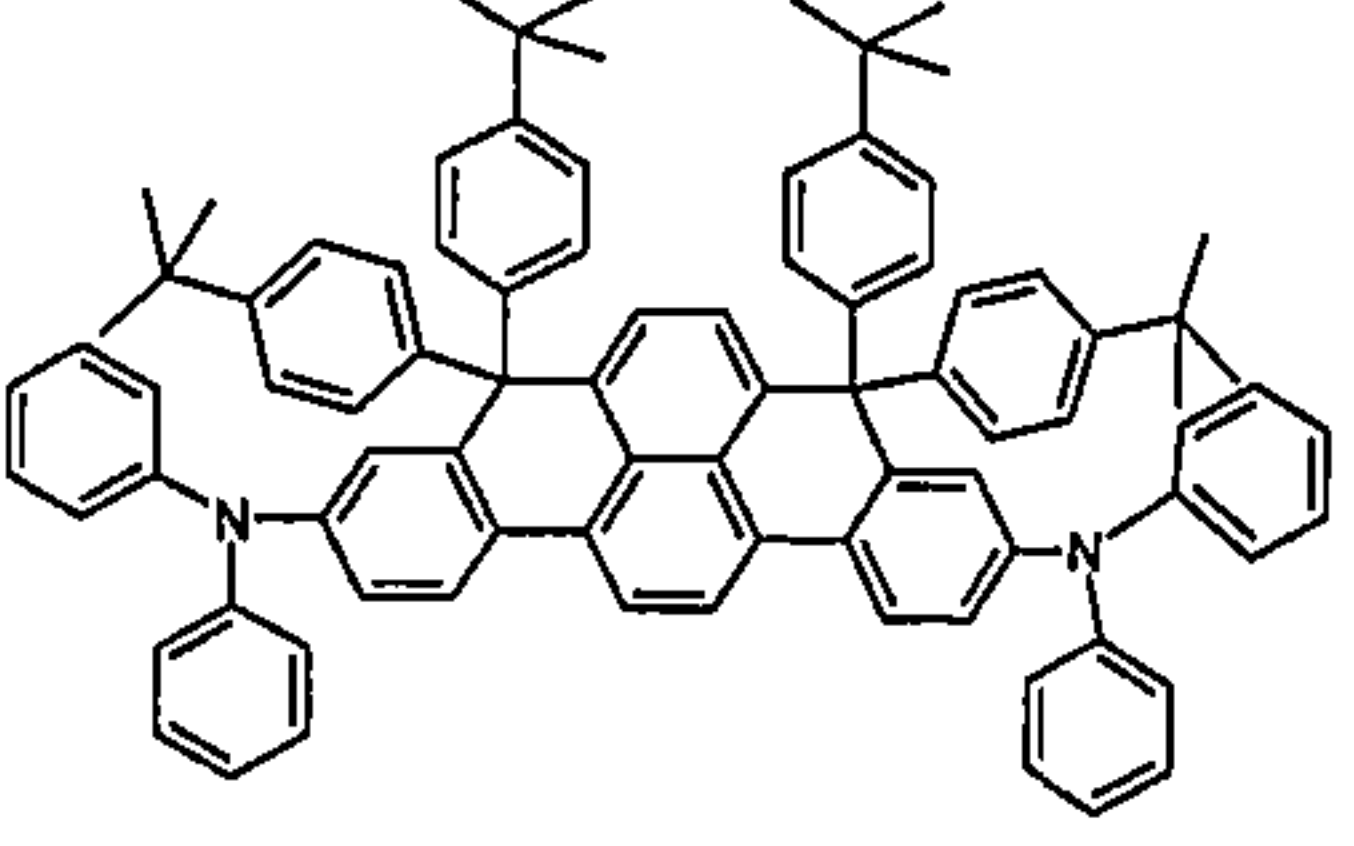
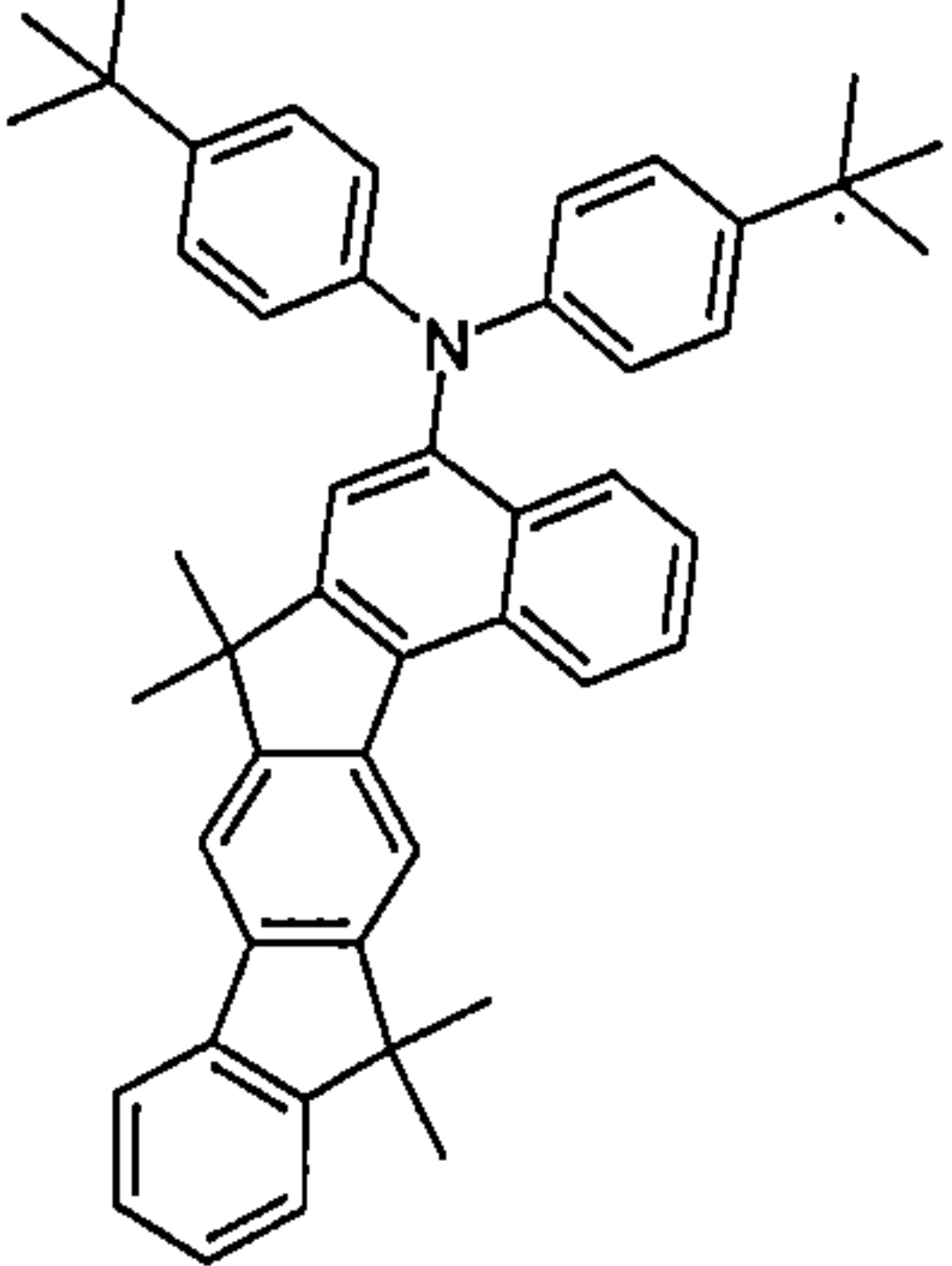
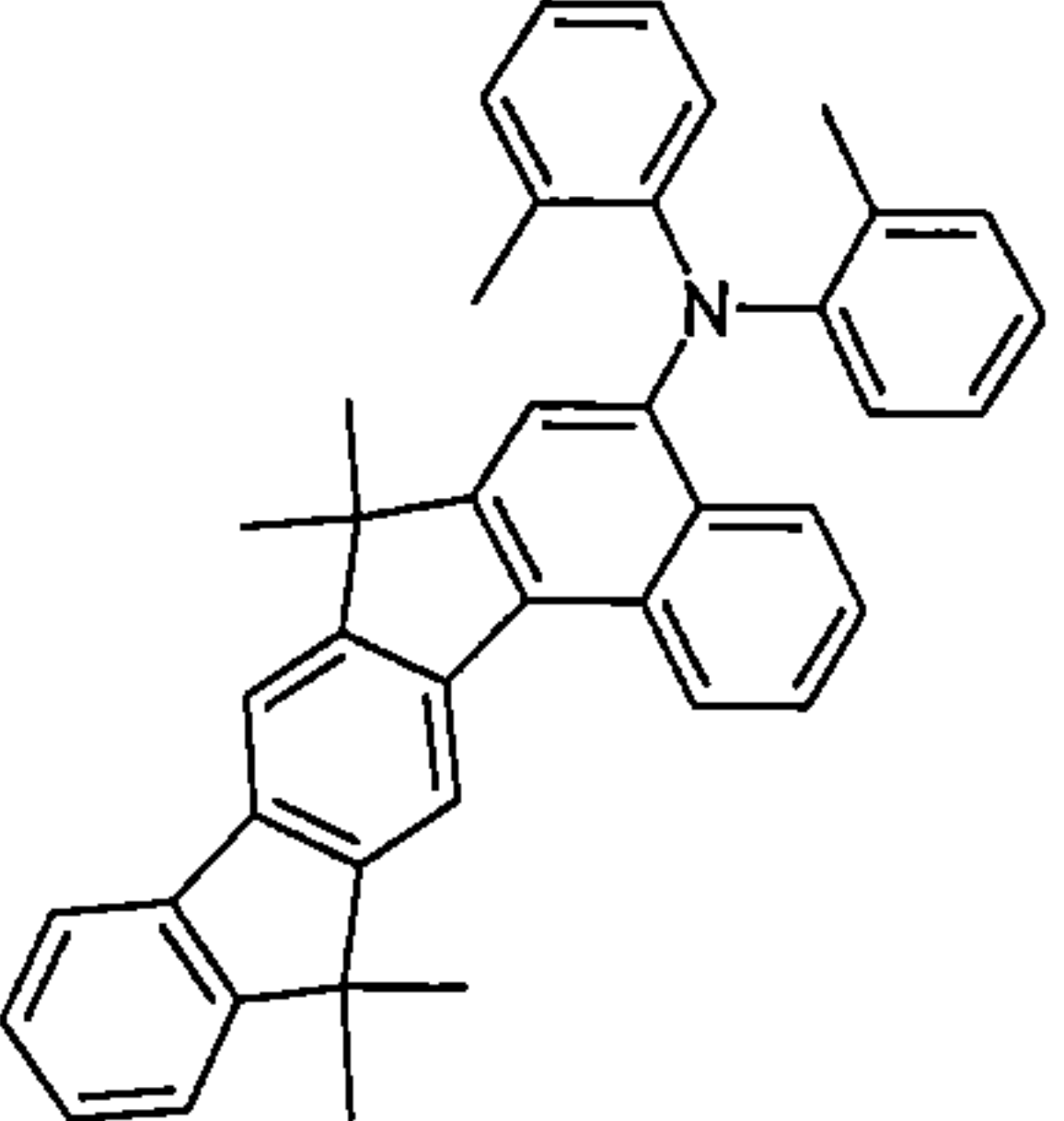
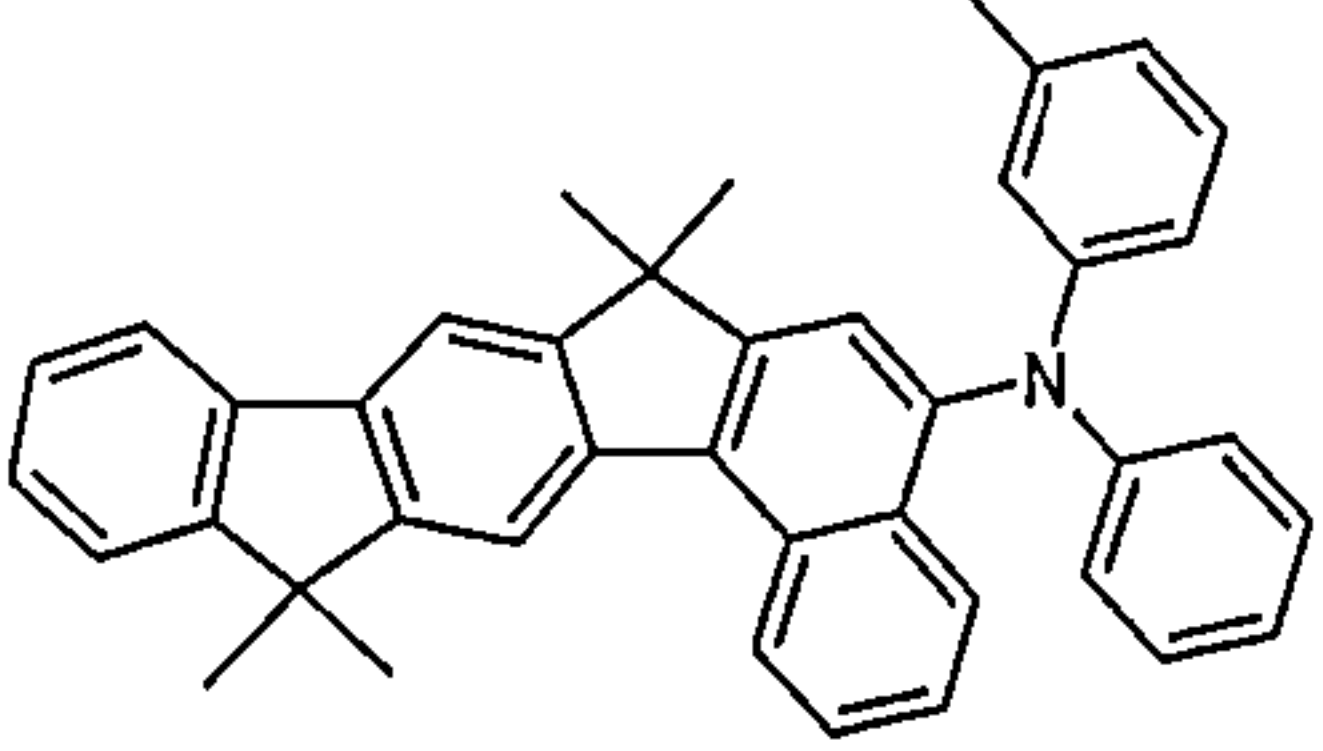
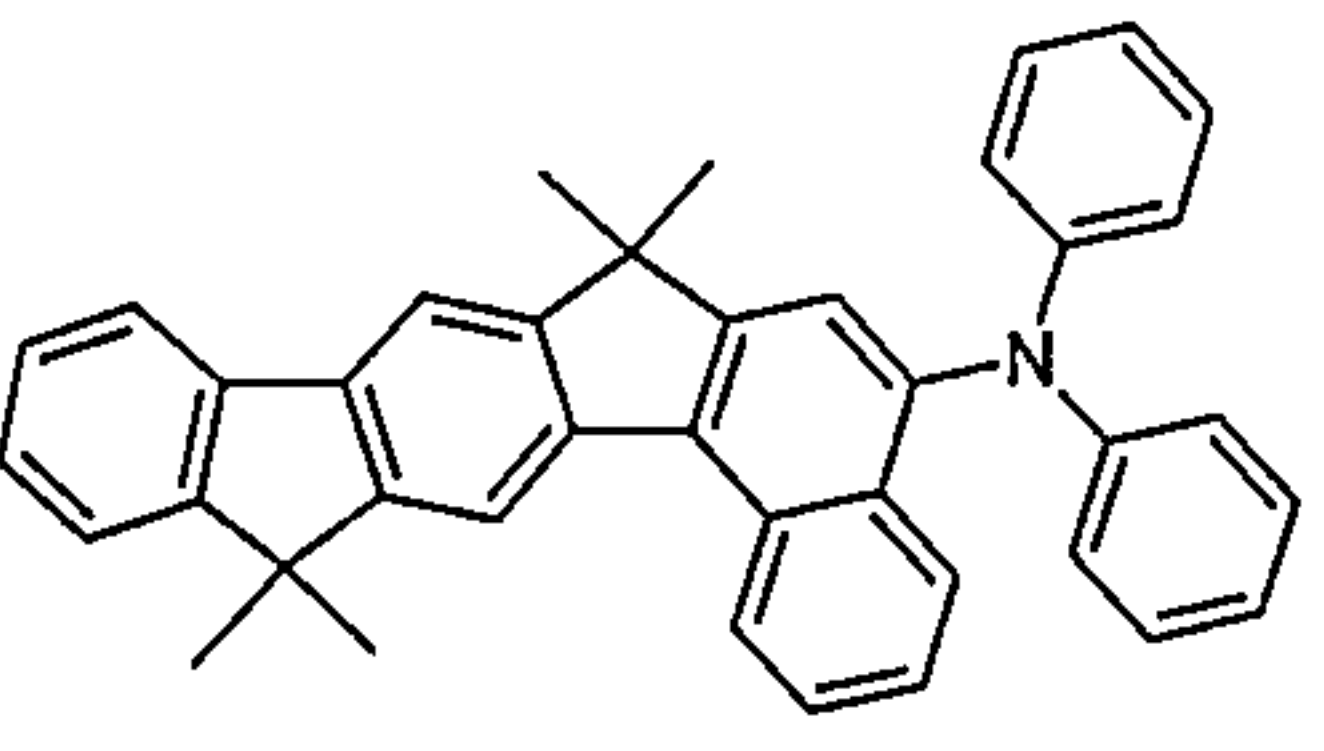
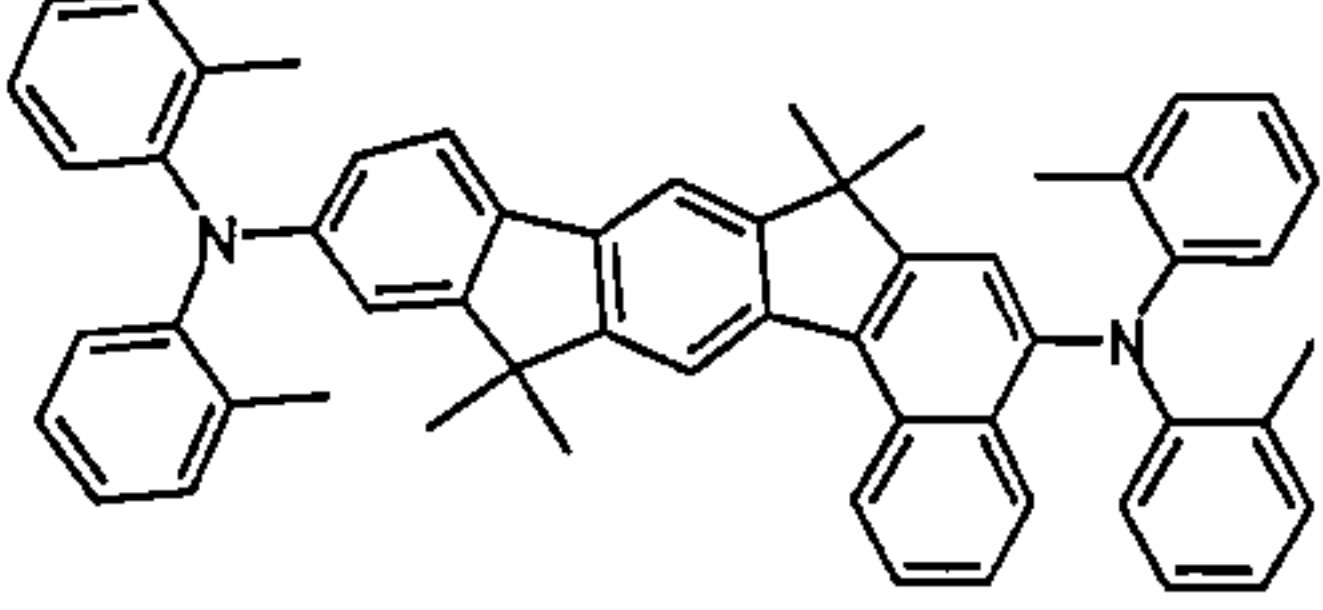
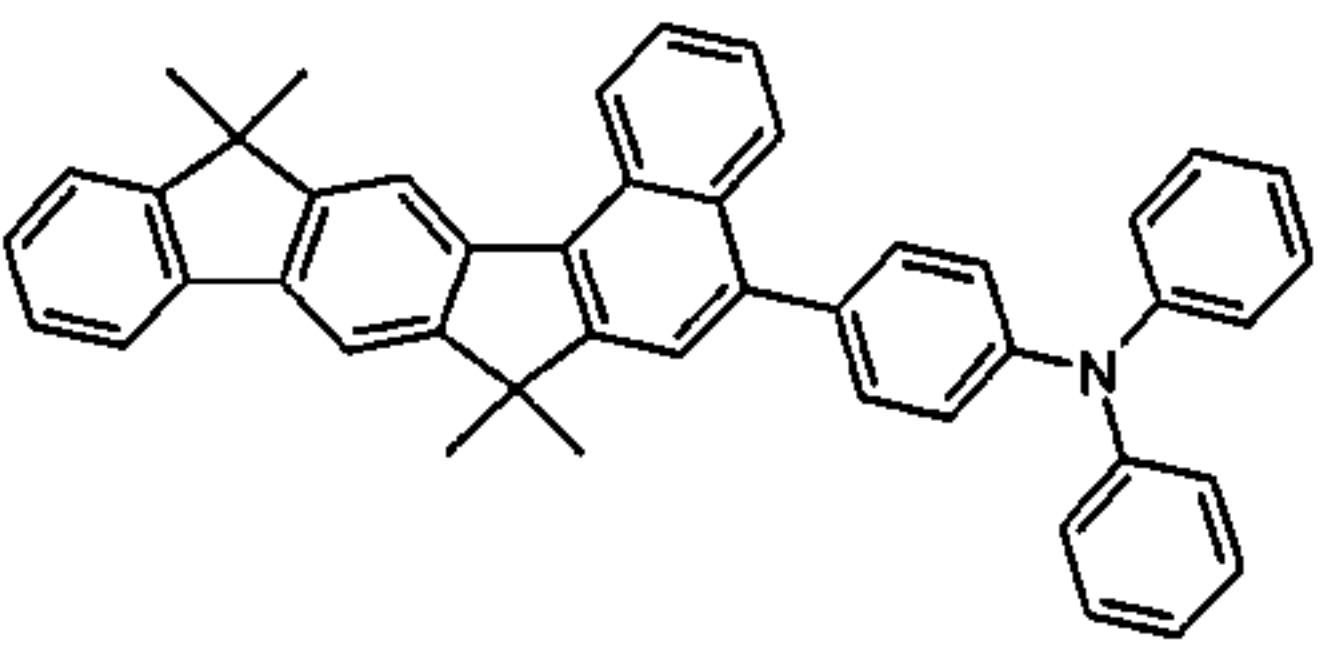
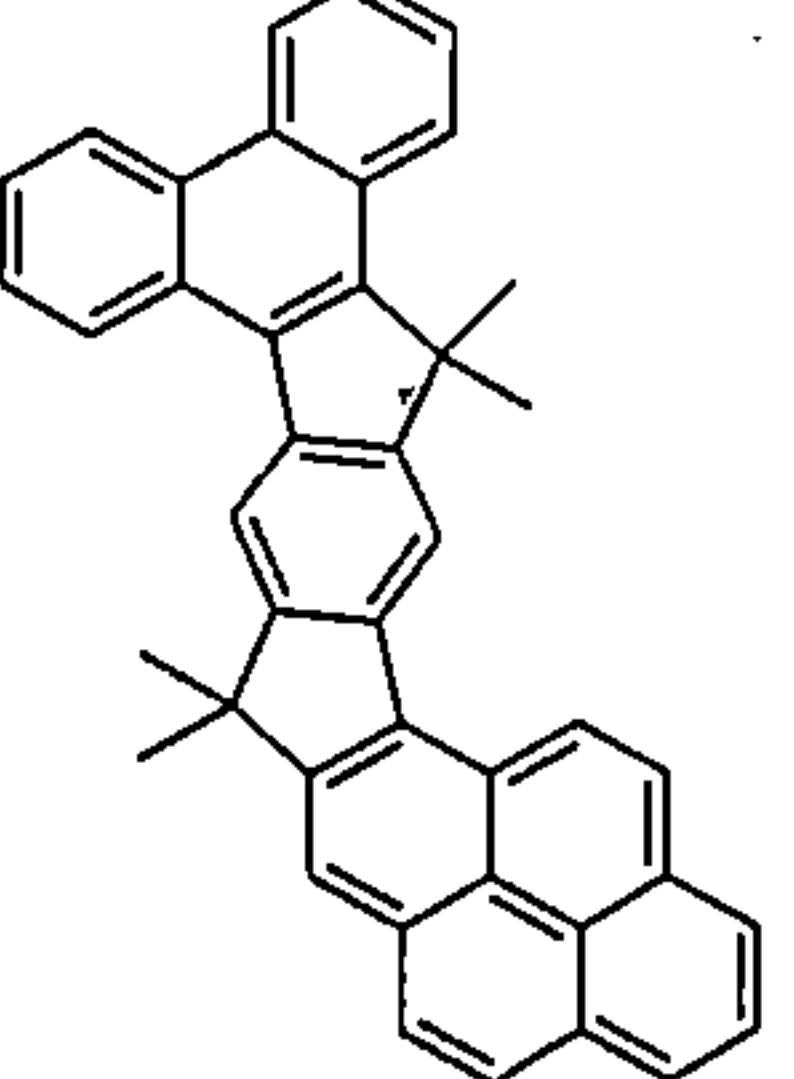
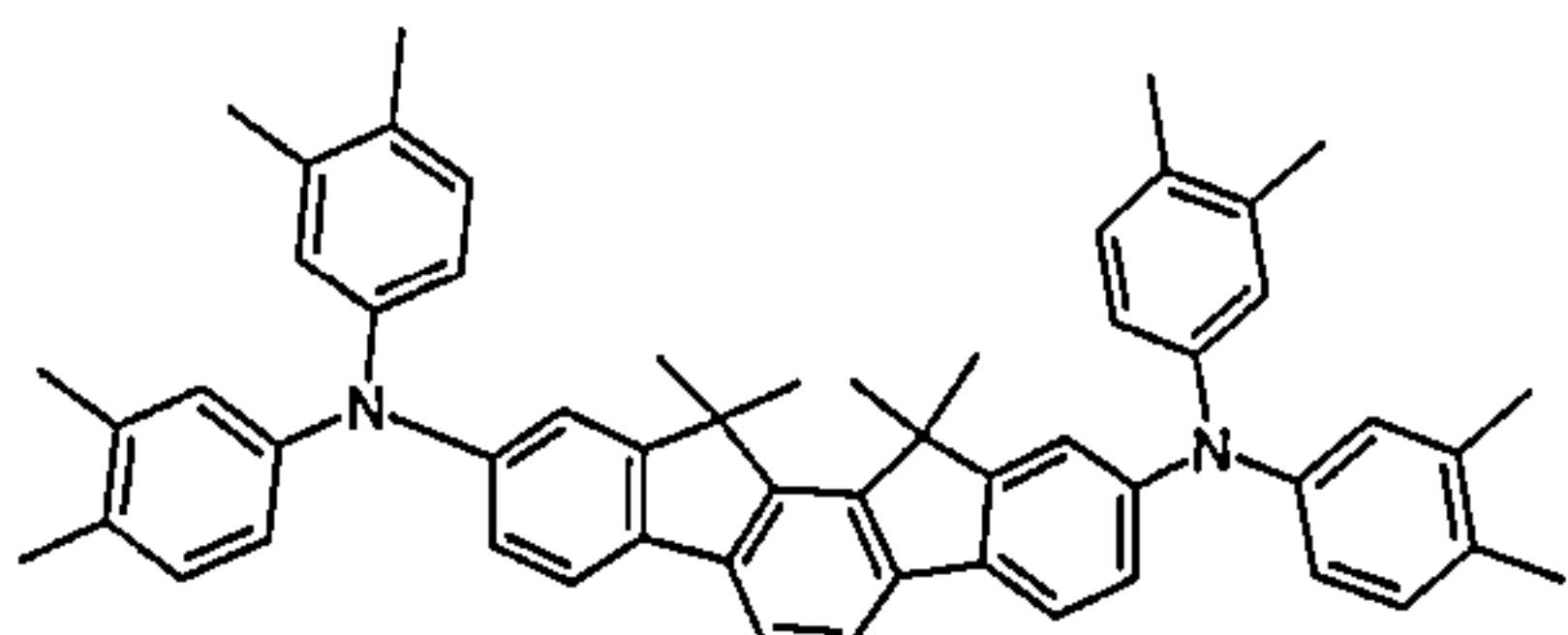
較佳螢光發射體材料係選自芳基胺類。在本發明意義上，芳基胺或芳族胺意指含有三個直接鍵結至氮之經取代或未經取代之芳族或雜芳族環系統的化合物。該等芳族或雜芳族環系統中之至少一者較佳係稠合環系統，尤佳具有至少14個芳族環原子。其較佳實例係芳族蔥胺、芳族蔥二胺、芳族芘胺、芳族芘二胺、芳族蒽胺或芳族蒽二胺。芳族蔥胺意指一個二芳基胺基係直接鍵結至蔥基(較佳在9位)之化合物。芳族蔥二胺意指兩個二芳基胺基係直接鍵結至蔥基(較佳在9,10位)之化合物。芳族芘胺、芘二胺、蒽胺及蒽二胺係以與其類似之方式定義，其中二芳基胺基較佳在1位或在1,6位鍵結至芘。其他較佳發

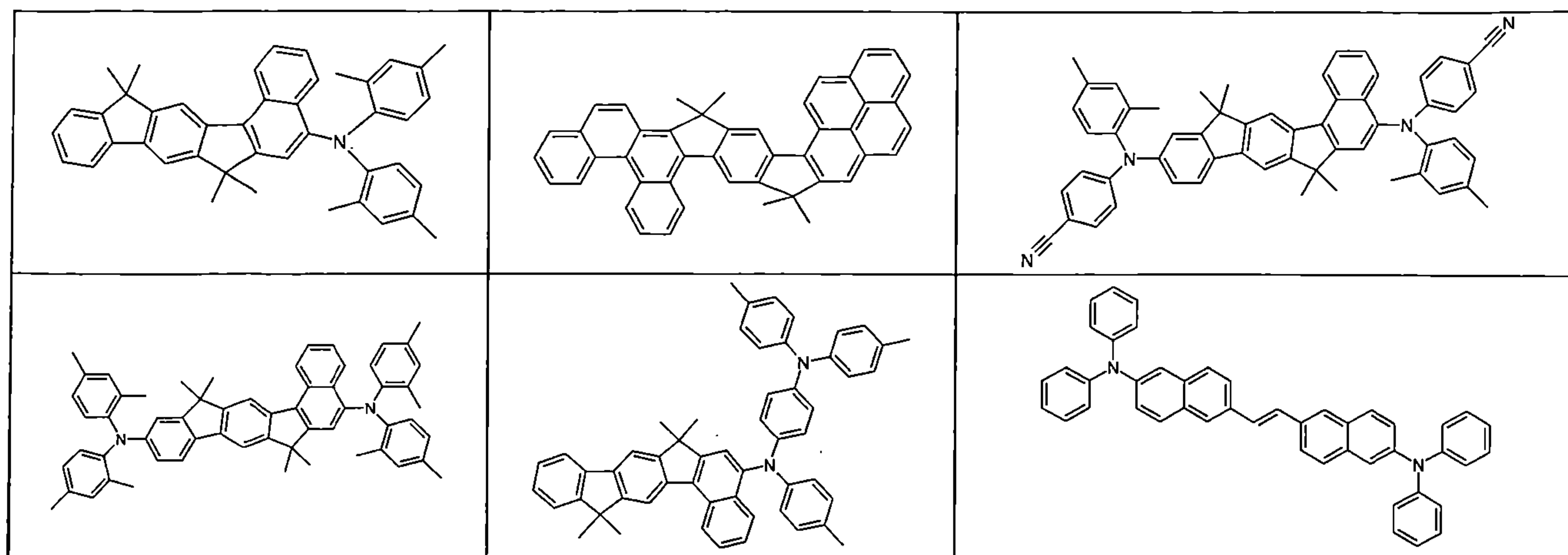
射體材料係選自茛并萘胺或茛并萘二胺，例如根據 WO 06/122630；
 苯并茛并萘胺或苯并茛并萘二胺，例如根據 WO 08/006449；及二苯
 并茛并萘胺或二苯并茛并萘二胺，例如根據 WO 07/140847。苯乙烯
 基胺類發射體材料之實例係經取代或未經取代之三(二苯乙烯)胺或
 WO 06/000388、WO 06/058737、WO 06/000389、WO 07/065549及
 WO 07/115610中所述之發射體材料。此外，較佳者係申請案 WO
 10/012328中所揭示之稠合烴。

此外，適宜發射體材料係下表中所繪示之結構及 JP 06/001973、
 WO 04/047499、WO 06/098080、WO 07/065678、US 2005/0260442及
 WO 04/092111中所揭示之該等結構之衍生物。



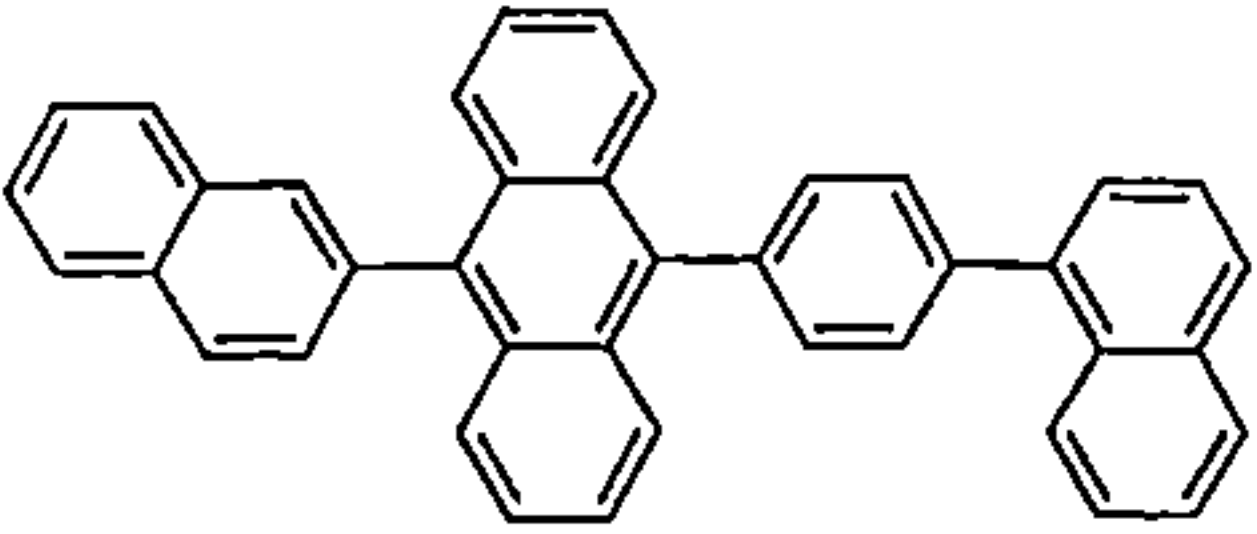
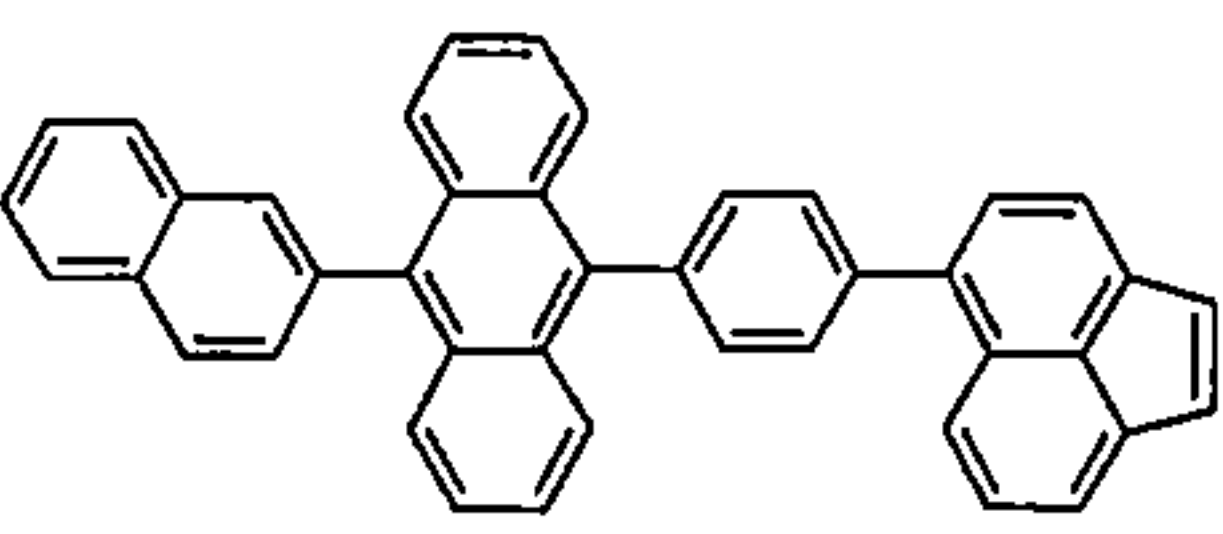
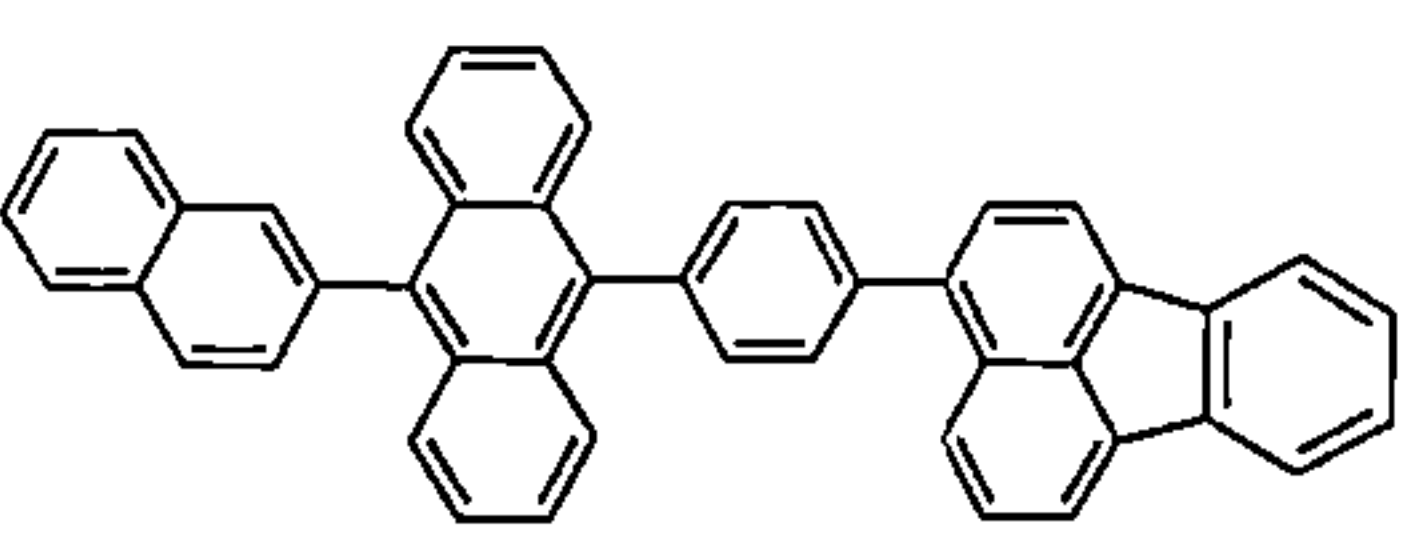
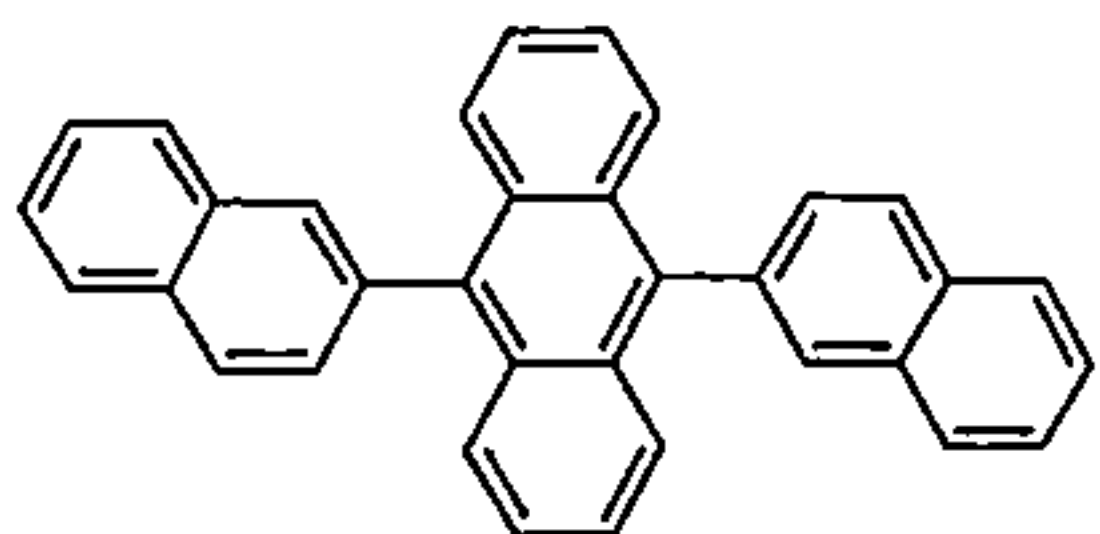
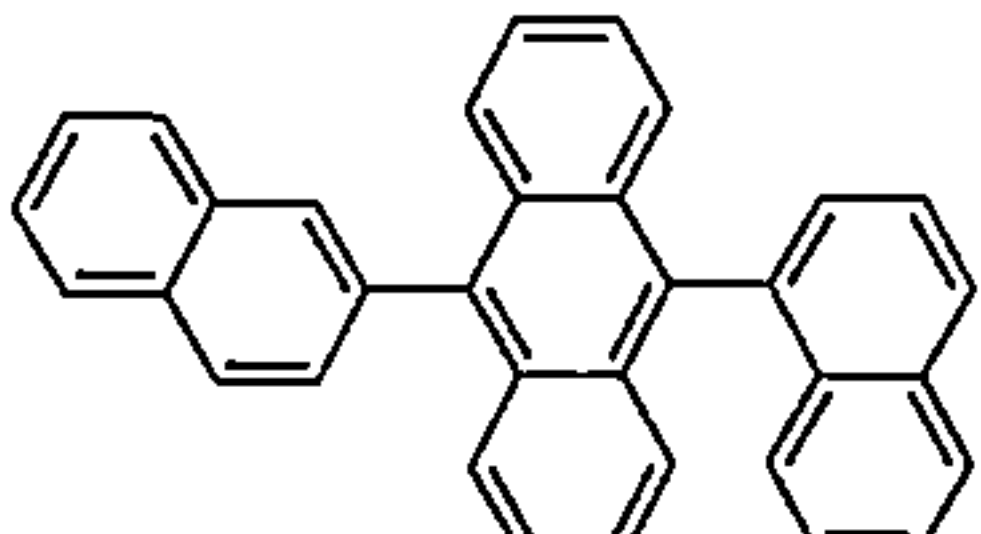
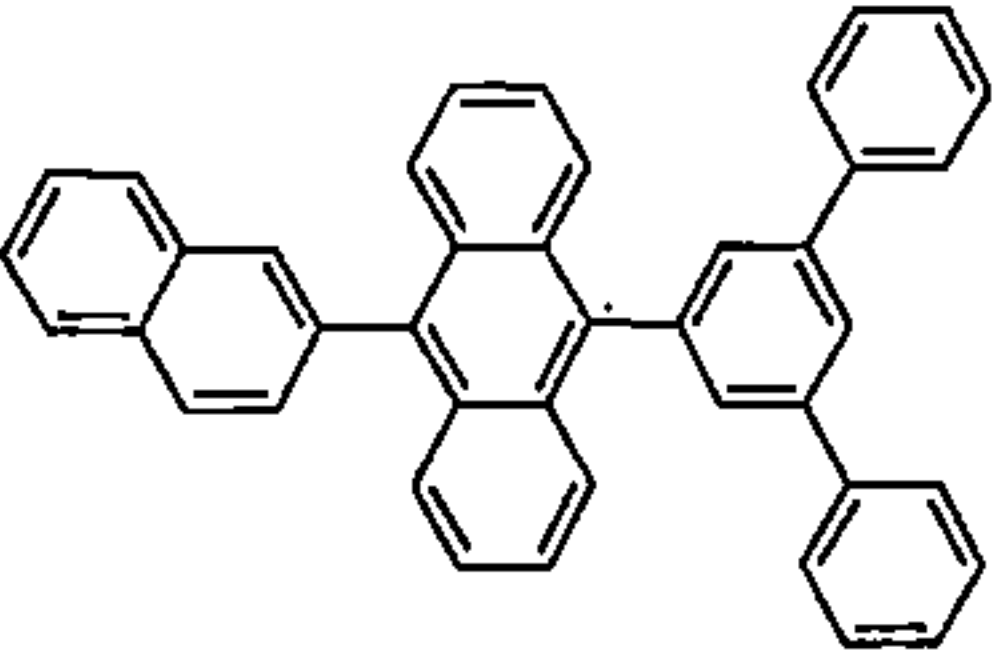
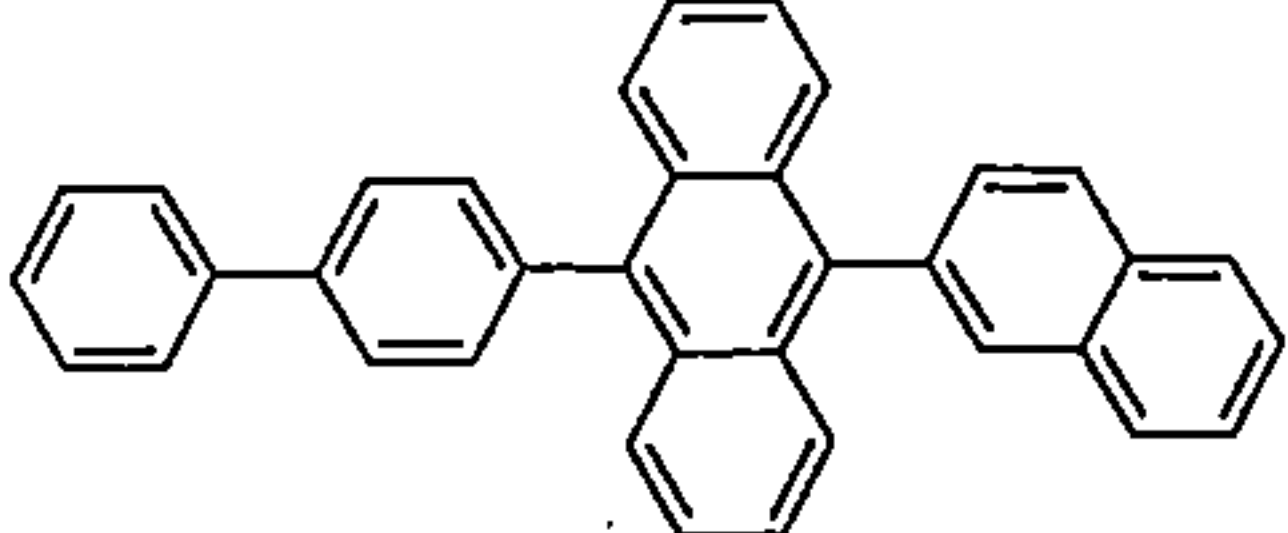
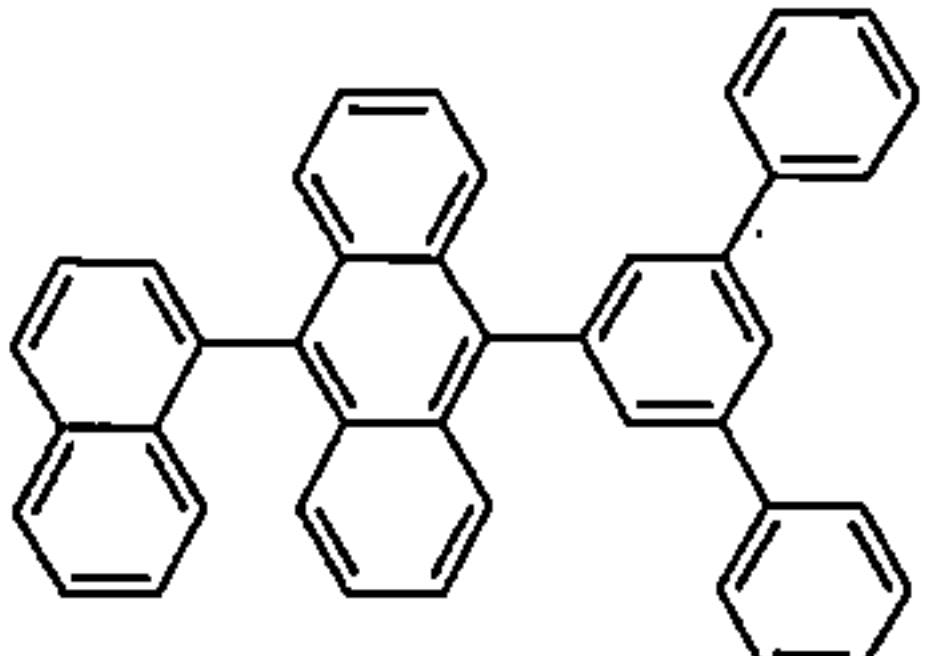
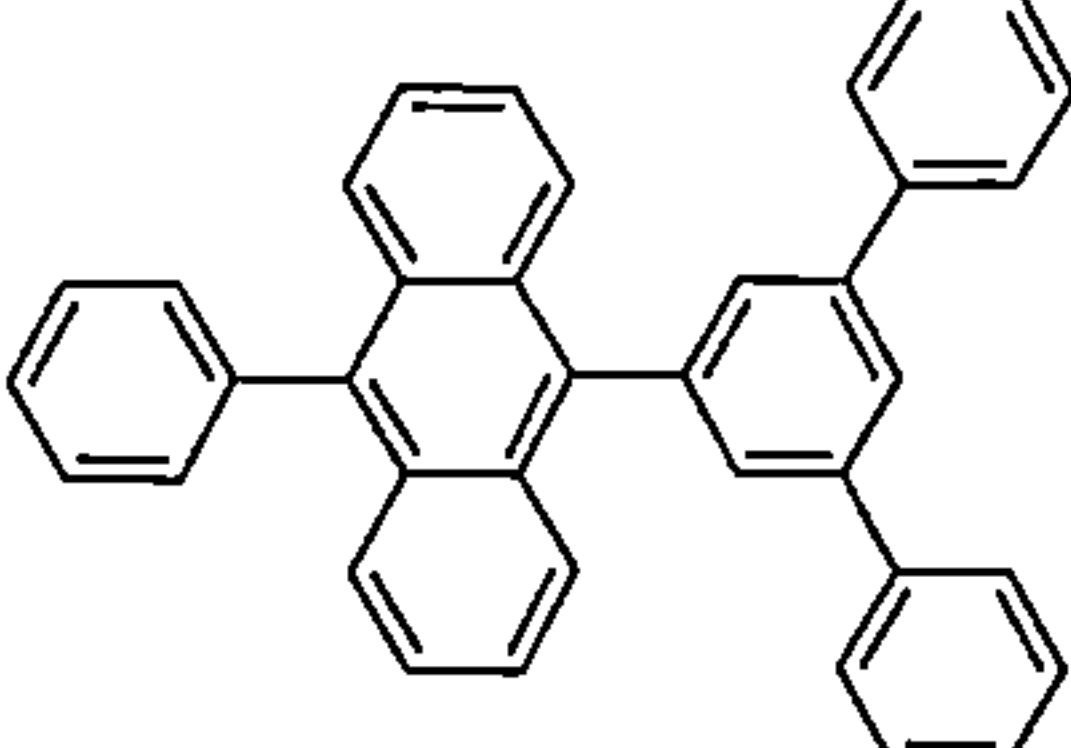
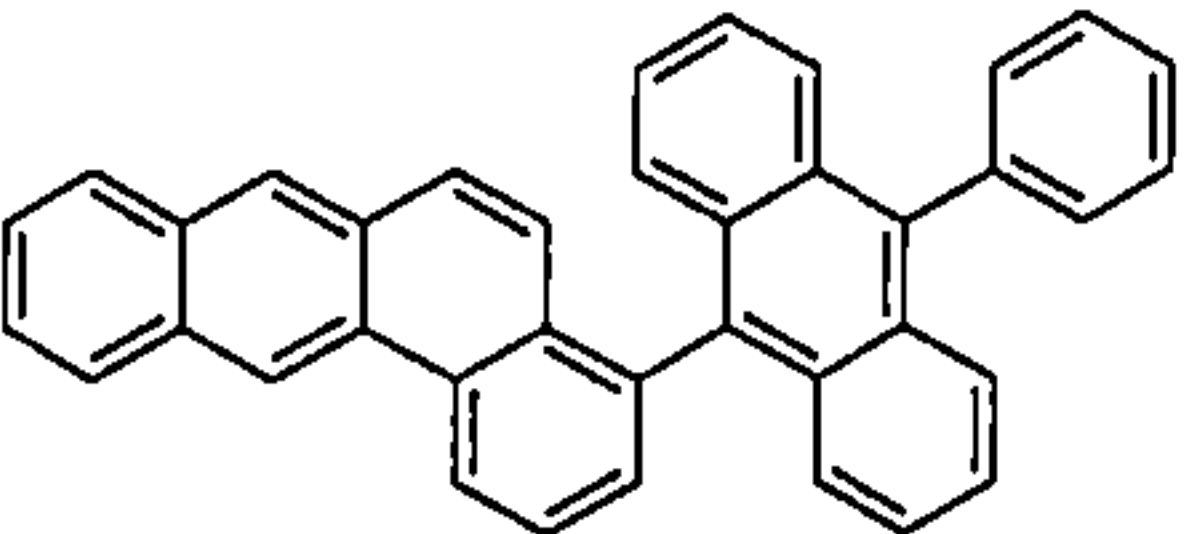
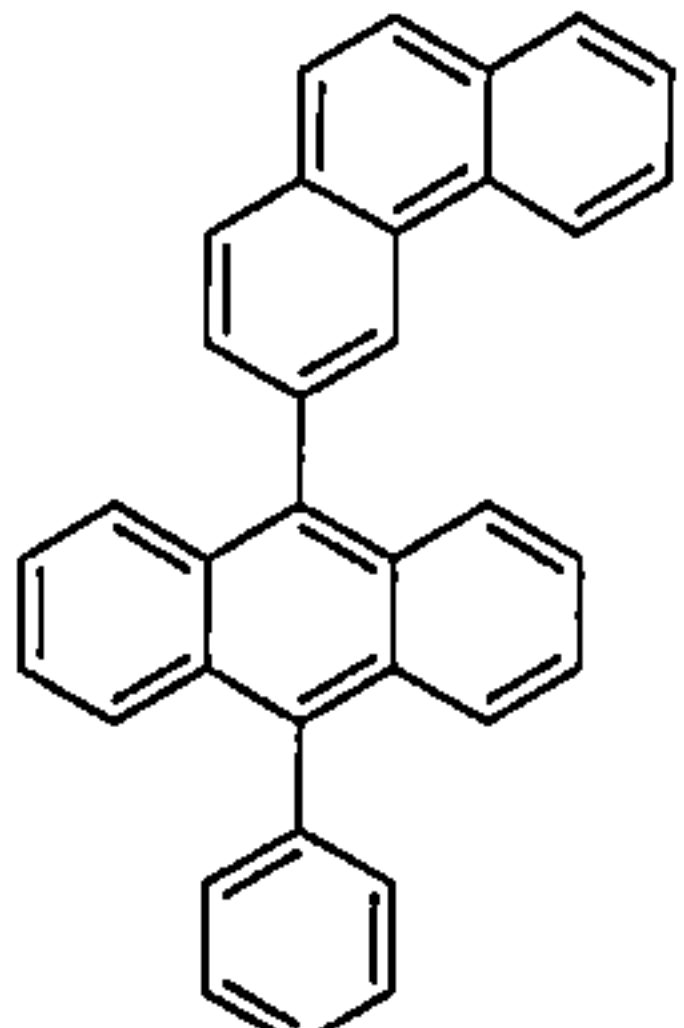
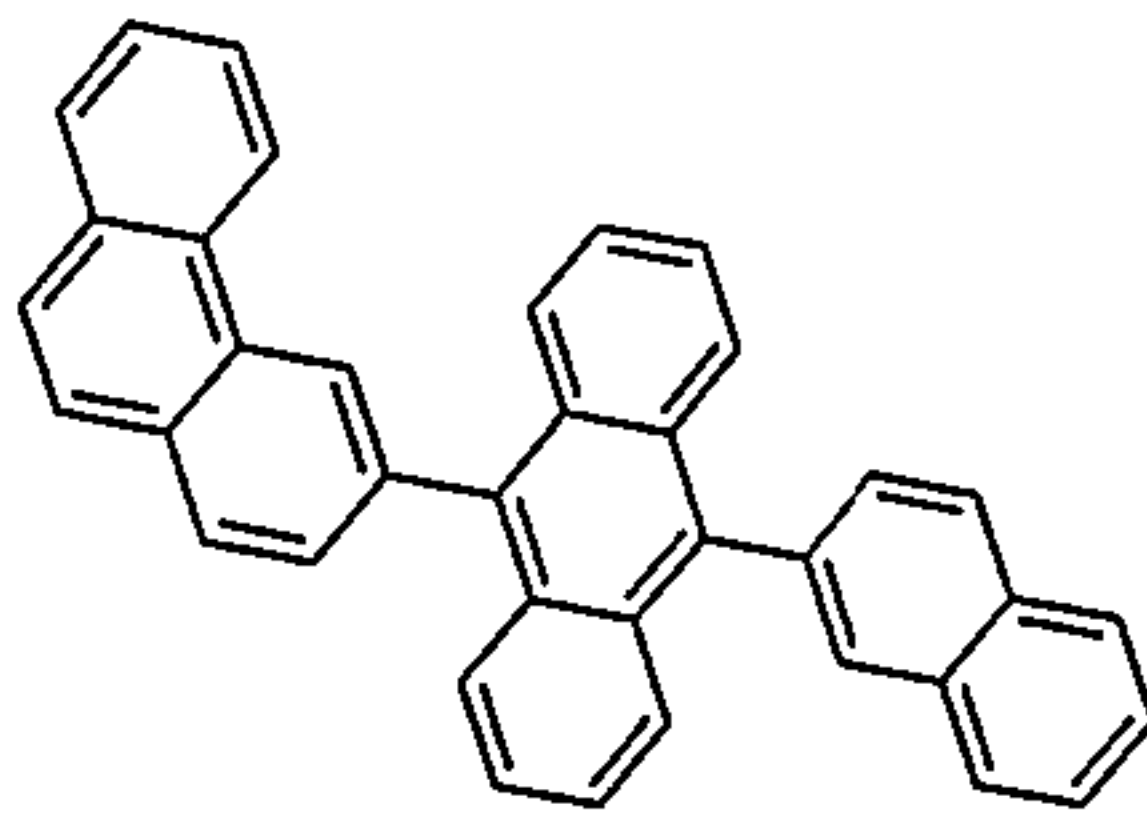
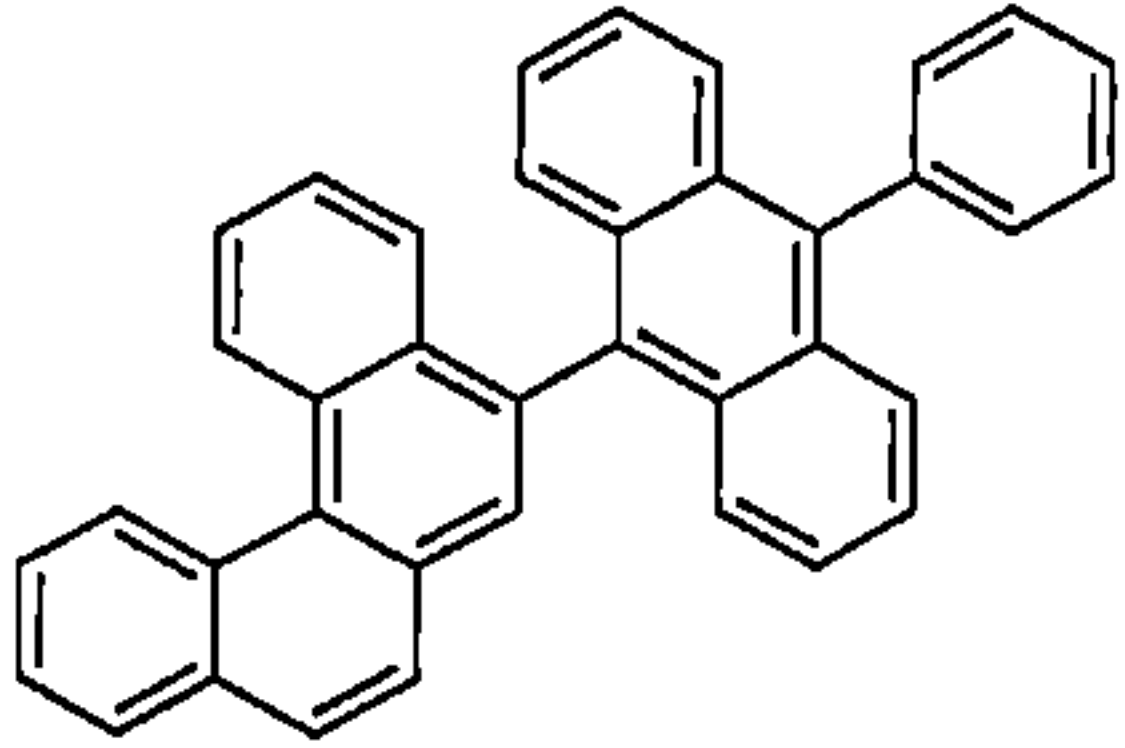
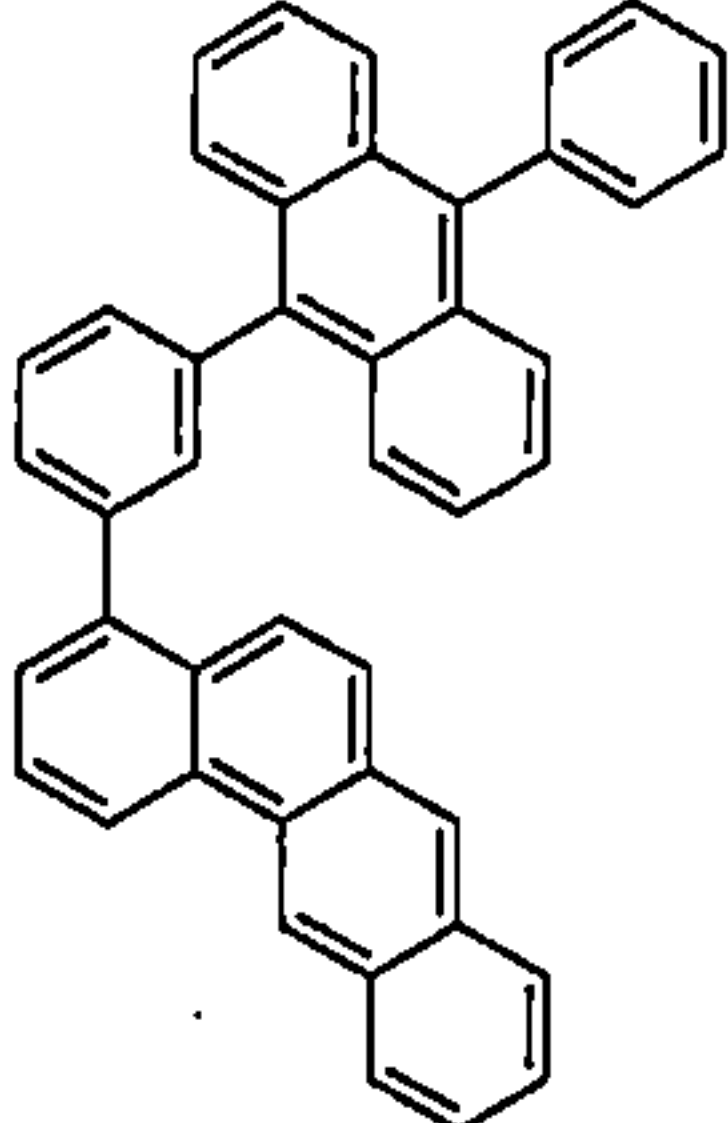
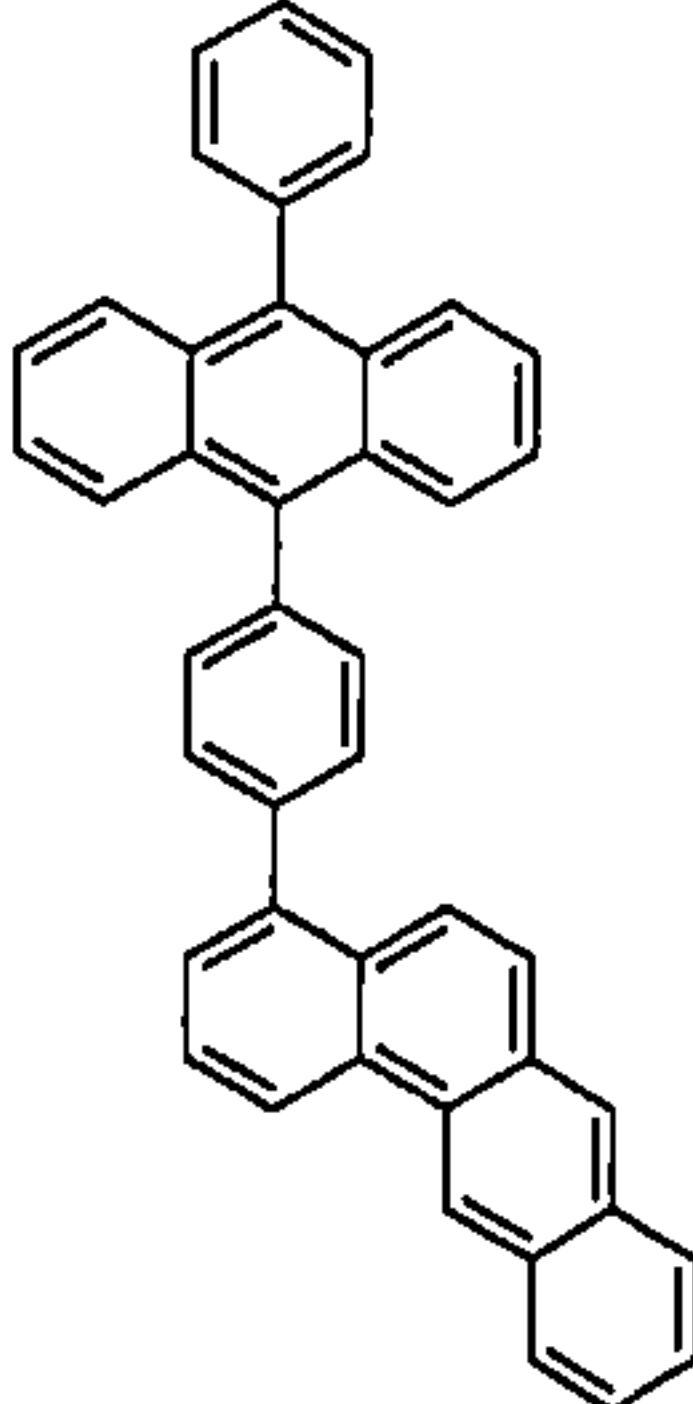
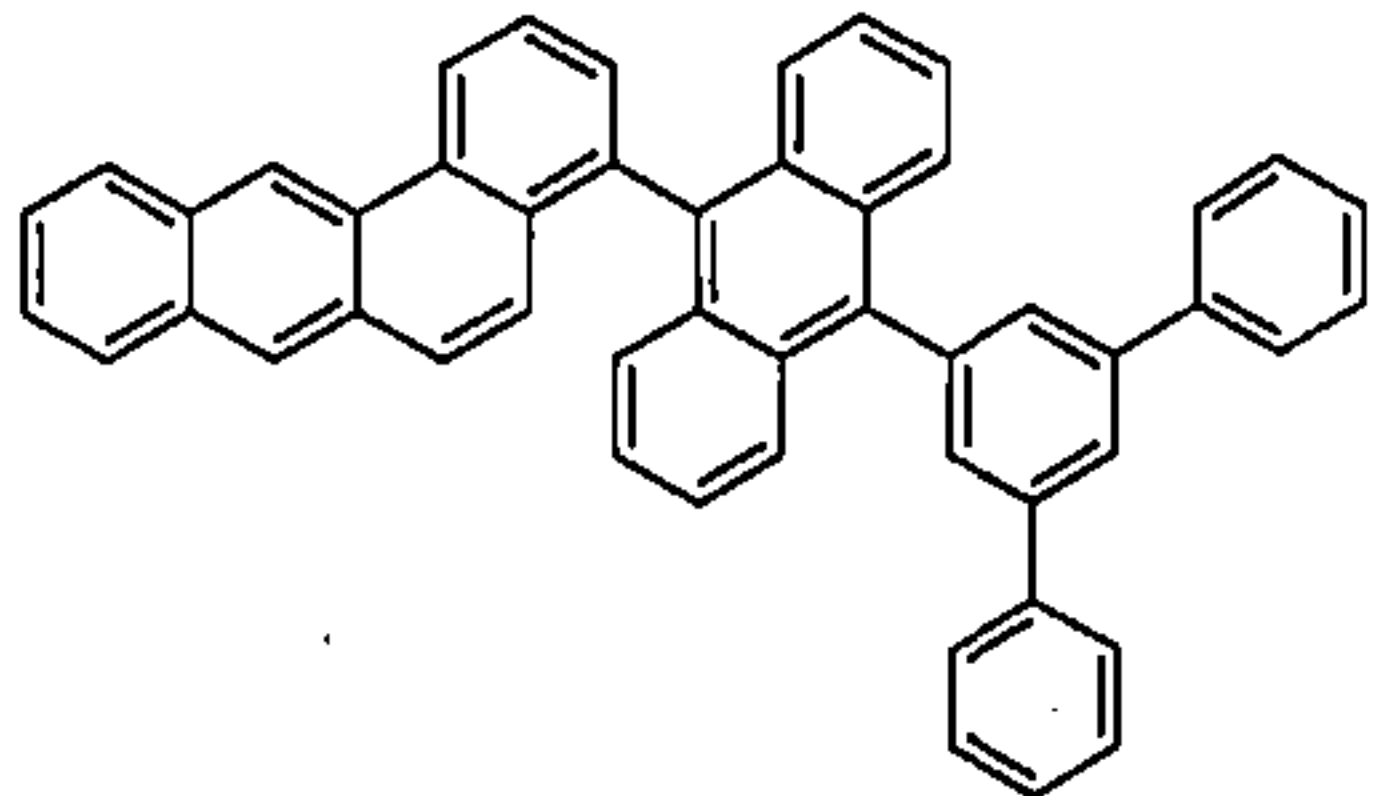
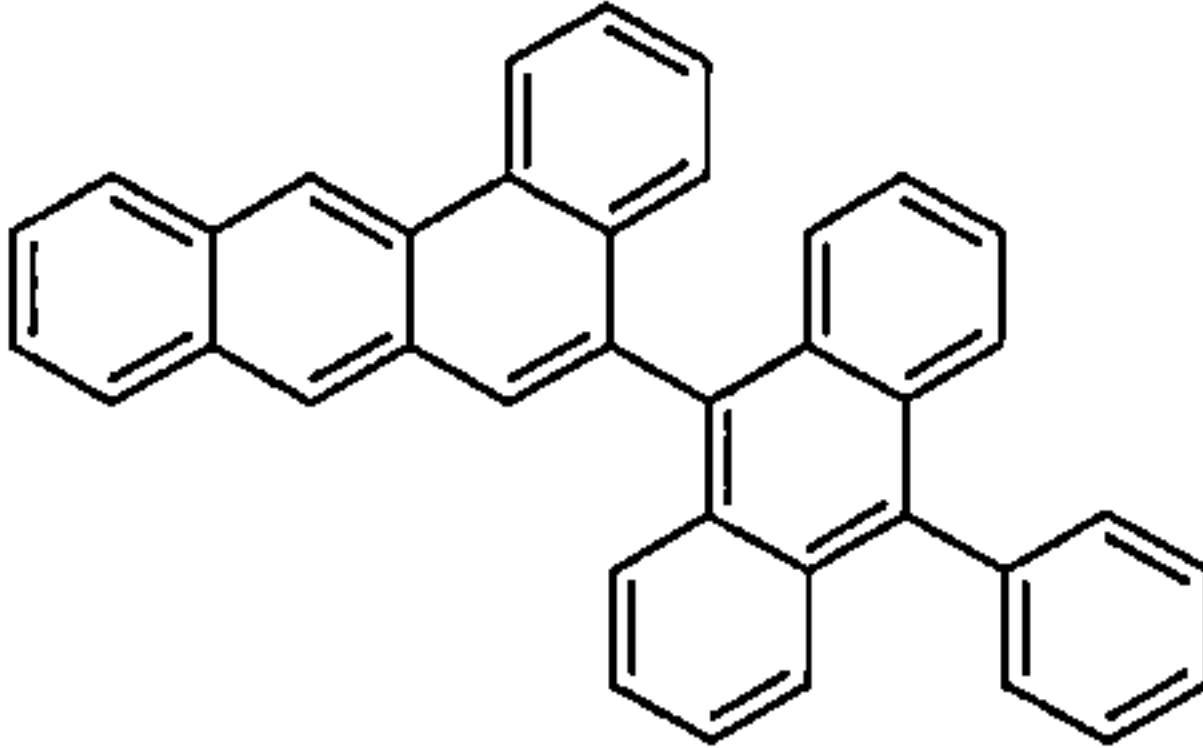
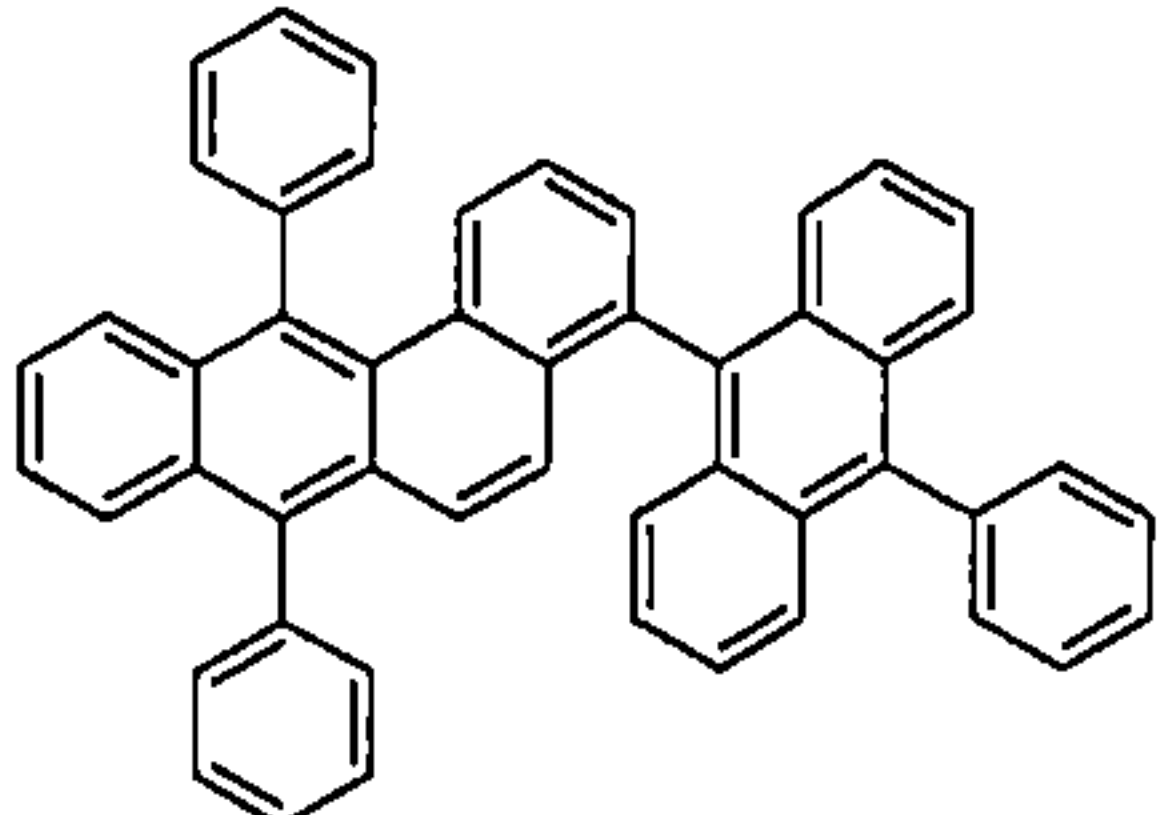
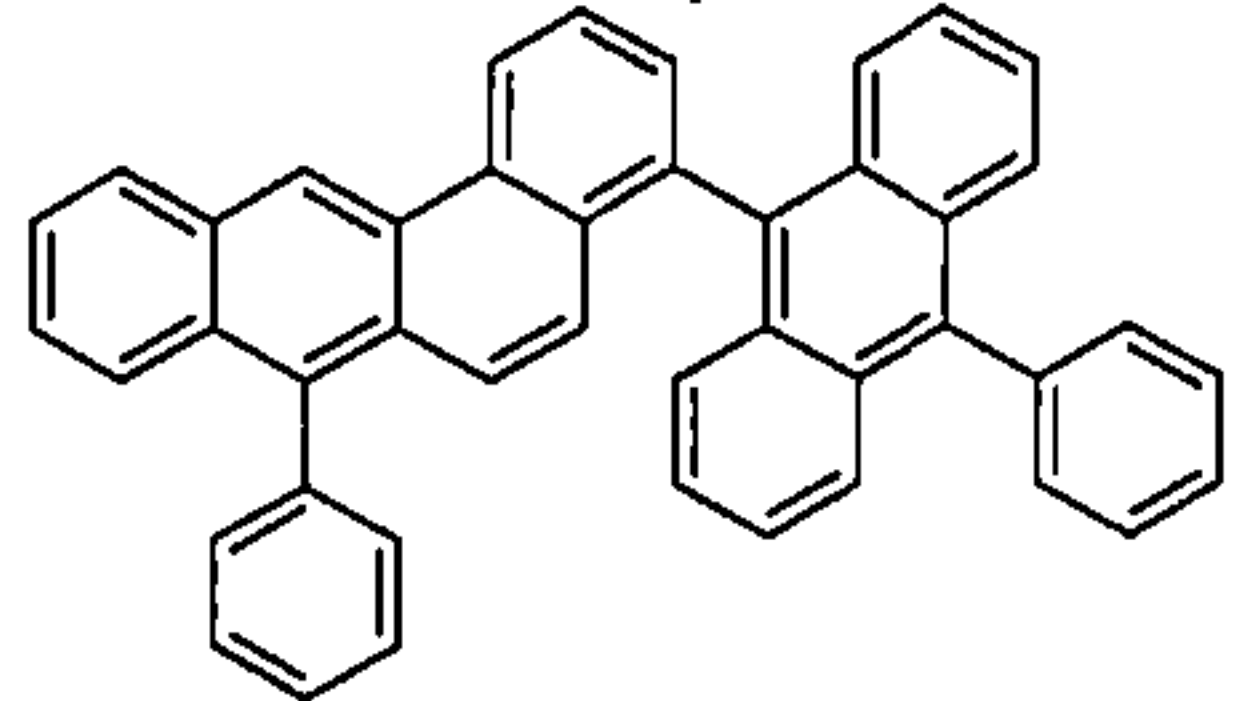
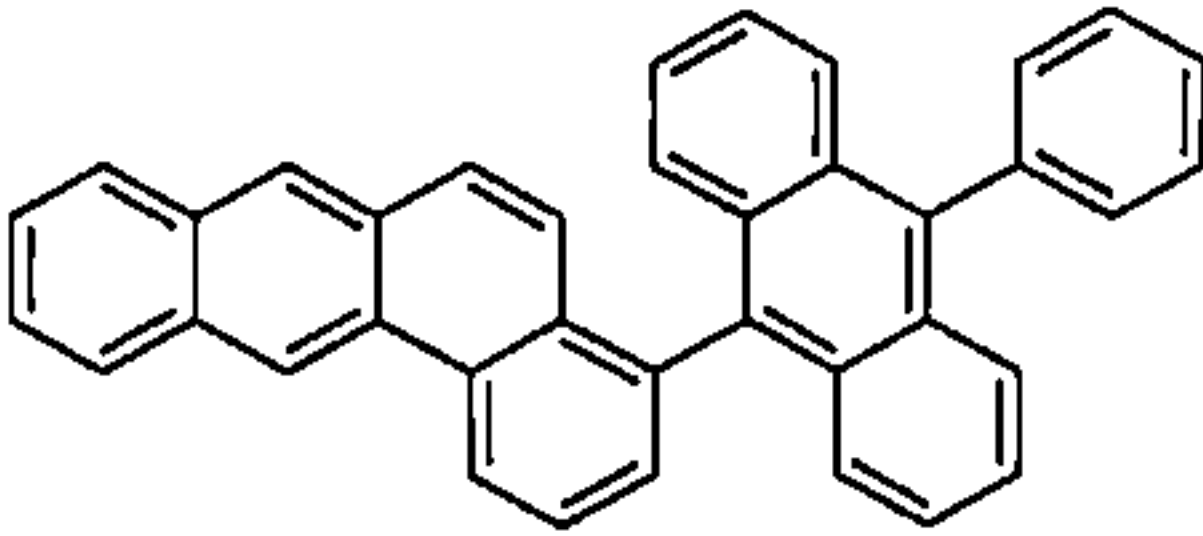
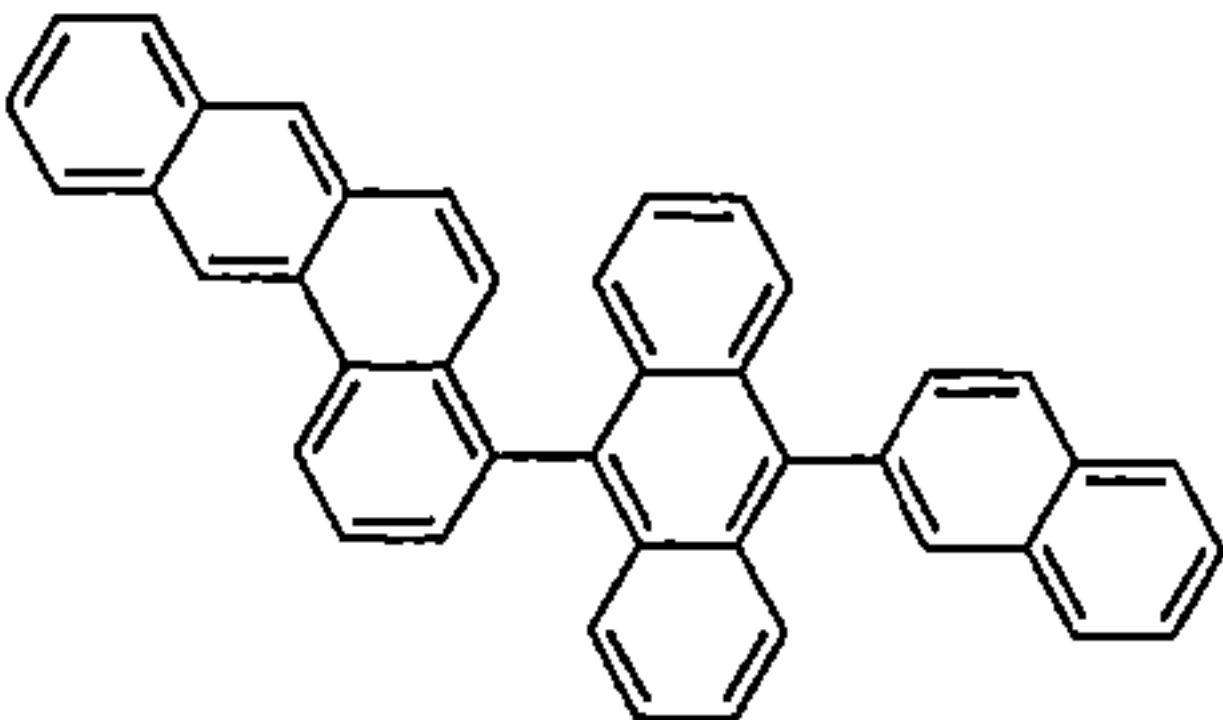
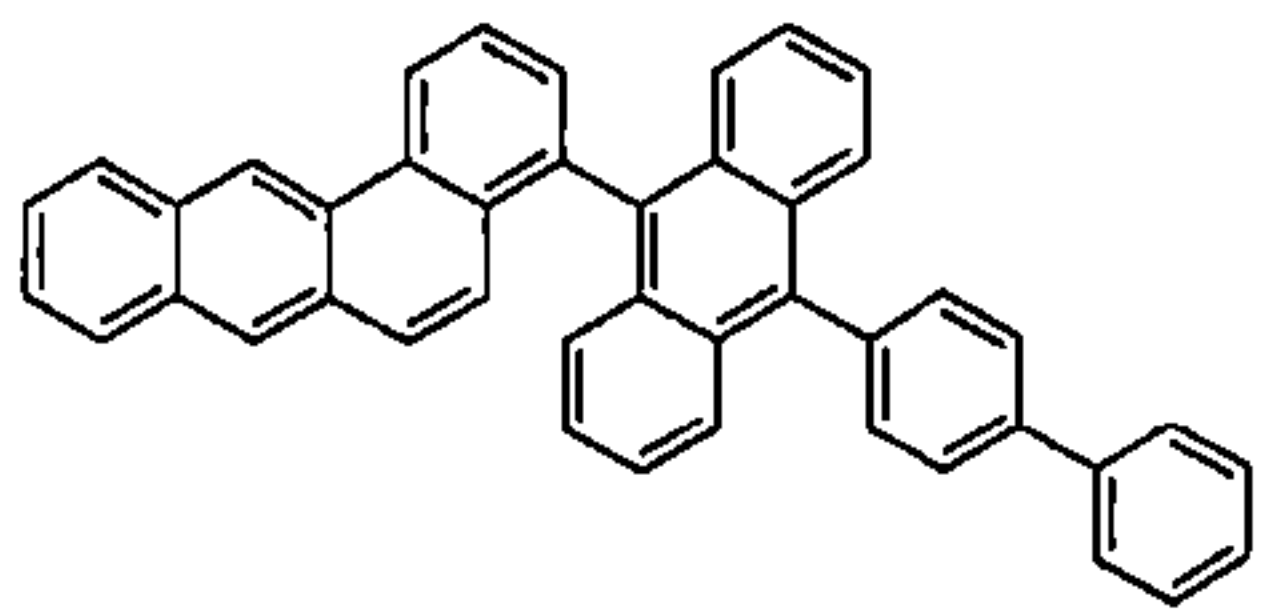
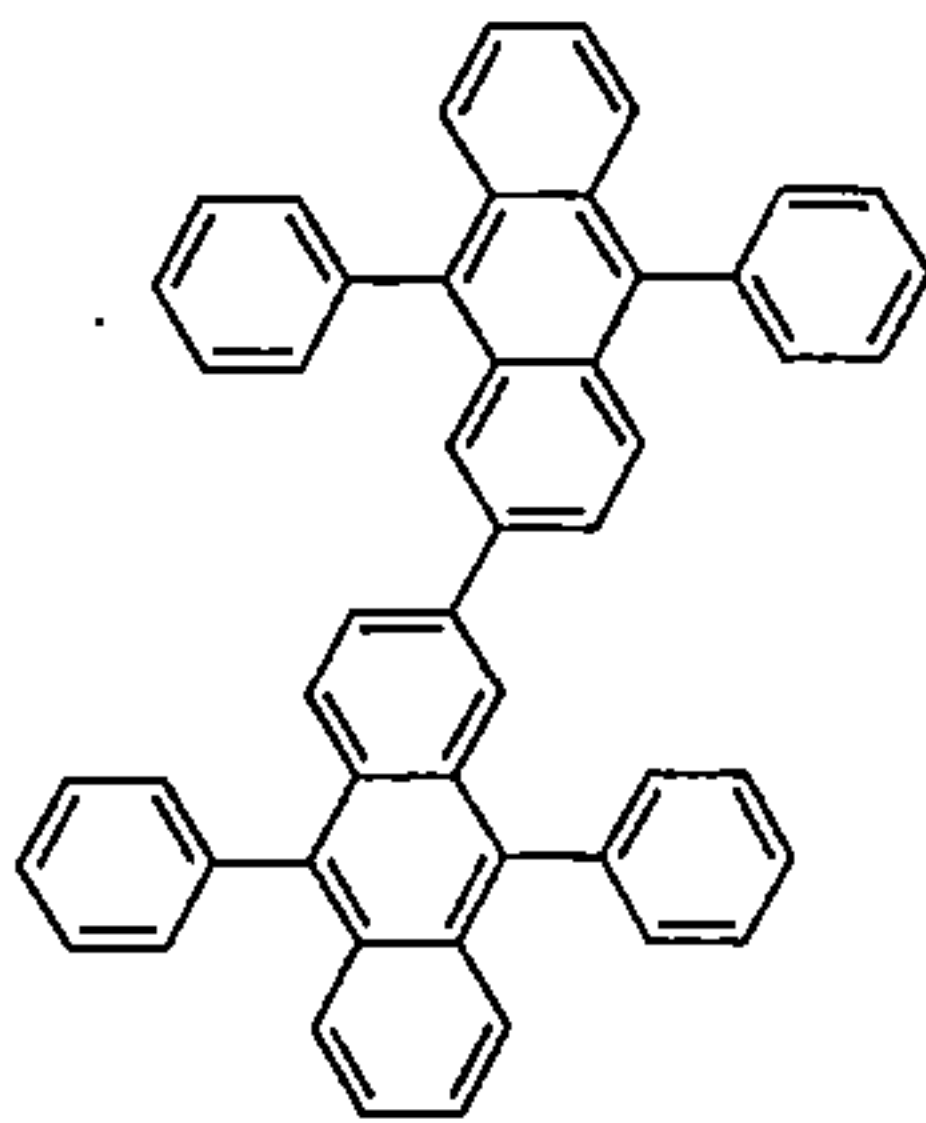
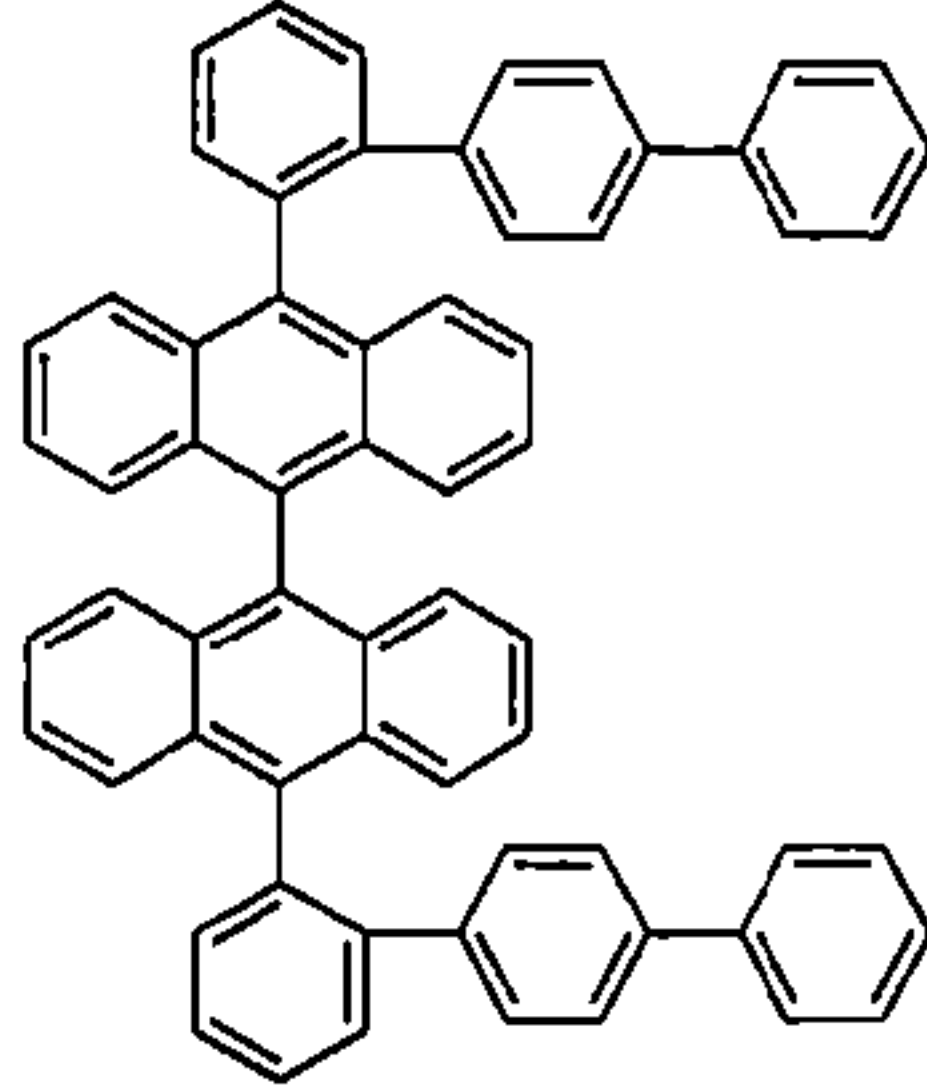
		
		
		
		
		

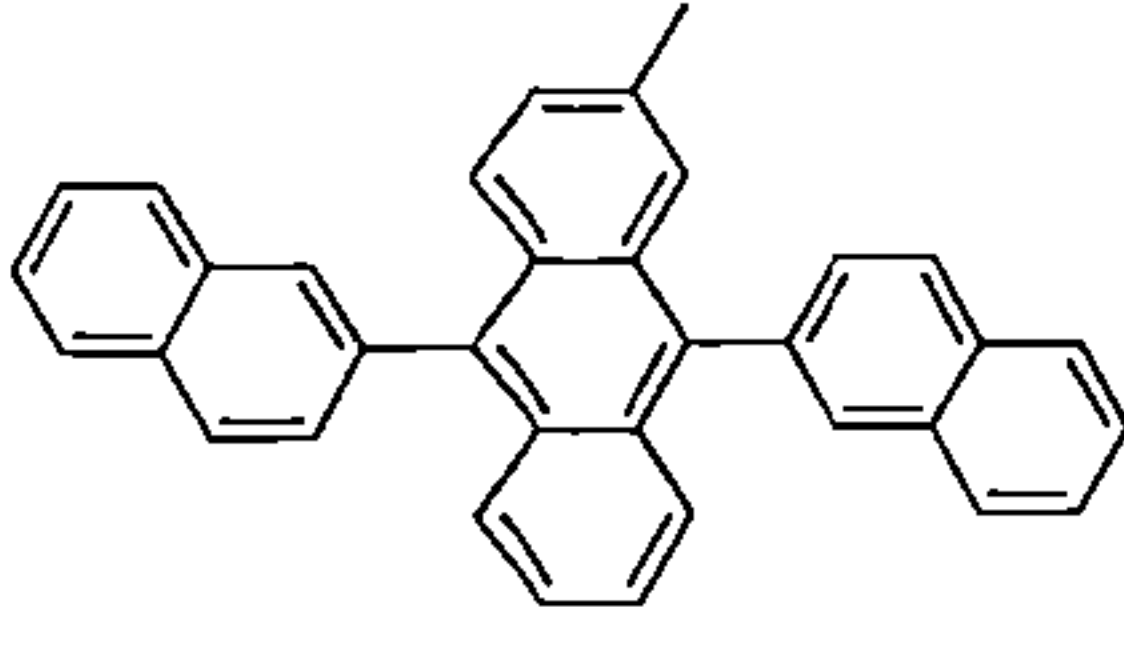
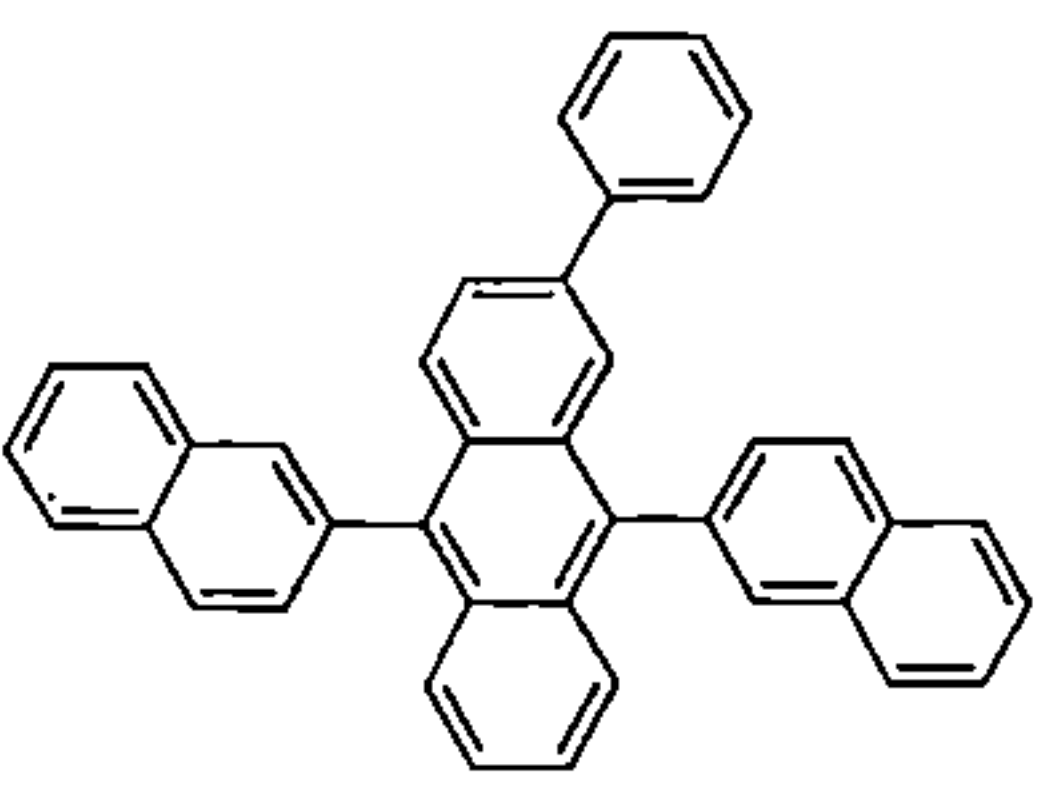
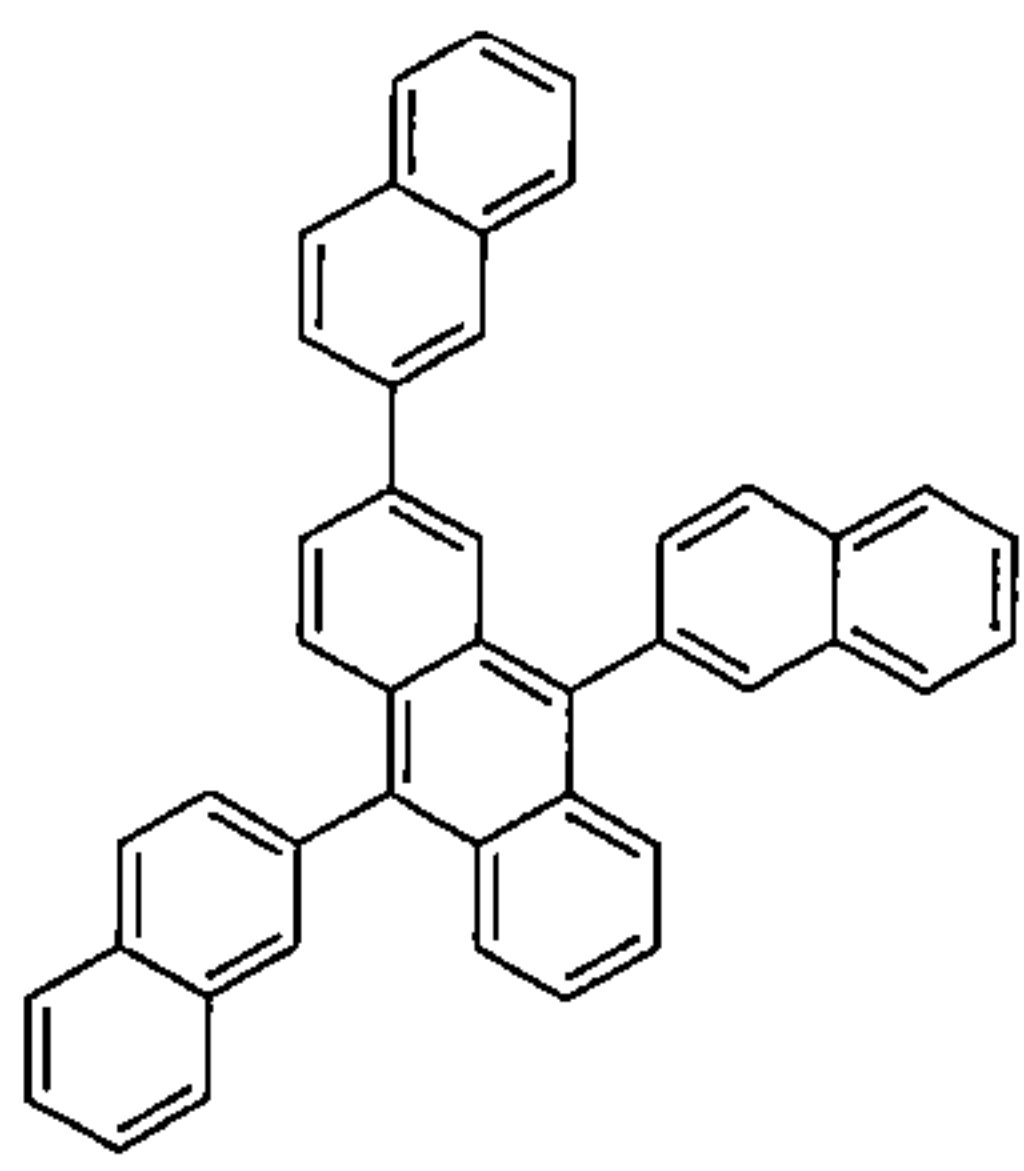
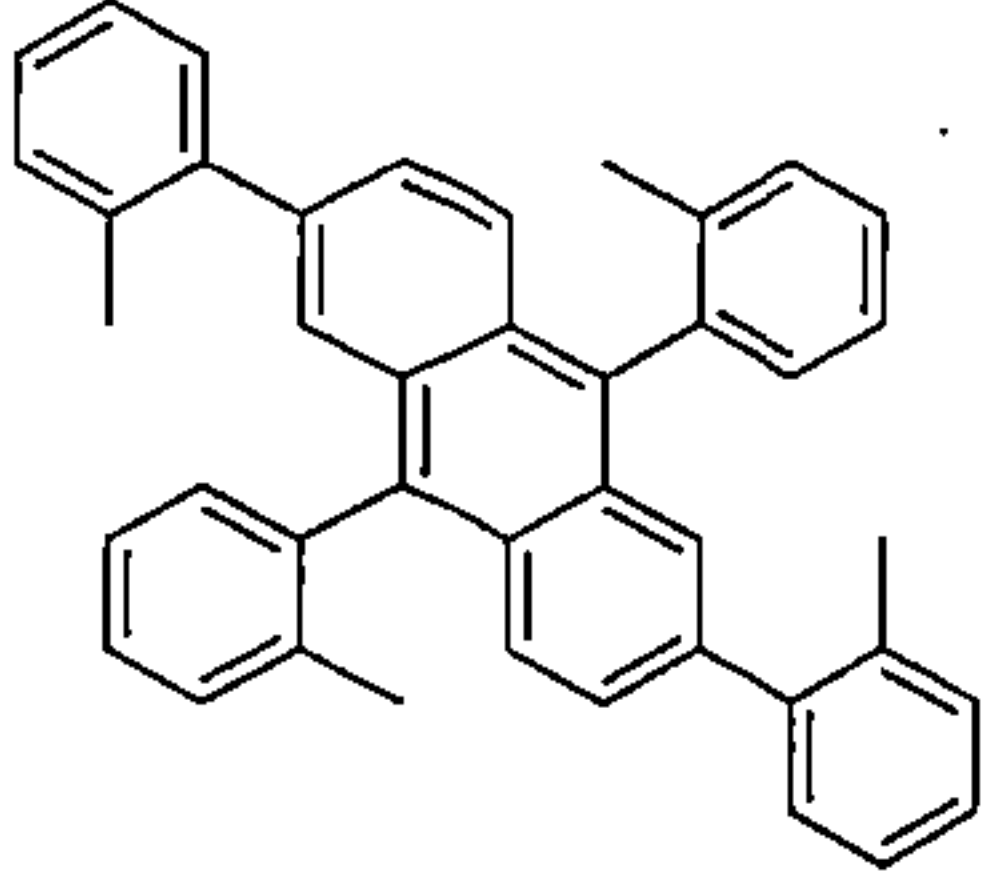
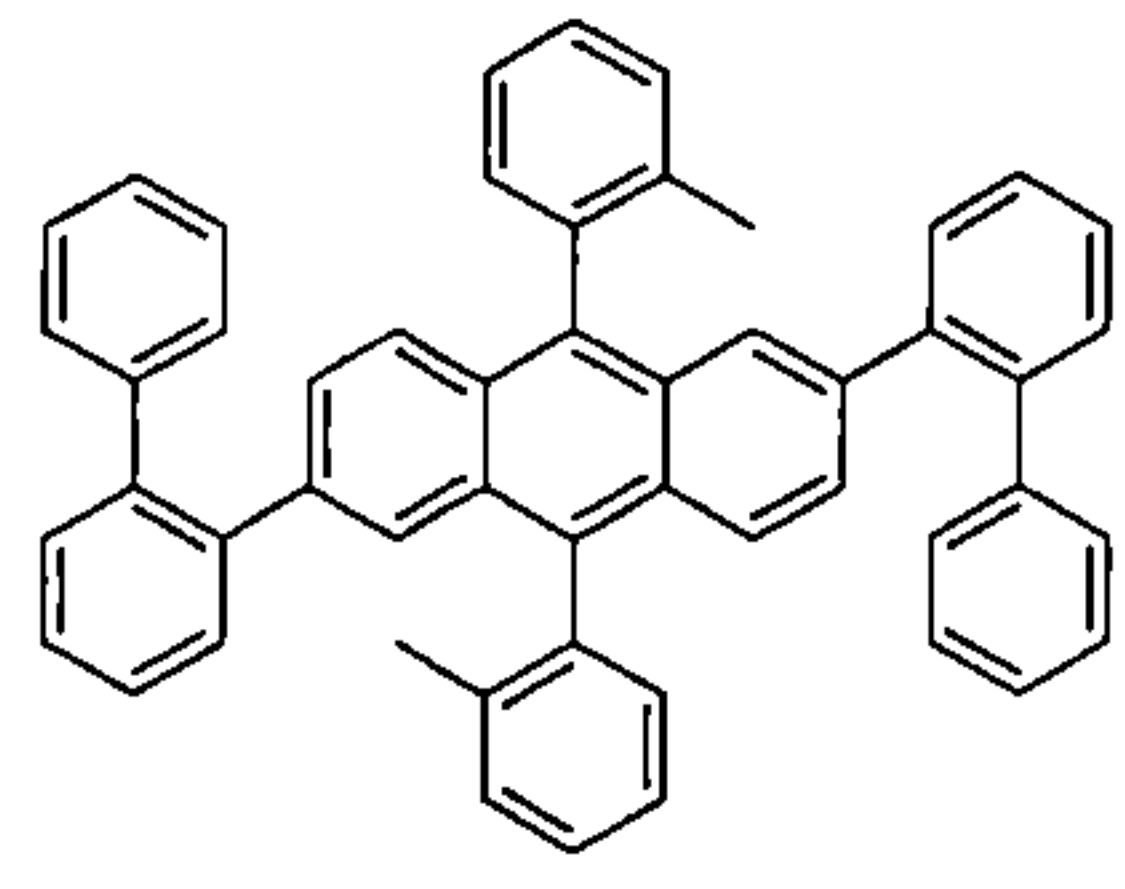
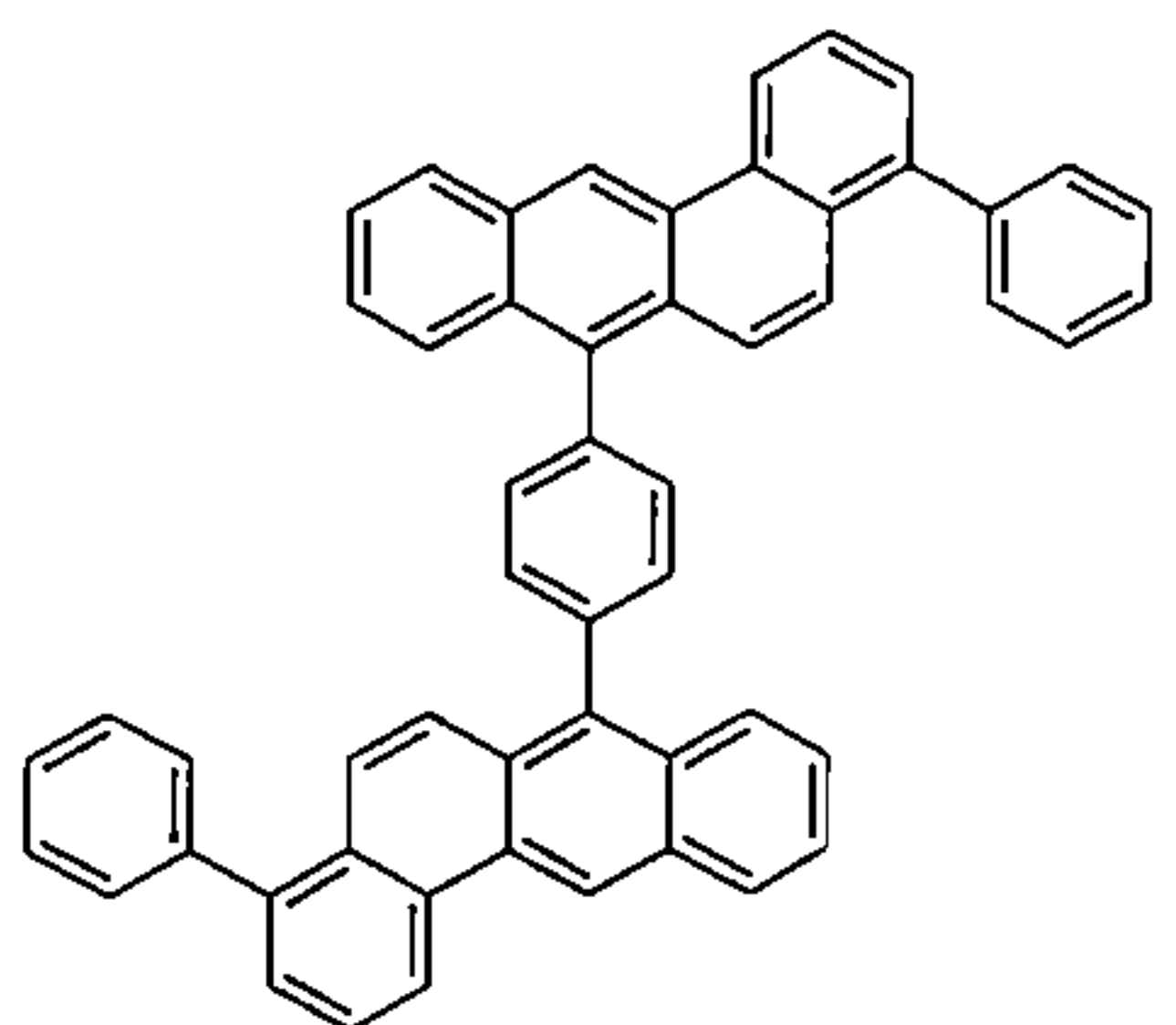
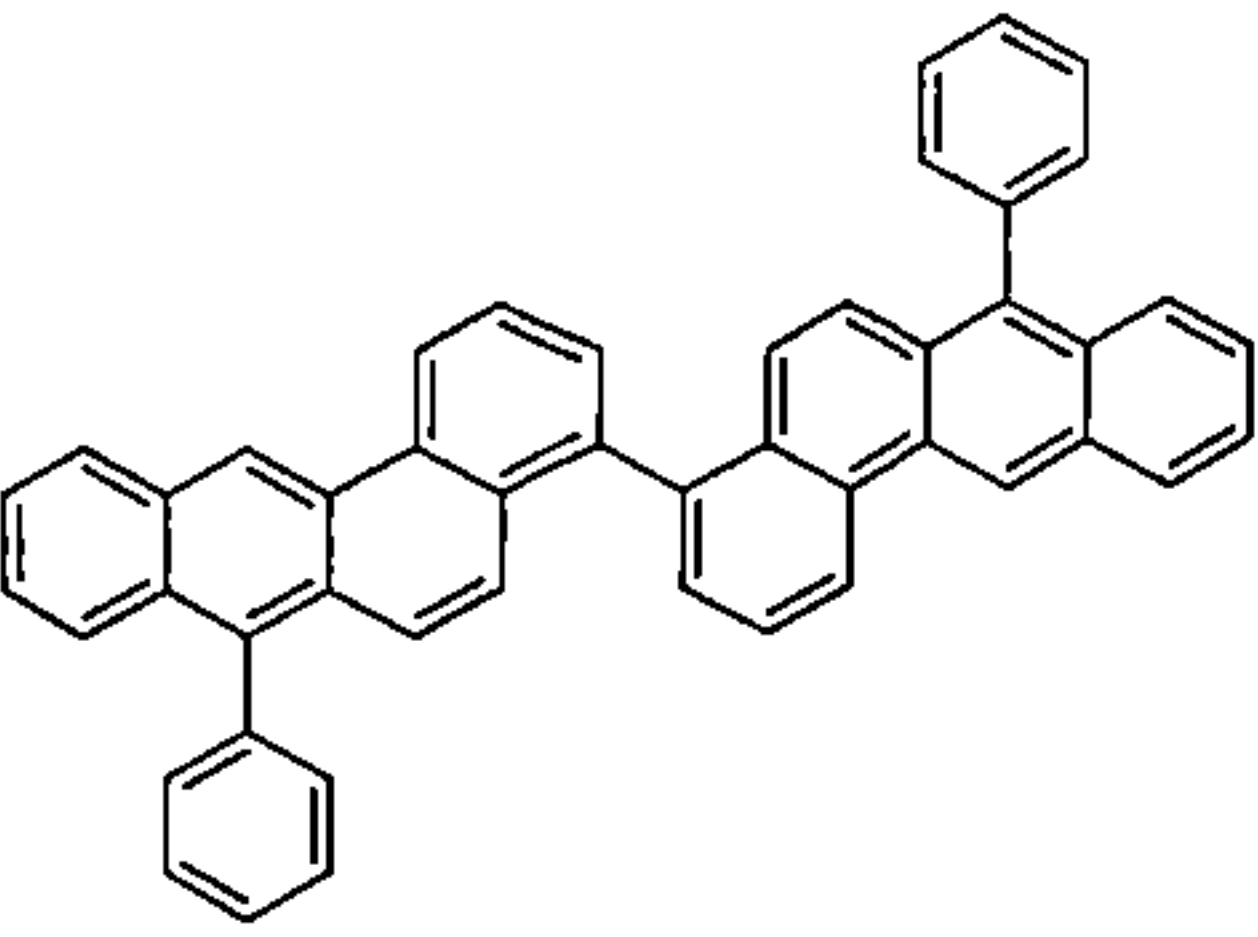
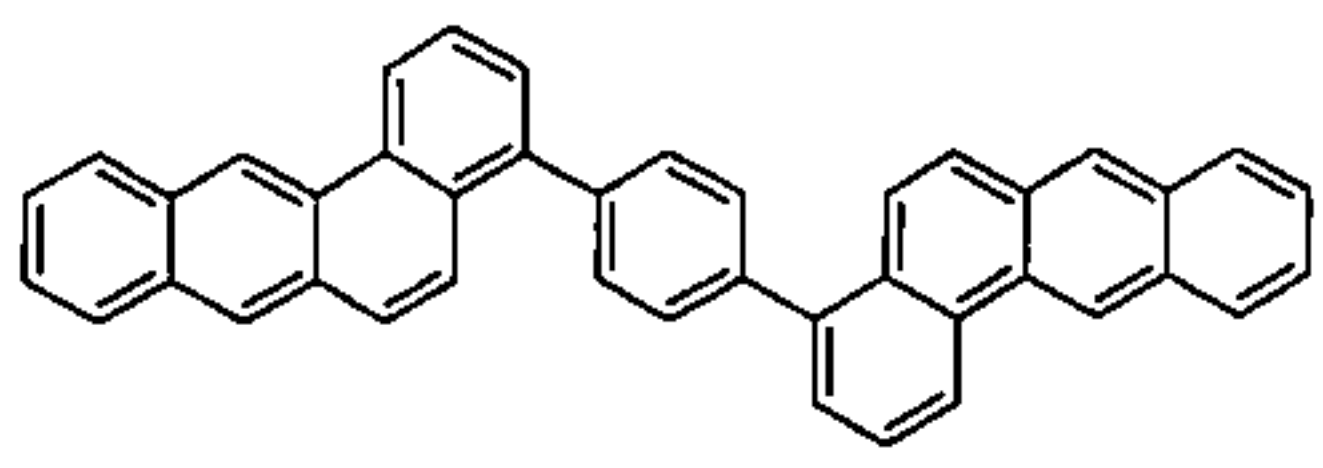
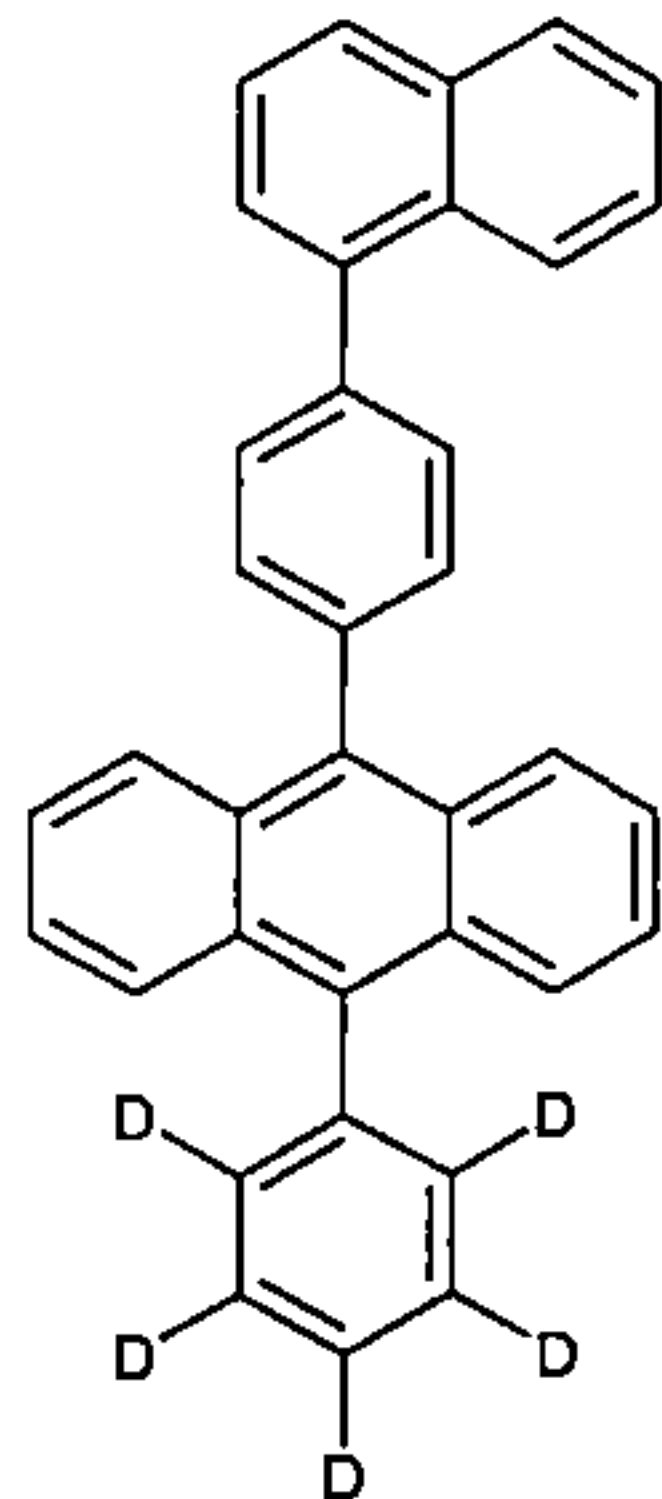
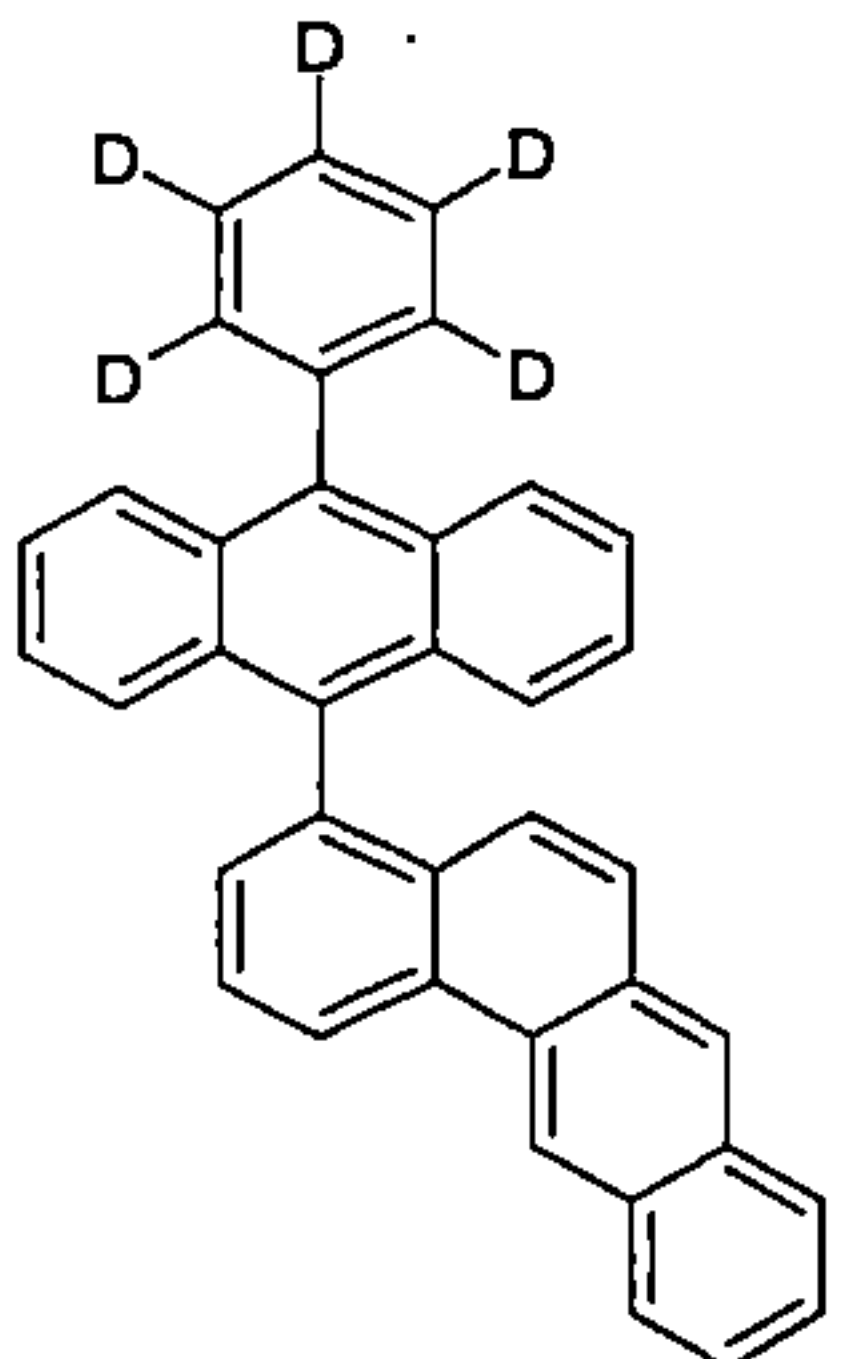
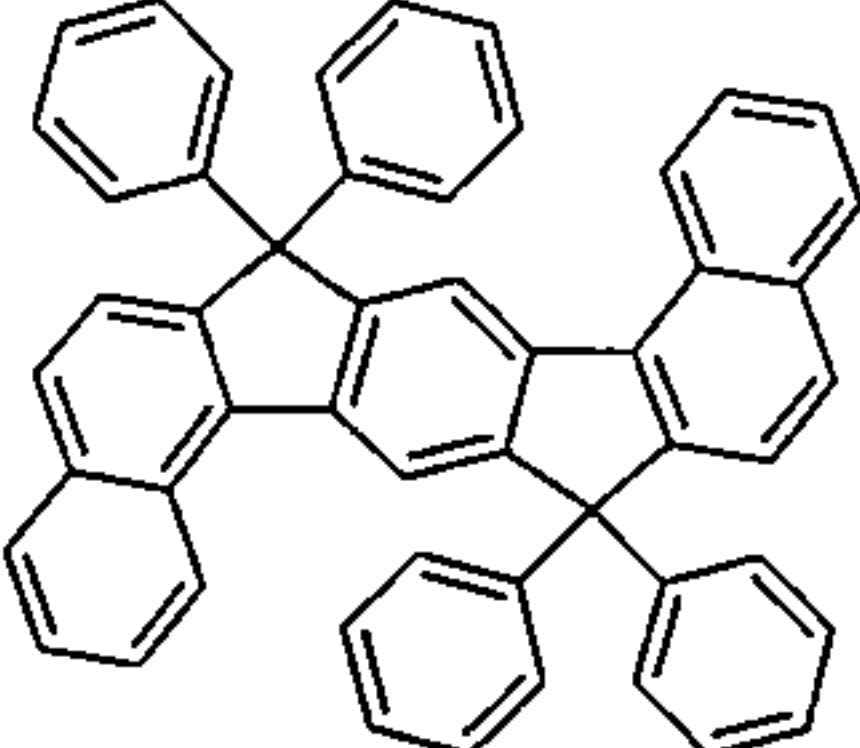
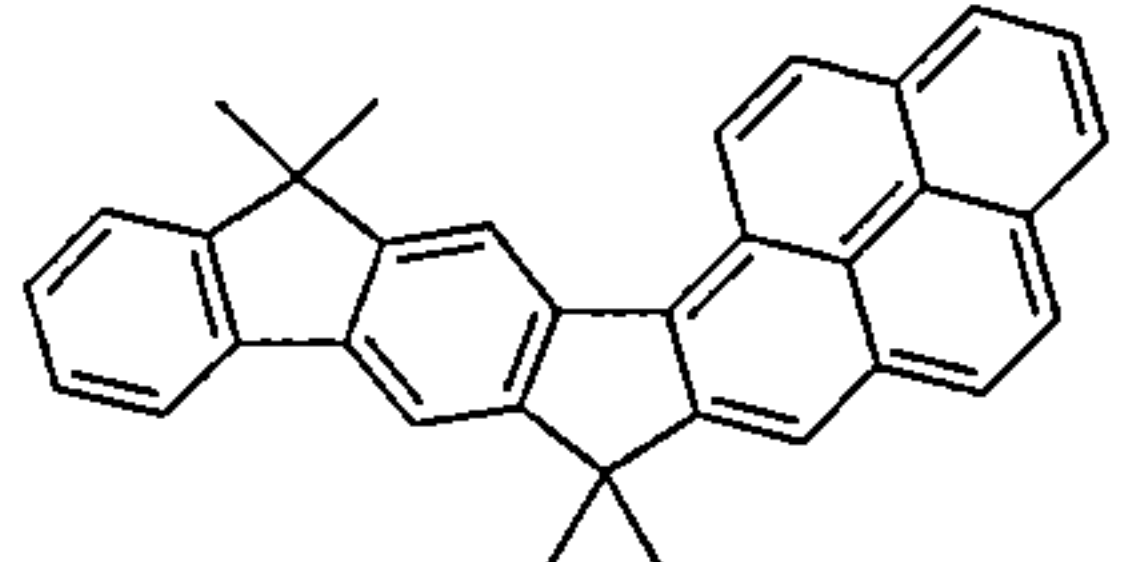
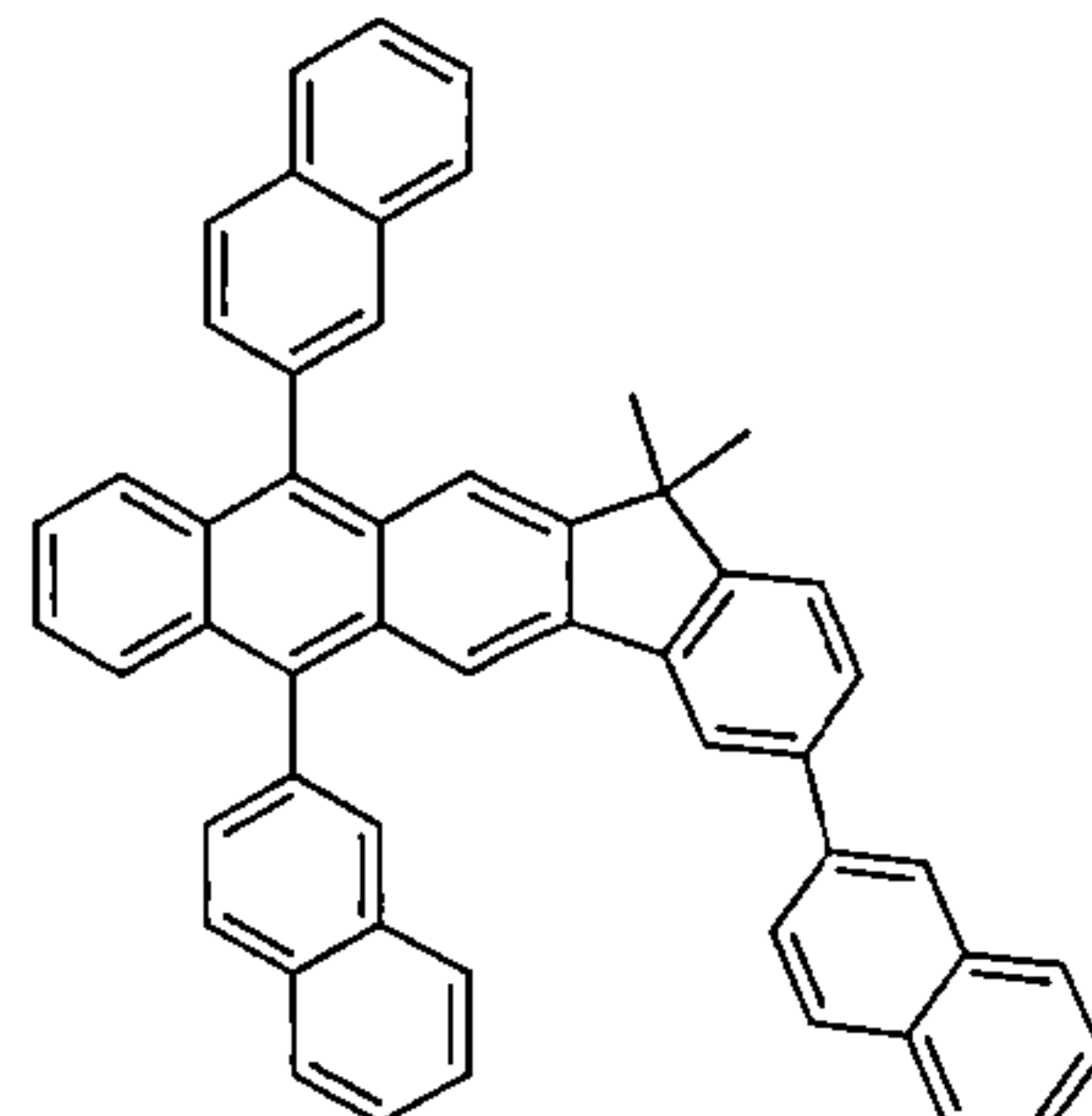
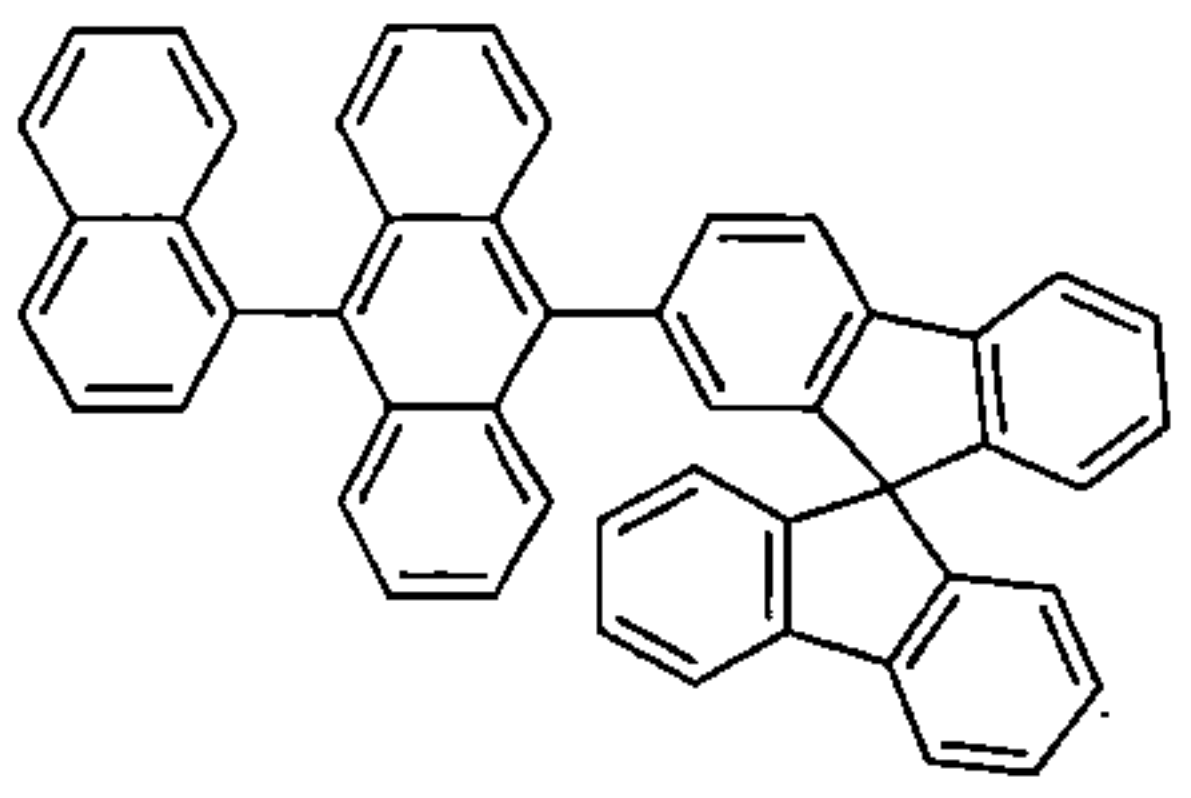
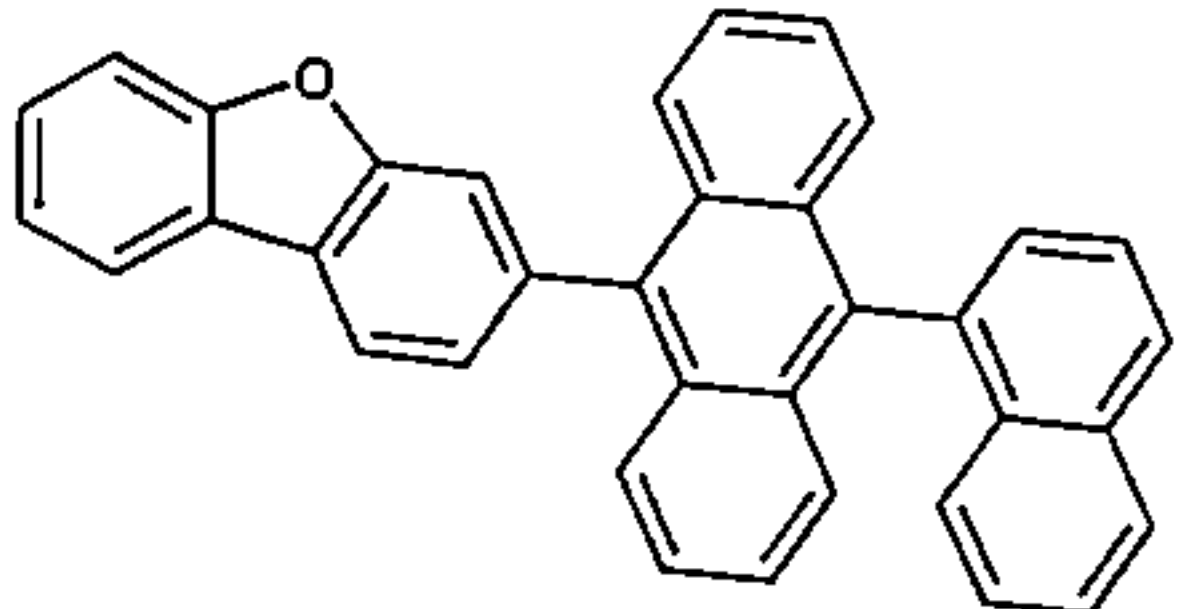
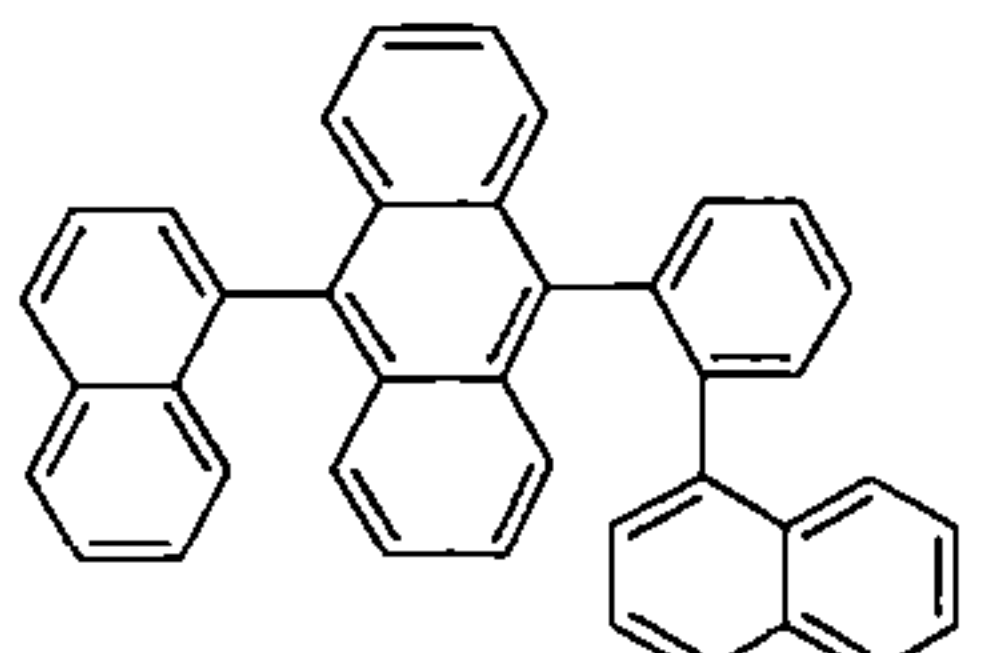
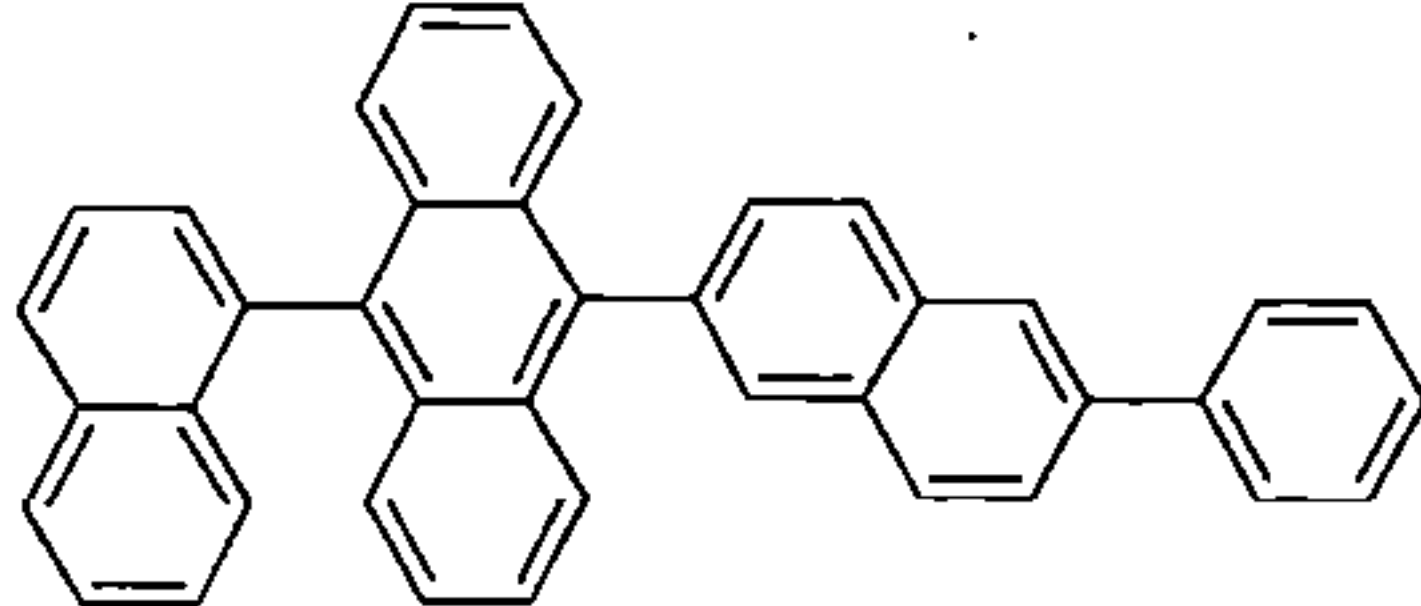
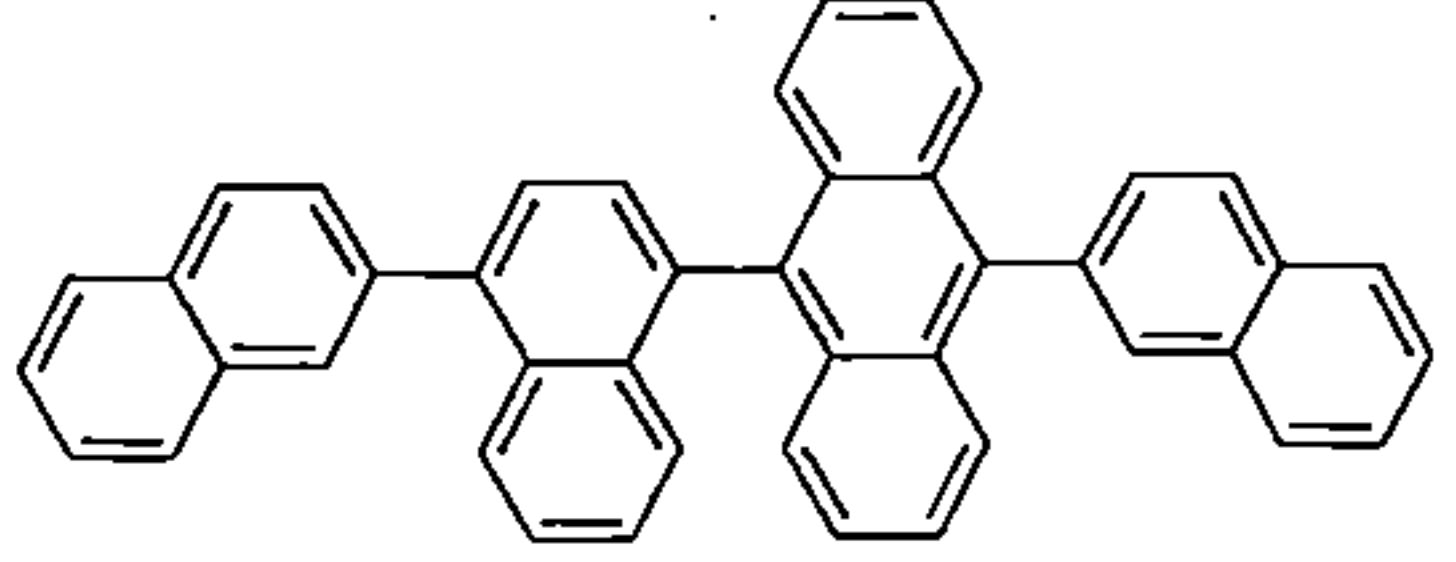
		
		
		
		
		
		

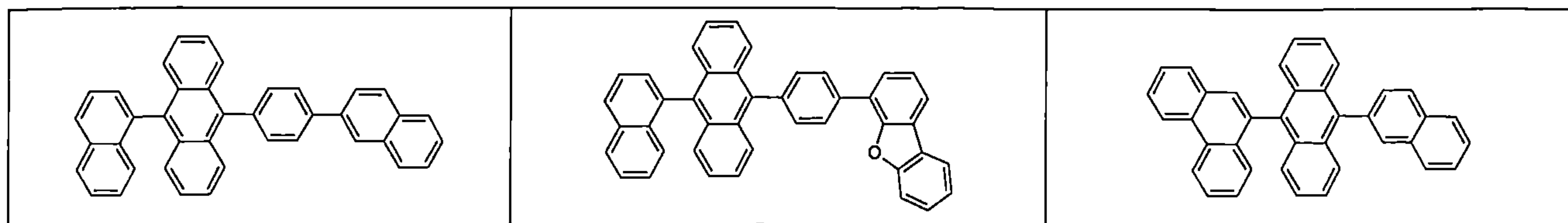


較佳針對螢光摻雜劑而言，可使用之基質材料係來自多種類別物質之材料。較佳基質材料係選自以下種類：寡聚伸芳基(例如 2,2',7,7'-四苯基螺二芴，根據EP 676461或二萘基蒽)，具體而言含有稠合芳族基團之寡聚伸芳基；寡聚伸芳基伸乙烯基(例如DPVBi或螺-DPVBi，根據EP 676461)；多足型(polypodal)金屬錯合物(例如根據WO 04/081017)；電洞傳導化合物(例如根據WO 04/058911)；電子傳導化合物，具體而言酮、氧化膦、亞碲等(例如根據WO 05/084081及WO 05/084082)；構型異構體(例如根據WO 06/048268)；醯酸衍生物(例如根據WO 06/117052)或苯并蒽(例如根據WO 08/145239)。此外，適宜基質材料較佳係本發明化合物。除本發明化合物以外，尤佳基質材料亦係選自以下種類：寡聚伸芳基(包含蒽、蒽、苯并蒽及/或芘或該等化合物之構型異構體)、寡聚伸芳基伸乙烯基、酮、氧化膦及亞碲。極佳基質材料係選自寡聚伸芳基類，其包含蒽、苯并蒽、苯并菲及/或芘或該等化合物之構型異構體。在本發明意義上，寡聚伸芳基欲指至少三個芳基或伸芳基彼此鍵結之化合物。

較佳針對螢光摻雜劑而言，適宜基質材料係(例如)下表中所繪示之材料及如WO 04/018587、WO 08/006449、US 5935721、US 2005/0181232、JP 2000/273056、EP 681019、US 2004/0247937及US 2005/0211958中所揭示之該等材料之衍生物。



除本發明化合物以外，可用於本發明有機電致發光裝置之電洞注入層或電洞傳輸層或電子傳輸層之適宜電荷傳輸材料係(例如) Y. Shirota等人，*Chem. Rev.* **2007**, *107*(4), 953 - 1010中所揭示之化合物或根據先前技術用於該等層之其他材料。

此外，較佳者係特徵在於一或多個層係借助昇華方法施加飛有機電致發光裝置，其中該等材料係在真空昇華單元中在通常小於 10^{-5} 毫巴、較佳小於 10^{-6} 毫巴之初始壓力下蒸氣沈積。然而，初始壓力亦可甚至更低，例如小於 10^{-7} 毫巴。

較佳者亦係特徵在於一或多個層係借助OVPD(有機氣相沈積)方法或藉助載體氣體昇華施加的有機電致發光裝置，其中該等材料係在介於 10^{-5} 毫巴與1巴之間之壓力下施加。此方法之特別情形係OVJP (有機蒸氣噴墨印刷)方法，其中該等材料係藉助噴嘴直接施加並由此結構化(例如M. S. Arnold等人，*Appl. Phys. Lett.* **2008**, *92*, 053301)。

此外，較佳者係特徵在於一或多個層係自溶液藉由(例如)旋塗或借助任一期望印刷方法(例如LITI (光誘導之熱成像、熱轉印)、噴墨印刷、絲網印刷、柔版印刷、平版印刷或噴嘴印刷)產生的有機電致發光裝置。出於此目的，需要藉由(例如)適宜取代獲得之可溶化合物。該等方法亦尤其適於本發明化合物，因為該等化合物通常在有機溶劑中具有極佳溶解度。

亦可能者係混合方法，其中，舉例而言，一或多個層係自溶液施加且一或多個其他層係藉由蒸氣沈積施加。因此，舉例而言，發射層可自溶液施加且電子傳輸層可藉由蒸氣沈積施加。

該等方法通常為熟習此項技術者已知且熟習此項技術者可在無

發明性步驟之情況下將該等方法應用於包含本發明化合物之有機電致發光裝置。

藉助(例如)旋塗或印刷方法對來自液相之本發明化合物之處理需要本發明化合物之調配物。該等調配物可為(例如)溶液、分散液或微小乳液。出於此目的，可較佳使用兩種或更多種溶劑之混合物。適宜且較佳之溶劑係(例如)甲苯、苯甲醚、鄰-、間-或對-二甲苯、苯甲酸甲酯、二甲基苯甲醚、均三甲苯、四氫萘、兒茶酚二甲醚、THF、甲基-THF、THP、氯苯、二噁烷或該等溶劑之混合物。較佳地，出於上文目的，使用WO 2010/093592中所揭示之溶劑。

因此，本發明此外係關於包含至少一種式(1)化合物或上文所指示之較佳實施例與至少一種溶劑(具體而言有機溶劑)之調配物(具體而言溶液、分散液或微小乳液)。可製備此類型溶液之方式為熟習此項技術者已知且闡述於(例如) WO 2002/072714、WO 2003/019694、WO 2010/093592及其中所引用之文獻中。

此外，本發明係關於包含至少一種式(1)化合物或上文所指示之較佳實施例與至少一種其他化合物之混合物。若本發明化合物用作基質材料，則其他化合物可為(例如)螢光或磷光摻雜劑。該混合物則亦可另外包含另一種材料作為額外基質材料。

本發明化合物及本發明有機電致發光裝置之特徵在於以下優於先前技術之令人驚訝之優點：

1. 本發明化合物極適合用於有機電致發光裝置中之電洞傳輸層或電洞注入層。具體而言，其亦適宜用於直接毗鄰磷光發射層之層，因為本發明化合物不會消除發光。

2. 用作螢光或磷光發射體之基質材料之本發明化合物達成極高效率及長壽命。具體而言，此適用於該等化合物作為基質材料與另一基質材料及磷光發射體一起使用的情形。

3. 用於有機電致發光裝置中之本發明化合物在低使用及操作電壓之情況下達成高效率及陡峭電流/電壓曲線。

該等上述優點並不伴隨對其他電子性質之損害。

藉由以下實例來更詳細地說明本發明，該等實例不欲限制本發明。基於該等說明，熟習此項技術者將能夠在整個所揭示範圍內實施本發明並在無發明性步驟之情況下根據本發明製備其他化合物並將其用於電子裝置或使用本發明方法。

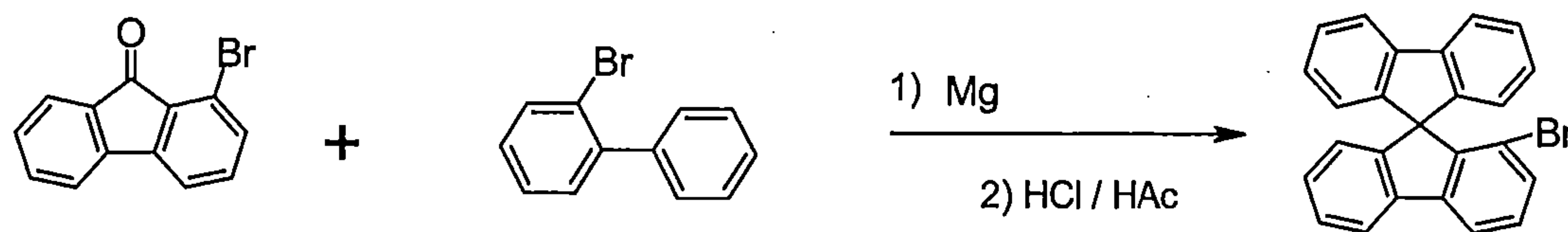
實例

A) 合成實例

除非另有說明，否則以下合成係在保護性氣體氣氛下實施。起始材料可自ALDRICH或ABCR購得。在起始材料係自文獻得知之情形下，方括號中之編號係相應CAS編號。

實例1：溴化螺二萘衍生物(起始材料)之合成

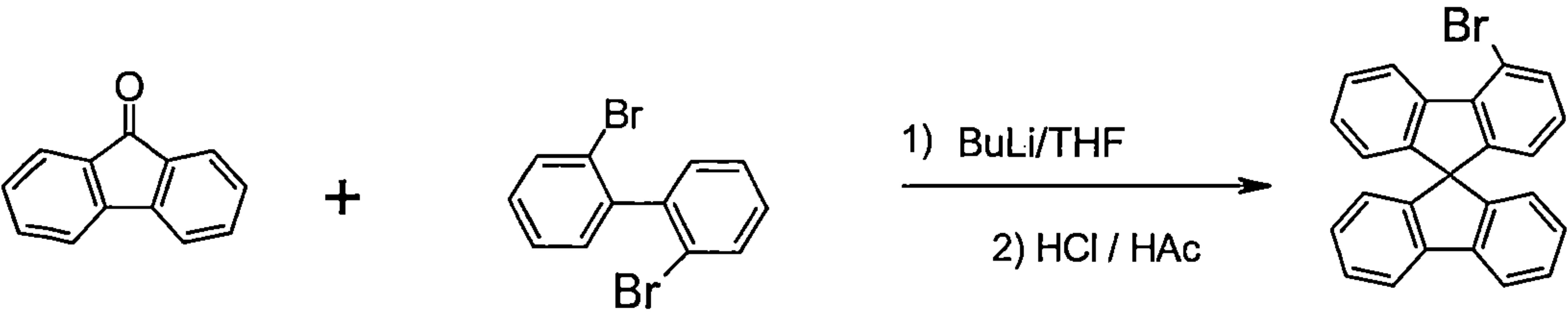
1a) 1-溴螺-9,9'-聯萘之合成



使用70°C油浴利用二次加熱自2.7 g (110 mmol)碘活化之鎂屑及25.6 g (110 mmol) 2-溴聯苯、0.8 ml 1,2-二氯乙烷、50 ml 1,2-二甲氧基乙烷、400 ml THF及200 ml甲苯之混合物來製備相應格氏試劑(Grignard reagent)。當鎂已完全反應時，使混合物冷卻至室溫，且然後逐滴添加25.9 g (100 mmol) 1-溴萘酮[36804-63-4]於500 ml THF中之溶液，將反應混合物在50°C下升溫4 h且然後在室溫下再攪拌12 h。添加100 ml水，短暫地攪拌混合物，分離出有機相，並在真空中去除溶劑。在40°C下將殘餘物懸浮於500 ml冰乙酸中，將0.5 ml濃硫酸添加至懸浮液中，且隨後在100°C下將混合物再攪拌2 h。在冷卻後，利

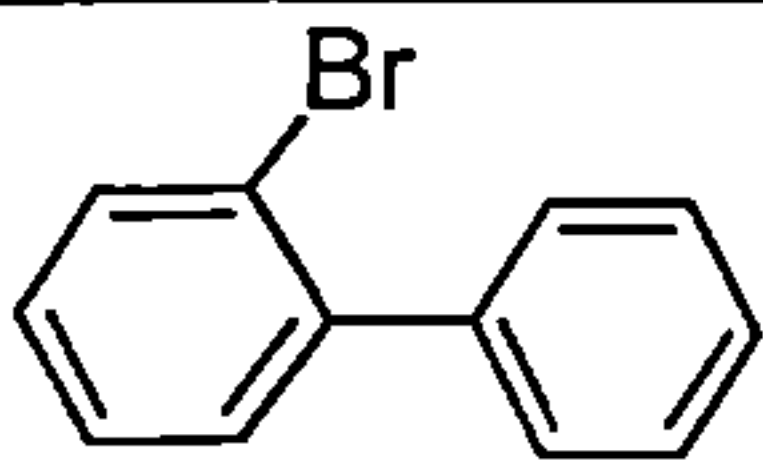
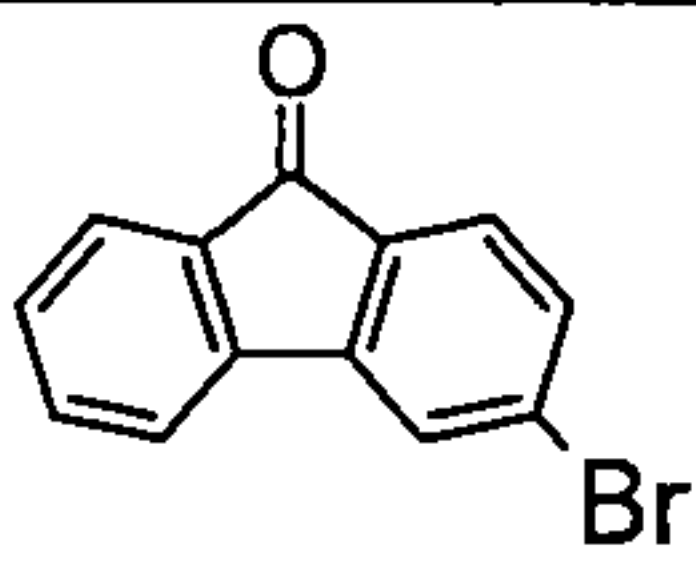
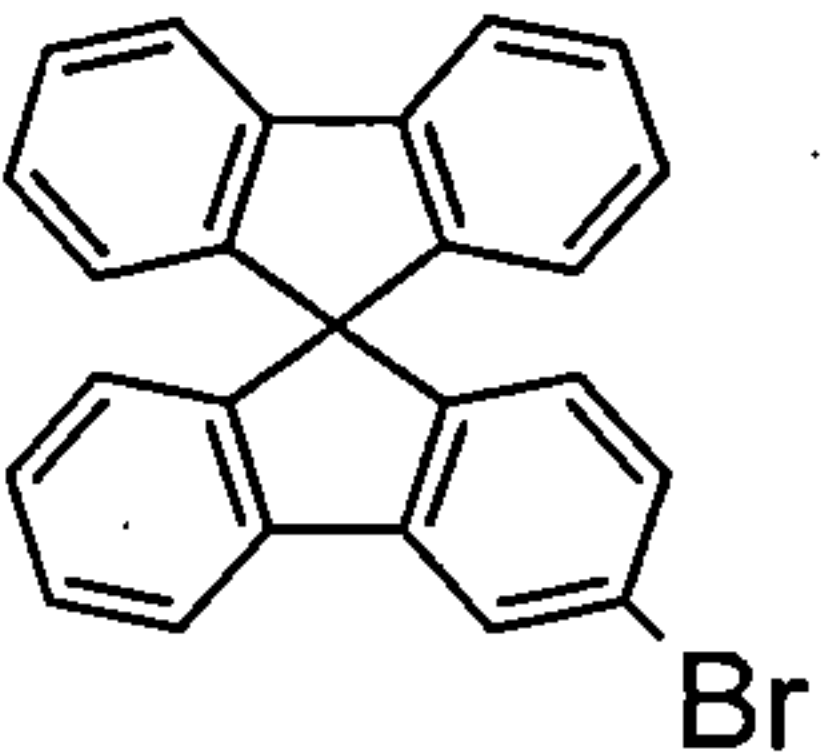
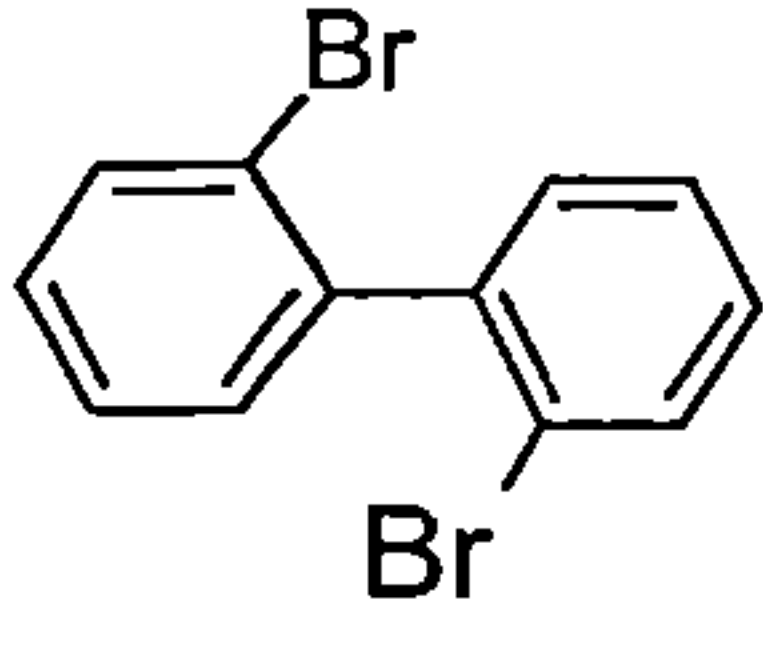
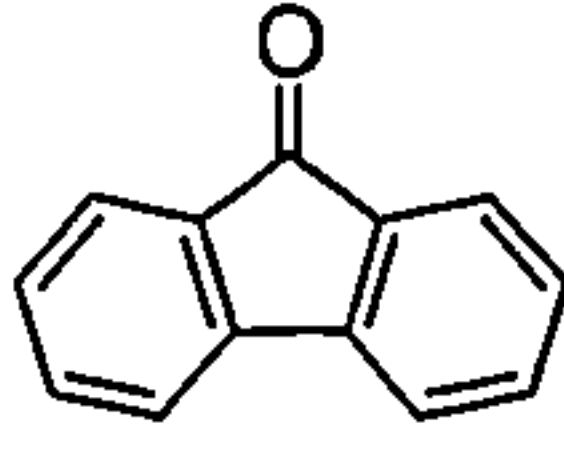
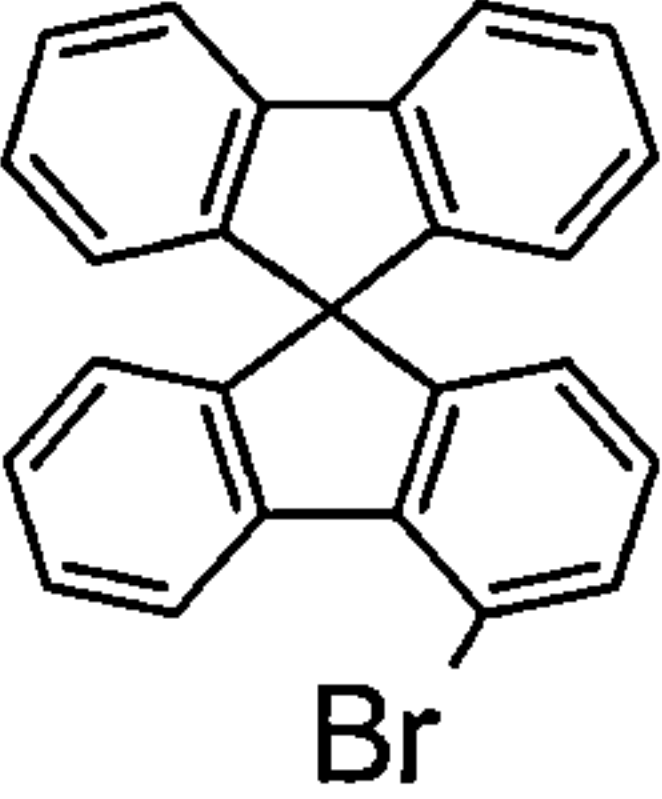
用抽吸濾出所沈澱固體，用100 ml冰乙酸洗滌一次，用乙醇洗滌三次(每次100 ml)，並最後自二噁烷重結晶。產率：26.9 g (68 mmol), 68%；根據¹H-NMR，純度為約98%。

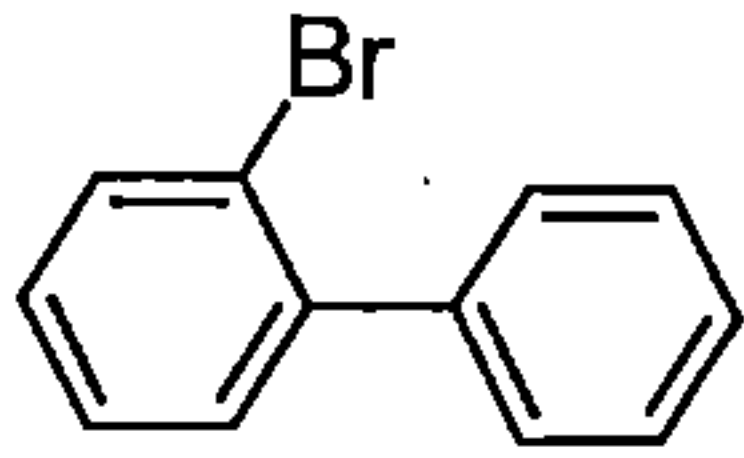
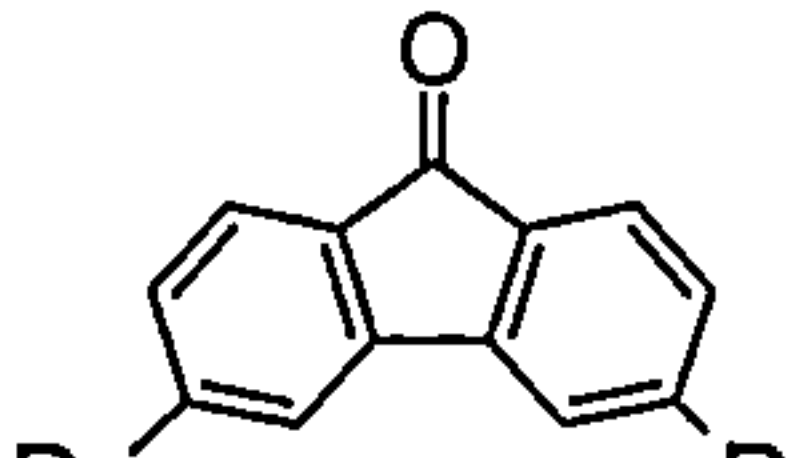
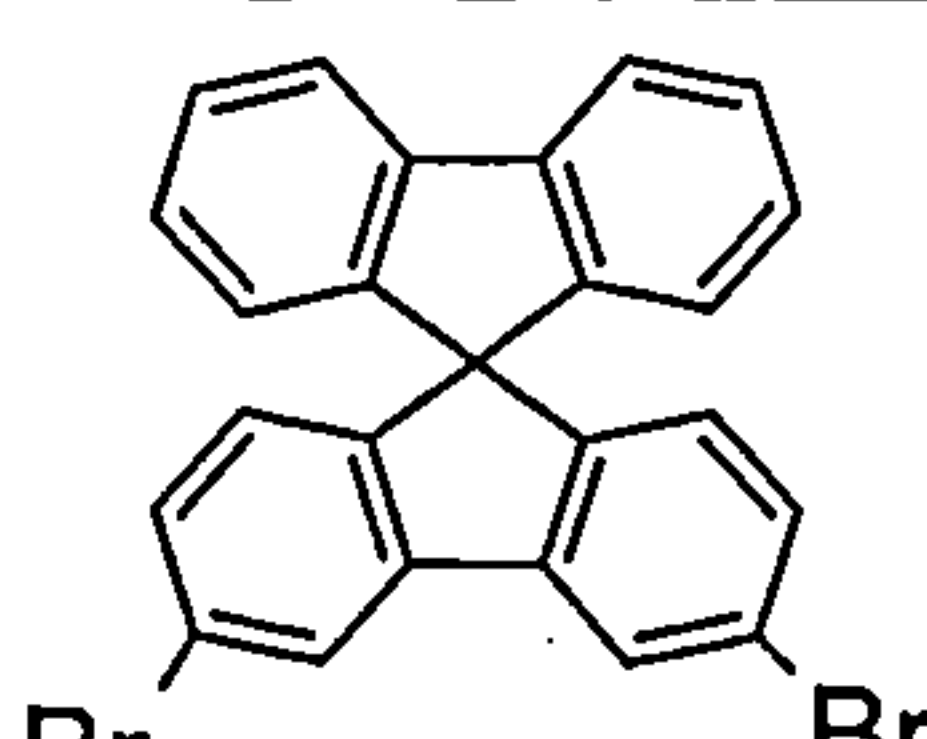
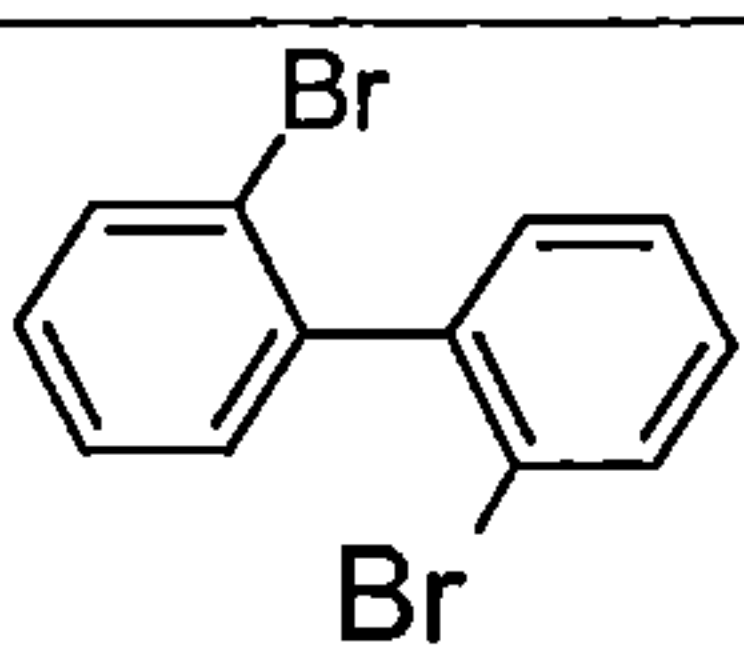
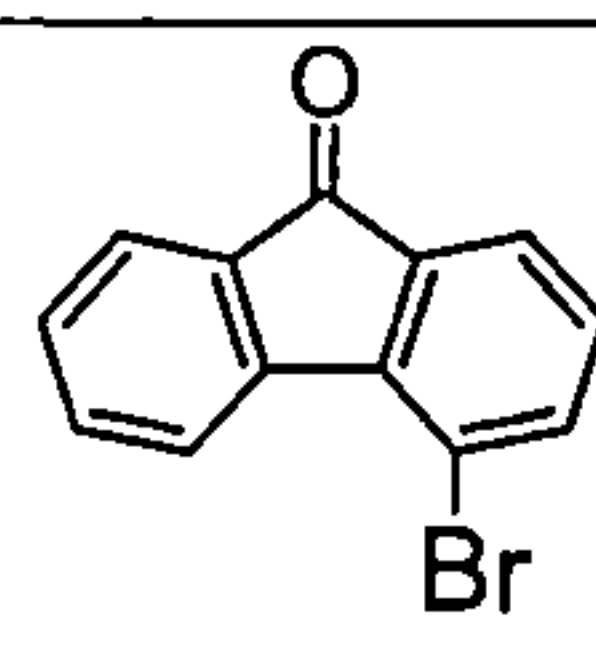
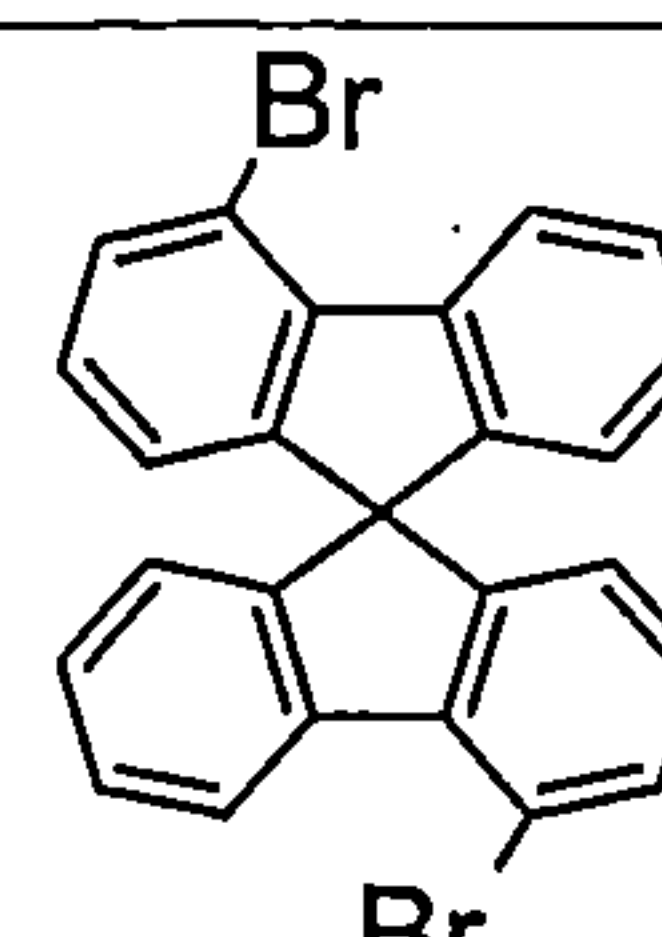
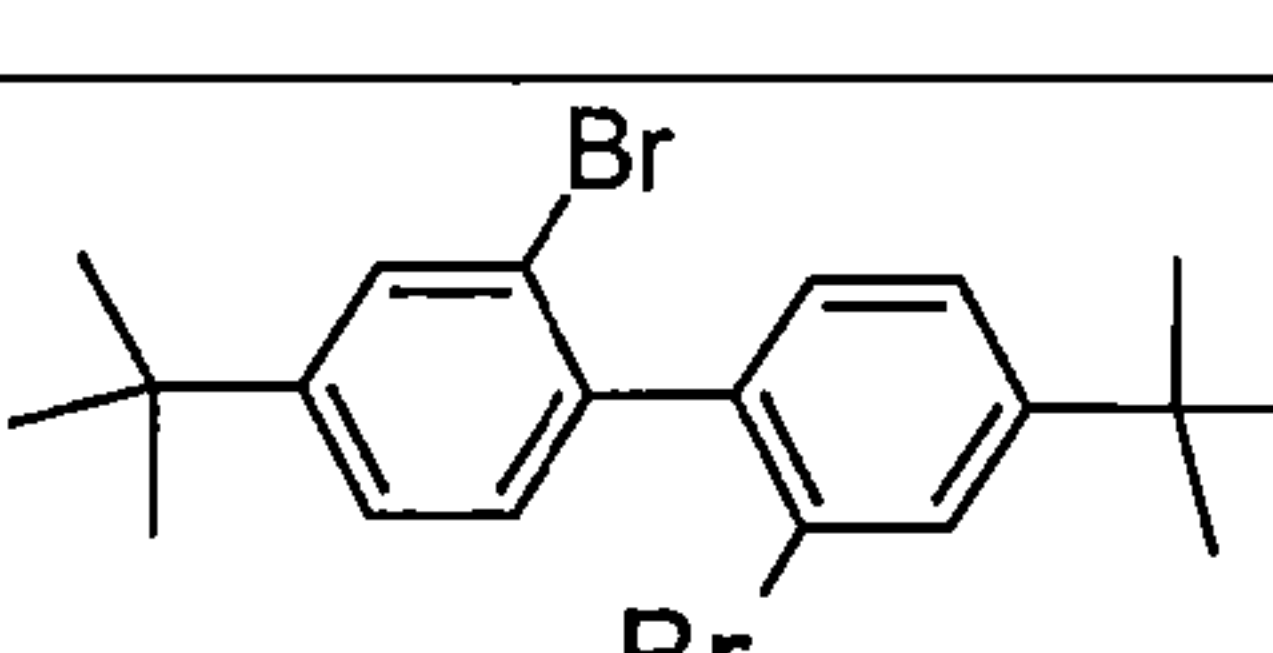
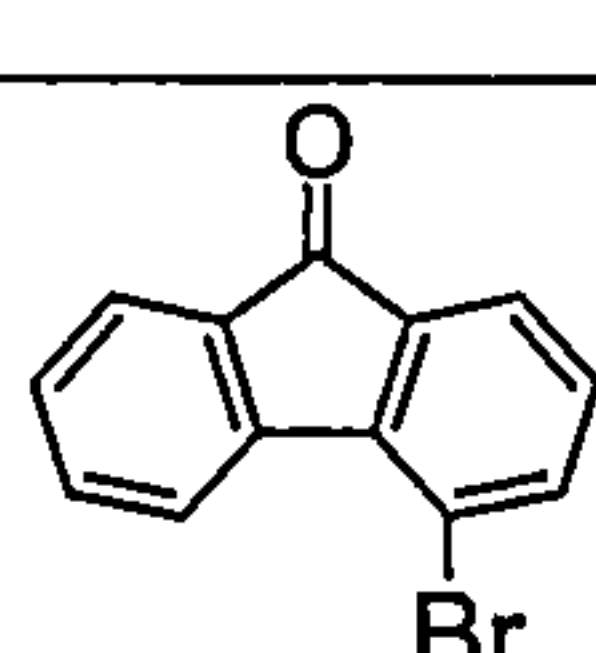
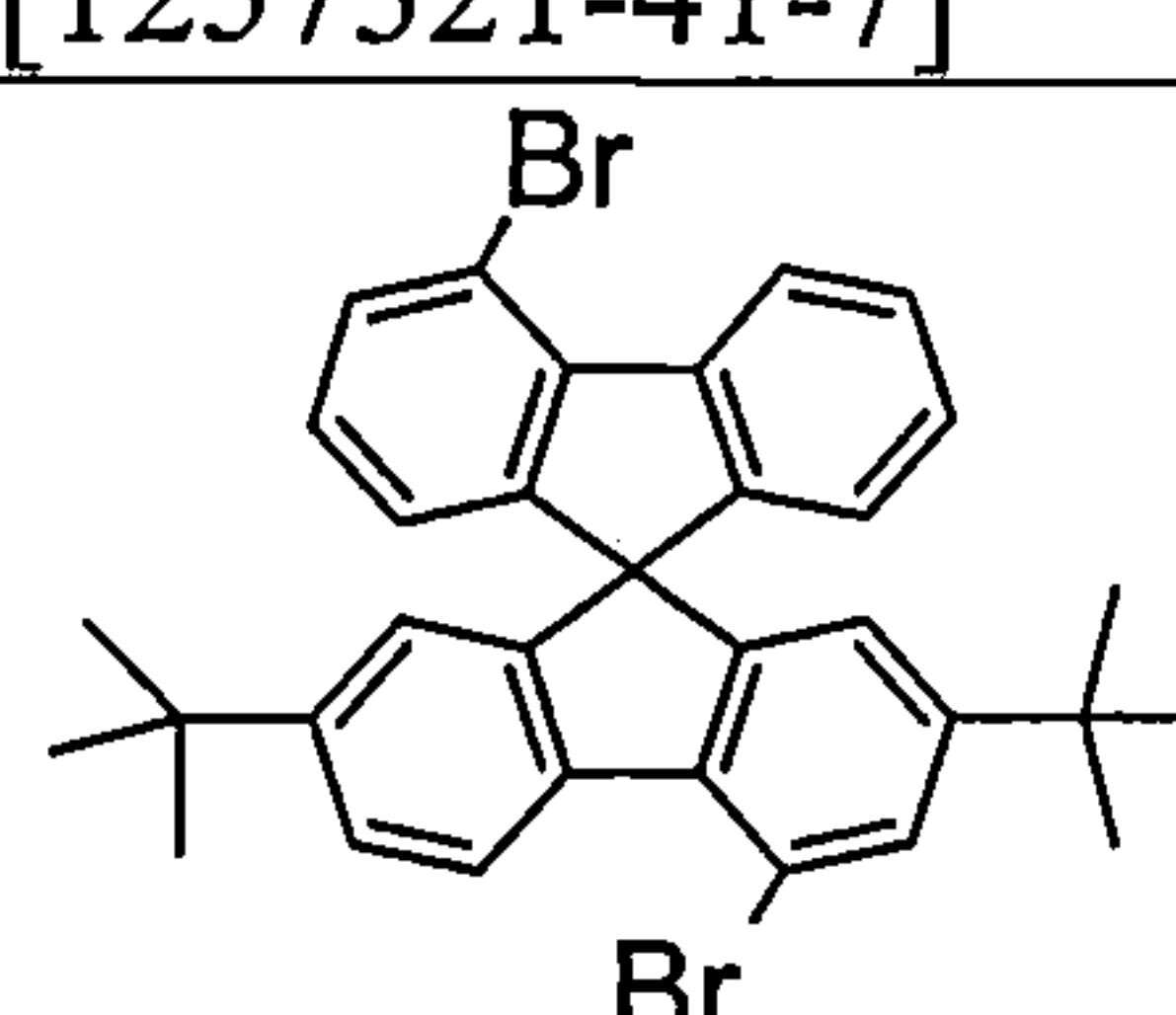
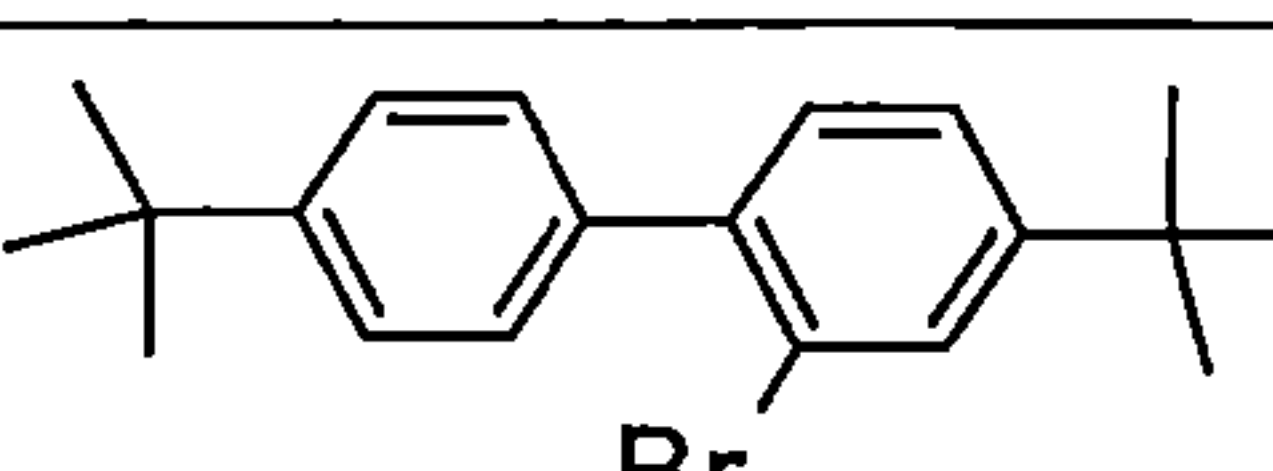
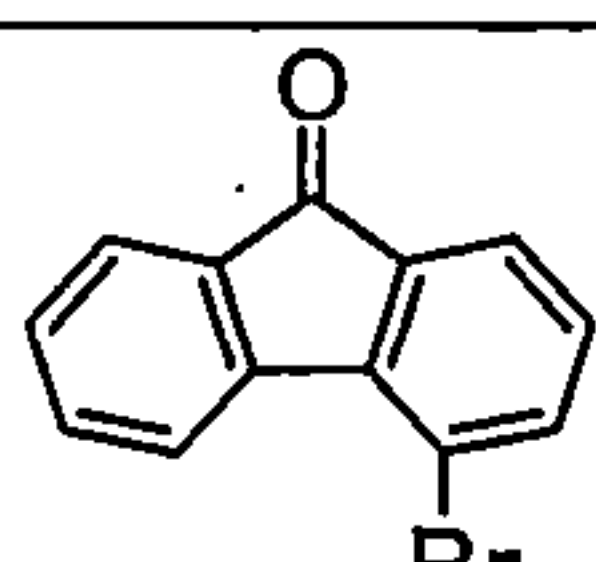
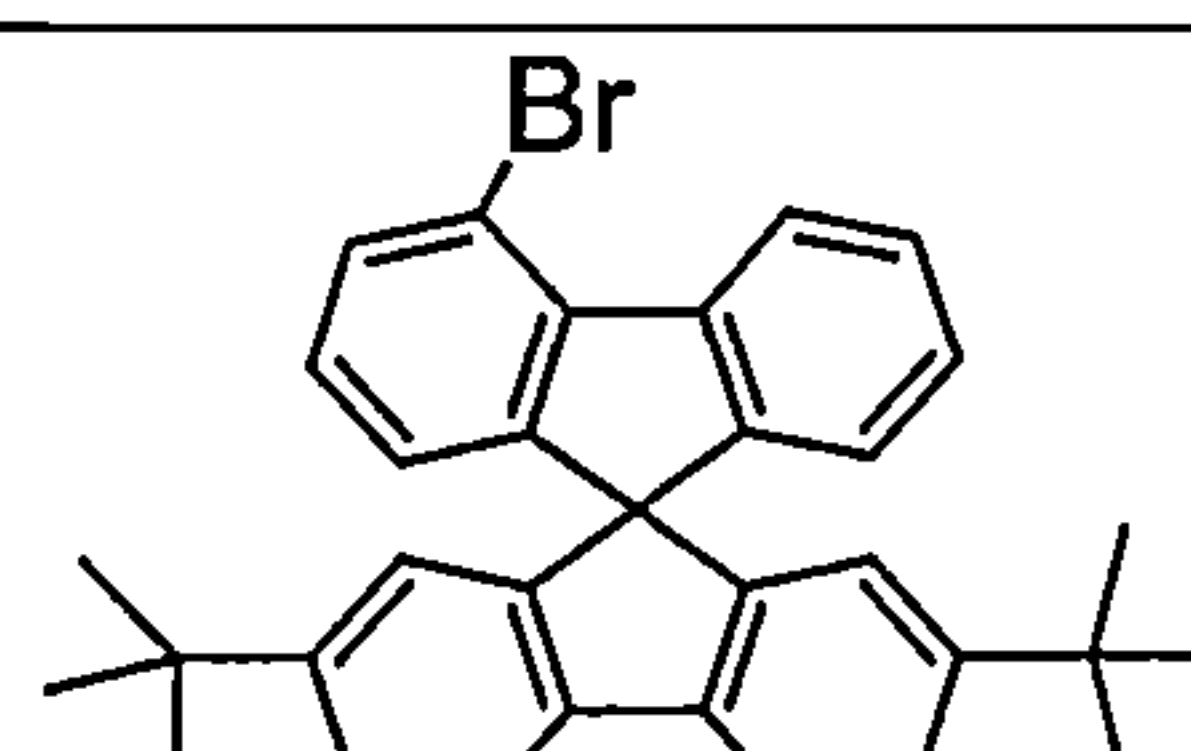
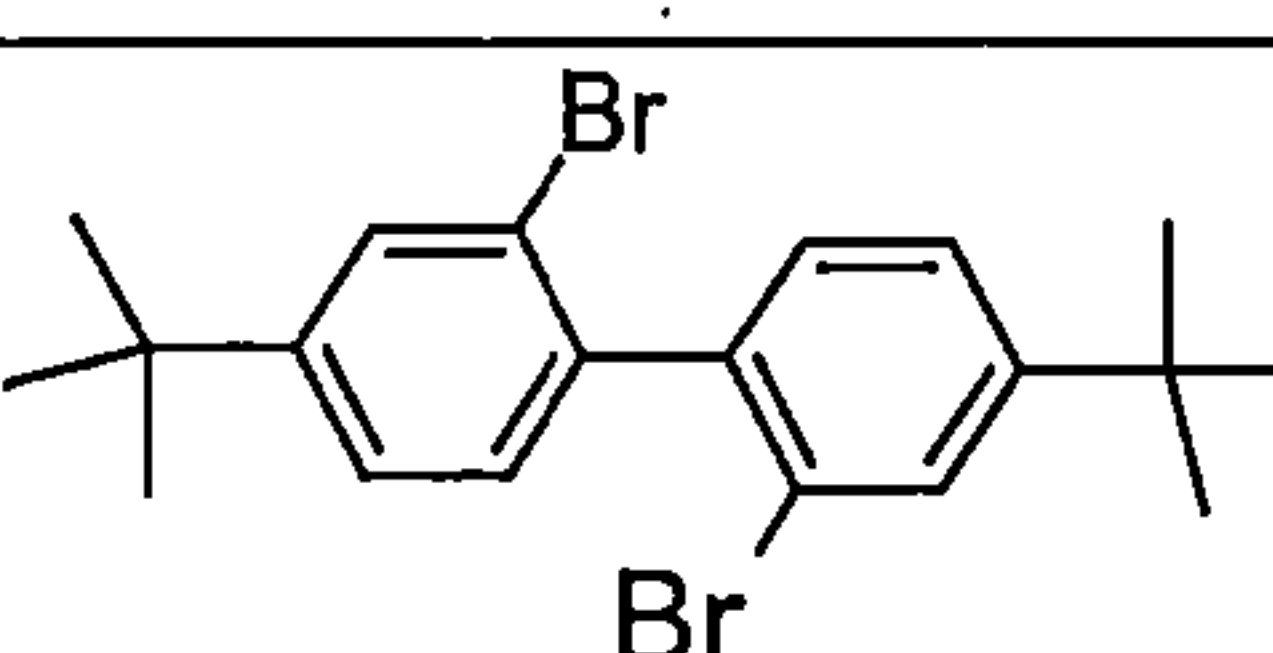
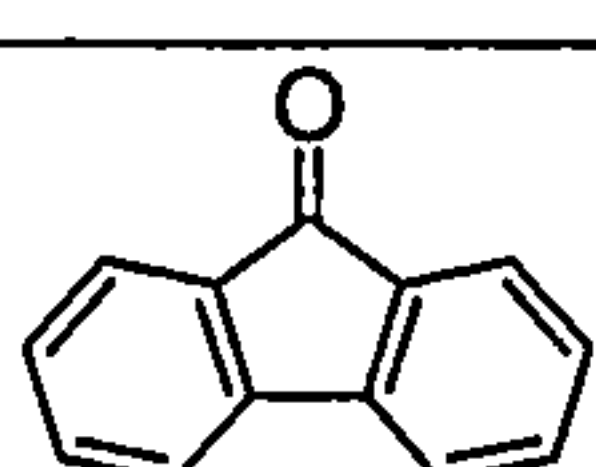
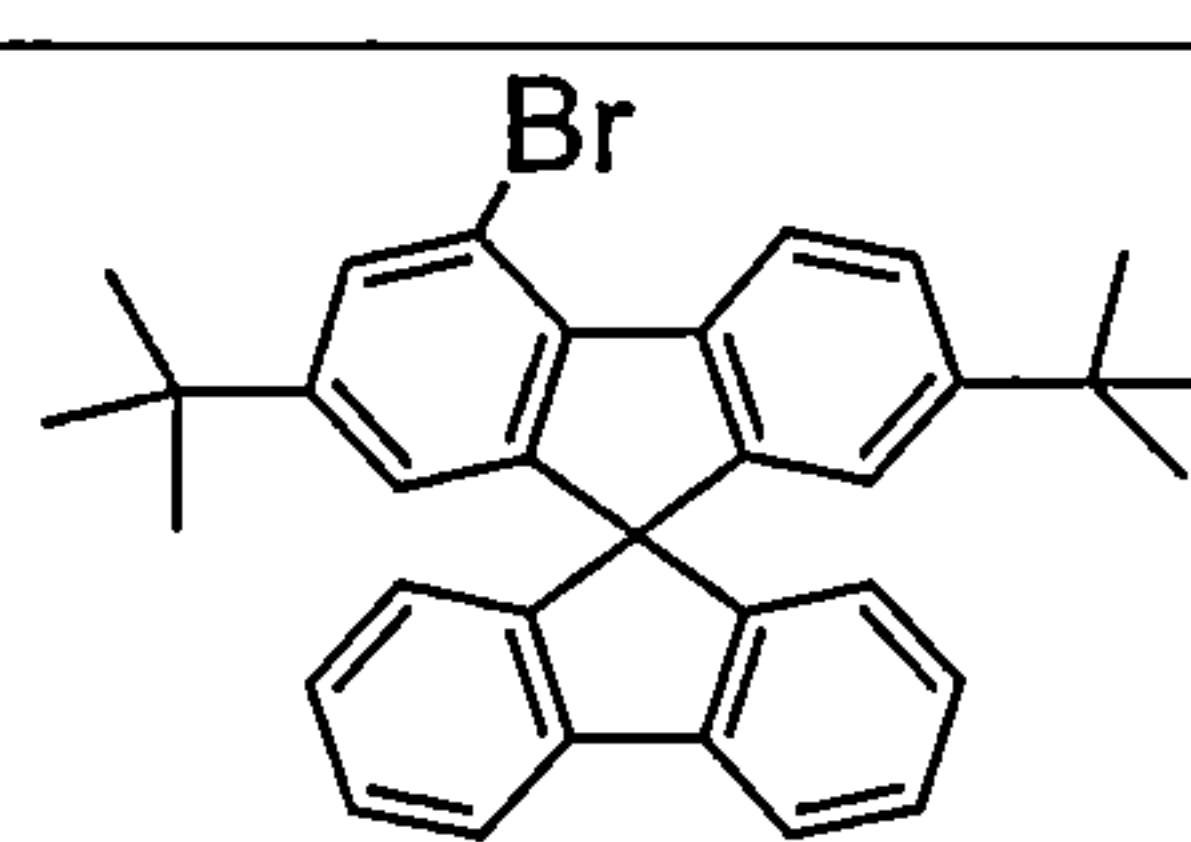
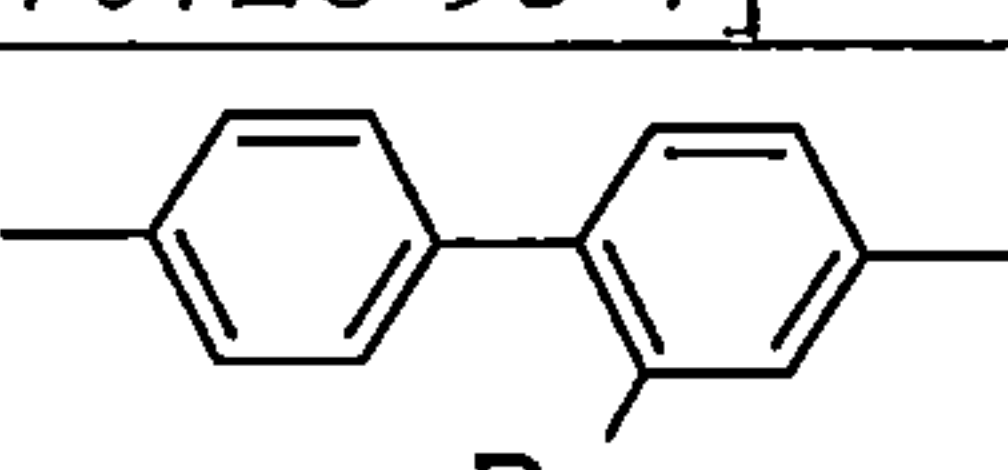
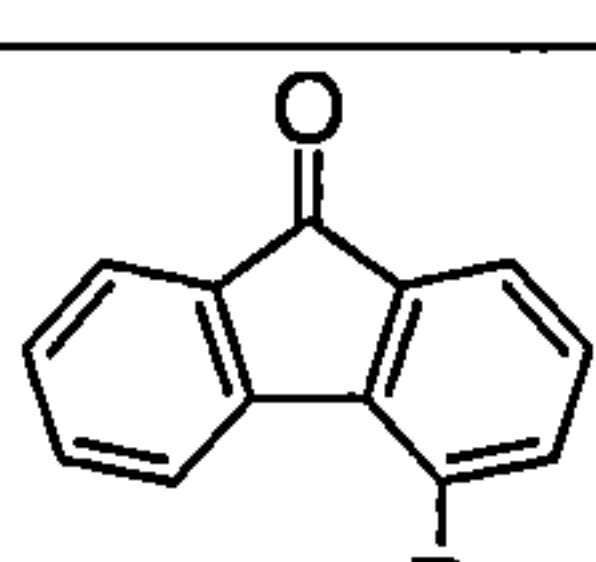
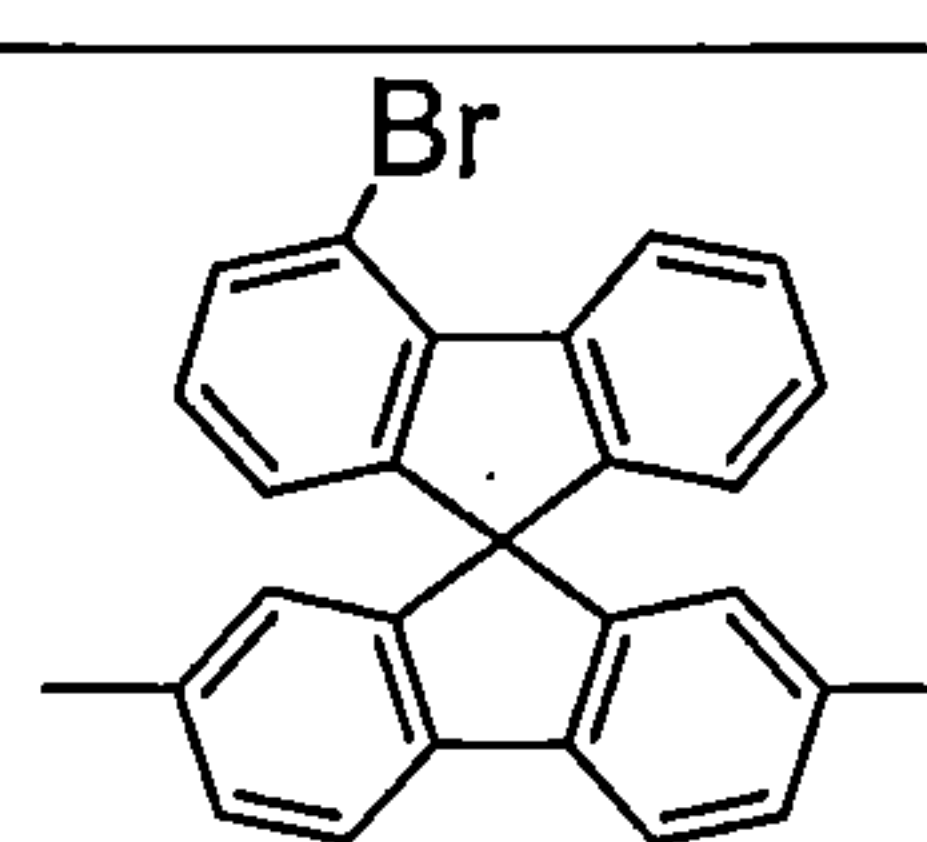
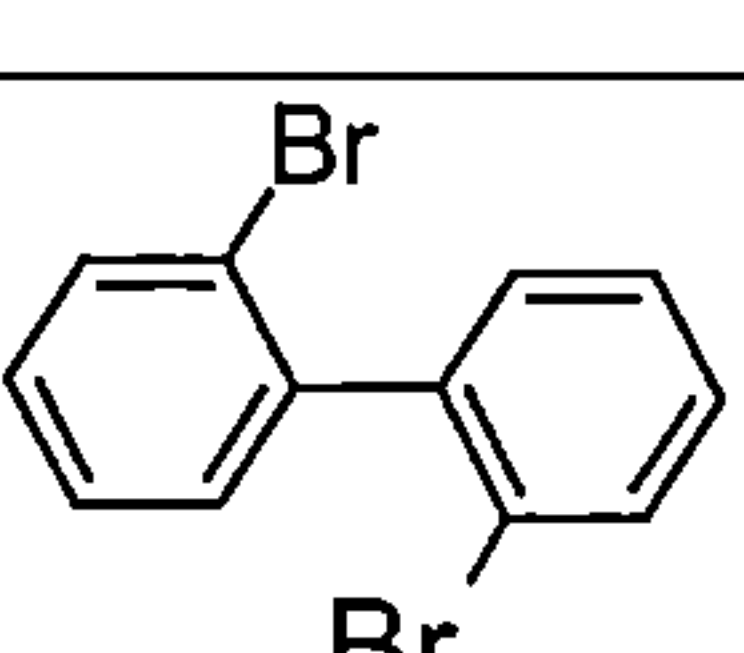
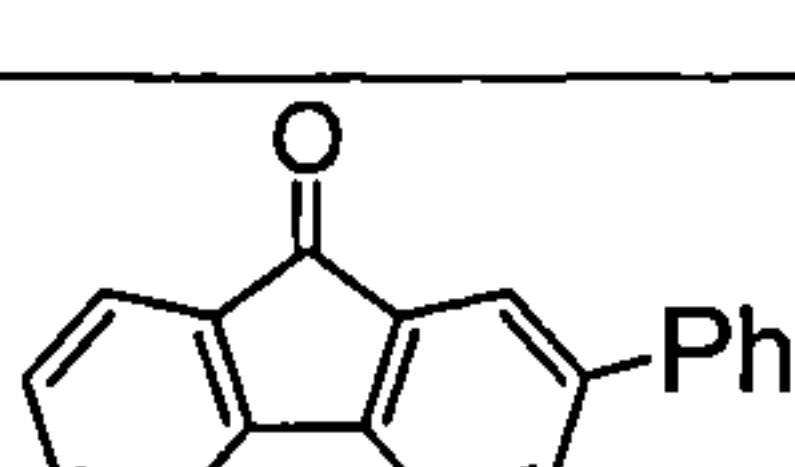
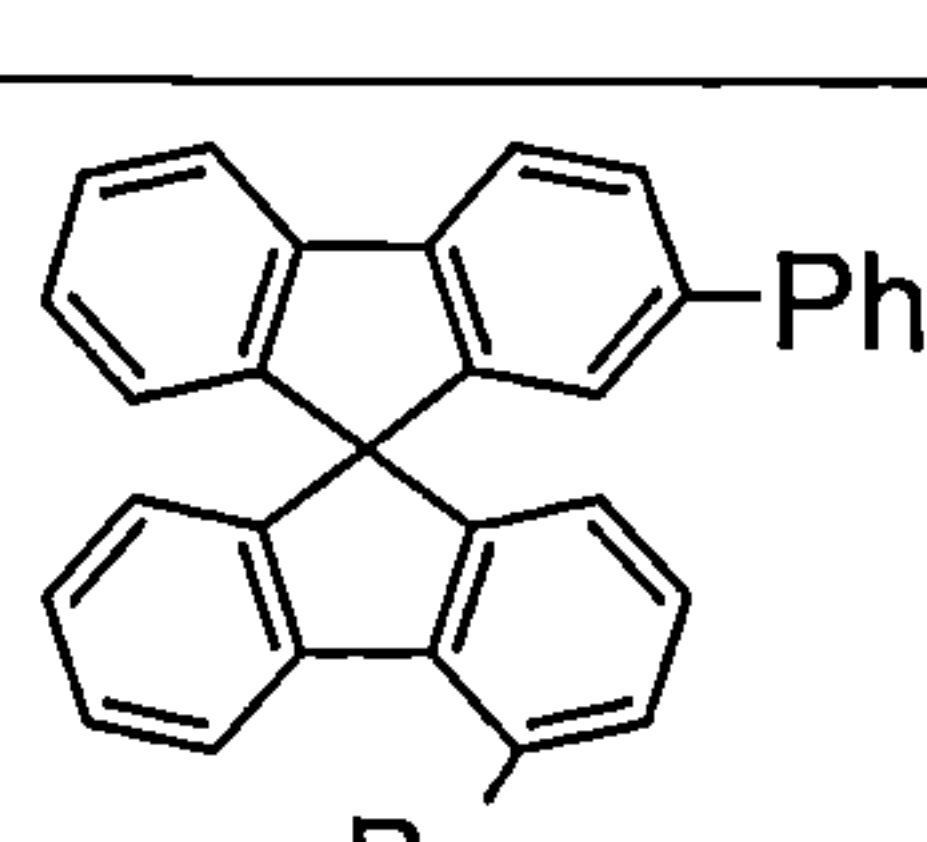
1b) 4-溴螺-9,9'-聯萘之合成

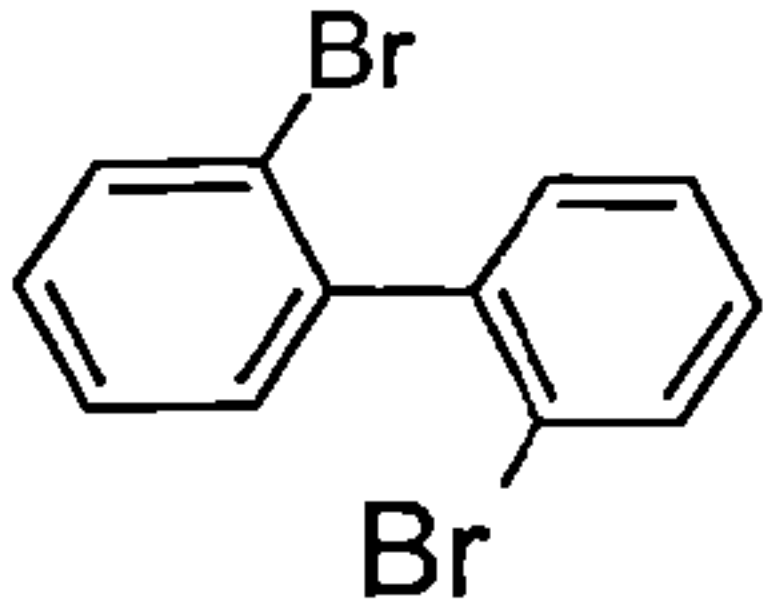
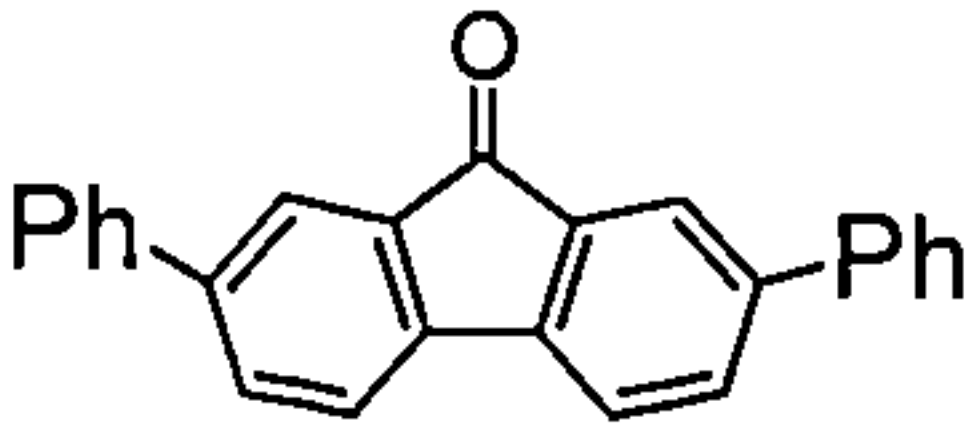
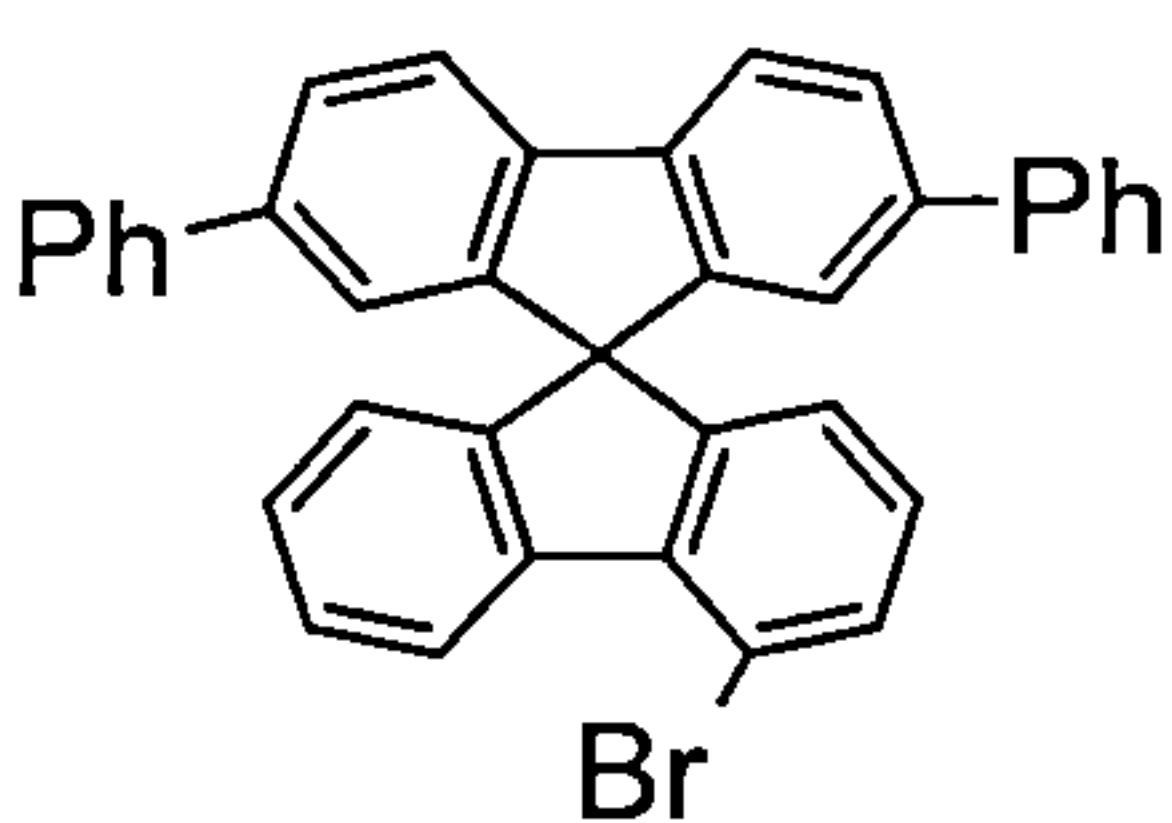
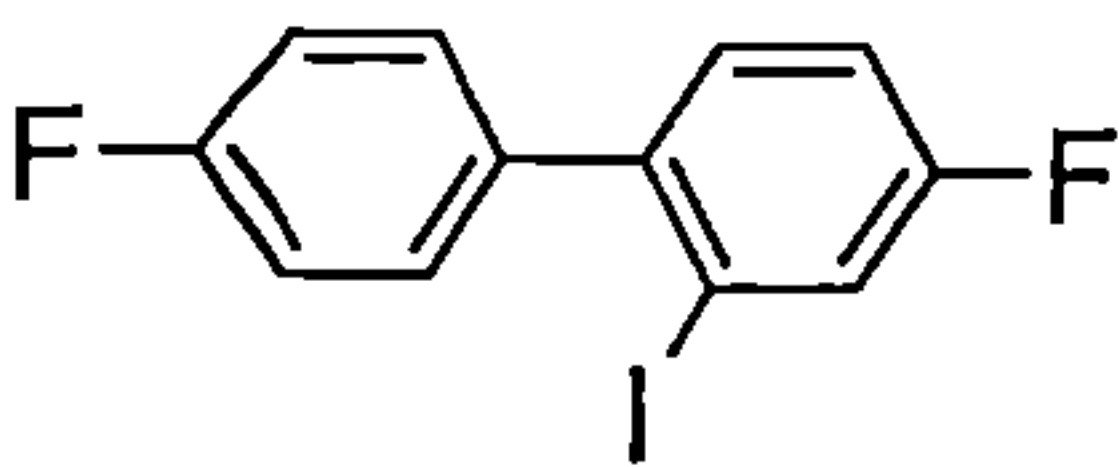
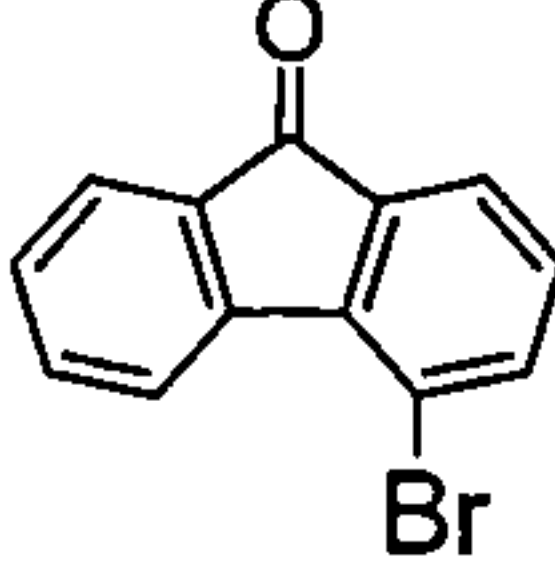
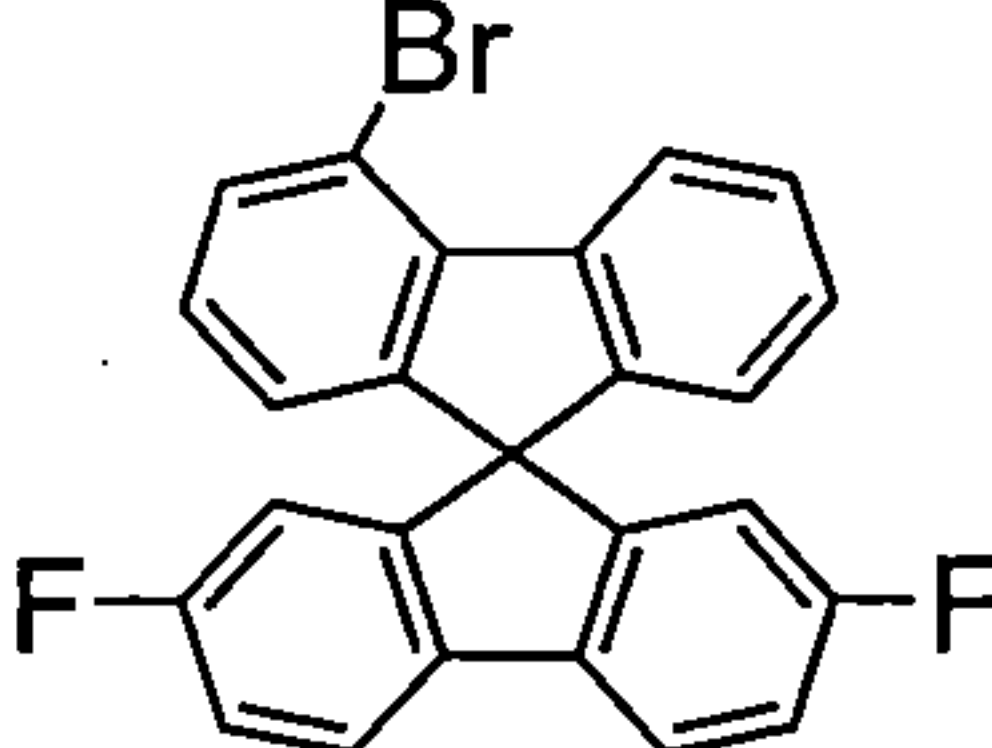
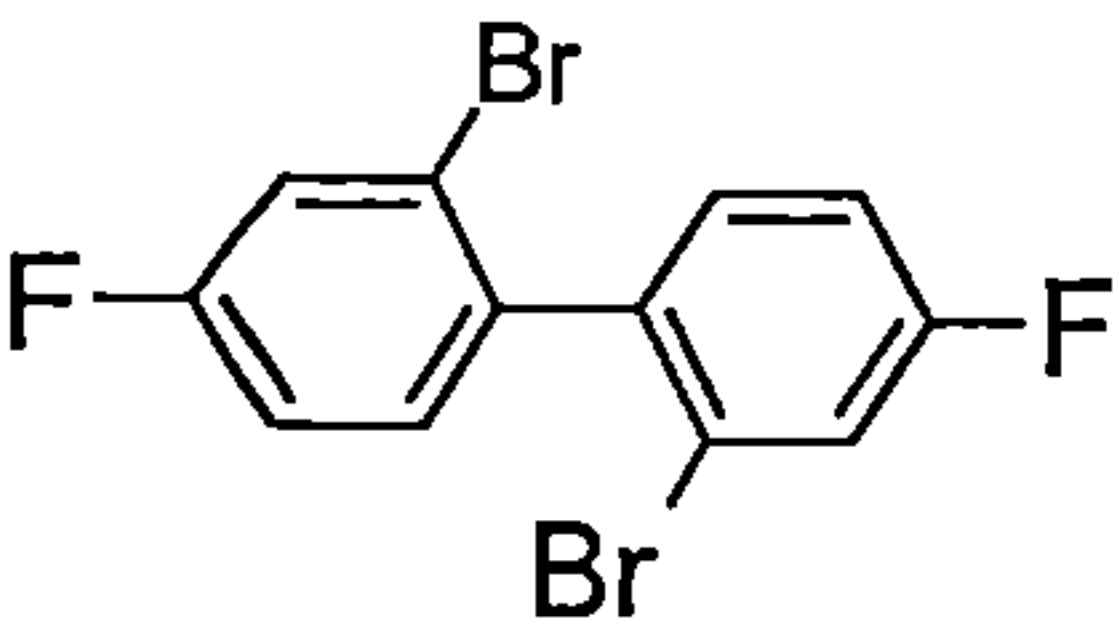
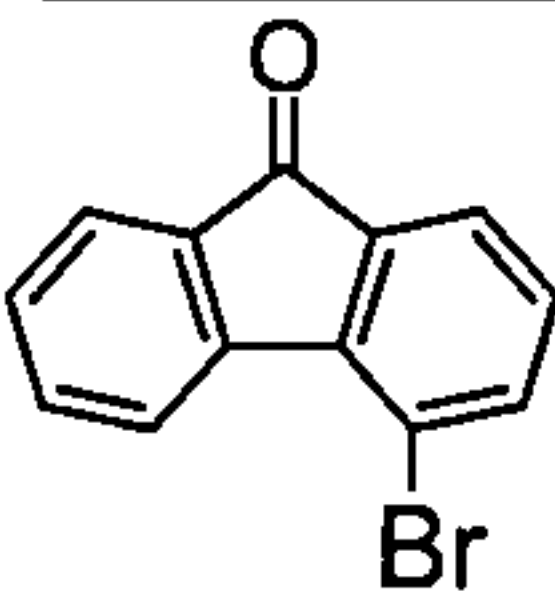
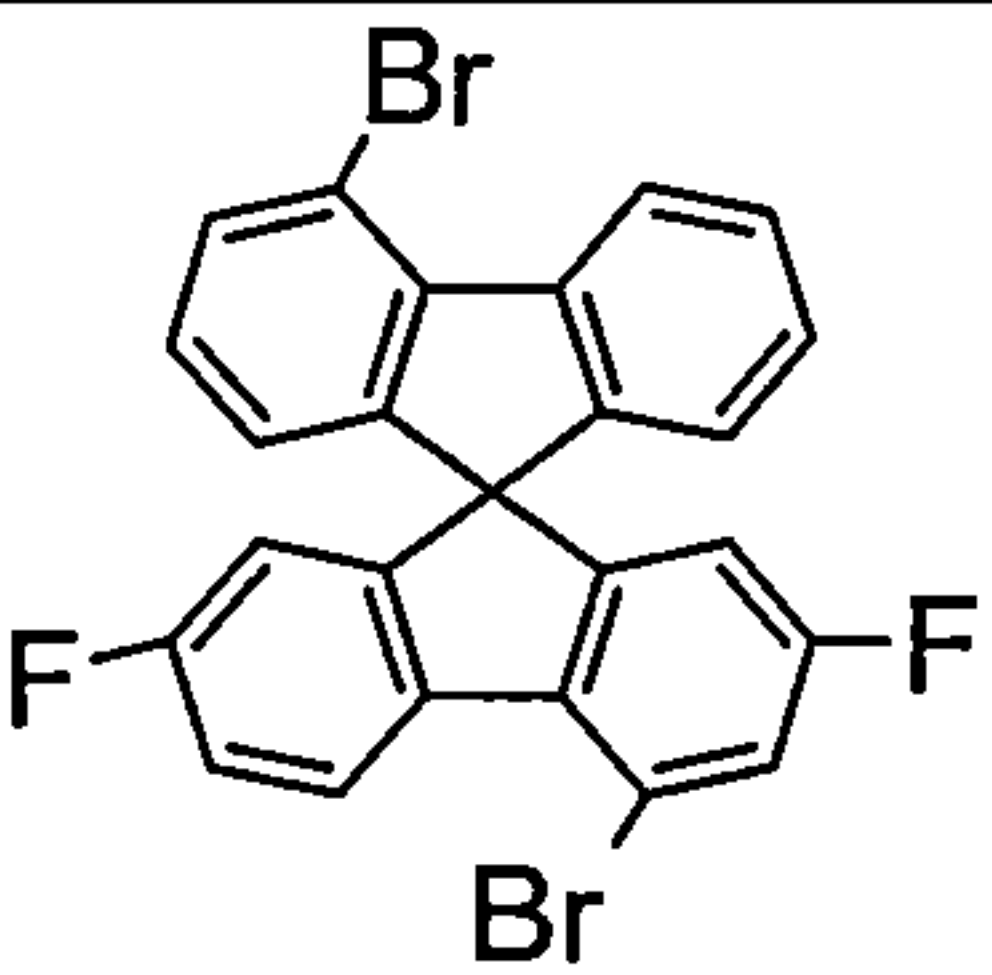


在 -78℃ 及氬氣下用 318 mL n-BuLi (2.5 M 存於己烷中，785 mmol)處理 2,2'-二溴-聯苯(250 g, 785 mmol)於 THF (1900 ml)中之溶液。將混合物攪拌30分鐘。逐滴添加萘-9-酮(144 g, 785 mmol)於1000 mL THF中之溶液。在-78℃下進行反應30分鐘且然後在室溫下攪拌過夜。用水中止反應並濾出固體。在未經進一步純化之情況下，將該醇(299 g, 92%)、乙酸(2200 mL)及濃HCl (100 mL)之混合物回流2小時。在冷卻後，過濾混合物並用水洗滌並在真空下乾燥。分離出呈白色固體形式之產物(280 g，理論為98%)。

其他溴化螺二萘衍生物之合成係以類似方式實施：

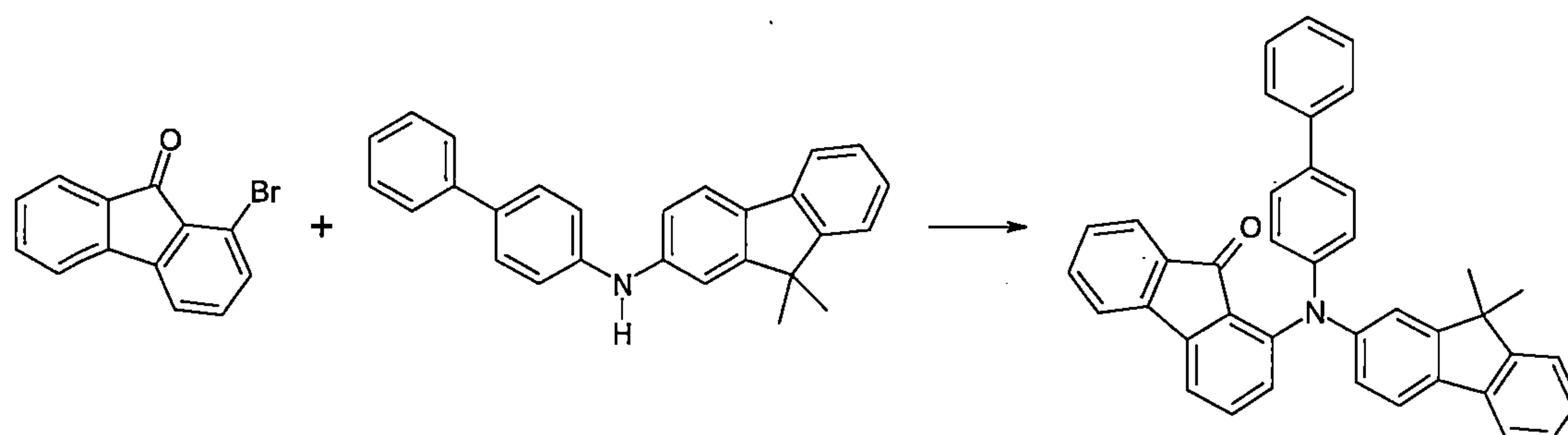
實例	溴-聯苯	溴-萘酮	產物： 溴-螺二萘	產率
1c	 [2052-07-5]	 [2041-19-2]		85%
1d	 [13029-09-9]	 [486-25-9]	 [1161009-88-6]	90%

1e	 [2052-07-5]	 [216312-73-1]	 Br Br	85%
1f	 [13029-09-9]	 [4269-17-4]	 [1257321-41-7]	90%
1g	 [70728-93-7]	 [4269-17-4]	 Br	85%
1h	 [70728-89-1]	 [4269-17-4]		90%
1i	 [70728-93-7]	 [486-25-9]		87%
1j	 [132462-55-6]	 [4269-17-4]	 Br	85%
1k	 [13029-09-9]	 [3096-49-9]	 Br	80%

1l	 [13029-09-9]	 [115033-91-5]	 80%
1m	 [1214351-66-2]	 [4269-17-4]	 90%
1n	 [124445-98-3]	 [4269-17-4]	 80%

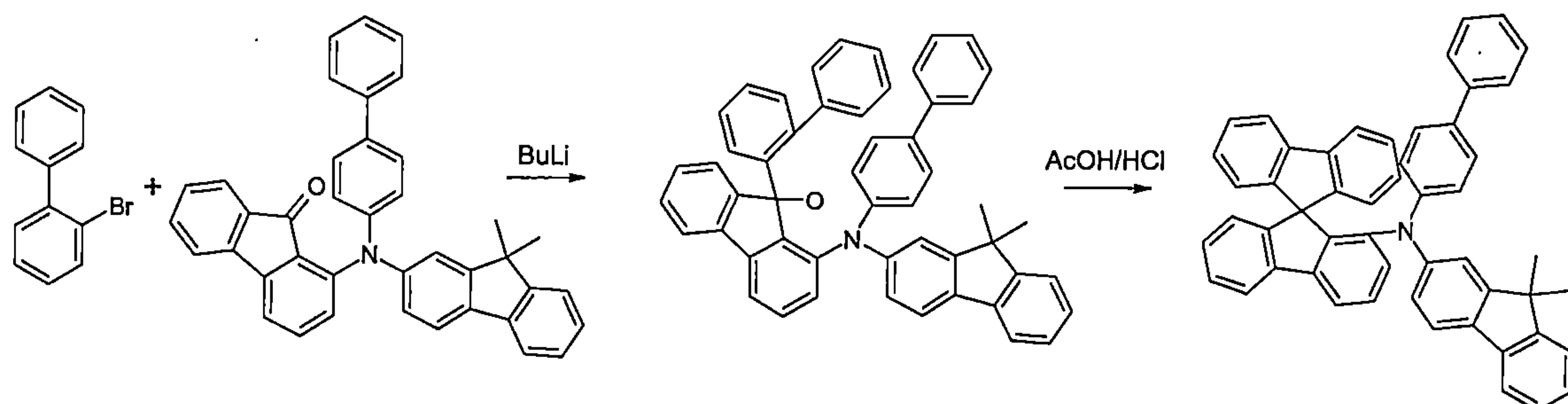
實例2：4-聯苯-2-(9,9'-二甲基芴基)-1-螺-9,9'-聯芴胺之合成

1-(1-聯苯-4-基)-(9,9'-二甲基芴-2-基)胺-9H-芴-9-酮之合成



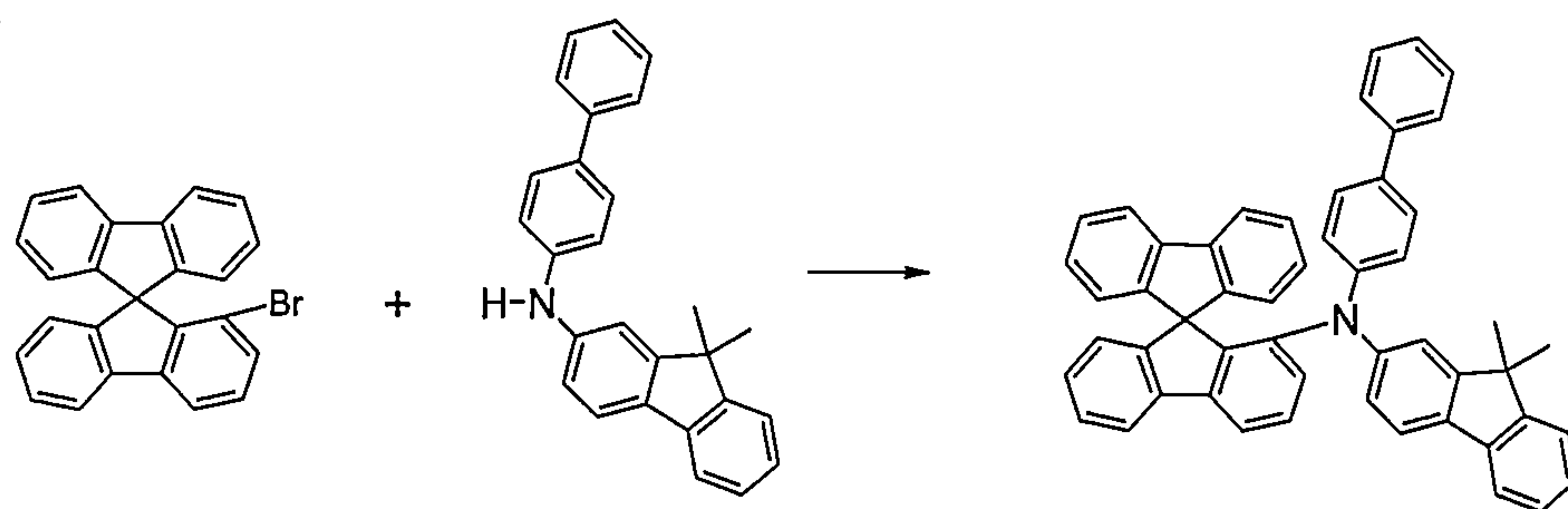
將三-第三丁基膦(4.5 ml存於甲苯中之1.0 M溶液，1.9 mmol)、乙酸鈣(217 mg, 0.97 mmol)及第三丁醇鈉(13.9 g, 145 mmol)添加至1-聯苯-基-(9,9-二甲基-9H-芴-2-基)胺(40.0 g, 111 mmol)、1-溴-芴-9-酮(25 g, 96 mmol)於經脫氣之甲苯(200 ml)中之溶液中，並在回流下將混合物加熱過夜。將反應混合物冷卻至室溫，用甲苯稀釋並藉助矽藻土過濾。在真空中蒸發掉濾液，並使殘餘物自甲苯/庚烷結晶。分離出呈淺黃色固體形式之產物(43 g，理論為82%)。

4-聯苯-2-(9,9'-二甲基芴基)-1-螺-9,9'-聯芴胺之合成



在 -78°C 及氬氣下用35 mL $n\text{-BuLi}$ (2.1 M存於己烷中, 70 mmol) 處理2-溴-聯苯(17 g, 70 mmol)於THF (90 ml)中之溶液。將混合物攪拌30分鐘。逐滴添加1-(1-聯苯-4-基)-(9,9'-二甲基芴-2-基)胺-9H-芴-9-酮(38 g, 70 mmol)於90 mL THF中之溶液。在 -78°C 下進行反應30分鐘且然後在室溫下攪拌過夜。用水中止反應並用乙酸乙酯萃取。在去除溶劑後獲得中間體醇(31 g, 64%)。在未經進一步純化之情況下, 將該醇、乙酸(700 mL)及濃HCl (62 mL)之混合物回流2小時。在冷卻後, 過濾混合物並用水洗滌。使殘餘物自甲苯結晶。在索氏萃取器(S Soxhlet extractor) (甲苯)中萃取粗製產物並藉由在真空中區域昇華來純化。分離出呈淺黃色固體形式之產物(13 g, 理論為43%, 根據HPLC, 純度 $> 99.99\%$)。

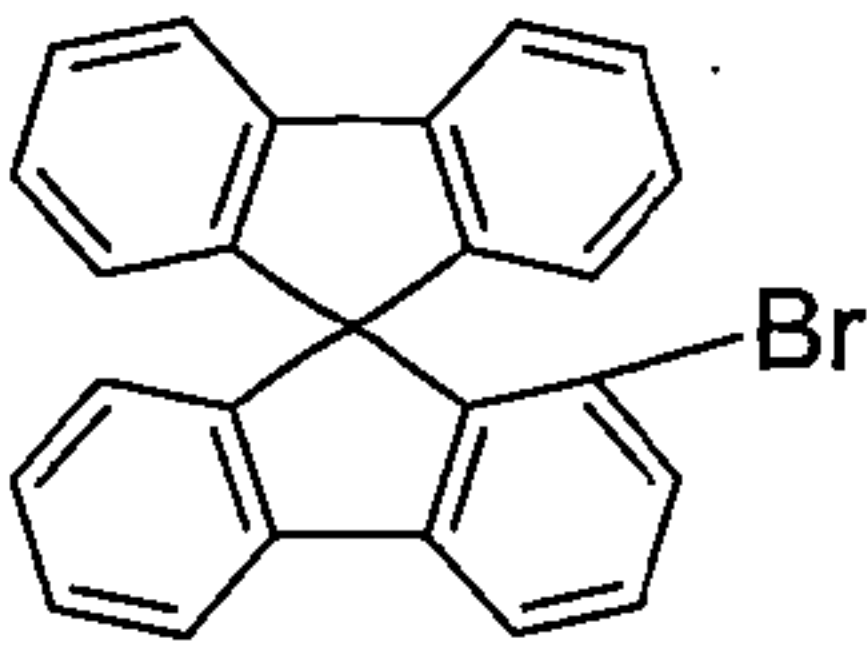
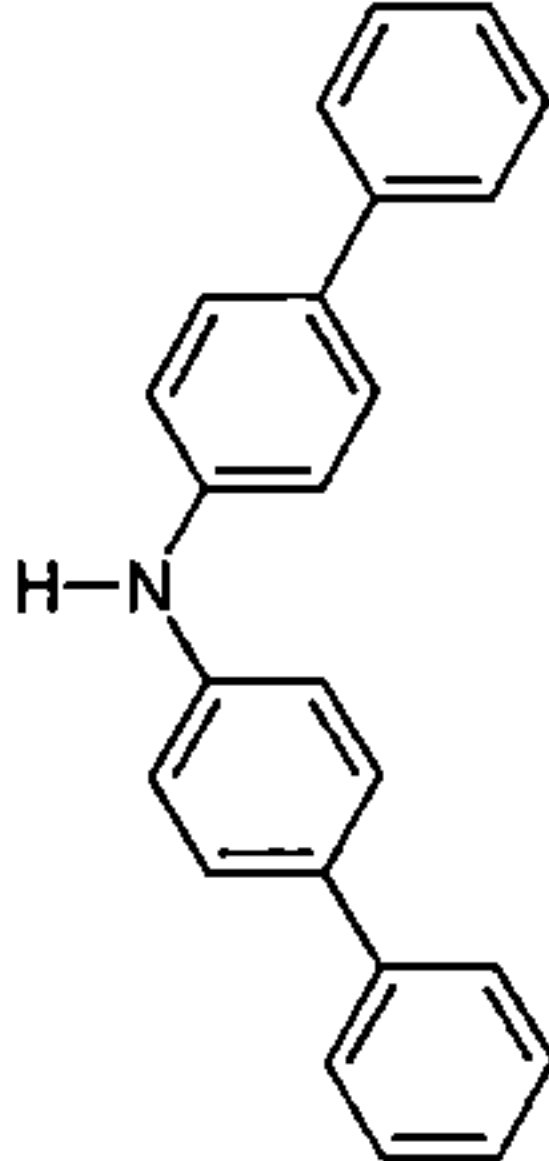
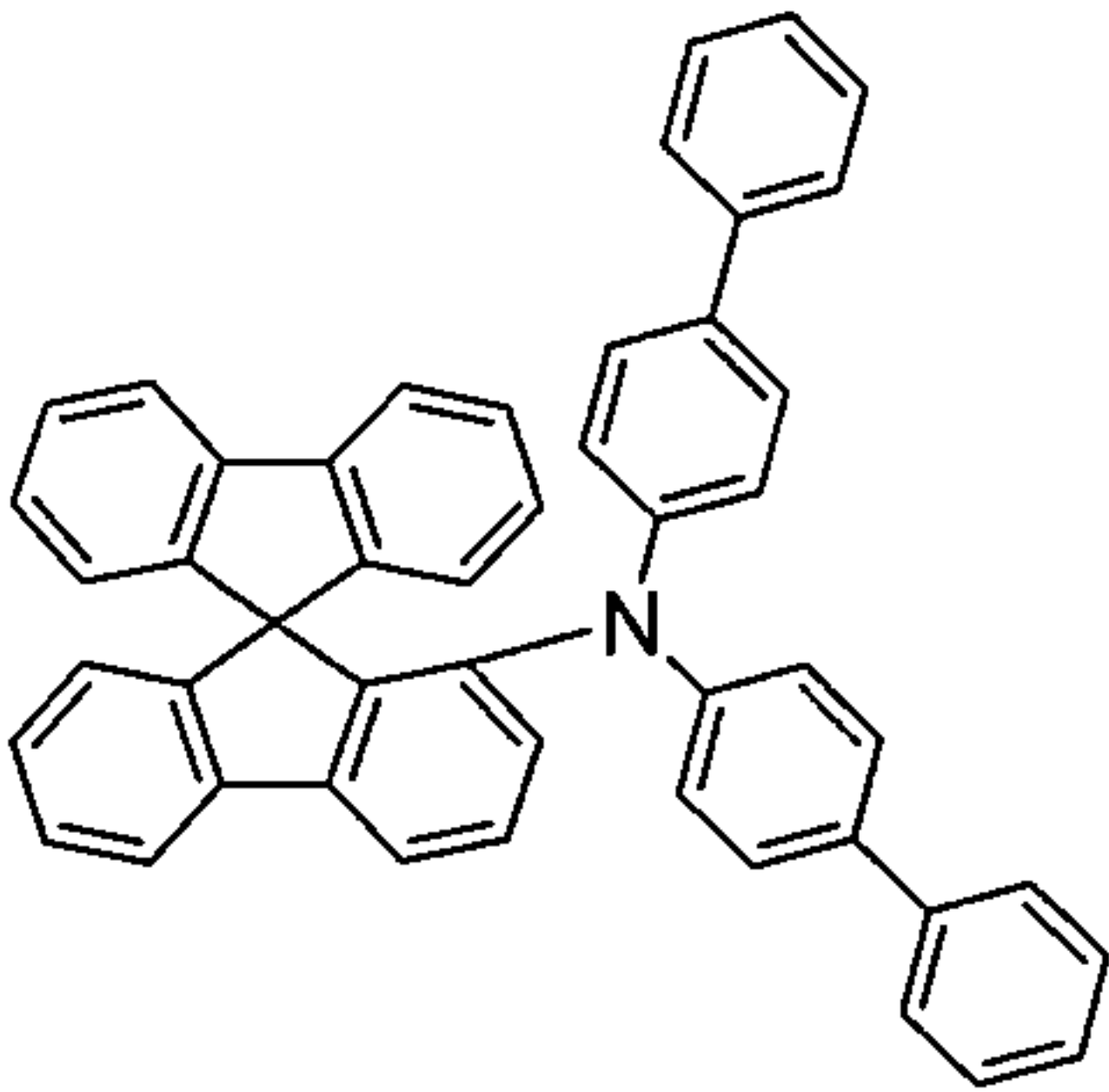
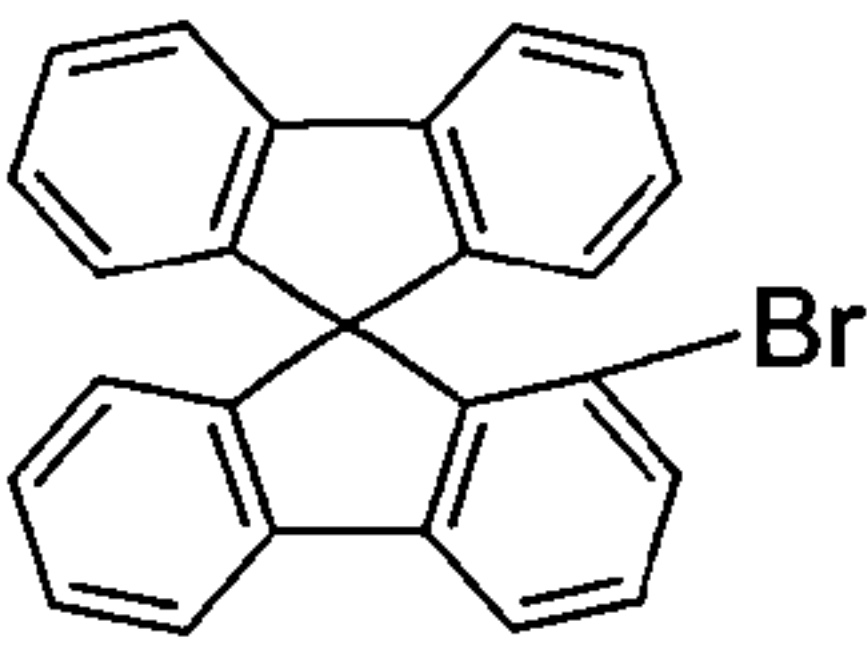
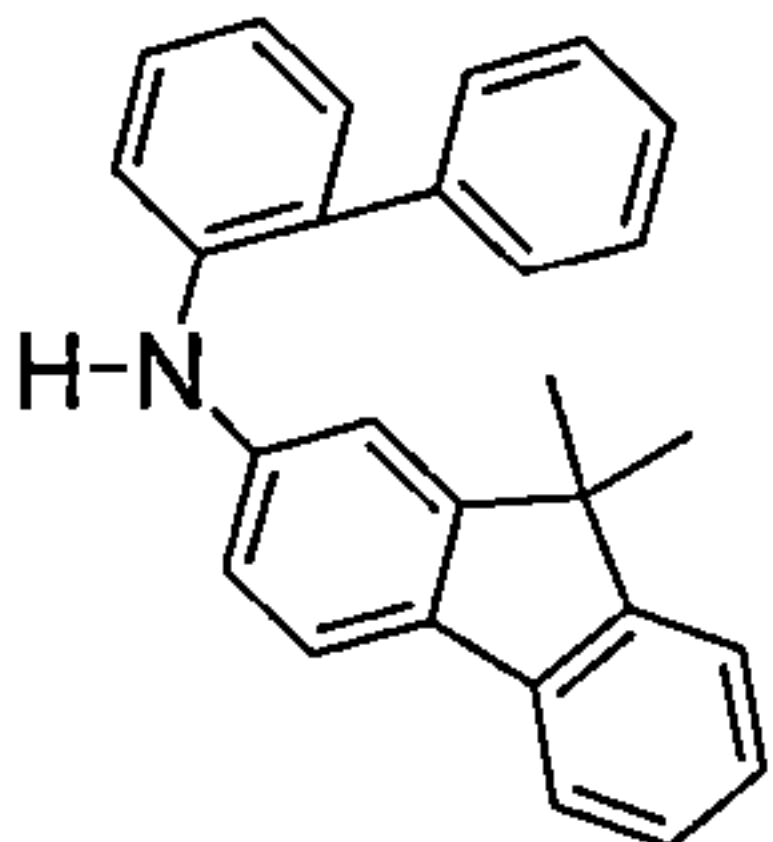
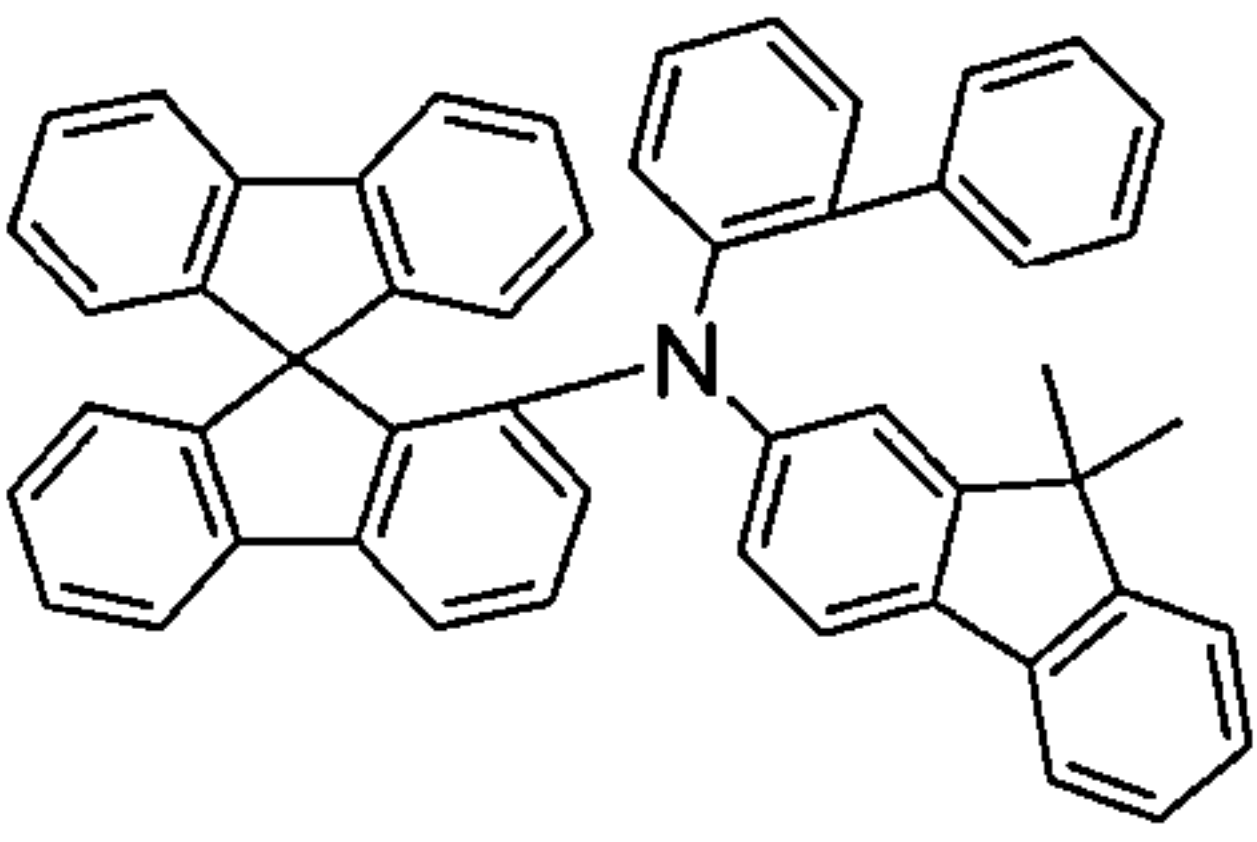
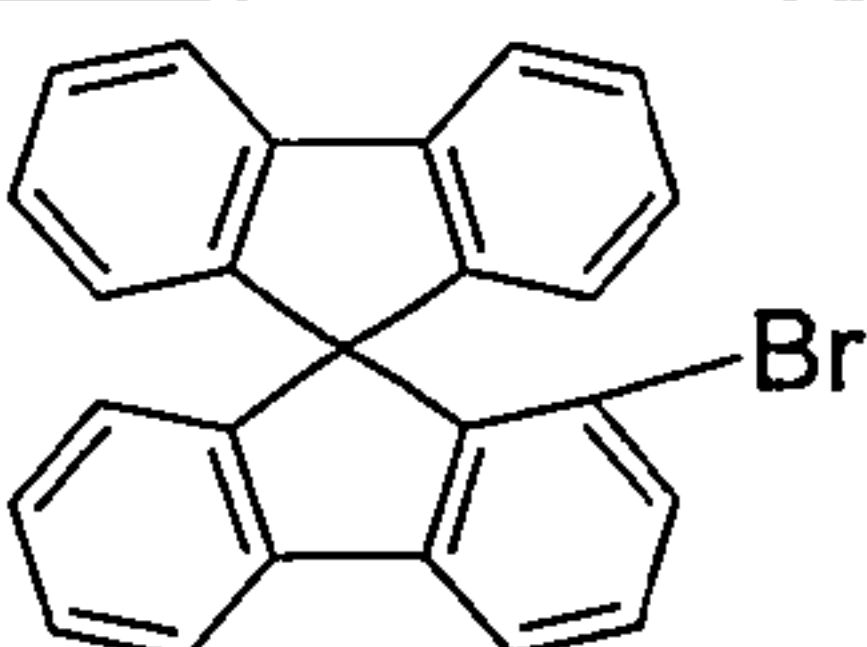
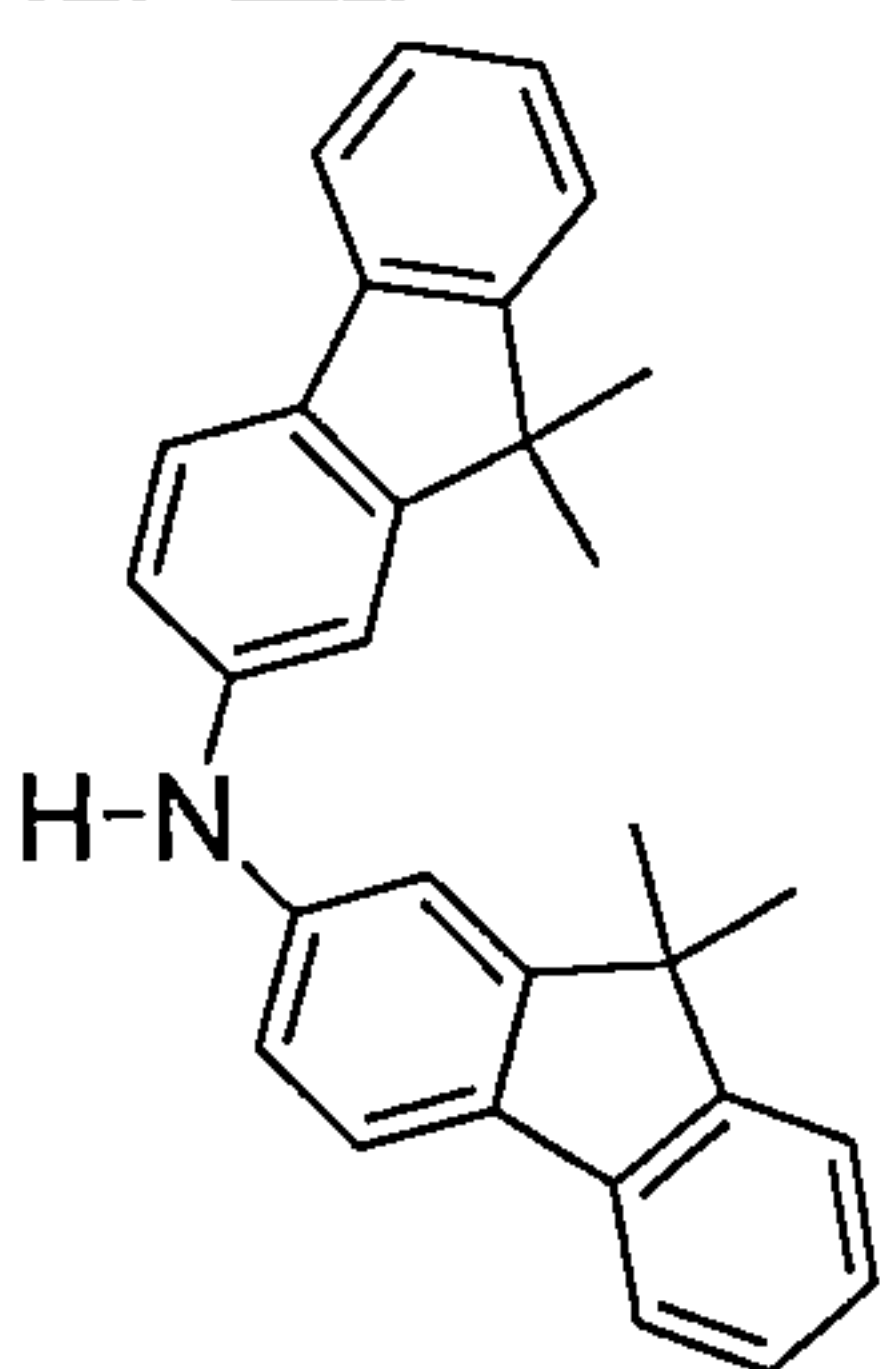
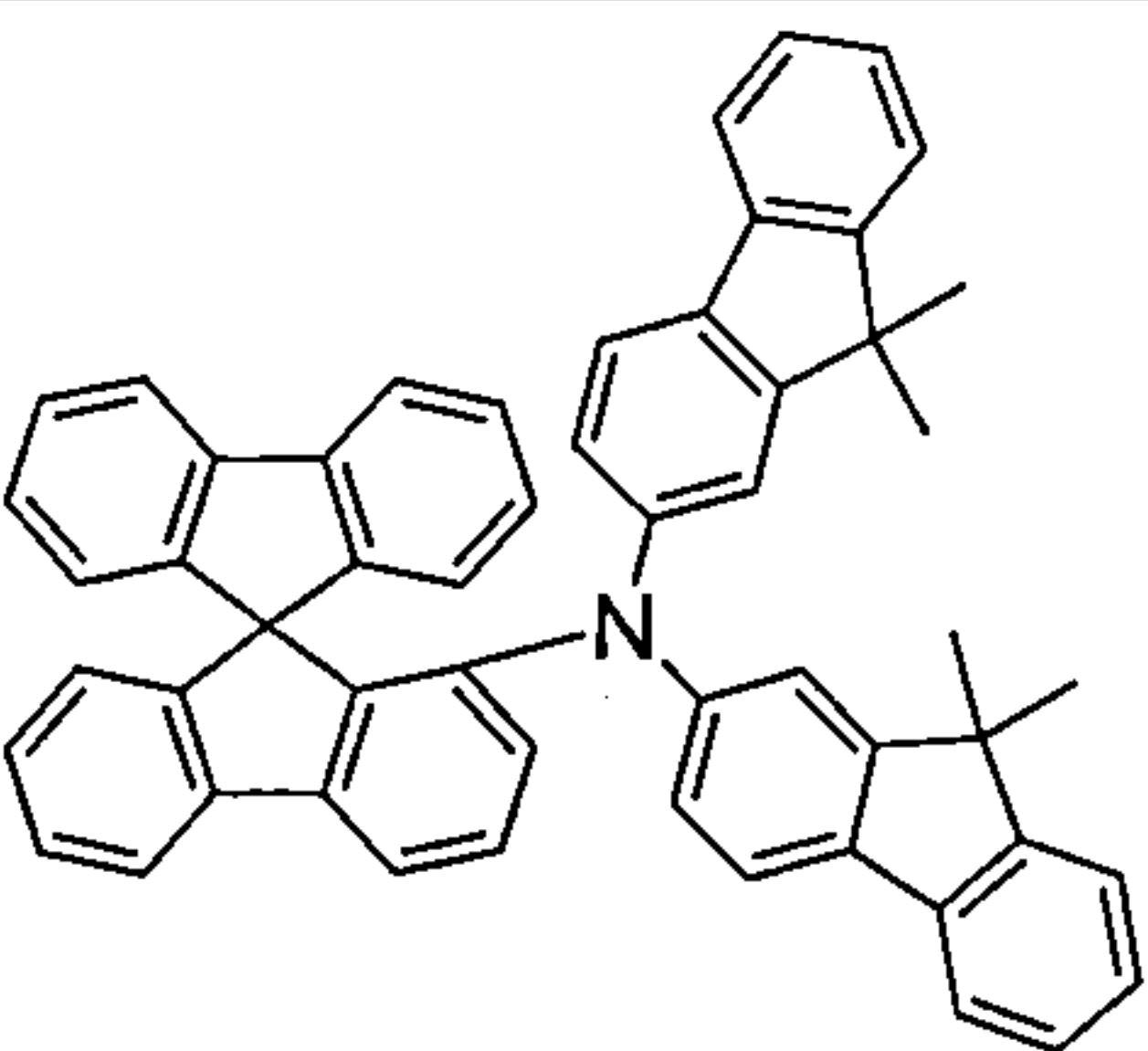
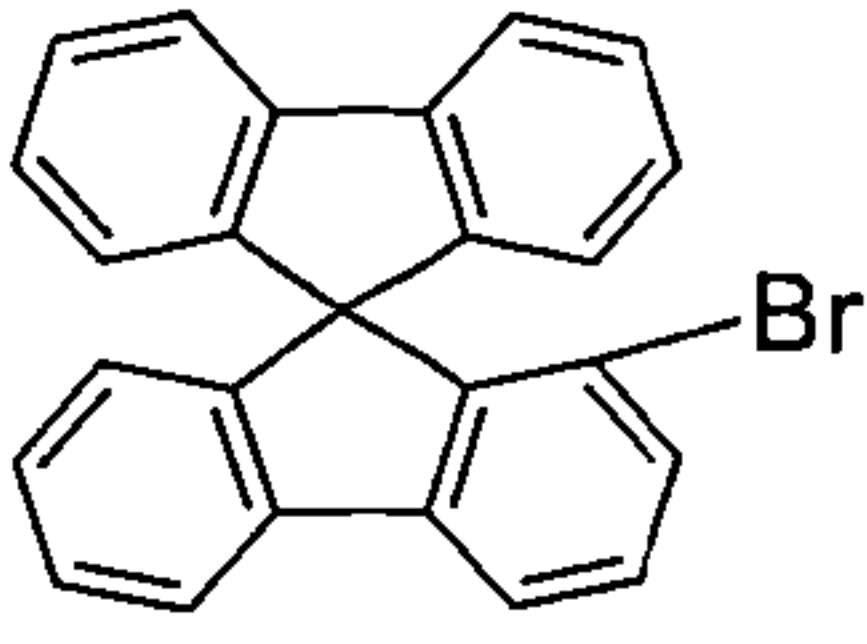
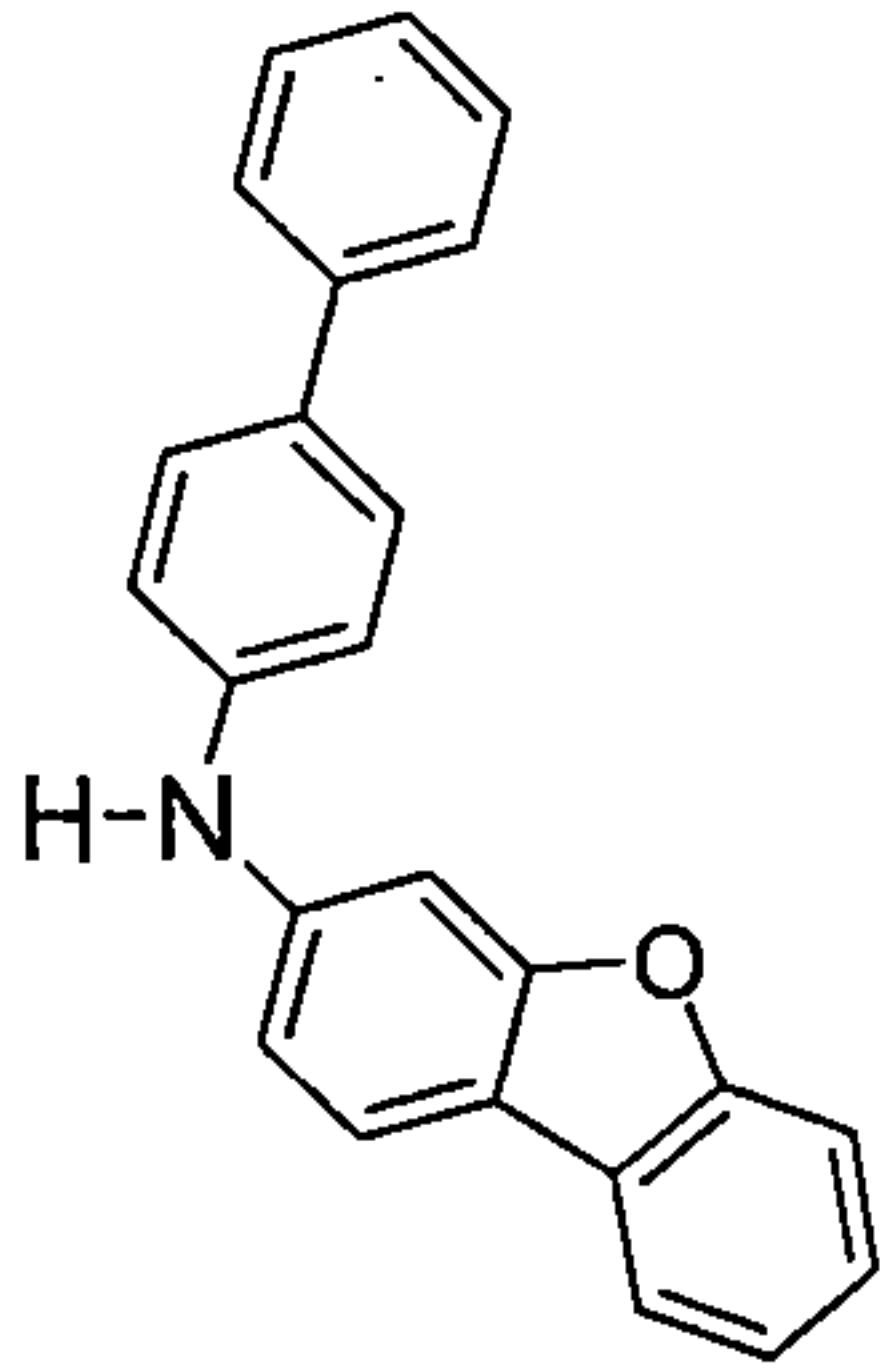
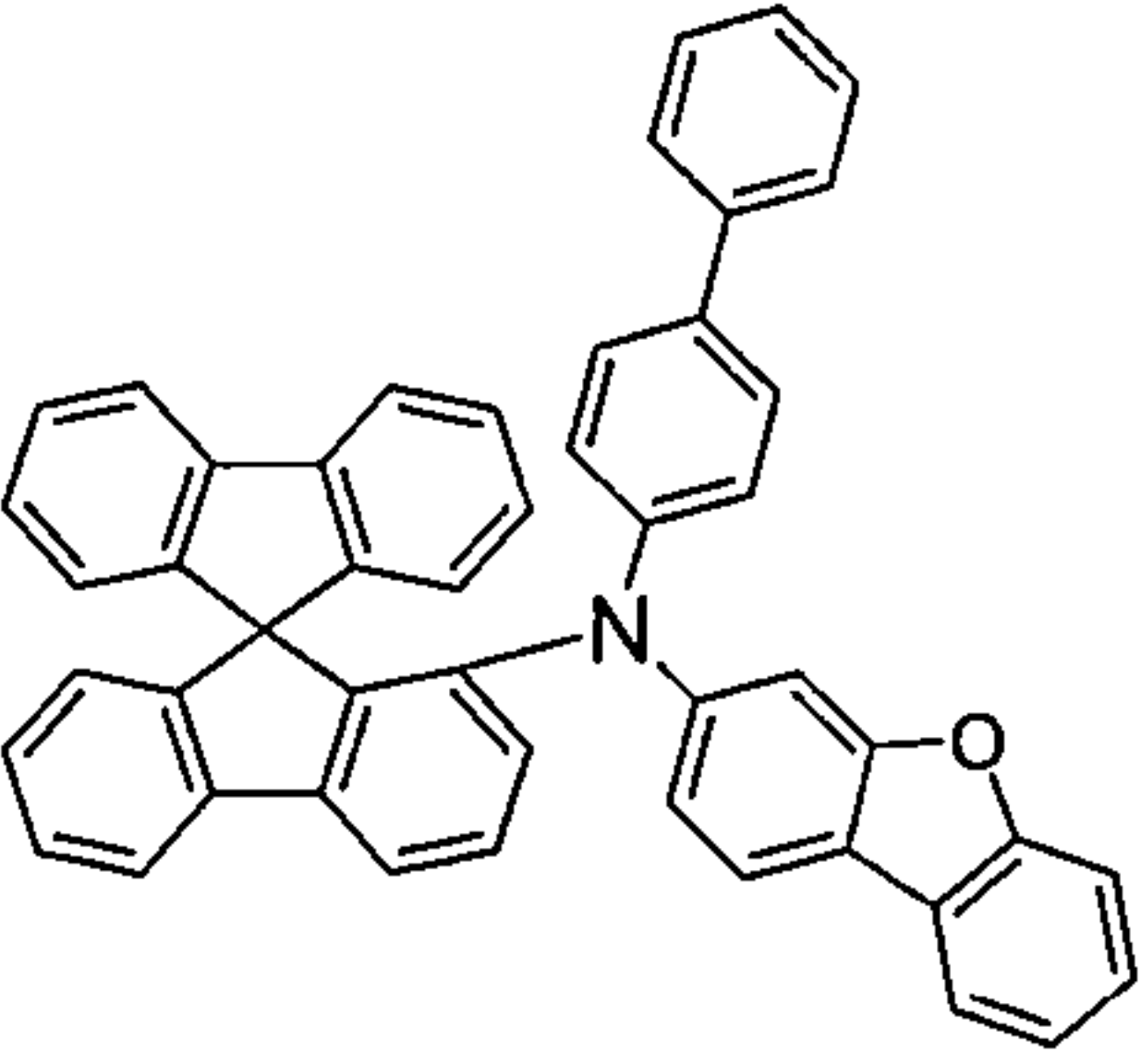
實例3a：4-聯苯-2-(9,9'-二甲基芴基)-1-螺-9,9'-聯芴胺之合成

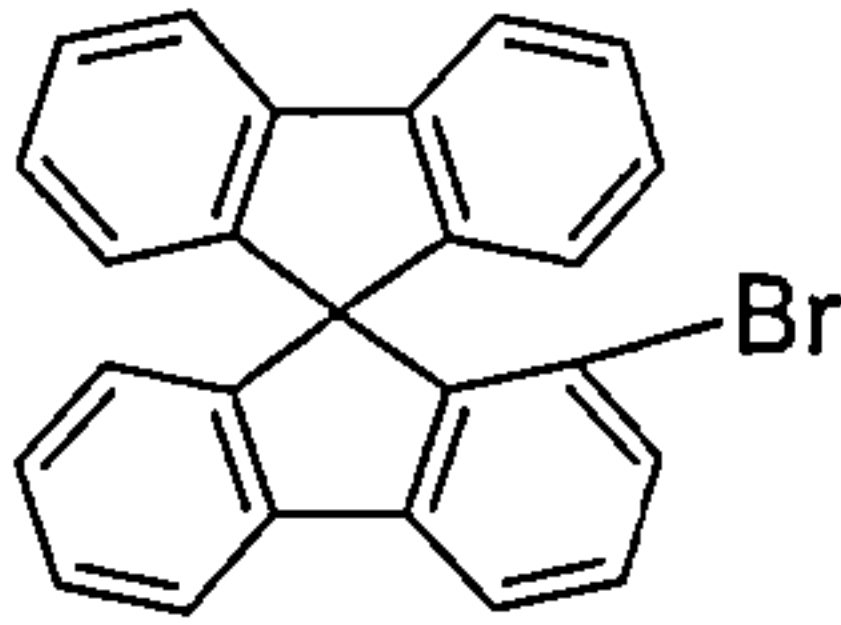
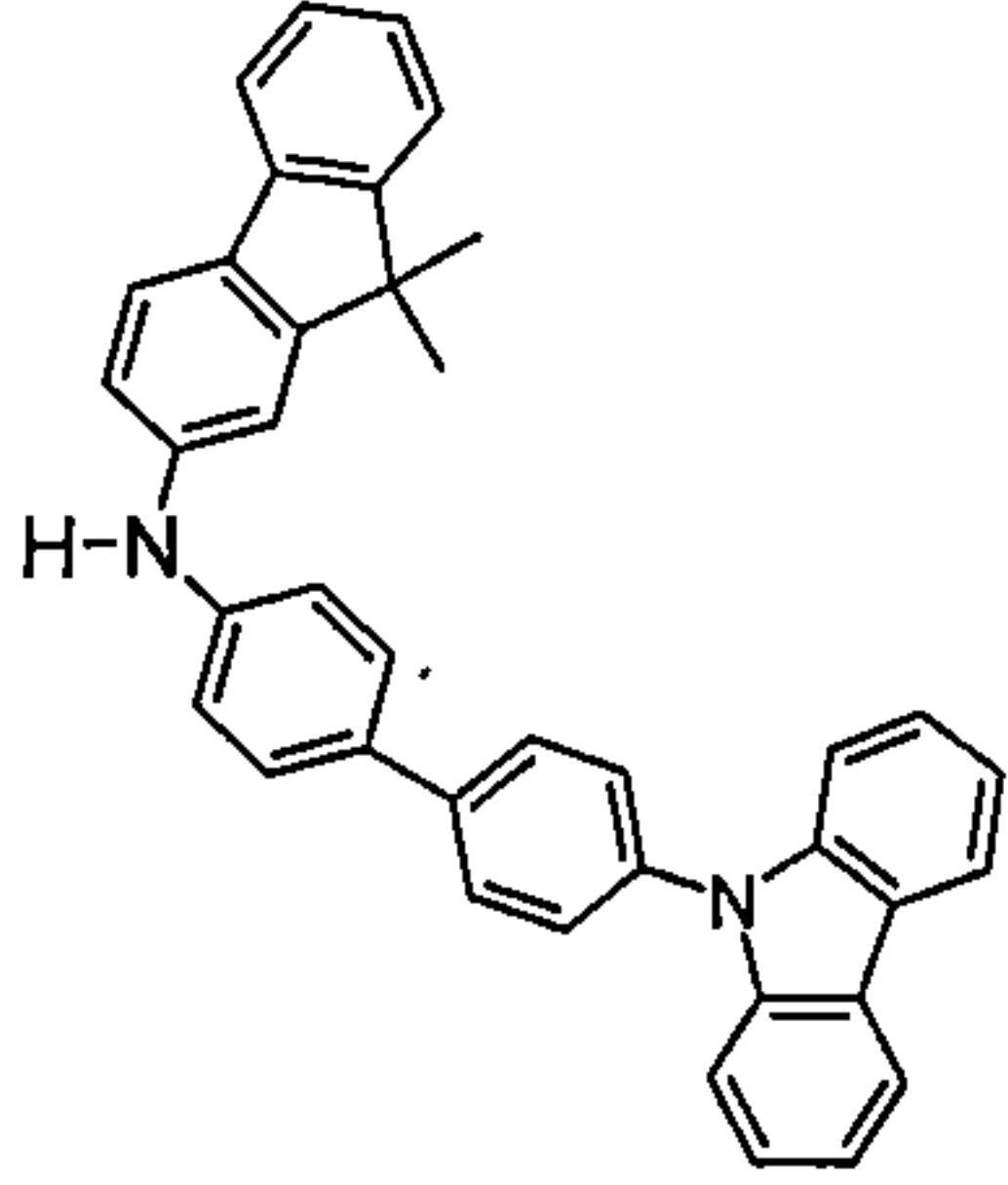
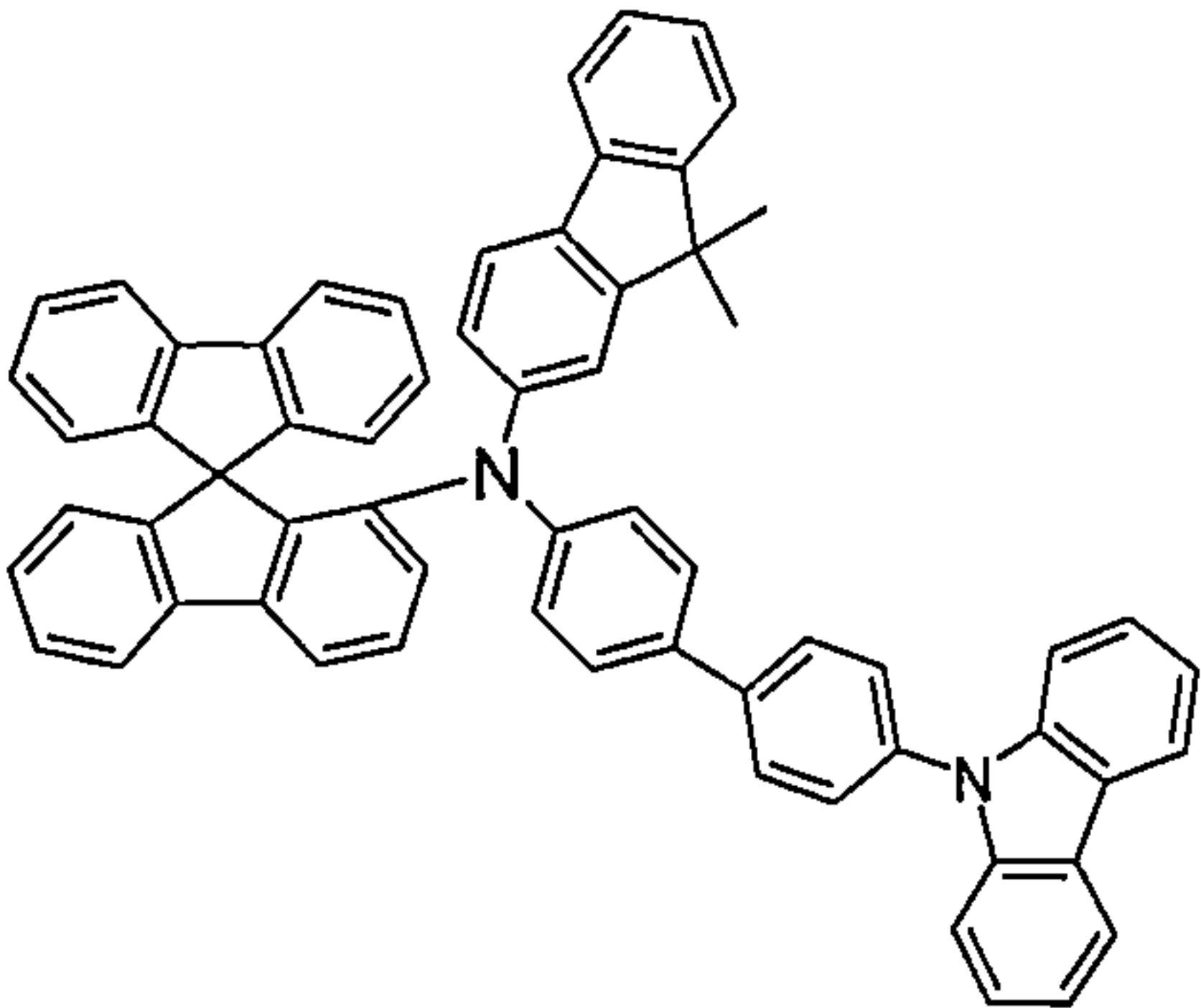
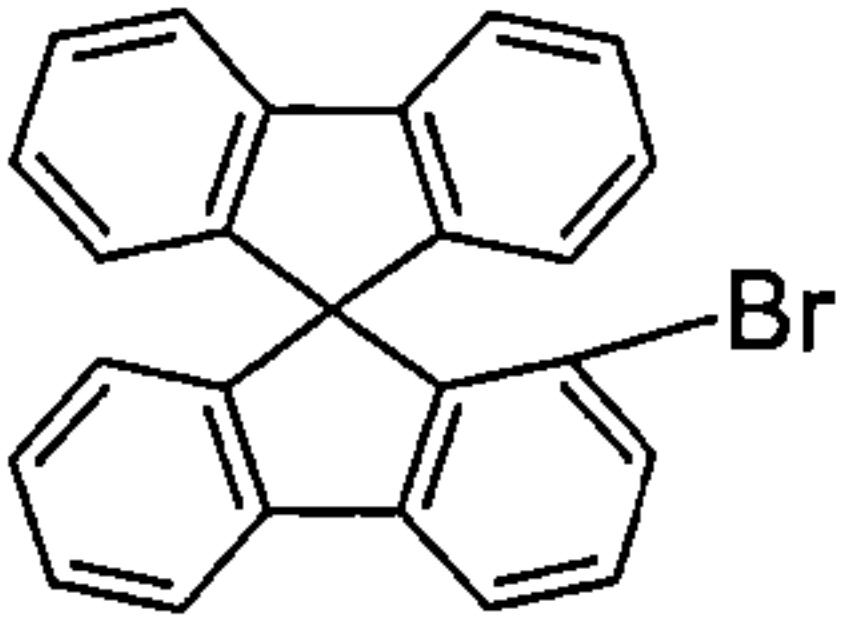
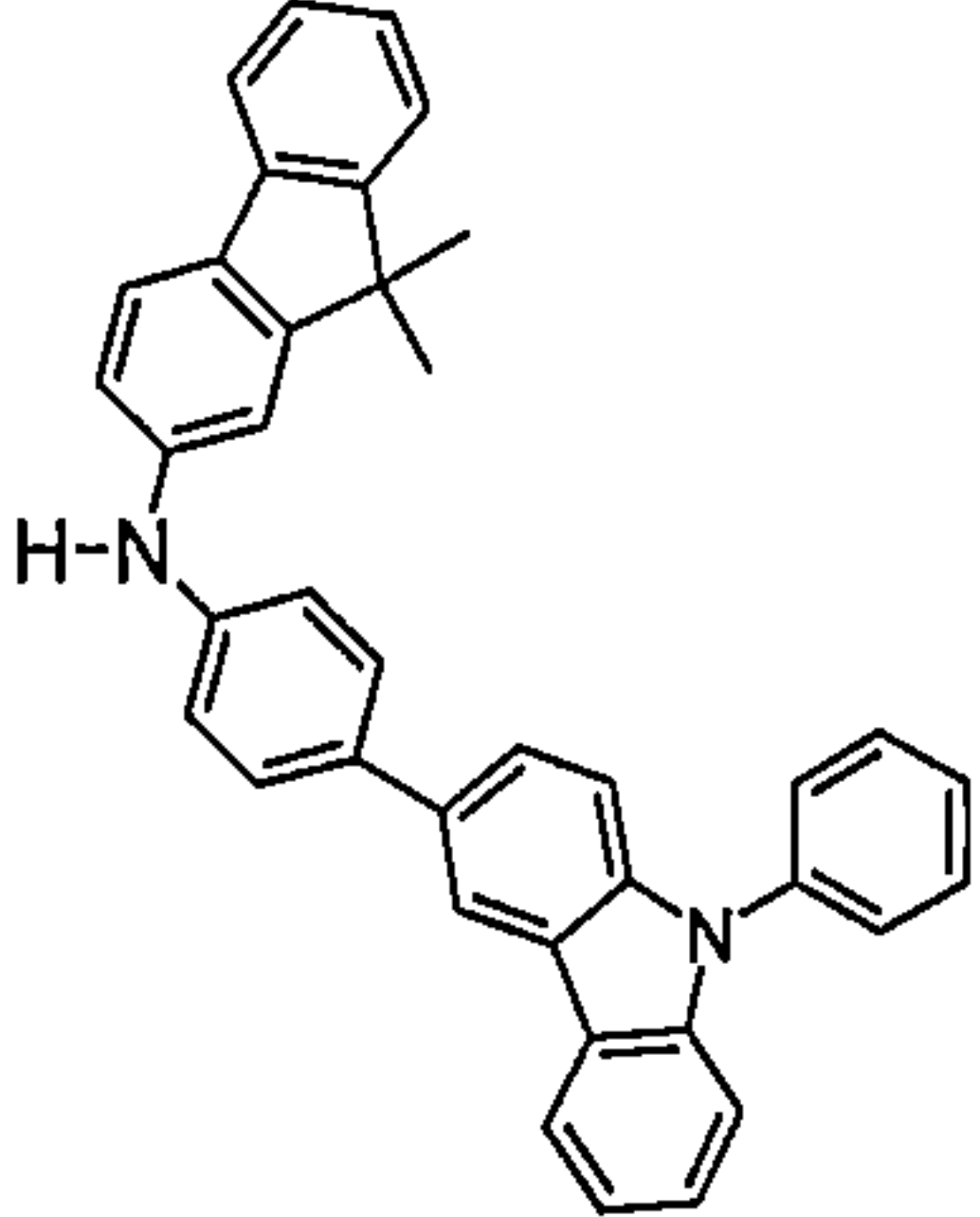
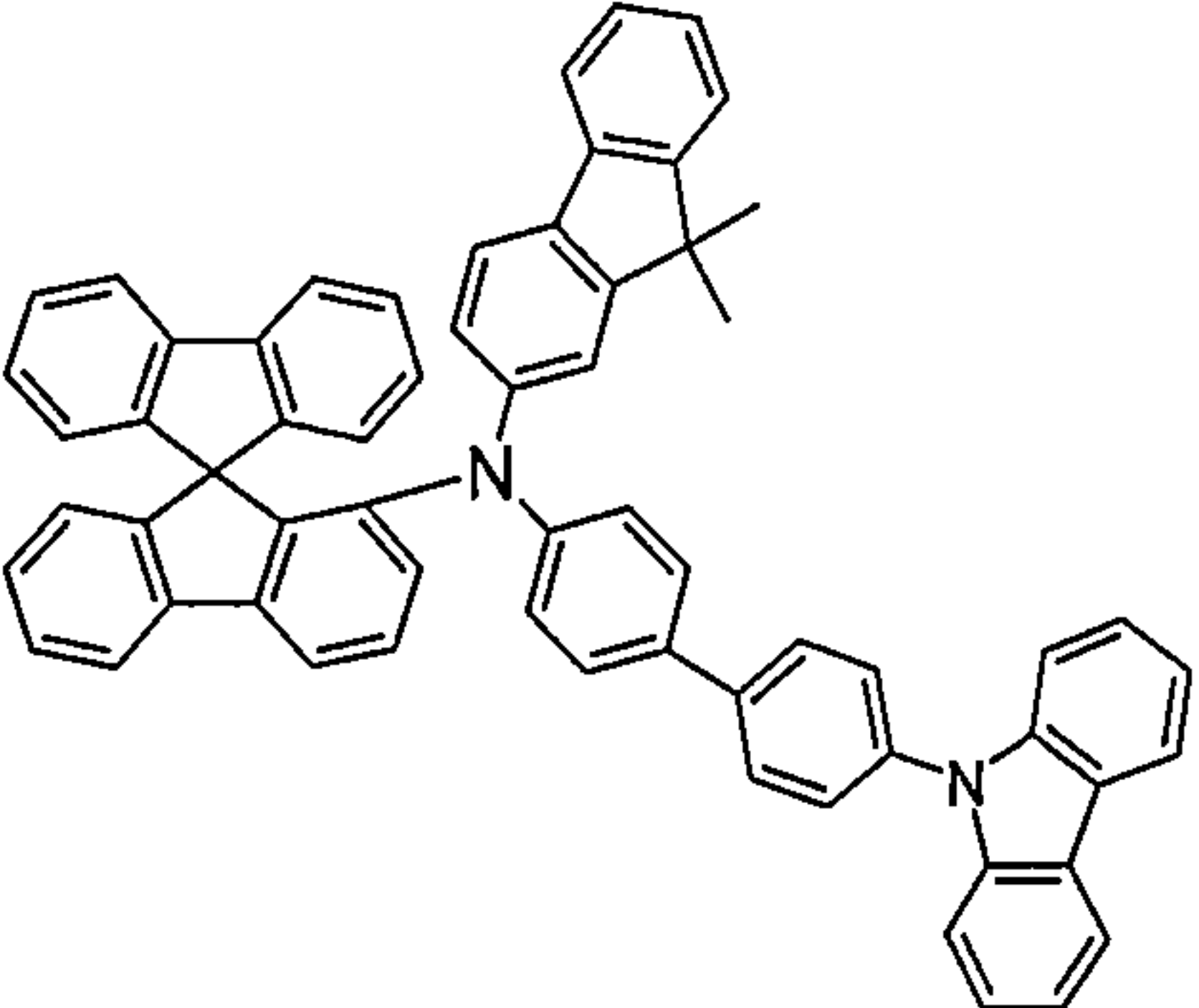
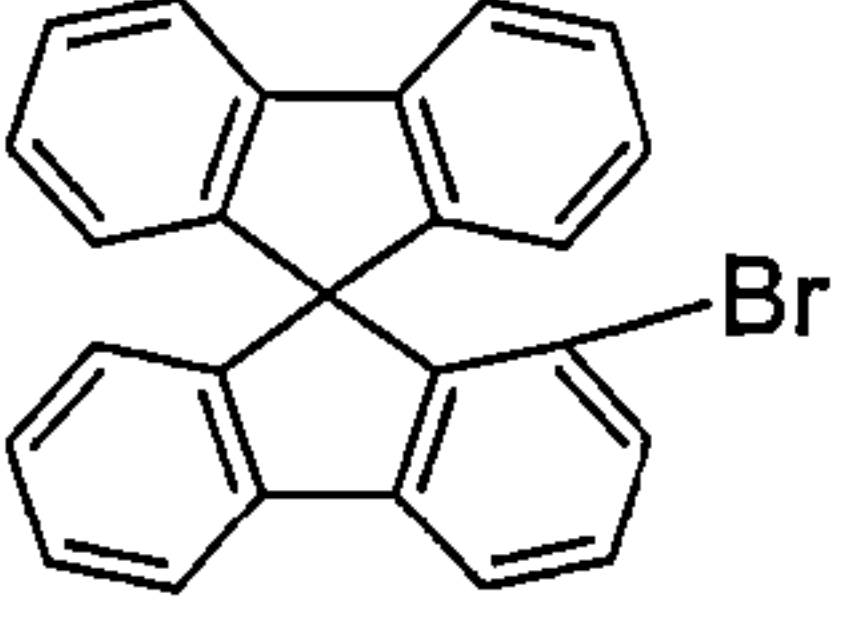
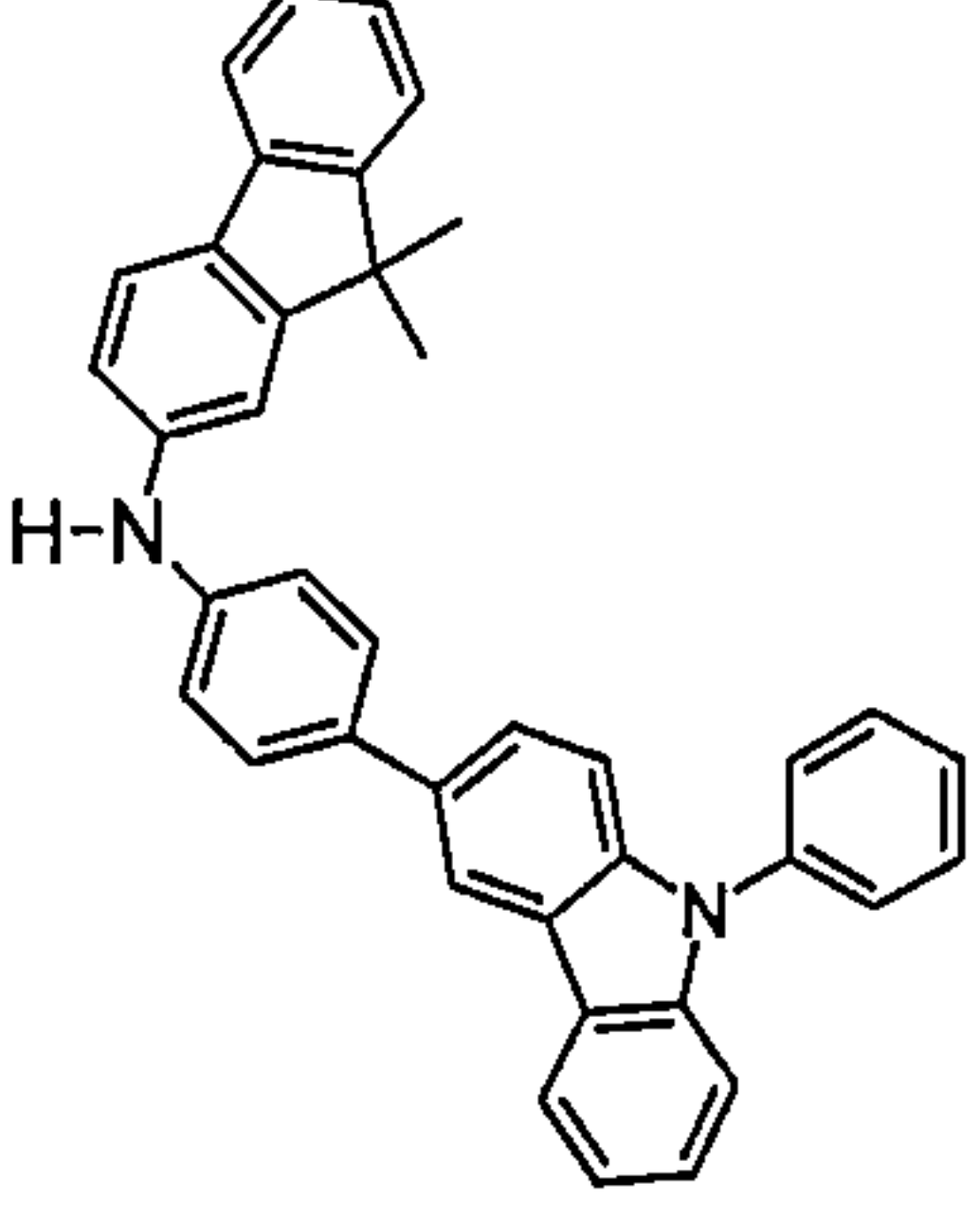
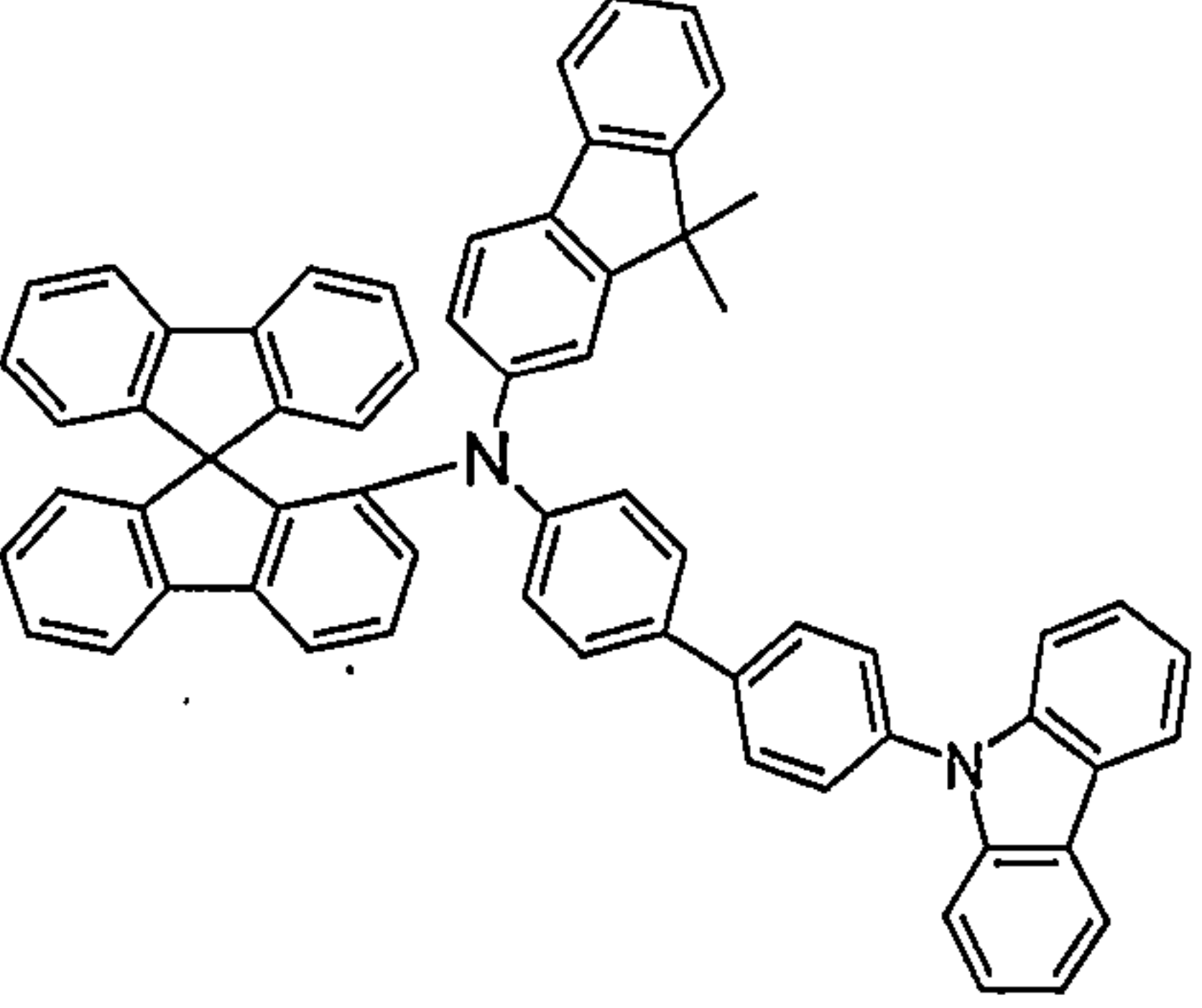
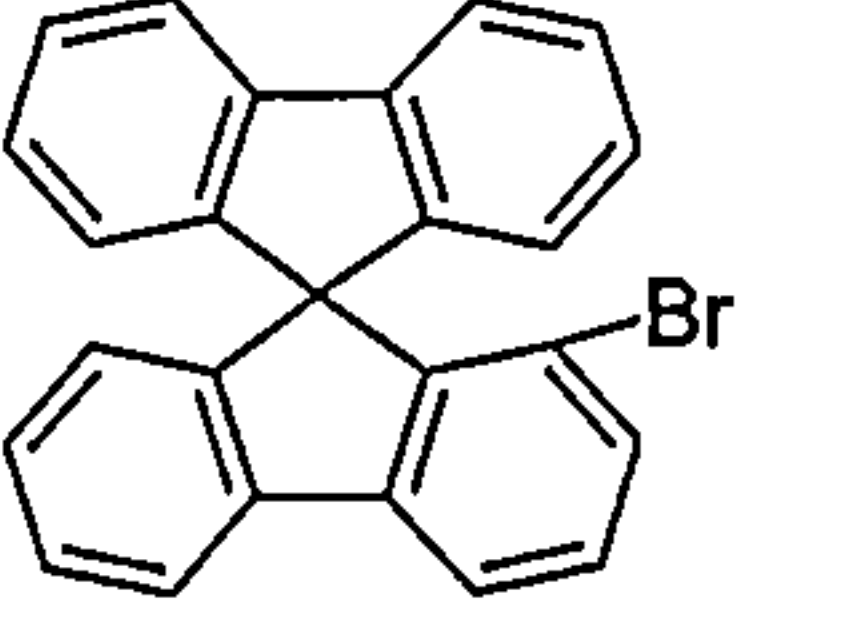
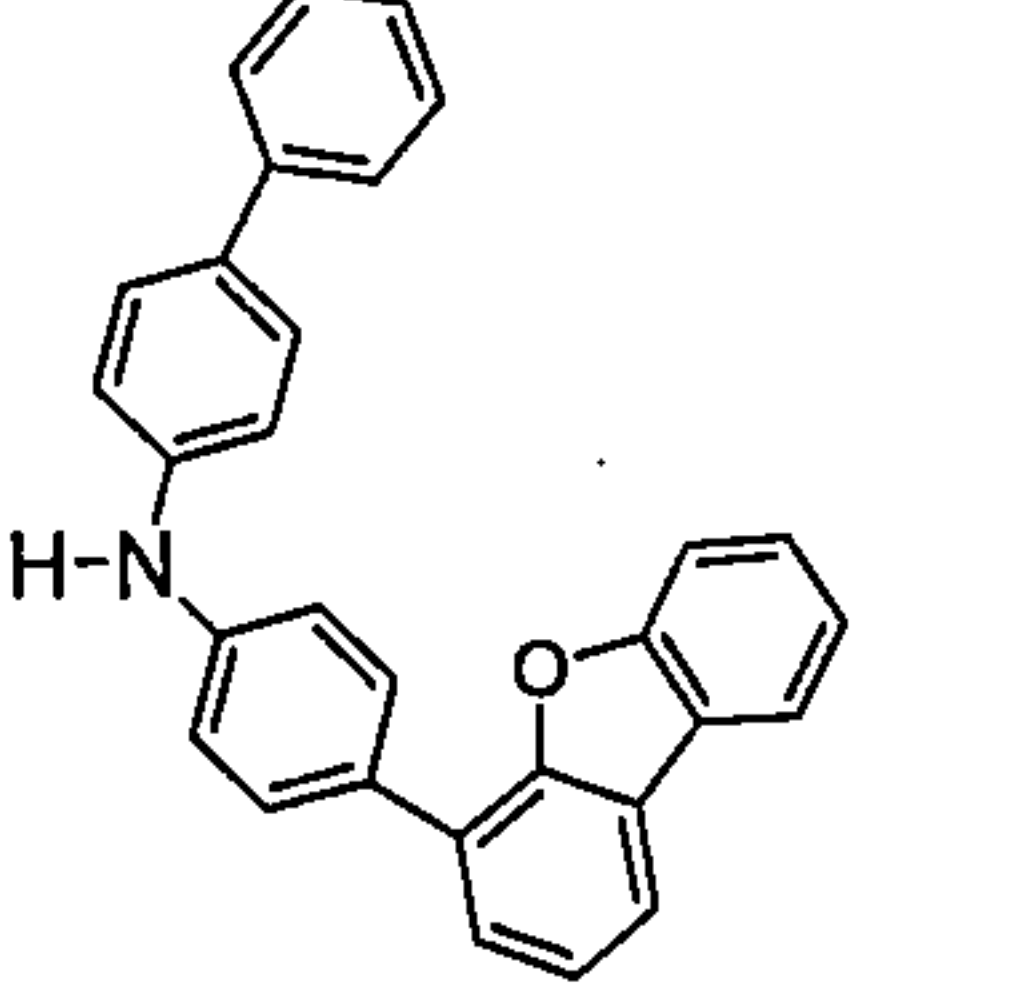
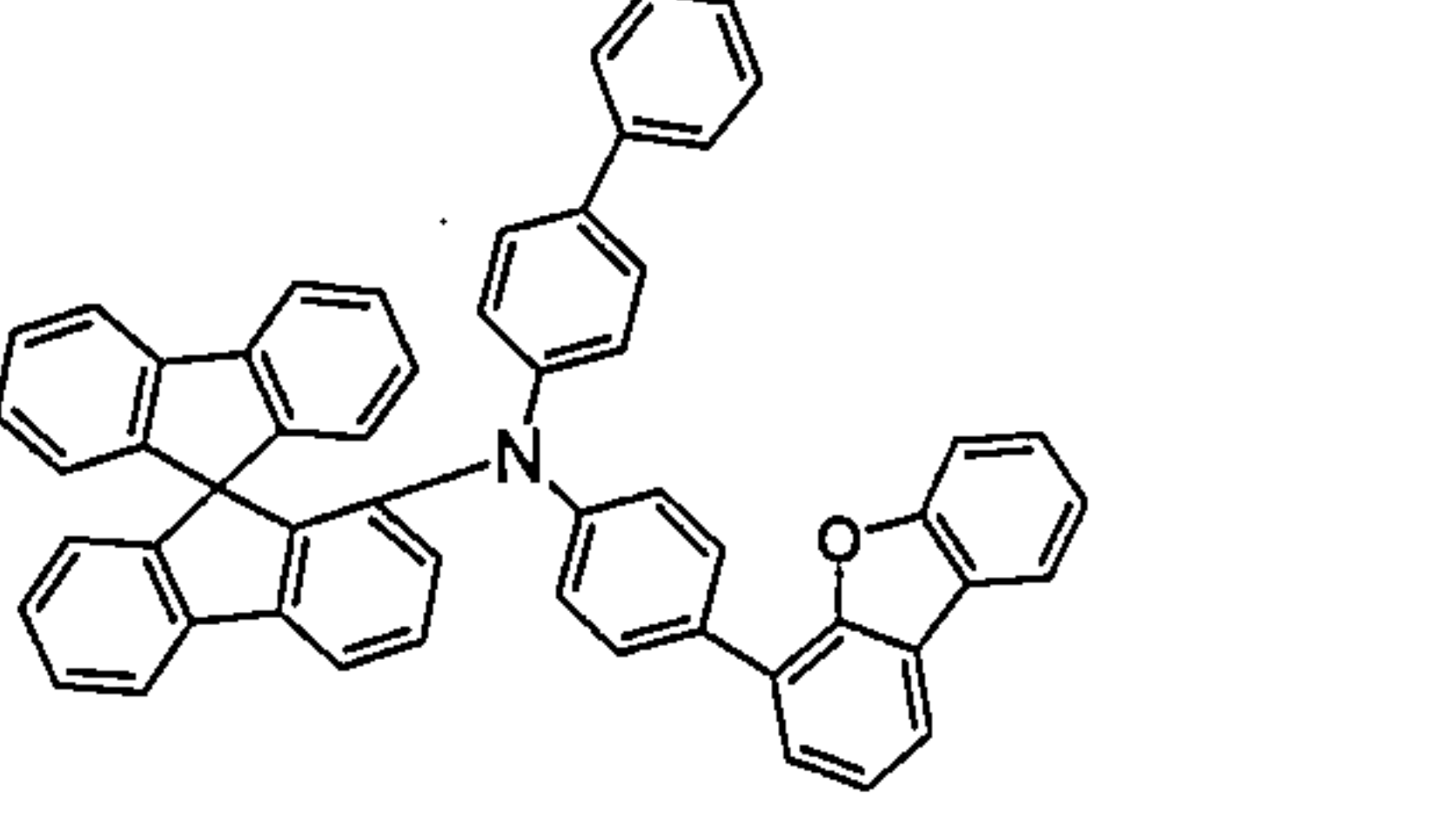
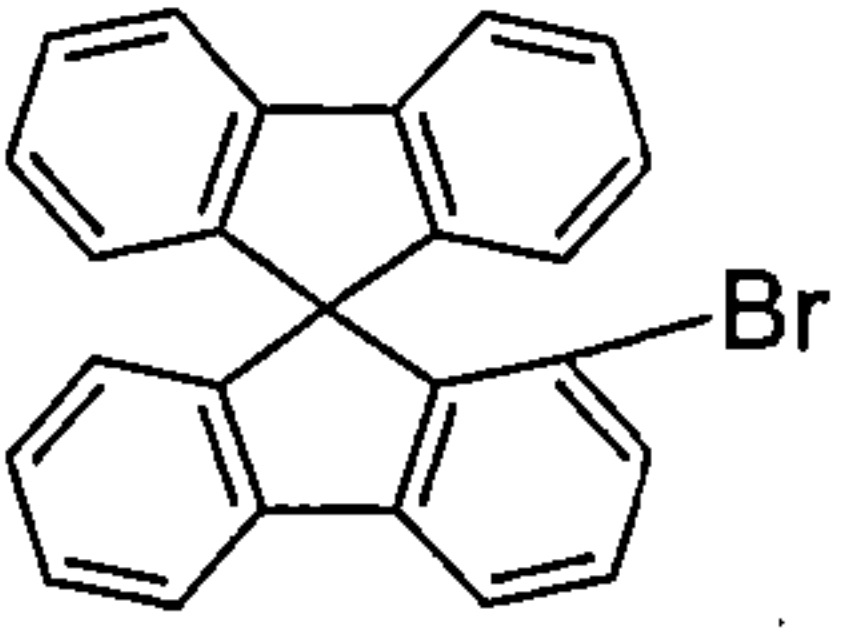
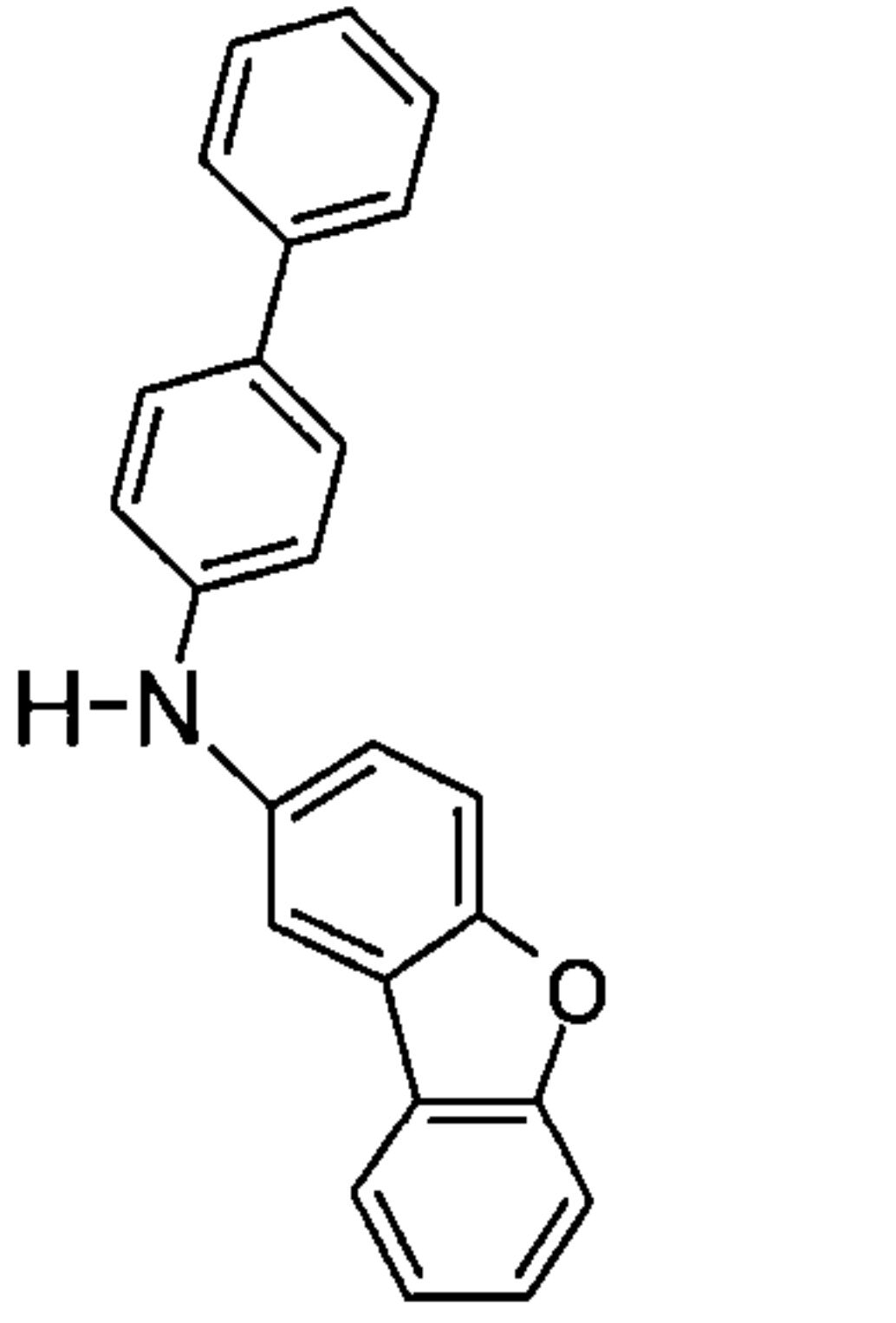
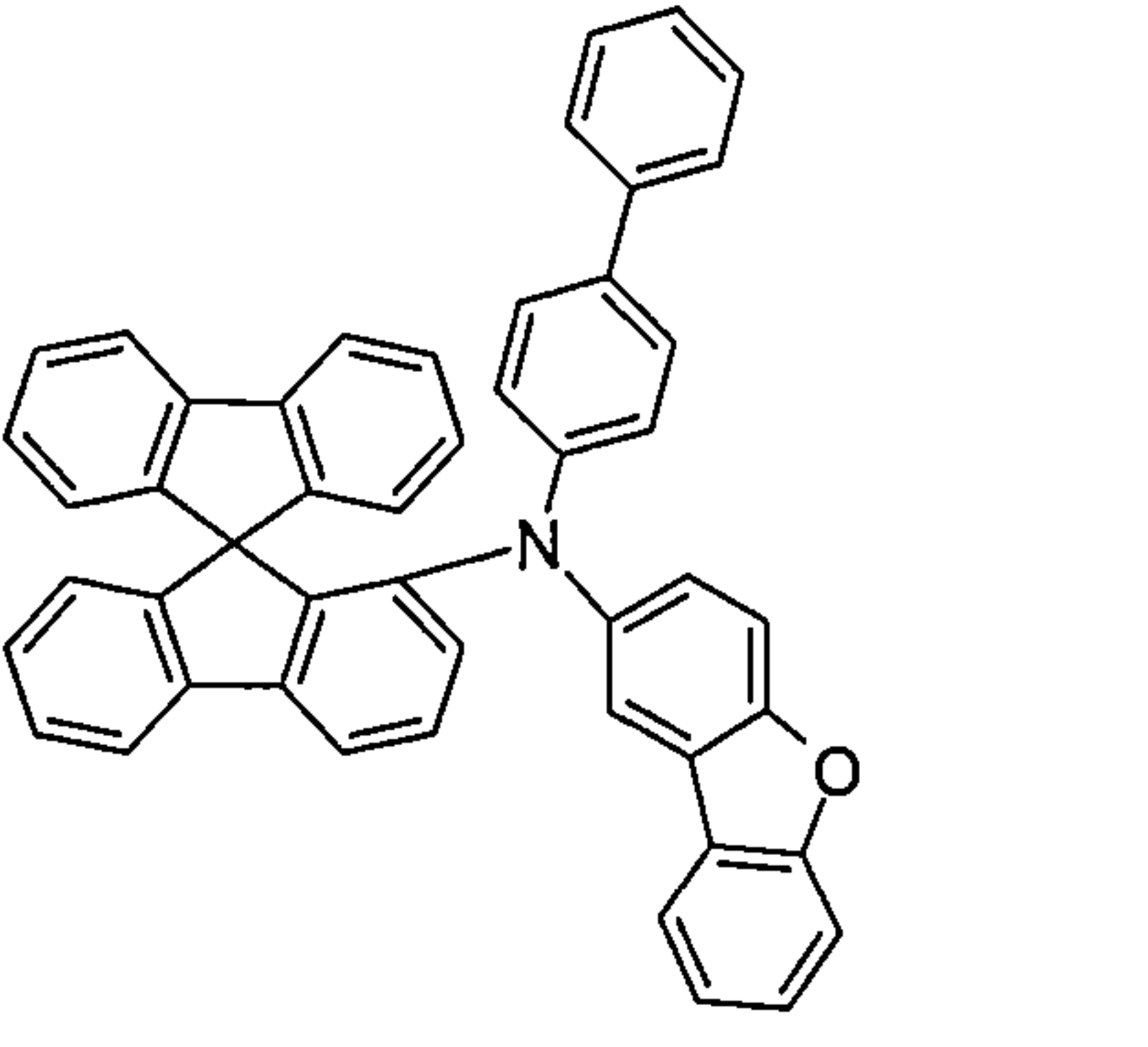


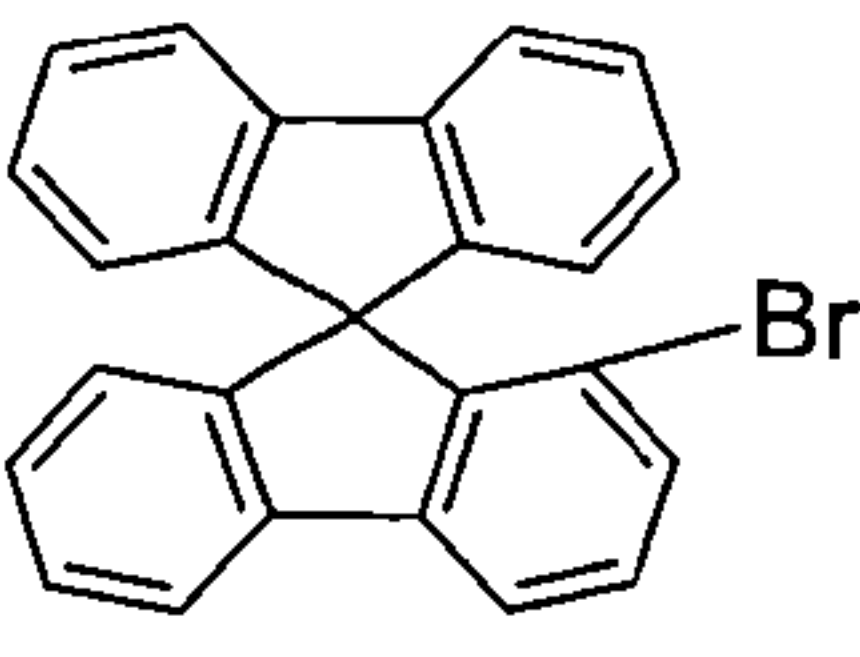
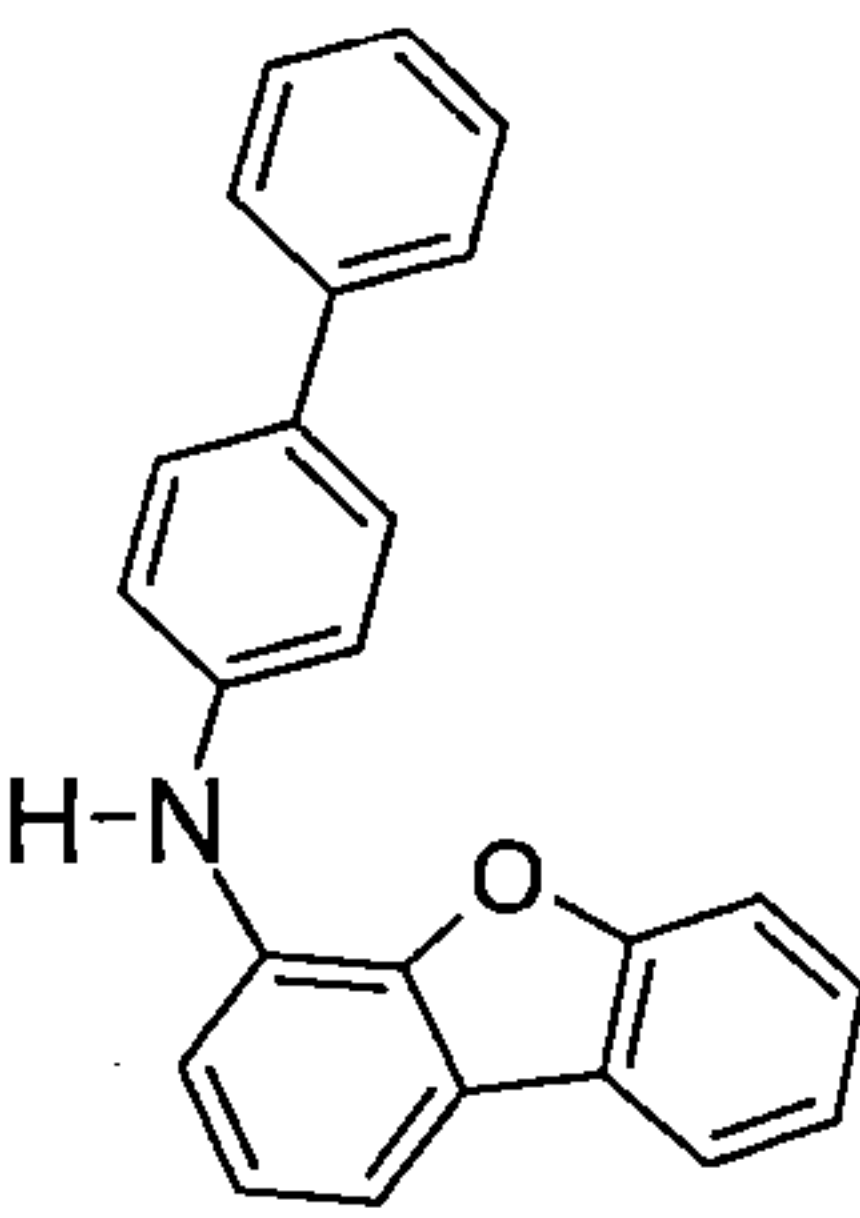
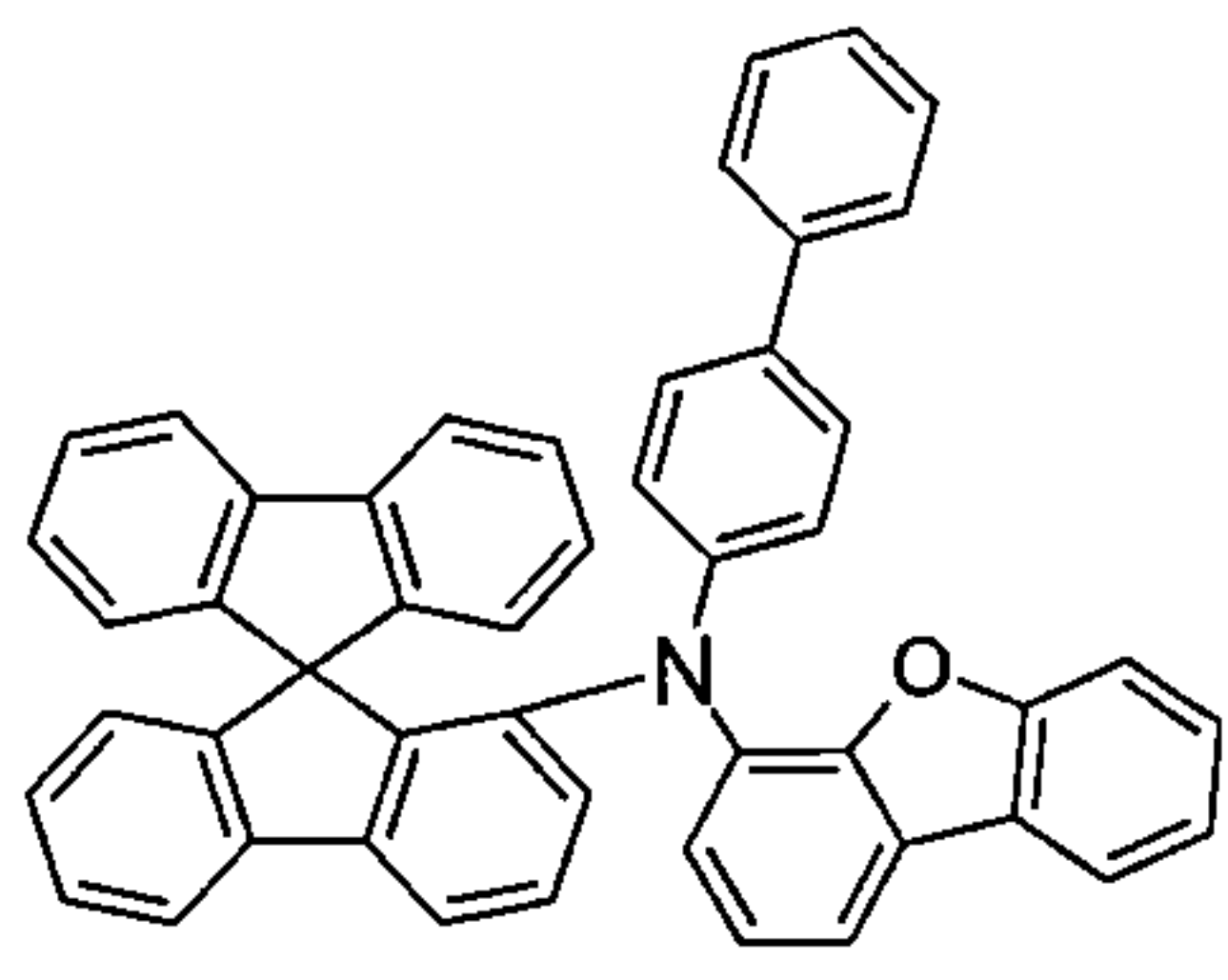
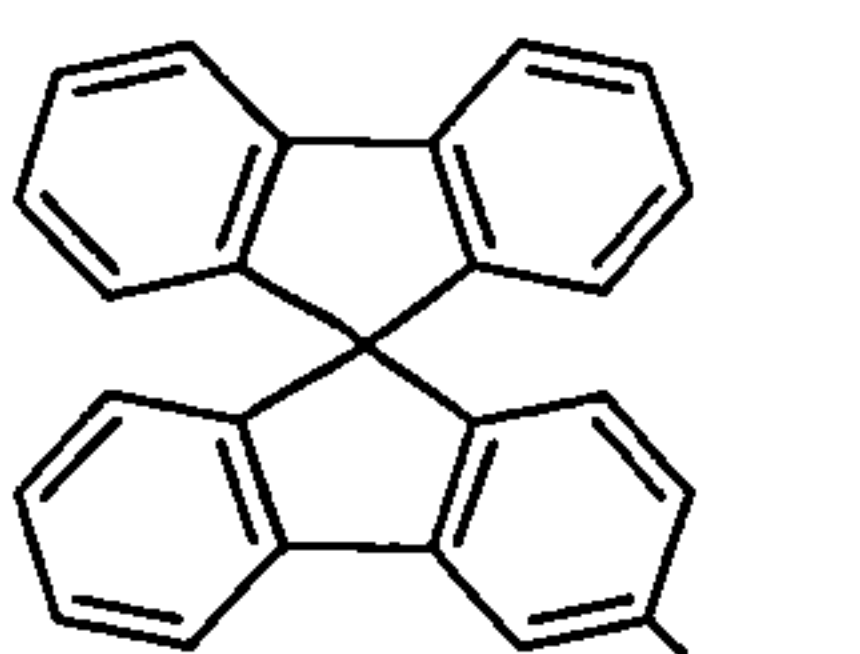
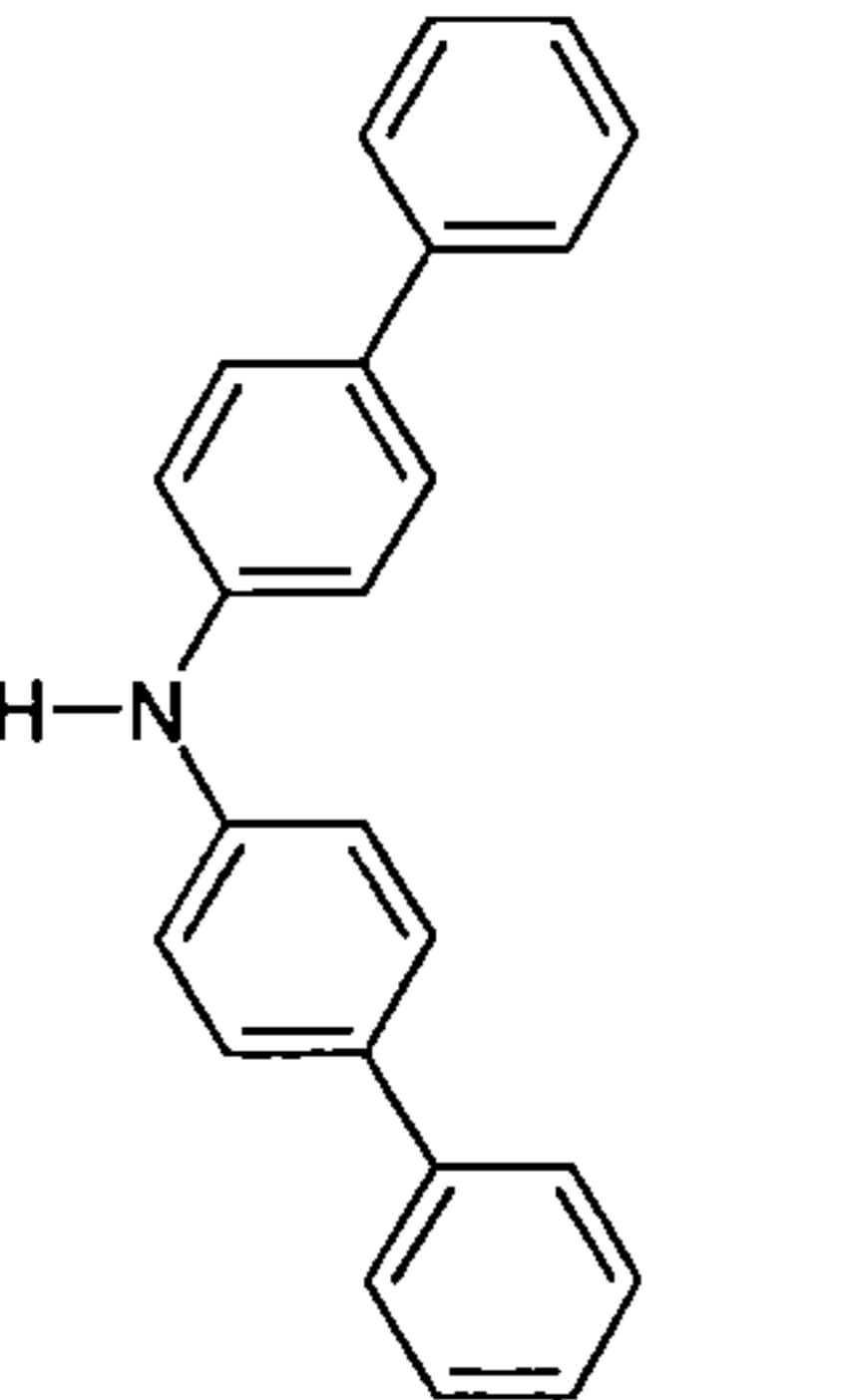
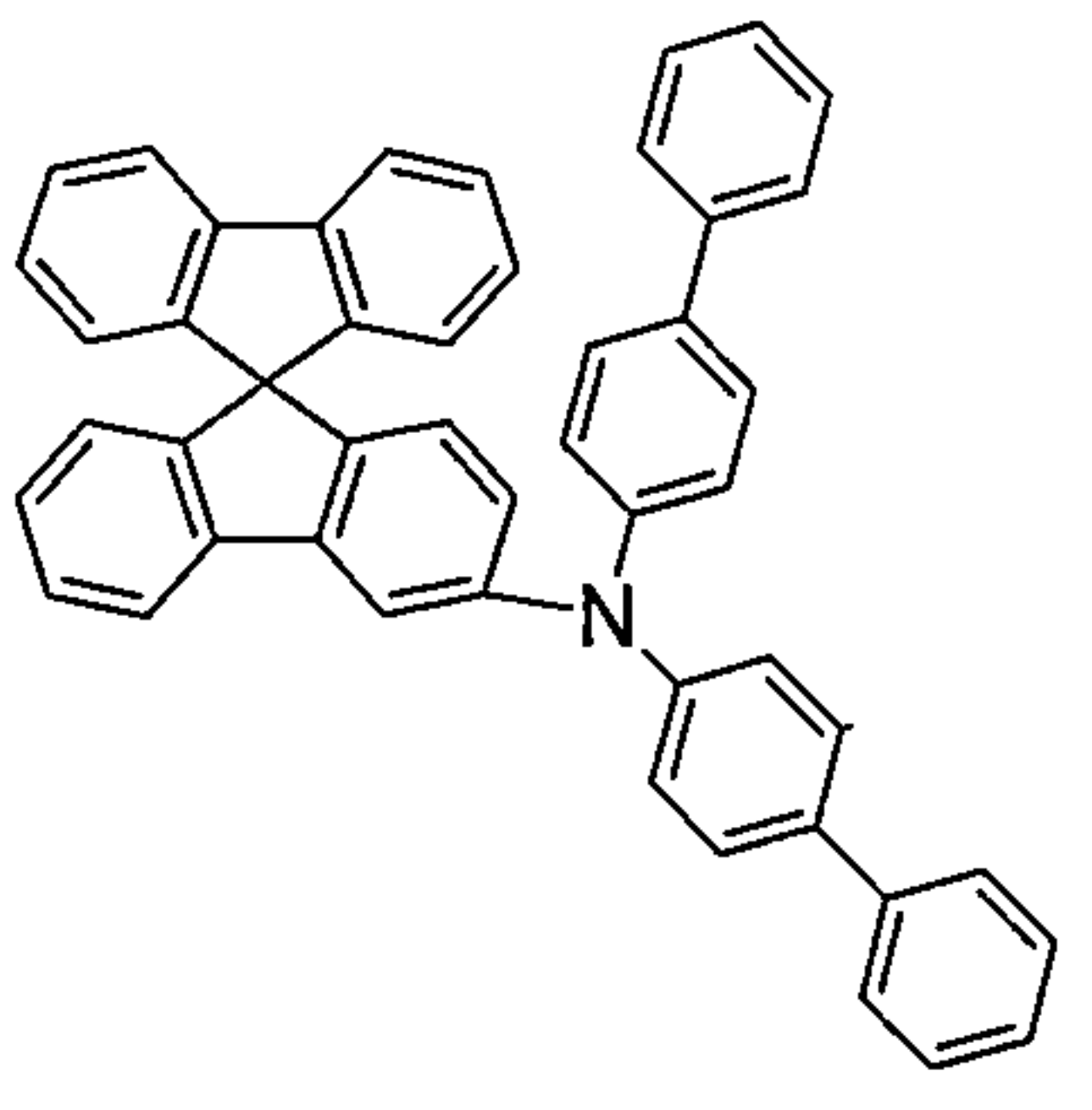
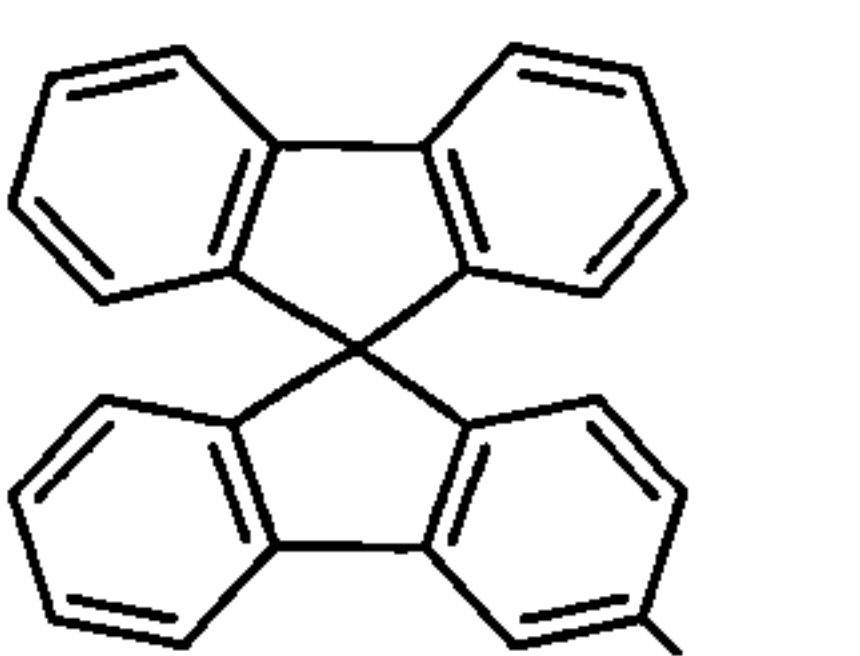
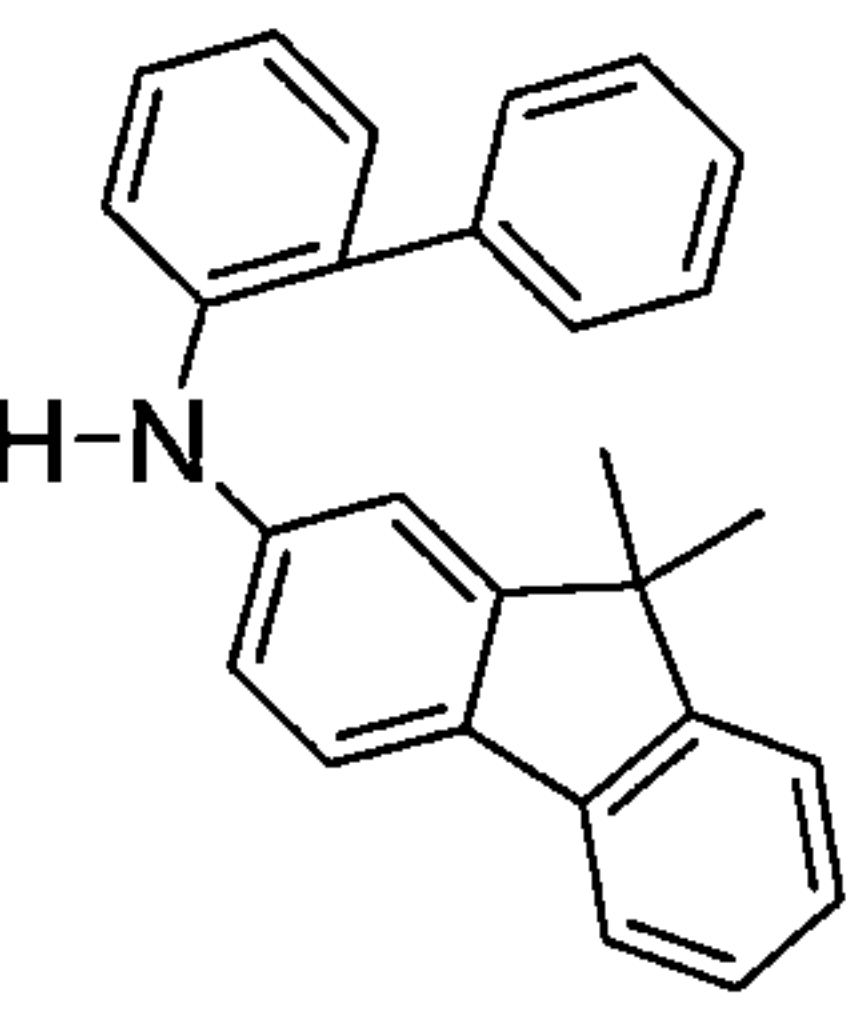
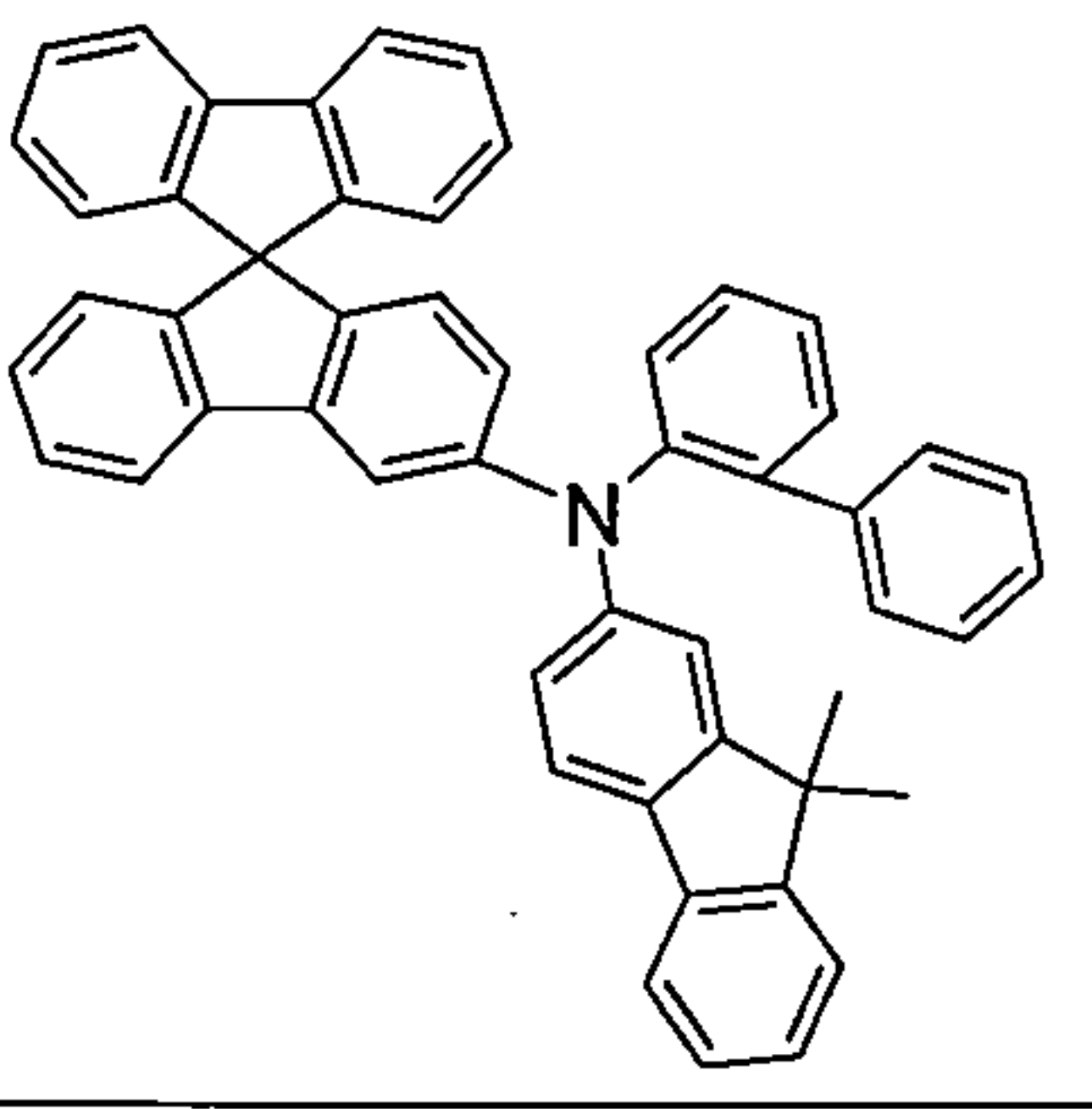
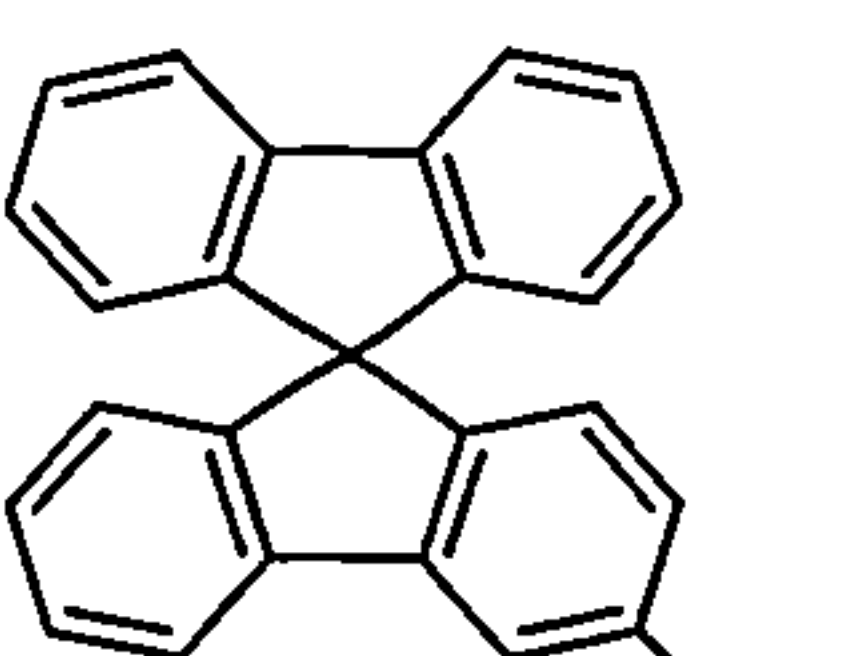
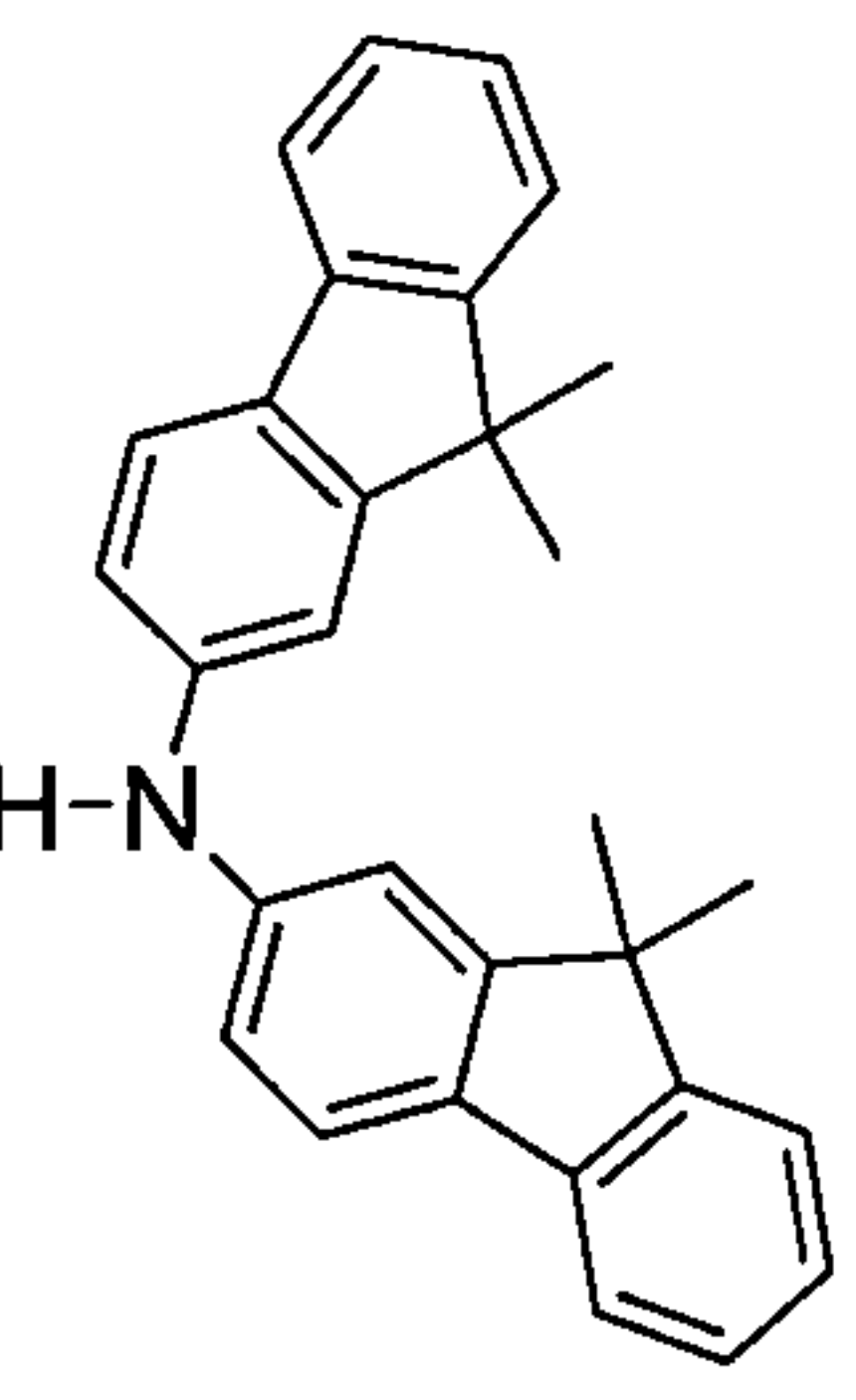
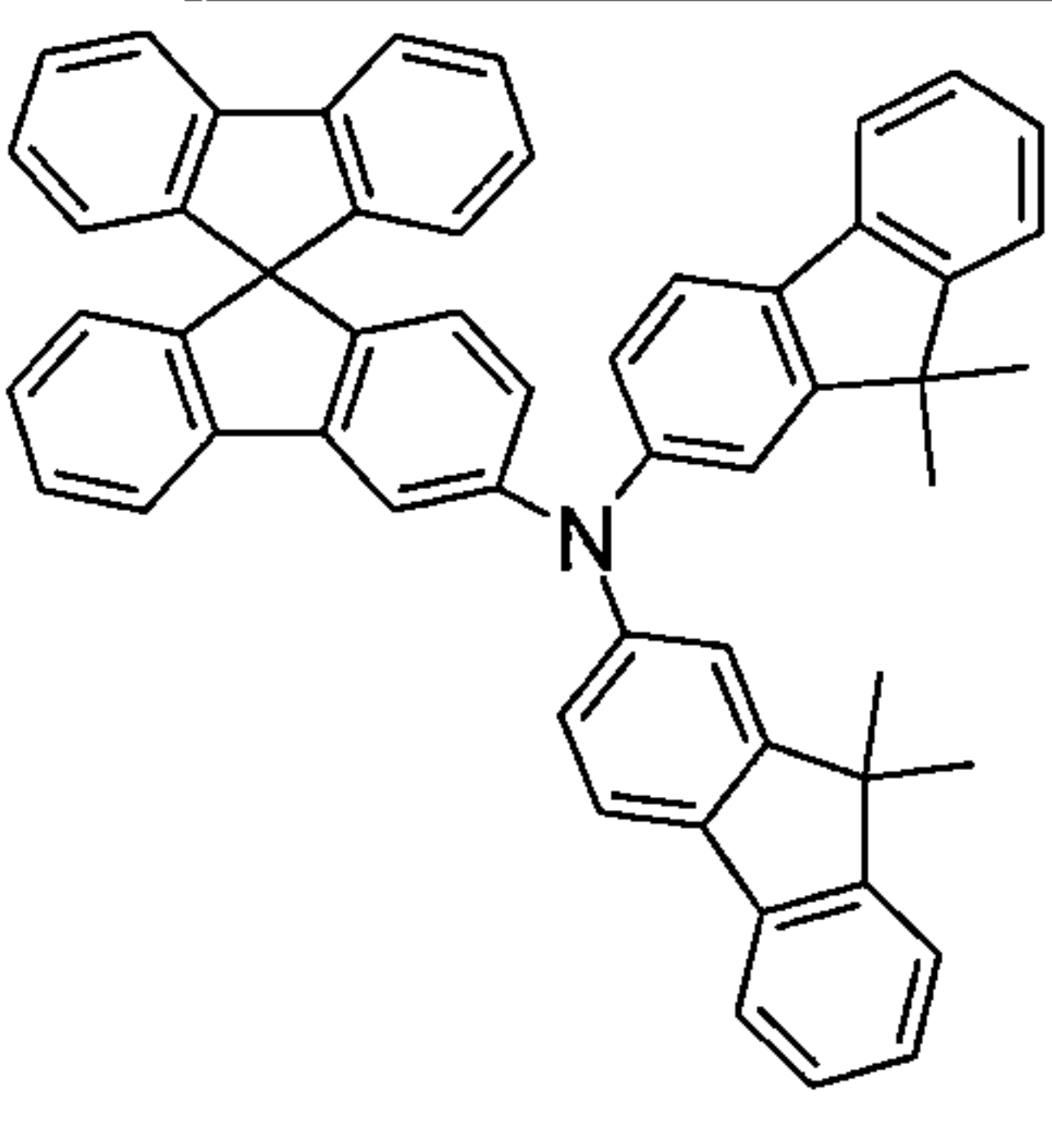
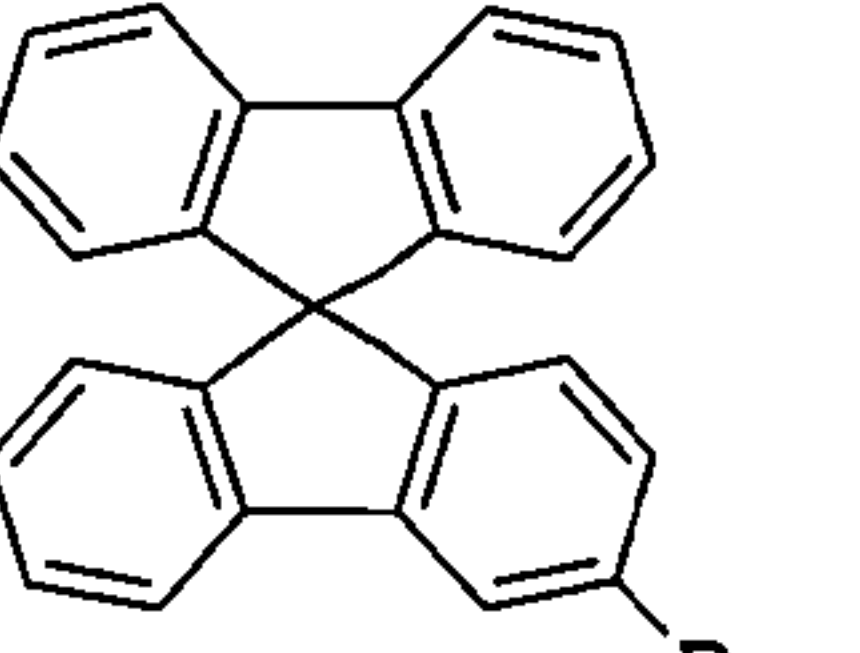
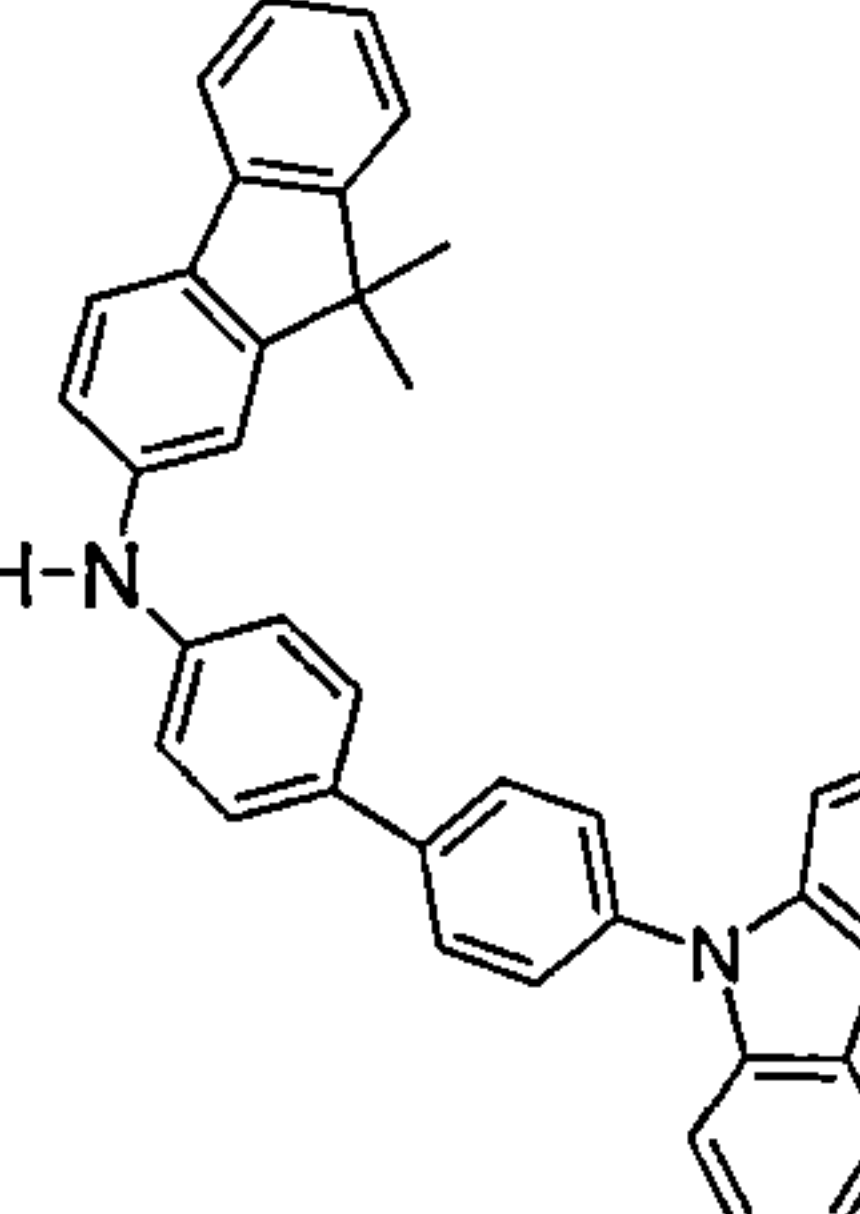
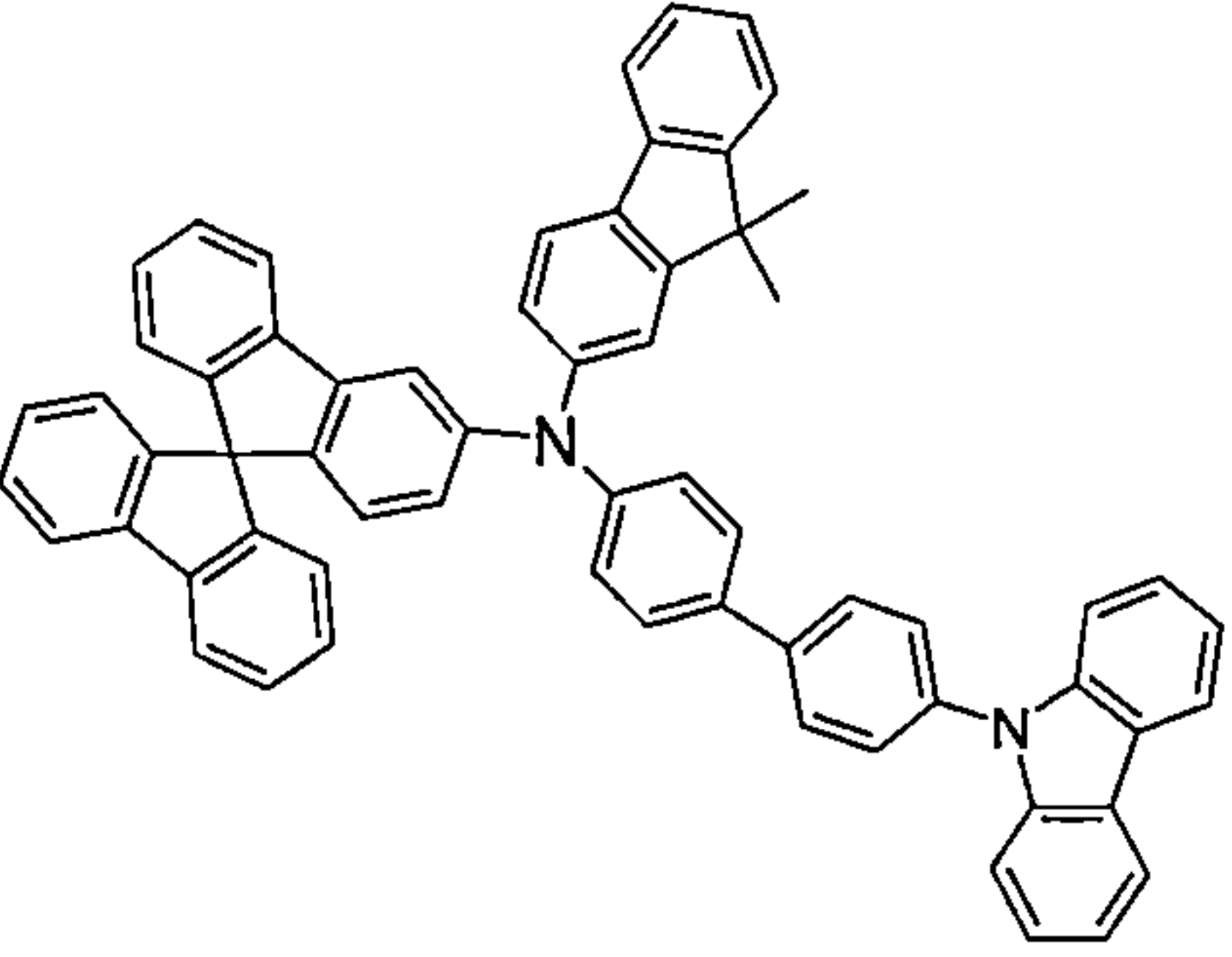
將三-第三丁基膦(4.4 mL存於甲苯中之1.0 M溶液, 4.4 mmol)、乙酸鈣(248 mg, 1.1 mmol)及第三丁醇鈉(16.0 g, 166 mmol)添加至聯苯-2-基-(9,9'-二甲基-9H-芴-2-基)胺(40.0 g, 111 mmol)及4-溴-9,9'-螺二芴(56.9 g, 144 mmol)於經脫氣之甲苯(500 mL)中之溶液中, 並在回流下將混合物加熱2 h。將反應混合物冷卻至室溫, 用甲苯稀釋並藉助矽

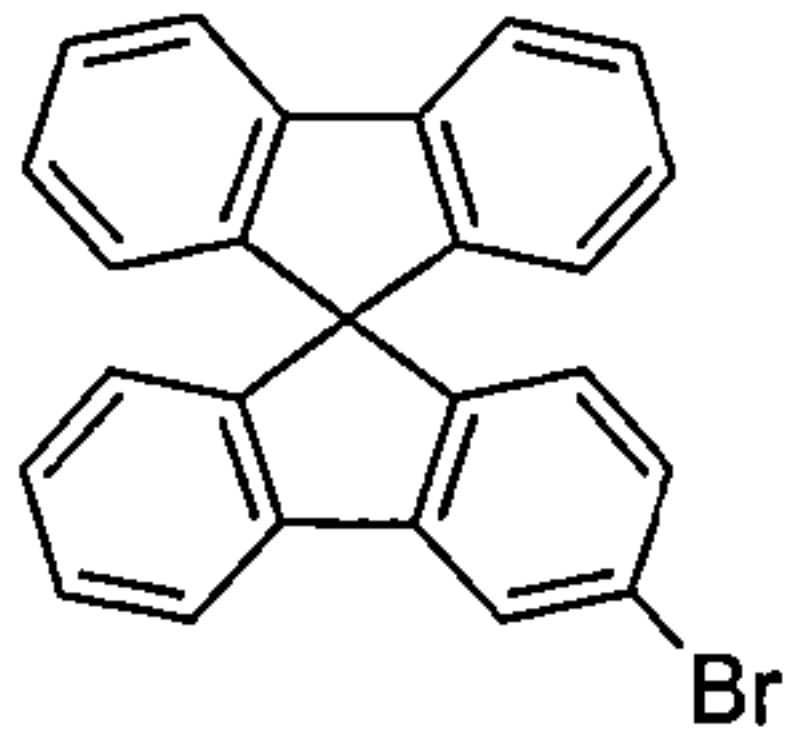
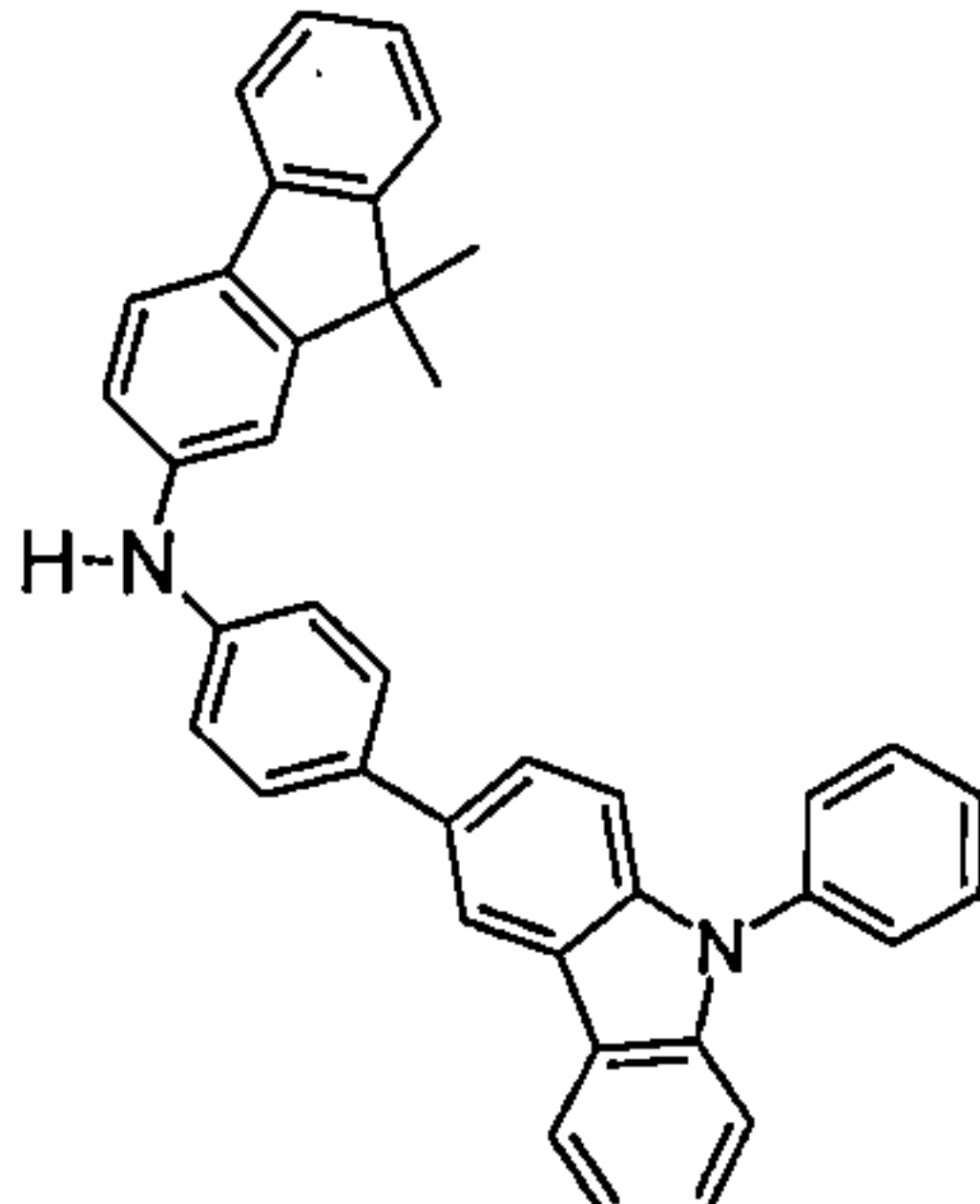
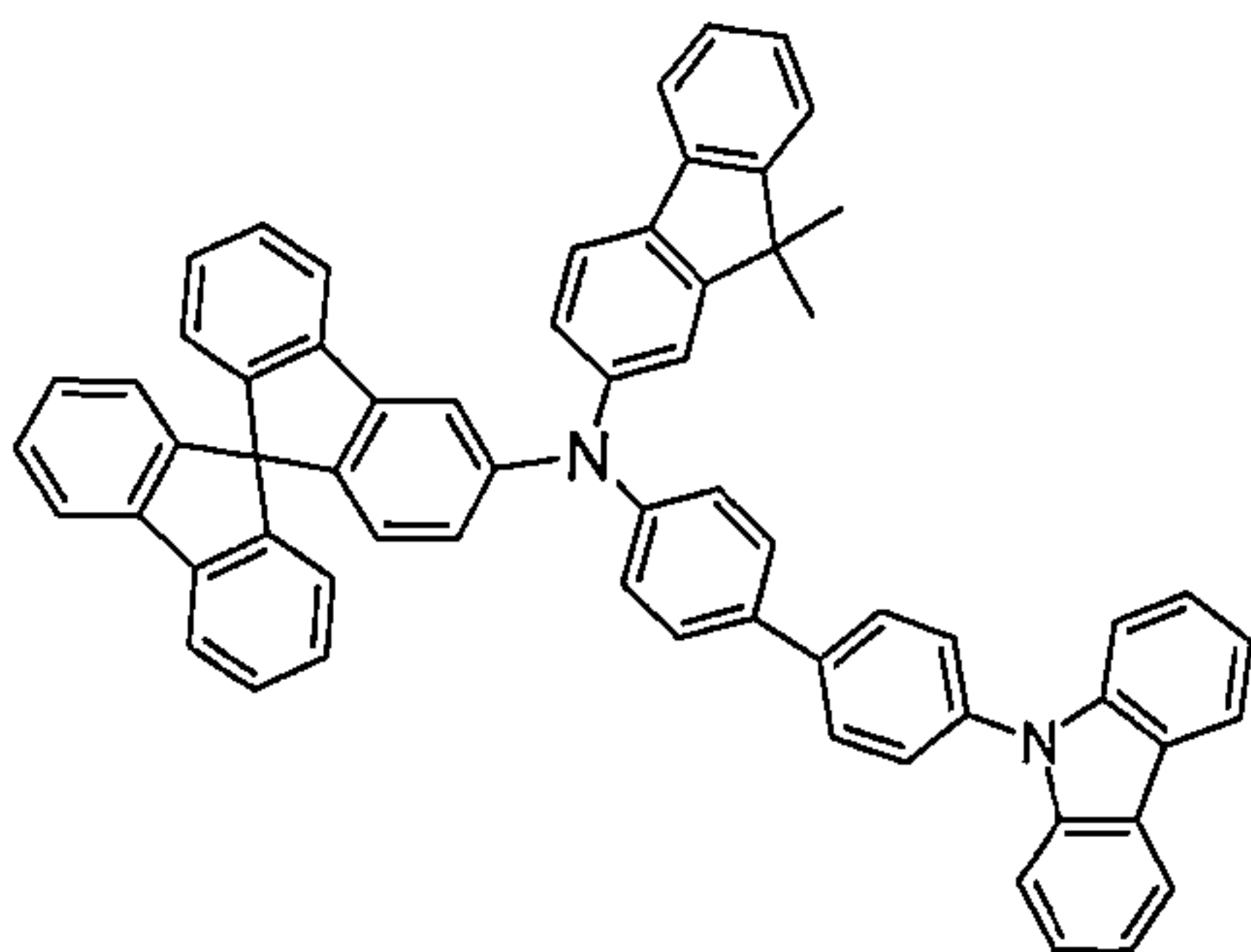
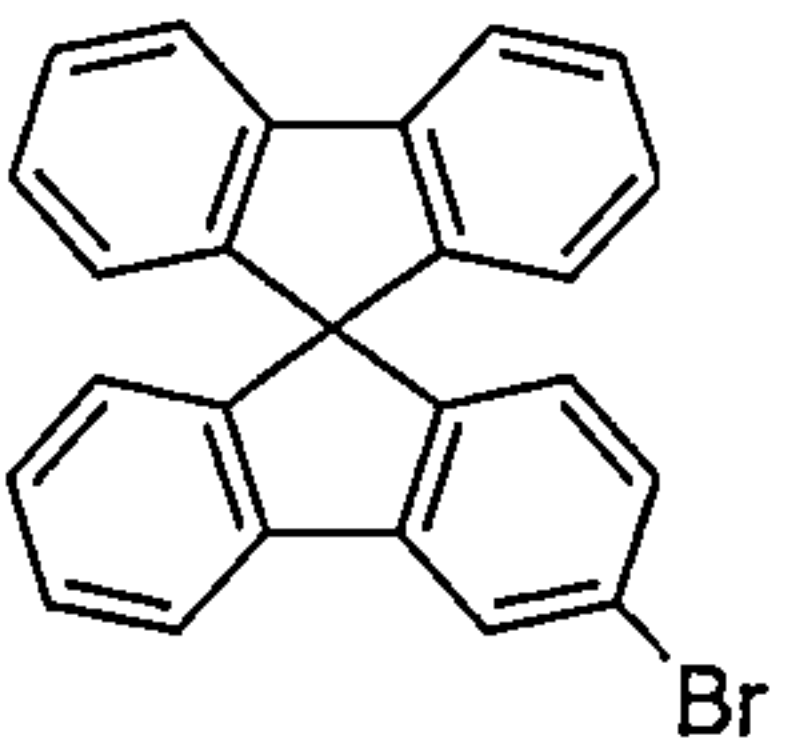
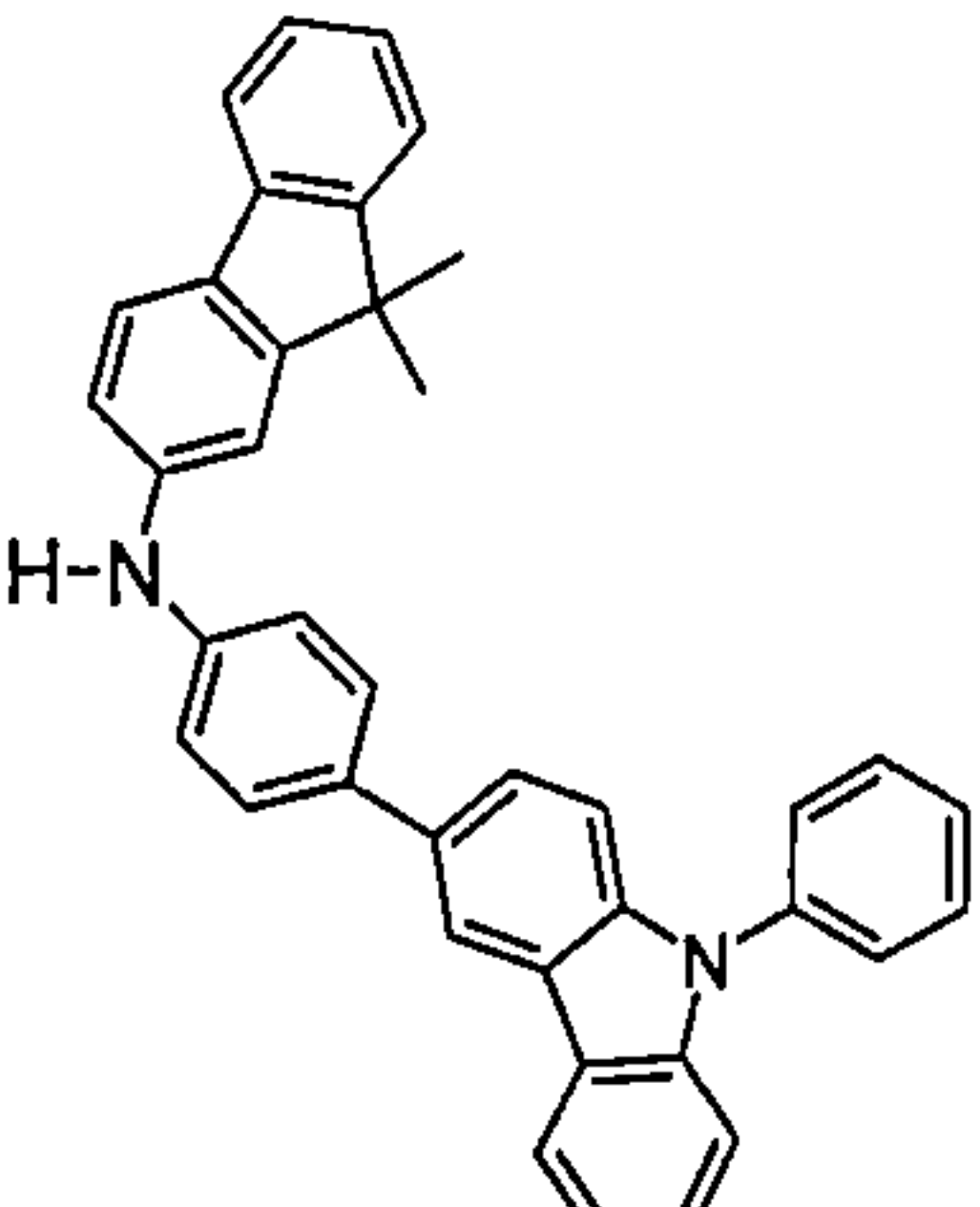
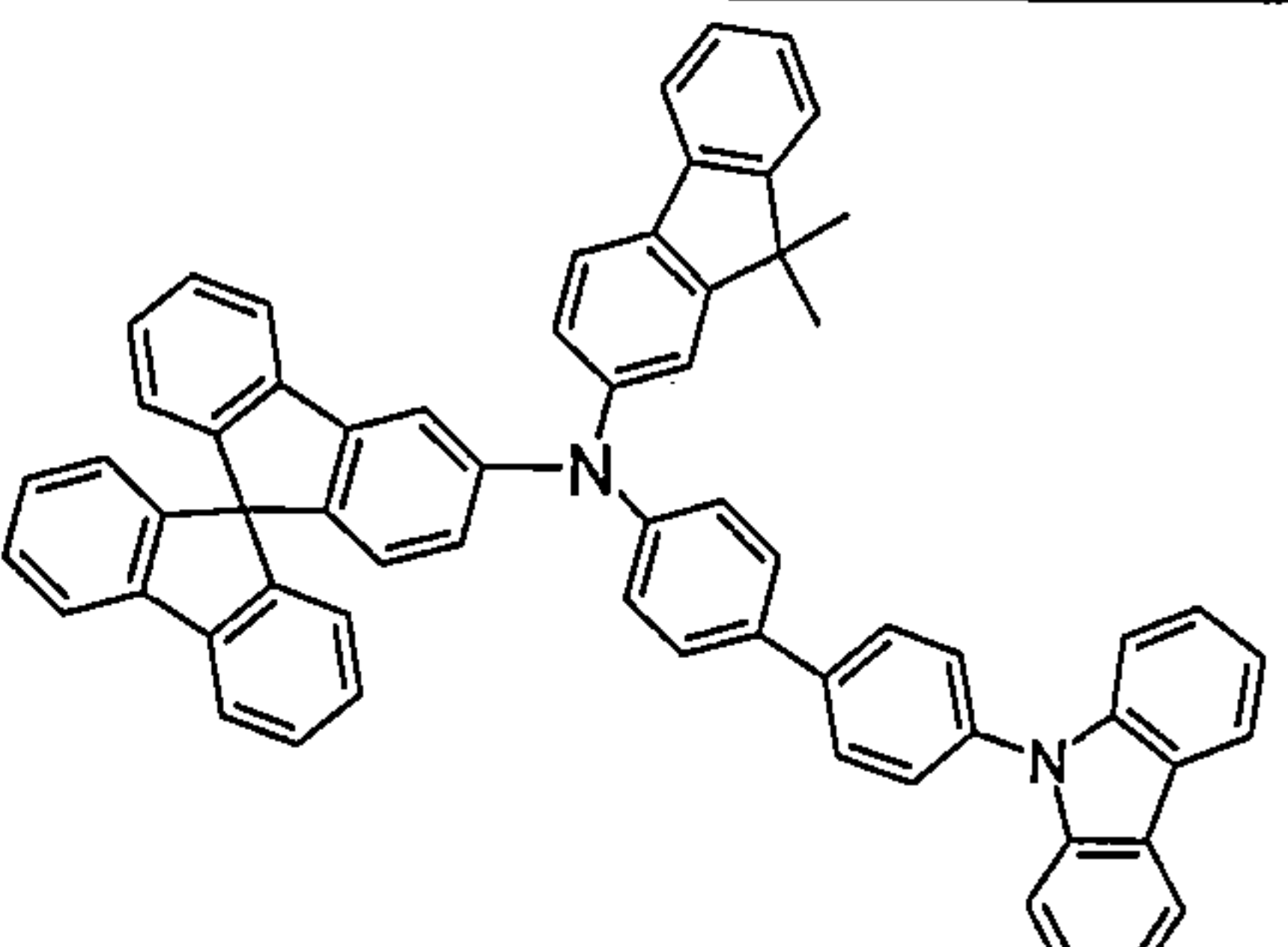
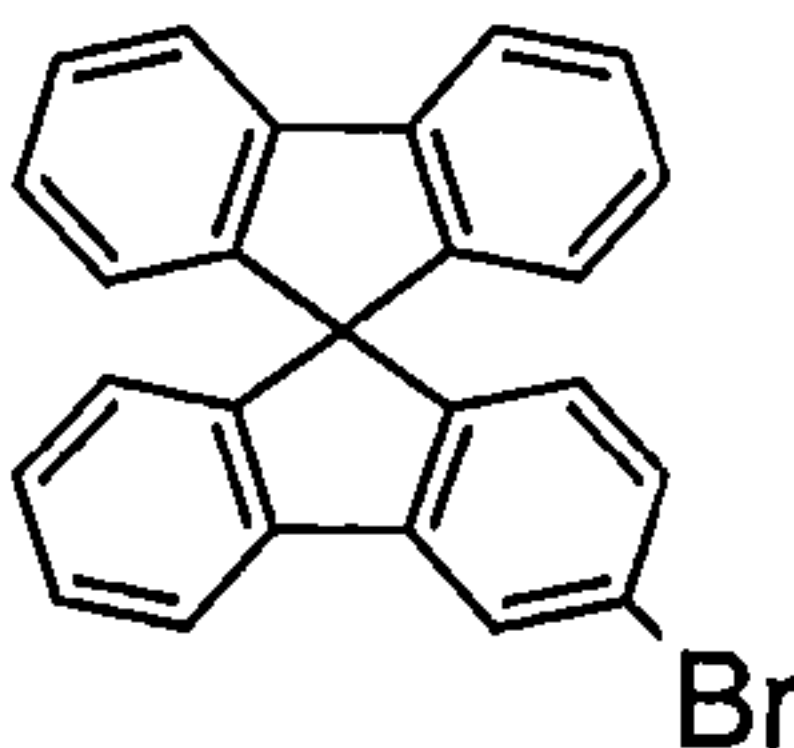
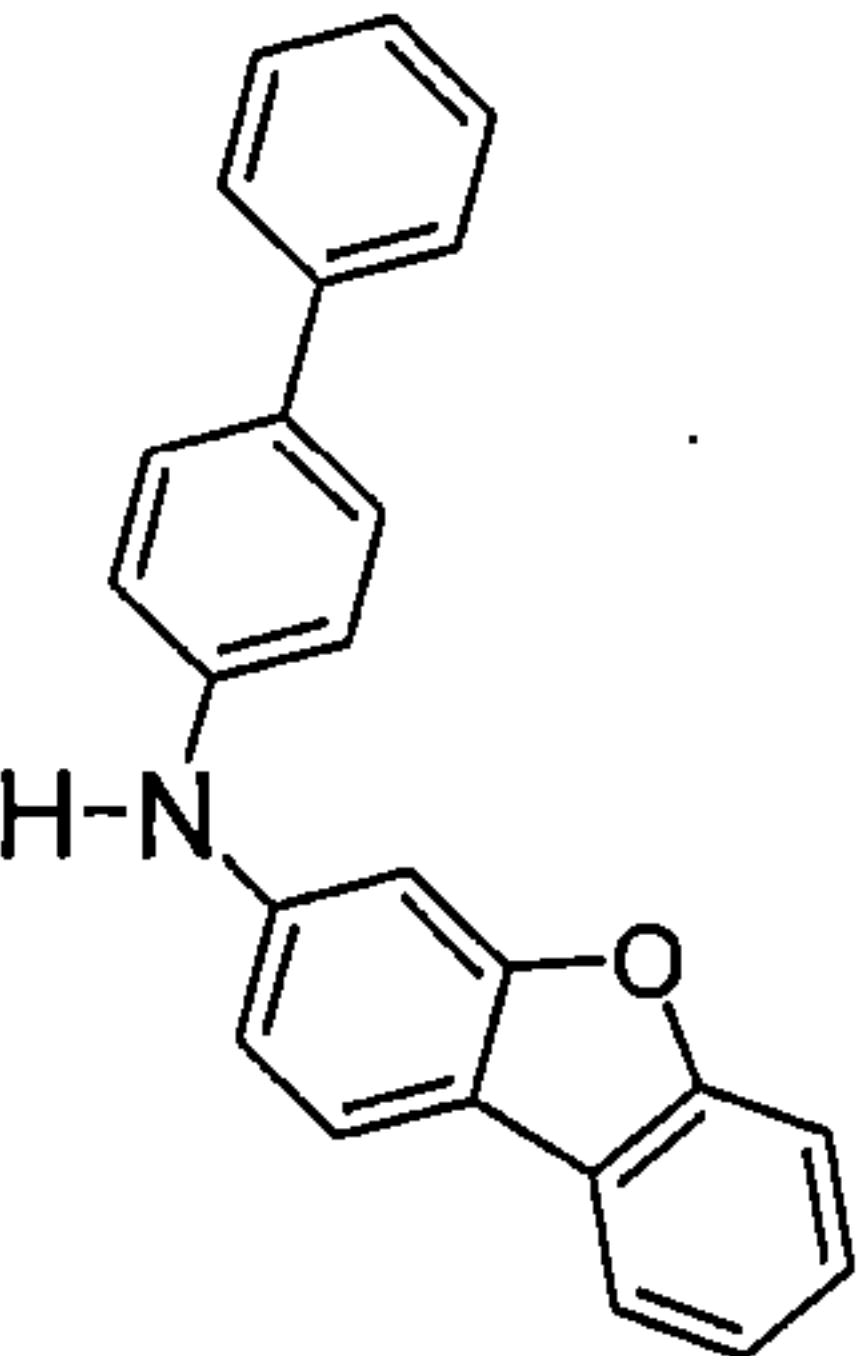
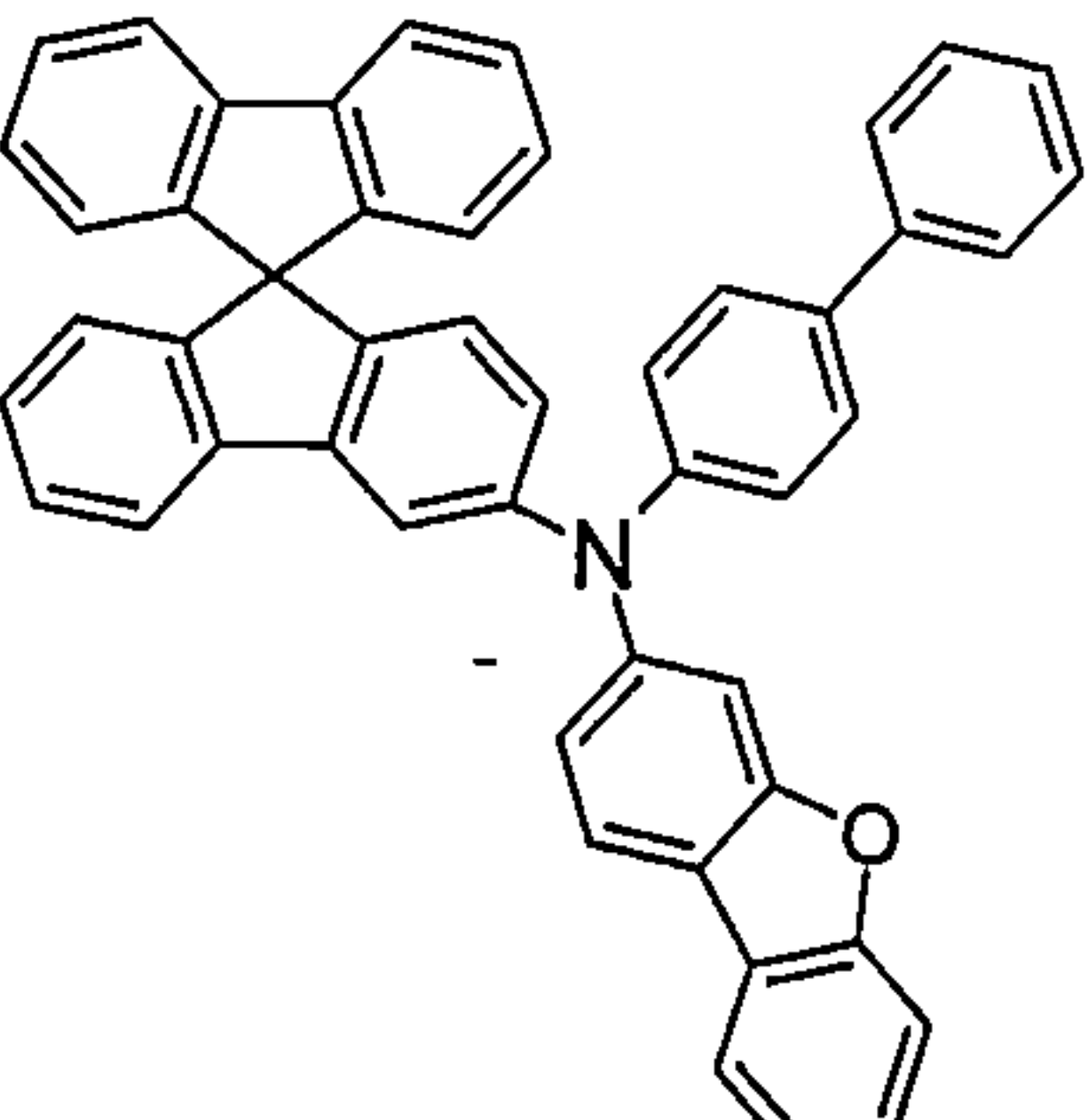
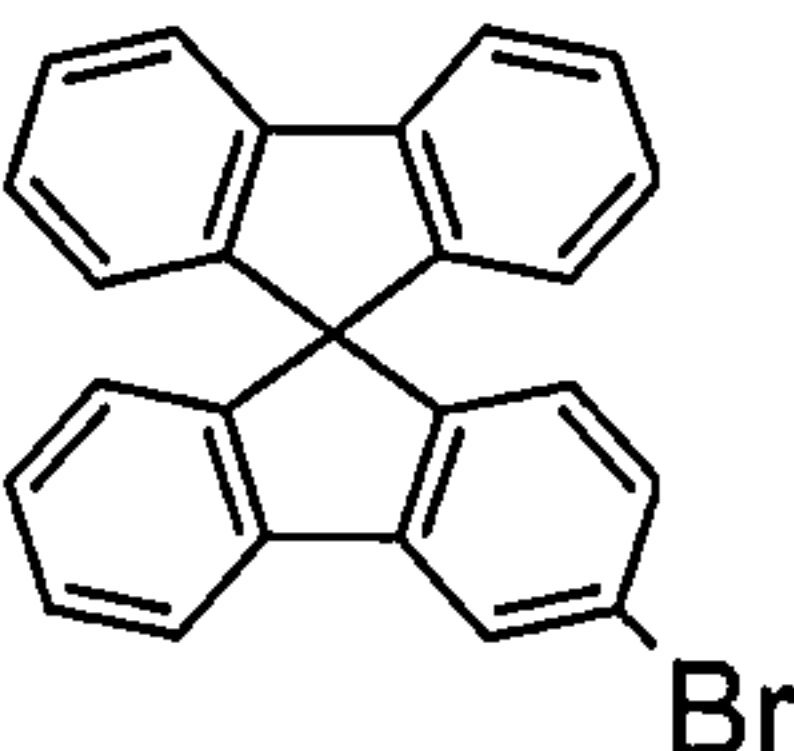
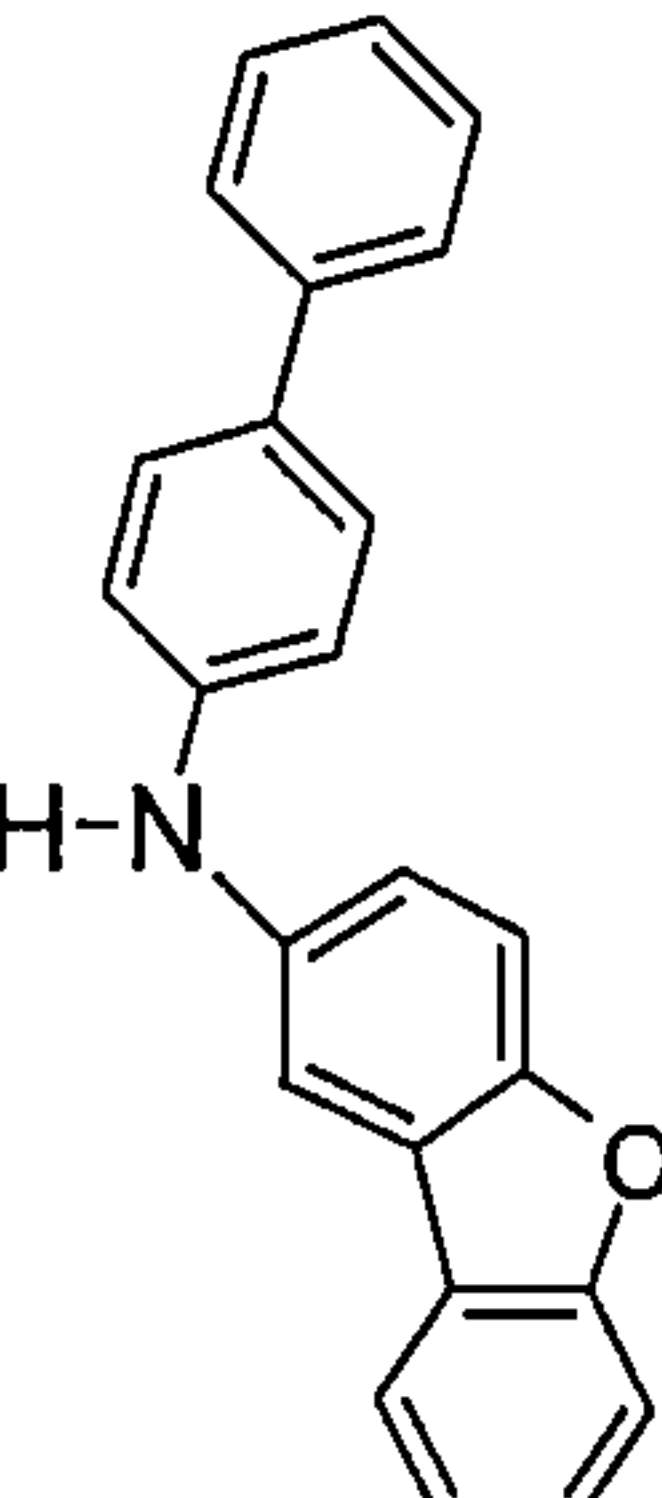
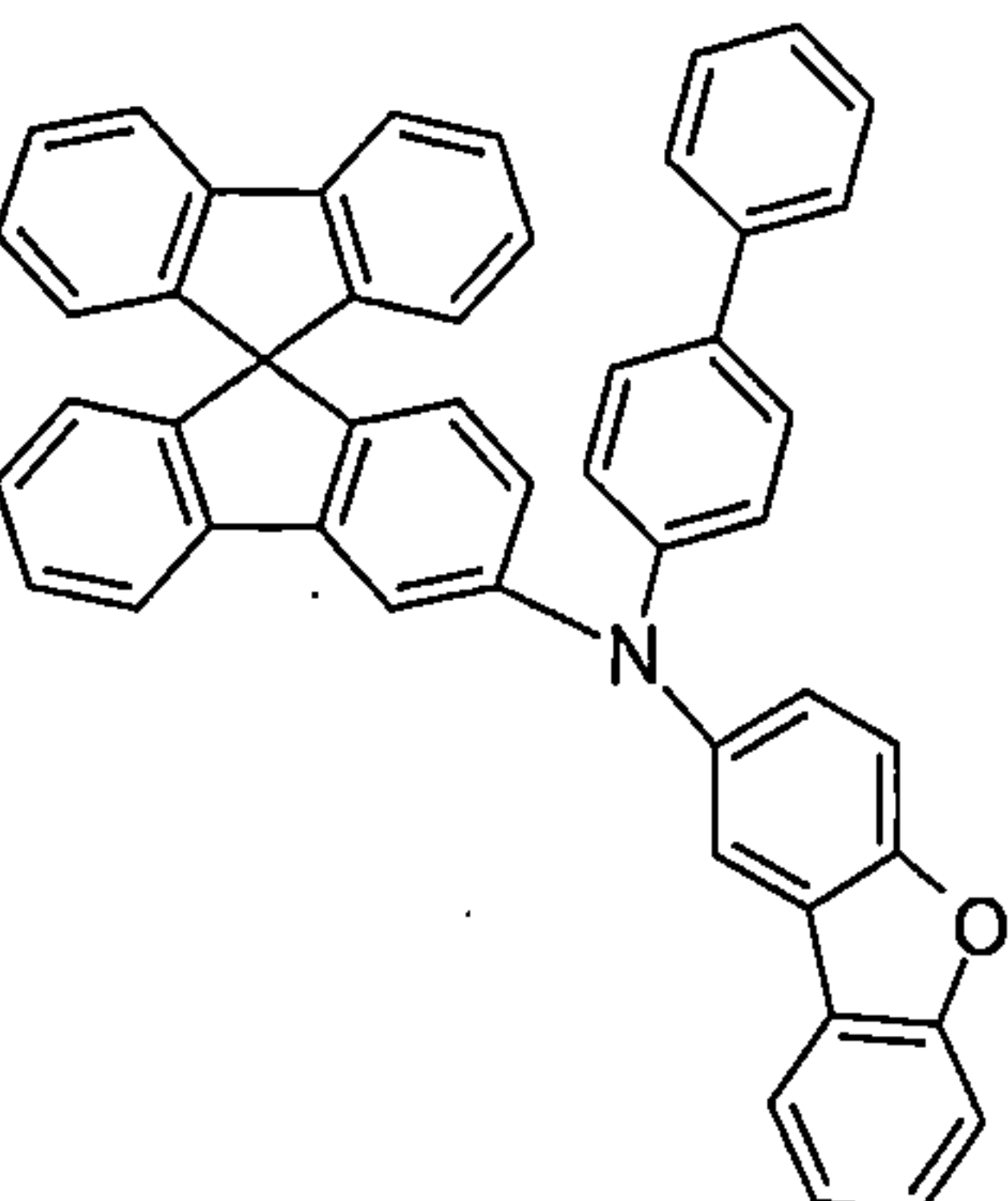
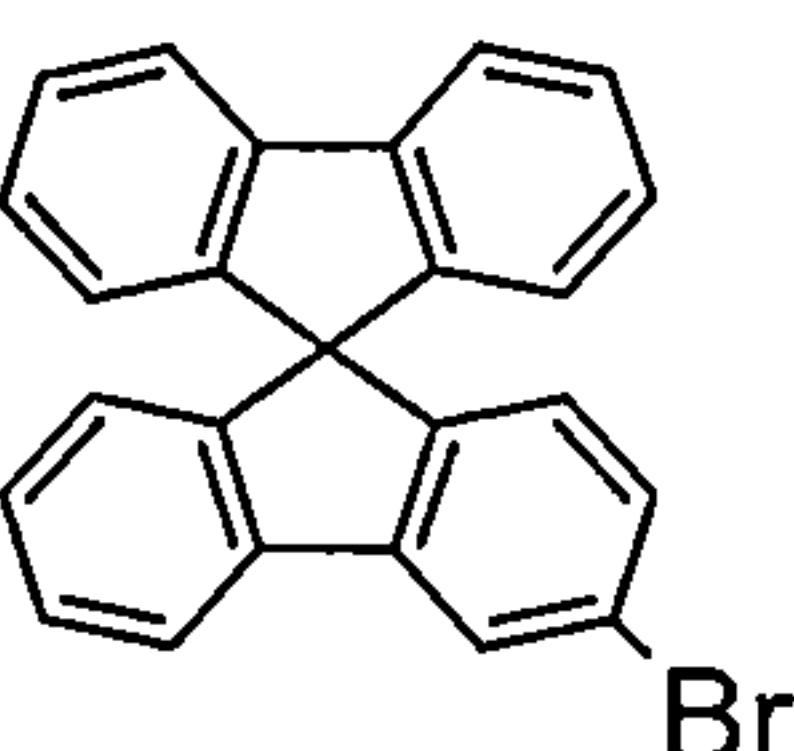
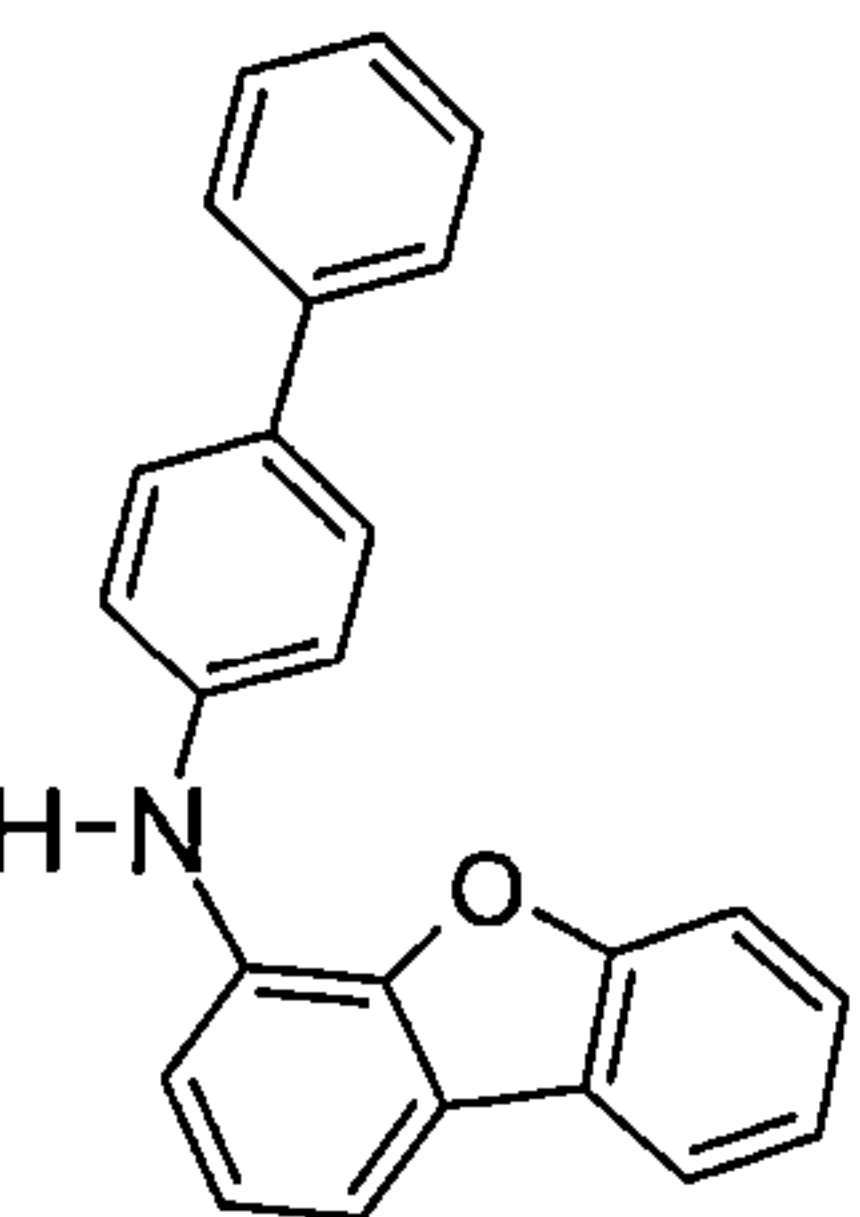
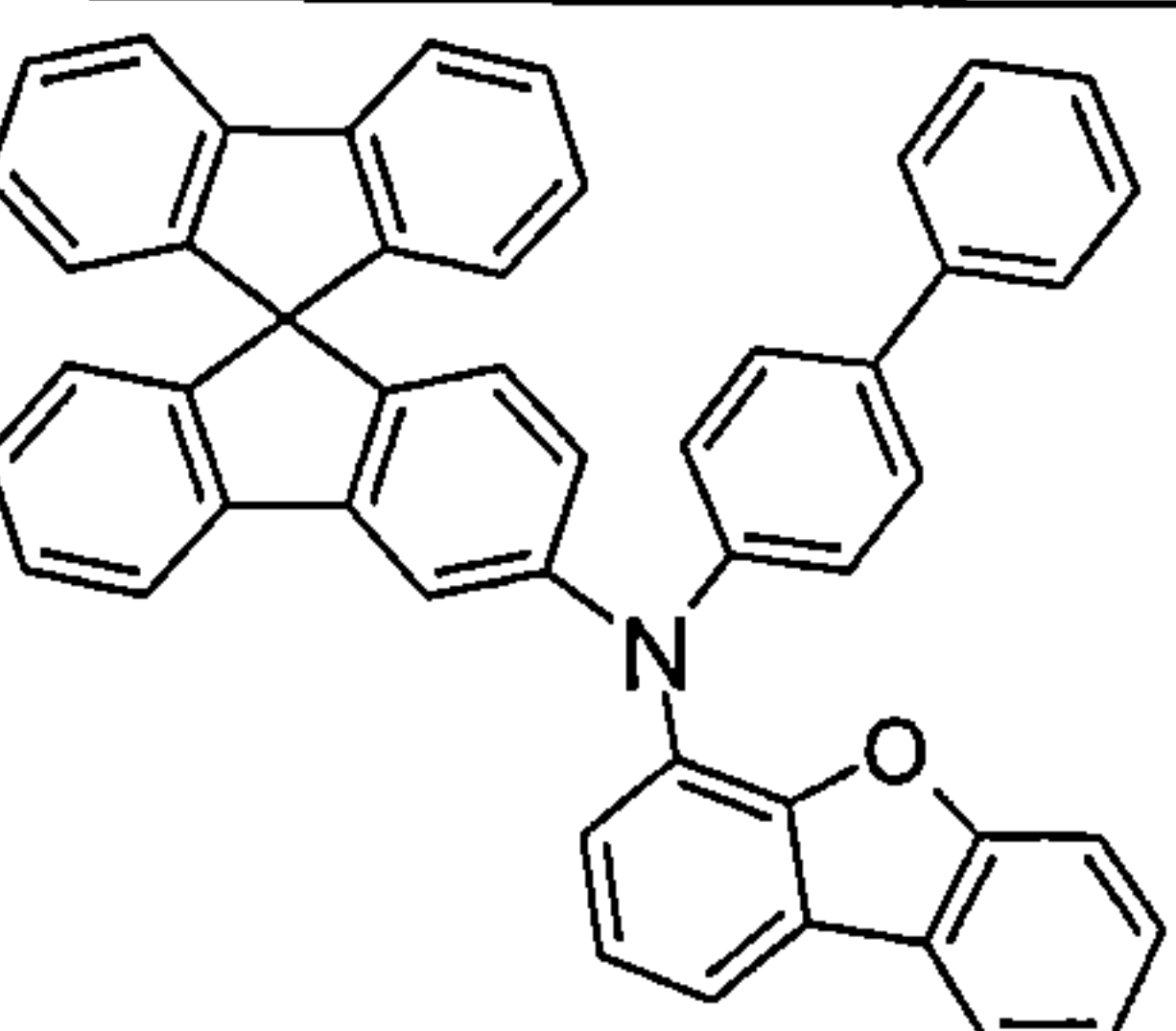
藻土過濾。在真空中蒸發掉濾液，並使殘餘物自乙酸乙酯/庚烷結晶。在索氏萃取器(甲苯)中萃取粗製產物並藉由在真空中區域昇華來純化兩次($p = 3 \times 10^{-4}$ 毫巴， $T = 298^{\circ}\text{C}$)。分離出呈淺黃色固體形式之產物(20.4 g，理論為27%，根據HPLC，純度> 99.99%)。

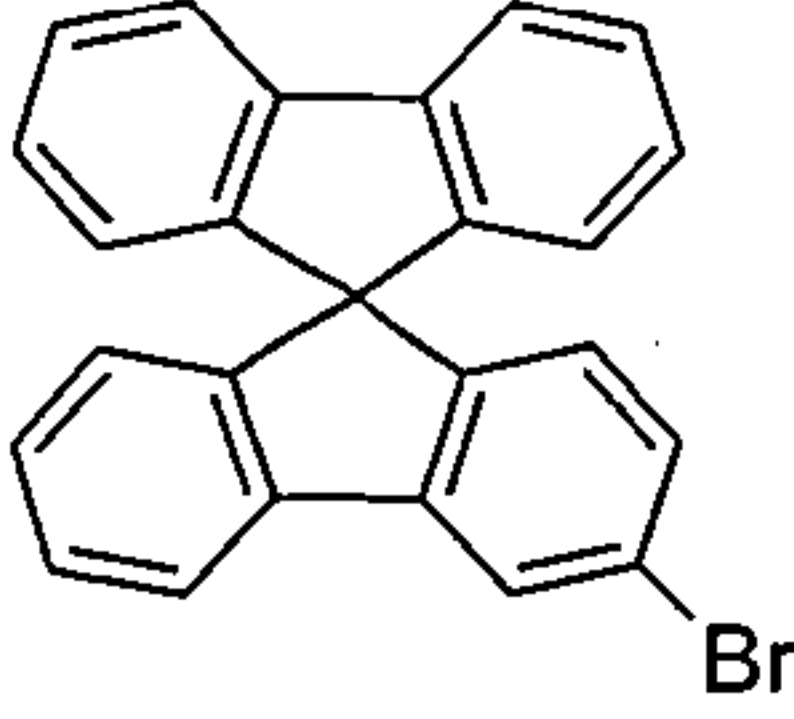
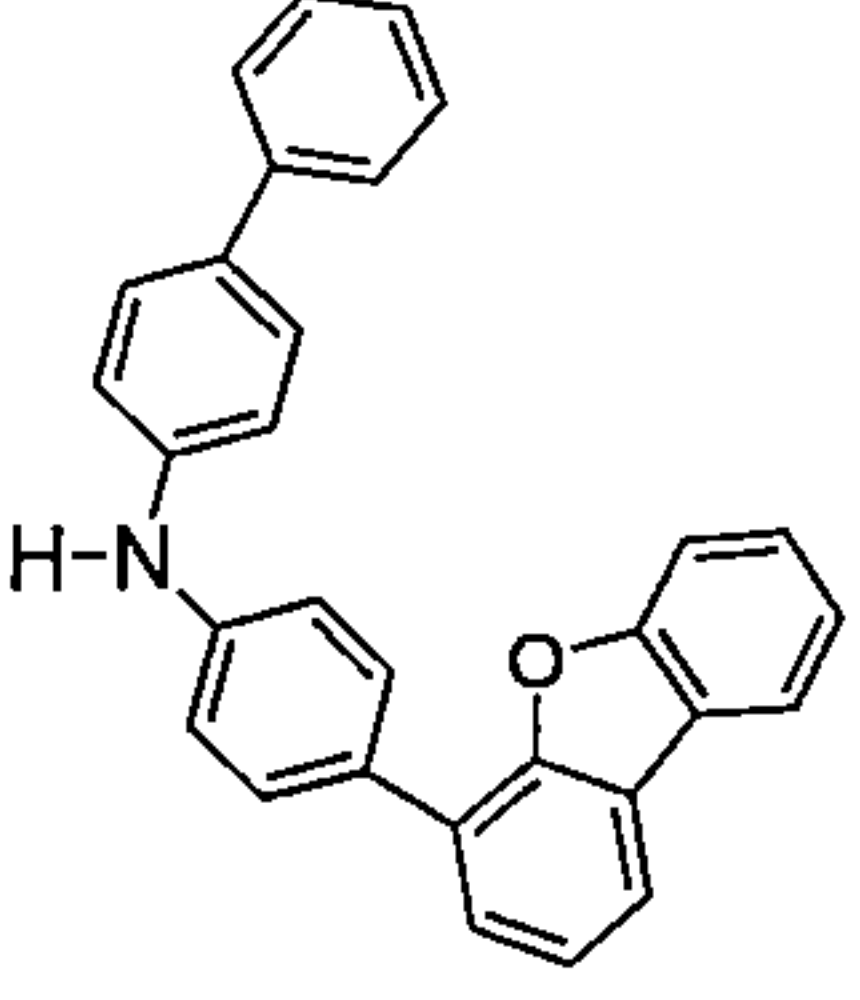
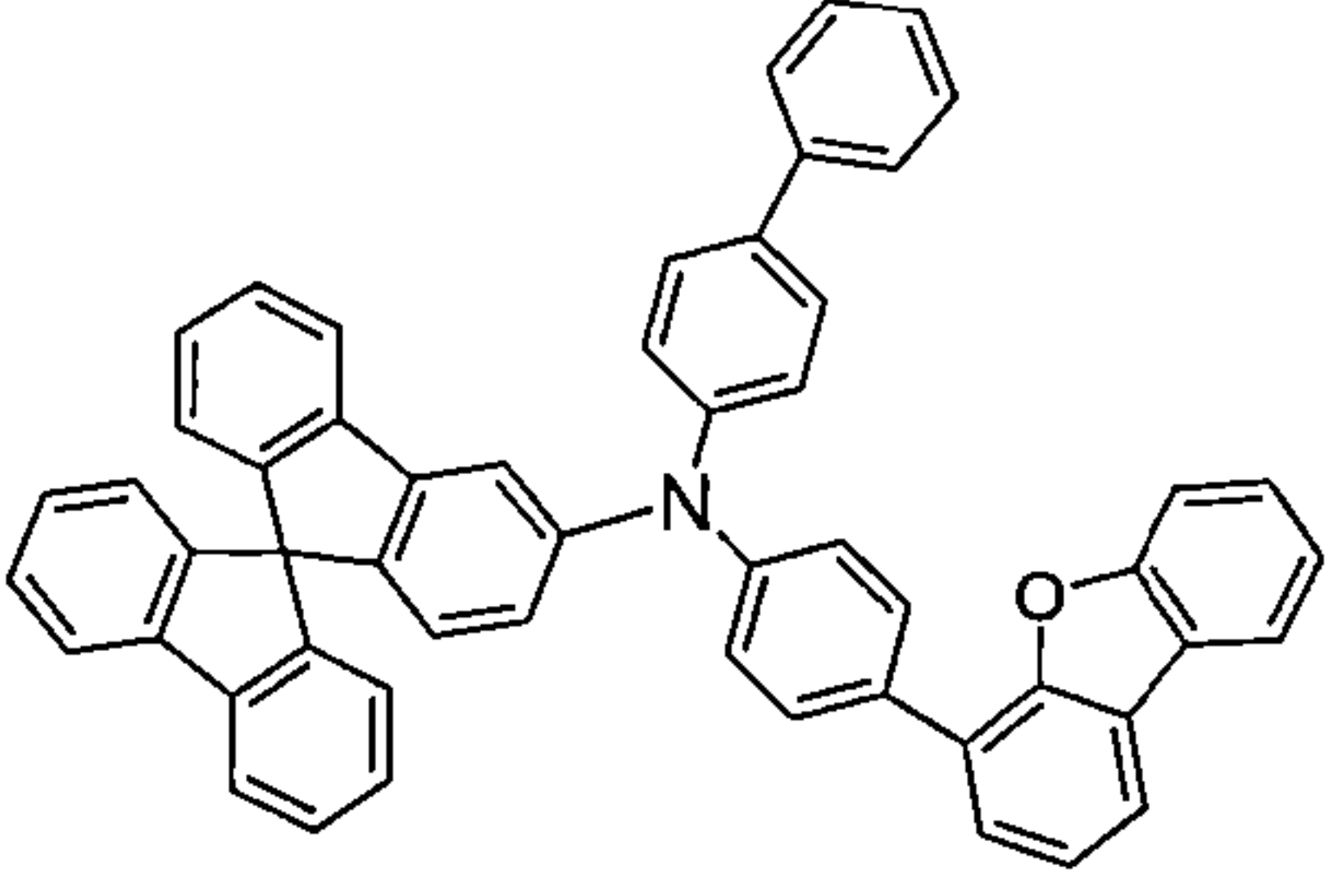
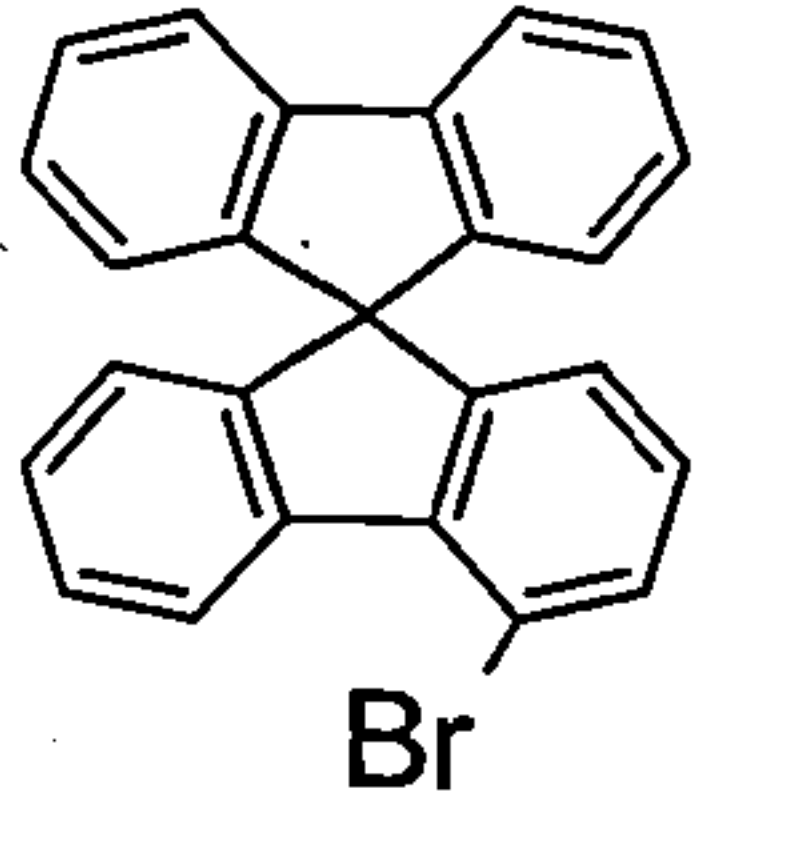
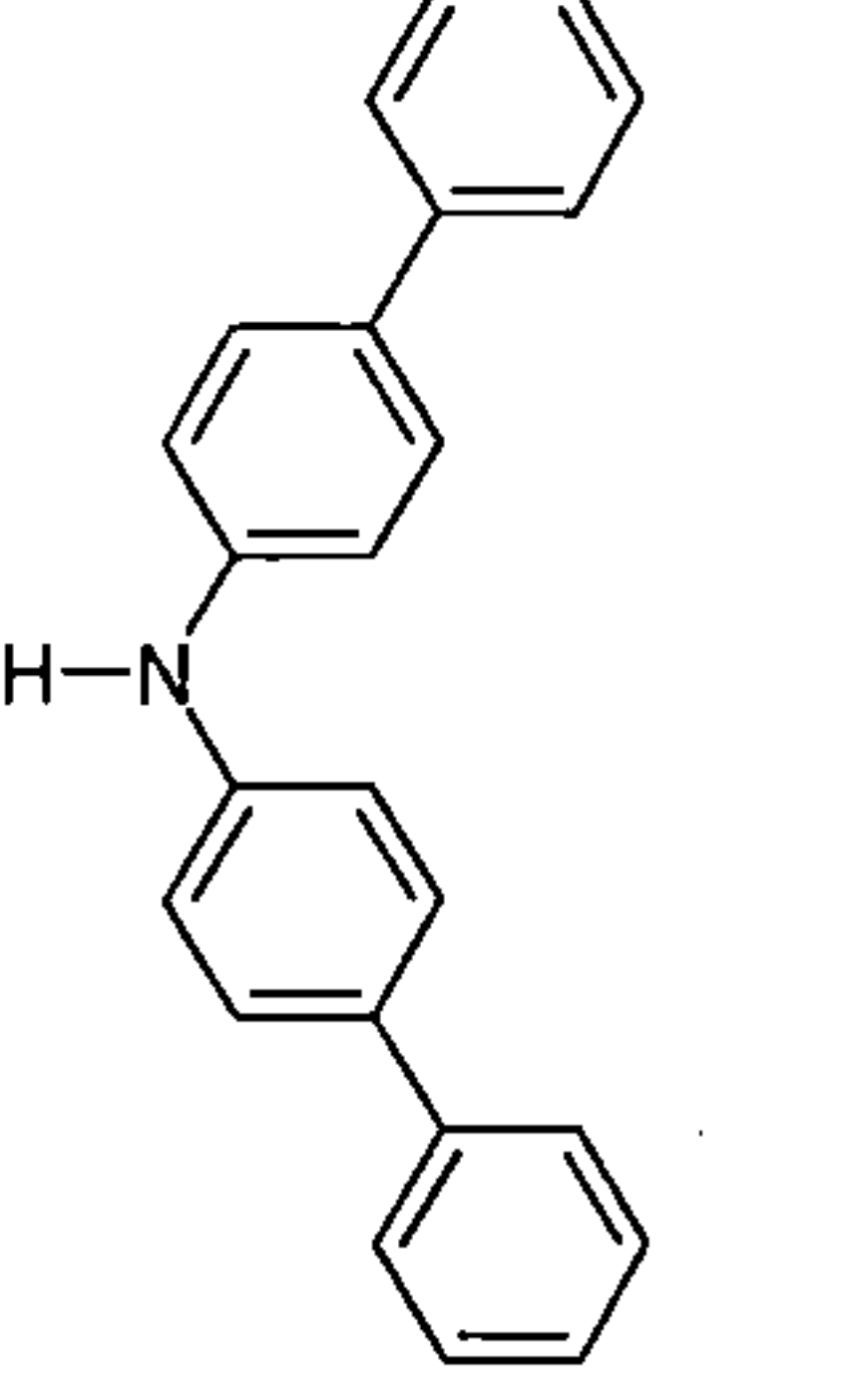
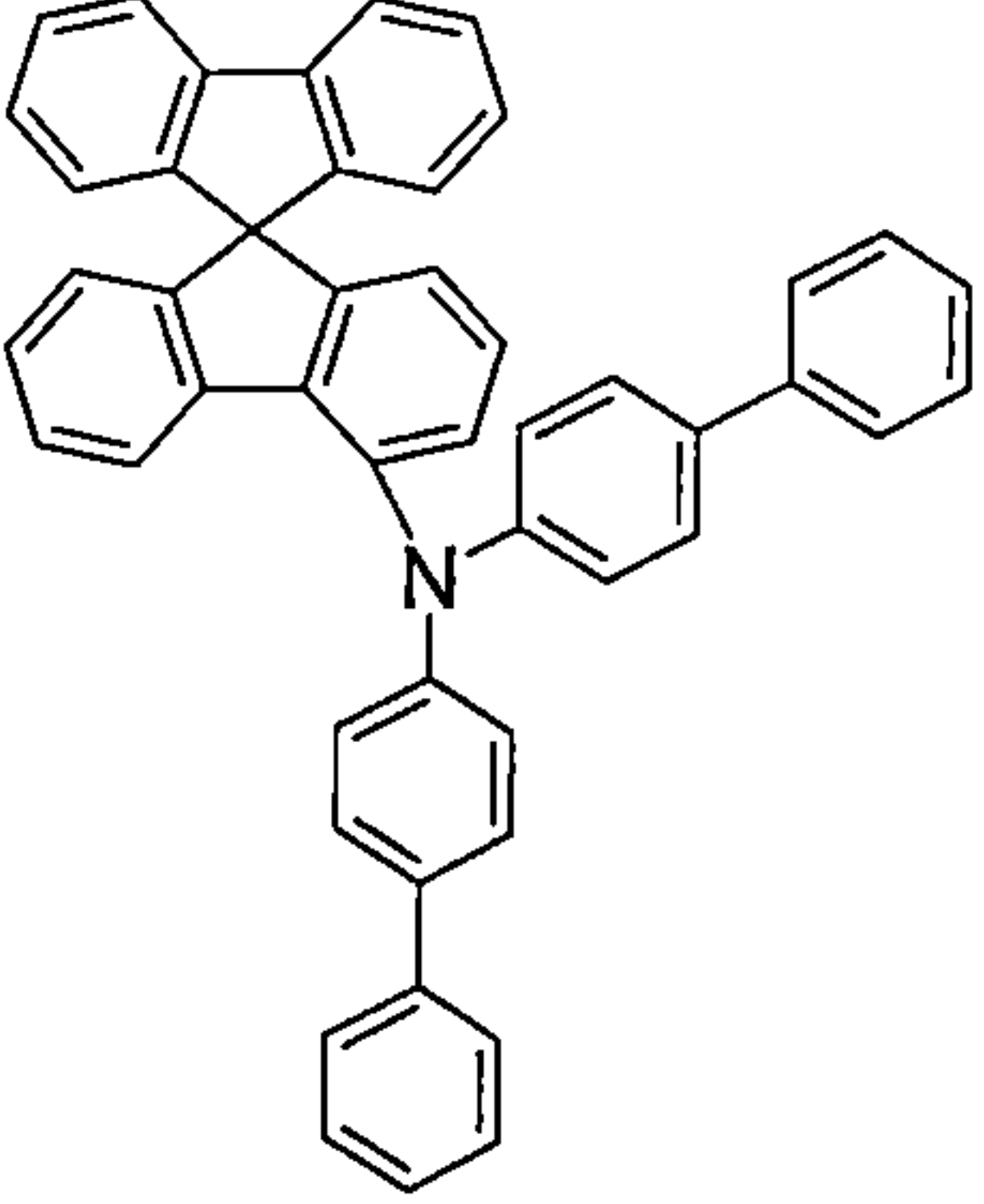
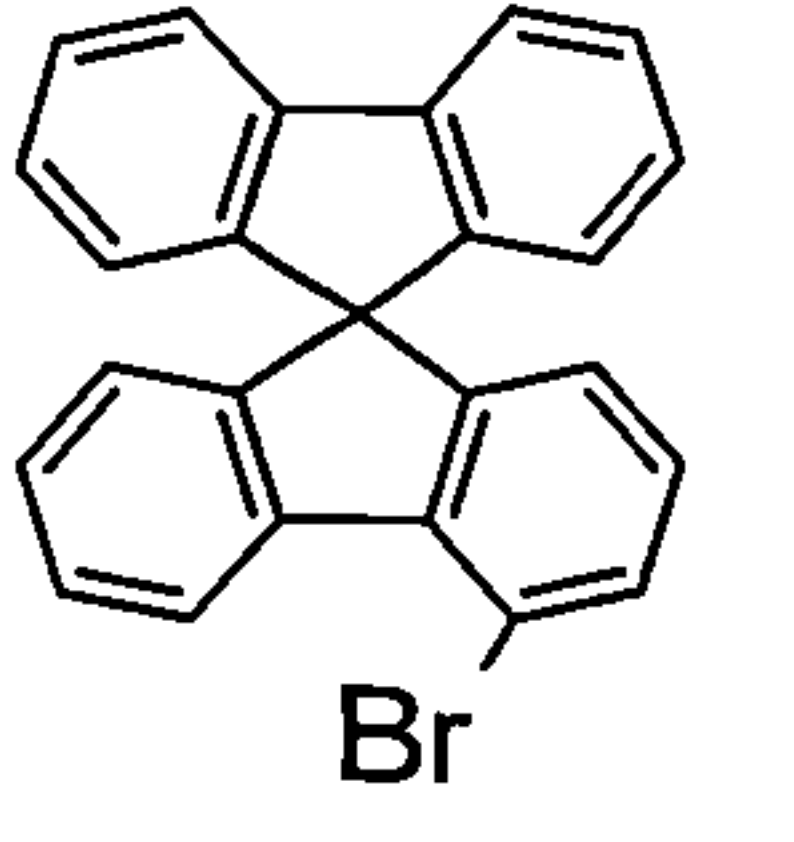
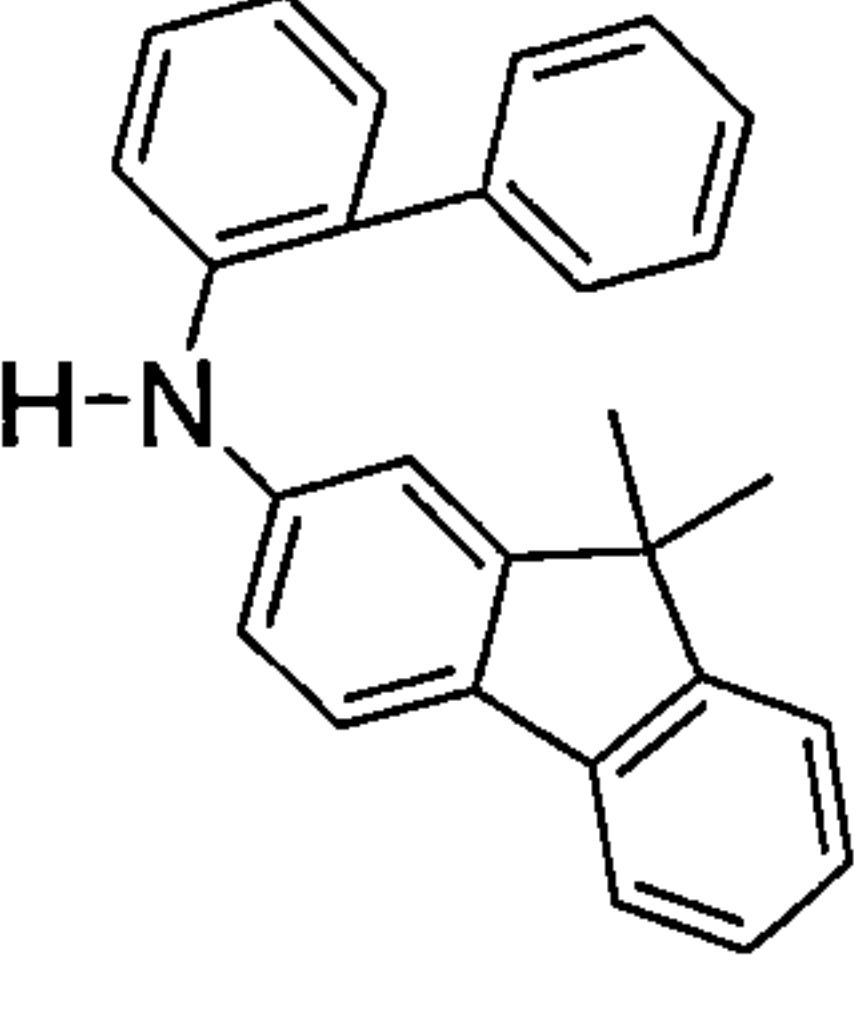
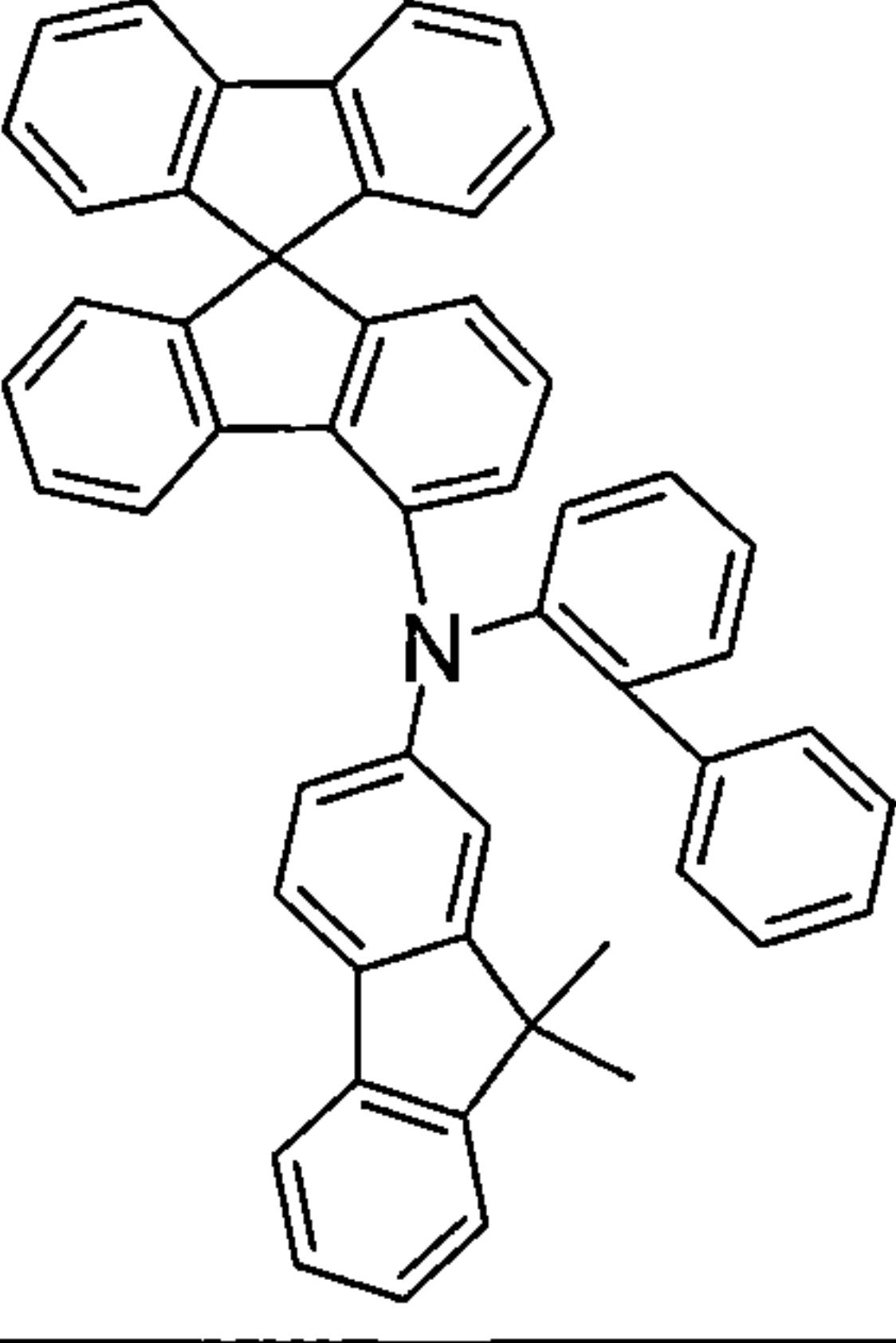
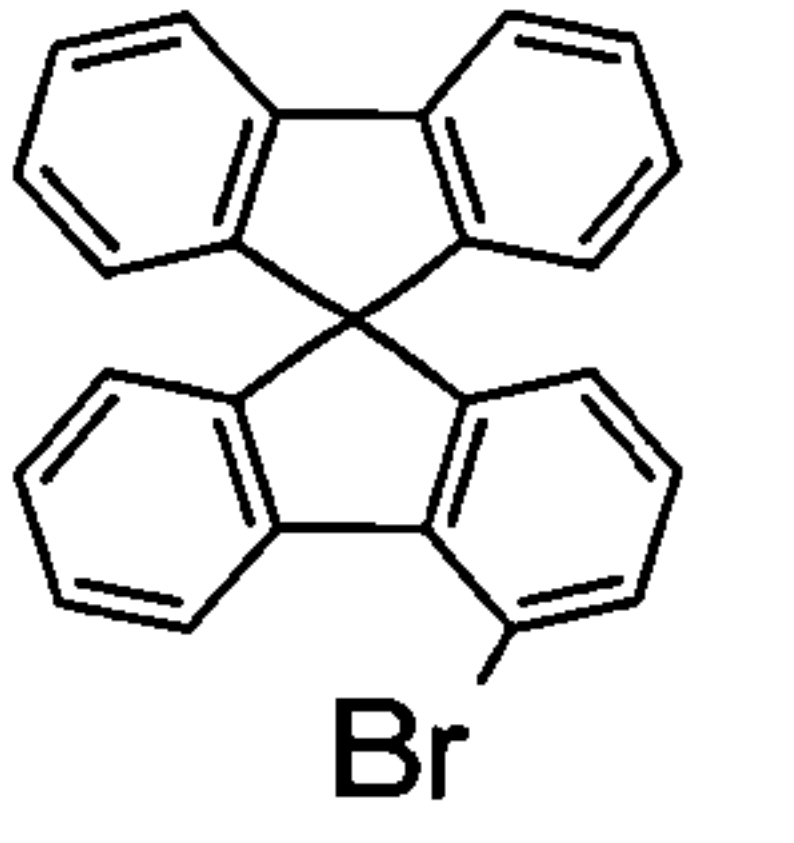
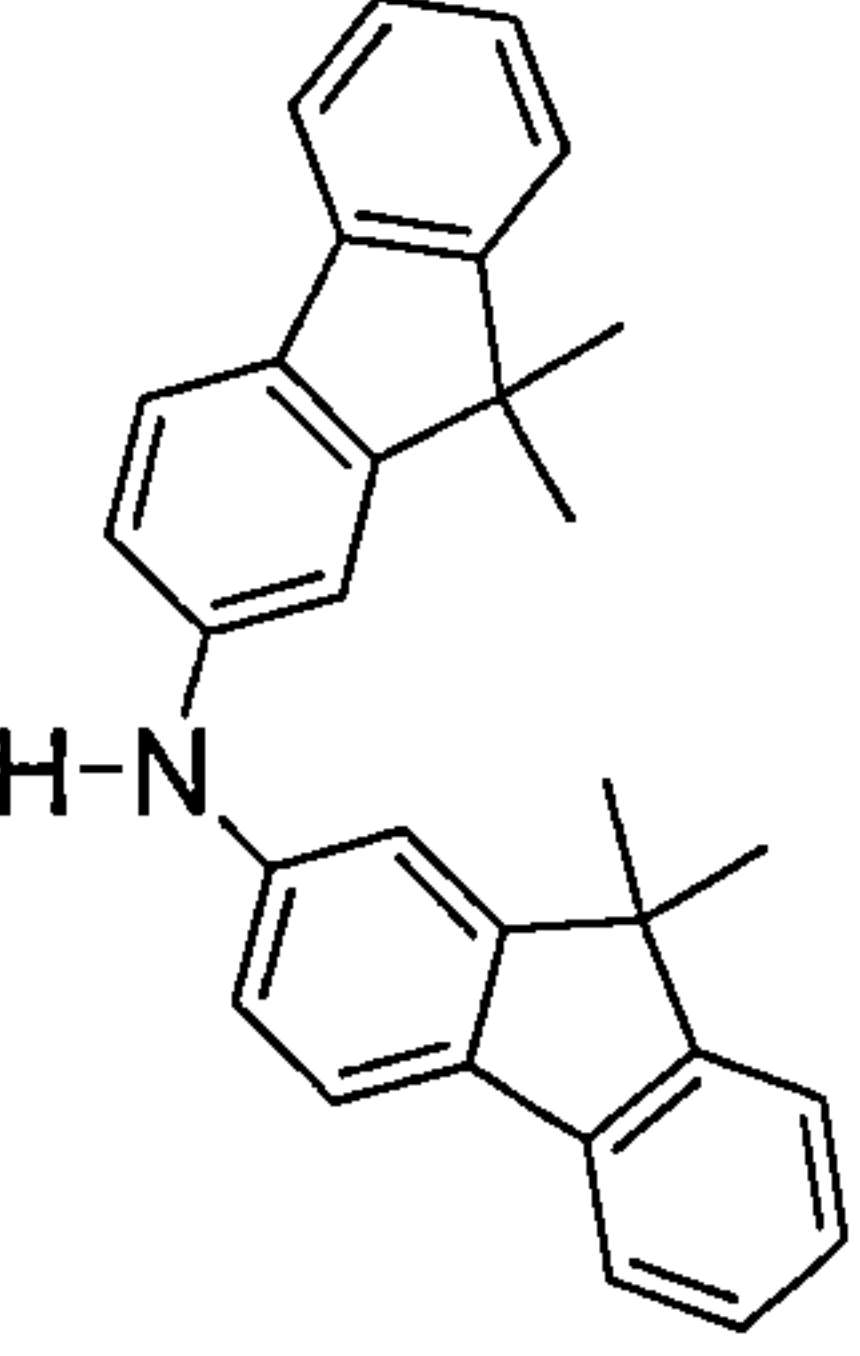
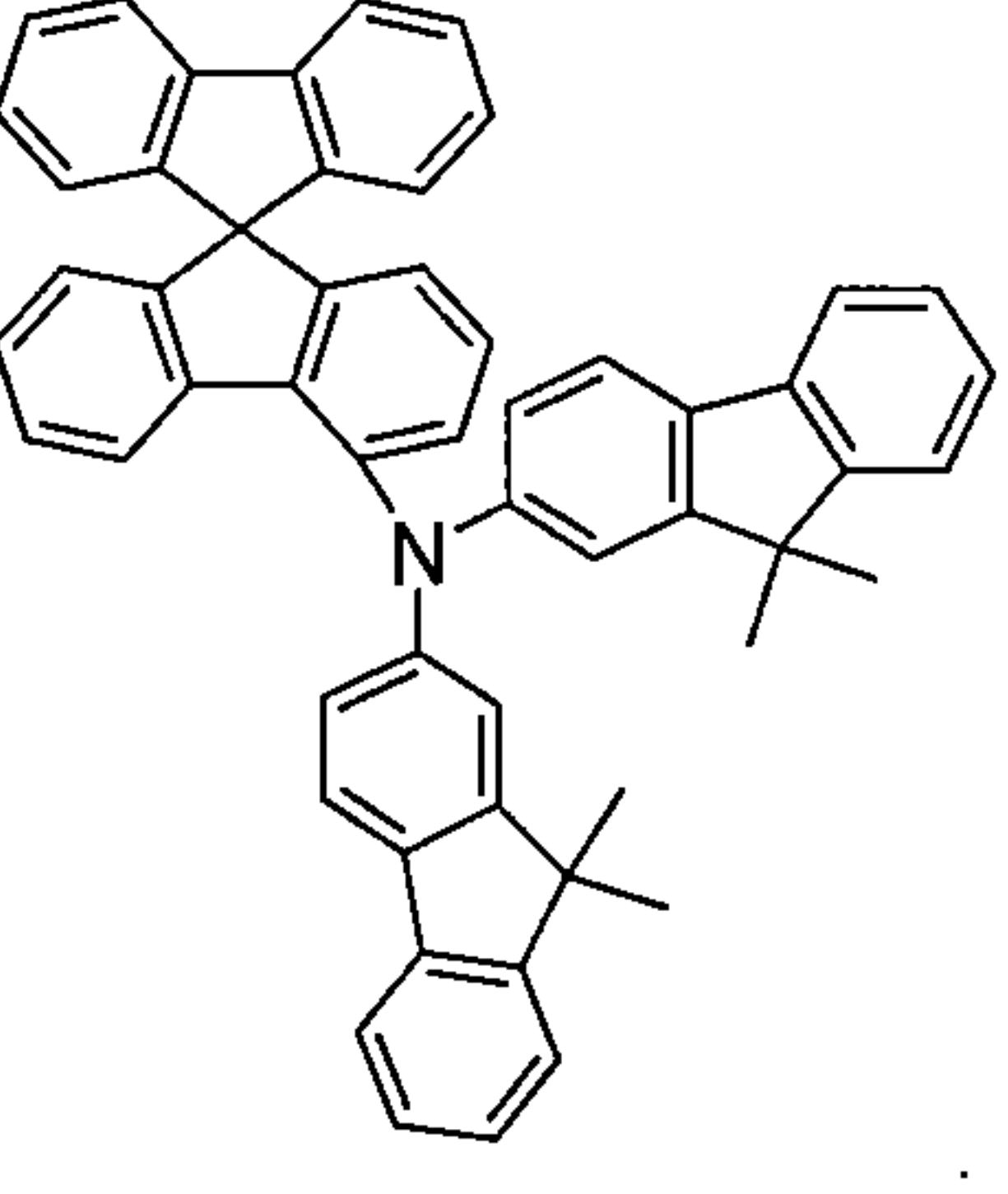
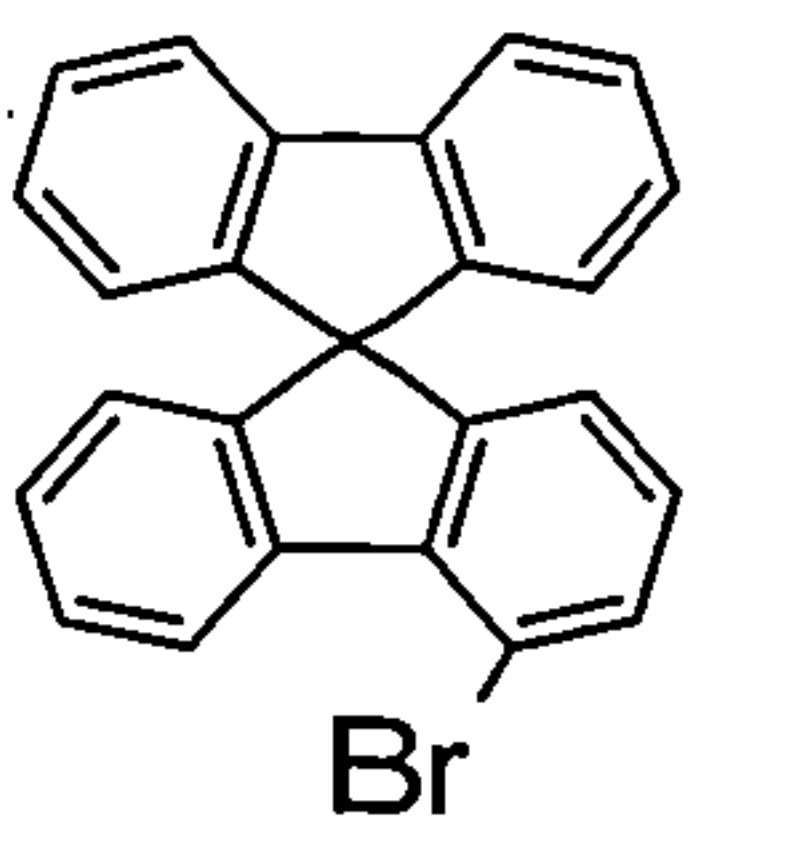
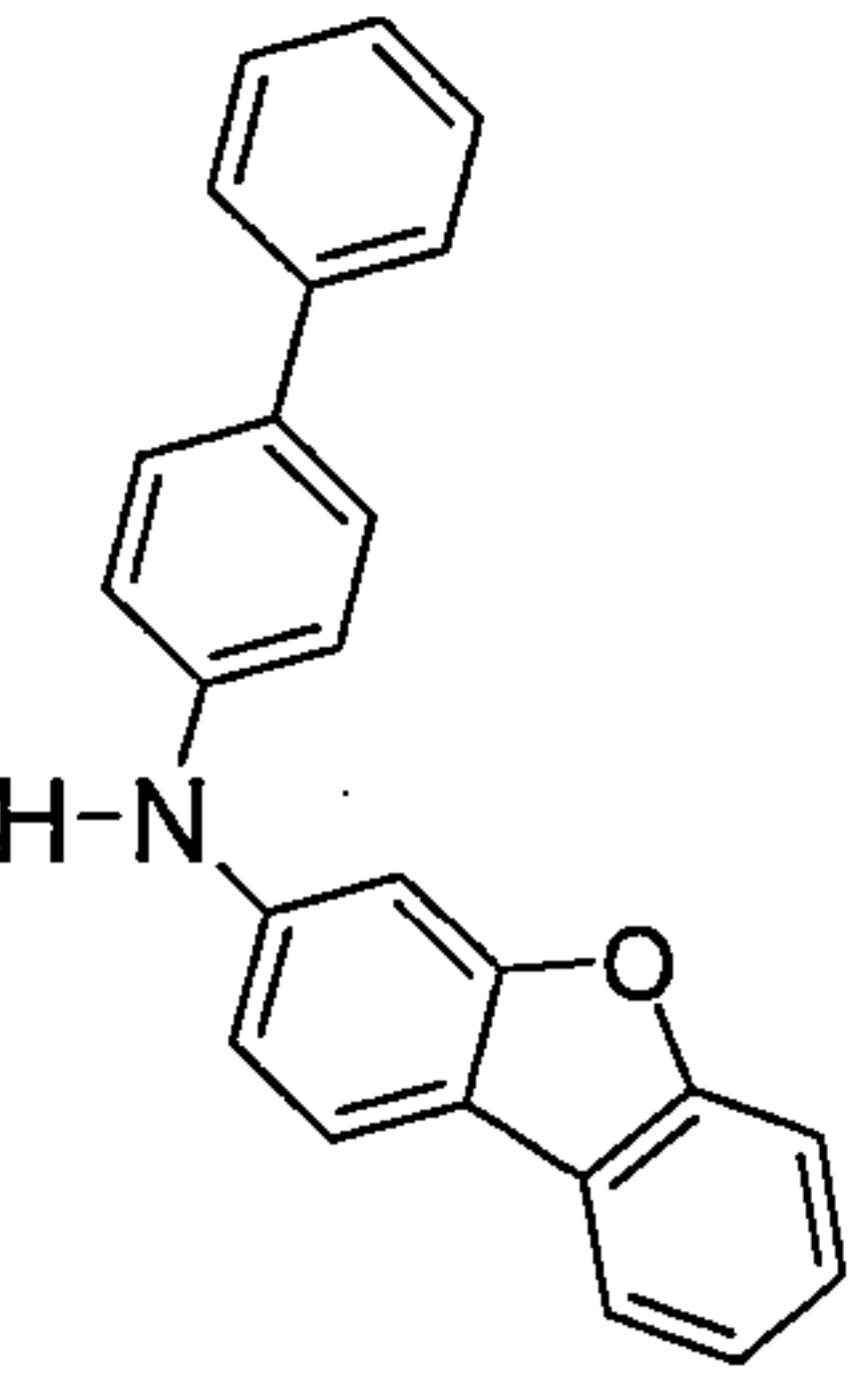
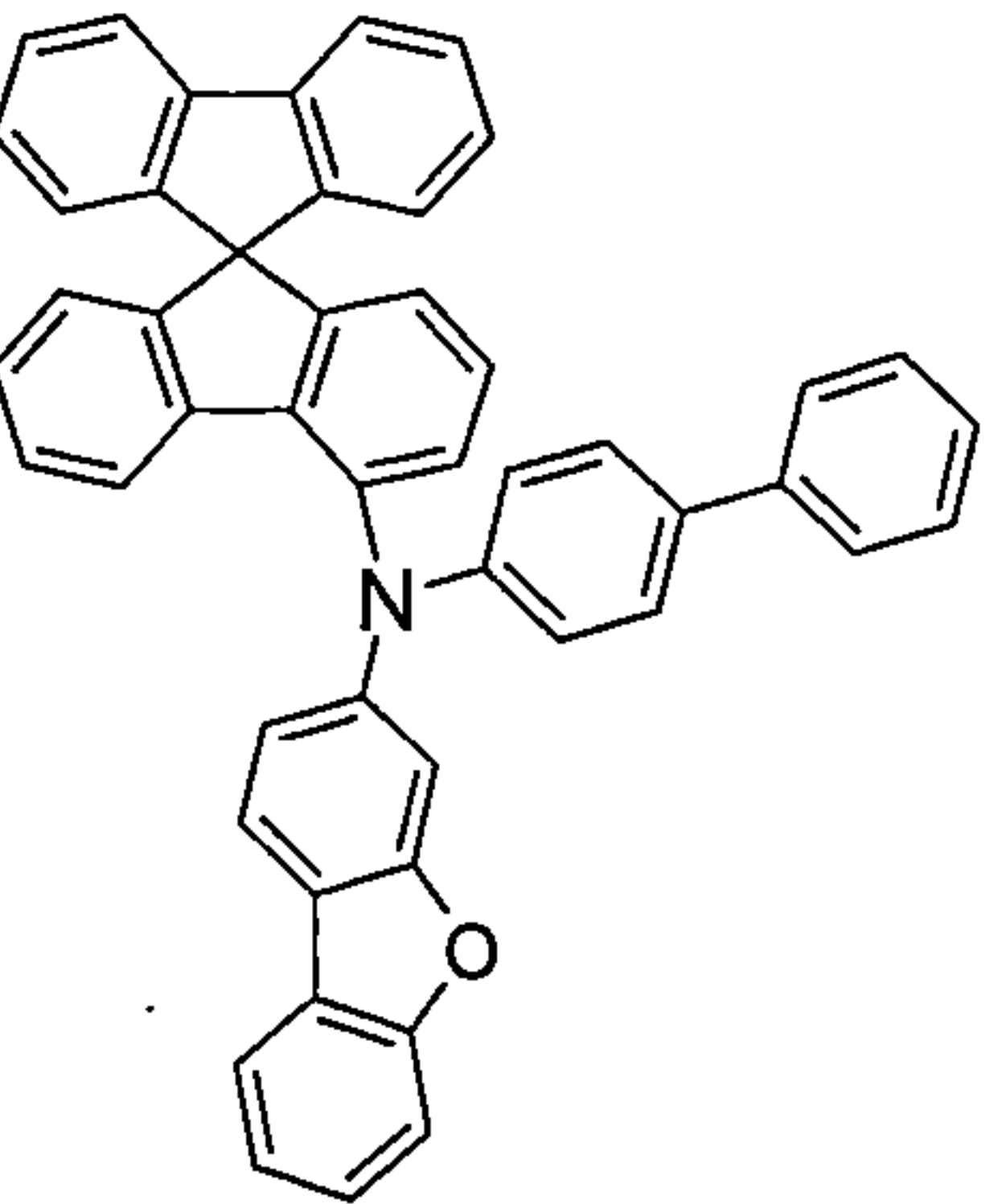
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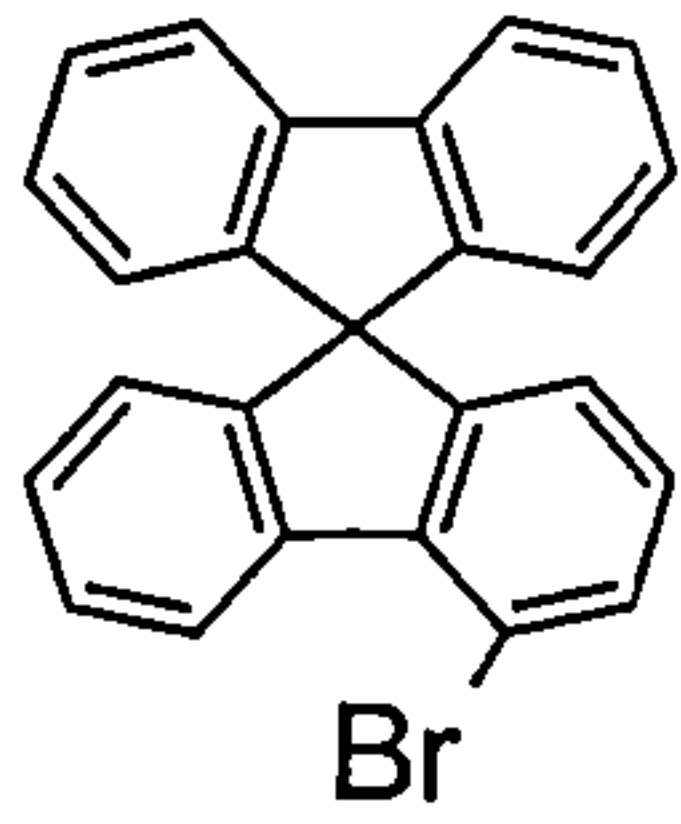
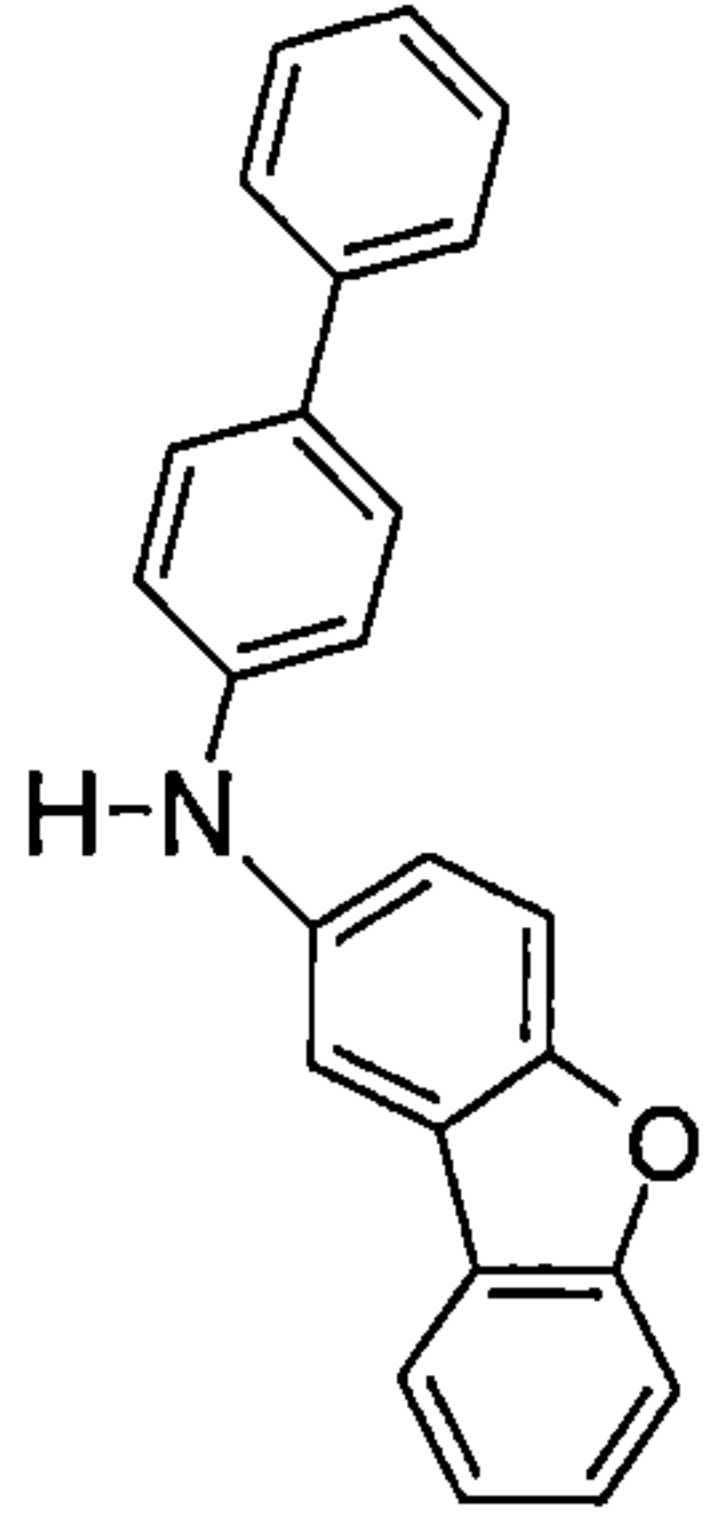
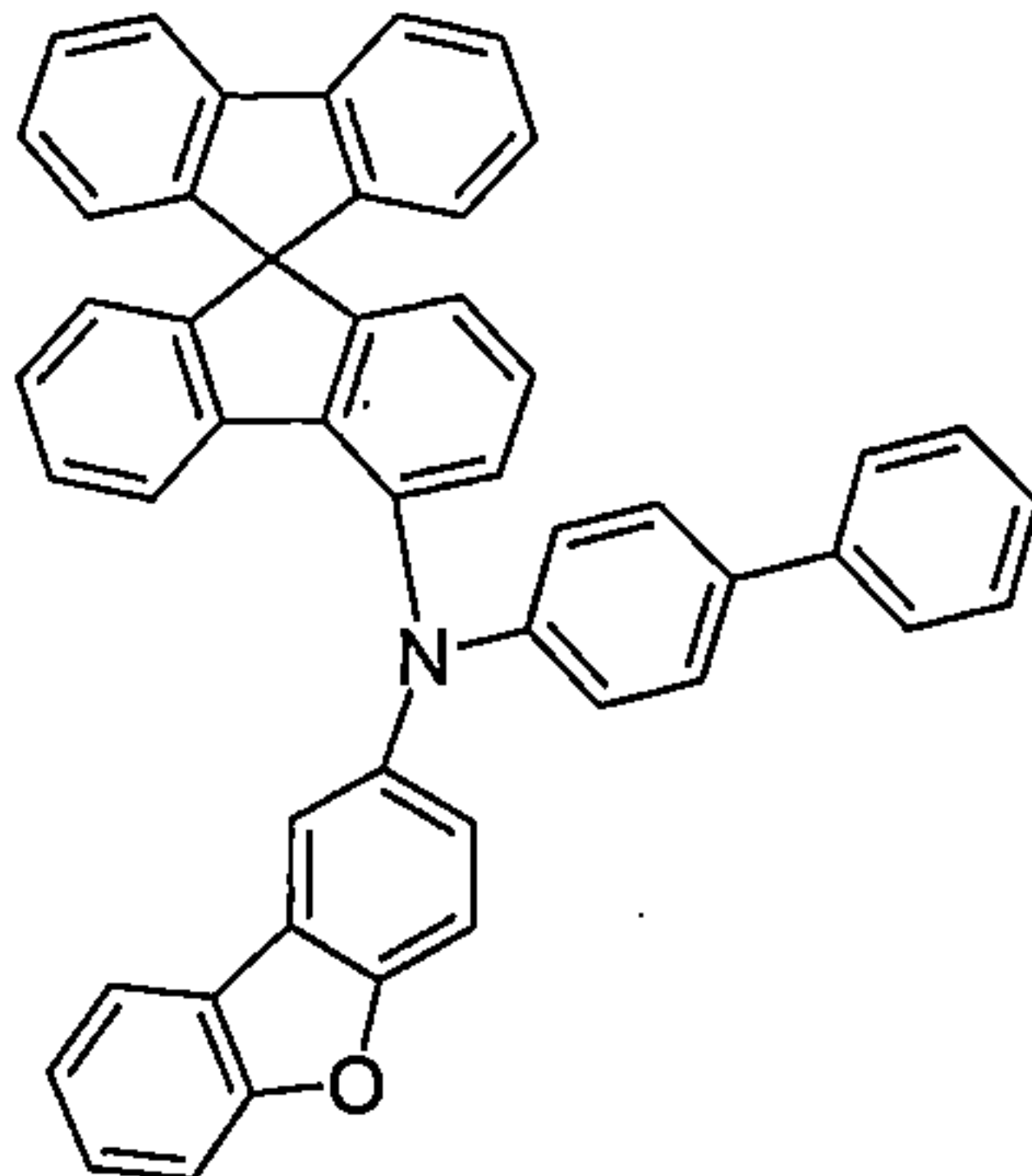
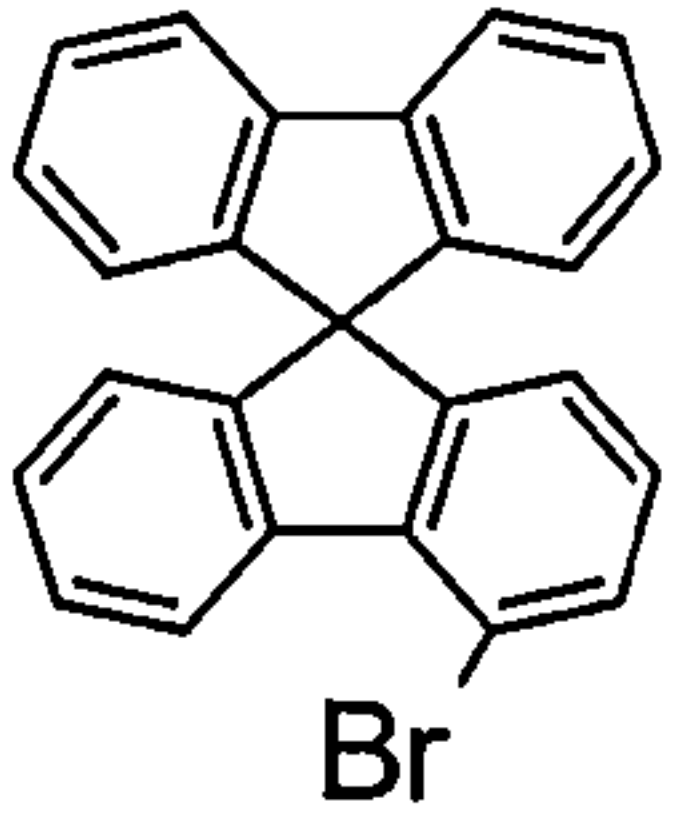
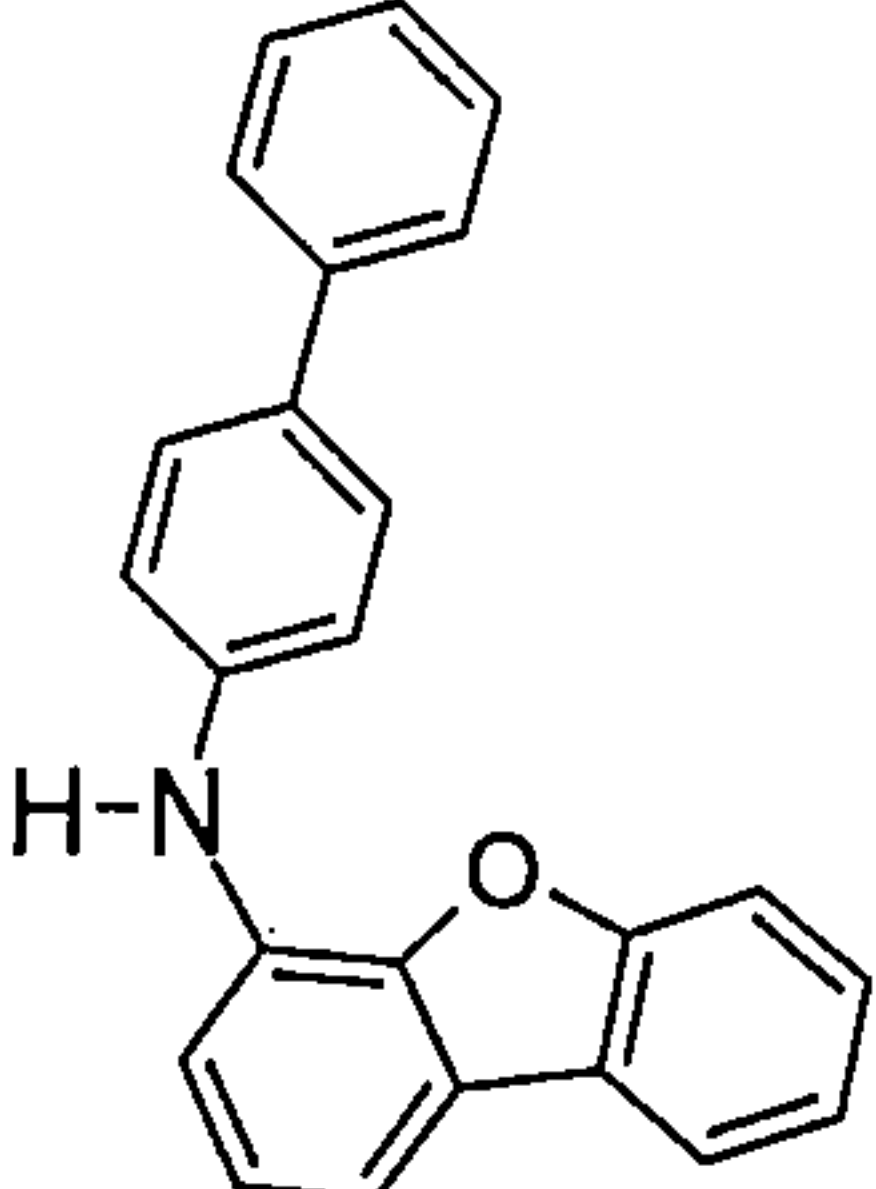
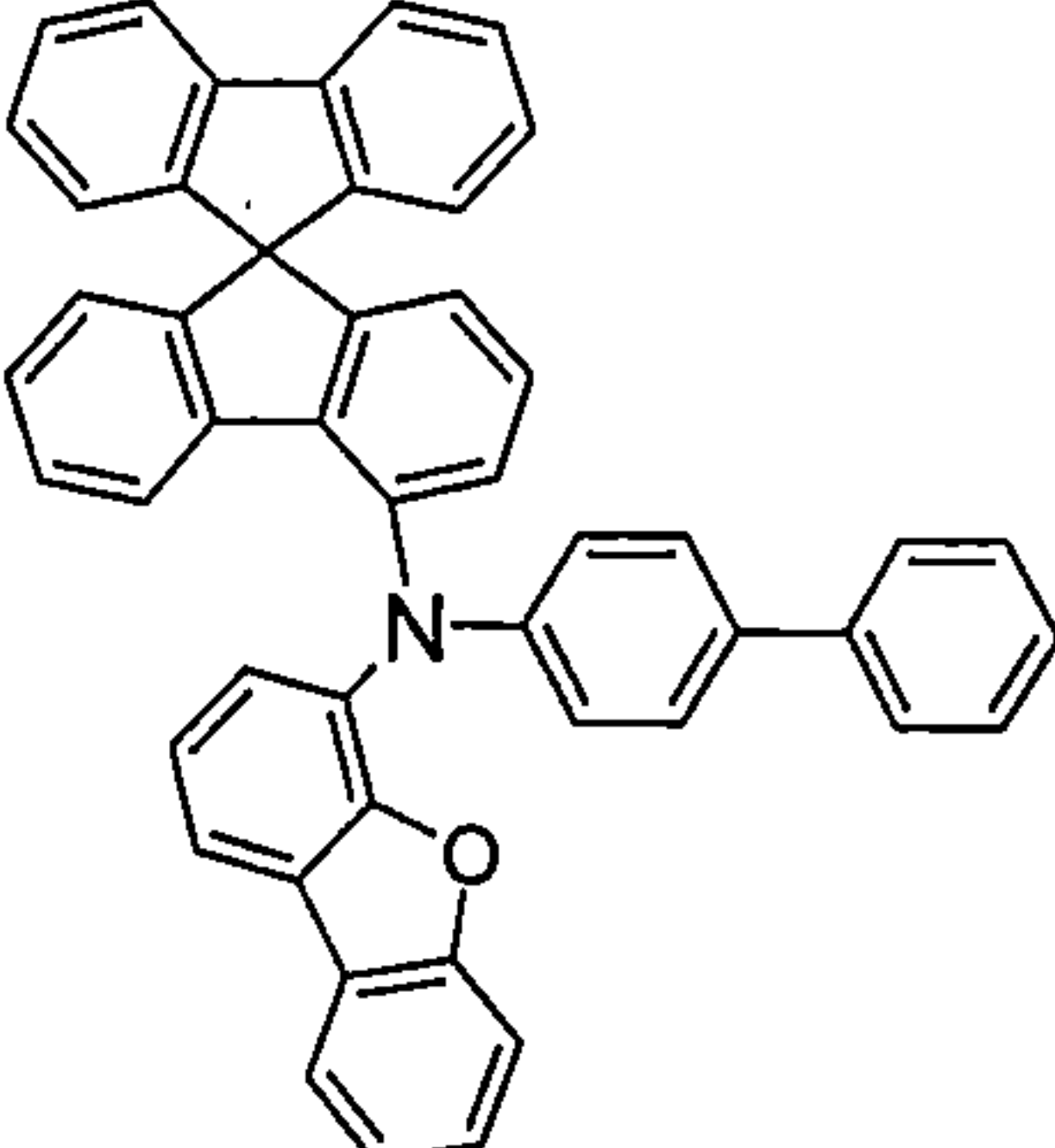
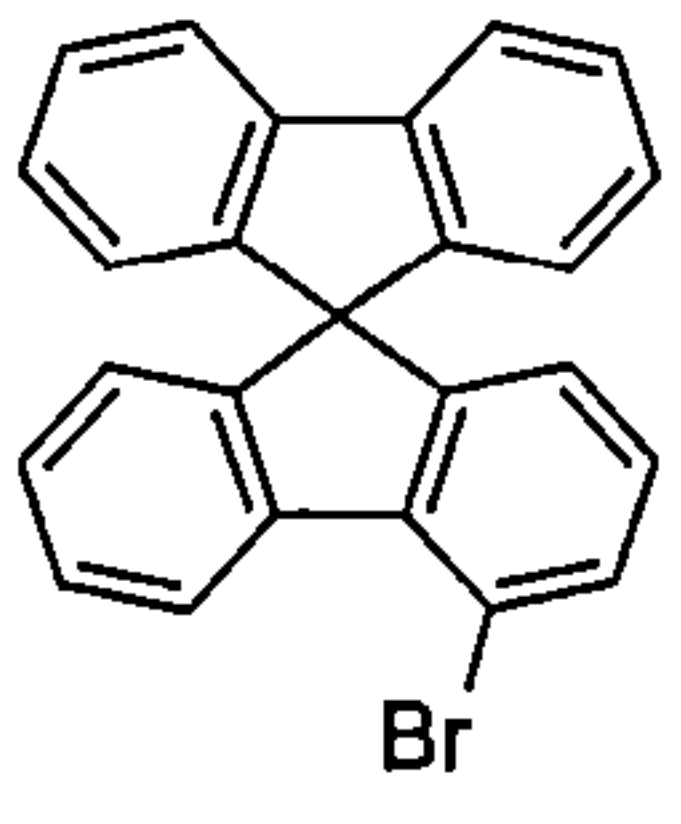
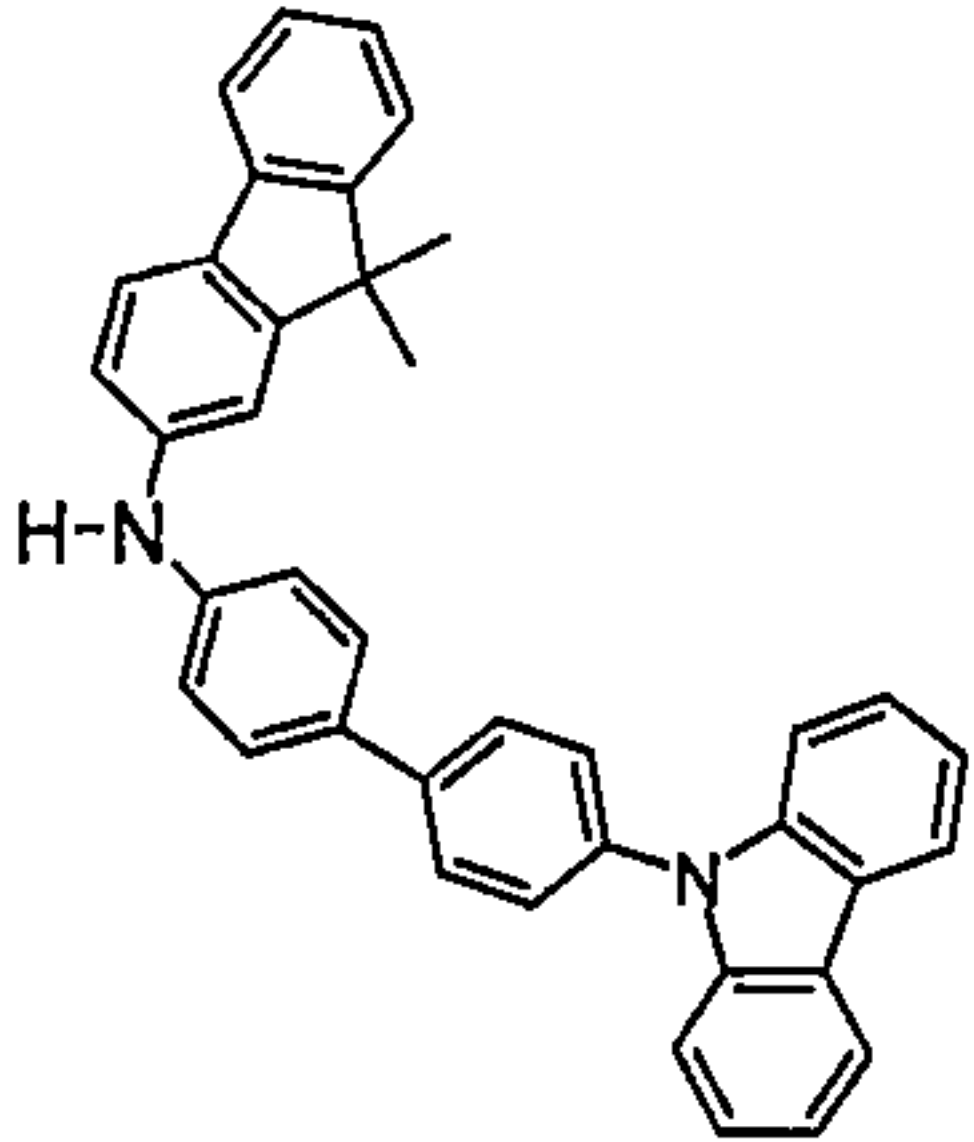
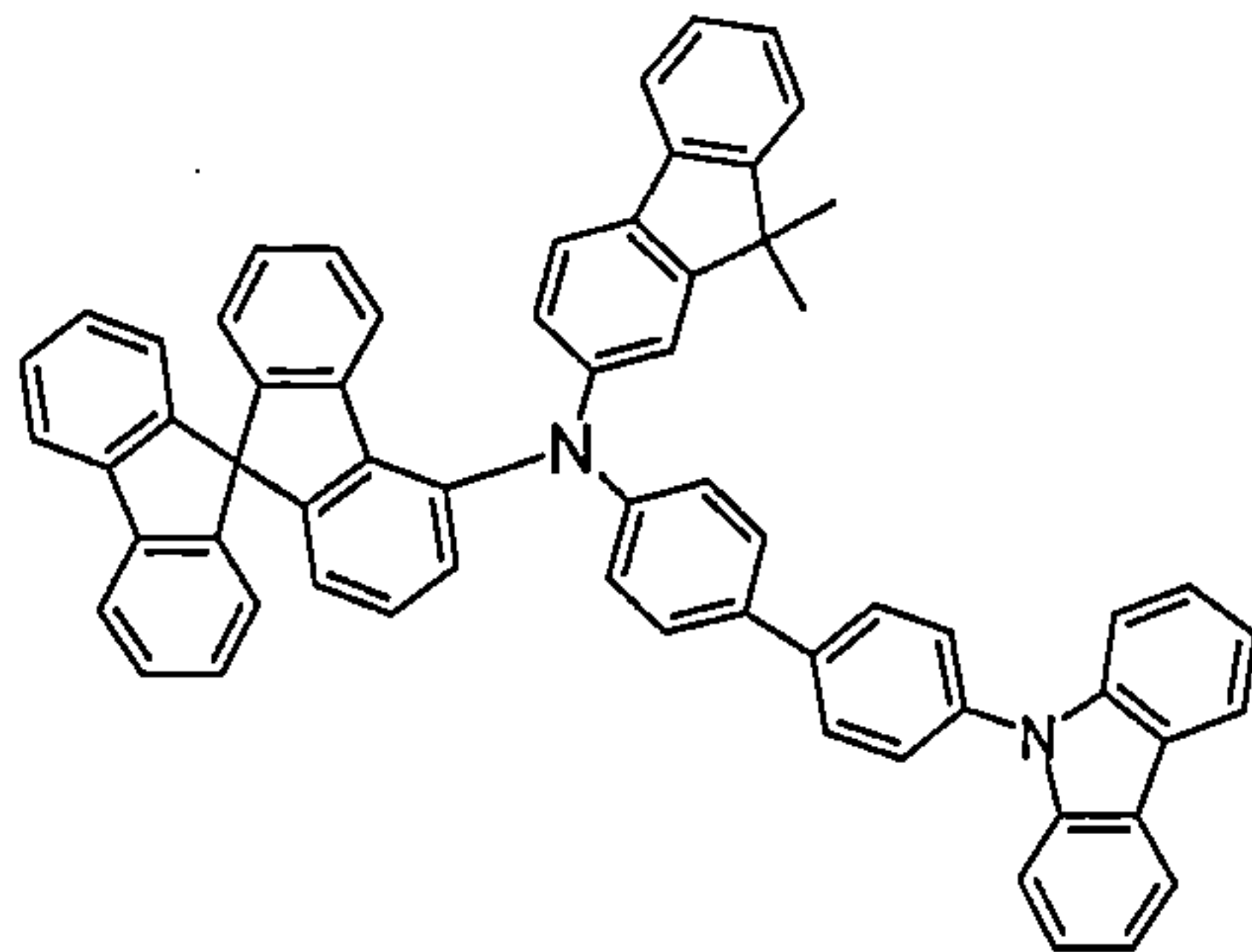
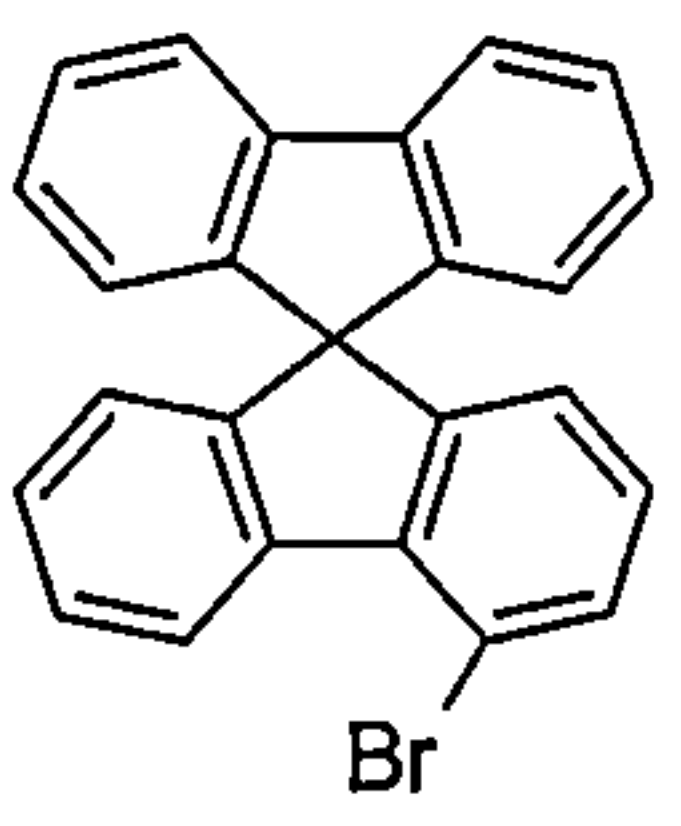
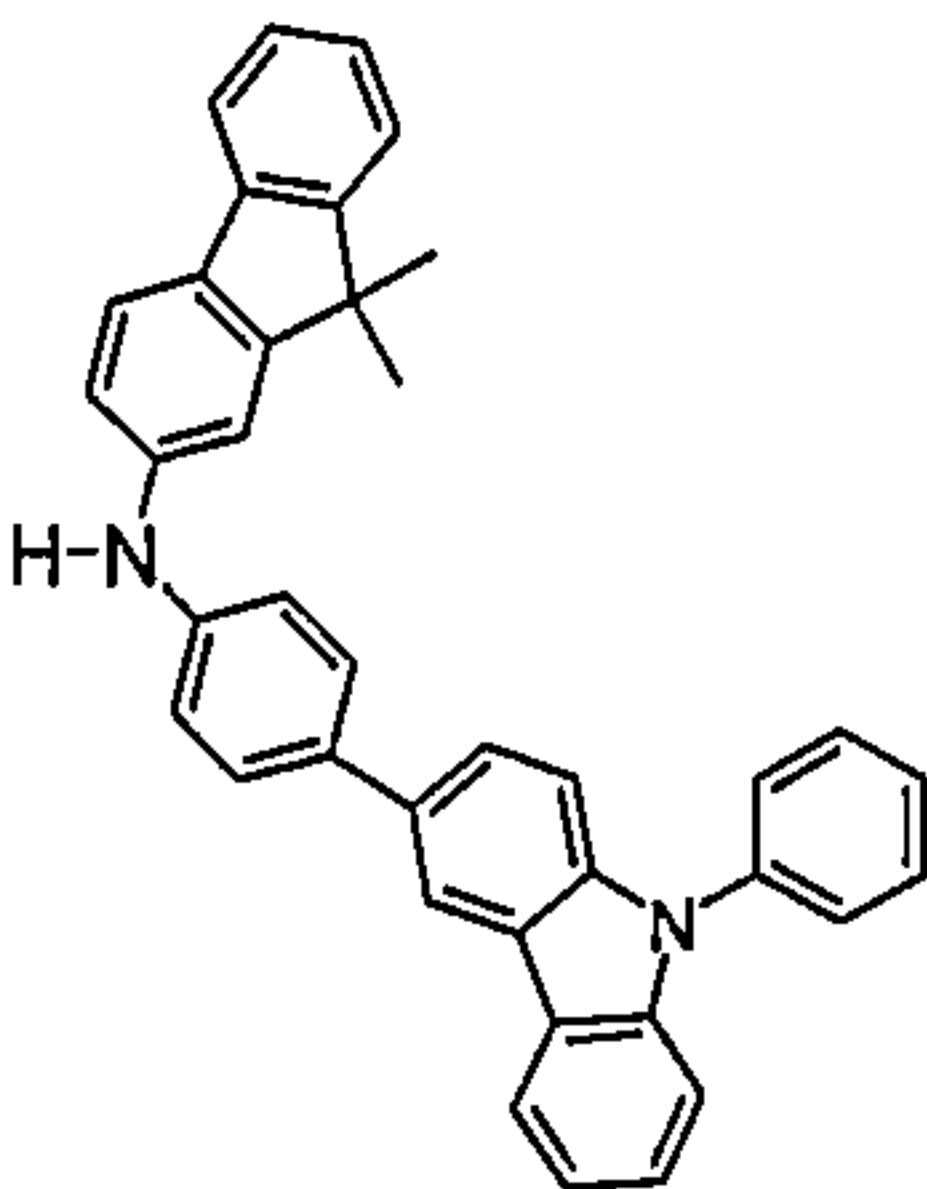
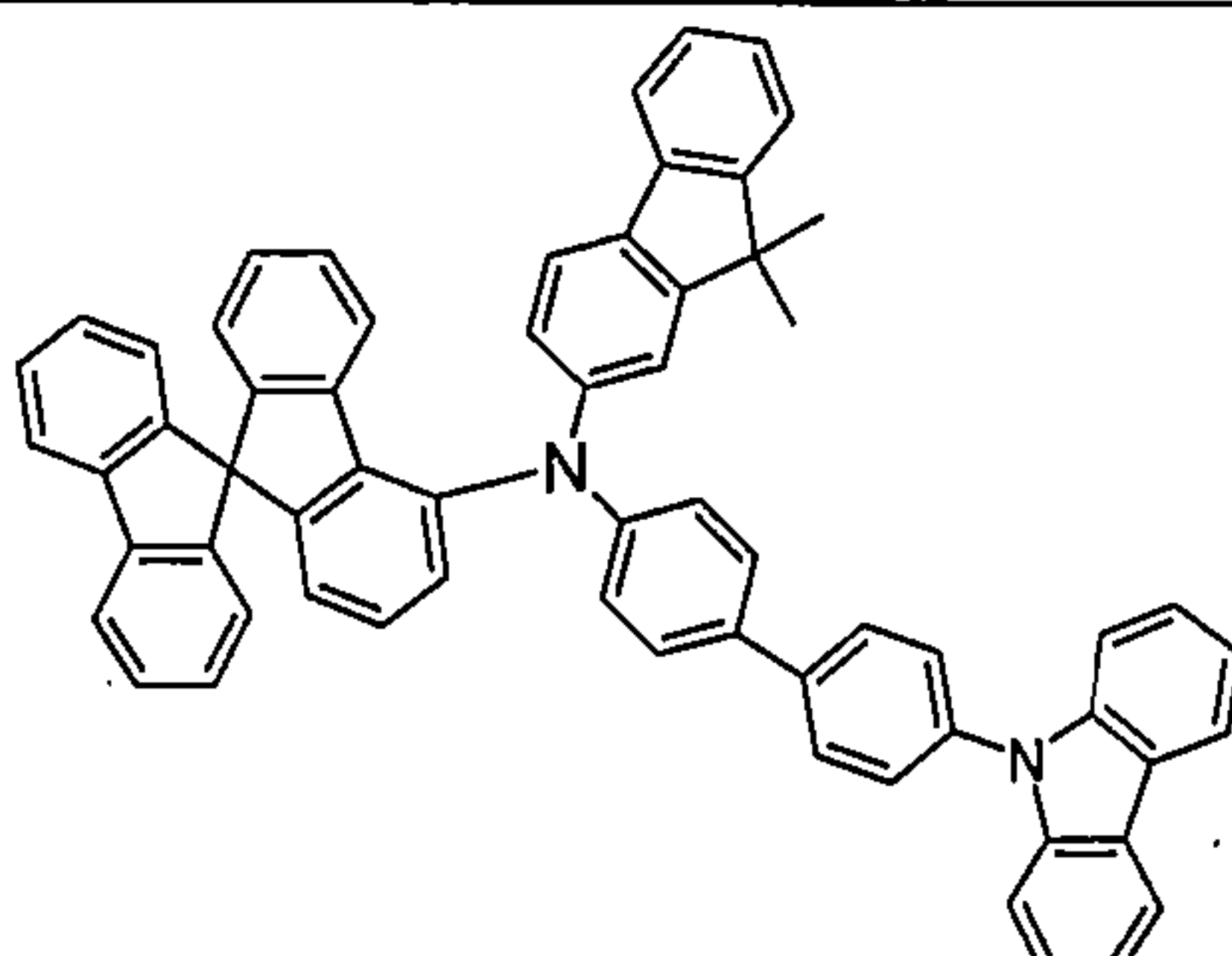
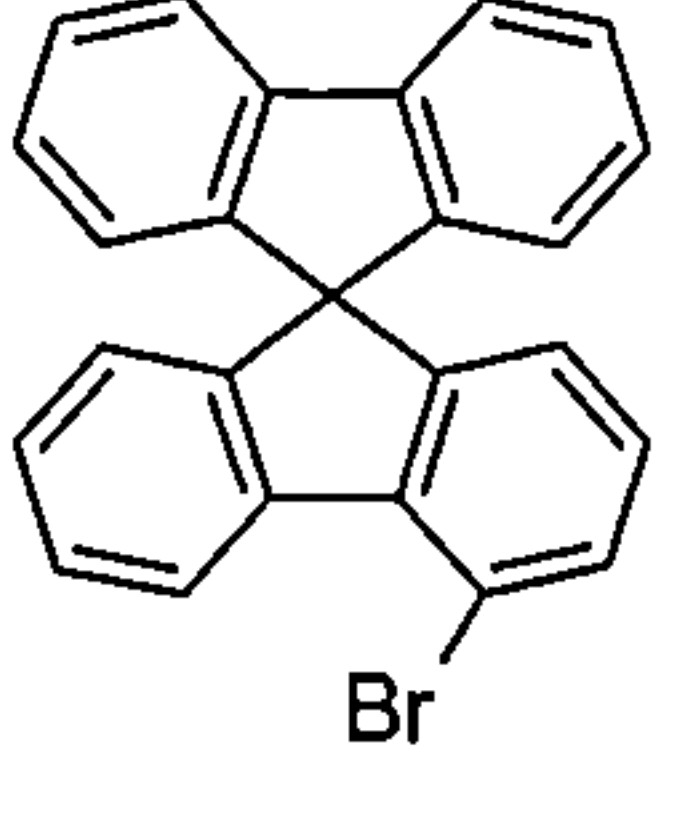
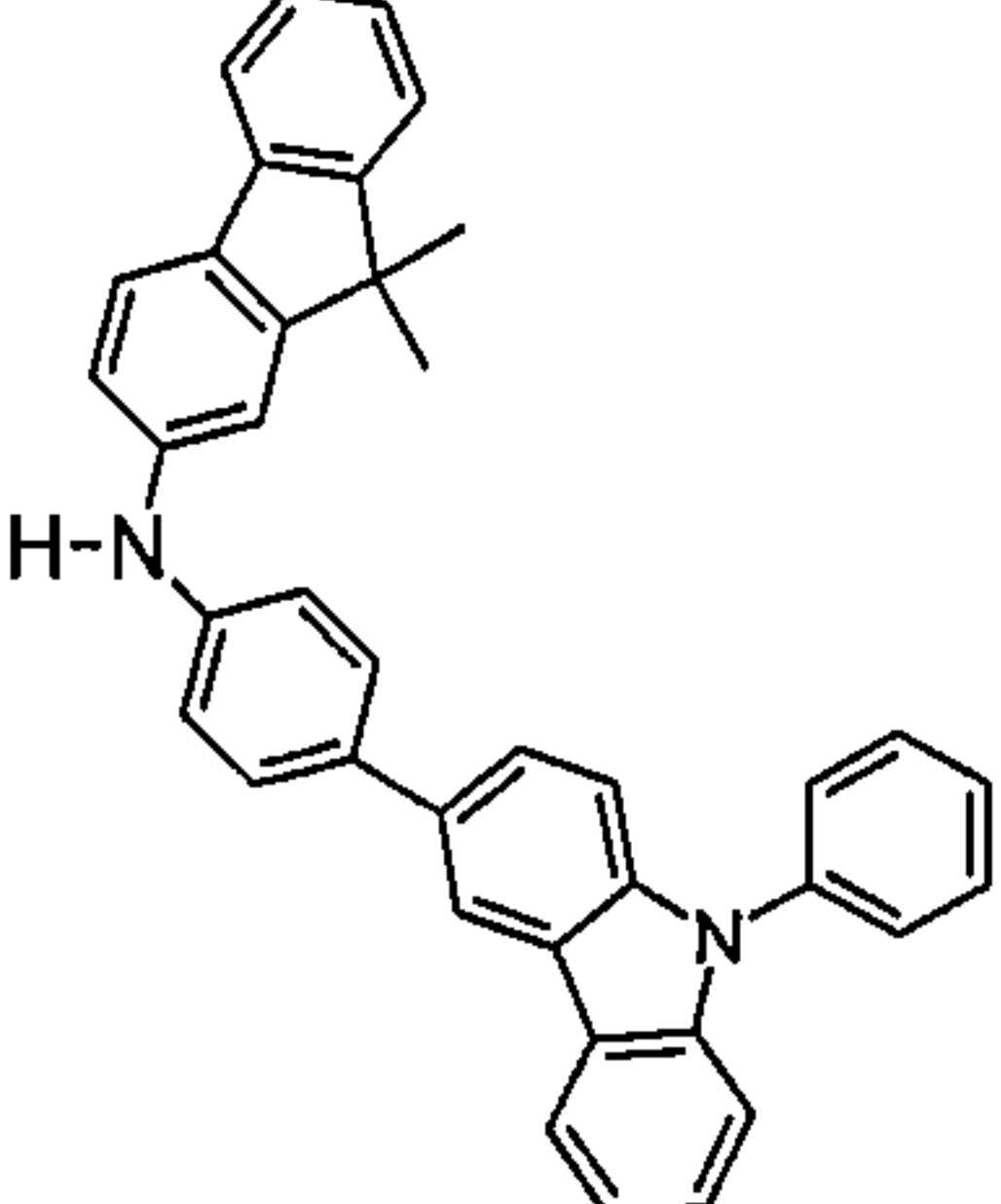
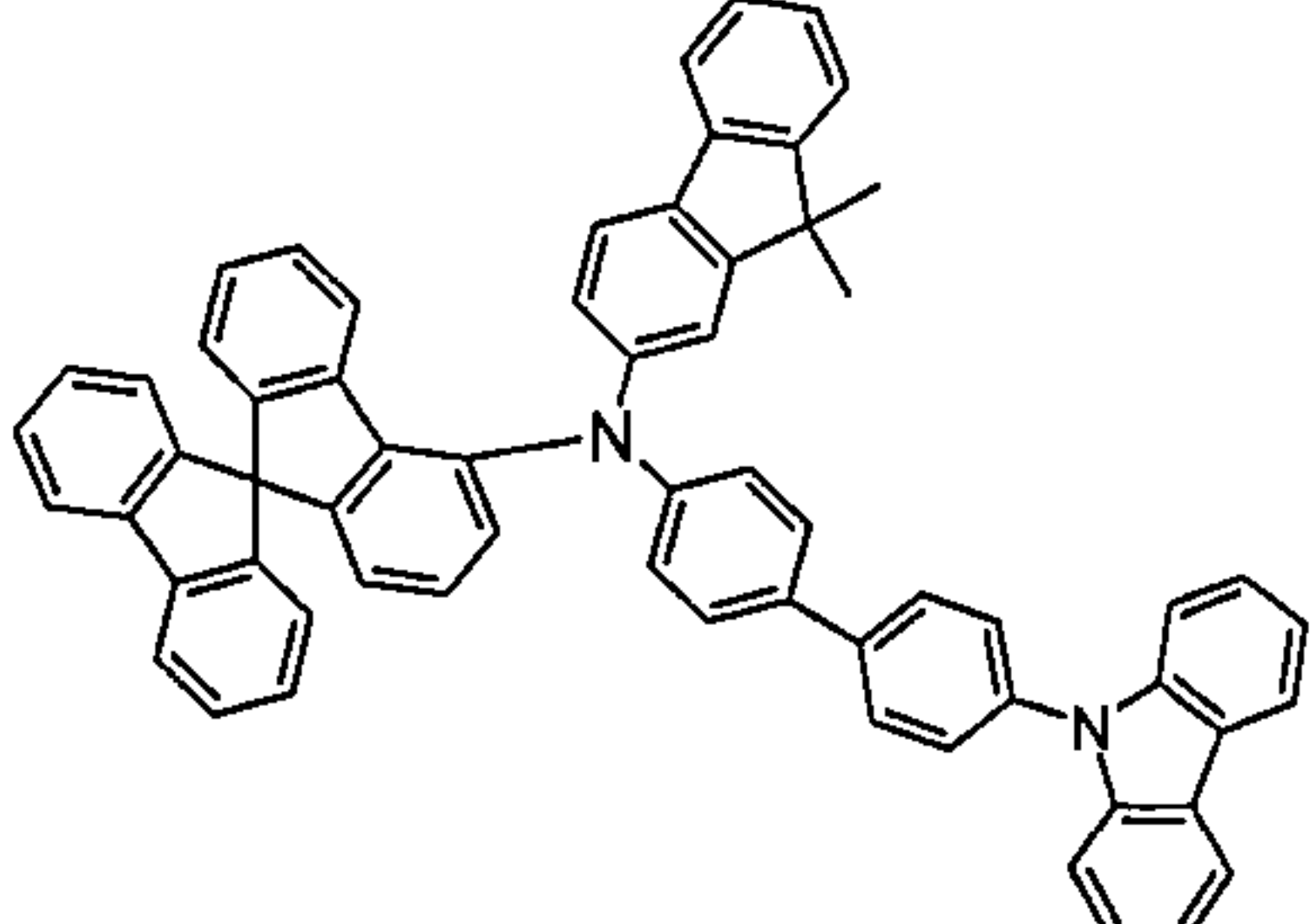
實例	Br-螺環	胺	產物	產率
3b		 [102113-98-4]		43%
3c		 [1198395-24-2]		56%
3d		 [500717-23-7]		61%
3e		 [1290039-85-8]		72%

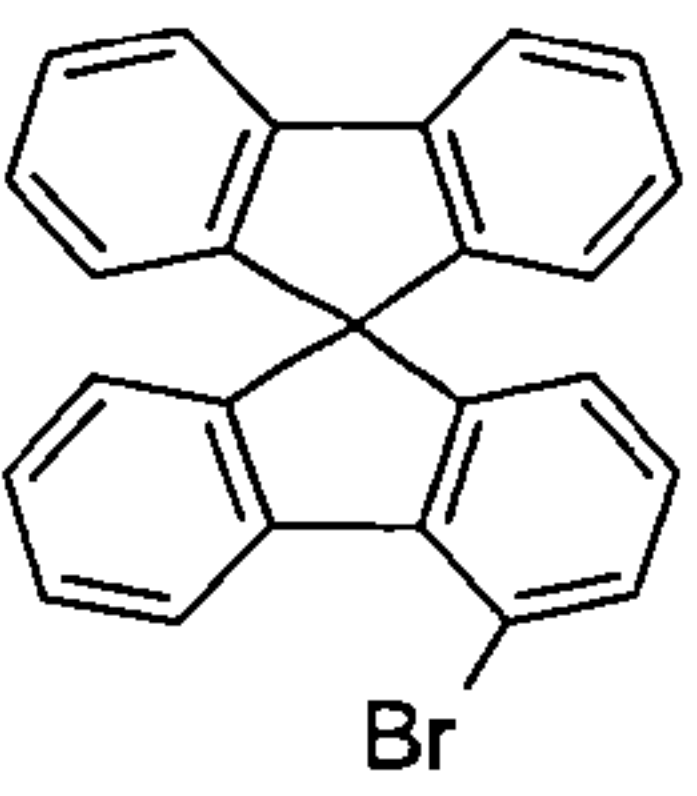
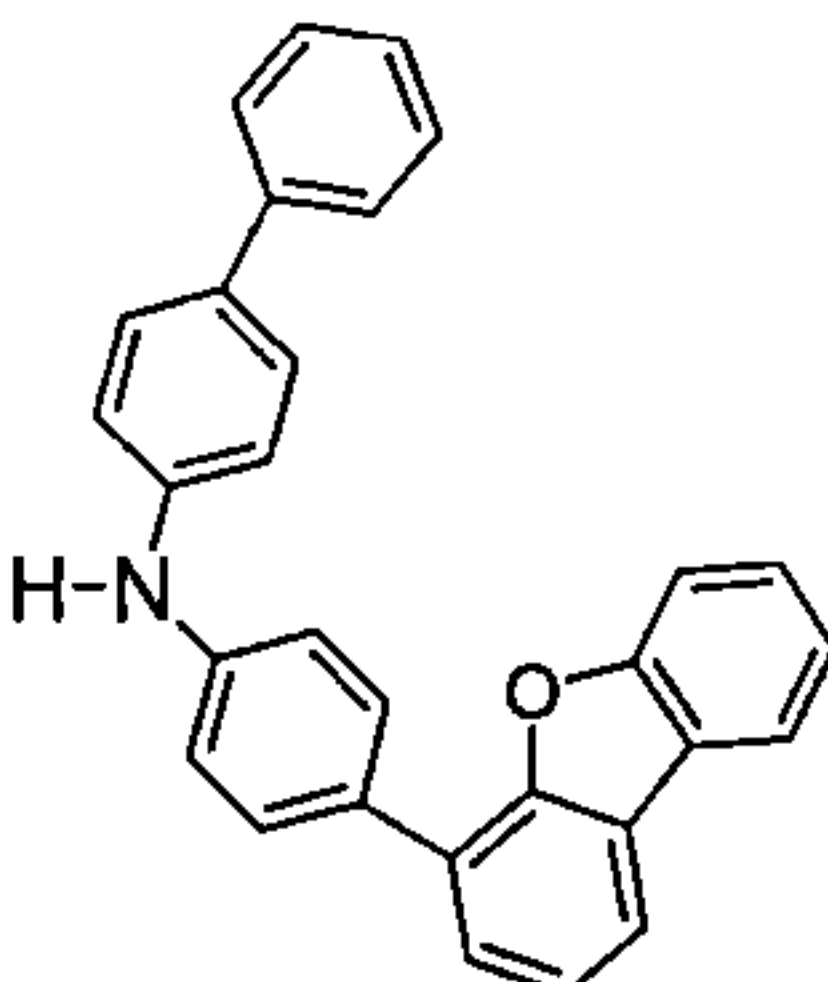
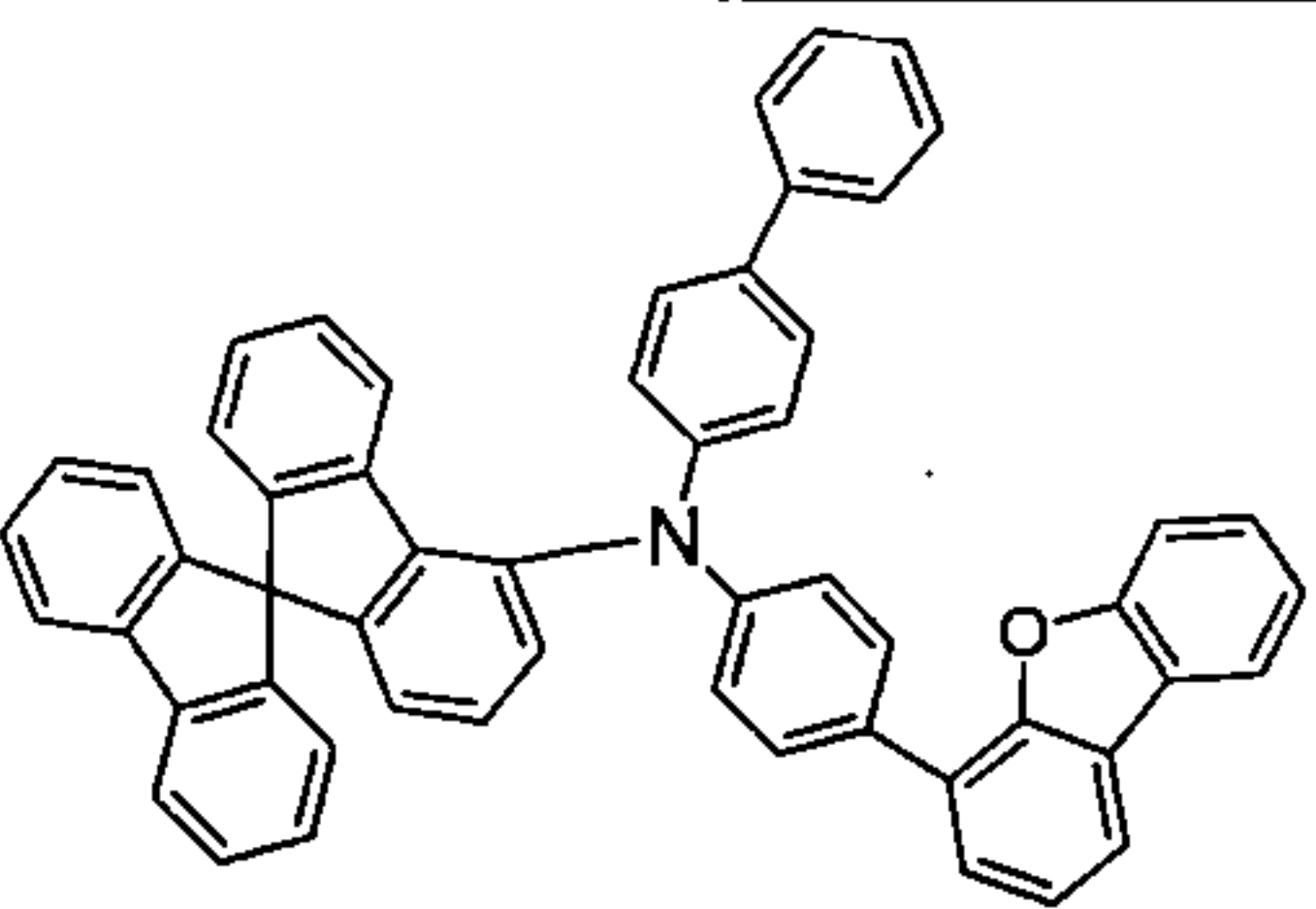
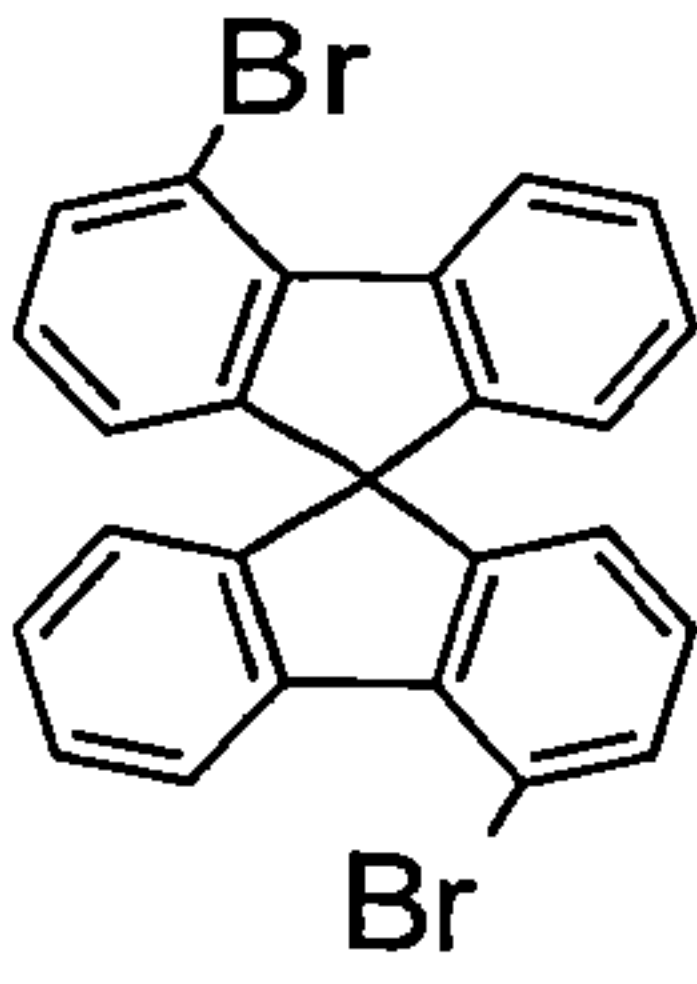
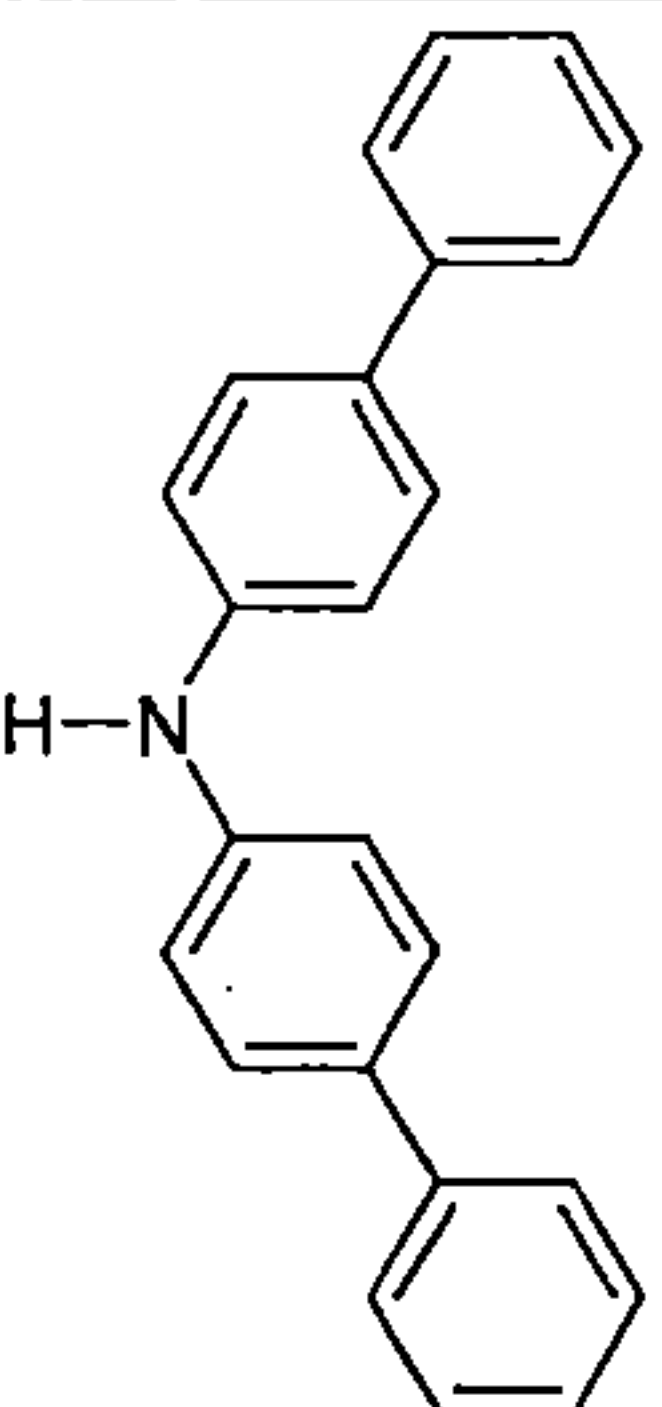
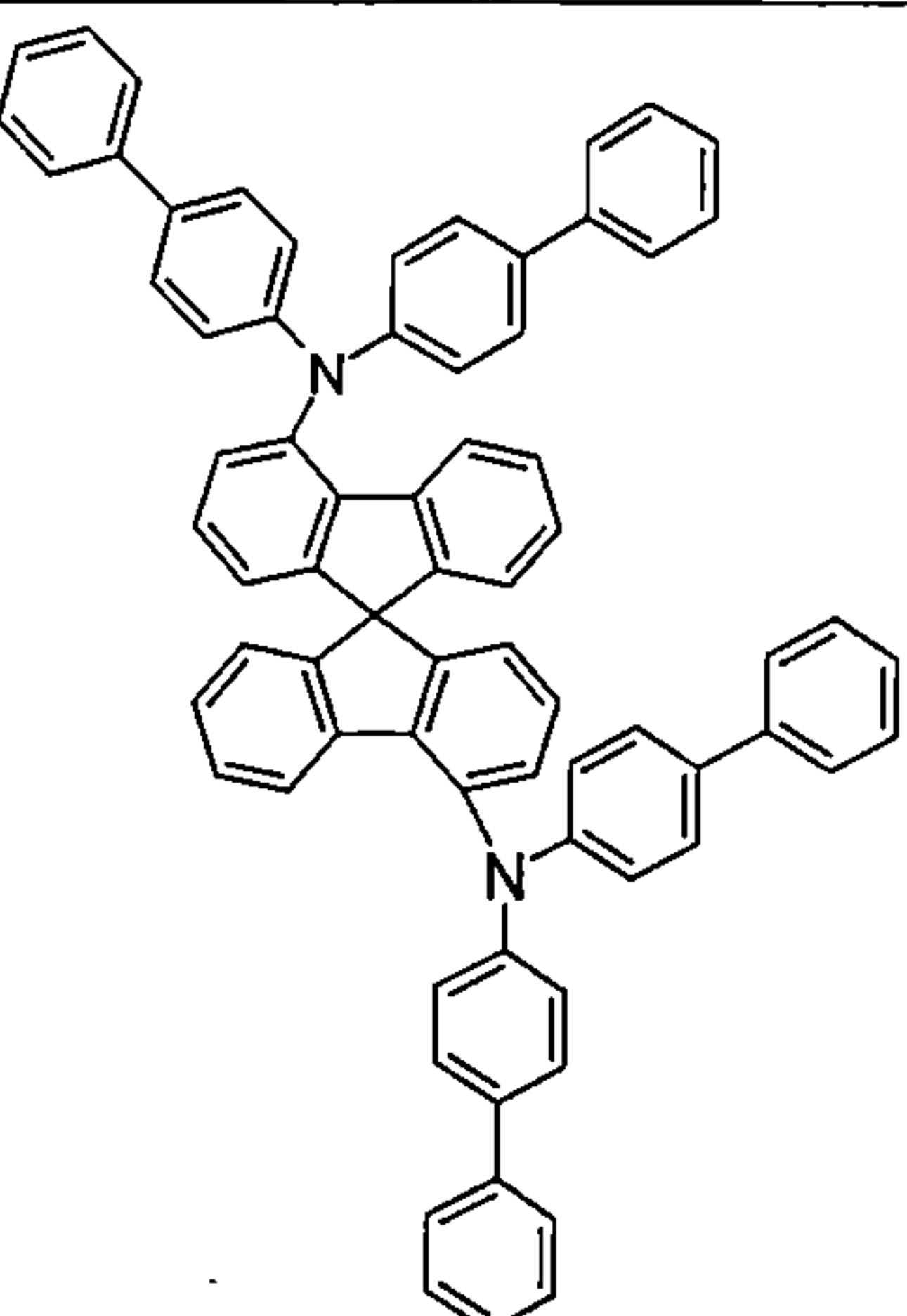
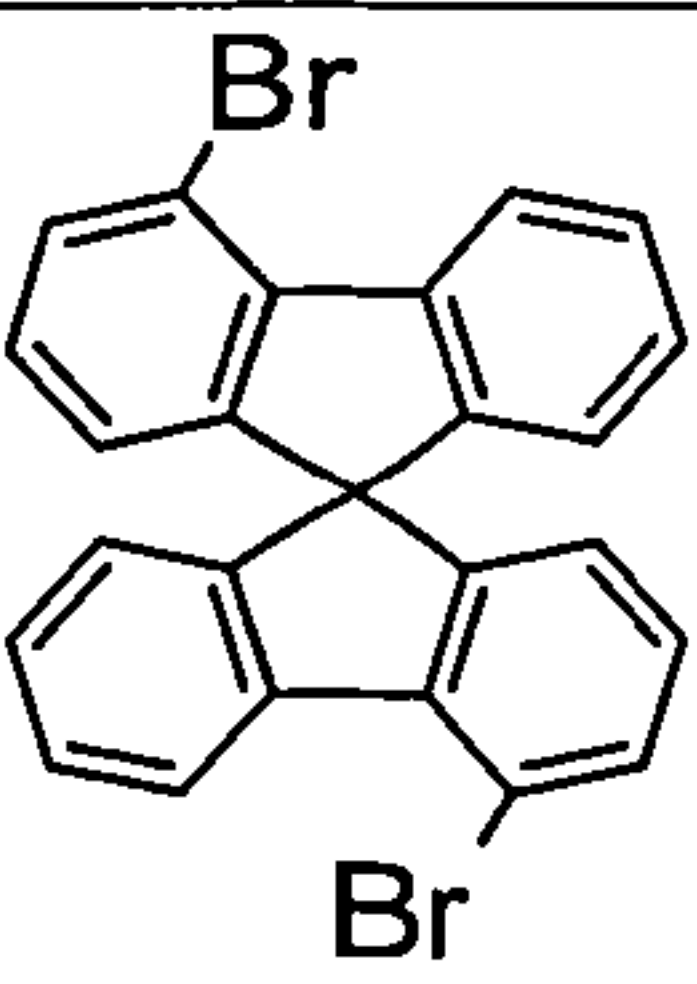
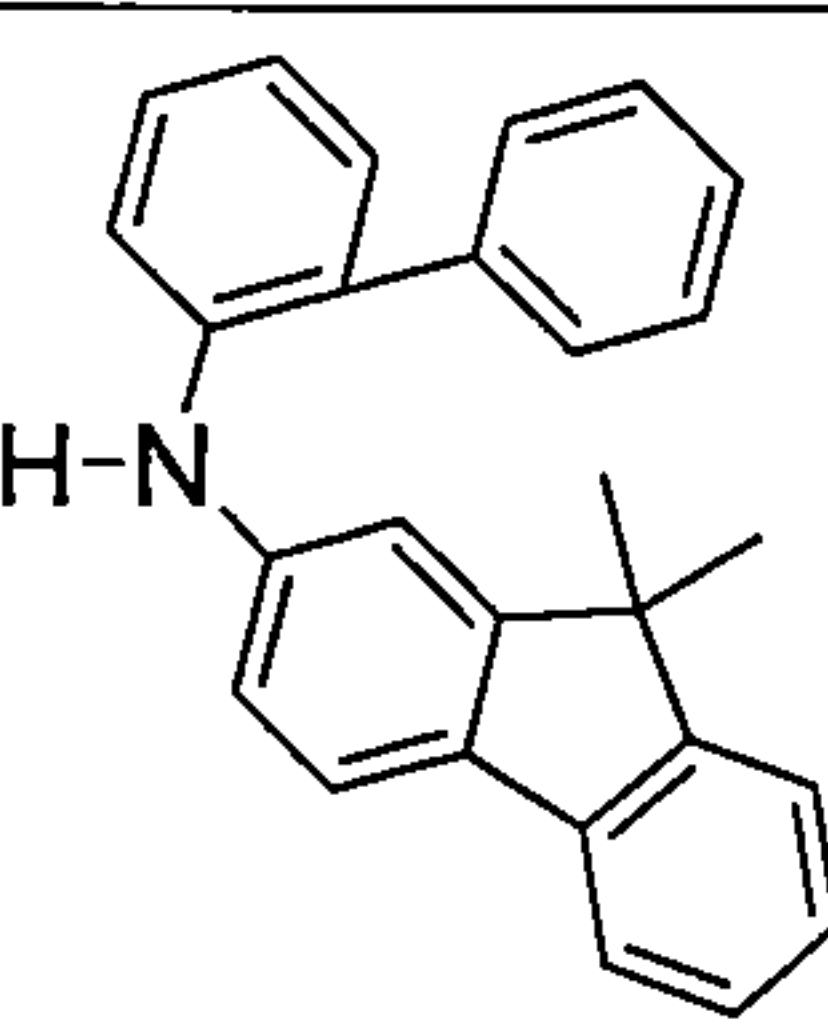
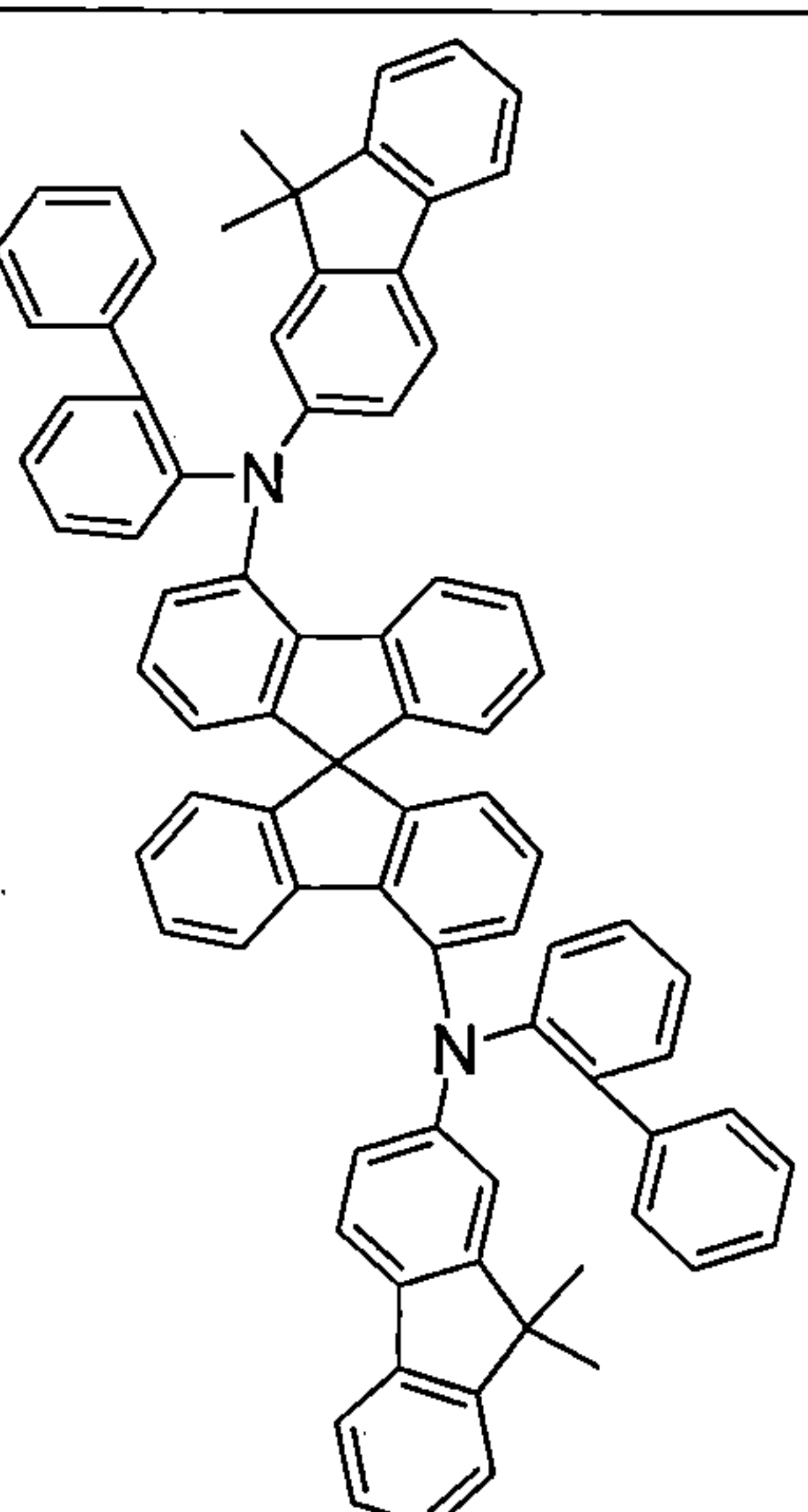
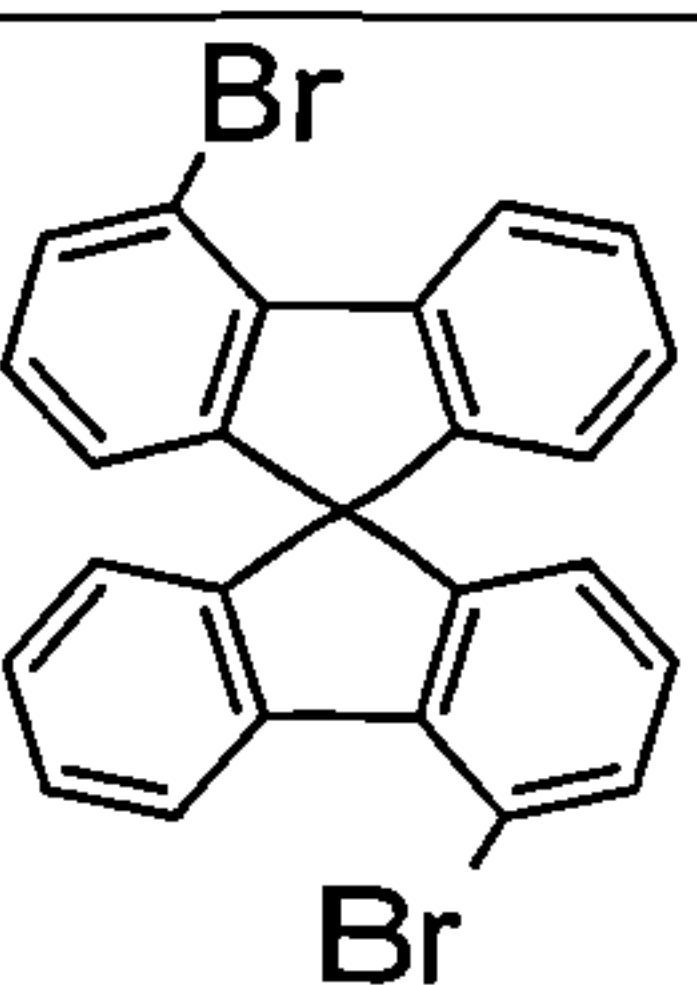
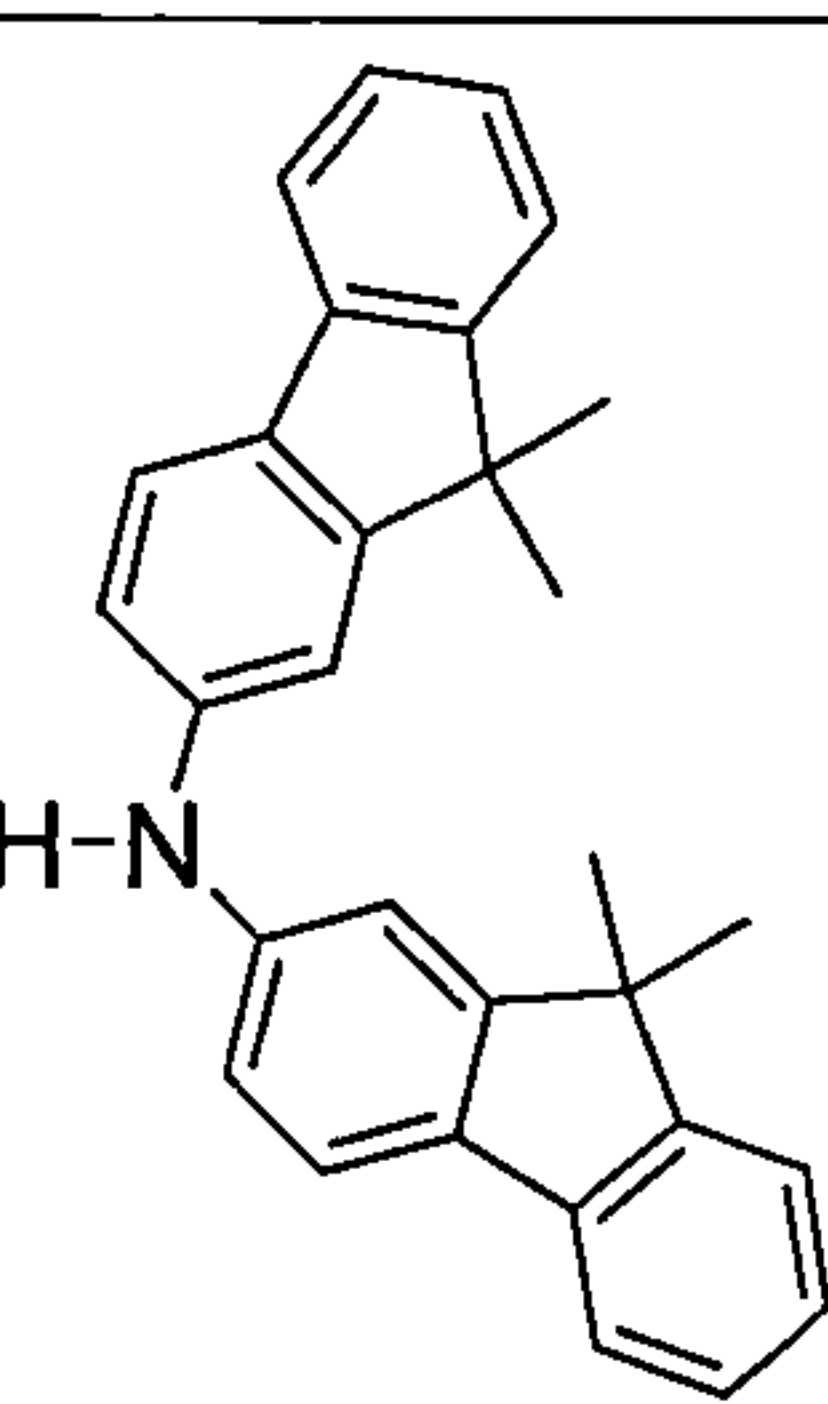
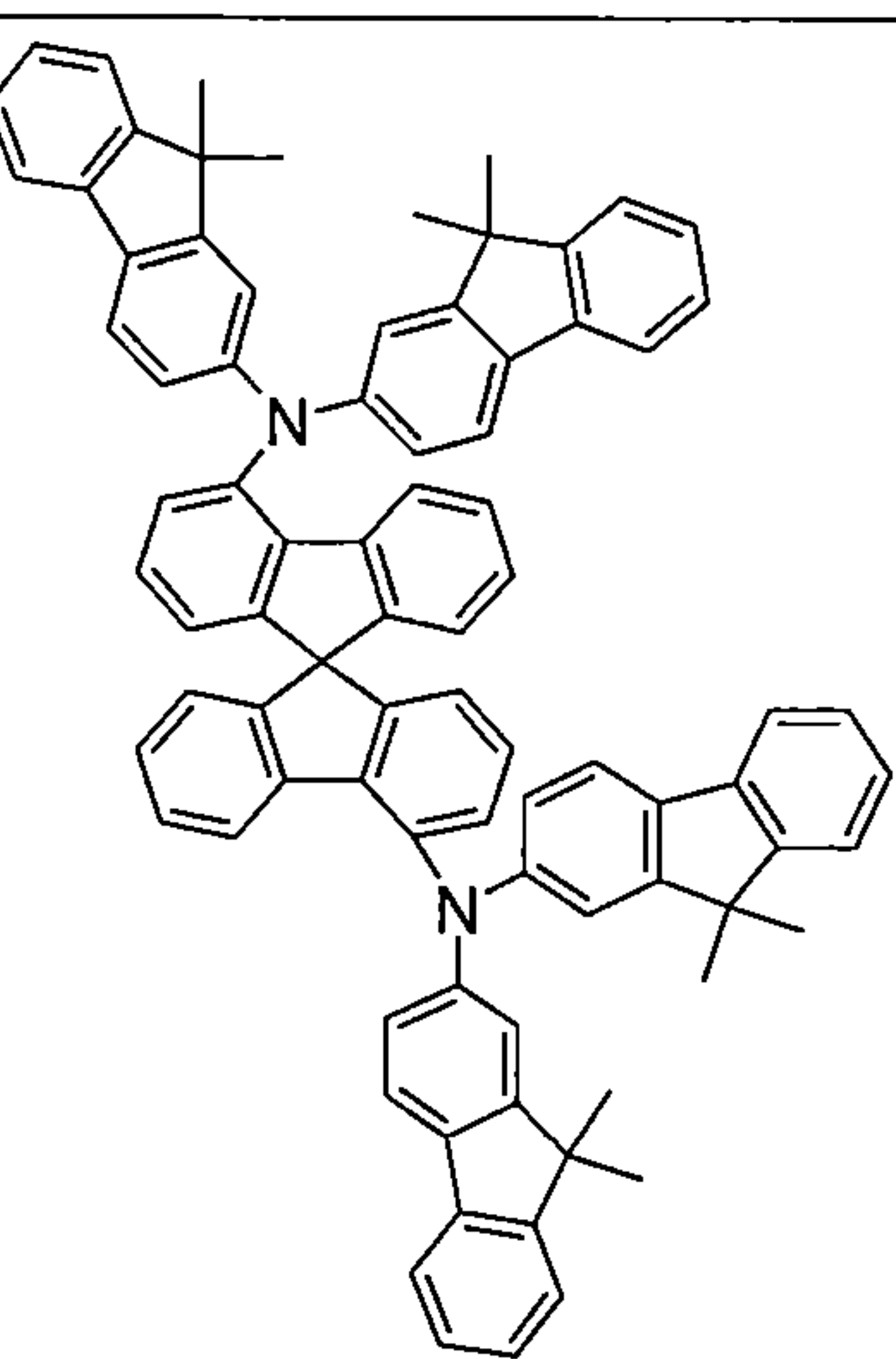
3f		 [1267248-54-3]		65%
3g		 [1354653-33-0]		75%
3h		 [1160294-96-1]		80%
3i		 [955959-89-4]		85%
3j		 [1300028-94-7]		55%

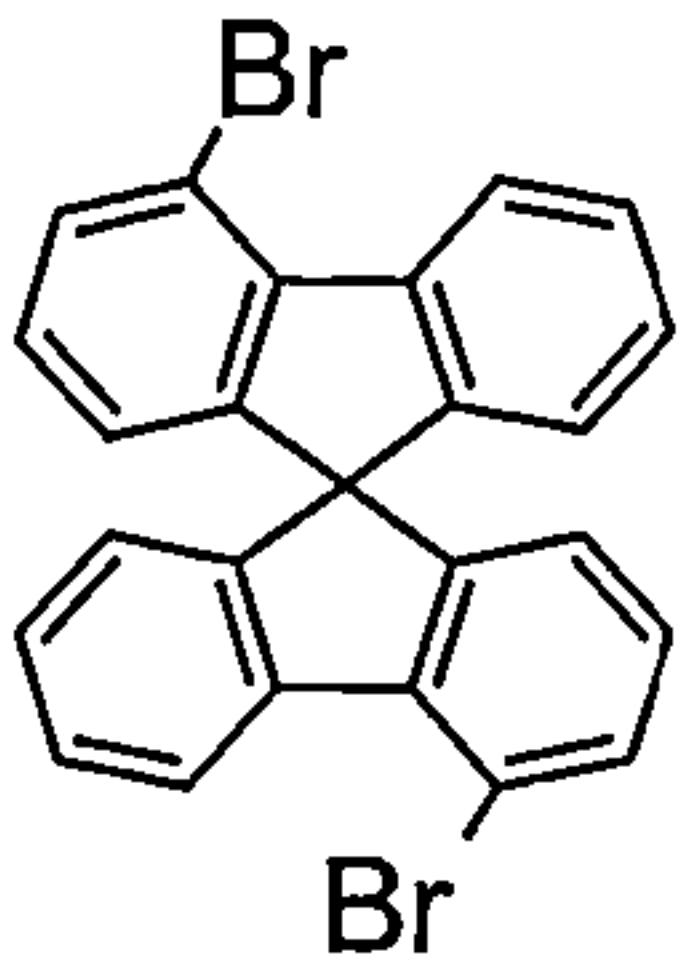
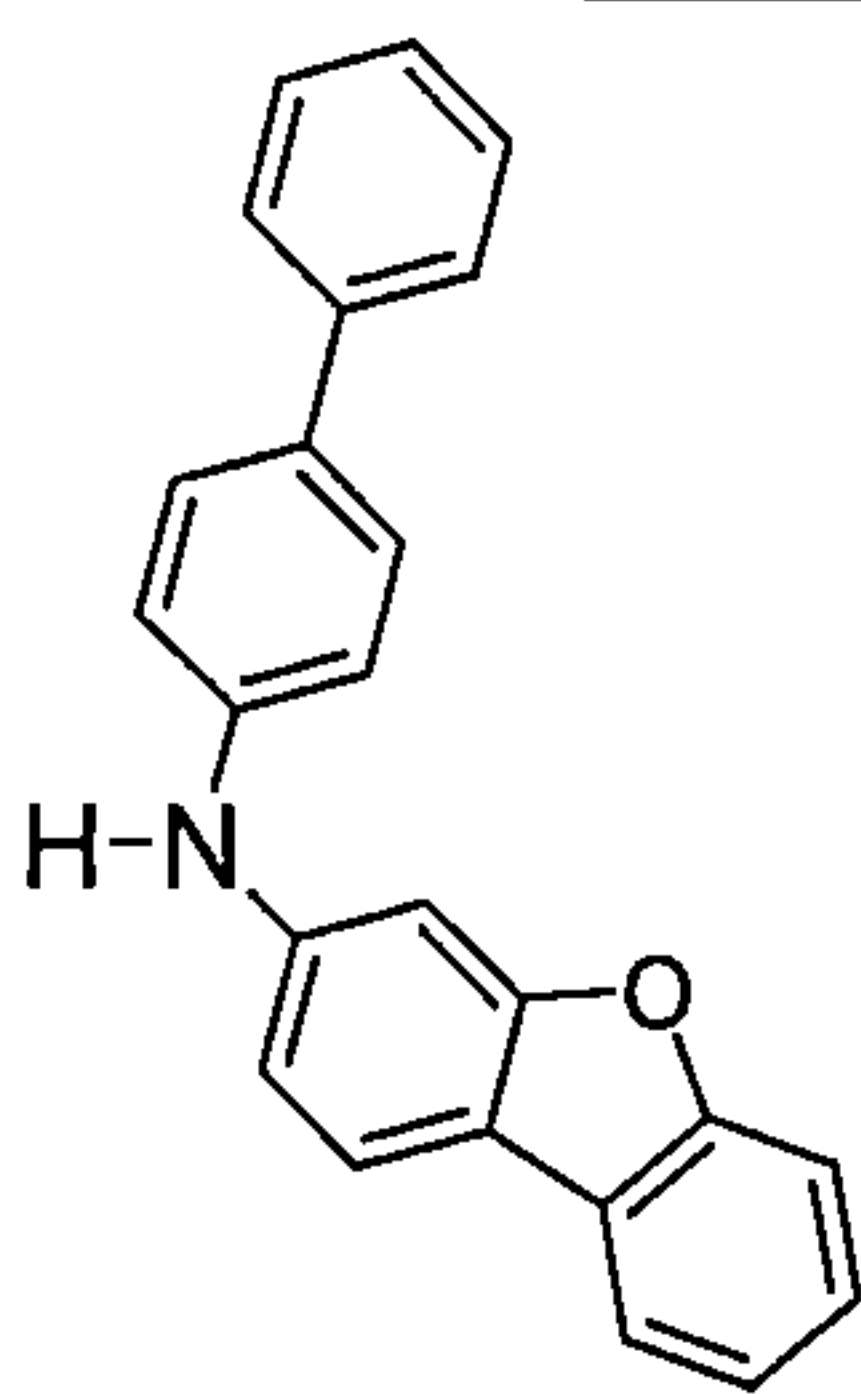
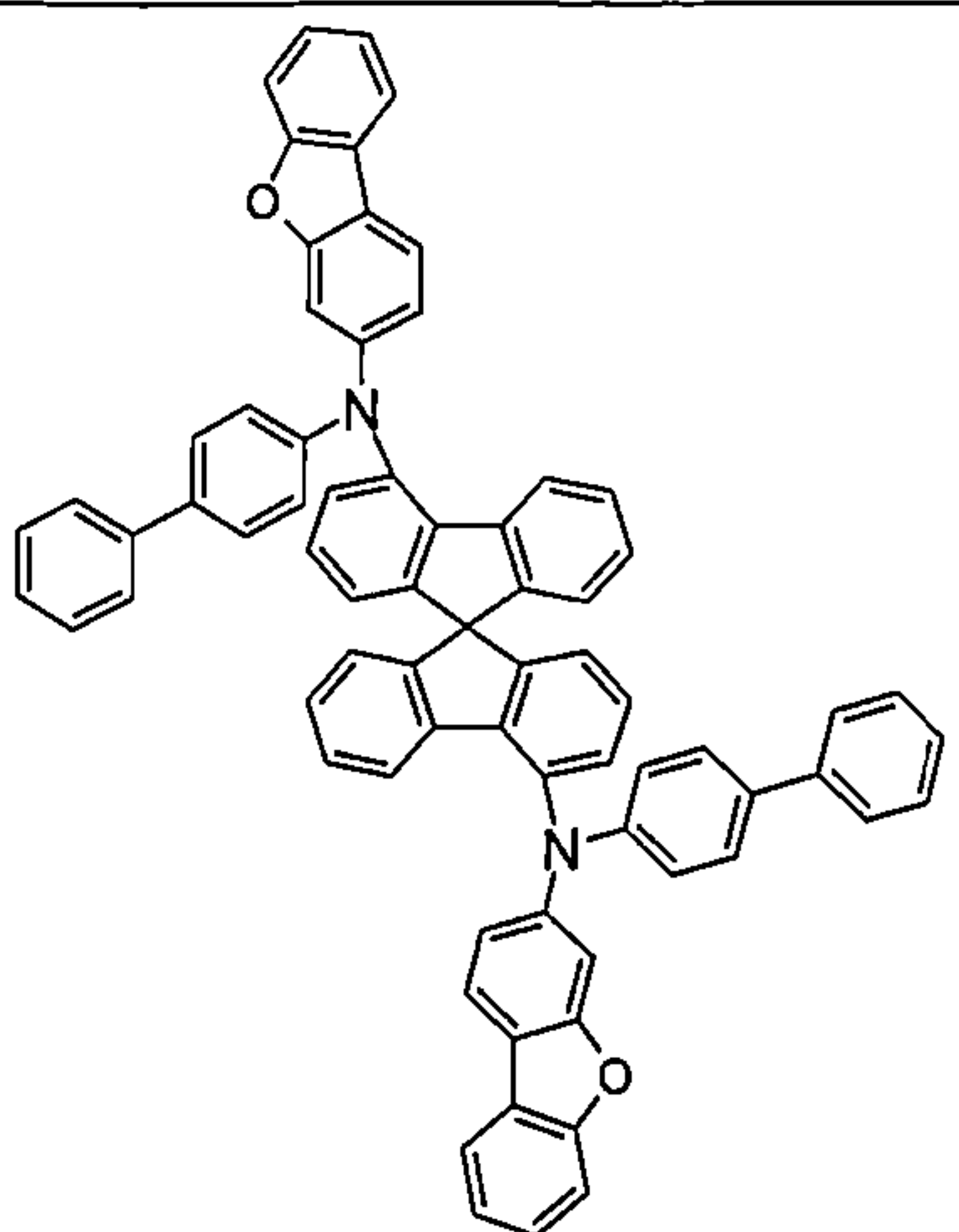
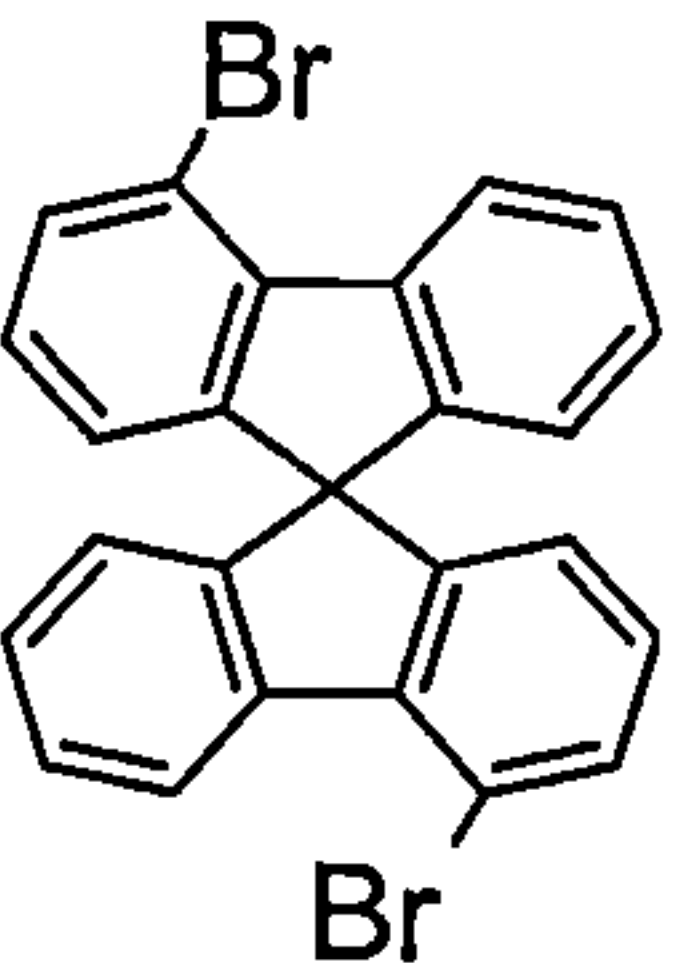
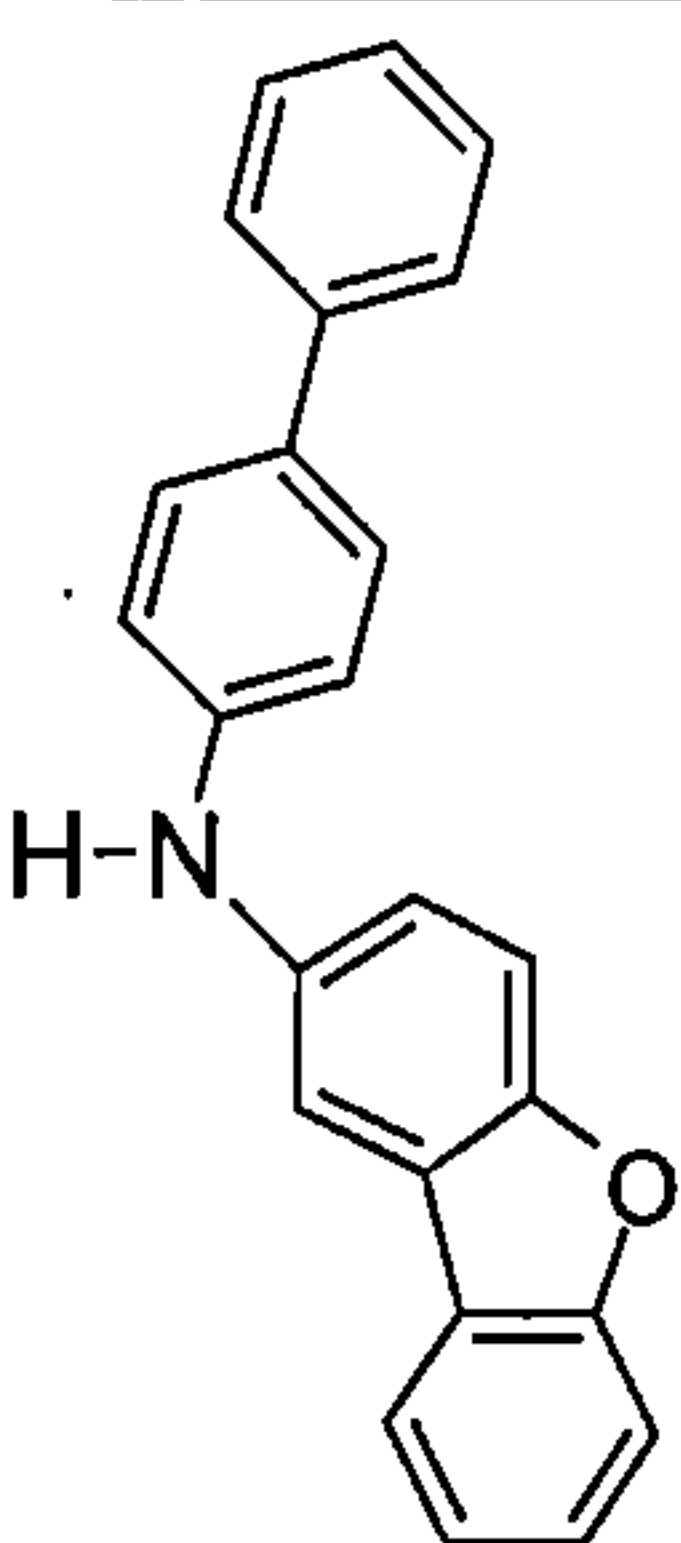
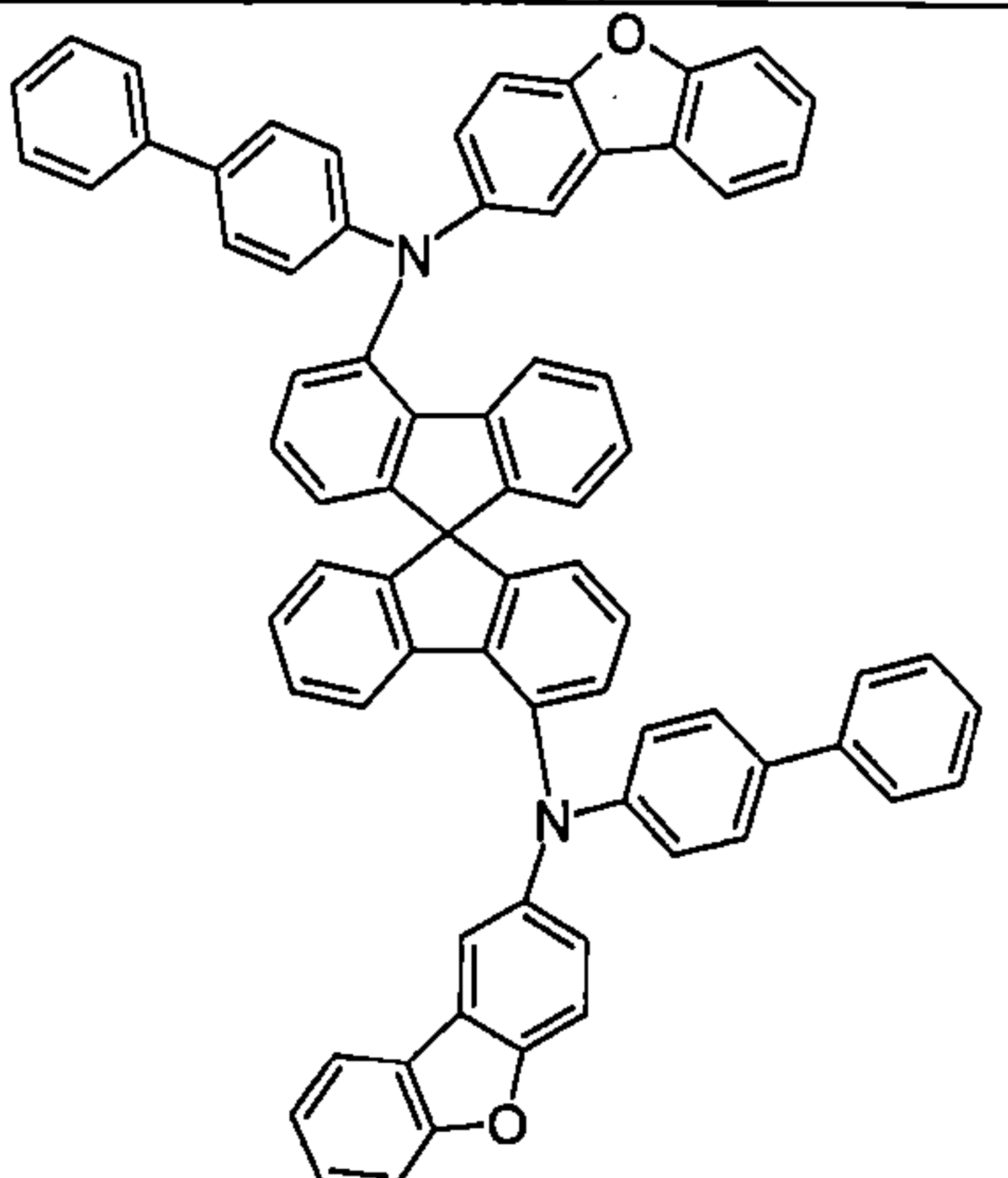
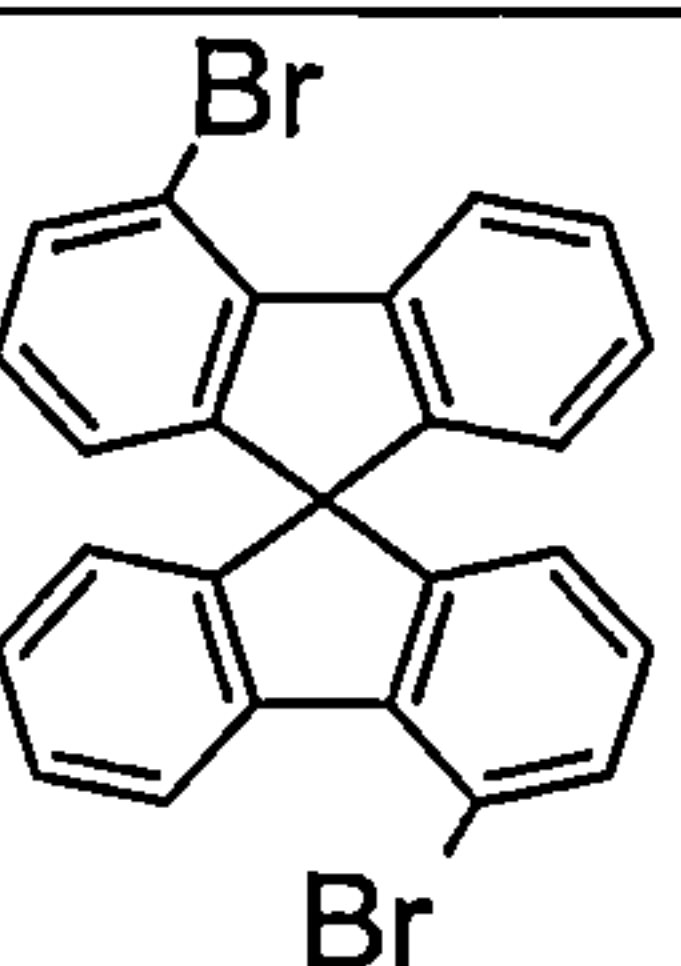
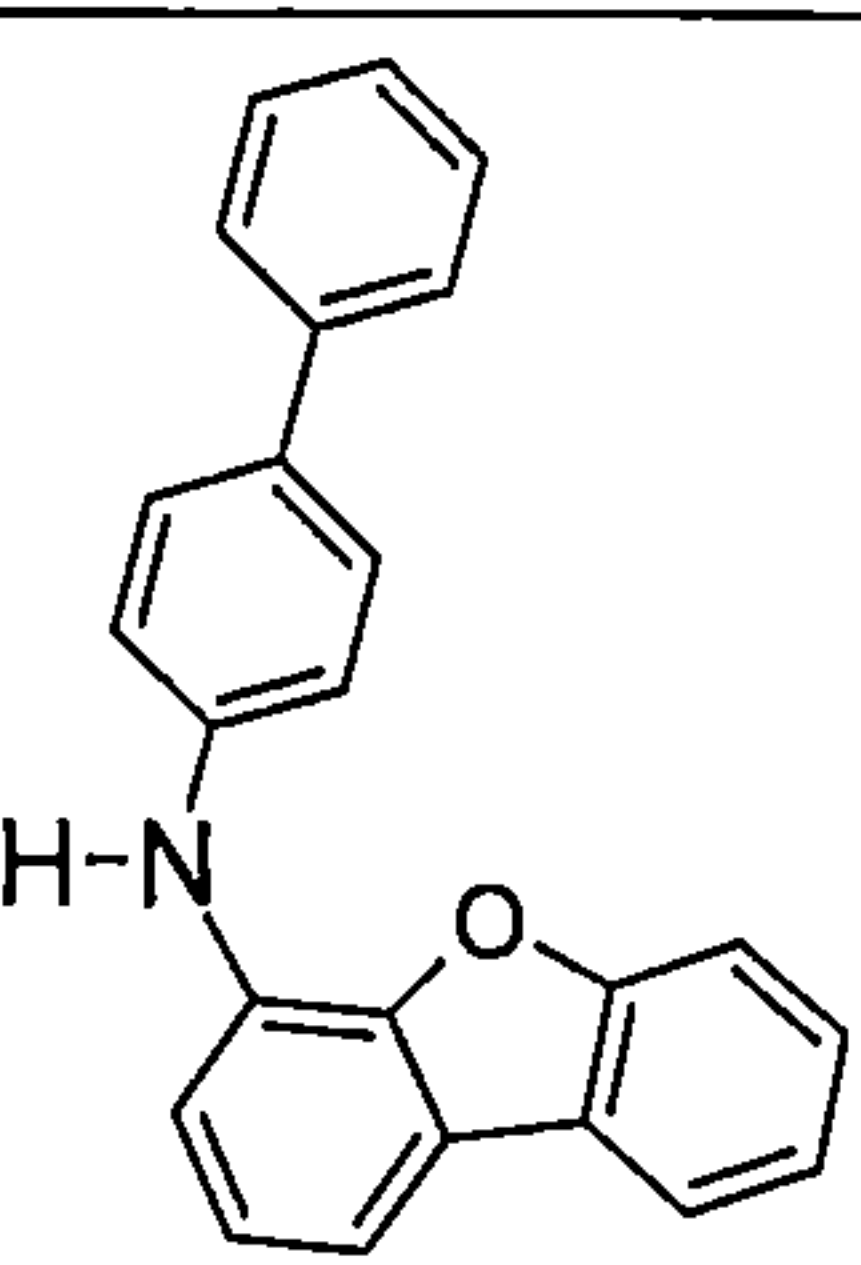
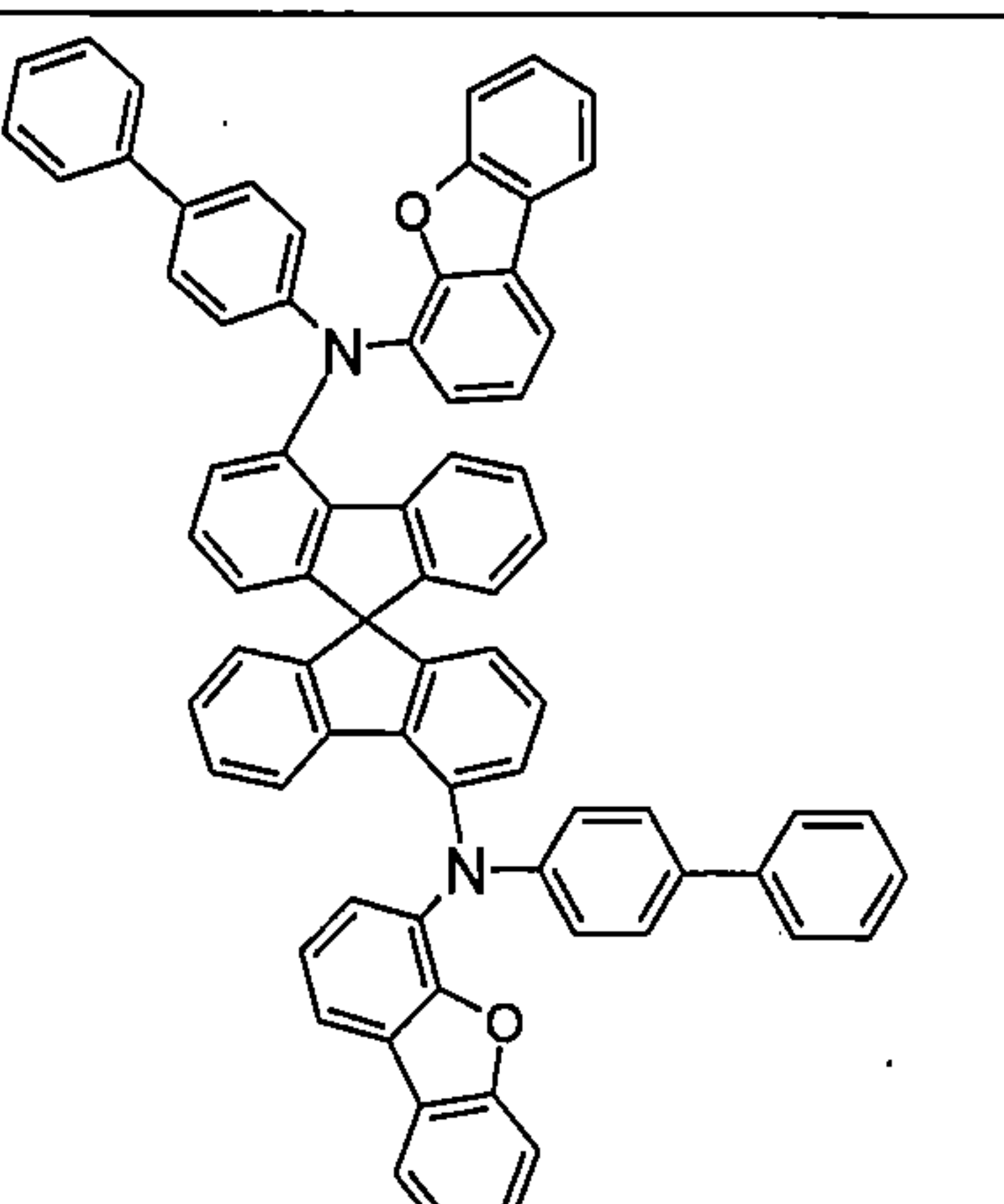
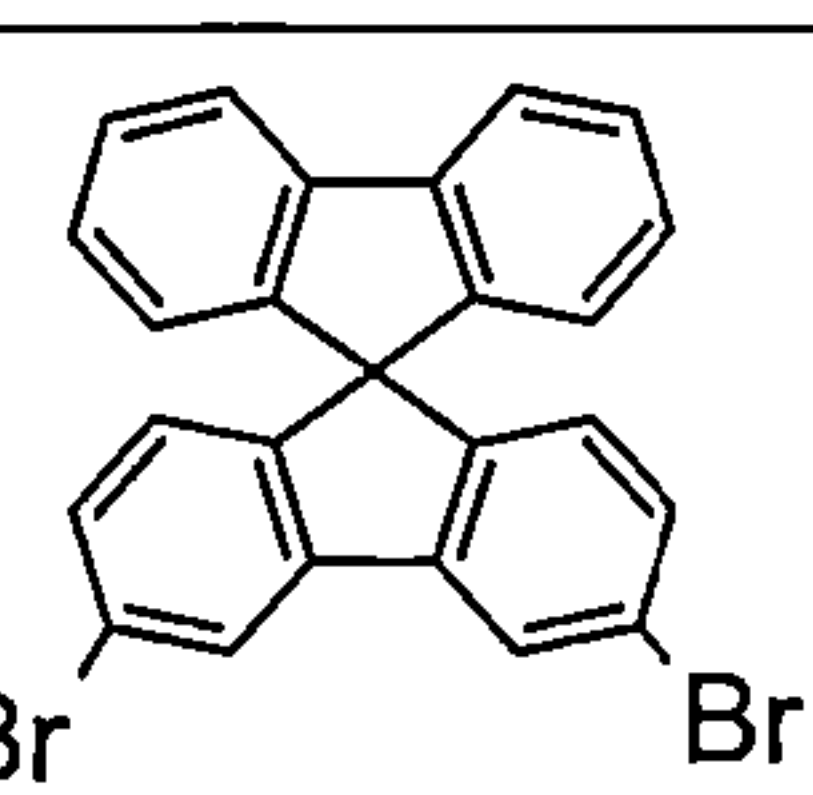
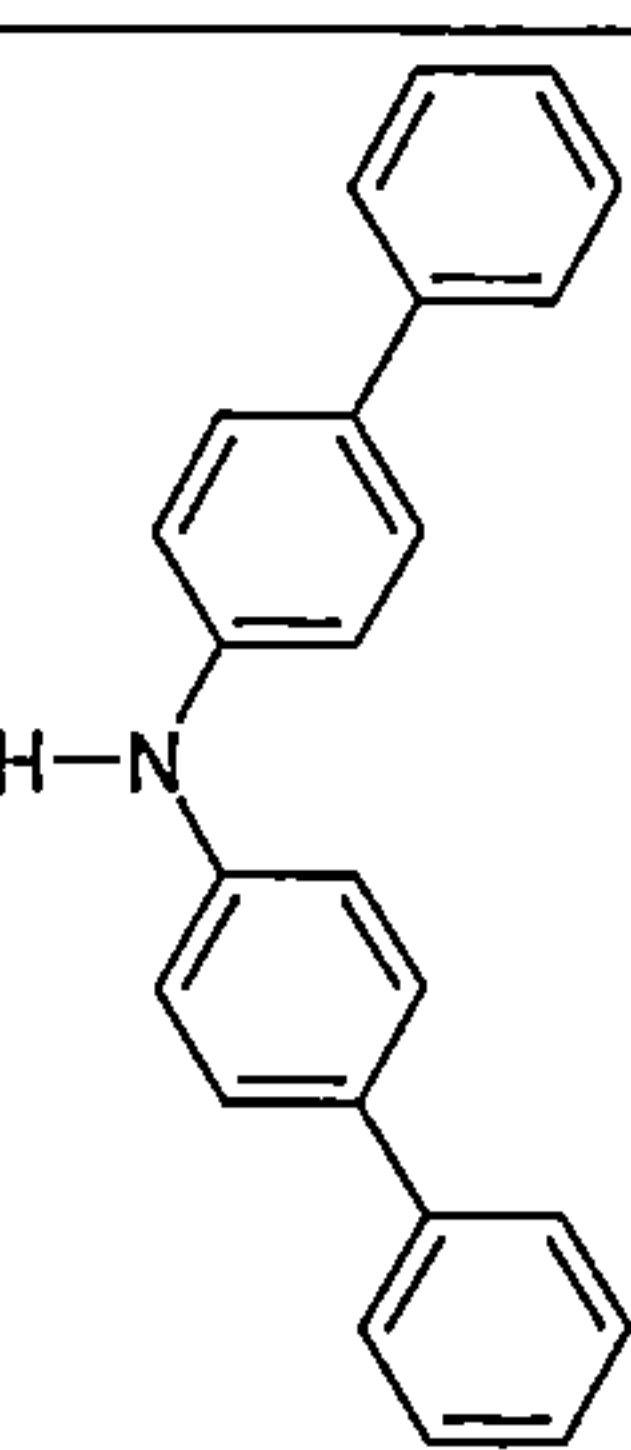
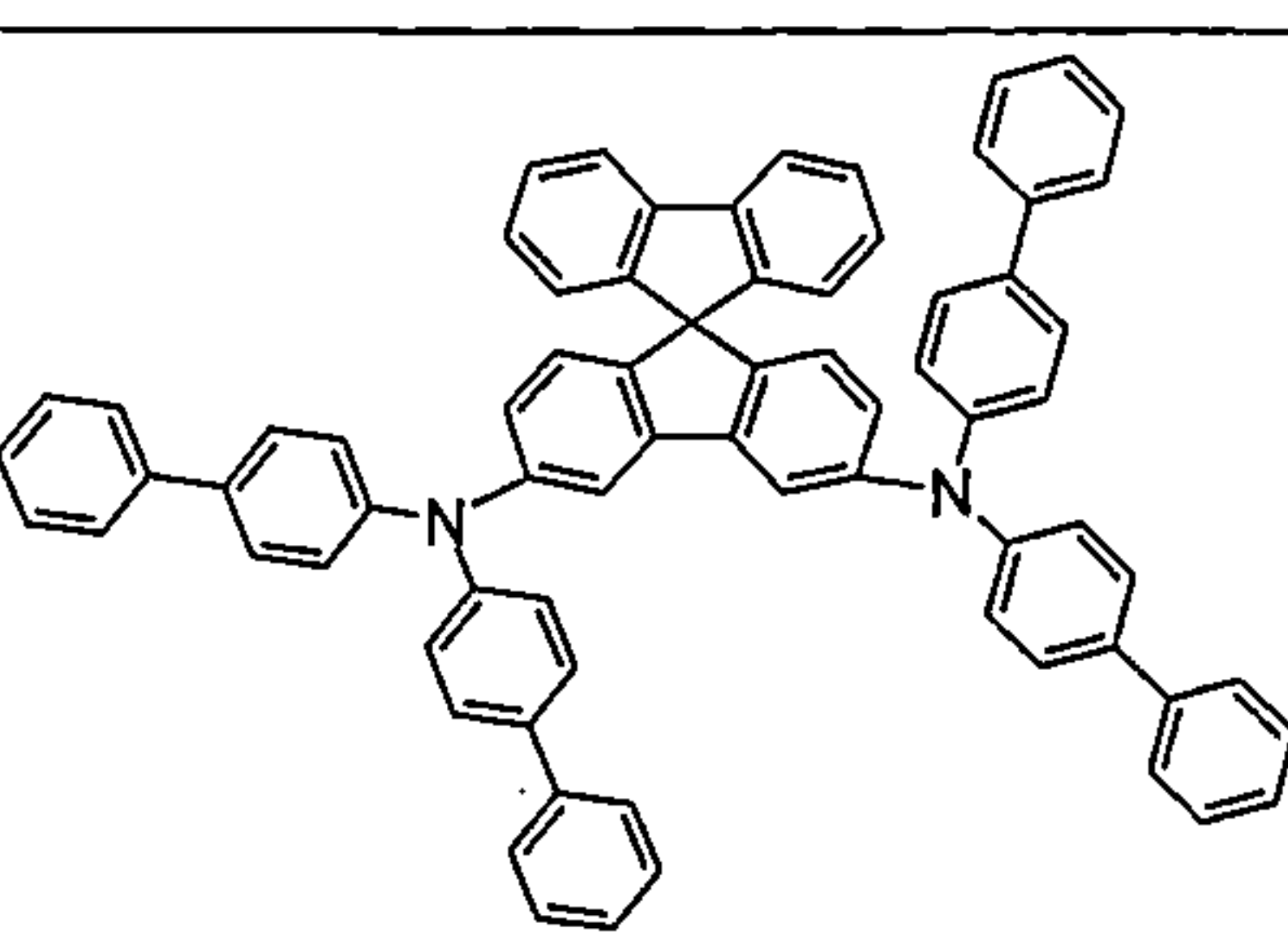
3k		 [1318338-47-4]		64%
3l		 [102113-98-4]		56%
3m		 [1198395-24-2]		66%
3n		 [500717-23-7]		46%
3o		 [1267248-54-3]		60%

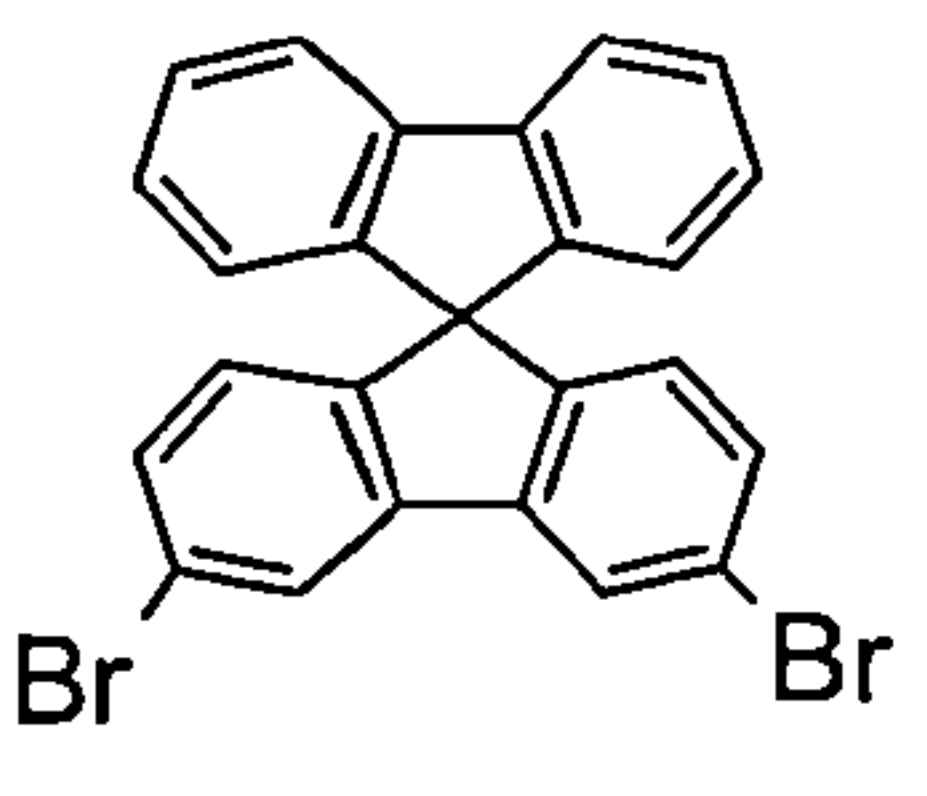
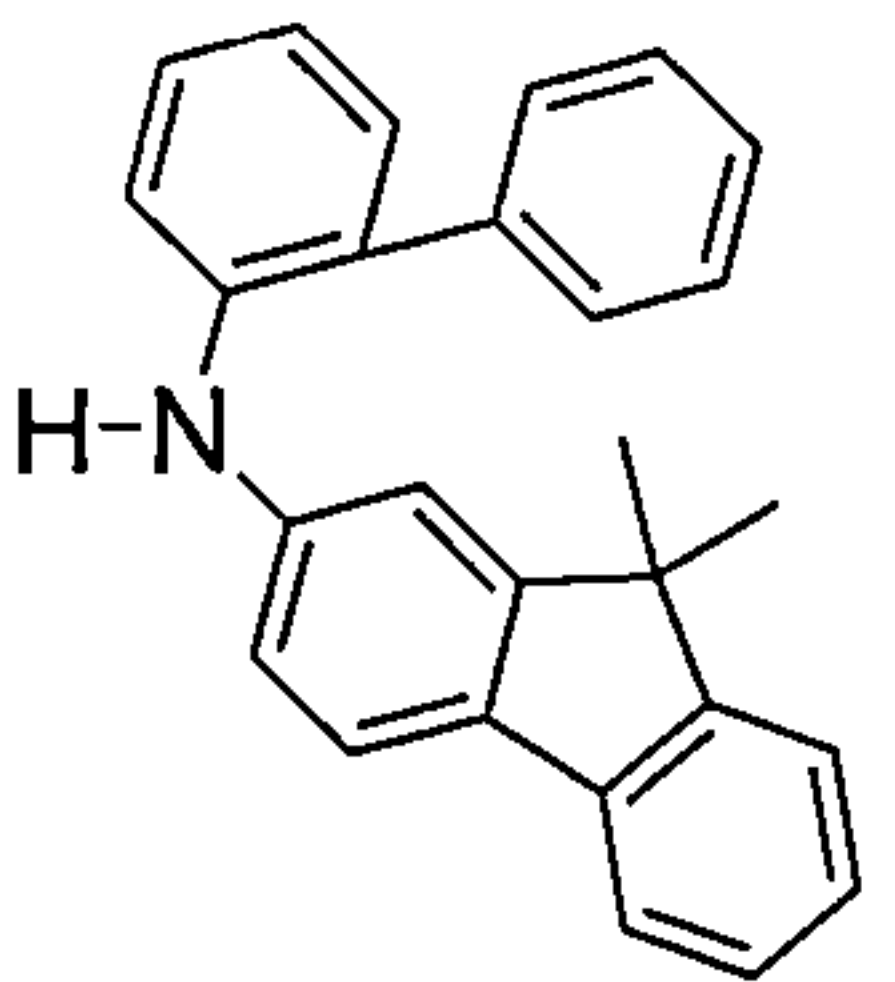
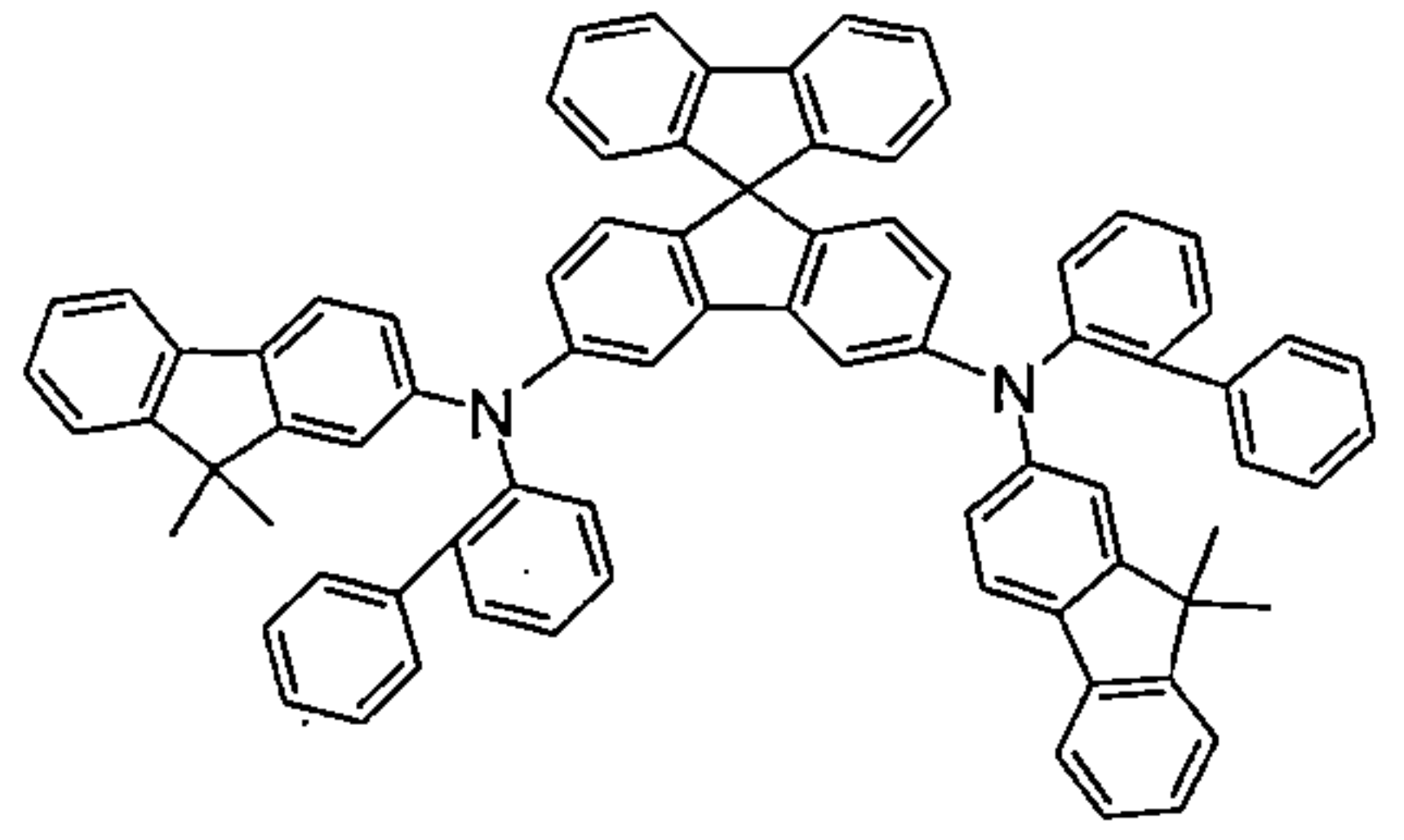
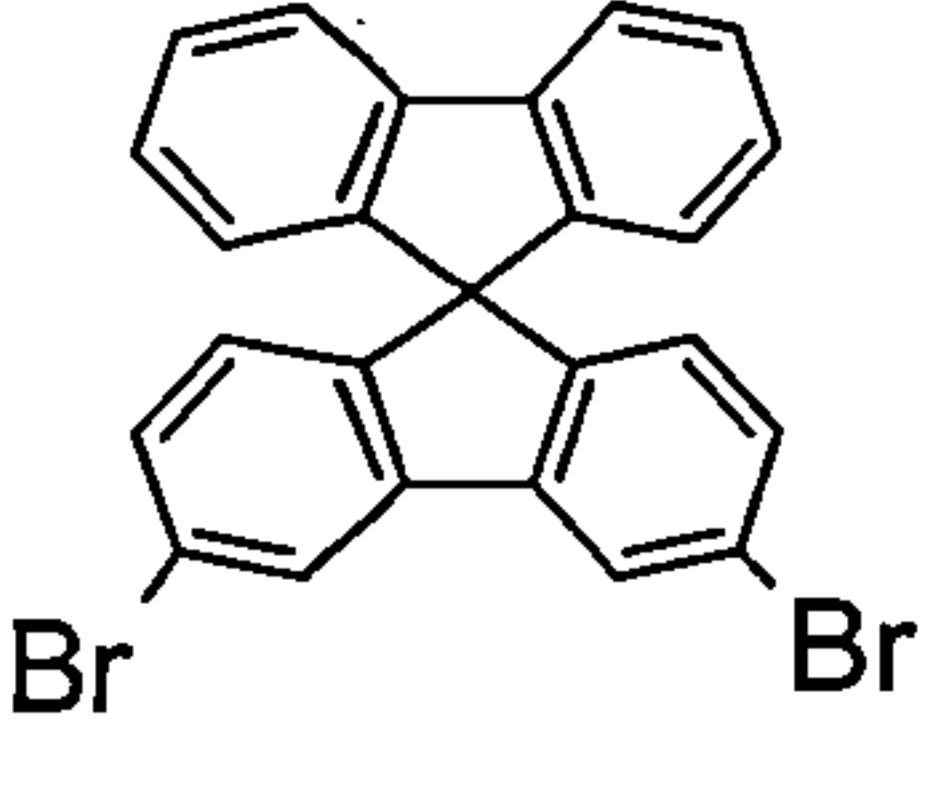
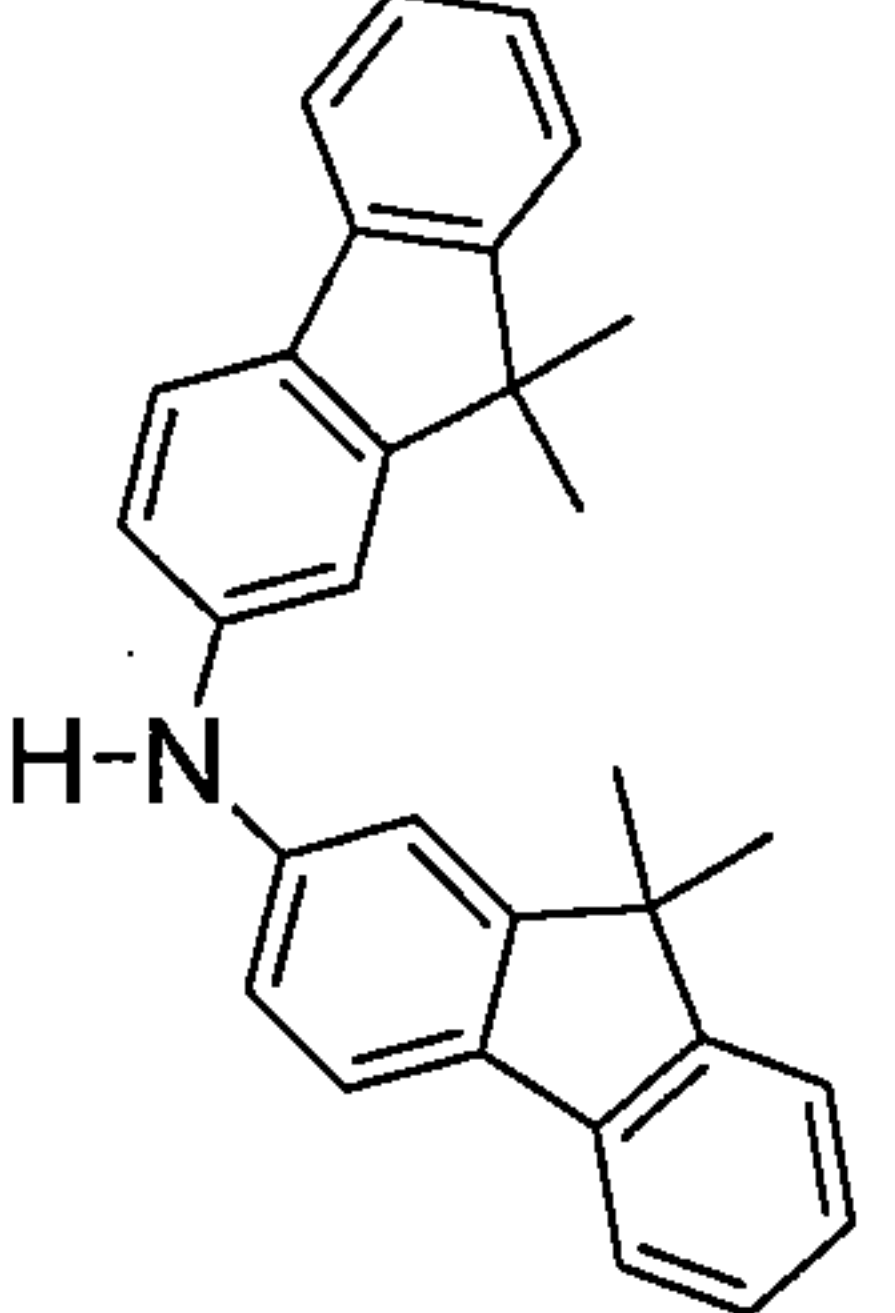
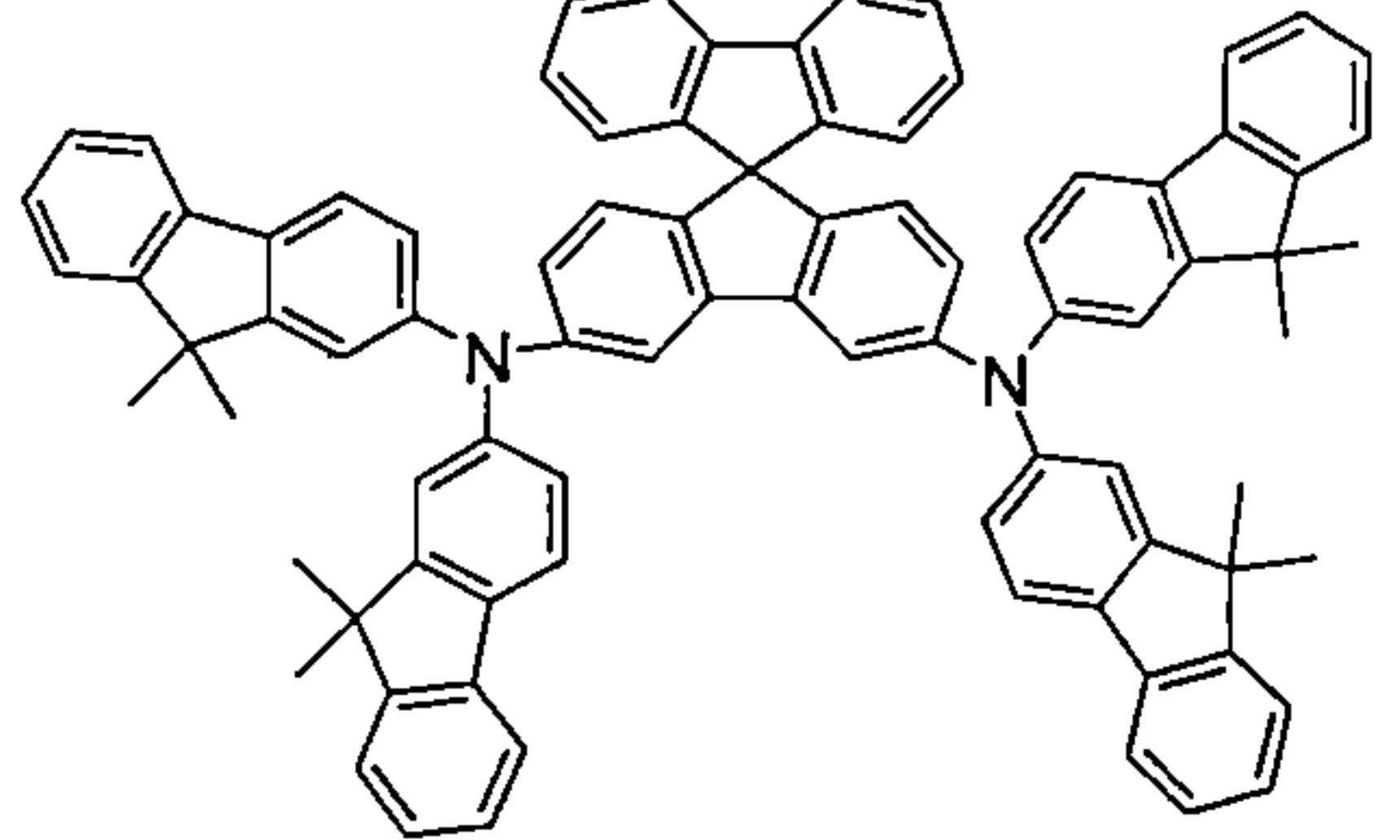
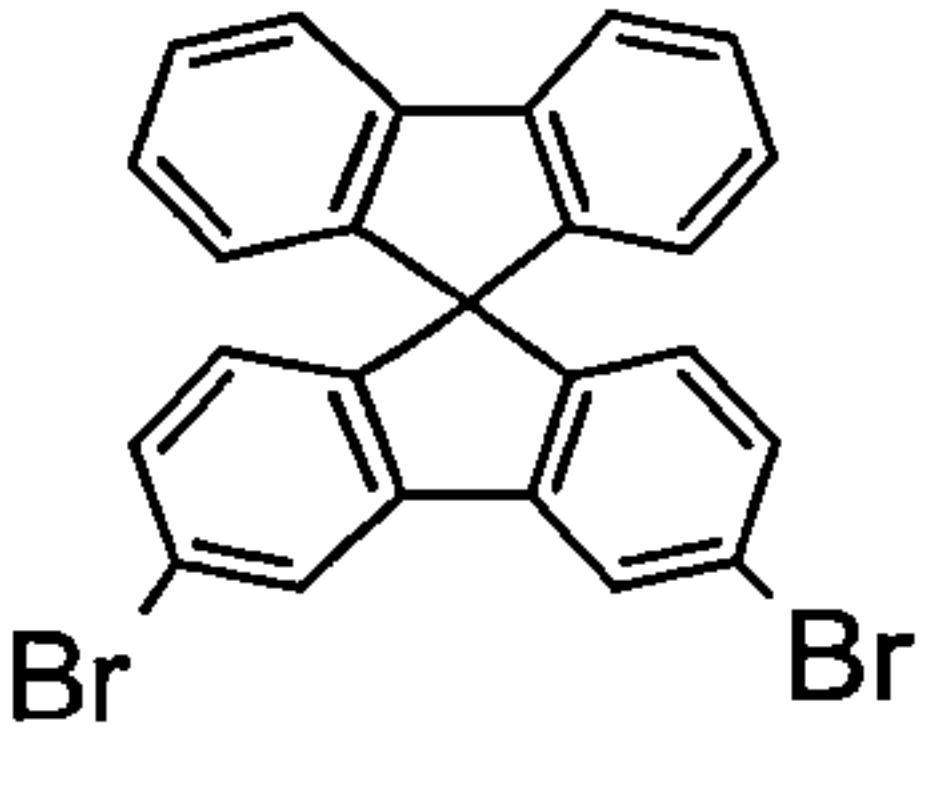
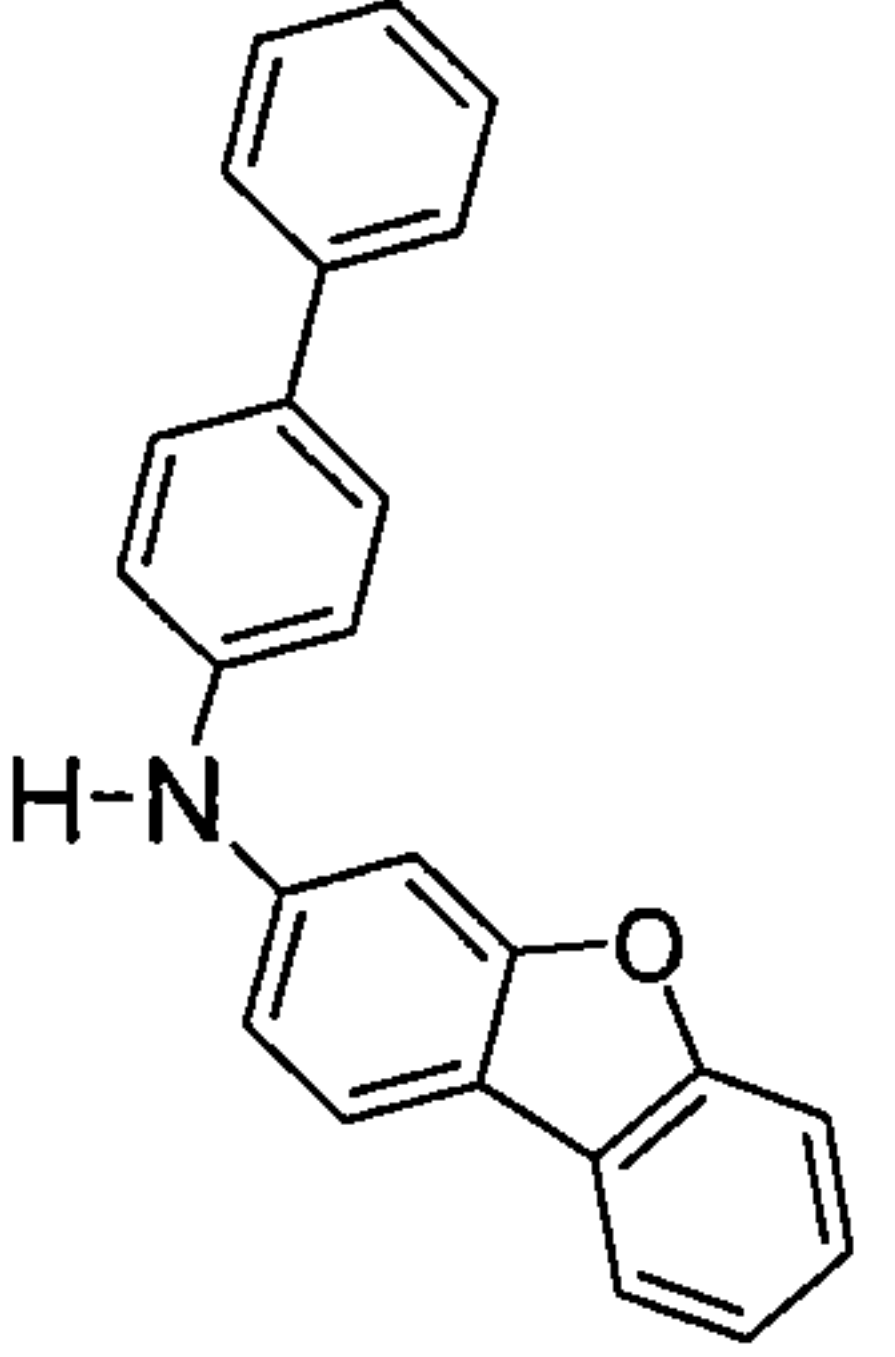
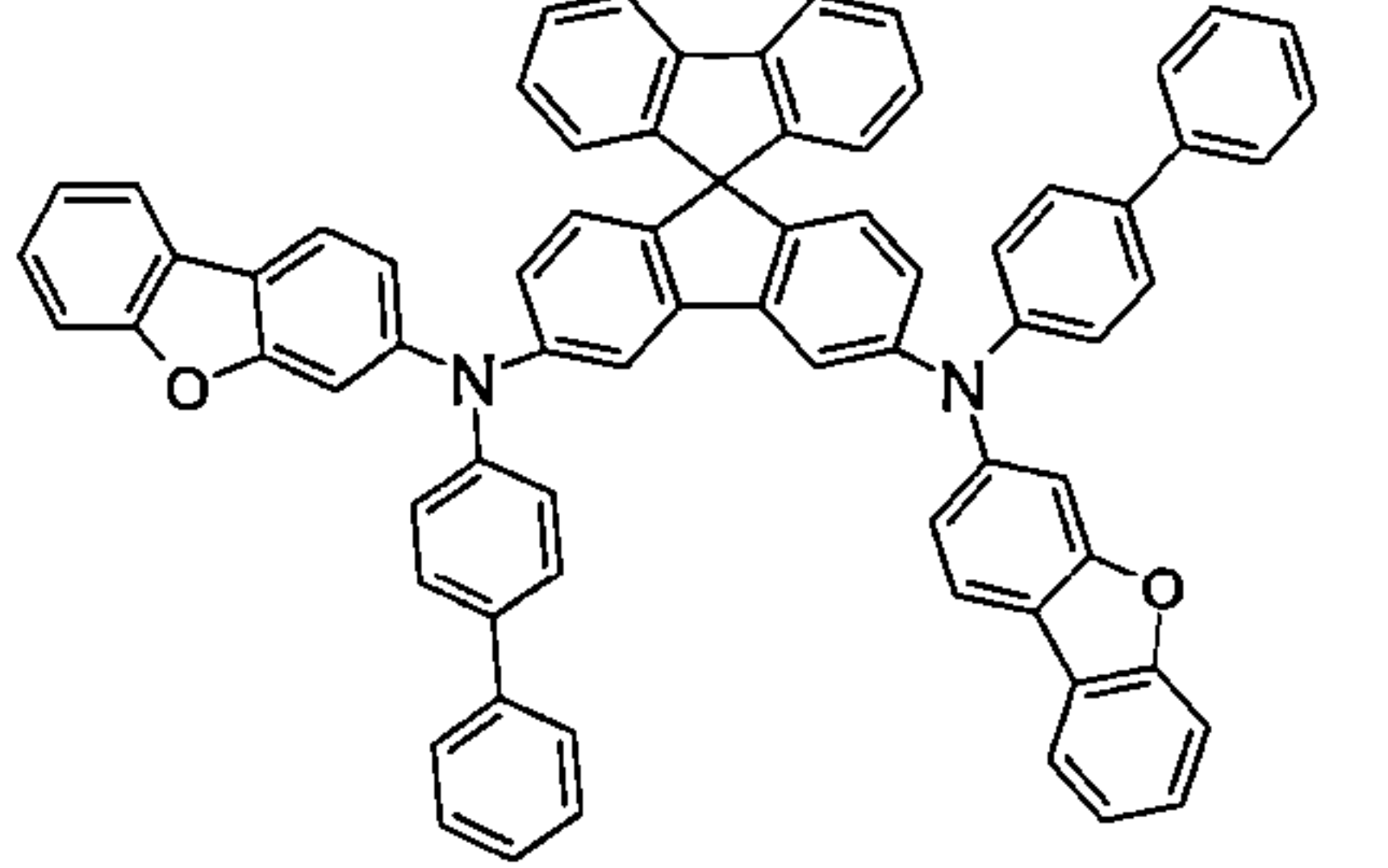
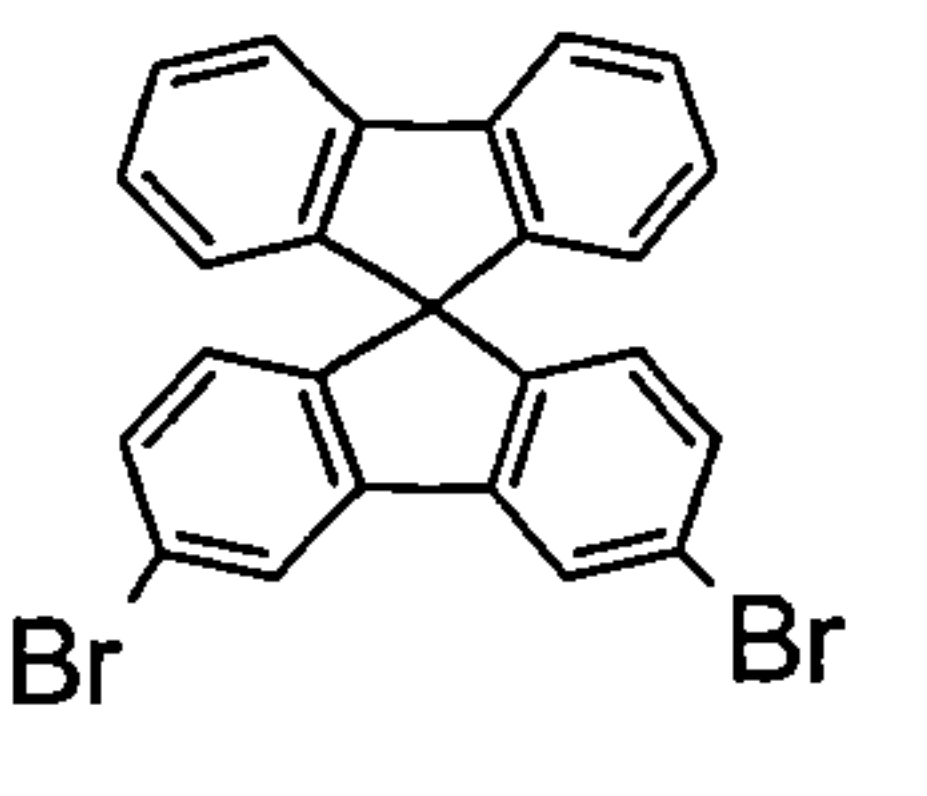
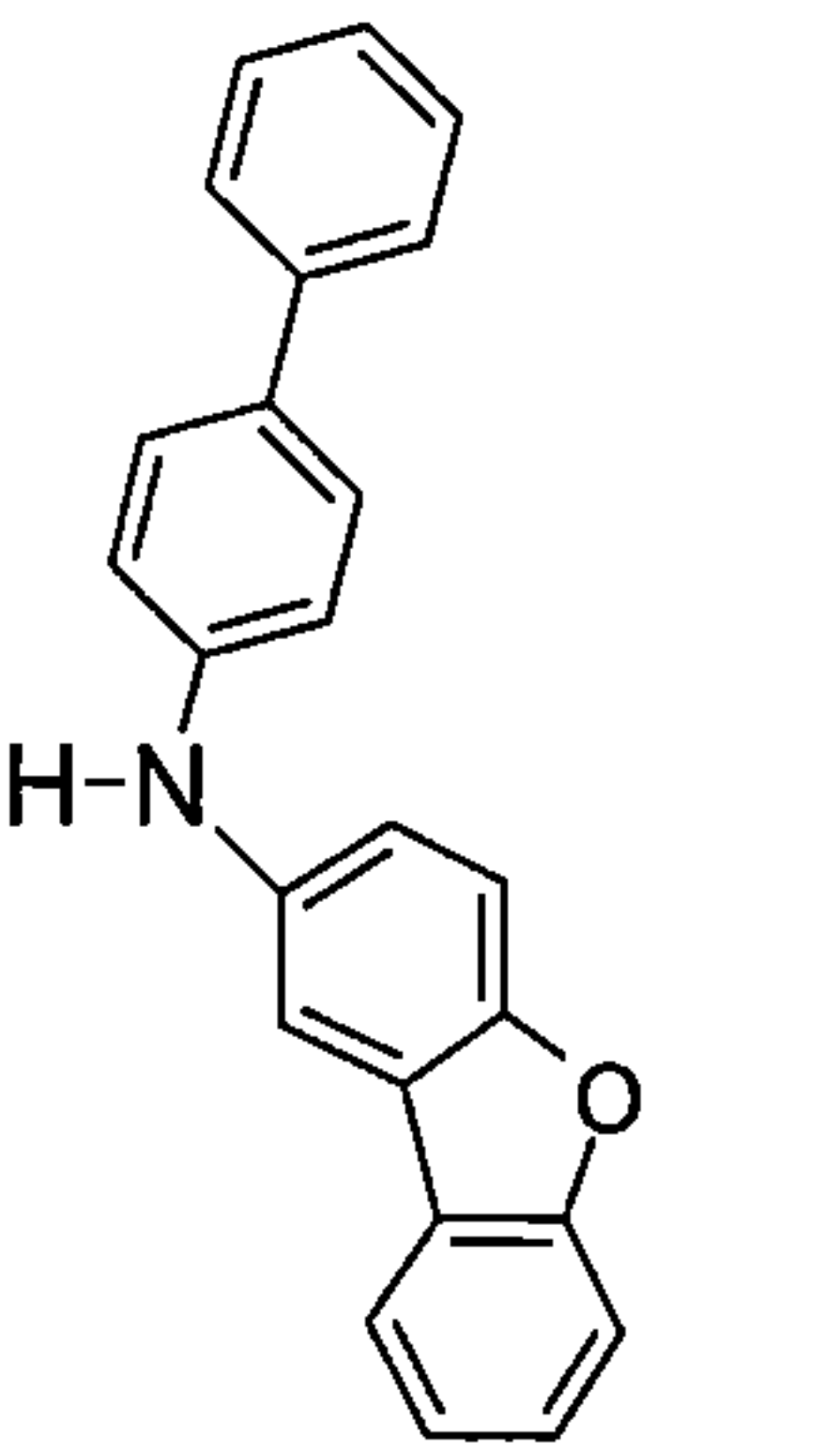
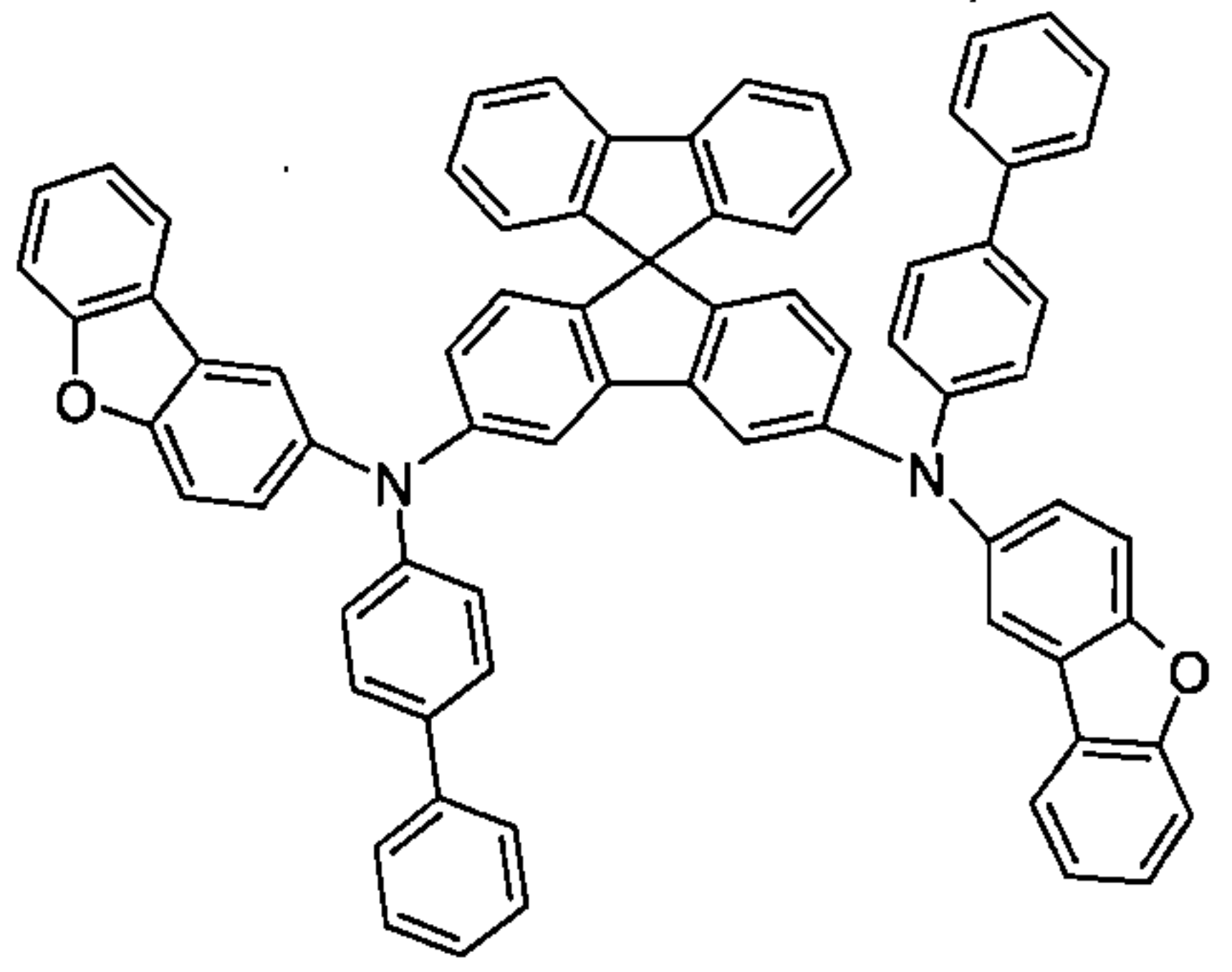
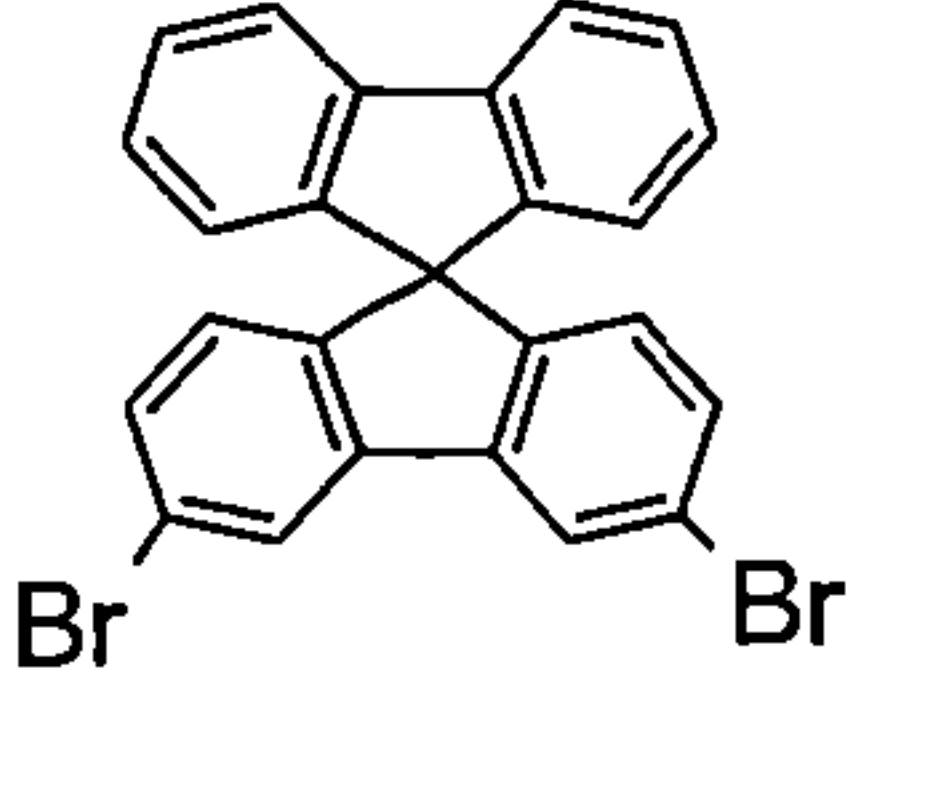
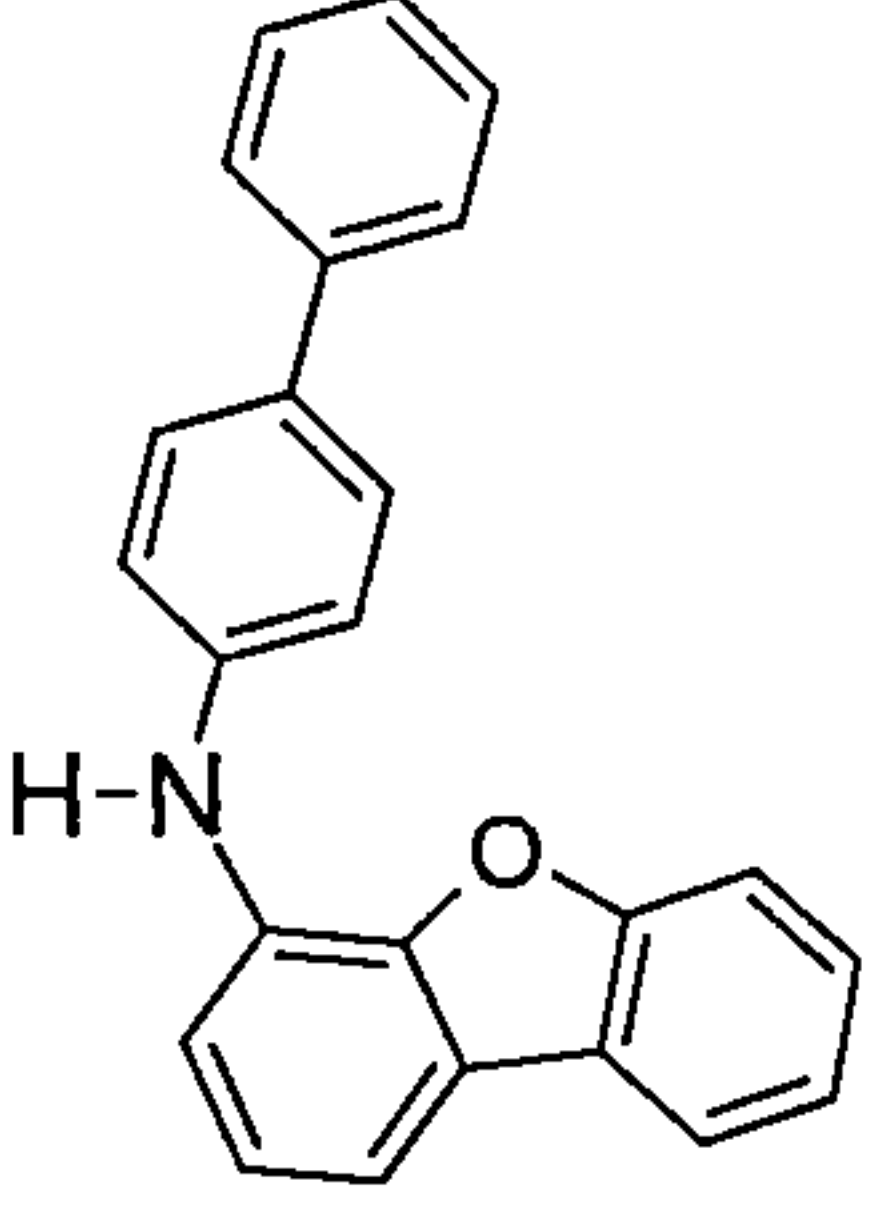
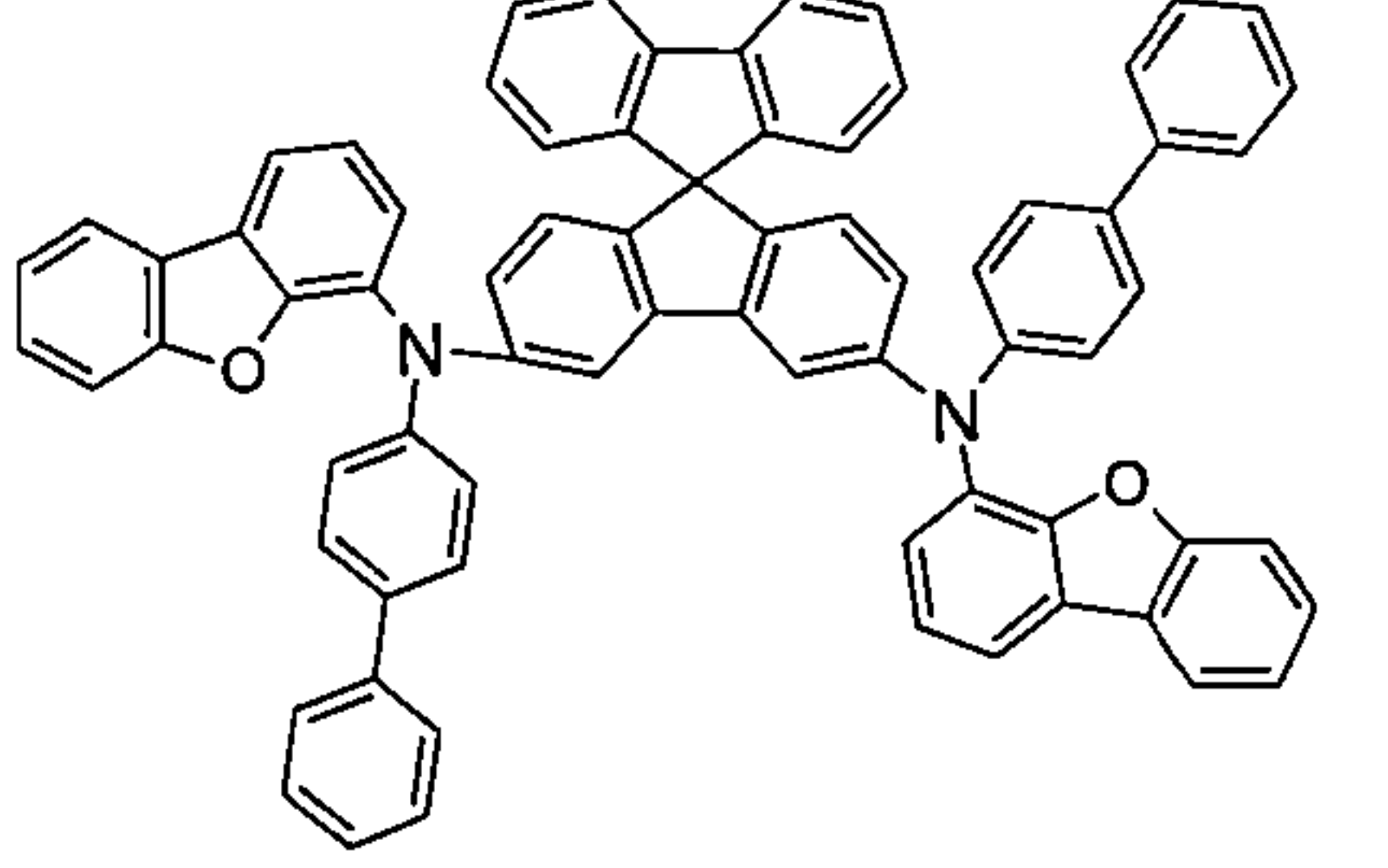
3p		 [1354653-33-0]		72%
3q		 [1160294-96-1]		85%
3r		 [1290039-85-8]		50%
3s		 [1300028-94-7]		70%
3t		 [1318338-47-4]		67%

3u		 [955959-89-4]		85%
3v		 [102113-98-4]		43%
3w		 [1198395-24-2]		76%
3x		 [500717-23-7]		41%
3y		 [1290039-85-8]		50%

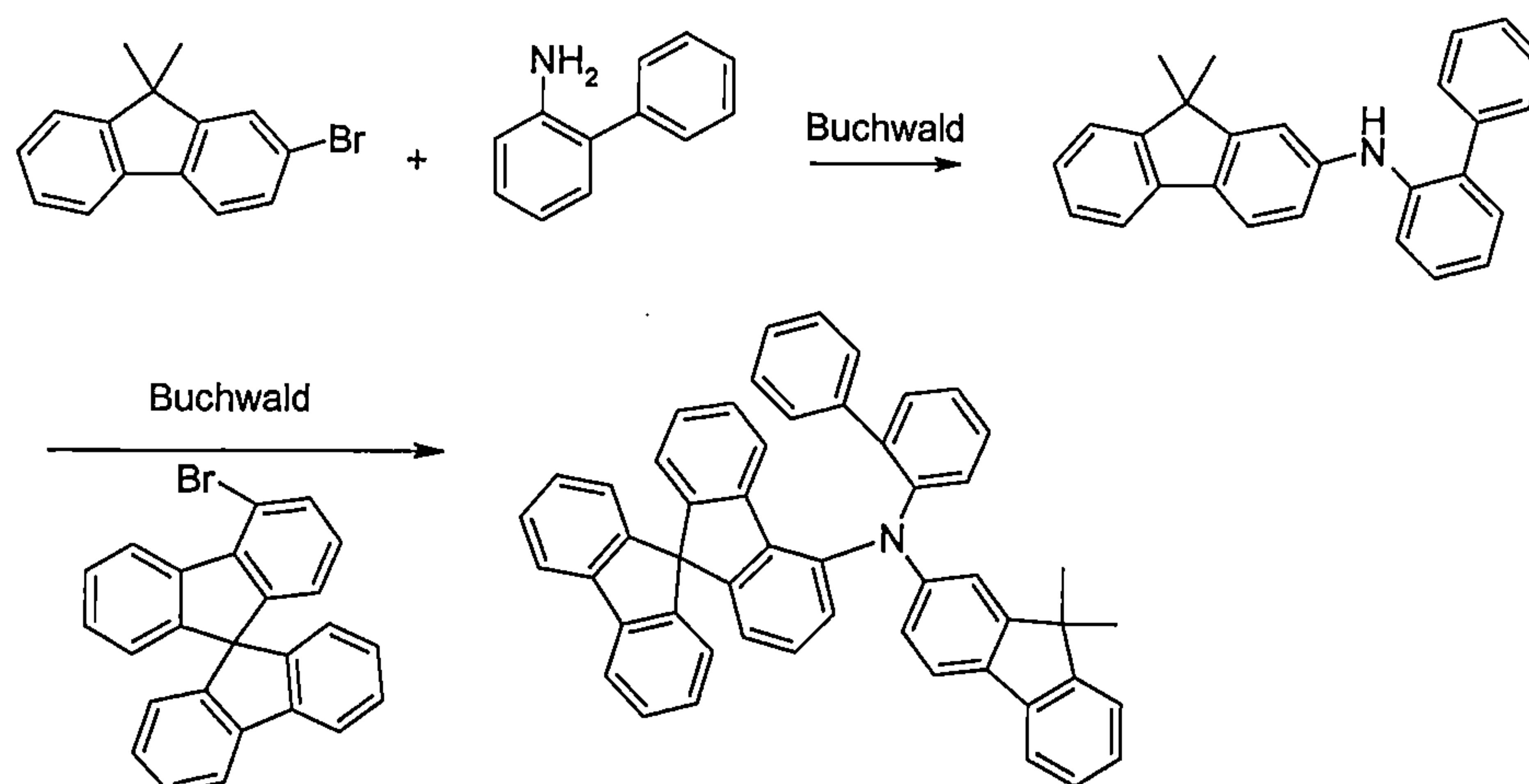
3z		 [1300028-94-7]		59%
3aa		 [1318338-47-4]		71%
3ab		 [1267248-54-3]		70%
3ac		 [1354653-33-0]		75%
3ad		 [1160294-96-1]		80%

3ae	 <chem>BrC1=C(C2=CC=CC=C2)C3=CC=CC=C3C4=CC=CC=C41</chem>	 <chem>c1ccc(cc1)Nc2ccc(Oc3cc4ccccc4cc3)cc2</chem> [955959-89-4]	 <chem>c1ccc(cc1)N(c2ccc(Oc3cc4ccccc4cc3)cc2)c4cc5ccccc5cc4</chem>	85%
3af	 <chem>BrC1=CC=C(C2=CC=CC=C2)C3=CC=CC=C3C4=CC=CC=C41Br</chem> 1257321-41-7	 <chem>c1ccc(cc1)Nc2ccc(cc2)Nc3ccc(cc3)c4ccccc4</chem> 102113-98-4	 <chem>c1ccc(cc1)N(c2ccc(Oc3cc4ccccc4cc3)cc2)c4cc5ccccc5cc4N(c6ccc(Oc7cc8ccccc8cc7)cc6)cc9ccccc9</chem>	48%
3ag	 <chem>BrC1=CC=C(C2=CC=CC=C2)C3=CC=CC=C3C4=CC=CC=C41Br</chem> [1257321-41-7]	 <chem>c1ccc(cc1)Nc2ccc(Oc3cc4ccccc4cc3)cc2</chem> [1198395-24-2]	 <chem>c1ccc(cc1)N(c2ccc(Oc3cc4ccccc4cc3)cc2)c4cc5ccccc5cc4N(c6ccc(Oc7cc8ccccc8cc7)cc6)cc9ccccc9</chem>	46%
3ah	 <chem>BrC1=CC=C(C2=CC=CC=C2)C3=CC=CC=C3C4=CC=CC=C41Br</chem> [1257321-41-7]	 <chem>c1ccc(cc1)Nc2ccc(Oc3cc4ccccc4cc3)cc2</chem> [500717-23-7]	 <chem>c1ccc(cc1)N(c2ccc(Oc3cc4ccccc4cc3)cc2)c4cc5ccccc5cc4N(c6ccc(Oc7cc8ccccc8cc7)cc6)cc9ccccc9</chem>	41%

3ai	 [1257321-41-7]	 [1290039-85-8]		50%
3aj	 [1257321-41-7]	 [1300028-94-7]		43%
3ak	 [1257321-41-7]	 [1318338-47-4]		53%
3al	 [102113-98-4]	 [102113-98-4]		33%

3am		 [1198395-24-2]		46%
3an		 [500717-23-7]		41%
3ao		 [1290039-85-8]		40%
3ap		 [1300028-94-7]		51%
3aq		 [1318338-47-4]		47%

實例 4a：聯苯-2-基-(9,9-二甲基-9*H*-芴-2-基)-(9,9'-螺聯芴-4-基)胺之合成



a) 聯苯-2-基-(9,9-二甲基-9*H*-芴-2-基)胺之合成

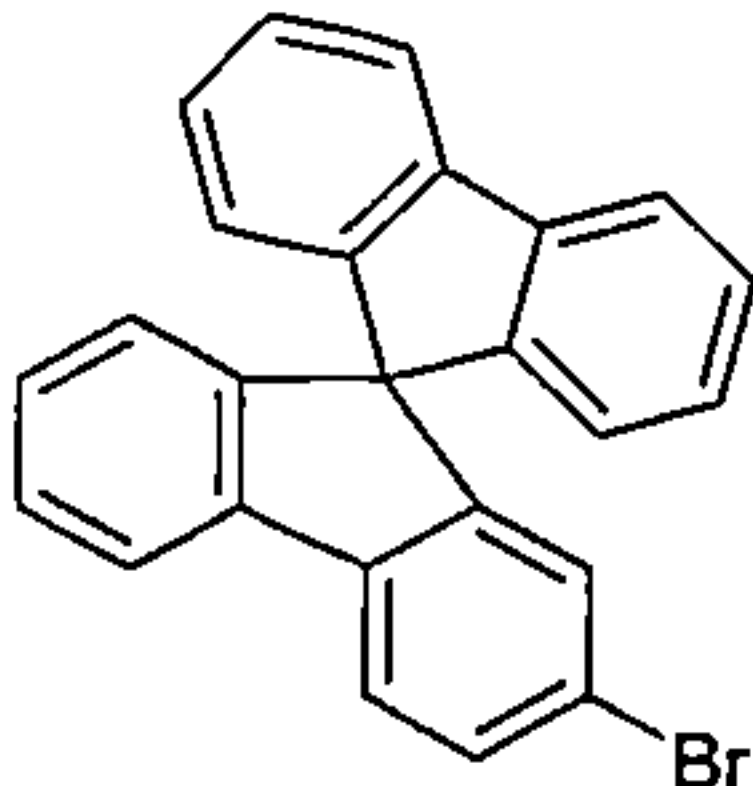
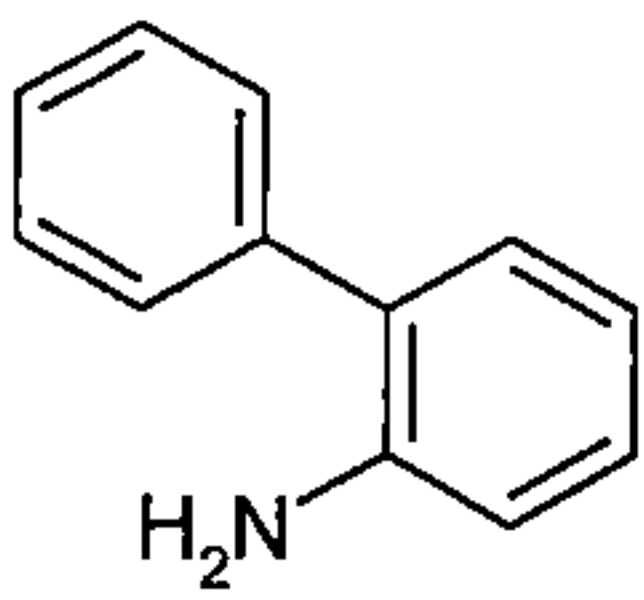
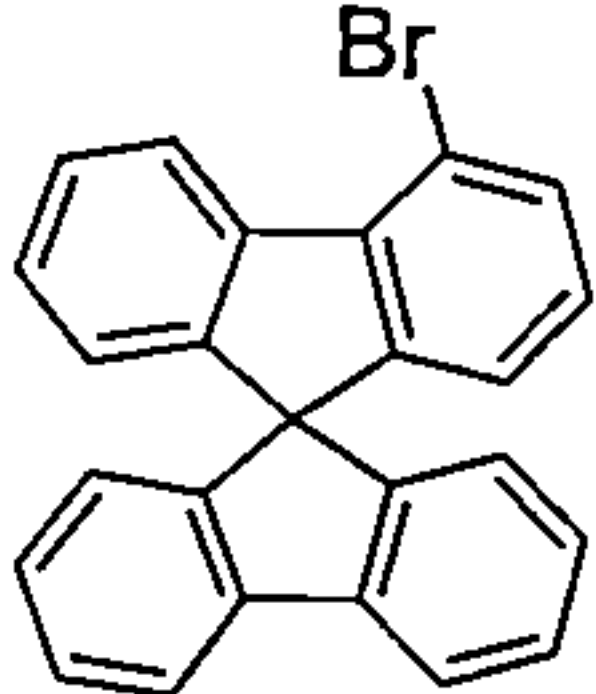
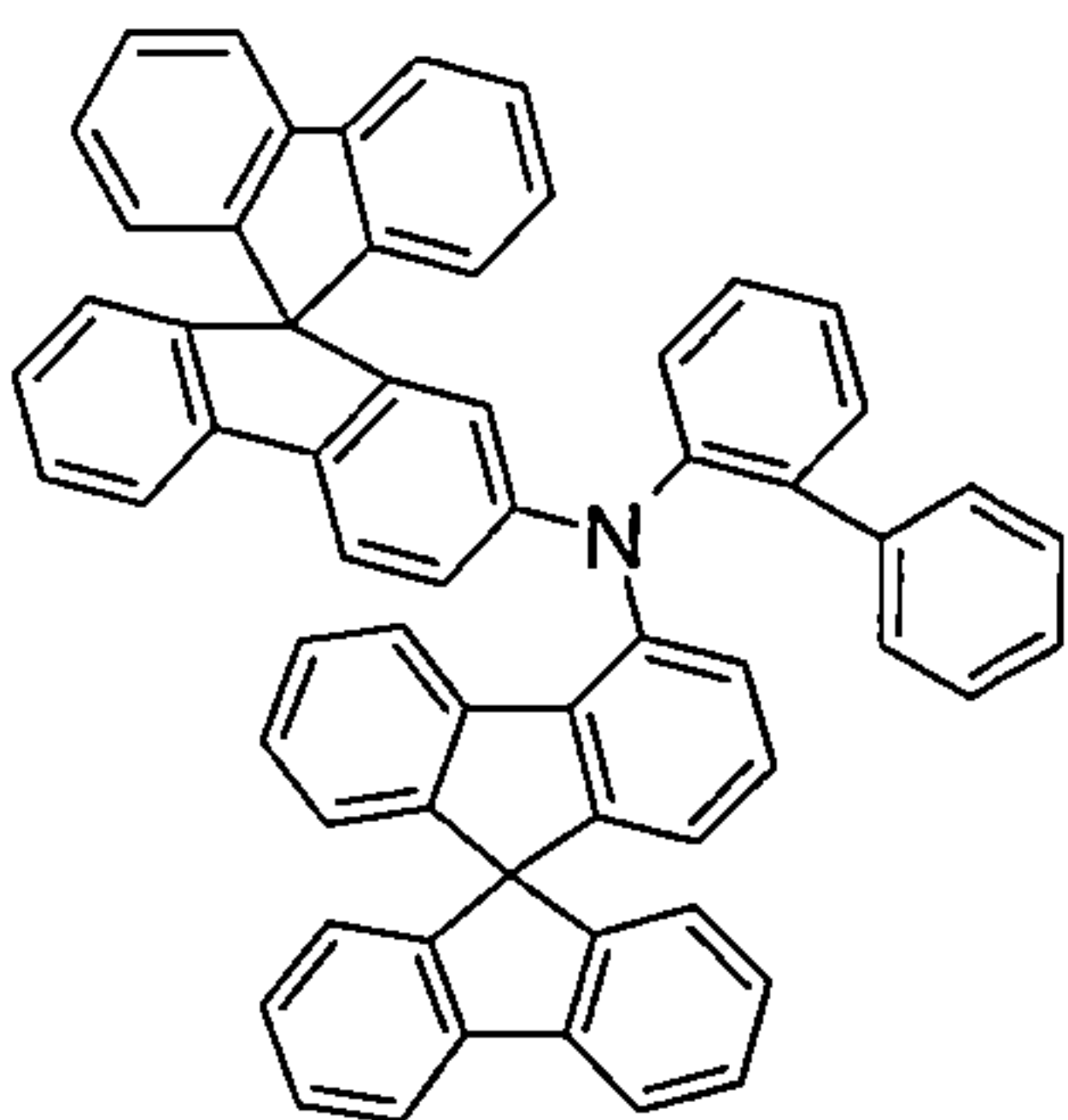
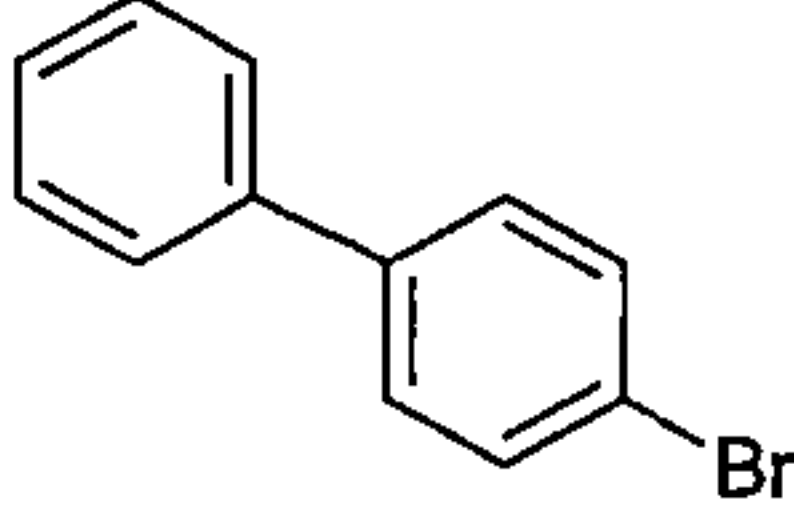
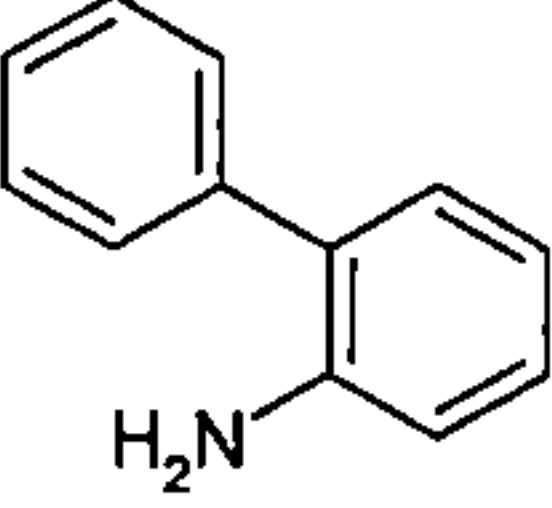
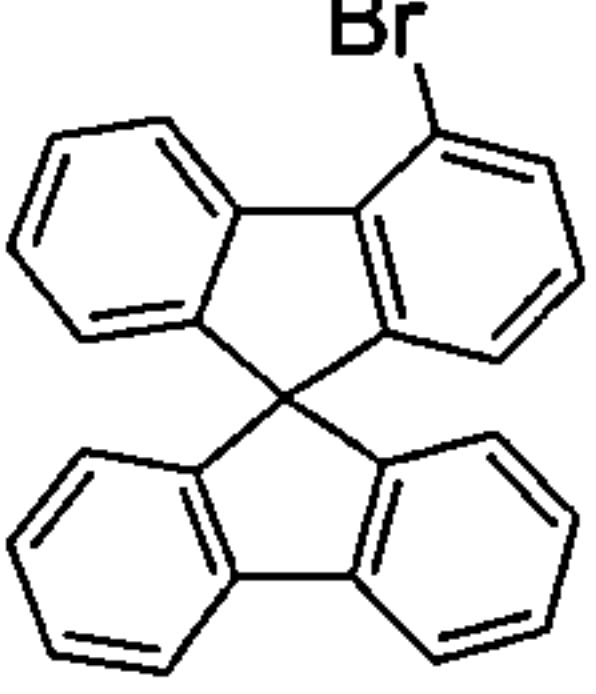
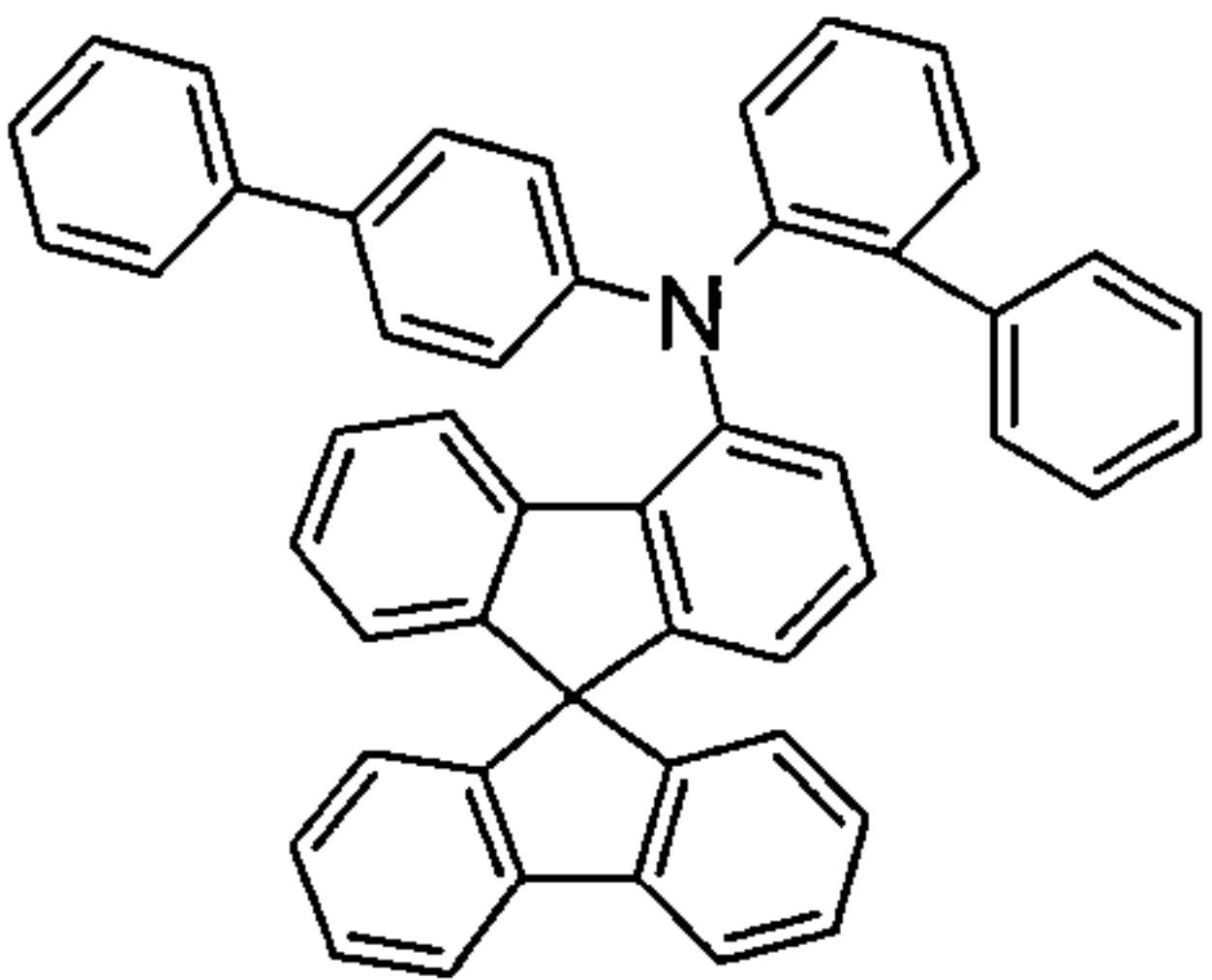
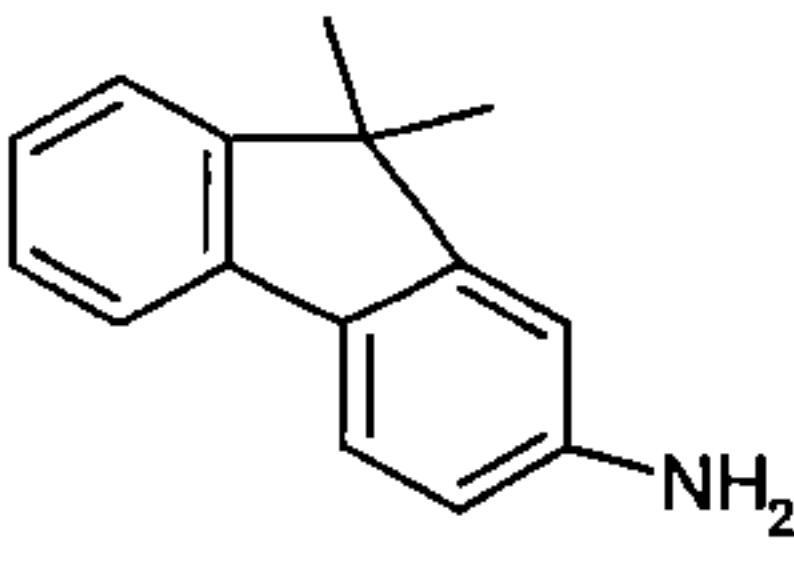
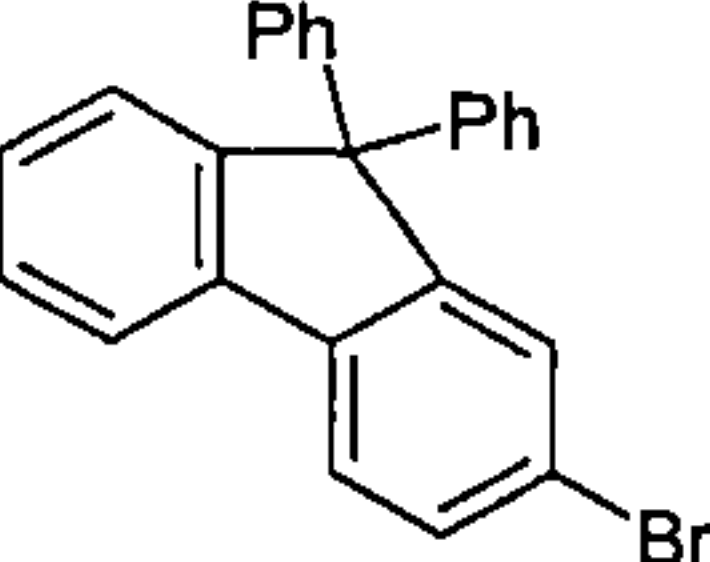
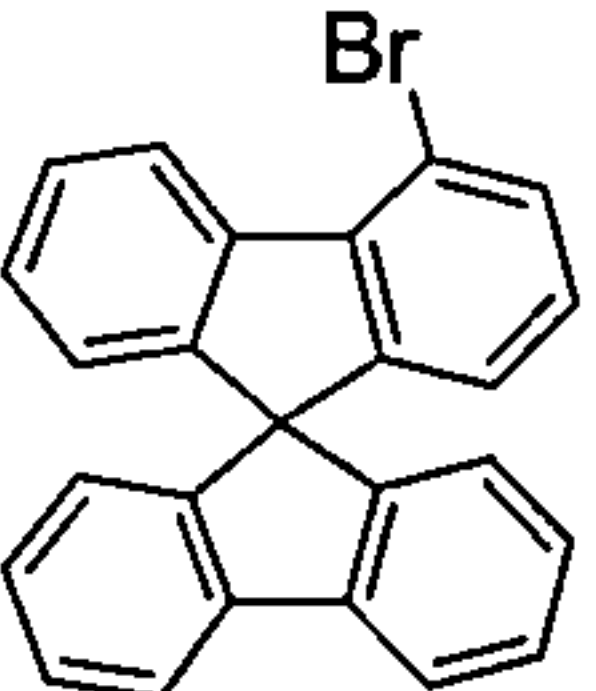
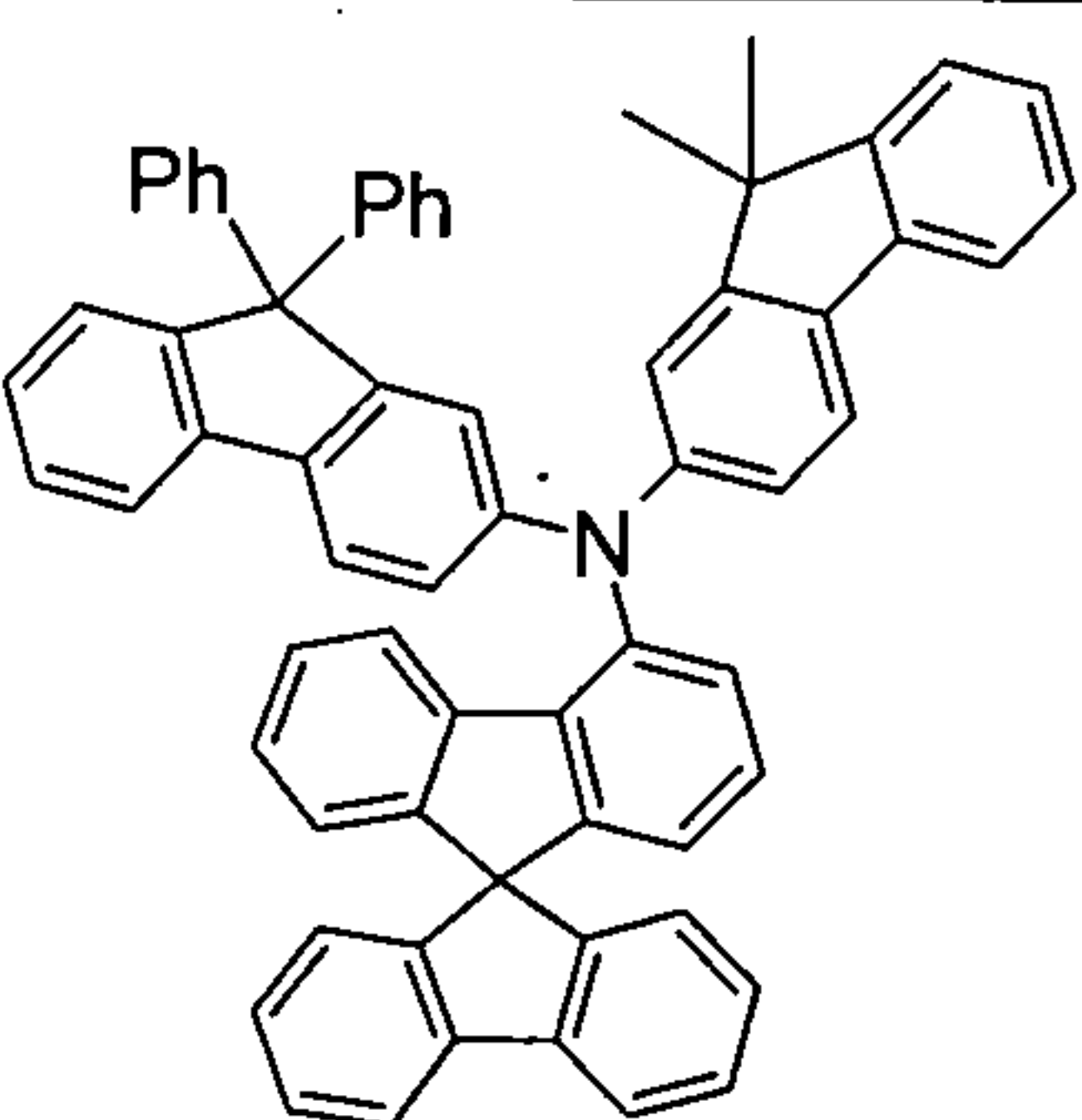
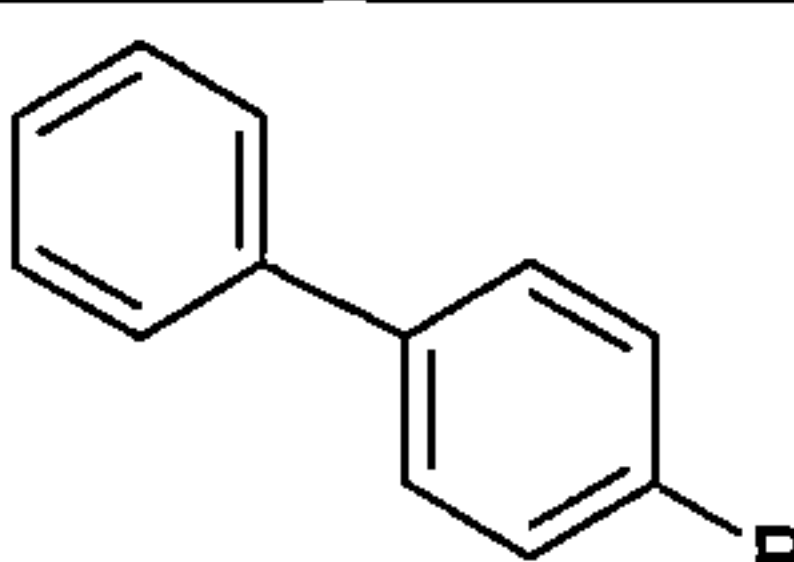
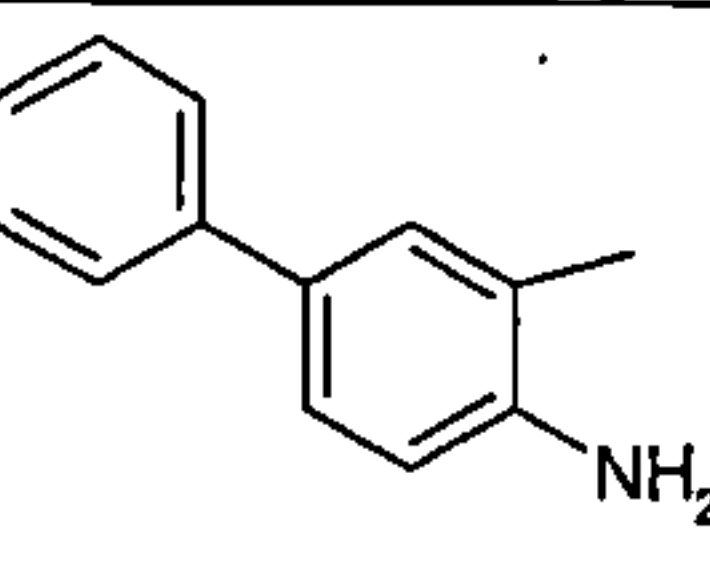
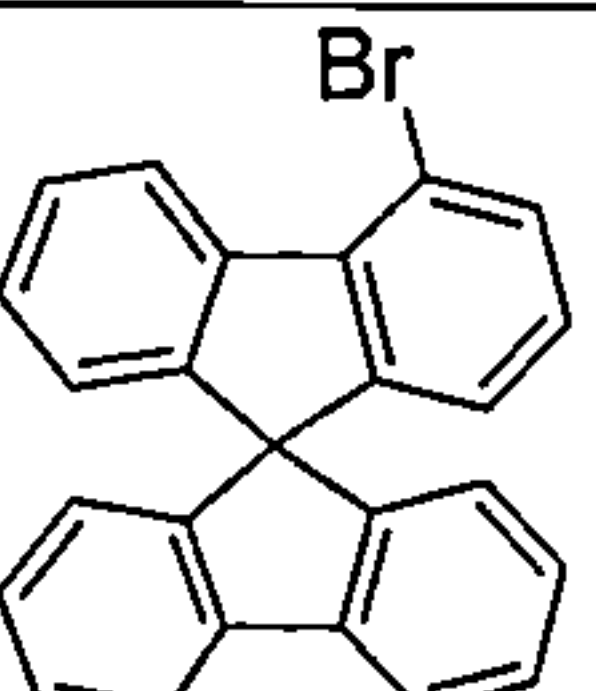
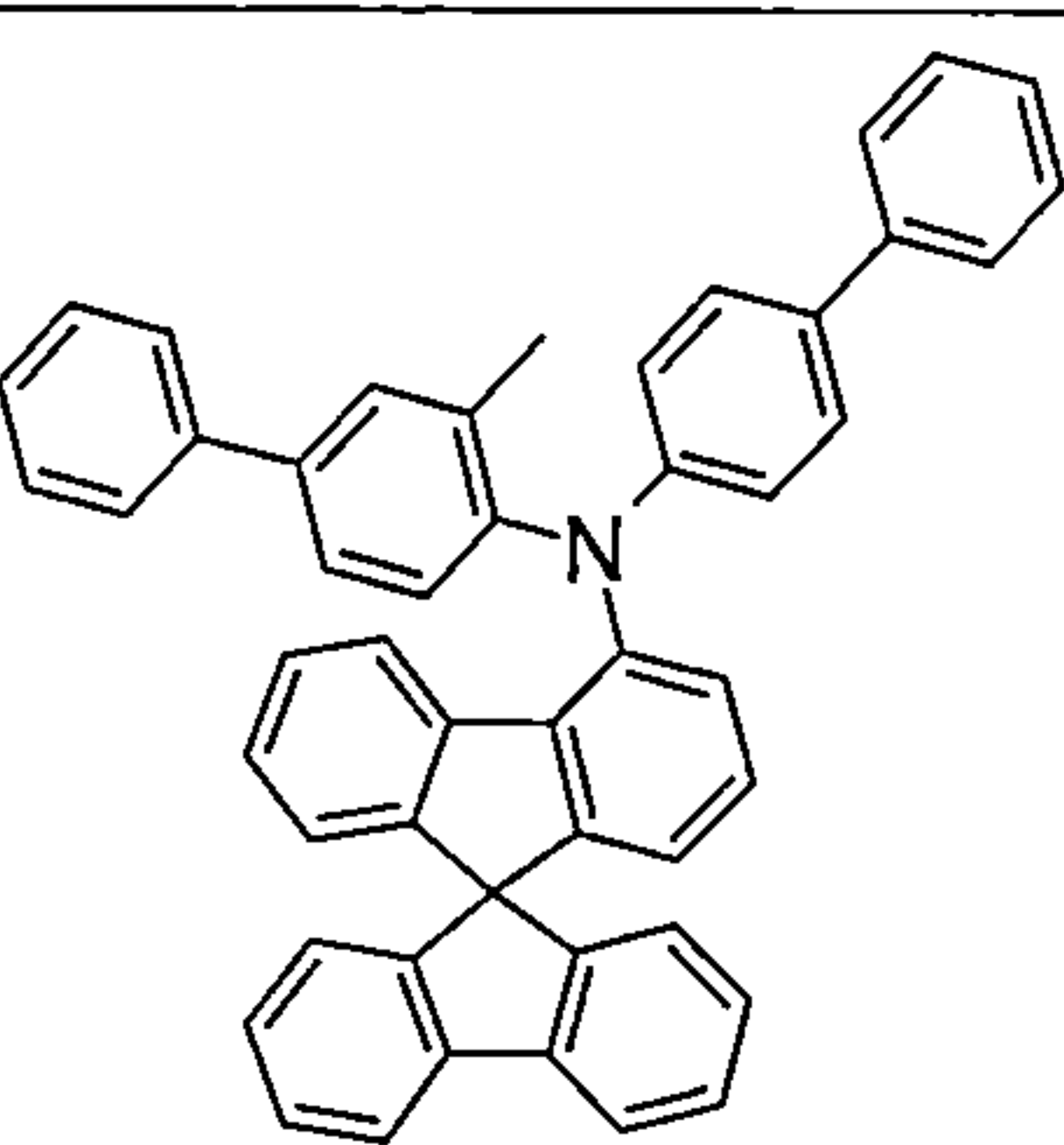
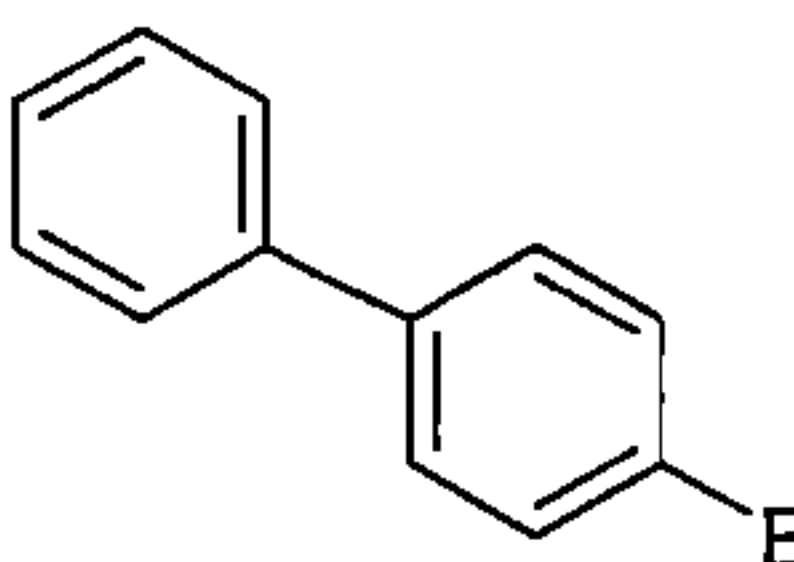
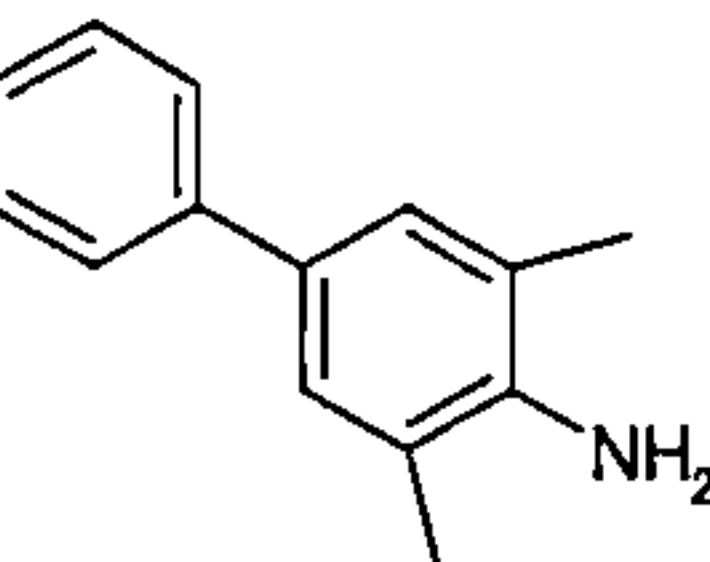
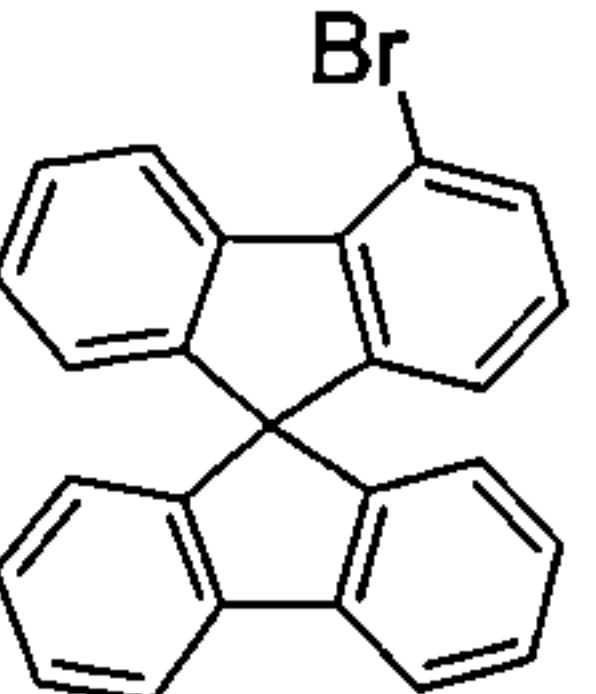
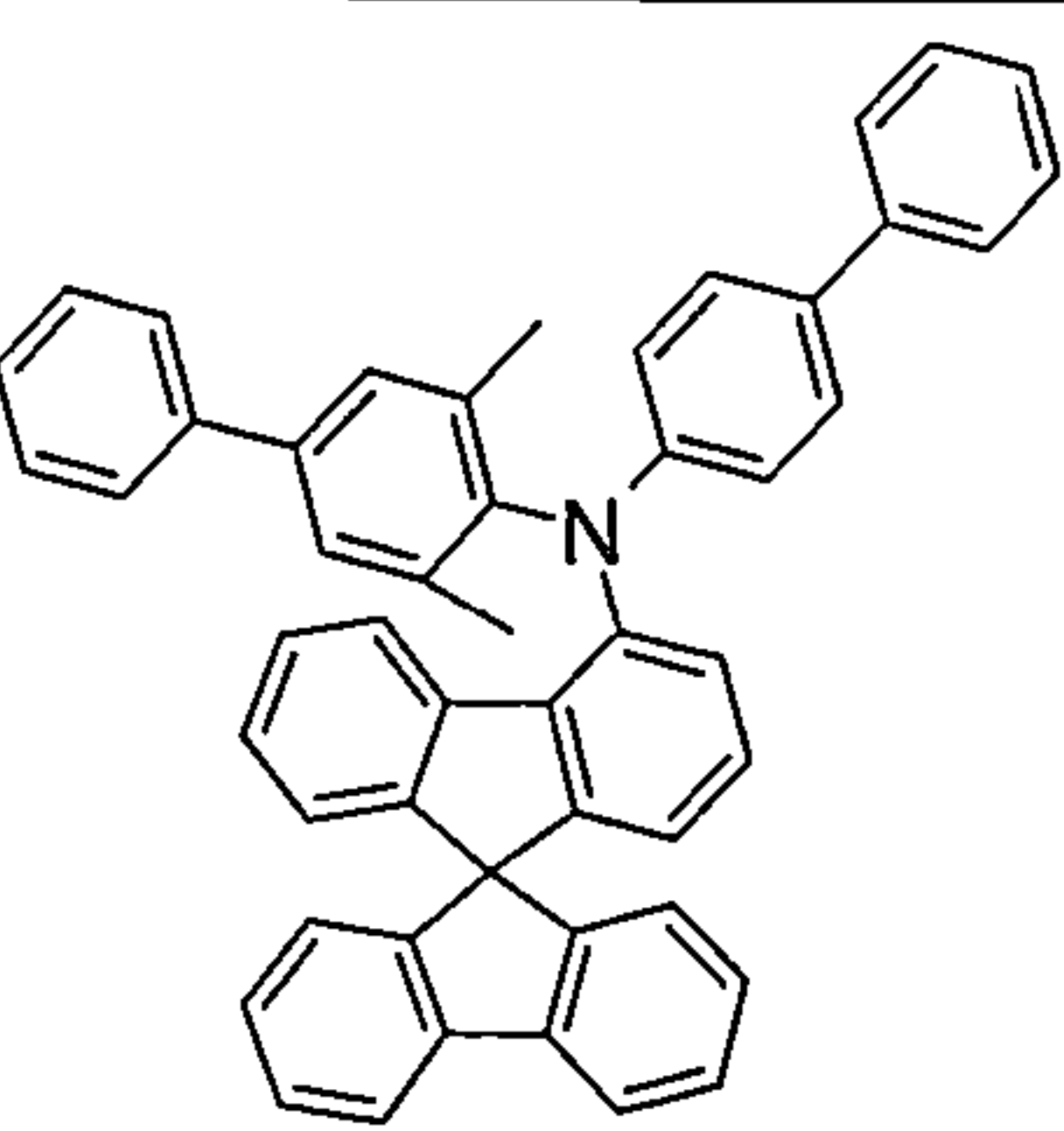
將1,1'-雙(二苯基膦基)二茂鐵(1.5 g, 2.7 mmol)、乙酸鈣(616 mg, 2.7 mmol)及第三丁醇鈉(22.9 g, 238 mmol) 添加至聯苯-2-基胺(31.0 g, 183 mmol)及2-溴-9,9-二甲基-9*H*-芴(50.0 g, 183 mmol)於經脫氣之甲苯(400 ml)中之溶液中，並在回流下將混合物加熱20 h。將反應混合物冷卻至室溫，用甲苯稀釋並藉助矽藻土過濾。用水稀釋濾液，用甲苯再萃取，並乾燥合併之有機相並在真空中蒸發。藉助矽膠(庚烷/二氯甲烷)過濾殘餘物並自異丙醇結晶。獲得呈淺黃色固體形式之聯苯-2-基-(9,9-二甲基-9*H*-芴-2-基)胺(63.0 g，理論為95%)。

b) 聯苯-2-基-(9,9-二甲基-9*H*-芴-2-基)-(9,9'-螺聯芴-4-基)胺之合成

將三-第三丁基膦(4.4 ml存於甲苯中之1.0 M溶液，4.4 mmol)、乙酸鈣(248 mg, 1.1 mmol)及第三丁醇鈉(16.0 g, 166 mmol)添加至聯苯-2-基-(9,9-二甲基-9*H*-芴-2-基)胺(40.0 g, 111 mmol)及4-溴-9,9'-螺二芴(56.9 g, 144 mmol)於經脫氣之甲苯(500 ml)中之溶液中，並在回流下將混合物加熱2 h。將反應混合物冷卻至室溫，用甲苯稀釋並藉助矽藻土過濾。在真空中蒸發掉濾液，並使殘餘物自乙酸乙酯/庚烷結晶。在索氏萃取器(甲苯)中萃取粗製產物並藉由在真空中區域昇華來

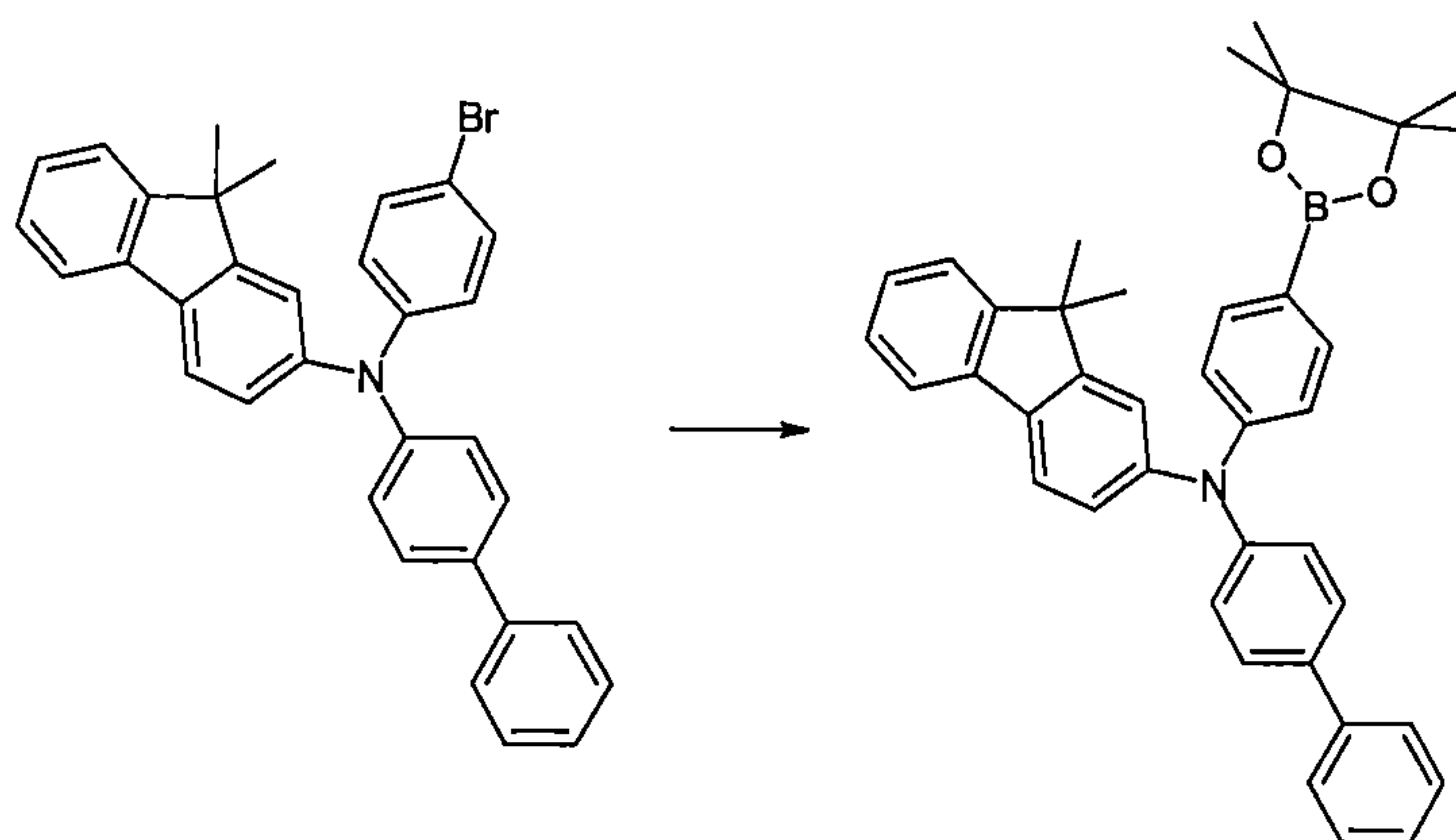
純化兩次($p = 3 \times 10^{-4}$ 毫巴， $T = 298^{\circ}\text{C}$)。分離出呈淺黃色固體形式之產物(20.4 g，理論為27%，根據HPLC，純度> 99.99%)。

以下化合物係以類似方式獲得：

實例	起始材料1	起始材料2	起始材料3	產物	產率
4b		 [90-41-5]	 [1161009-88-6]		78%
4c		 H_2N			73%
4d	 NH_2	 Ph Ph			75%
4e		 [63019-98-7]			79%
4f		 [54810-82-1]			78%

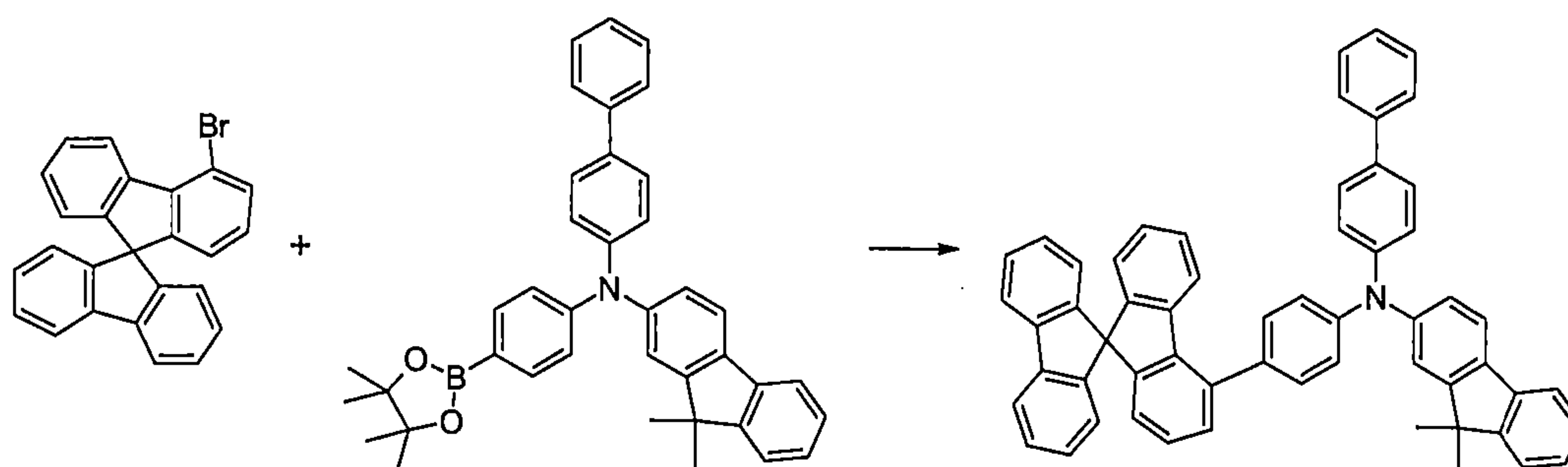
實例 5a：聯苯-4-基-(9,9-二甲基-9H-芴-2-基)-[4-(9,9'-螺-聯芴-4-基)-苯基]-胺之合成

聯苯-4-基-(9,9-二甲基-9H-芴-2-基(4,4,5,5四甲基-[1,3,2]二氧硼啉-2-基)-苯基]-胺之合成



將102 g (198 mmol)聯苯-4-基-(4-溴-苯基)-(9,9-二甲基-9H-芴-2-基)-胺、4.8 g (5.9 mmol) Pd(dppf)Cl_2 、61.6 g (238 mmol)雙(戊醯)二硼及58.3 g (594 mmol)乙酸鉀溶解於1300 ml 1,4-二噁烷中。在氬氣氣氛下將反應混合物回流並攪動12小時並在冷卻至室溫後，藉助矽藻土過濾混合物。在真空中蒸發濾液，並使殘餘物自庚烷結晶。分離出呈淺黃色固體形式之產物(87 g，理論為78%)。

聯苯-4-基-(9,9-二甲基-9H-芴-2-基)-[4-(9,9'-螺-聯芴-4-基)-苯基]-胺之合成

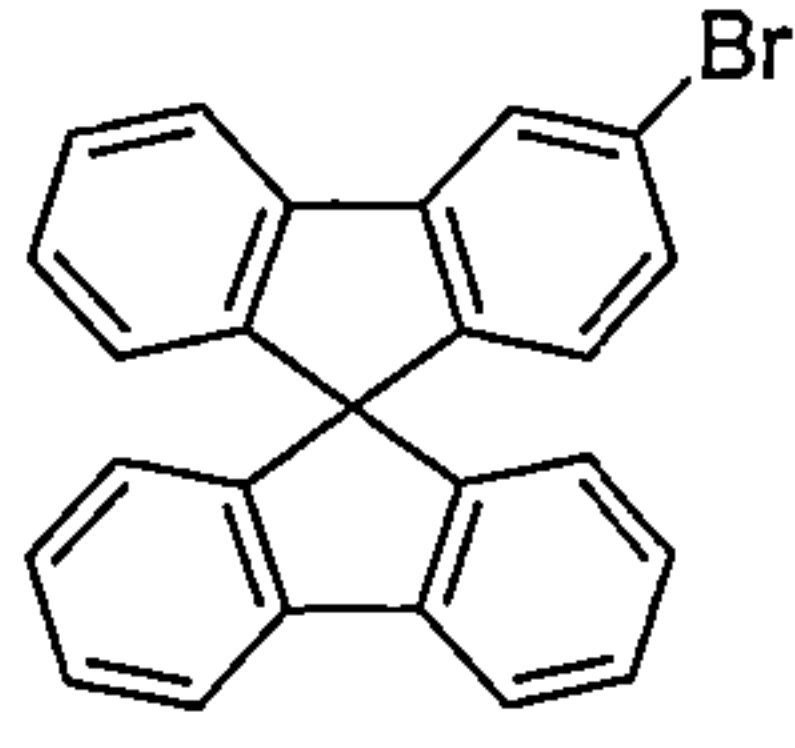
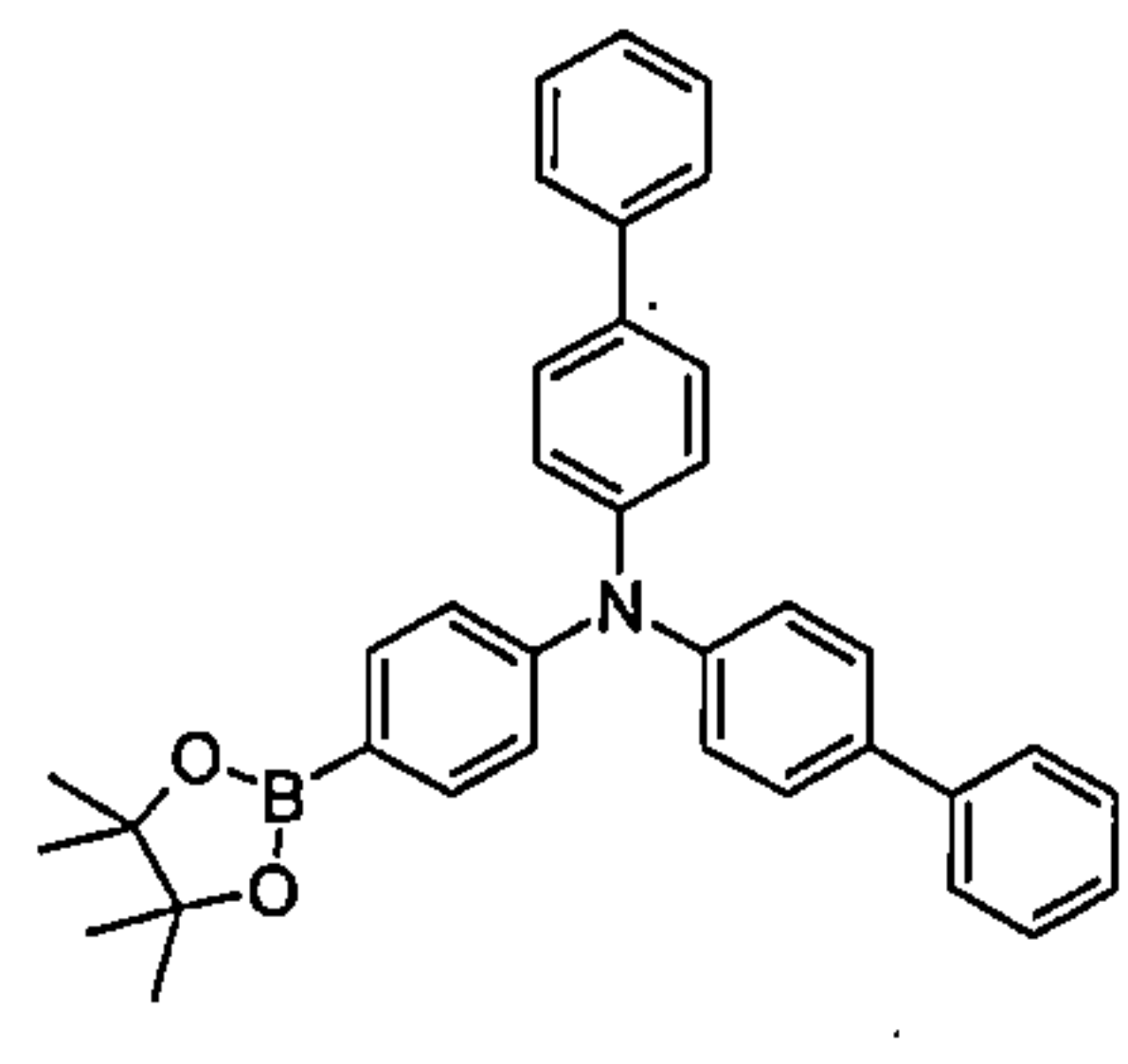
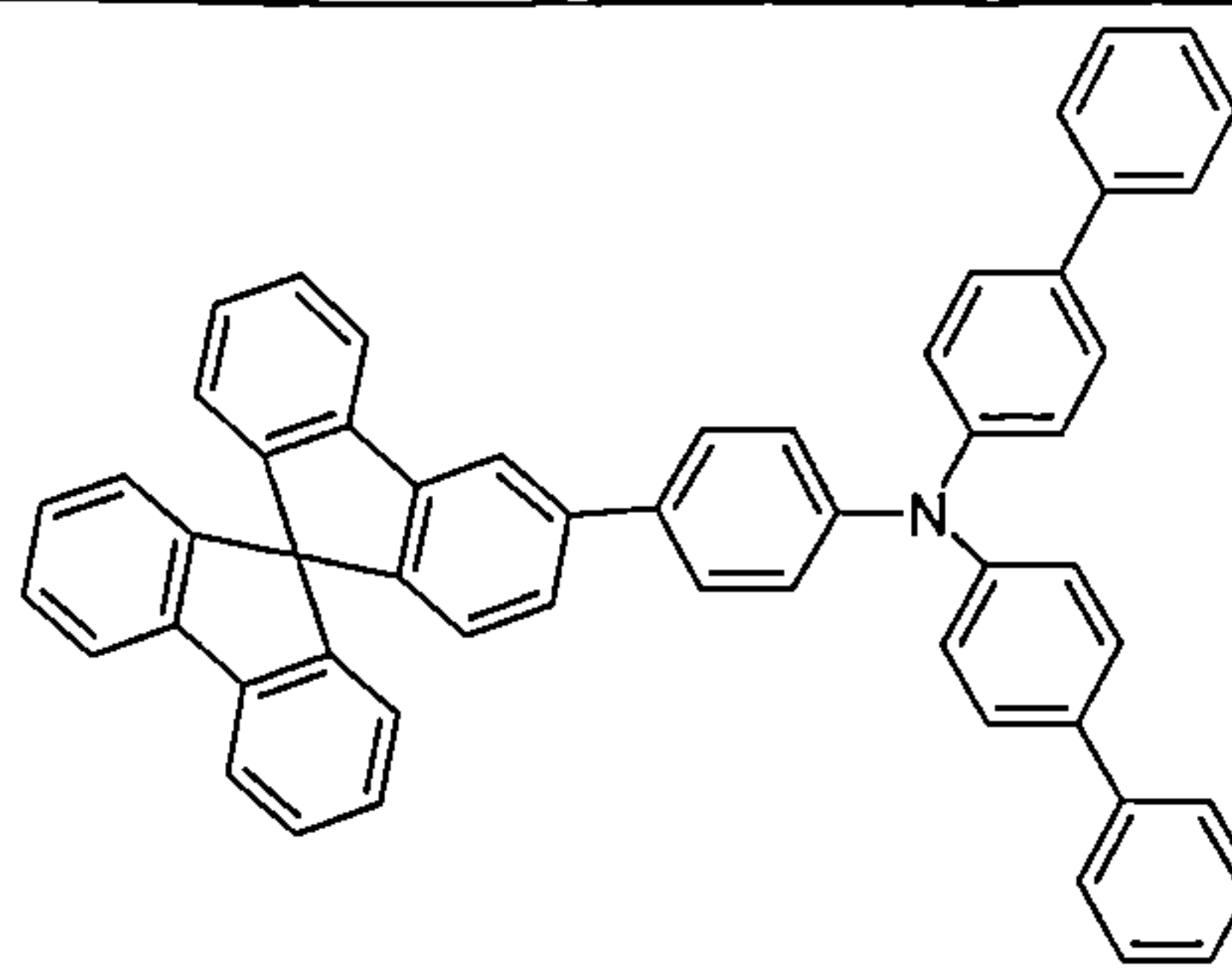
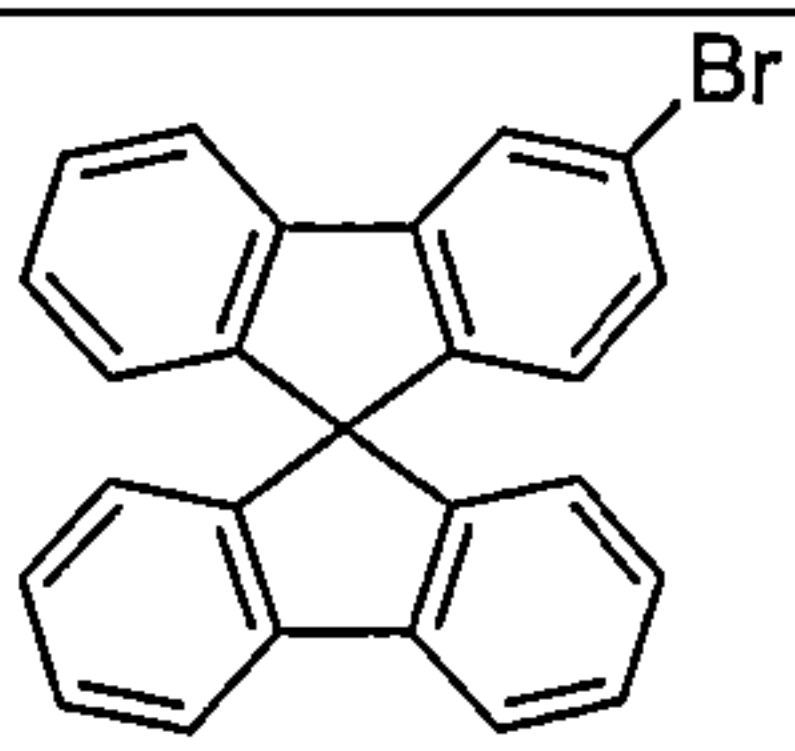
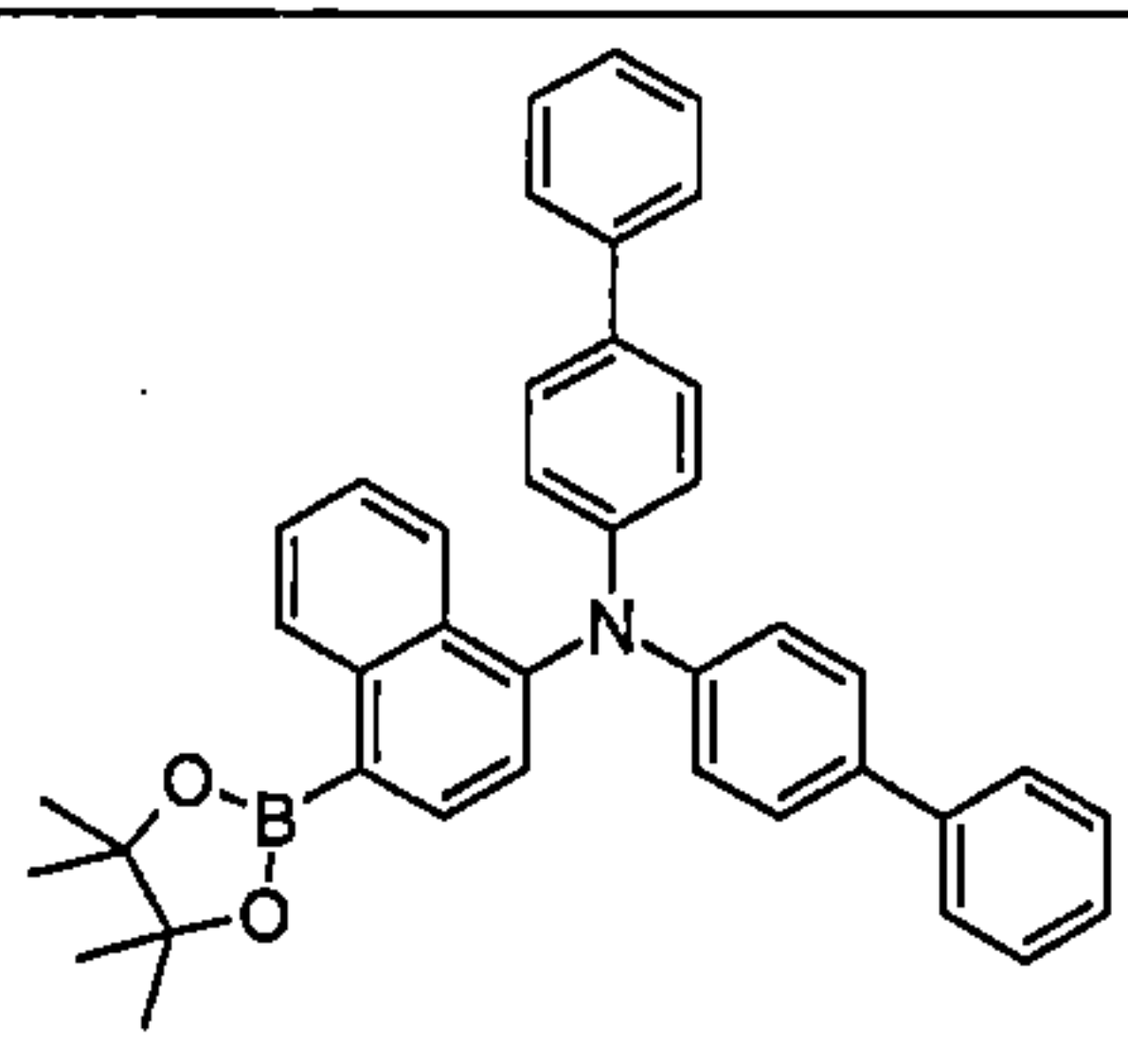
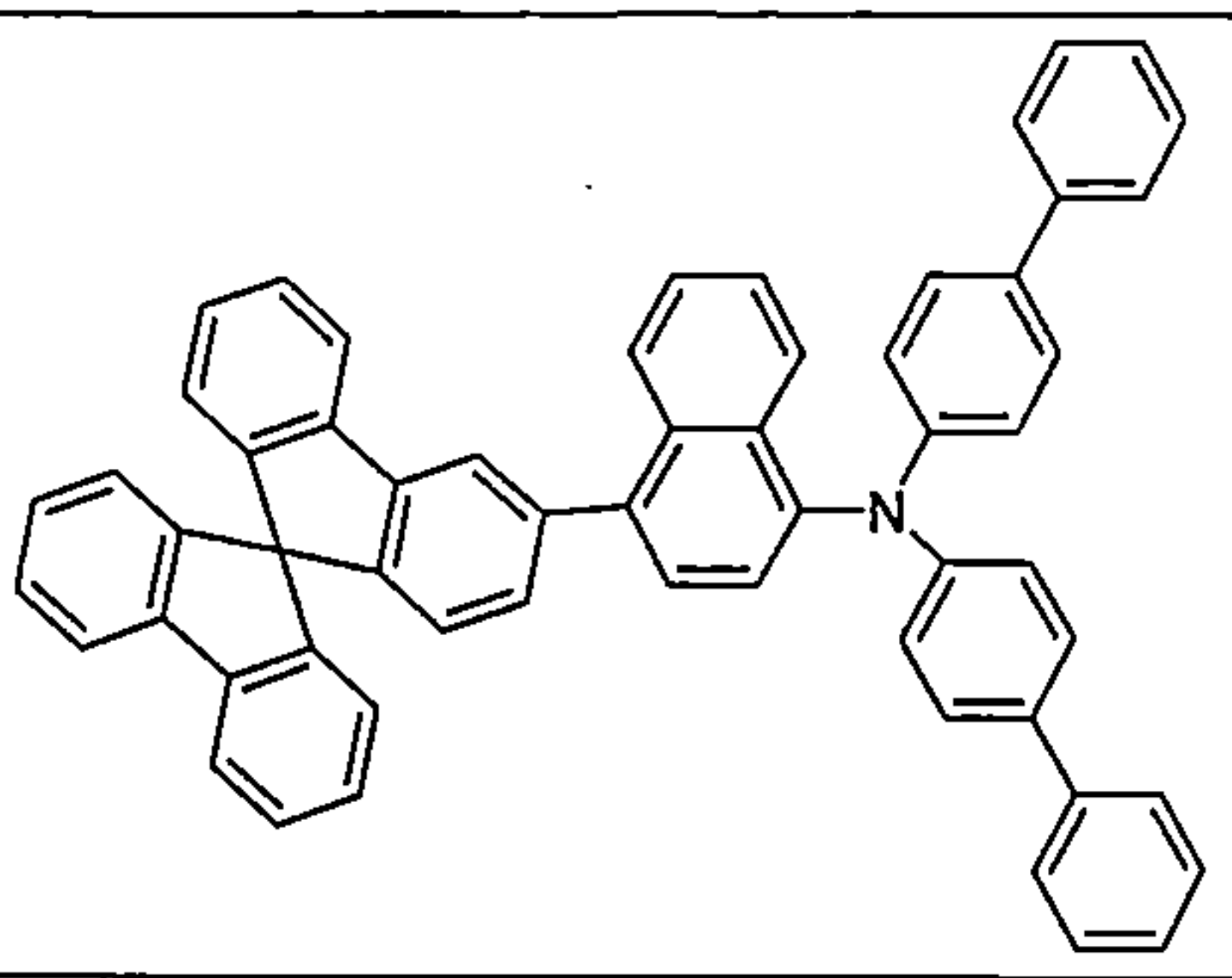
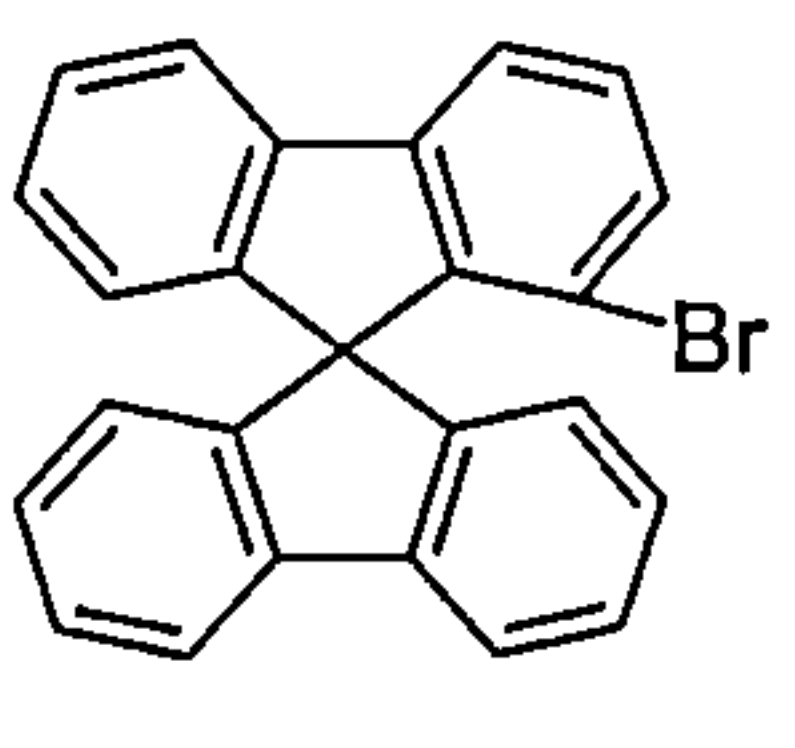
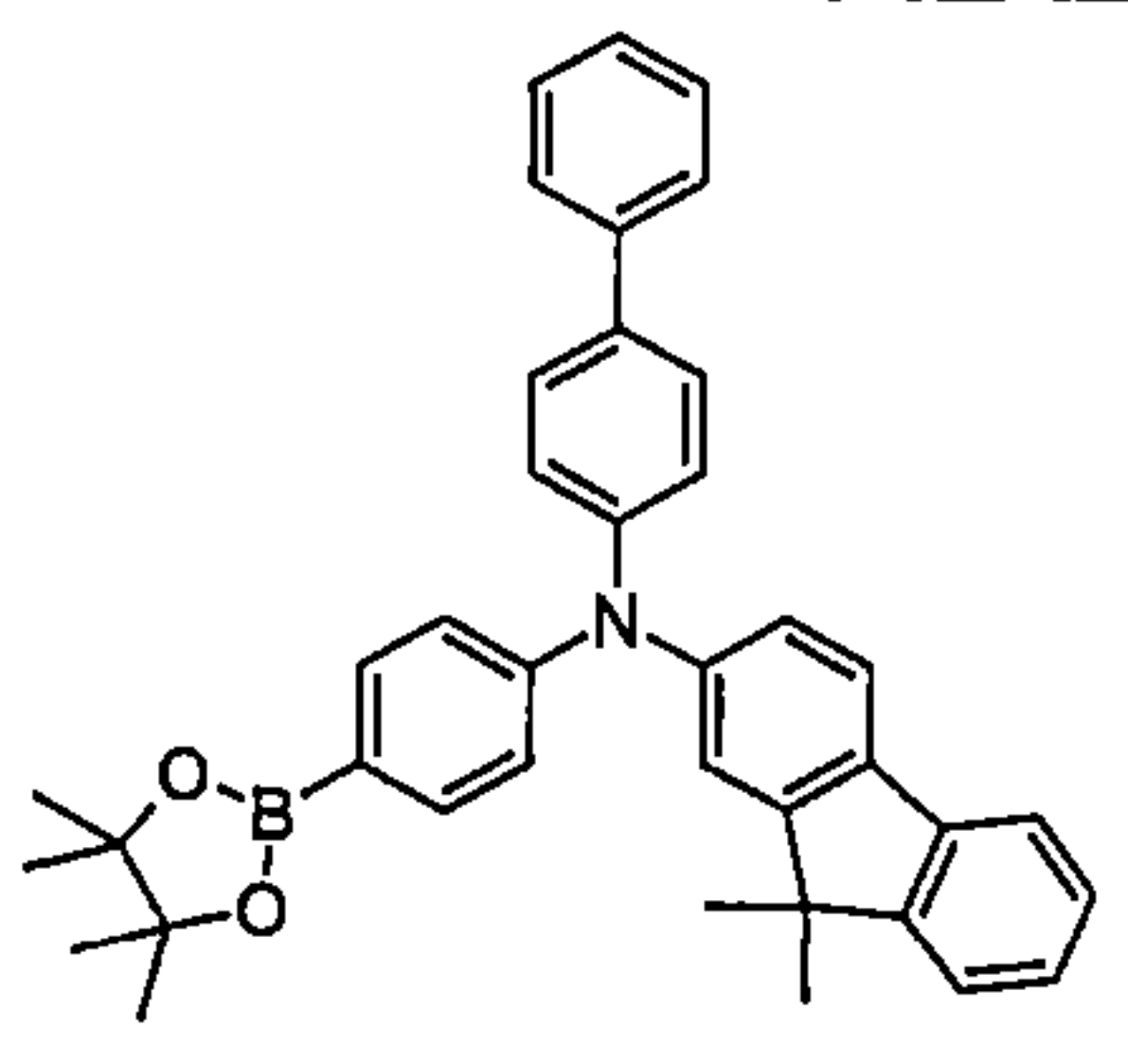
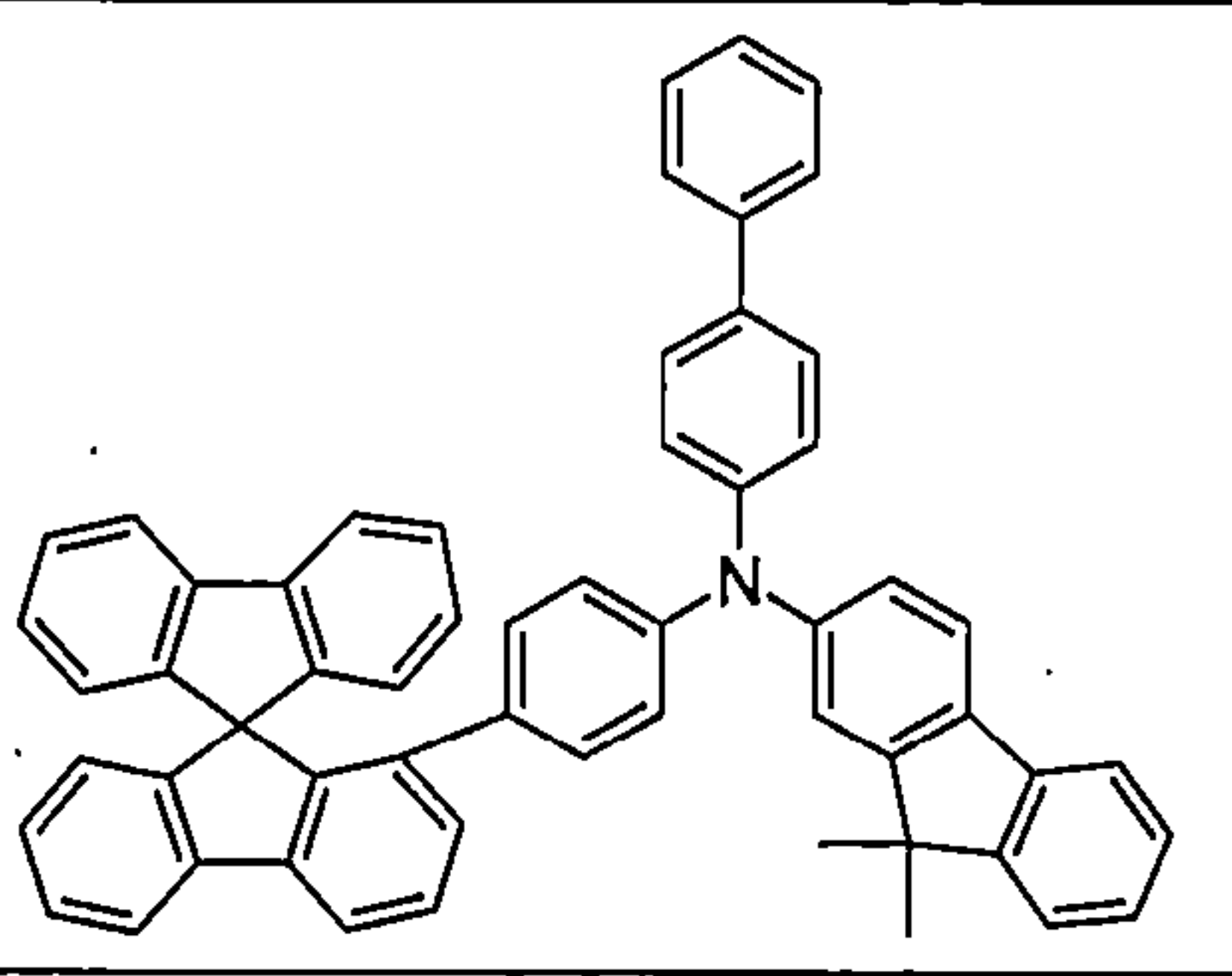
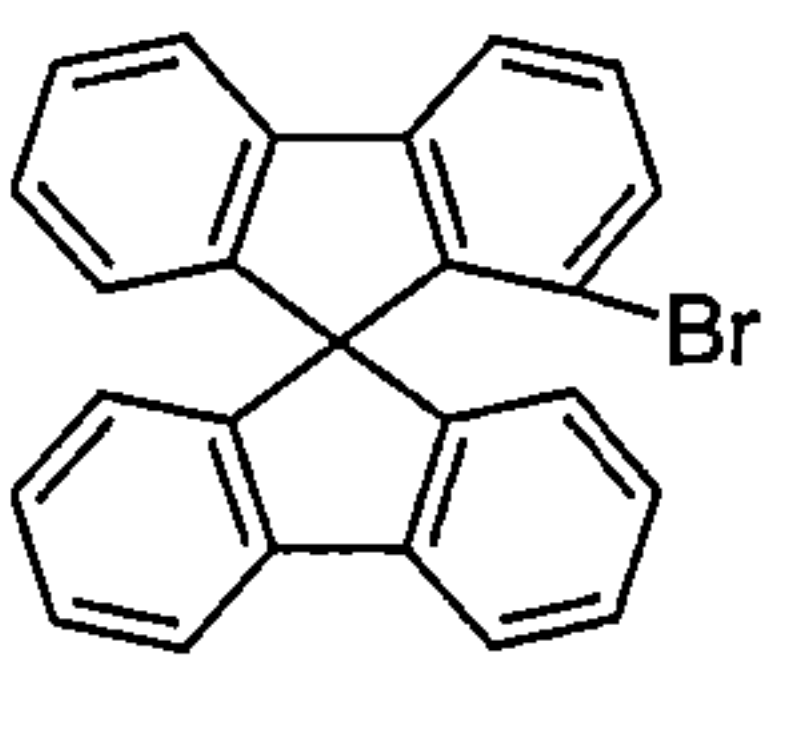
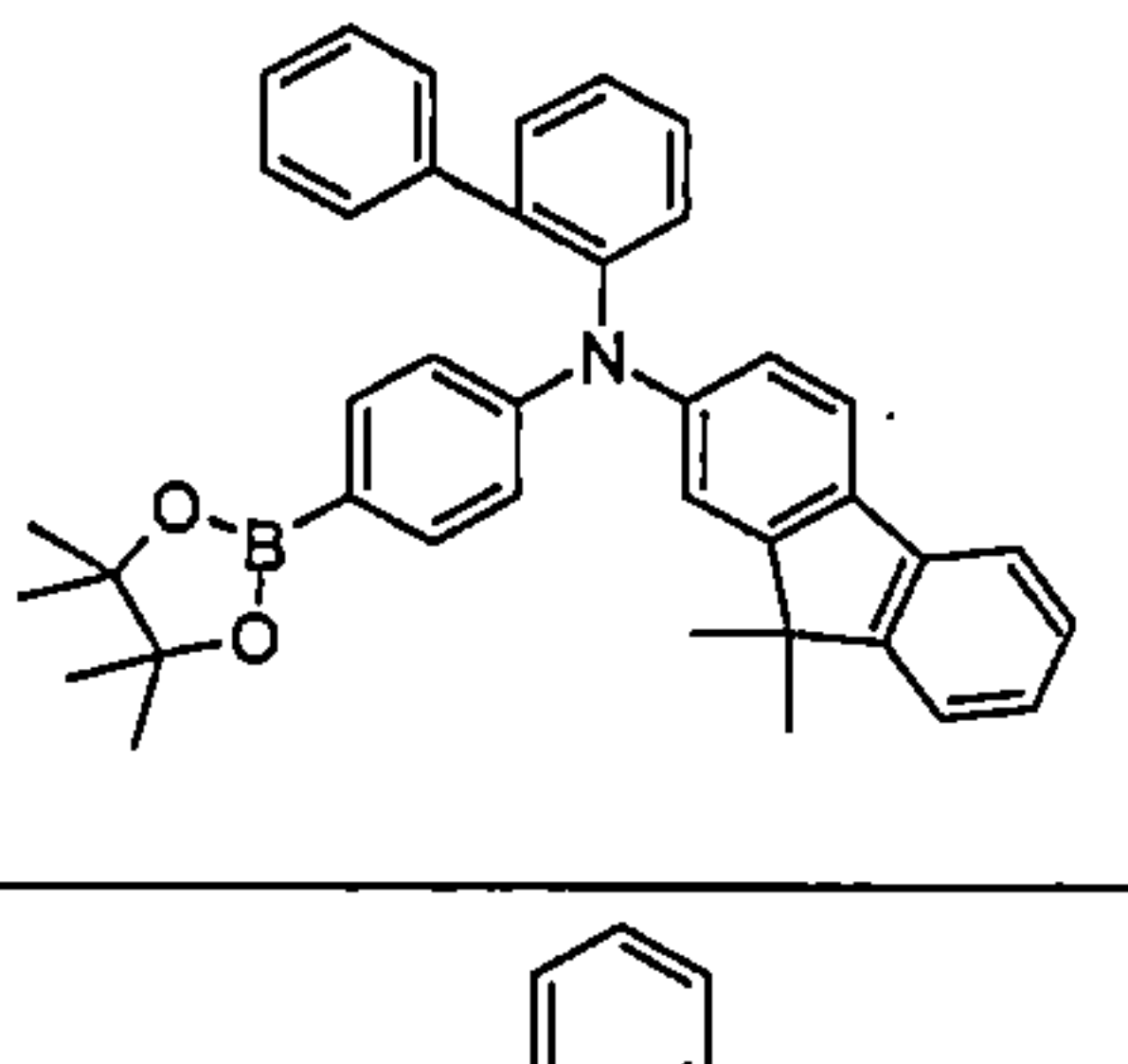
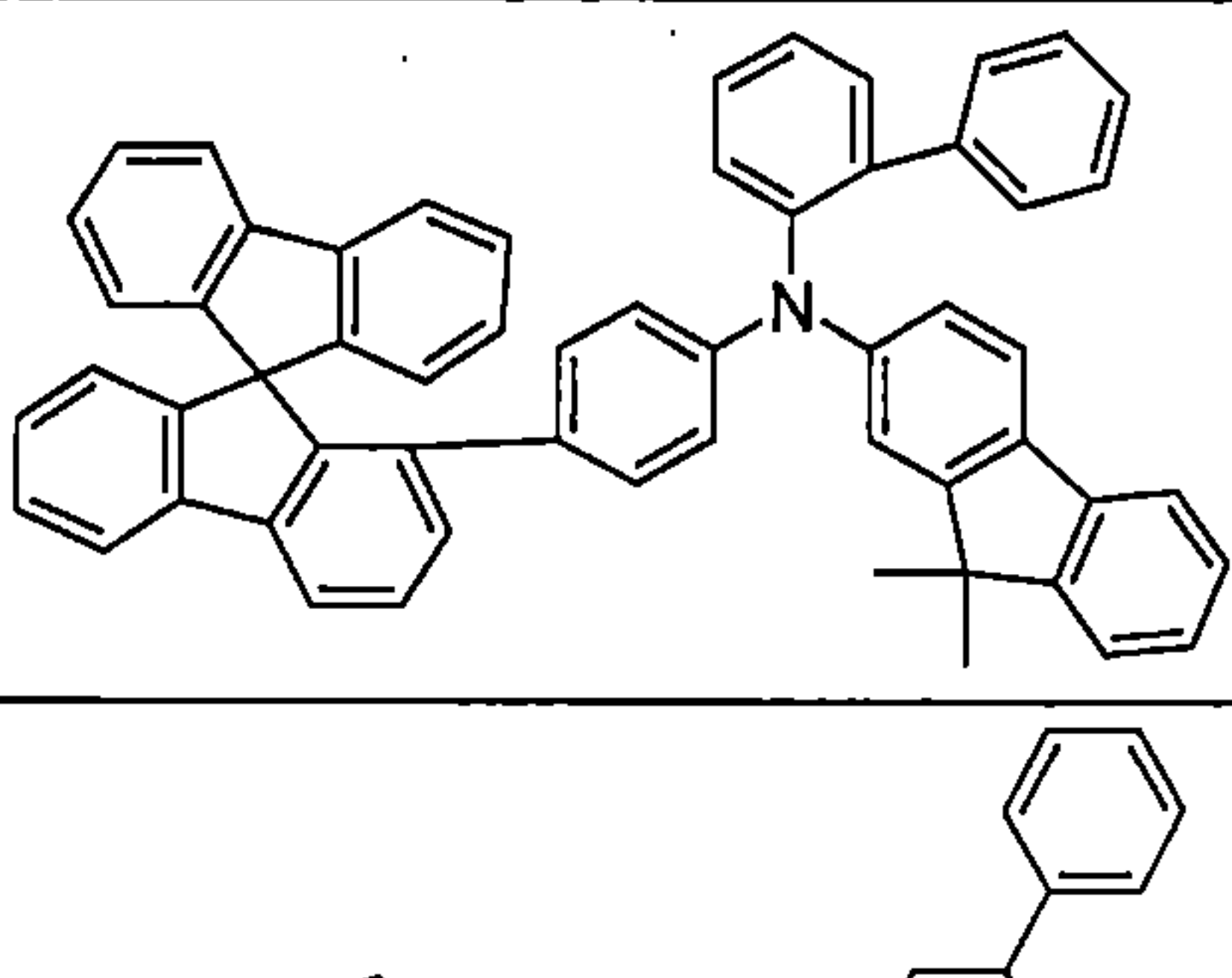
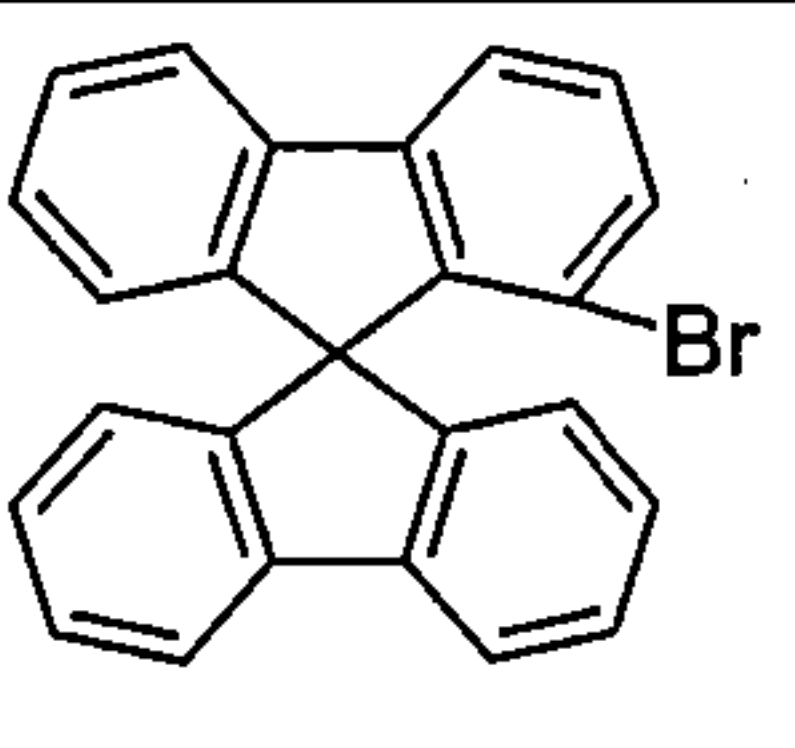
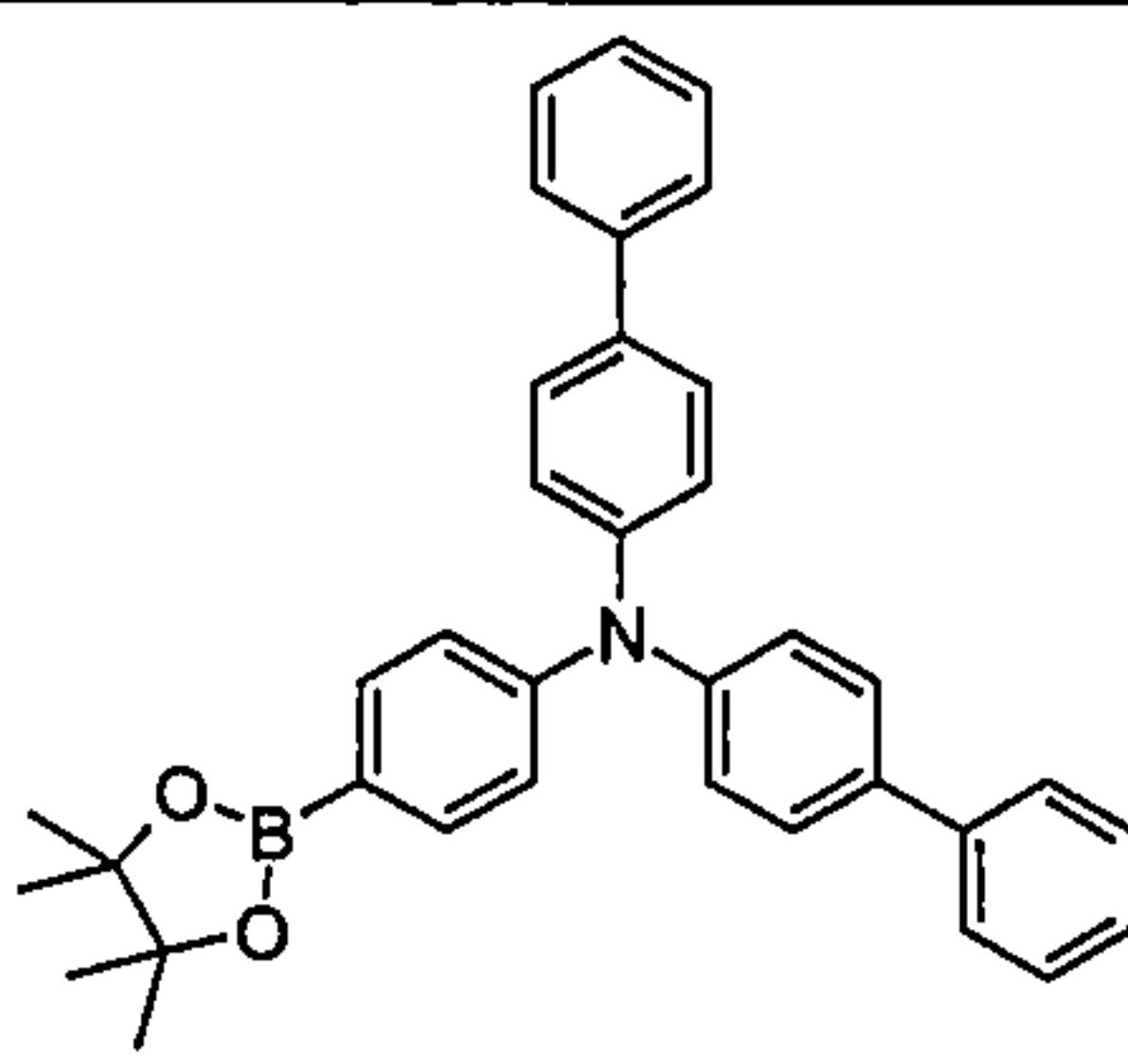
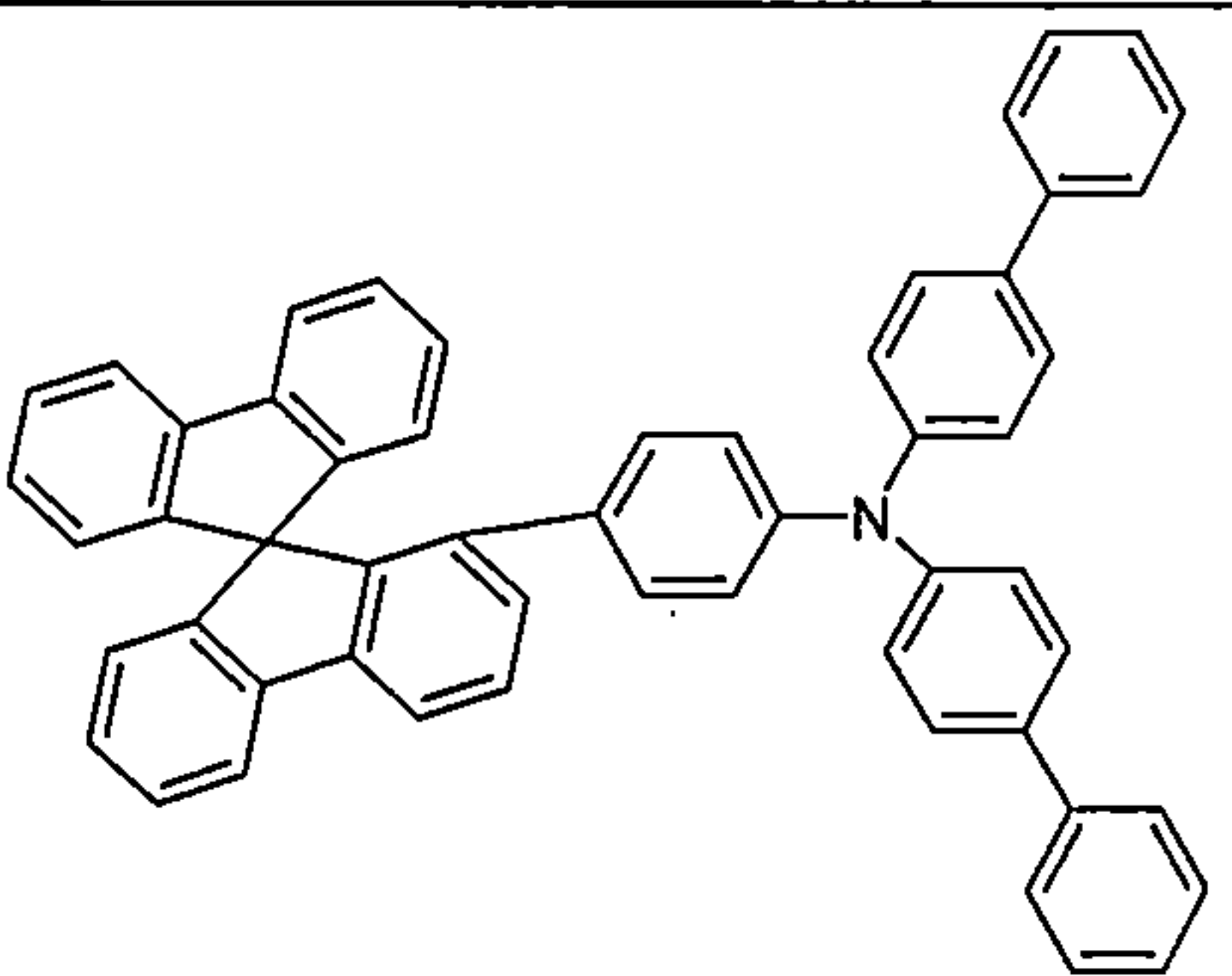
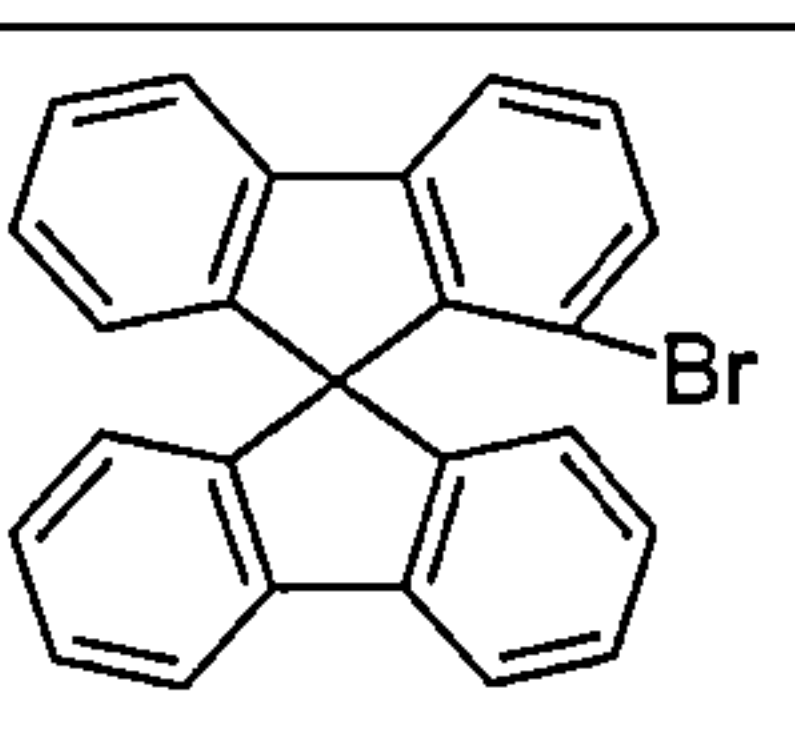
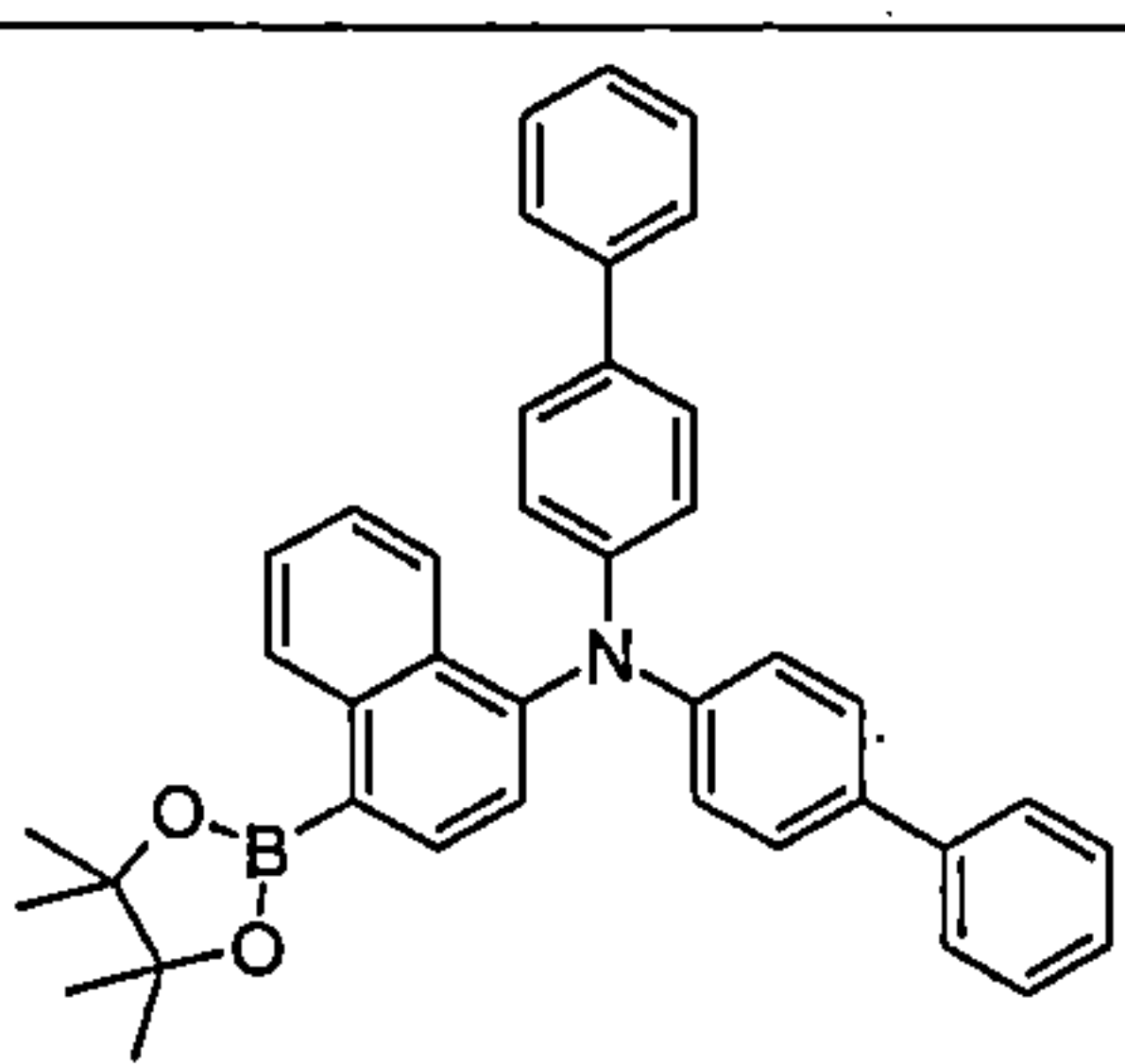
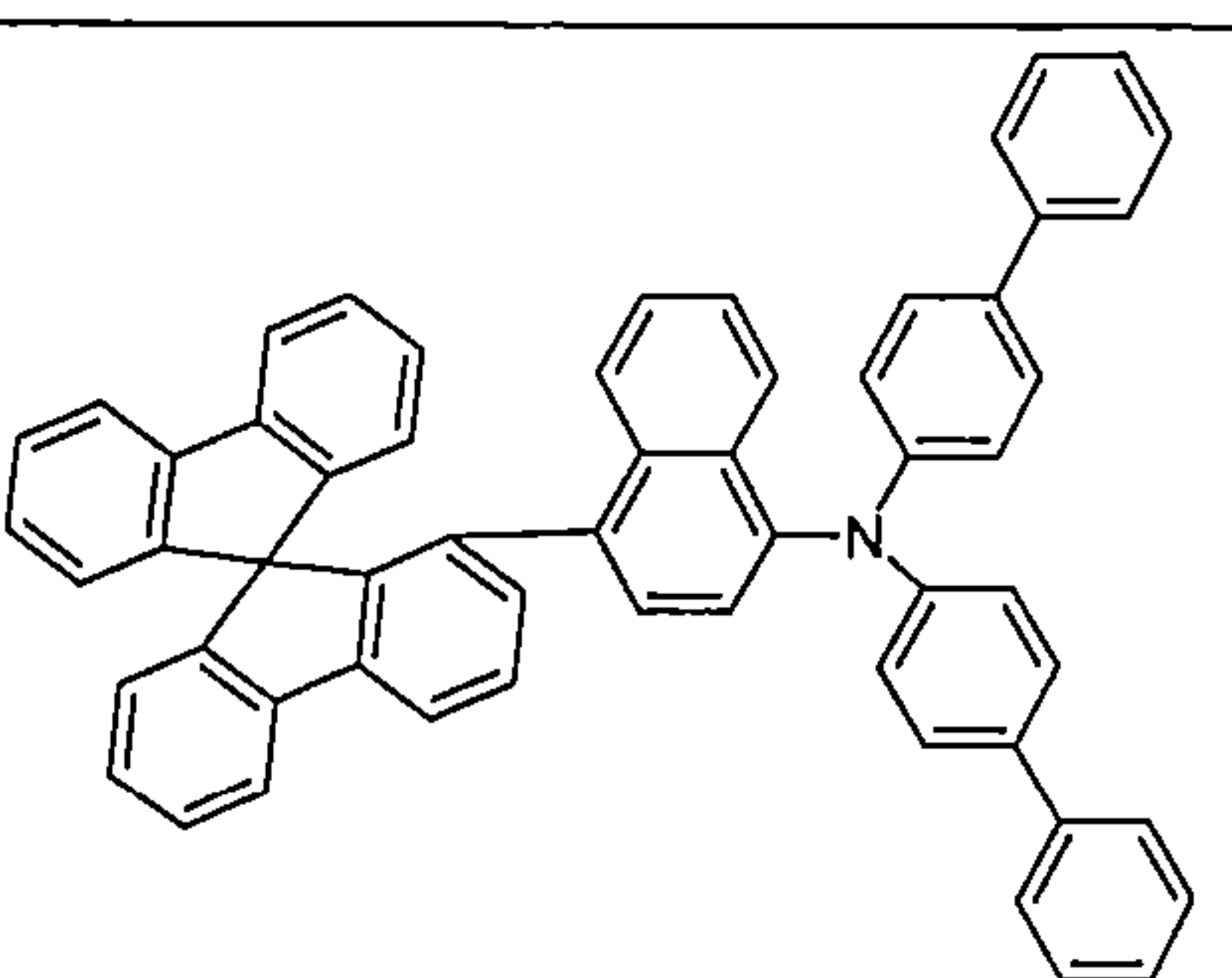


將28 g (49.4 mmol)聯苯-4-基-(9,9-二甲基-9H-芴-2-基(4,4,5,5-四甲基-[1,3,2]二氧硼啉-2-基)-苯基)-胺、20 g (49.4 mmol) 4-溴螺二芴、1.8 g (2.5 mmol) $\text{PdCl}_2(\text{Cy})_3$ 、15 g (99 mmol)氟化銣溶解於500 ml甲苯中。在氬氣氣氛下將反應混合物回流並攪動12小時並在冷卻至室溫

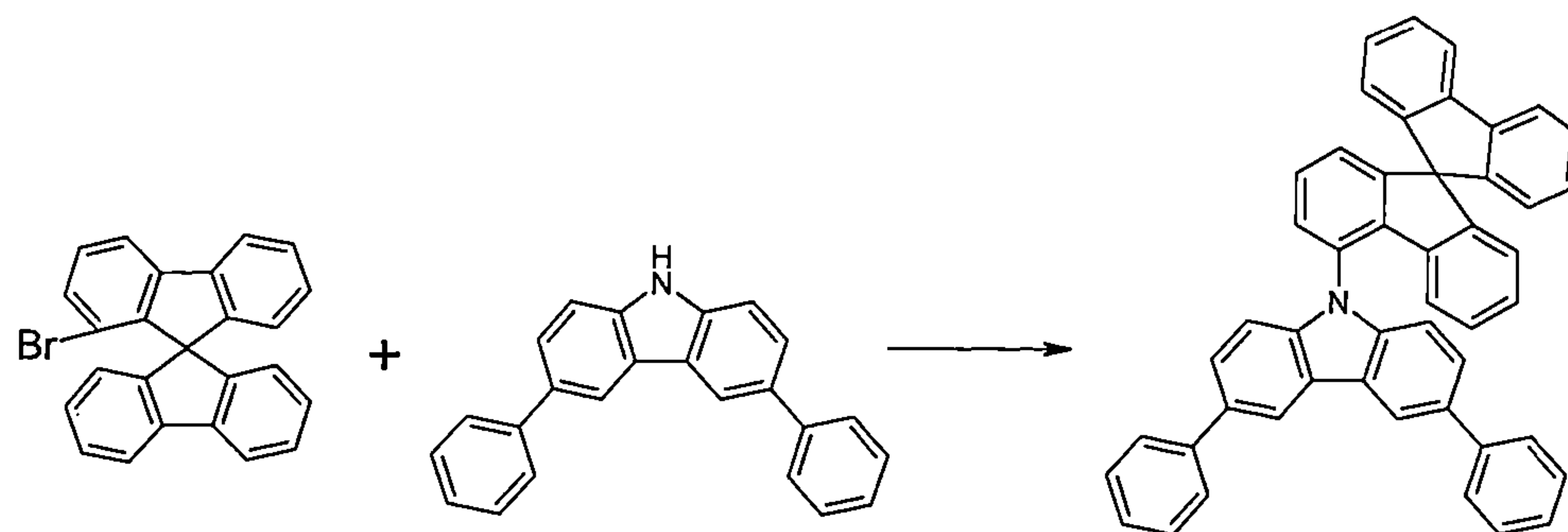
後，藉助矽藻土過濾混合物。在真空中蒸發濾液，並使殘餘物自庚烷結晶。在索氏萃取器(甲苯)中萃取粗製產物並藉由在真空中區域昇華兩次來純化。分離出呈淺黃色固體形式之產物(9 g，理論為24%，根據HPLC，純度> 99.99%)。

以下化合物係以類似方式合成：

實例	Br-螺環	胺	產物	產率
5b				43%
5c				55%
5d				60%
5e				63%
5f				70%

5g				75%
5h				55%
5i				64%
5j				60%
5k				67%
5l				58%

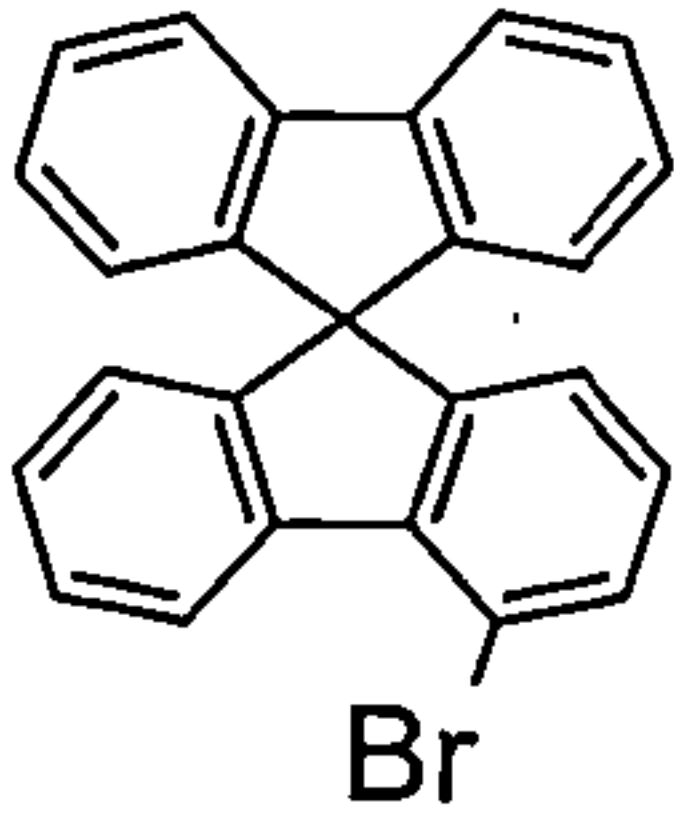
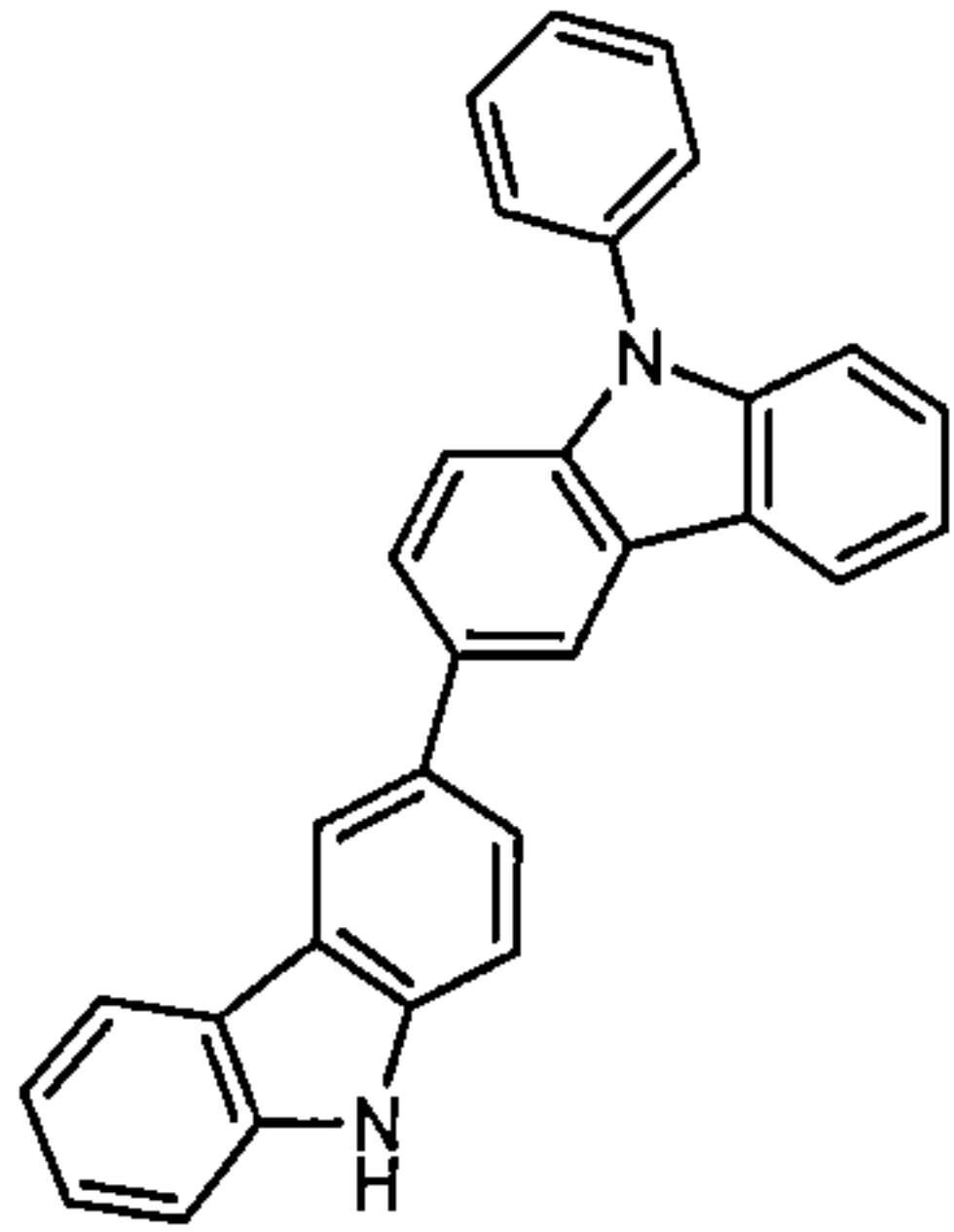
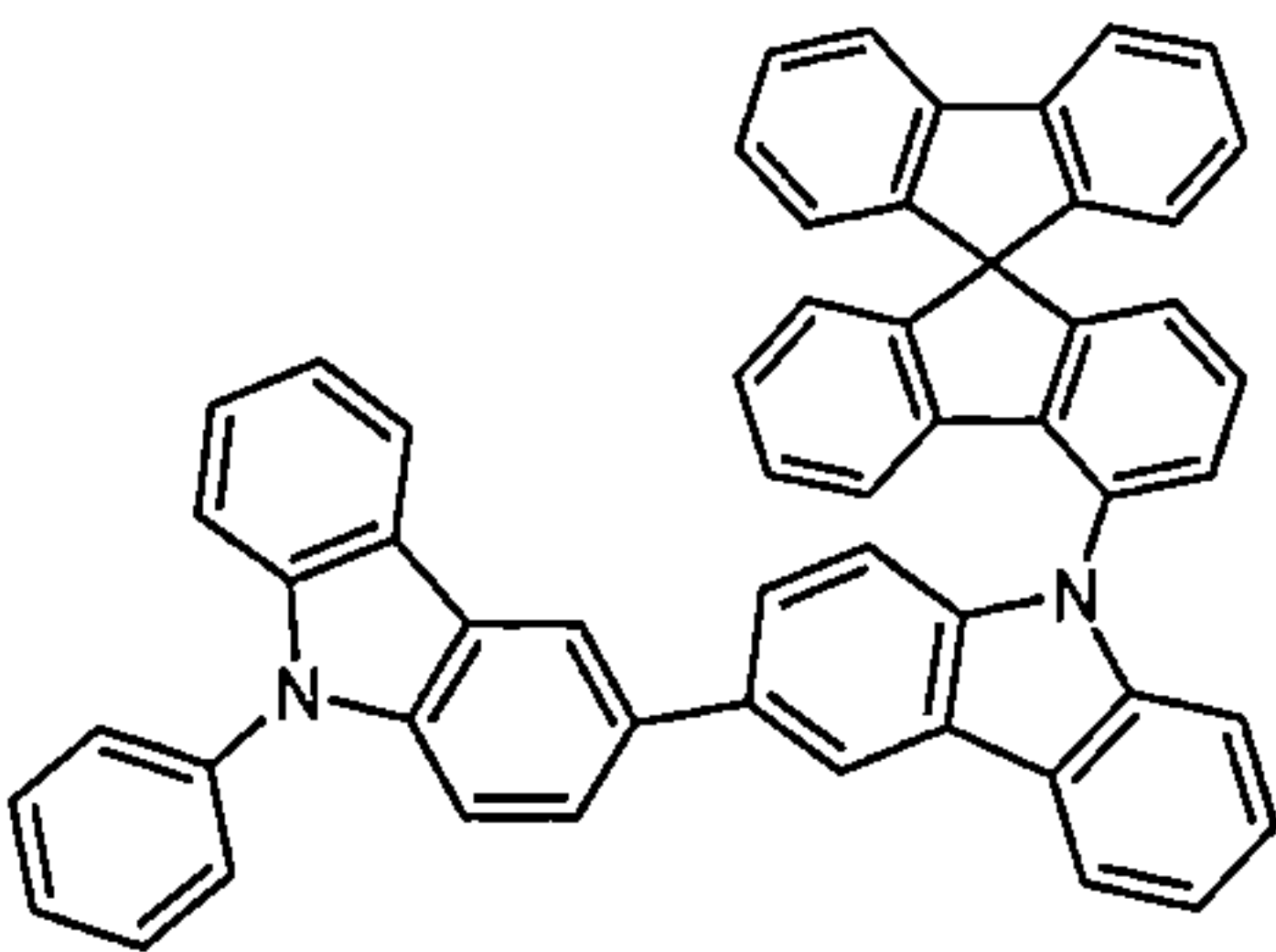
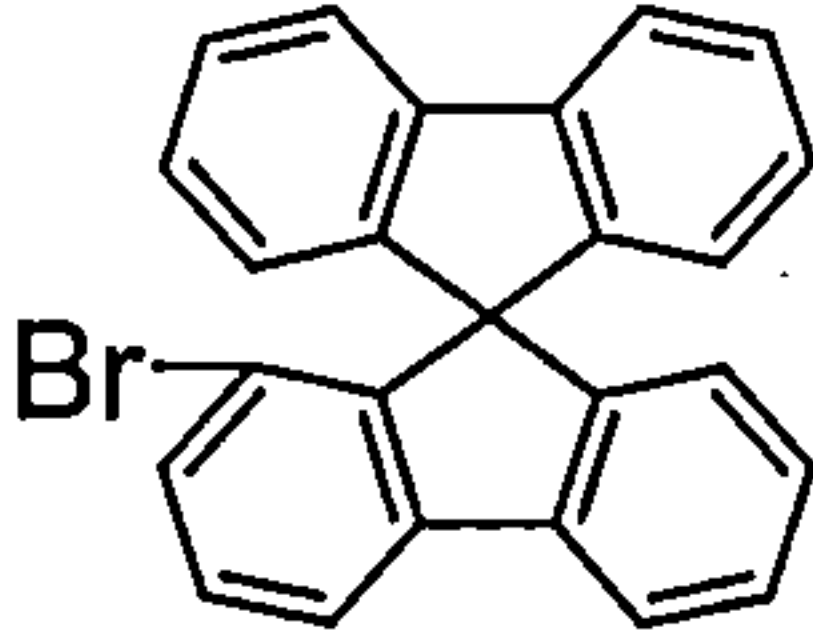
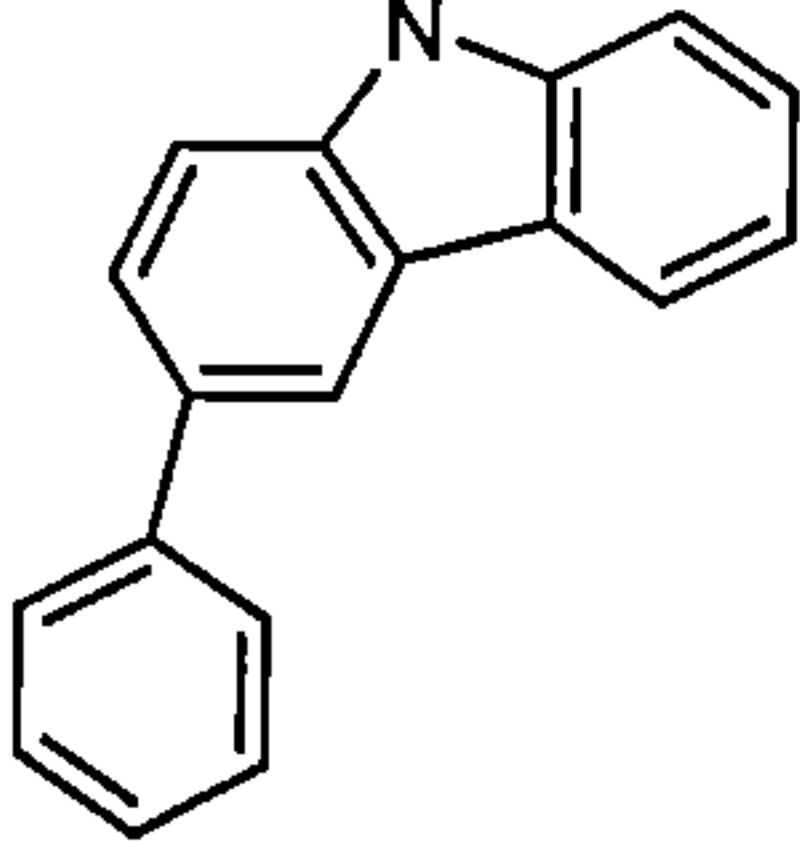
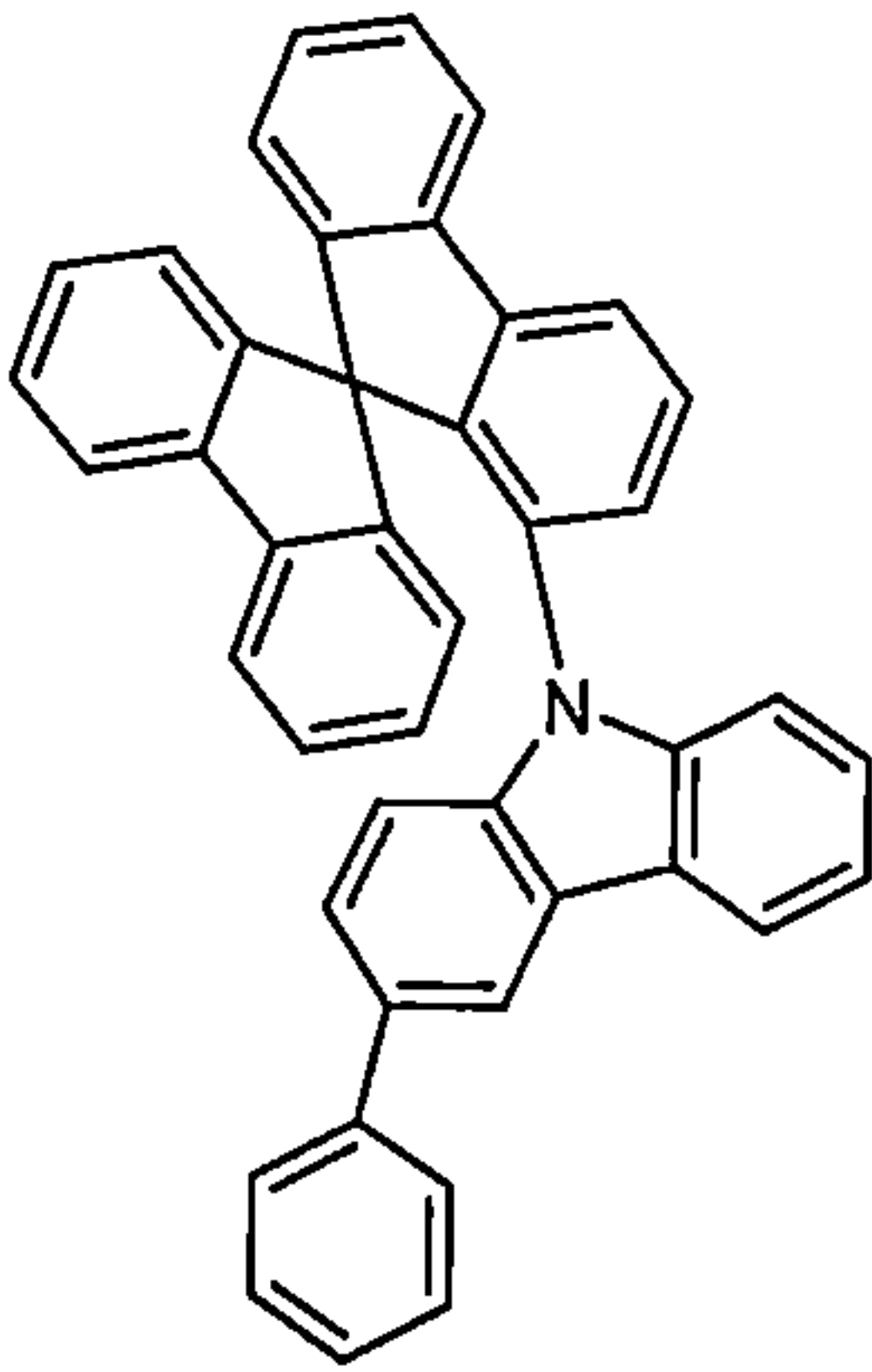
實例 6a：9-螺-4-基-3,6-二苯基-9H-吡啶



將19.2 g (47 mmol) 4-溴-9-螺二萸、15 g (47 mmol) 3,6-二苯基-9-H-卡啞及29.2 g Rb_2CO_3 懸浮於250 mL對-二甲苯中。向懸浮液中給與0.95 g (4.2 mmol) $\text{Pd}(\text{OAc})_2$ 及12.6 ml 1M三-第三丁基膦溶液。在回流下將混合物攪拌24 h。在冷卻後，分離出有機相，用150 mL水洗滌3次且隨後在真空中濃縮至乾燥。用甲苯熱萃取殘餘物，自甲苯重結晶三次，隨後在高真空下昇華。產率為19.6 g (30.9 mmol)，此對應於理論為66%。根據HPLC，純度為99.9%。

以下化合物係以類似方式獲得：

	起始材料1	起始材料2	產物	產率
6b		 1257220-47-5		76%
6c		 1257220-47-5		65%

6d		 1060735-14-9		77%
6e		 103012-26-6		69%

B)裝置實例

藉由WO 2004/058911之一般方法來製造本發明OLED及先前技術OLED，該方法適於此處所述情況(層厚度變化，材料)。

多個OLED之數據展示於下文實例1至5中(參見表1至表7)。

所用基板係以50 nm厚度塗佈有結構化ITO (氧化銦錫)之玻璃板。OLED基本上具有以下層結構：基板/電洞注入層(IL)/電洞傳輸層(HTL)/電洞注入層(IL)電子阻擋層(EBL)/發射層(EML)/電子傳輸層(ETL)及最後陰極。在表3之裝置結構中，使用類似結構，只是省略第一電洞注入層。

其他實例係以表6中所顯示之以下一般裝置結構展示：基板/p型摻雜電洞傳輸層(HIL1)/電洞傳輸層(HTL)/p型摻雜電子阻擋層(HIL2)/電子阻擋層(EBL)/發射層(EML)/電子傳輸層(ETL)/電子注入層(EIL)及最後陰極。陰極係由厚度為100 nm之鋁層形成。

其他實例係以表7中所顯示之以下一般裝置結構展示。此結構與表6實例之結構不同之處在於省略第二p型摻雜電子阻擋層且在發射層

與電子傳輸層之間存在電洞阻擋層(HBL)。

在本實例中製備之所有OLED之精確結構顯示於表1、表3、表6及表7中。製造該等OLED所需之材料顯示於表5中。所獲得之數據存於正文中及/或顯示於表2及表4中。

所有材料均係在真空室中藉由熱蒸氣沈積來施加。此處發射層通常由至少一種基質材料(主體材料)及一種發射摻雜劑(發射體)組成，該發射摻雜劑係藉由共蒸發與該(等)基質材料以某一體積比混合。此處諸如H1:SEB1 (95%:5%)等表達意指材料H1係以95%之體積比存於該層中且SEB1係以5%之比例存於該層中。類似地，電子傳輸層亦可由兩種材料之混合物組成。

OLED係藉由標準方法來表徵。出於此目的，測定電致發光光譜、電流效率(以cd/A量測)、功率效率(以lm/W量測)及外部量子效率(EQE，以百分比量測)隨發光密度(自假定Lambert發射特性之電流/電壓/發光密度特性線(IUL特性線)計算)之變化及壽命。在1000 cd/m²之發光密度下測定電致發光光譜，並自其計算CIE 1931 x及y色坐標。表達在1000 cd/m²下之EQE表示在1000 cd/m²之操作發光密度下之外部量子效率。在6000 cd/m²下之LT80係直至OLED已自6000 cd/m²之亮度下降至初始強度之80% (即4800 cd/m²)的壽命。在60 mA/cm²下之LT80係直至OLED在60 mA恆定電流下已自其初始亮度下降至初始亮度之80%的壽命。所獲得之多個OLED之數據係匯總於正文中及/或顯示於表2及表4中。

本發明化合物在螢光及磷光OLED中作為電洞傳輸材料之用途

具體而言，本發明化合物適宜作為OLED中之HIL、HTL或EBL。其適宜以單一層亦及混合組份形式用作HIL、HTL、EBL或用於EML內。

實例1

單重態藍色裝置係顯示於表1及表2中，且三重態綠色裝置係顯示於表3及表4中。

與作為參考之包含NPB之裝置(V1、V3)相比，包含本發明化合物之樣品同時在單重態藍色裝置中以及在三重態綠色裝置中展示較高效率以及顯著改良之壽命二者。與參考材料HTMV1 (V2、V4)相比，本發明化合物HTM1具有顯著改良之效率及顯著更佳之壽命。

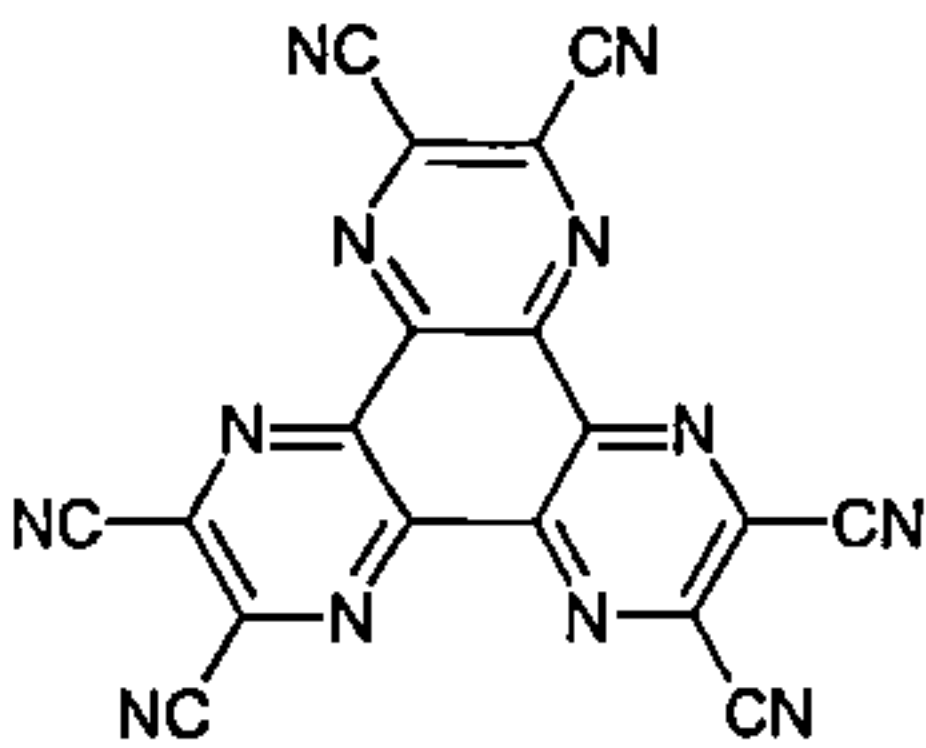
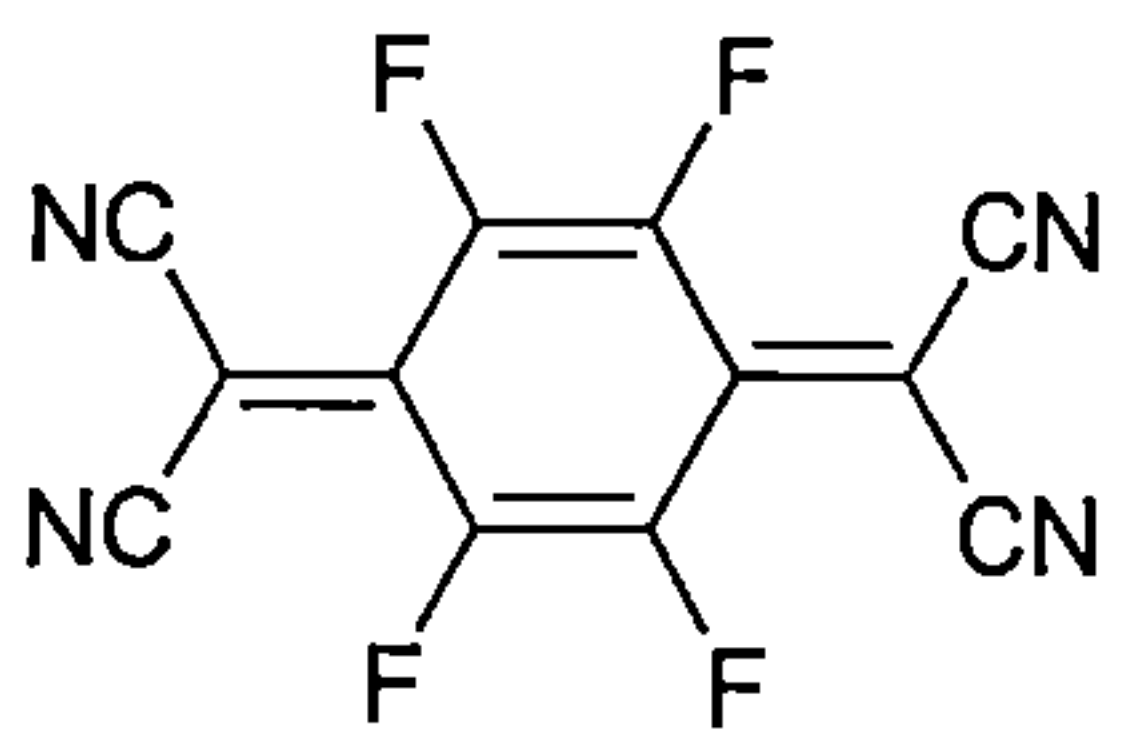
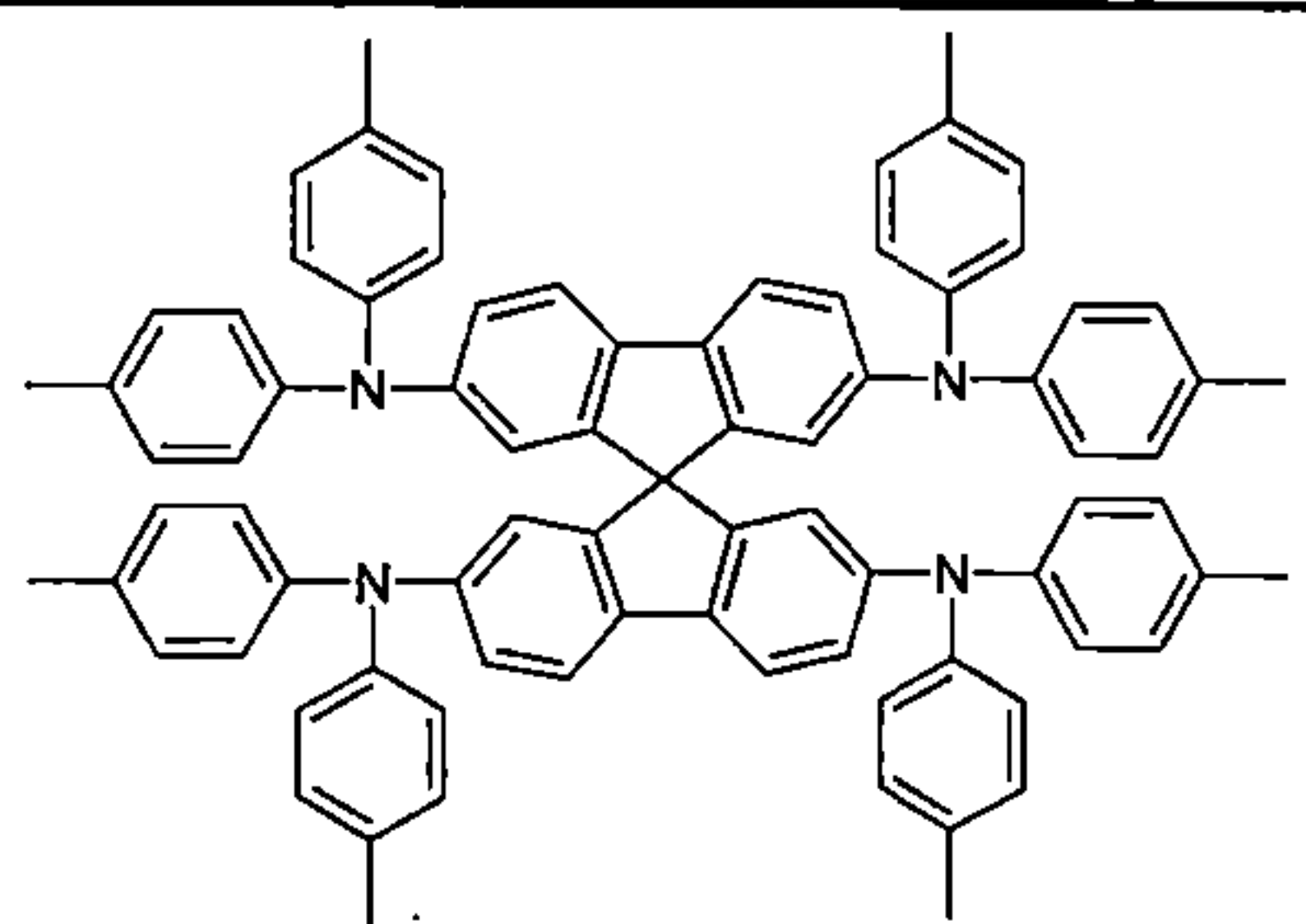
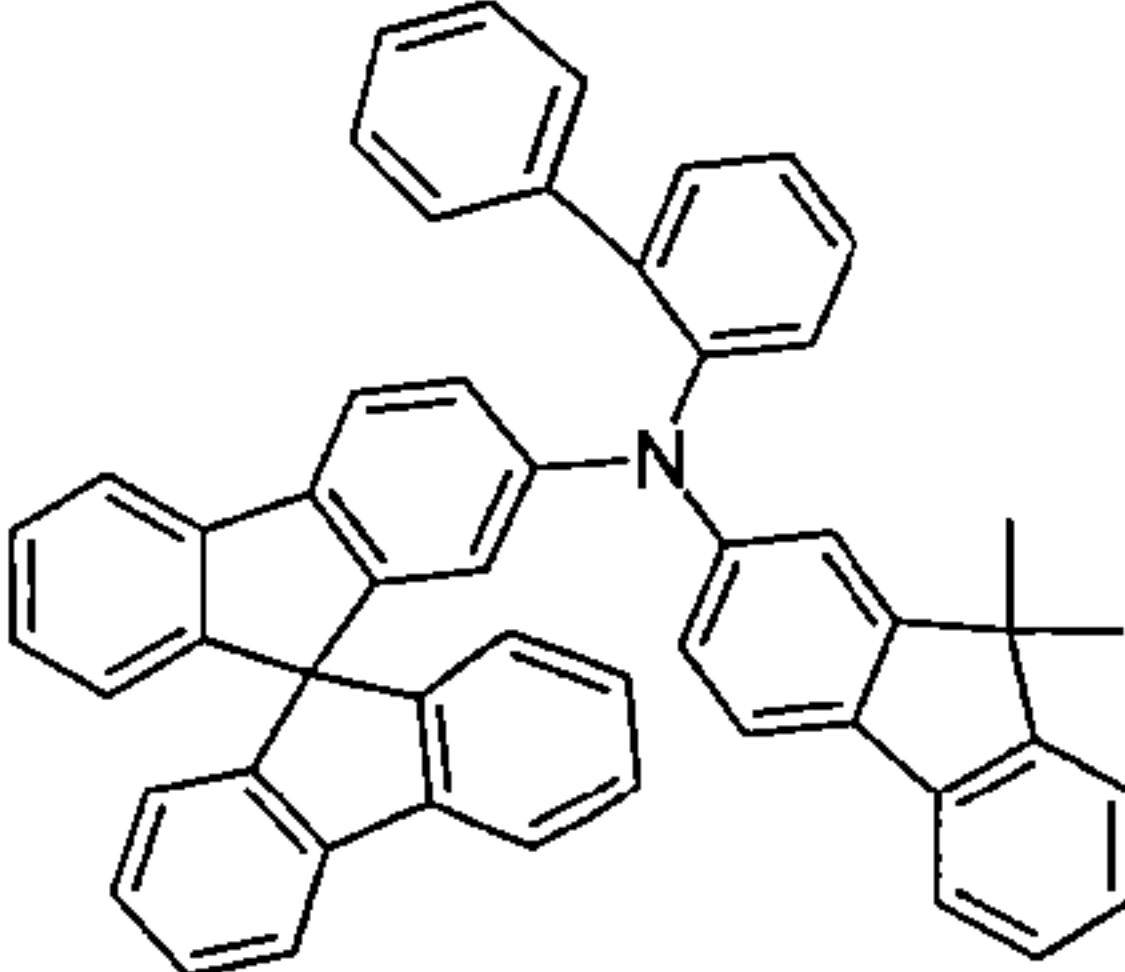
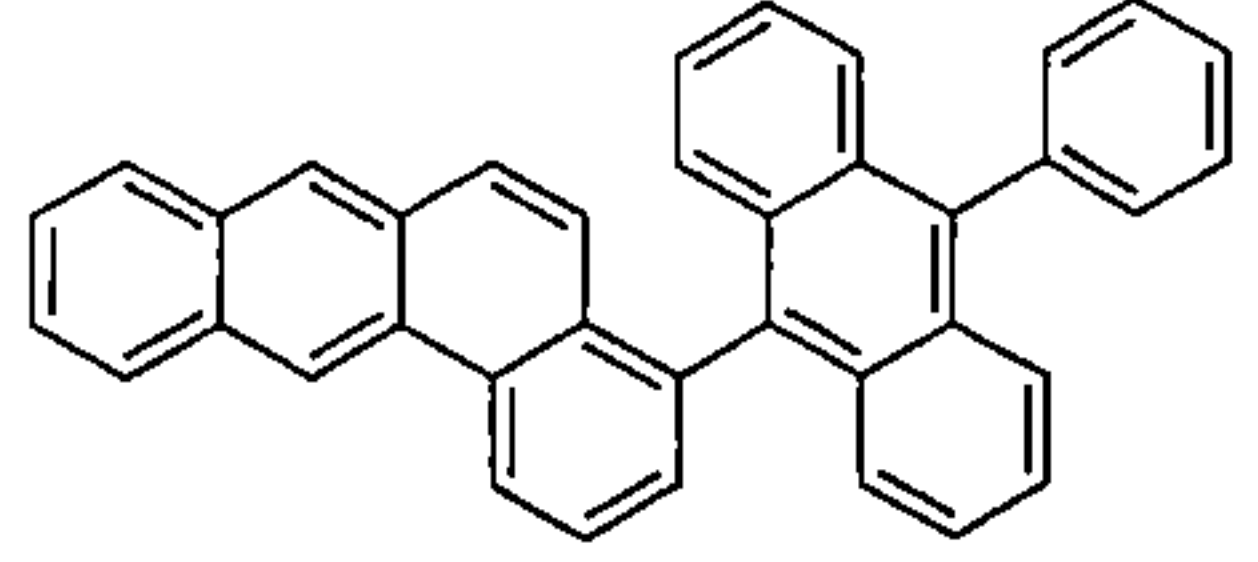
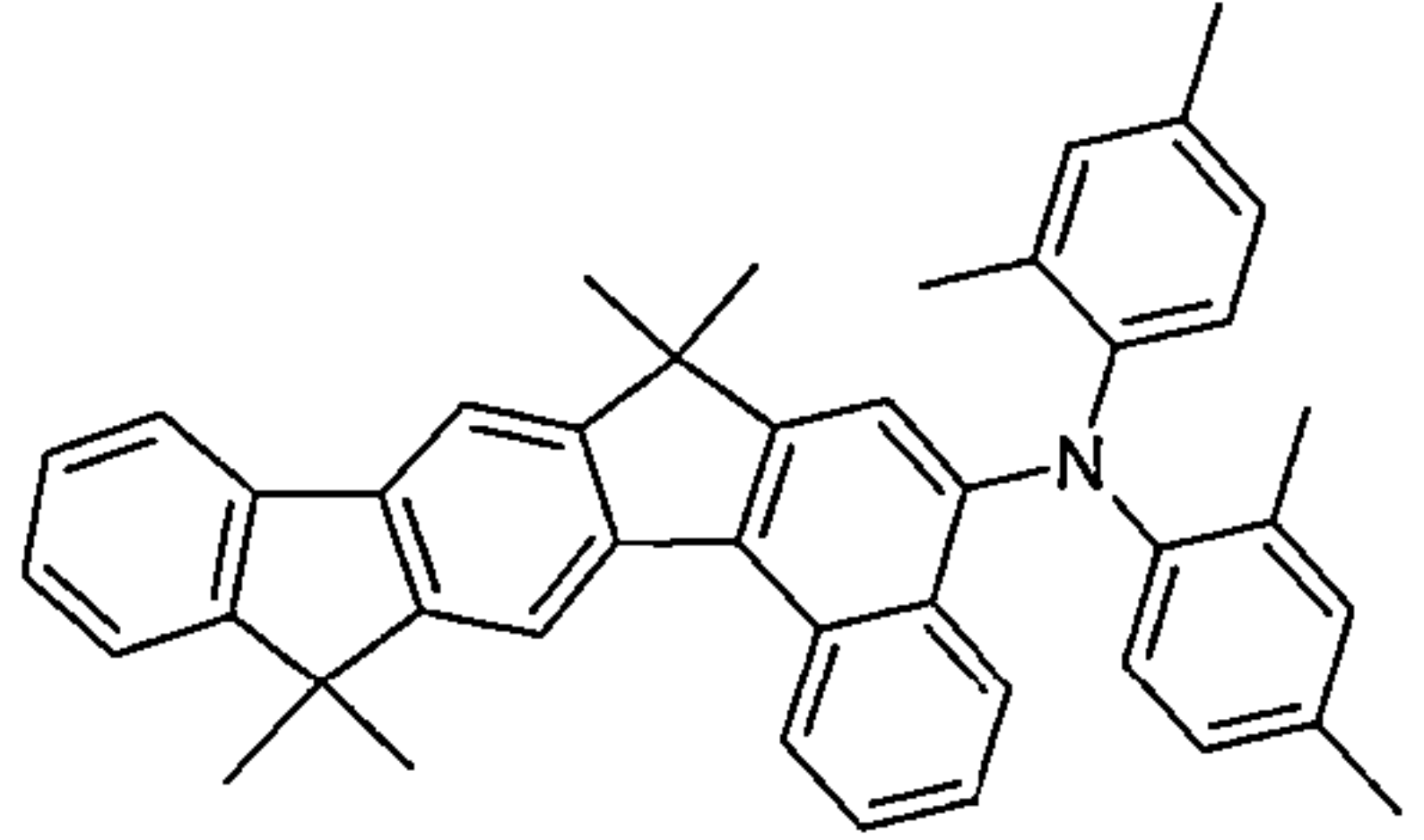
表1：OLED之結構						
實例	IL	HTL	IL	EBL	EML	ETL
	厚度 /nm	厚度 /nm	厚度 /nm	厚度 /nm	厚度/nm	厚度/nm
V1	HIL1 5 nm	HIL2 140 nm	HIL1 5 nm	NPB 20 nm	H1(95%):SEB1(5%) 20 nm	ETM1(50%):LiQ(50%) 30 nm
V2	HIL1 5 nm	HIL2 140 nm	HIL1 5 nm	HTMV1 20 nm	H1(95%):SEB1(5%) 20 nm	ETM1(50%):LiQ(50%) 30 nm
E1	HIL1 5 nm	HIL2 140 nm	HIL1 5 nm	HTM1 20 nm	H1(95%):SEB1(5%) 20 nm	ETM1(50%):LiQ(50%) 30 nm

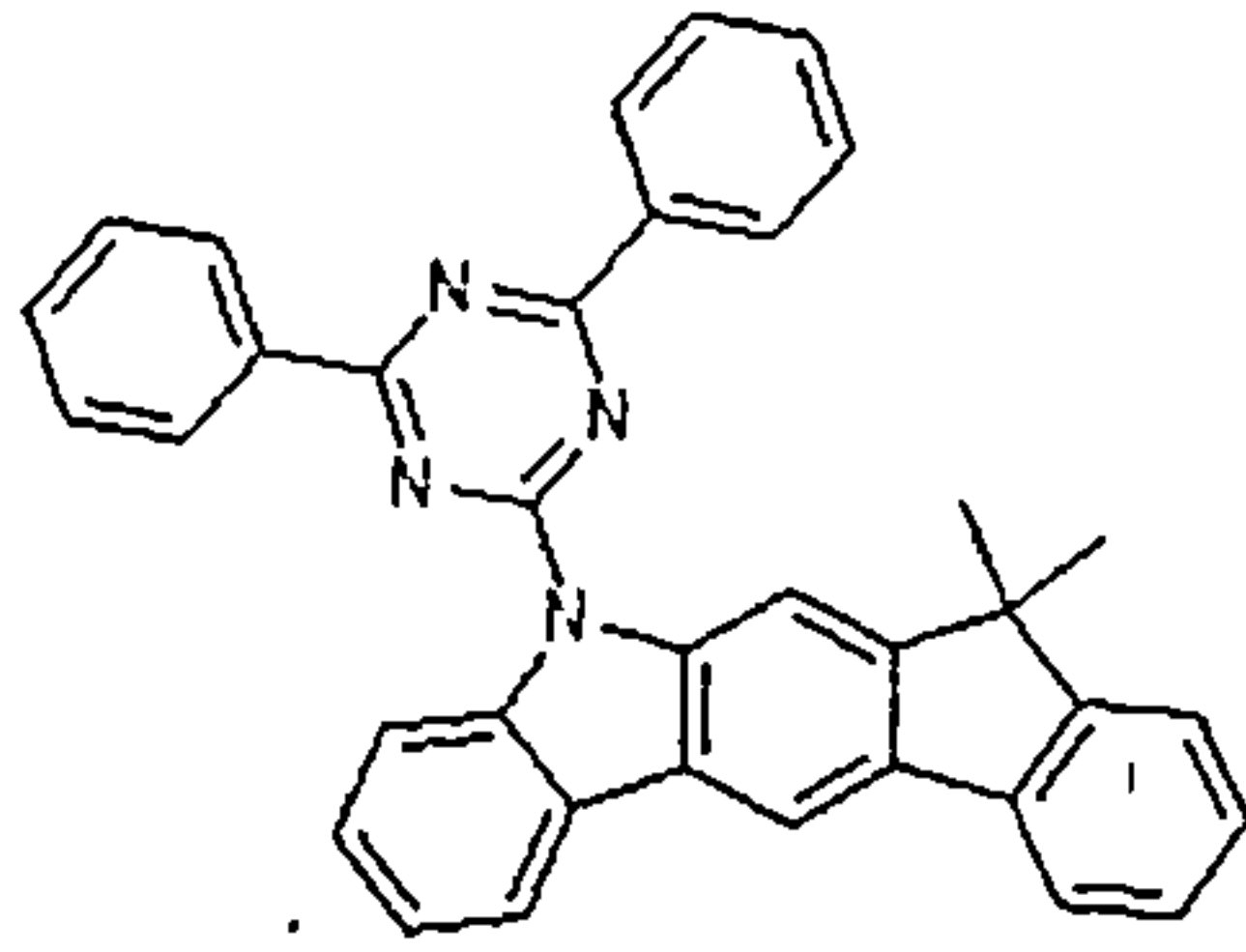
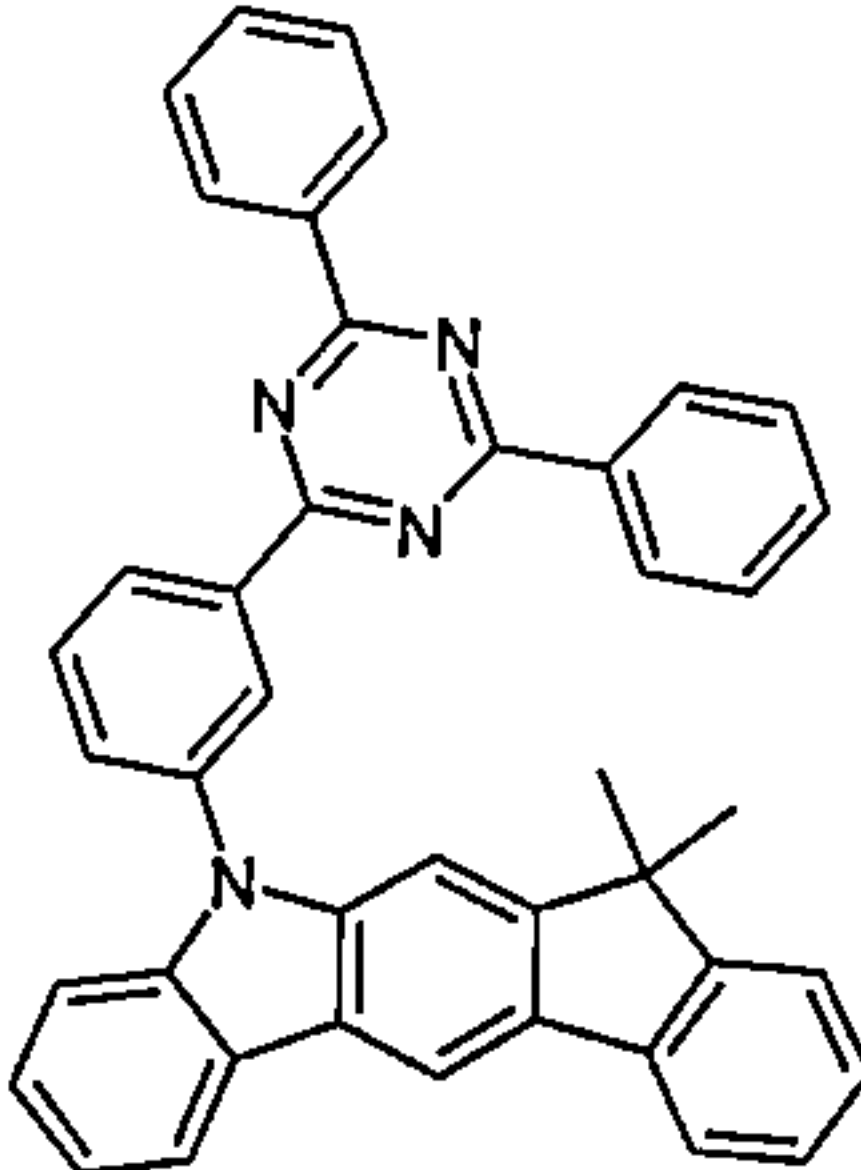
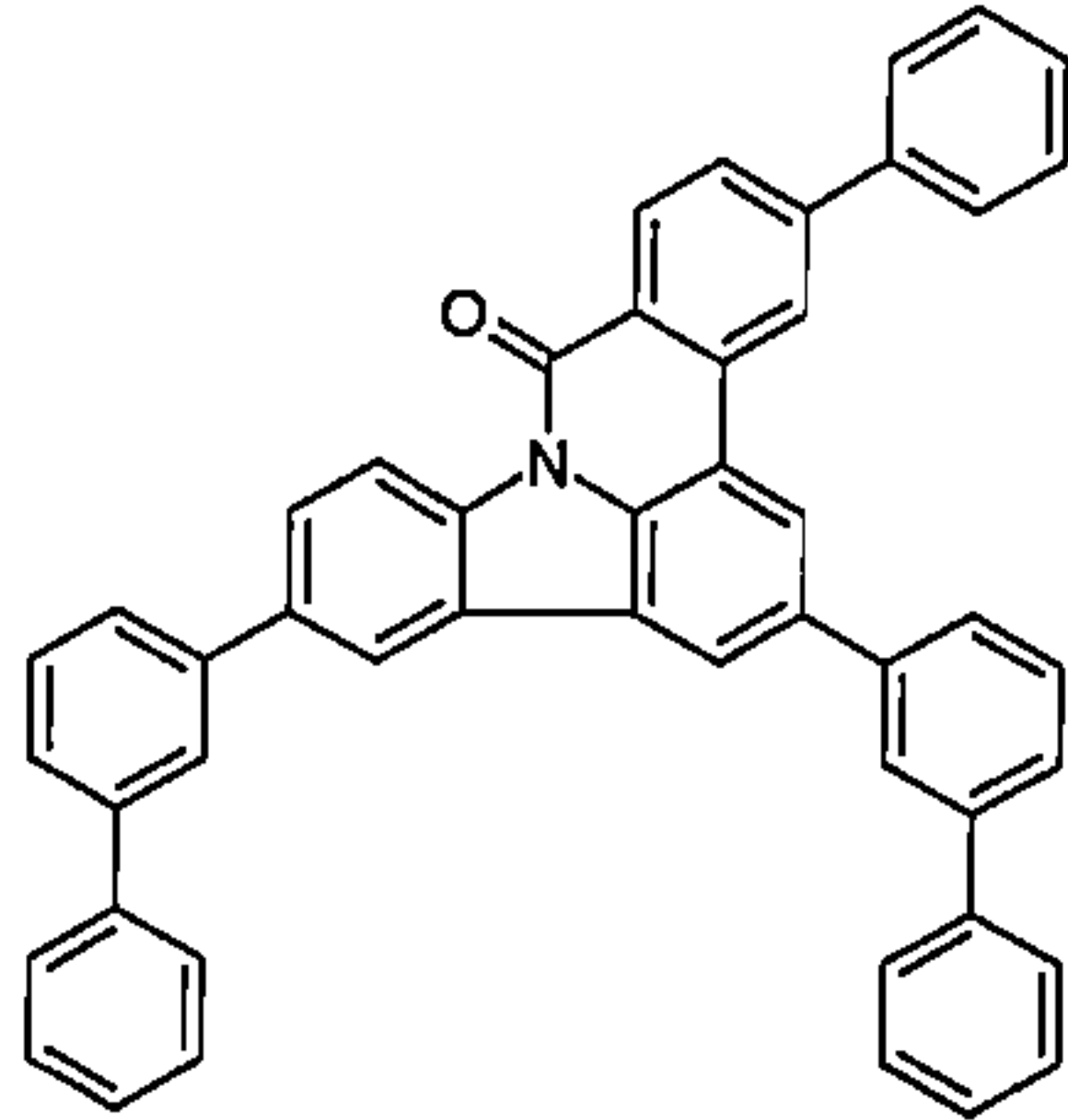
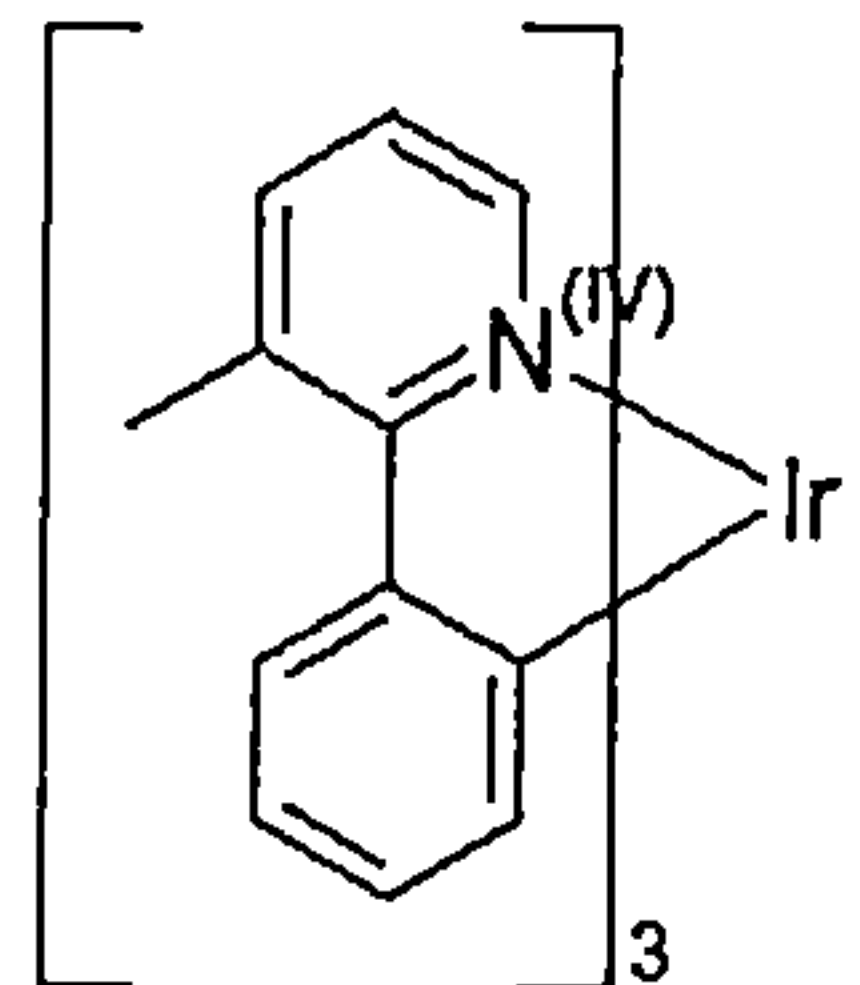
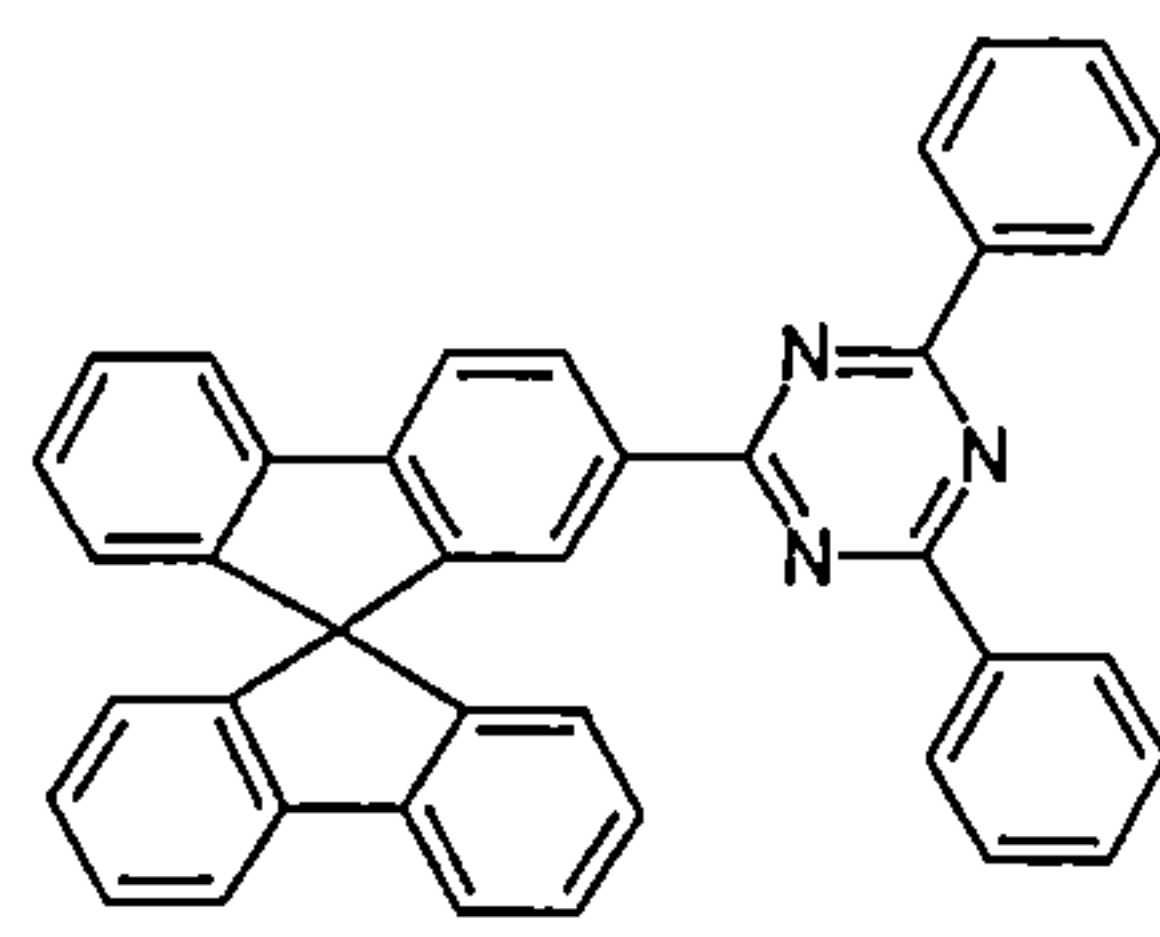
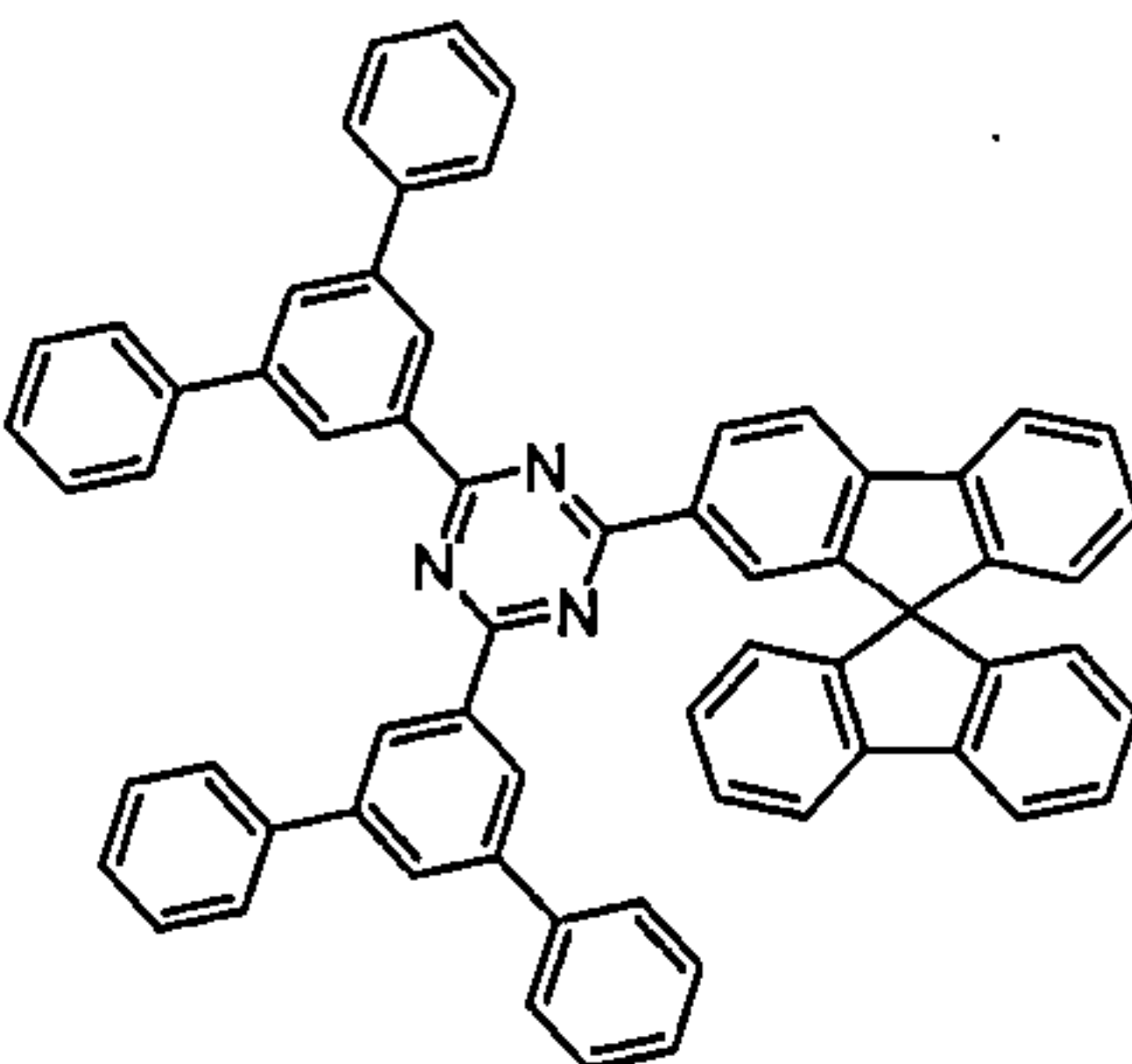
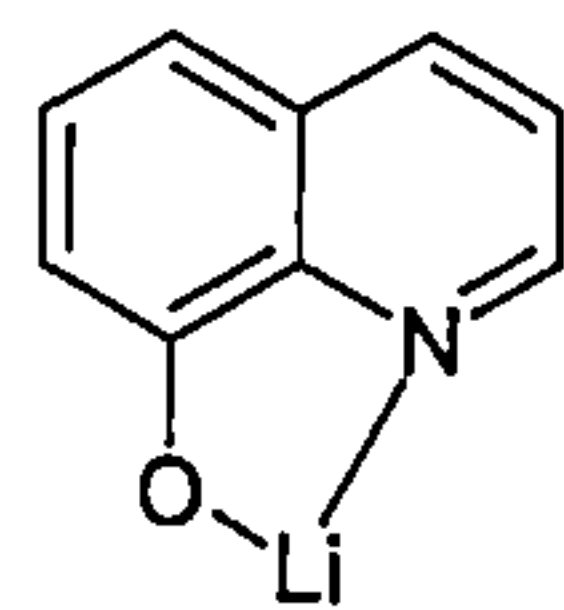
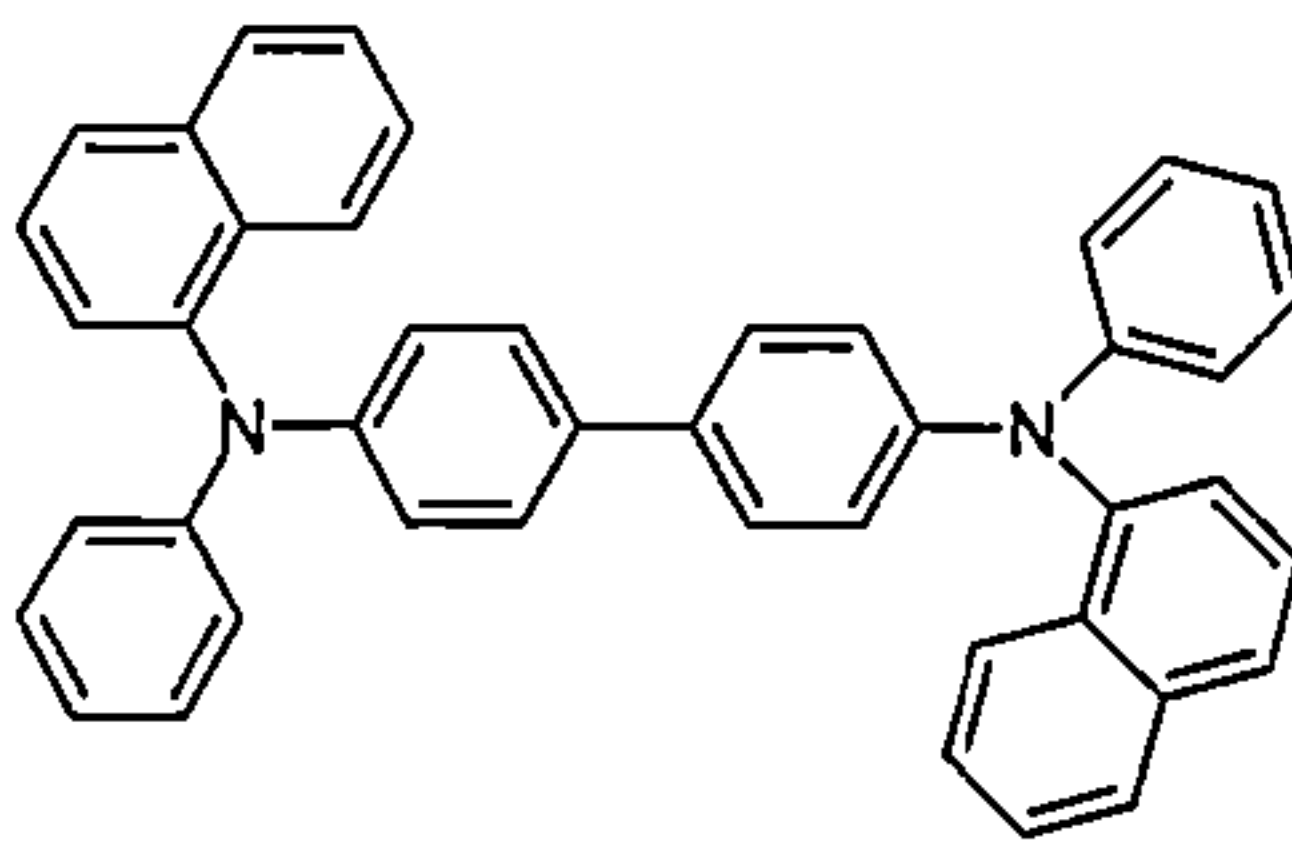
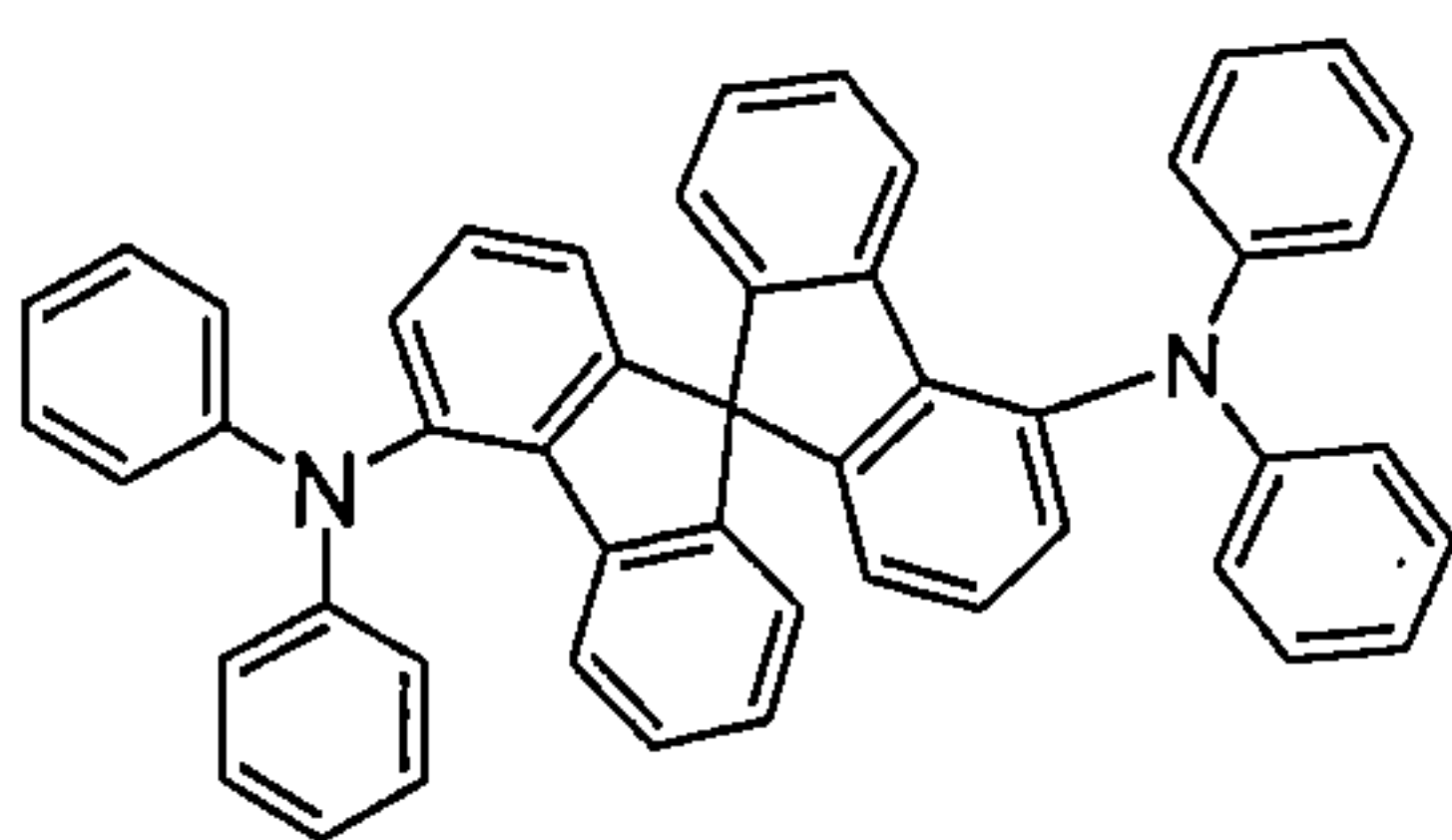
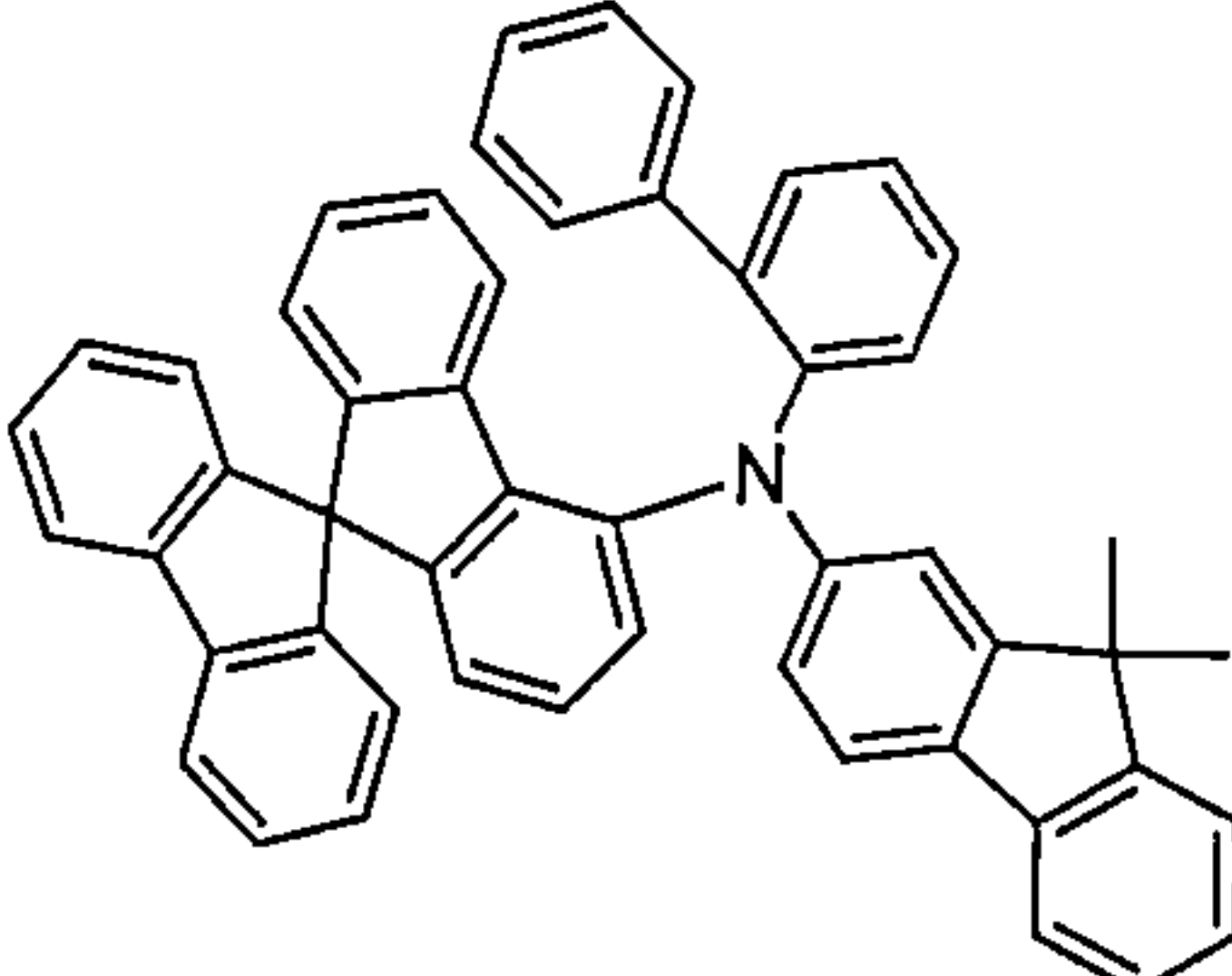
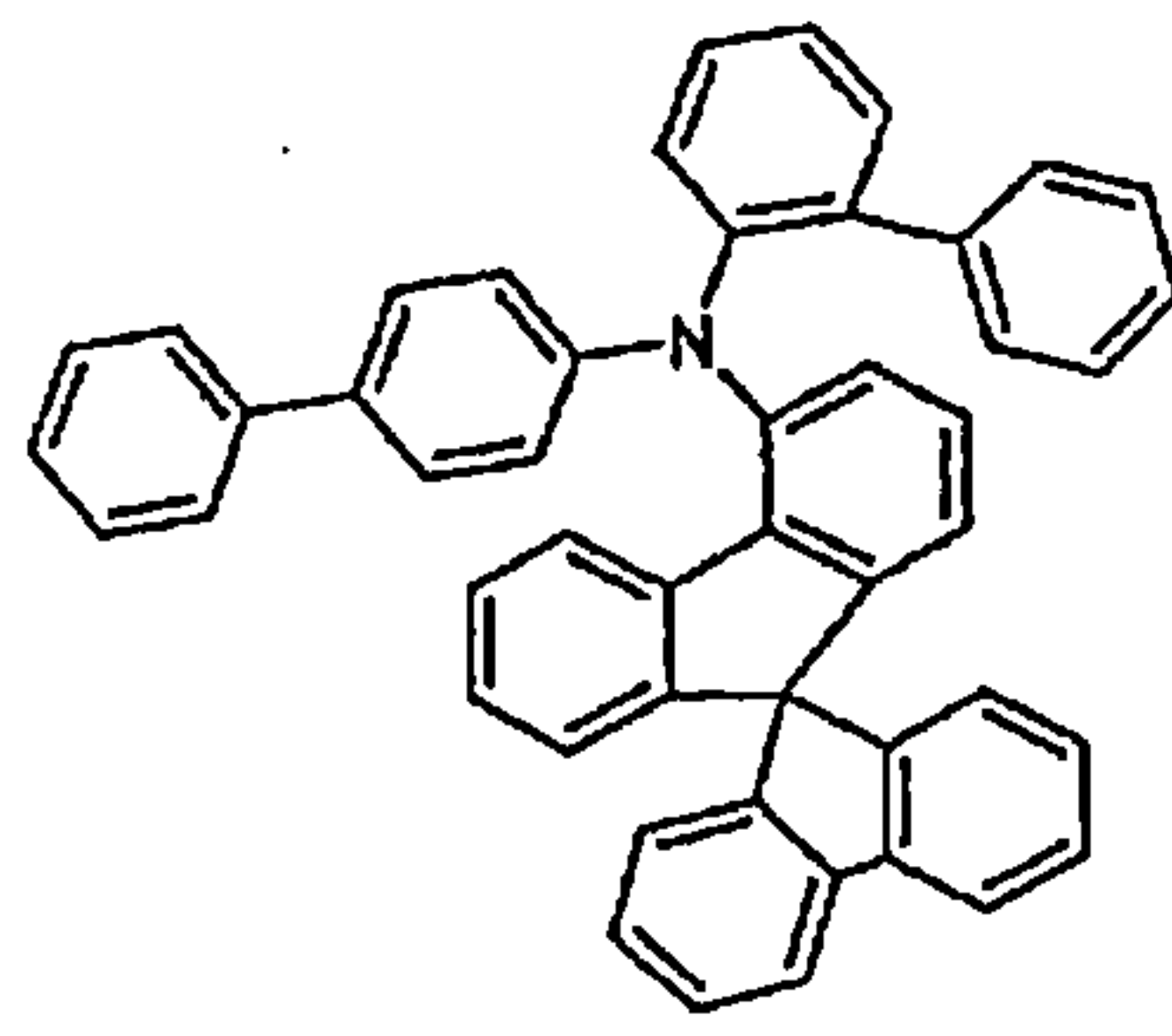
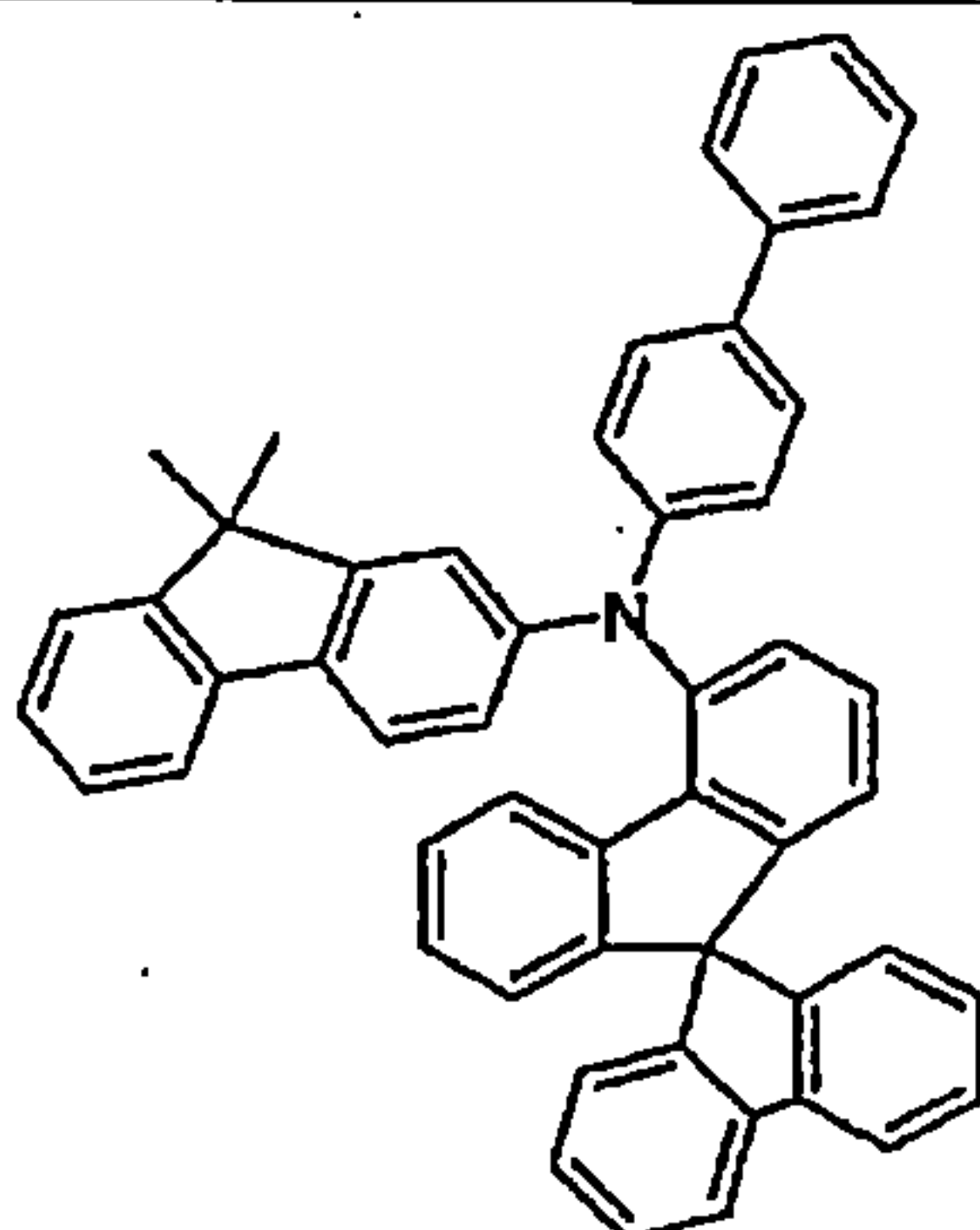
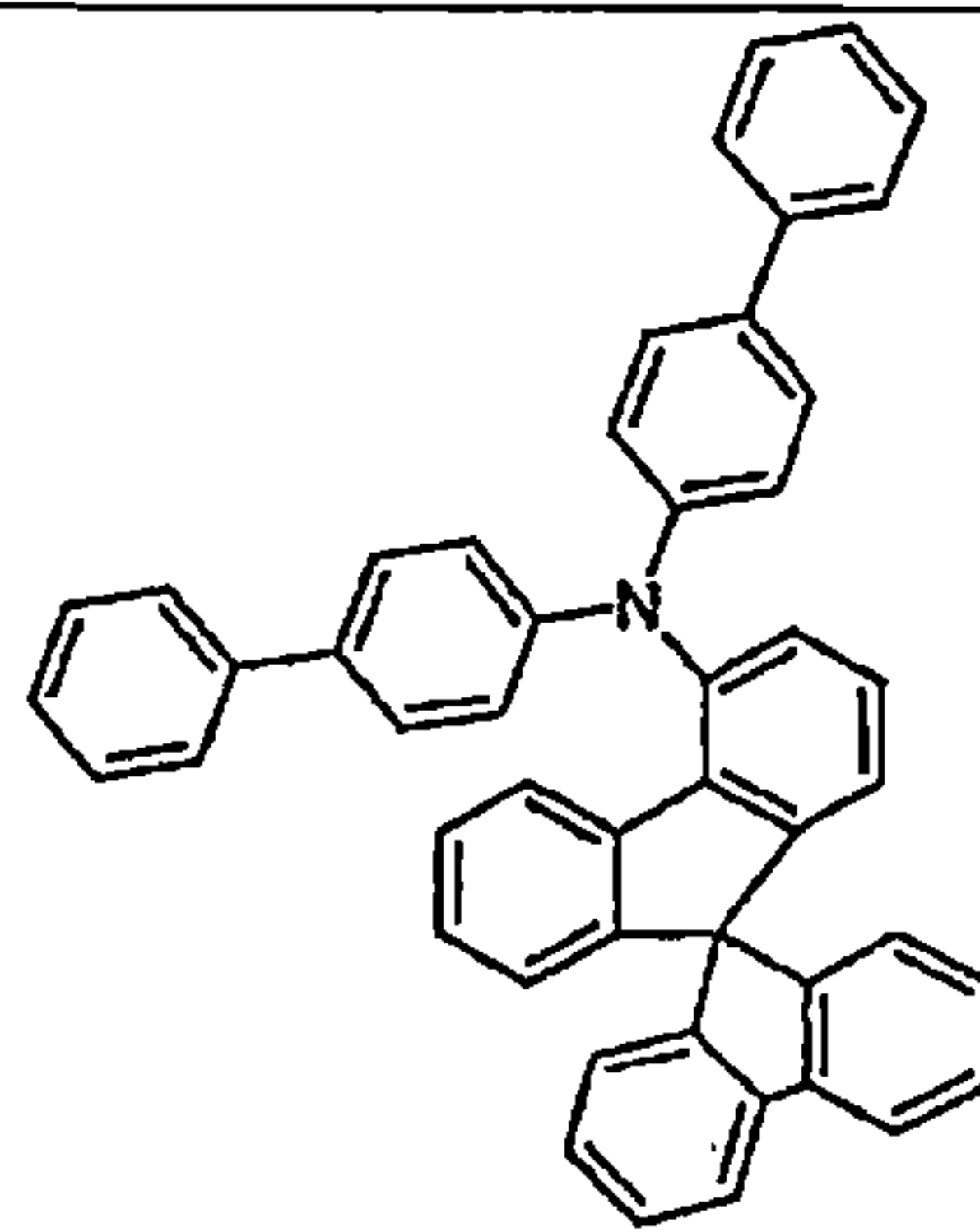
表2：OLED之數據				
實例	在 1000 cd/m ² 下之EQE	在 6000 cd/m ² 下之LT80	CIE	
	%	[h]	x	y
V1	4.8	70	0.14	0.17
V2	4.3	45	0.13	0.15
E1	6.8	130	0.13	0.16

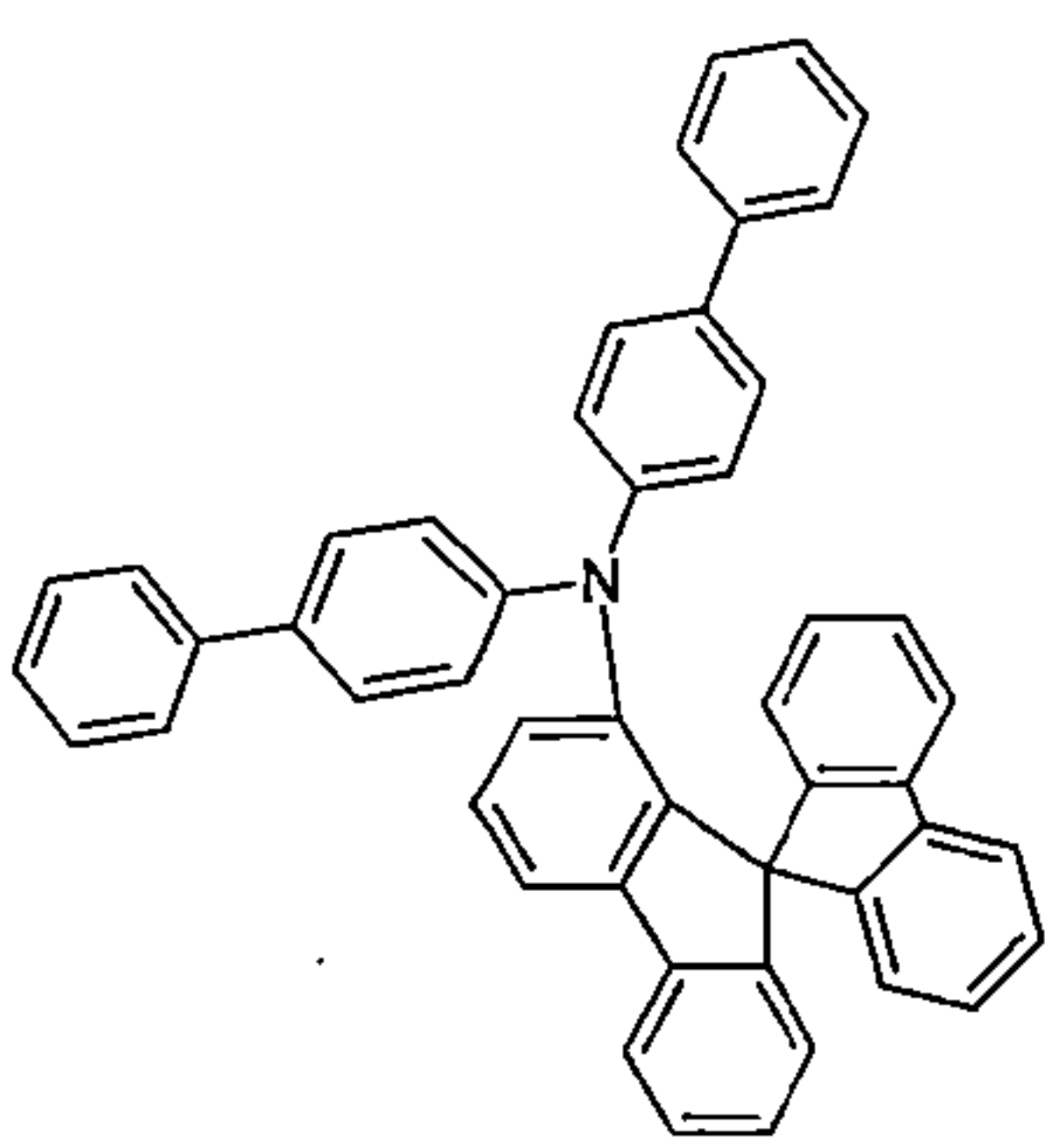
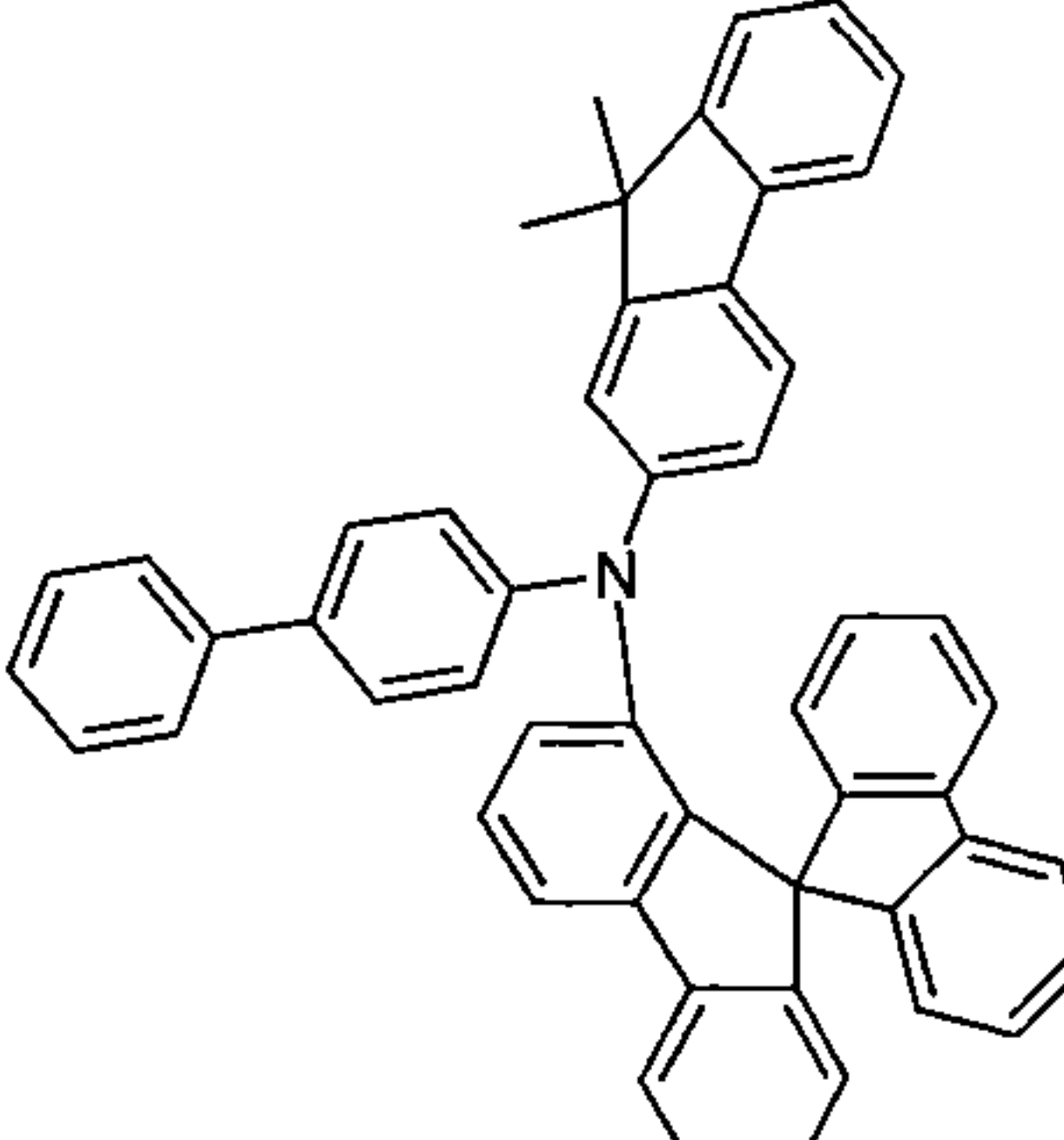
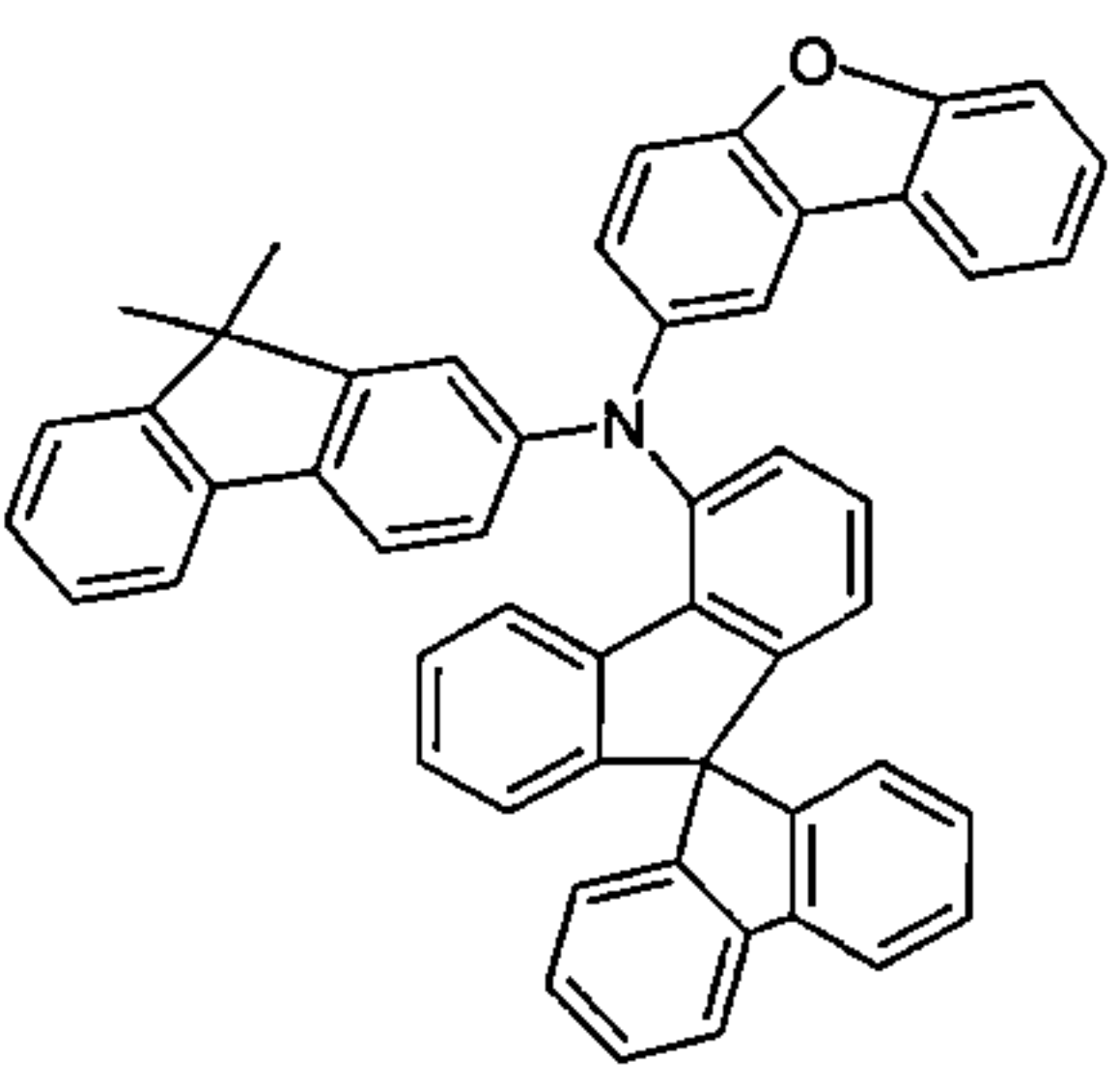
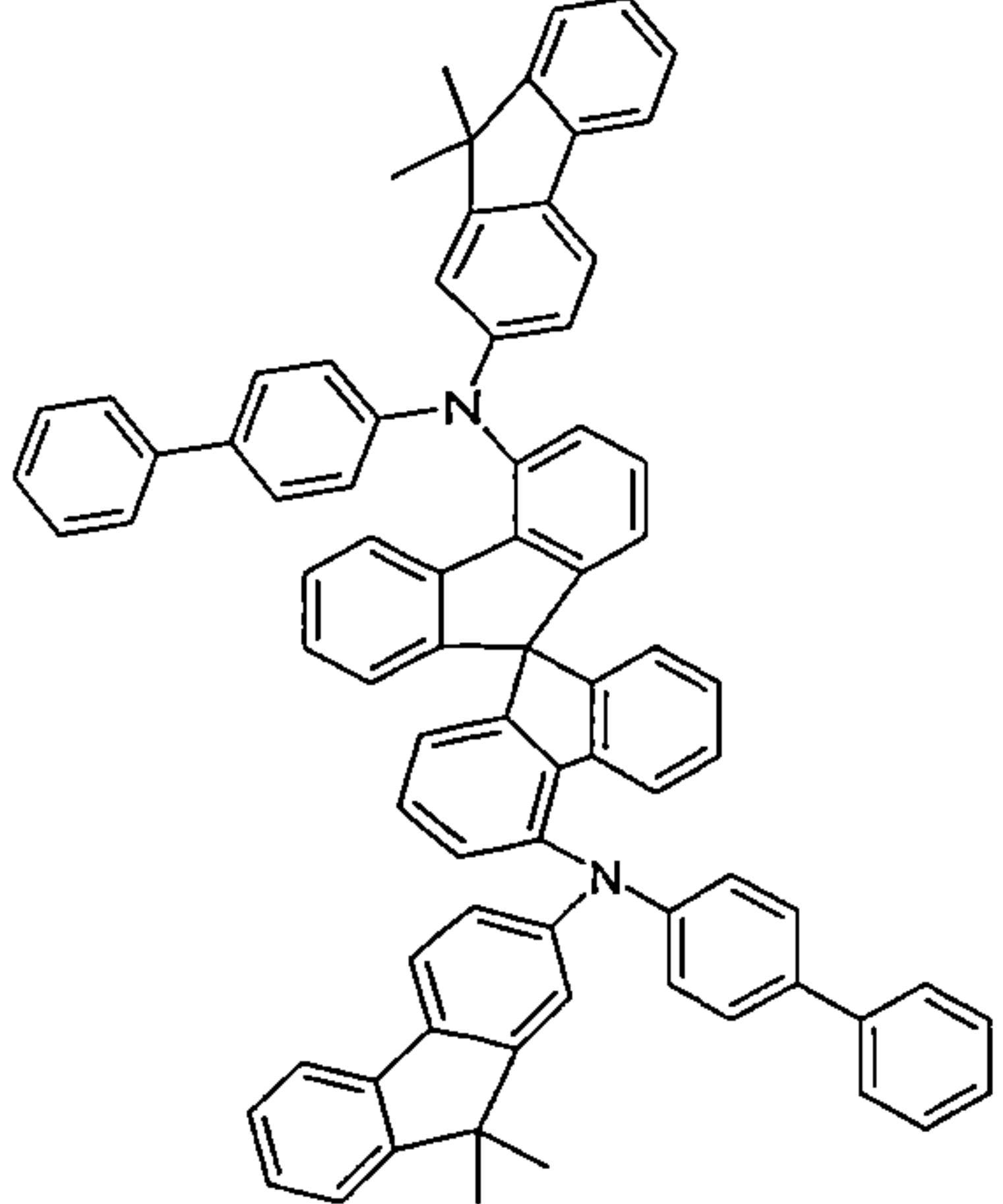
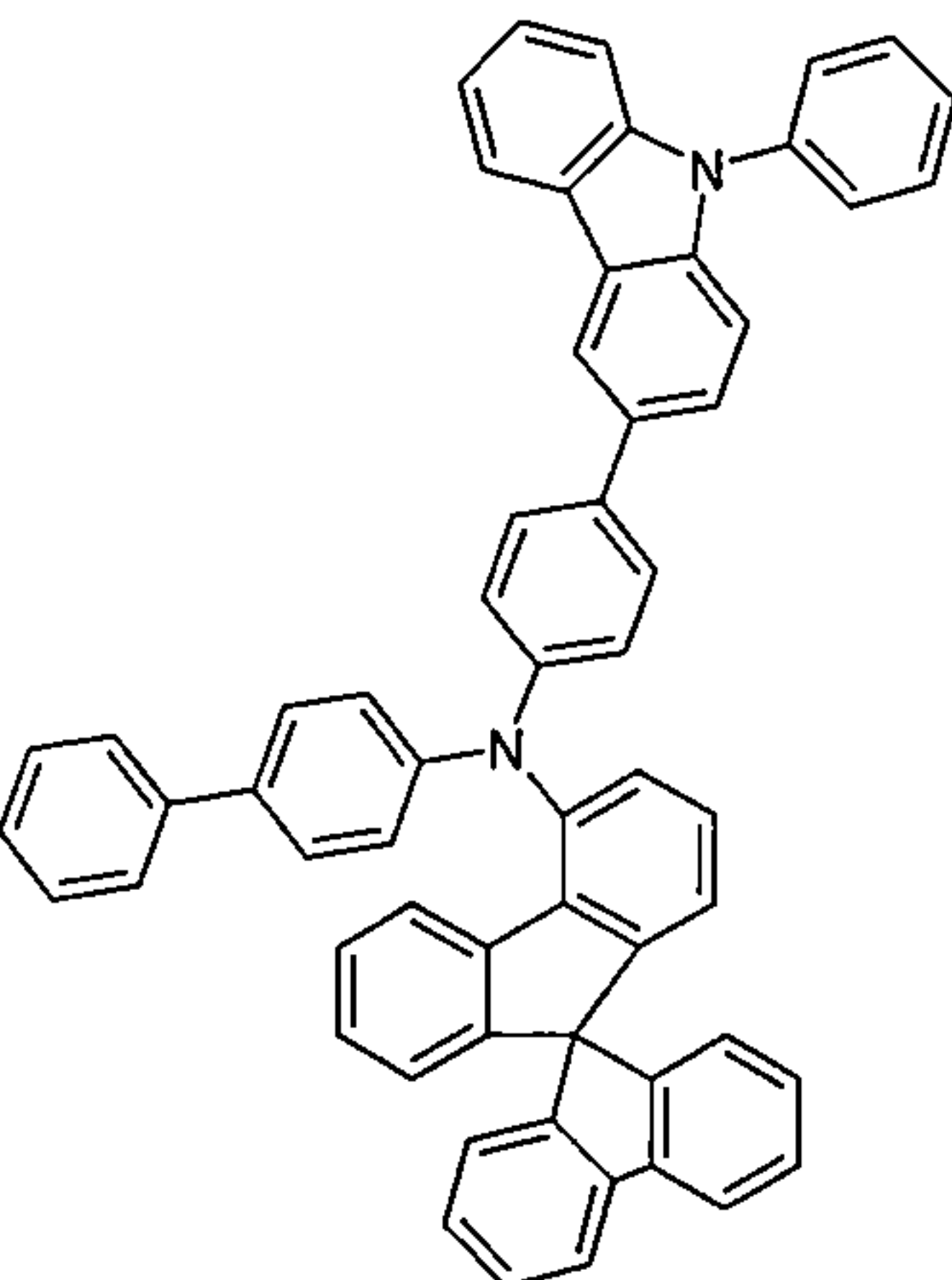
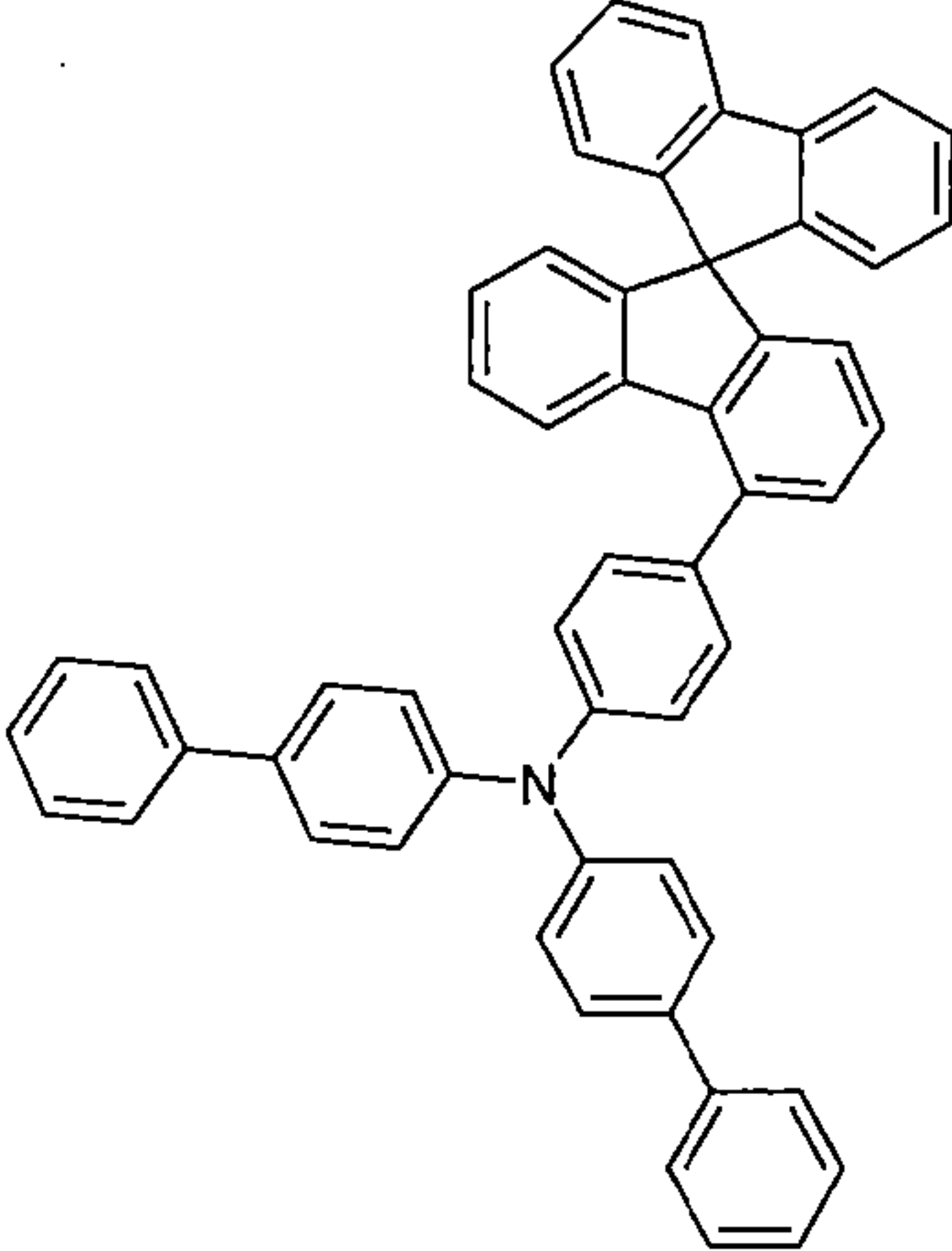
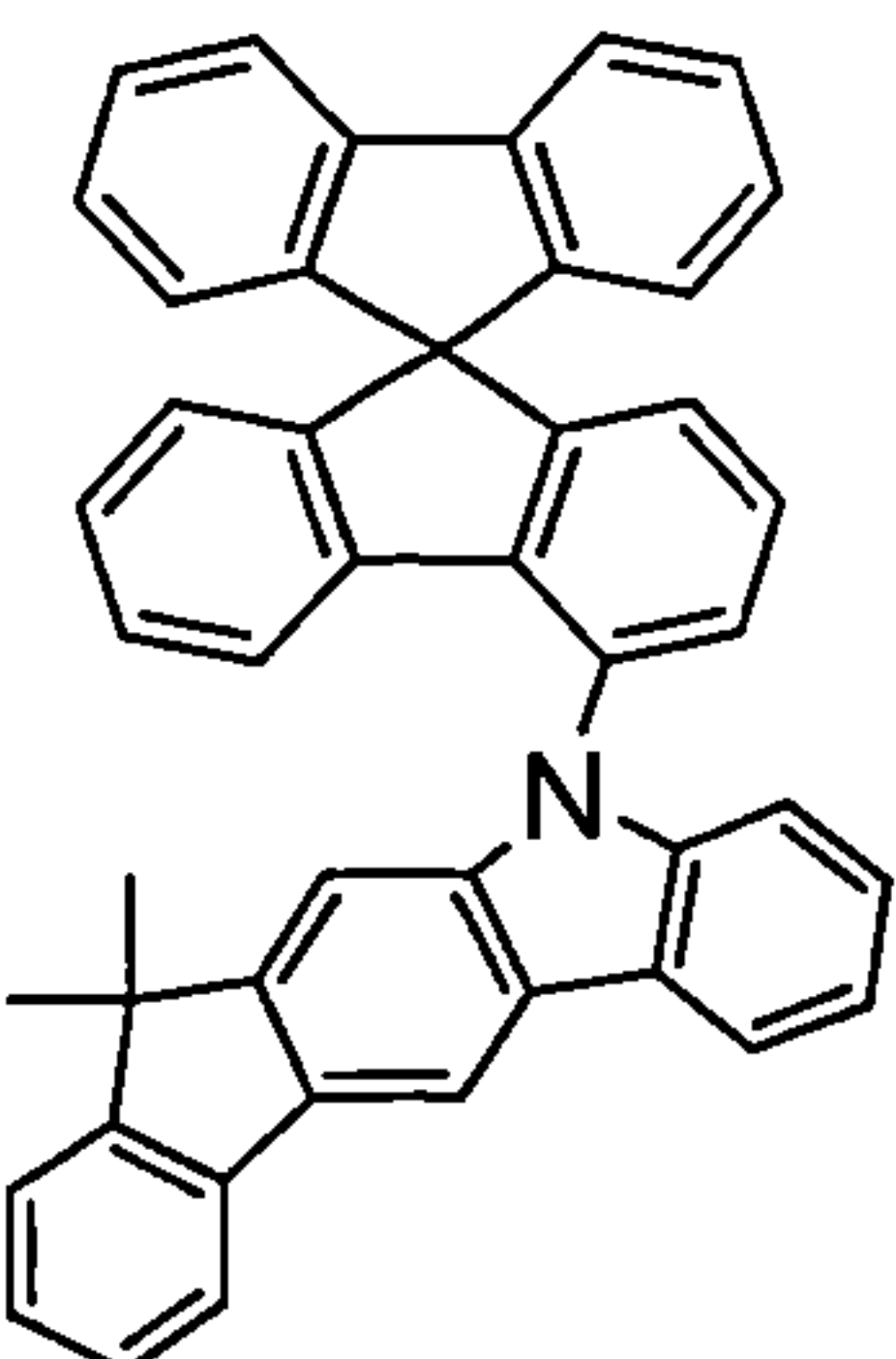
表3：OLED之結構					
實例	<i>HTL</i>	<i>IL</i>	<i>EBL</i>	<i>EML</i>	<i>ETL</i>
	厚度/nm	厚度/nm	厚度/nm	厚度/nm	厚度/nm
V3	HIL2 70 nm	HIL1 5 nm	NPB 90 nm	H2(88%):TEG(12%) 30 nm	ETM1(50%):LiQ(50%) 40 nm
V4	HIL2 70 nm	HIL1 5 nm	HTMV1 90 nm	H2(88%):TEG(12%) 30 nm	ETM1(50%):LiQ(50%) 40 nm
E2	HIL2 70 nm	HIL1 5 nm	HTM1 90 nm	H2(88%):TEG(12%) 30 nm	ETM1(50%):LiQ(50%) 40 nm

表4：OLED之數據				
實例	在 1000 cd/m ² 下之效率	在 8000 cd/m ² 下之LT80	<i>CIE</i>	
			<i>x</i>	<i>y</i>
V3	14.4%	85 h	0.32	0.63
V4	16.6%	60 h	0.37	0.6
E2	17.3%	195 h	0.37	0.61

表5：所用材料之結構

		
HIL1	F4TCNQ	HIL2
		
HIL3	H1	SEB1

		
H2	H3	H4
		
TEG		
		
ETM1	ETM2	LiQ
		
NPB	HTMV1	HTM1
		
HTM2	HTM3	HTM4

		
HTM5	HTM6	HTM7
		
HTM8	HTM9	HTM10
		
HTM11		

實例2

在不同藍色螢光裝置結構(表6)中，使用先前技術材料(NPB及HTMV1)之參考裝置V5及V6具有較低之效率(V5為6.2% (在10 mA/cm²下之EQE)且V6為5.8%)，此係與包含本發明化合物之裝置E3 (8.5%)、E4 (8.3%)、E5 (7.9%)、E6 (7.6%)、E7 (7.8%)、E8 (8.9%)、E9 (8.4%)、E10 (8.1%)及E11(8.2%)相比而言。

參考樣品V5及V6亦具有較低之壽命(V5為120 h (在60 mA下之

LT80)且V6為105 h)，此係與樣品E3 (305 h)、E4 (290 h)、E5 (320 h)、E6 (390 h)、E7 (365 h)、E8 (165 h)、E9 (280 h)、E10(285 h)及E11(340 h)相比而言。

實例3

在不同綠色磷光裝置結構(表6)中，參考裝置V7具有較低之效率(在2 mA/cm²下之EQE) (11.7%)，此係與包含本發明化合物之樣品E12 (20.0%)、E13 (19.6%)、E14 (18.9%)、E15 (19.2%)及E16 (20.2%)相比而言。參考樣品V6亦具有較低之壽命(在20 mA下之LT80) (80 h)，此係與樣品E12 (90 h)、E13 (185 h)、E14 (105 h)、E15 (205 h)及E16 (185 h)相比而言。

表 6：OLED 之結構							
Bsp.	HIL1	HTL	HIL2	EBL	EML	ETL	EIL
	Dicke / nm	Dicke / nm	Dicke / nm	Dicke / nm	Dicke / nm	Dicke / nm	Dicke / nm
V5	HIL3:F4TCNQ(3%) 20 nm	HIL3 155 nm	NPB:F4TCNQ(3%) 20 nm	NPB 20 nm	H1:SEB1(5%) 20 nm	ETM2(50%):LiQ(50%) 30 nm	LiQ 1 nm
V6	HIL3:F4TCNQ(3%) 20 nm	HIL3 155 nm	HTMV1:F4TCNQ(3%) 20 nm	HTMV1 20 nm	H1:SEB1(5%) 20 nm	ETM2(50%):LiQ(50%) 30 nm	LiQ 1 nm
E3	HIL3:F4TCNQ(3%) 20 nm	HIL3 155 nm	HTM2:F4TCNQ(3%) 20 nm	HTM2 20 nm	H1:SEB1(5%) 20 nm	ETM2(50%):LiQ(50%) 30 nm	LiQ 1 nm
E4	HIL3:F4TCNQ(3%) 20 nm	HIL3 155 nm	HTM3:F4TCNQ(3%) 20 nm	HTM3 20 nm	H1:SEB1(5%) 20 nm	ETM2(50%):LiQ(50%) 30 nm	LiQ 1 nm
E5	HIL3:F4TCNQ(3%) 20 nm	HIL3 155 nm	HTM4:F4TCNQ(3%) 20 nm	HTM4 20 nm	H1:SEB1(5%) 20 nm	ETM2(50%):LiQ(50%) 30 nm	LiQ 1 nm
E6	HIL3:F4TCNQ(3%) 20 nm	HIL3 155 nm	HTM5:F4TCNQ(3%) 20 nm	HTM5 20 nm	H1:SEB1(5%) 20 nm	ETM2(50%):LiQ(50%) 30 nm	LiQ 1 nm
E7	HIL3:F4TCNQ(3%) 20 nm	HIL3 155 nm	HTM6:F4TCNQ(3%) 20 nm	HTM6 20 nm	H1:SEB1(5%) 20 nm	ETM2(50%):LiQ(50%) 30 nm	LiQ 1 nm
E8	HIL3:F4TCNQ(3%) 20 nm	HIL3 155 nm	HTM7:F4TCNQ(3%) 20 nm	HTM7 20 nm	H1:SEB1(5%) 20 nm	ETM2(50%):LiQ(50%) 30 nm	LiQ 1 nm
E9	HIL3:F4TCNQ(3%) 20 nm	HIL3 155 nm	HTM8:F4TCNQ(3%) 20 nm	HTM8 20 nm	H1:SEB1(5%) 20 nm	ETM2(50%):LiQ(50%) 30 nm	LiQ 1 nm
E10	HIL3:F4TCNQ(3%) 20 nm	HIL3 155 nm	HTM9:F4TCNQ(3%) 20 nm	HTM9 20 nm	H1:SEB1(5%) 20 nm	ETM2(50%):LiQ(50%) 30 nm	LiQ 1 nm
E11	HIL3:F4TCNQ(3%) 20 nm	HIL3 155 nm	HTM10:F4TCNQ(3%) 20 nm	HTM10 20 nm	H1:SEB1(5%) 20 nm	ETM2(50%):LiQ(50%) 30 nm	LiQ 1 nm
V7	HIL3:F4TCNQ(3%) 20 nm	HIL3 210 nm	NPB:F4TCNQ(3%) 20 nm	NPB 20 nm	H2:TEG(10%) 30 nm	ETM2(50%):LiQ(50%) 40 nm	LiQ 1 nm
E12	HIL3:F4TCNQ(3%) 20 nm	HIL3 210 nm	HTM2:F4TCNQ(3%) 20 nm	HTM2 20 nm	H2:TEG(10%) 30 nm	ETM2(50%):LiQ(50%) 40 nm	LiQ 1 nm
E13	HIL3:F4TCNQ(3%) 20 nm	HIL3 210 nm	HTM3:F4TCNQ(3%) 20 nm	HTM3 20 nm	H2:TEG(10%) 30 nm	ETM2(50%):LiQ(50%) 40 nm	LiQ 1 nm
E14	HIL3:F4TCNQ(3%) 20 nm	HIL3 210 nm	HTM4:F4TCNQ(3%) 20 nm	HTM4 20 nm	H2:TEG(10%) 30 nm	ETM2(50%):LiQ(50%) 40 nm	LiQ 1 nm
E15	HIL3:F4TCNQ(3%) 20 nm	HIL3 210 nm	HTM5:F4TCNQ(3%) 20 nm	HTM5 20 nm	H2:TEG(10%) 30 nm	ETM2(50%):LiQ(50%) 40 nm	LiQ 1 nm
E16	HIL3:F4TCNQ(3%) 20 nm	HIL3 210 nm	HTM6:F4TCNQ(3%) 20 nm	HTM6 20 nm	H2:TEG(10%) 30 nm	ETM2(50%):LiQ(50%) 40 nm	LiQ 1 nm

表 7：OLED 之結構							
Bsp.	HIL1	HTL	EBL	EML	HBL	ETL	EIL
	Dicke / nm	Dicke / nm	Dicke / nm	Dicke / nm	Dicke / nm	Dicke / nm	Dicke / nm
V8	HIL3:F4TCNQ(3%) 20 nm	HIL3 230 nm		H3:TEG(10%) 40 nm	H2 5 nm	ETM2(50%):LiQ(50%) 25 nm	
E17	HIL3:F4TCNQ(3%) 20 nm	HIL3 230 nm		H3:HTM3(60%):TEG(10%) 40 nm	H2 5 nm	ETM2(50%):LiQ(50%) 25 nm	
V9	HIL3:F4TCNQ(3%) 20 nm	HIL3 220 nm	HTM3 10 nm	H4:TEG(10%) 40 nm		ETM2(50%):LiQ(50%) 30nm	LiQ 1 nm
E18	HIL3:F4TCNQ(3%) 20 nm	HIL3 220 nm	HTM3 10 nm	H4:HTM4(10%):TEG(10%) 40 nm		ETM2(50%):LiQ(50%) 30nm	LiQ 1 nm
E19	HIL3:F4TCNQ(3%) 20 nm	HIL3 220 nm	HTM3 10 nm	H4:HTM11(45%):TEG(10%) 40 nm		ETM2(50%):LiQ(50%) 30nm	LiQ 1 nm

本發明化合物在磷光OLED中作為基質材料之用途

實例4

在不同綠色磷光裝置結構(表7)中，與包含本發明化合物HTM3用作EML中之混合基質組份之樣品E17（在2 mA/cm²下之EQE為16.1%）相比，不具有本發明化合物作為發射層之基質材料之參考裝置V8具有較低效率(在2 mA/cm²下之EQE為14.4%)。與樣品E17 (330 h)相比，參考樣品V8亦具有較低壽命(305 h) (在20 mA下之LT80)。

實例5

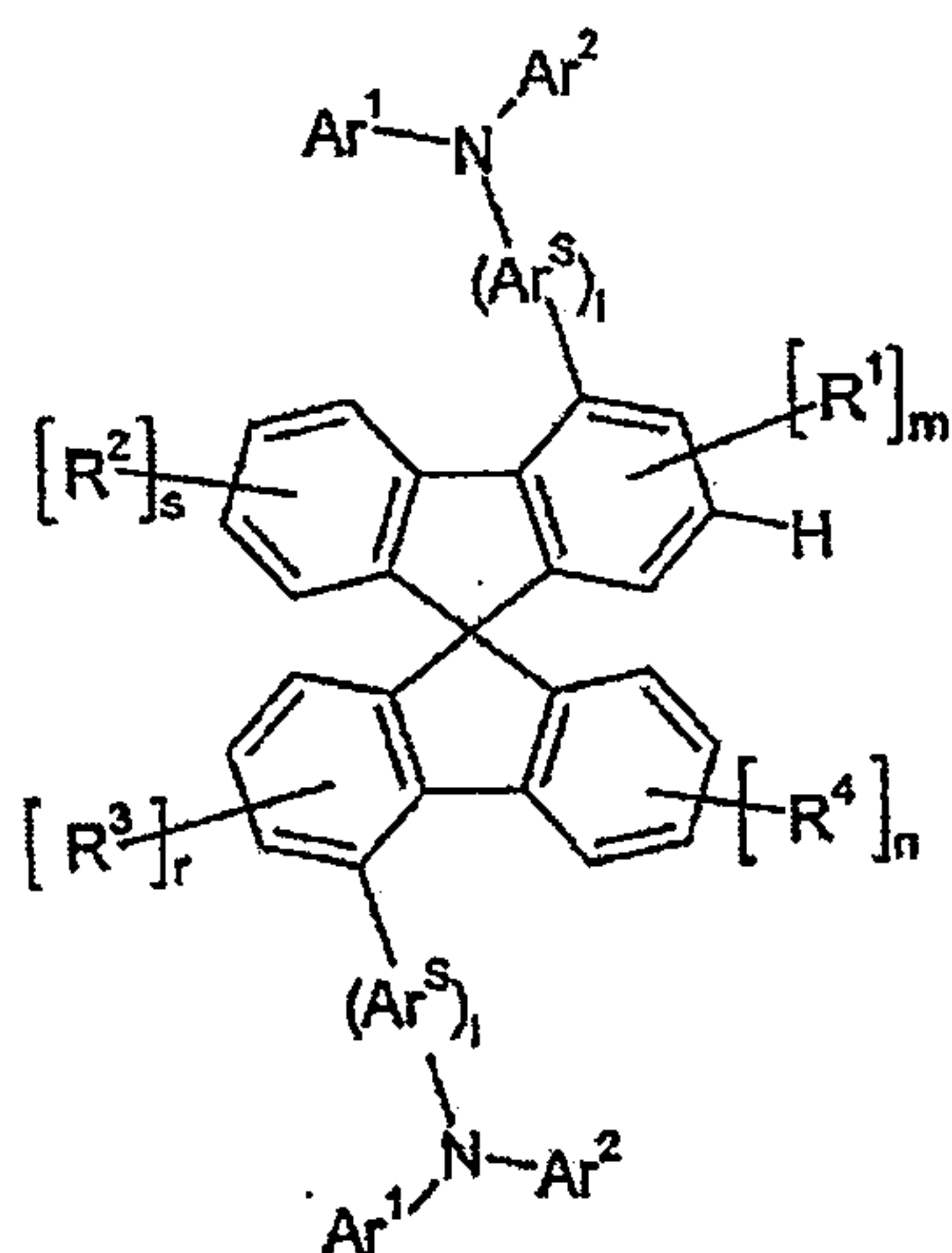
在不同綠色磷光裝置結構(表7)中，其顯示，本發明化合物與內醯胺化合物H4組合作為發射層中之混合基質組份顯示有利影響。參考裝置V9之效率(在2 mA/cm²下之EQE)為17.6%且壽命為255 h。可藉由將本發明化合物作為共基質材料添加至發射層中來改良壽命，如實例E18及E19與V9之比較所顯示。裝置E18顯示13.4%之效率及400 h之壽命，且裝置E19顯示17.9%之效率及270之壽命，該二者與參考裝置V9相比均有所改良。

【符號說明】

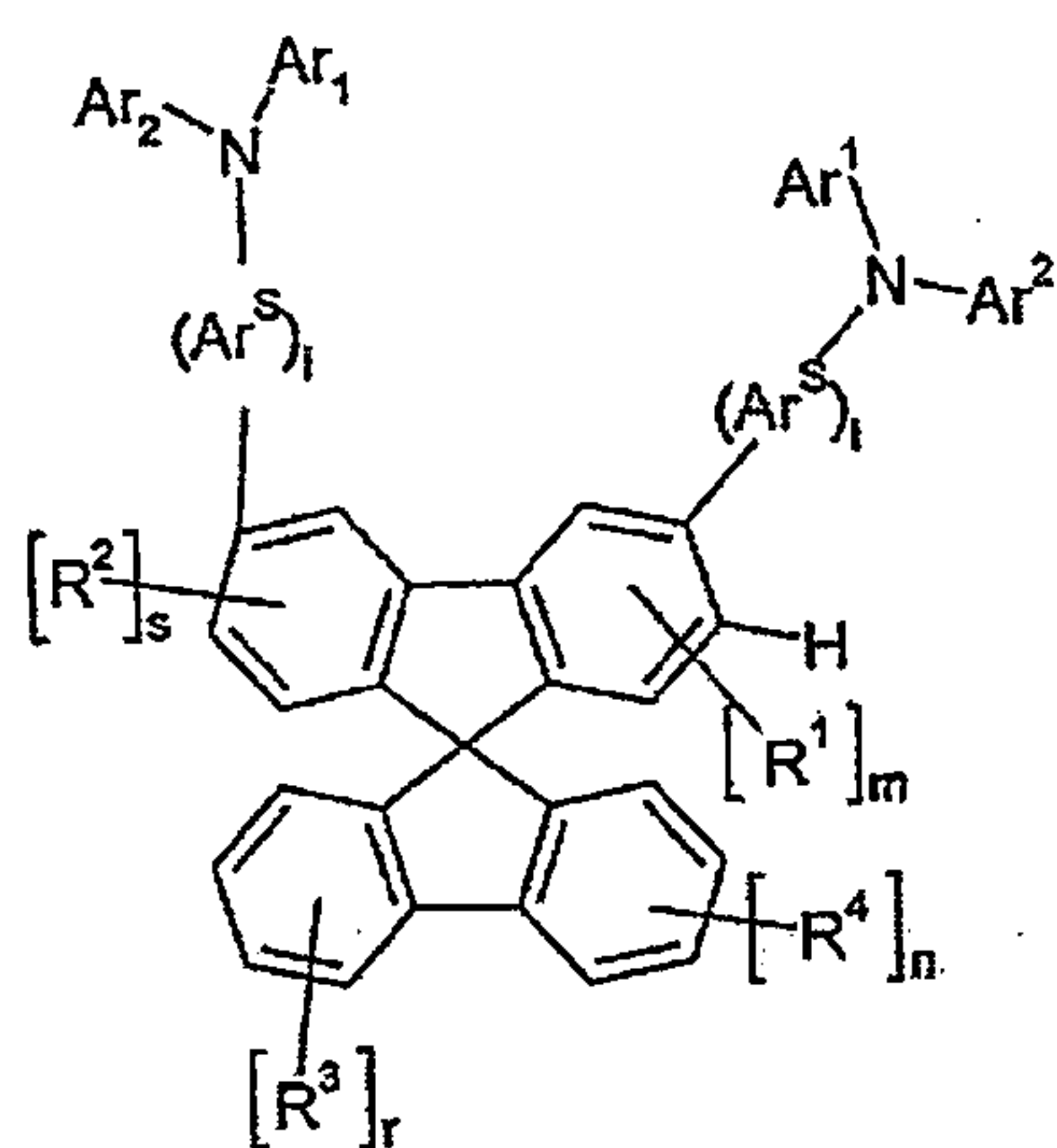
(無)

申請專利範圍

1. 一種如式(3)及(7)中任一式之化合物，



式(3)



式(7)

其中以下適用於所用符號及下標：

Ar^1 及 Ar^2 在每次出現時係相同或不同且係具有6至60個C原子之芳族環系統，該芳族環系統係選自由下列組成之群：萸、螺二萸、聯苯、聯三苯及聯四苯，其每一者亦可經一或多個 R^5 基團取代；

Ar^S 在每次出現時係相同或不同且係具有6至60個C原子之芳族或雜芳族環系統，在每一情形下，其亦可經一或多個 R^5 基團取代；

R^1 、 R^2 、 R^3 、 R^4 在每次出現時係相同或不同且係選自由下列

組成之群：H、D、F、Cl、Br、I、CN、 $\text{Si}(\text{R}^6)_3$ ；具有1至40個C原子之直鏈烷基、烷氧基或硫烷基或具有3至40個C原子之具支鏈或環狀烷基、烷氧基或硫烷基，其每一者可經一或多個 R^6 基團取代，其中在每一情形下，一或多個非毗鄰 CH_2 基團可經 $\text{Si}(\text{R}^6)_2$ 、 $\text{C}=\text{NR}^6$ 、 $\text{P}(=\text{O})(\text{R}^6)$ 、SO、 SO_2 、 NR^6 、O、S或 CONR^6 替代且其中一或多個H原子可經D、F、Cl、Br或I替代；具有6至60個C原子之芳族或雜芳族環系統，在每一情形下，其可經一或多個 R^6 基團取代；具有5至60個芳族環原子之芳氧基或雜芳氧基，其可經一或多個 R^6 基團取代；或具有5至60個芳族環原子之芳烷基或雜芳烷基，在每一情形下，其可經一或多個 R^6 基團取代，其中兩個或更多個毗鄰取代基 R^1 或 R^2 或 R^3 或 R^4 可視情況形成可經一或多個 R^6 基團取代之單環或多環脂肪族環系統；

R^5 在每次出現時係相同或不同且係選自由下列組成之群：H、D、F、Cl、Br、I、CN、 $\text{Si}(\text{R}^6)_3$ ；具有1至40個C原子之直鏈烷基、烷氧基或硫烷基或具有3至40個C原子之具支鏈或環狀烷基、烷氧基或硫烷基，其每一者可經一或多個 R^6 基團取代，其中在每一情形下，一或多個非毗鄰 CH_2 基團可經 $\text{Si}(\text{R}^6)_2$ 、 $\text{C}=\text{NR}^6$ 、 $\text{P}(=\text{O})(\text{R}^6)$ 、SO、 SO_2 、 NR^6 、O、S或 CONR^6 替代且其中一或多個H原子可經D、F、Cl、Br或I替代；具有6至60個C原子之芳族或雜芳族環系統，在每一情形下，其可經一或多個 R^6 基團取代；具有5至60個芳族環原子之芳氧基或雜芳氧基，其可經一或多個 R^6 基團取代；或具有5至60個芳族環原子之芳烷基或雜芳烷基，在每一情形下，其可經一或多個 R^6 基團取代，其中兩個或更多個毗鄰取代基 R^5 可視情況形成可經一或多個 R^6 基團取代之單環或多環脂肪族環系統；

R^6 係選自由下列組成之群：H、D、F、具有1至20個C原

子之脂肪族烴基或具有5至30個C原子之芳族或雜芳族環系統，其中一或多個H原子可經D或F替代，其中兩個或更多個毗鄰取代基 R^6 可與彼此形成單環或多環脂肪族環系統；

i 每次出現時係相同或不同且係0或1；且於式(3)化合物中，i為0；

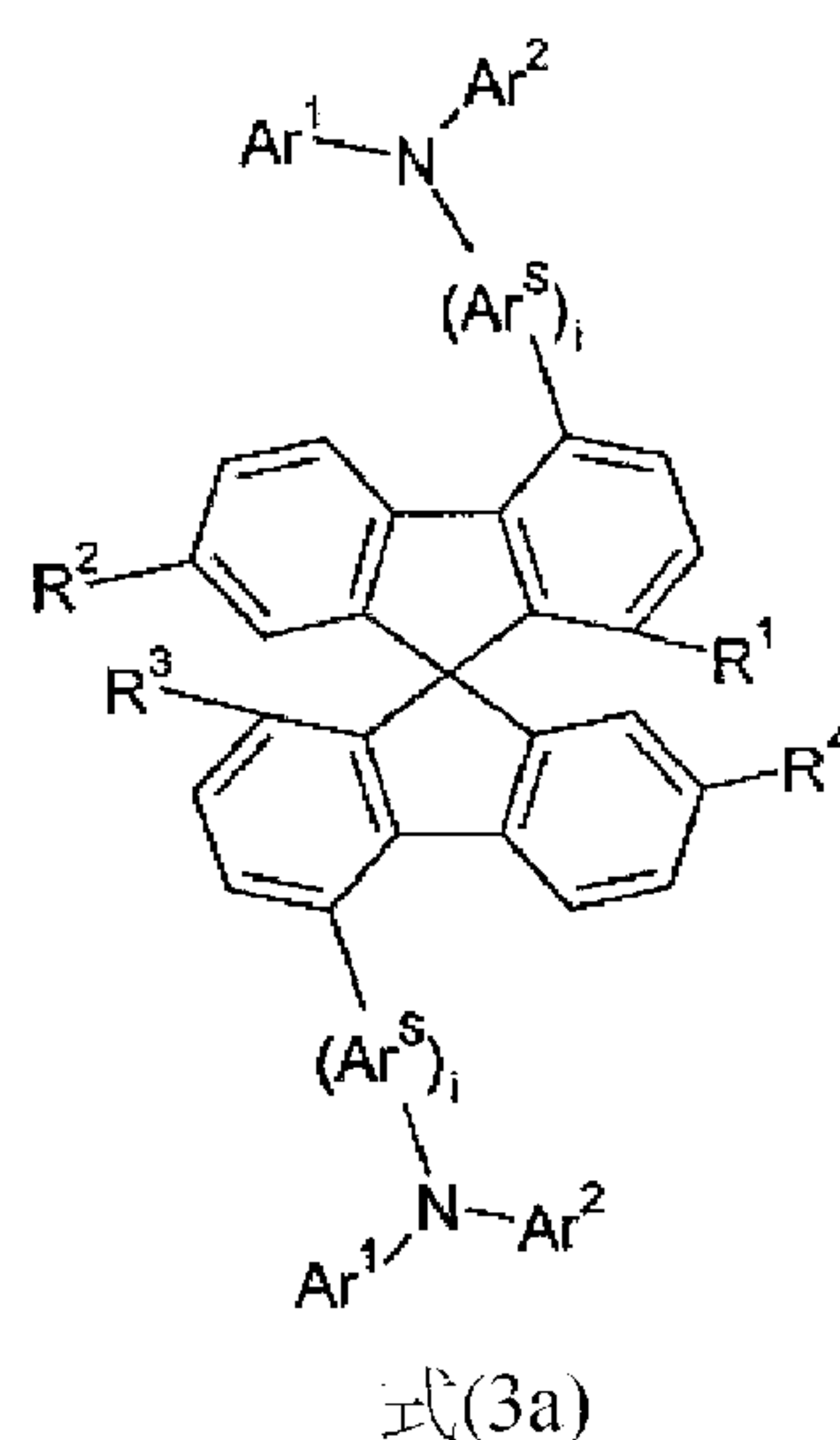
m 係0、1或2；

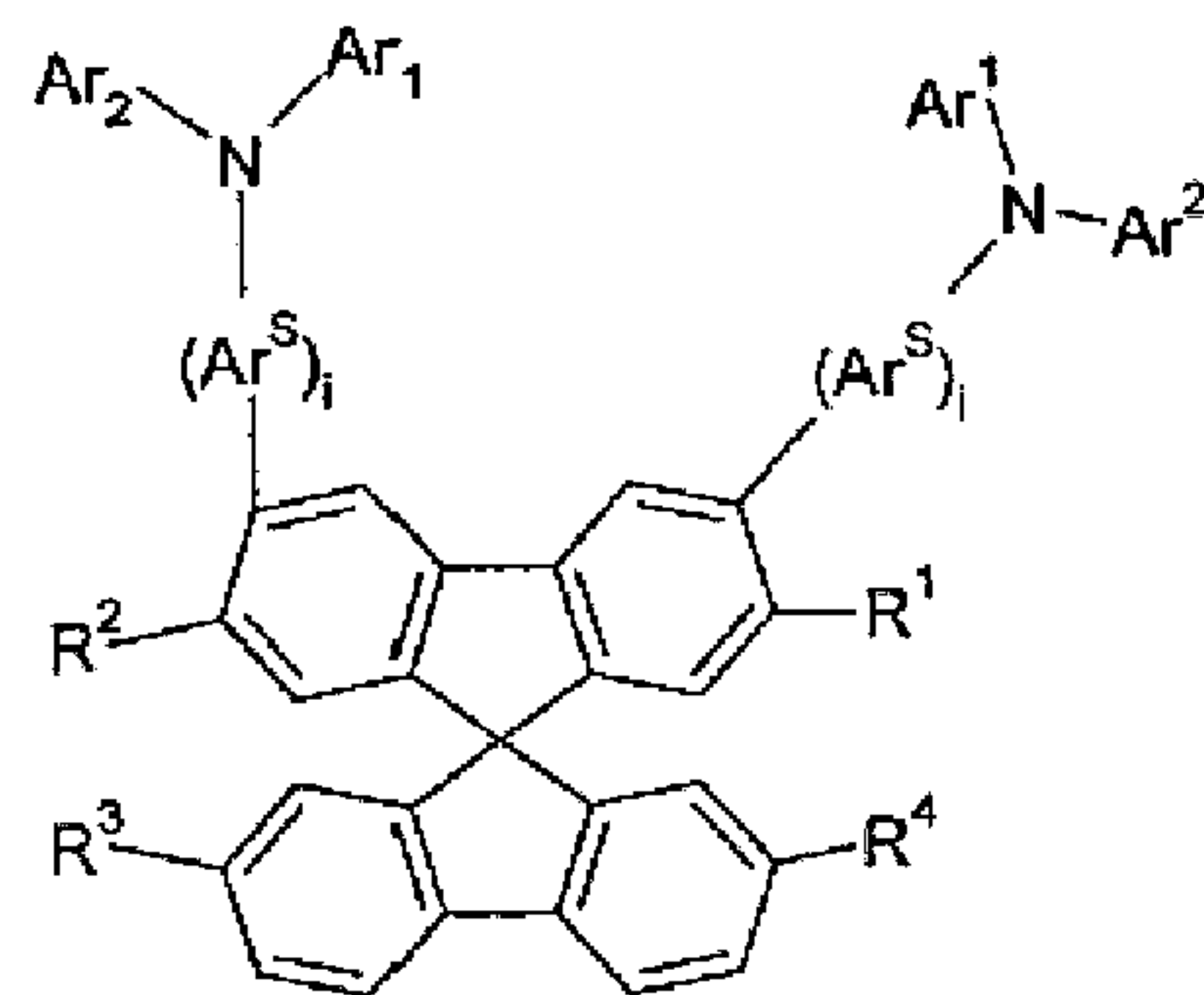
n 每次出現時係相同或不同且係0、1、2、3或4；

r、s 每次出現時係相同或不同且係0、1、2、3或4，其中與 R^2 或 R^3 鍵合的苯環鍵合的取代基的最大數量係4。

2. 如請求項1之化合物，其中該下標i係0。

3. 如請求項1之化合物，其係選自具有下式(3a)或(7a)之一之化合物，

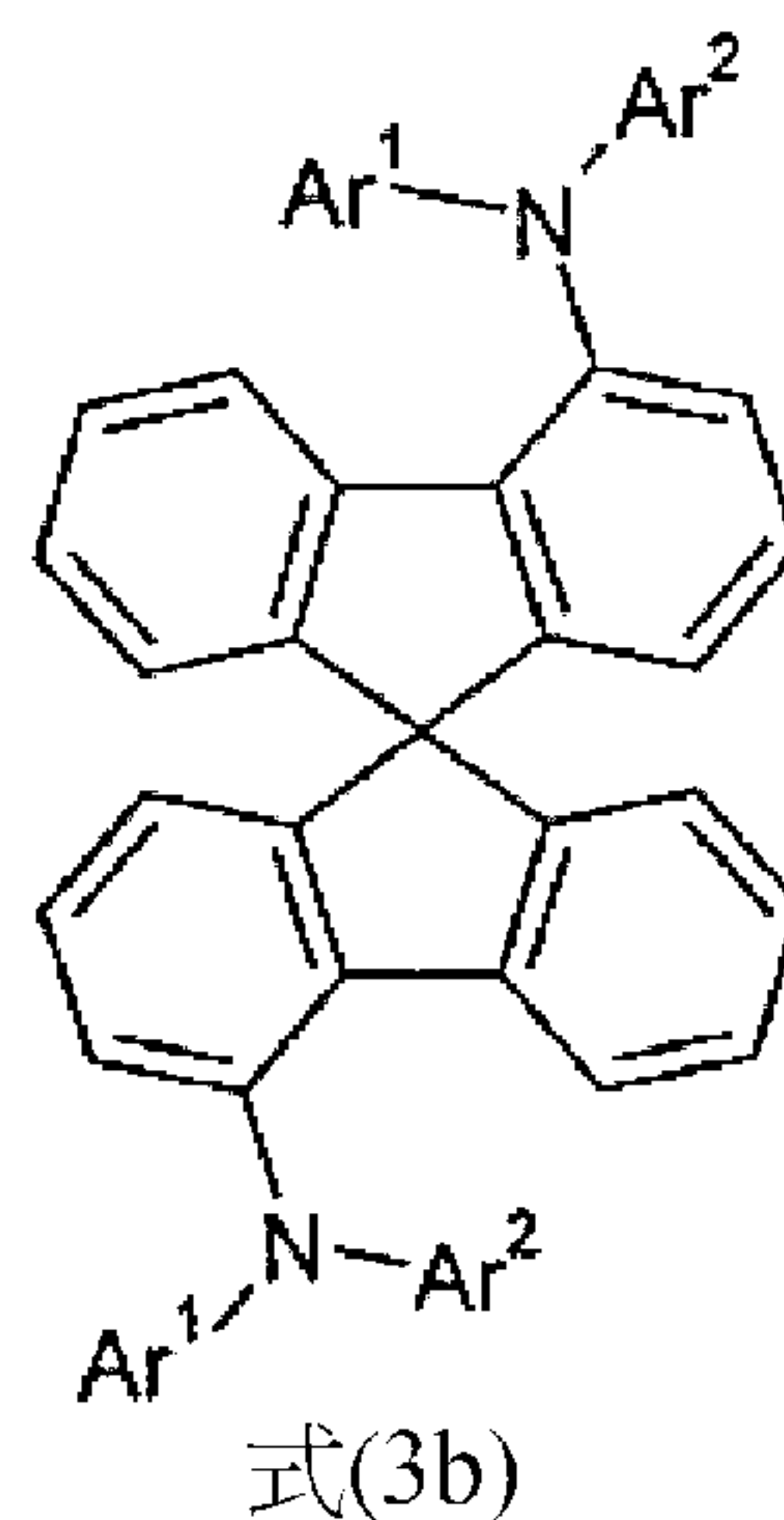




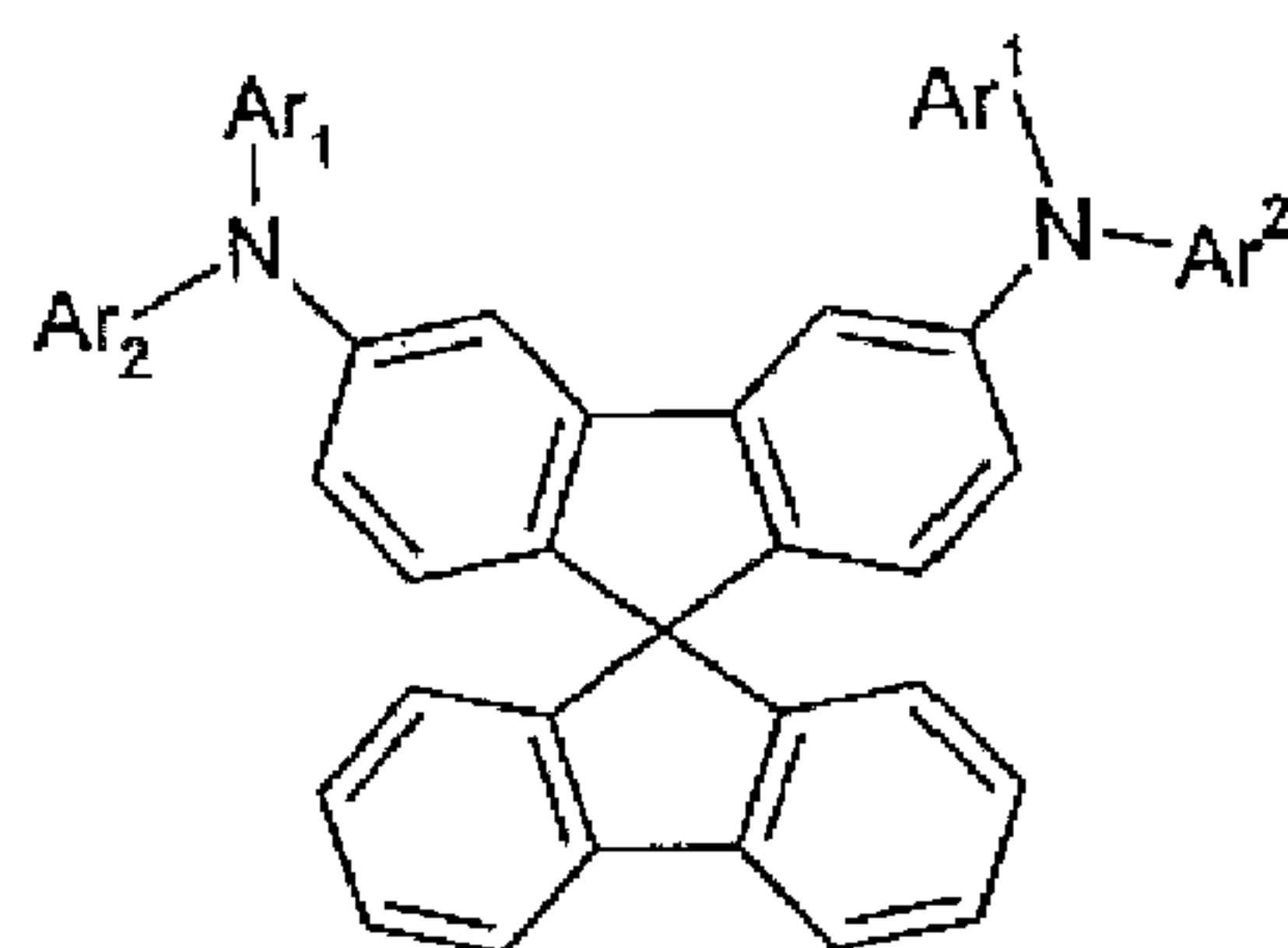
式(7a)

其中所用符號及下標係如請求項1或2中所定義。

4. 如請求項1之化合物，其係選自具有下式(3b)或(7b)之一之化合物，



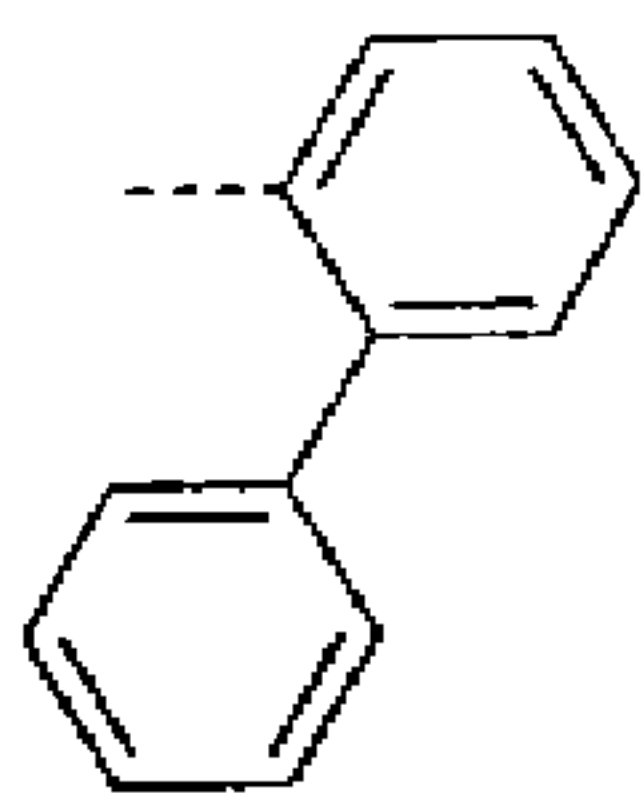
式(3b)



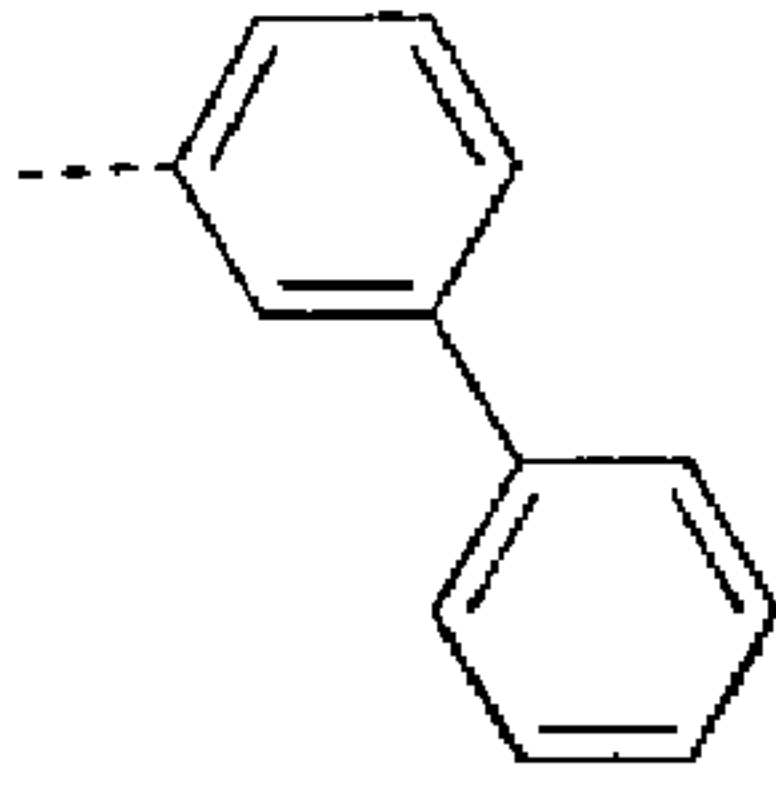
式(7b)

其中所用符號係如請求項1或2中所定義。

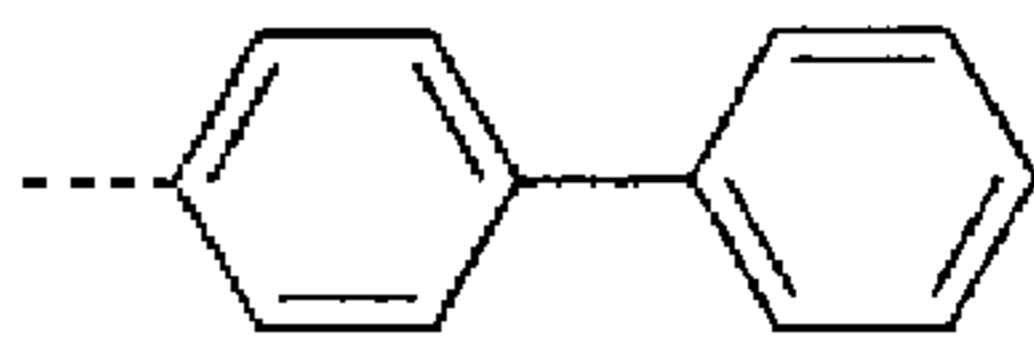
5. 如請求項1至4中任一項之化合物，其中Ar¹及Ar²基團在每次出現時係相同或不同且係選自下式之基團，



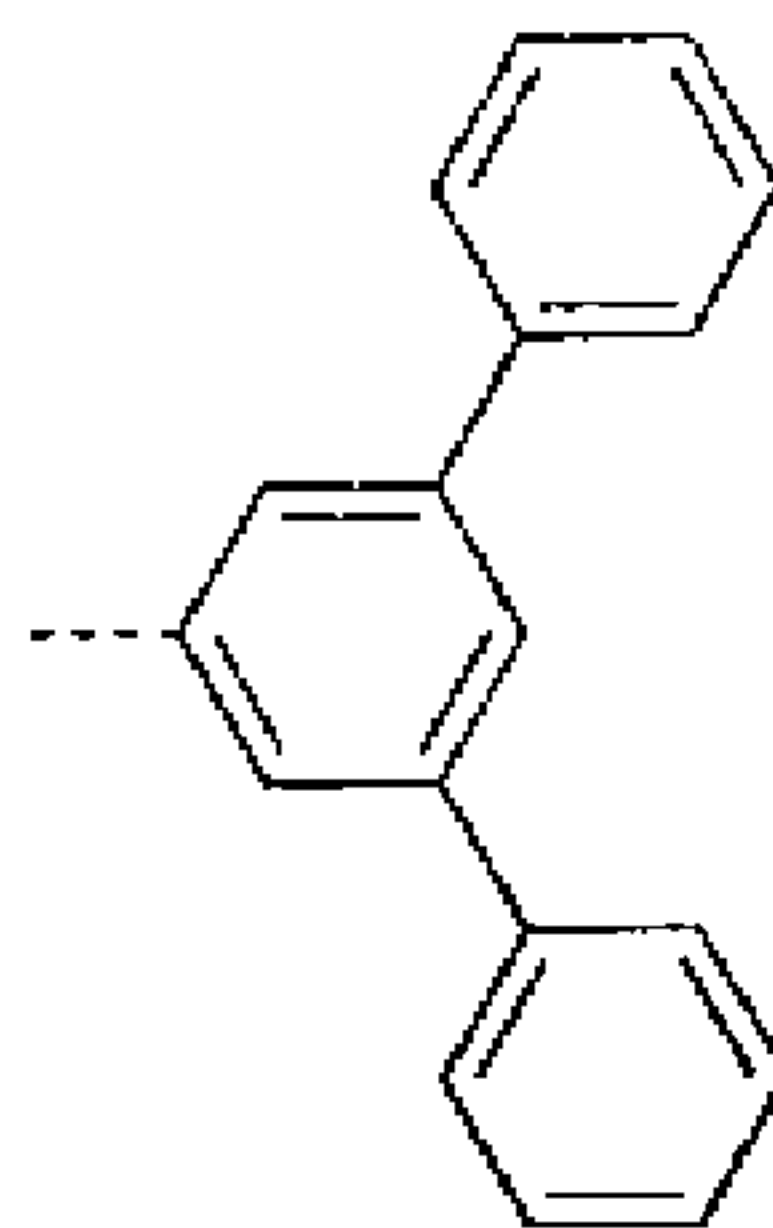
式(11)



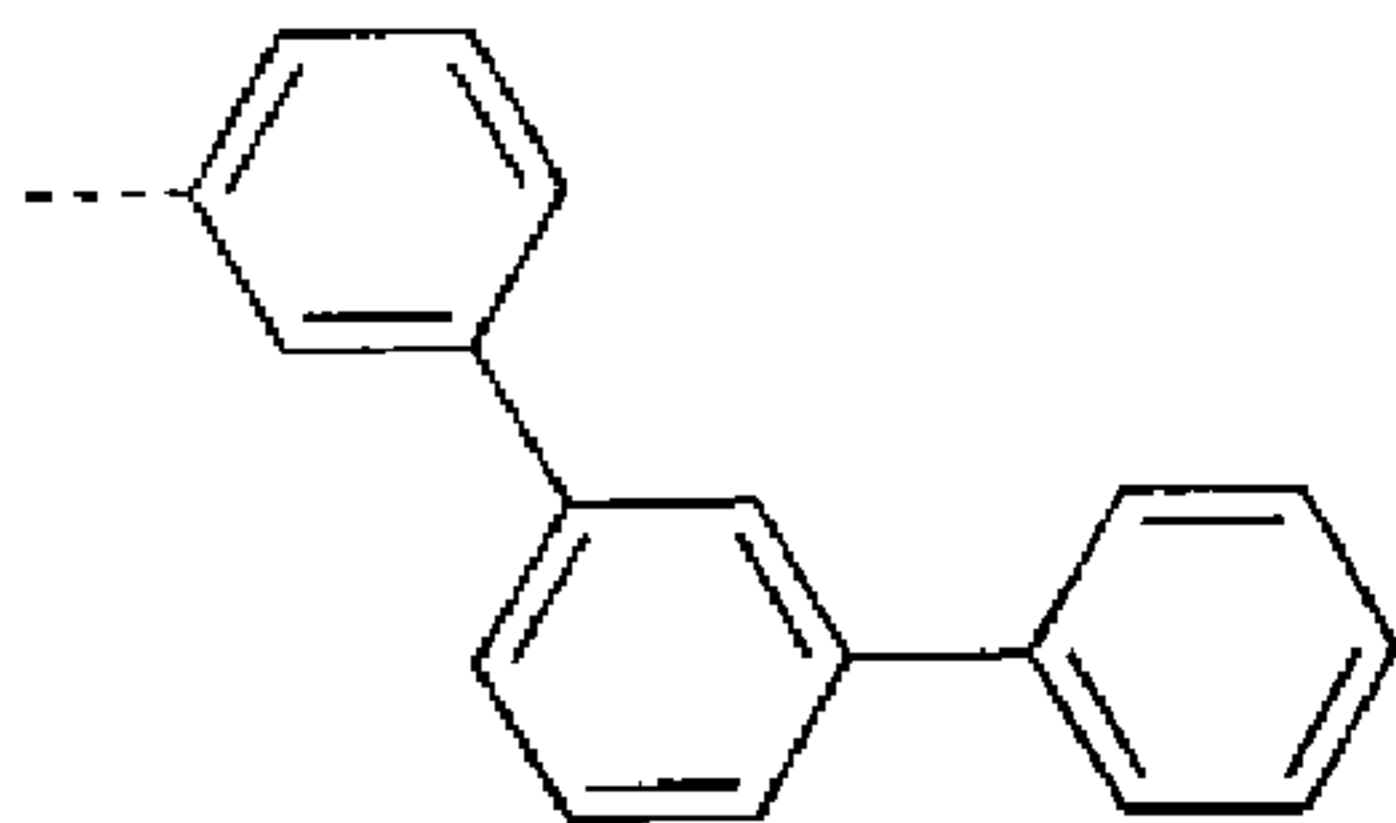
式(12)



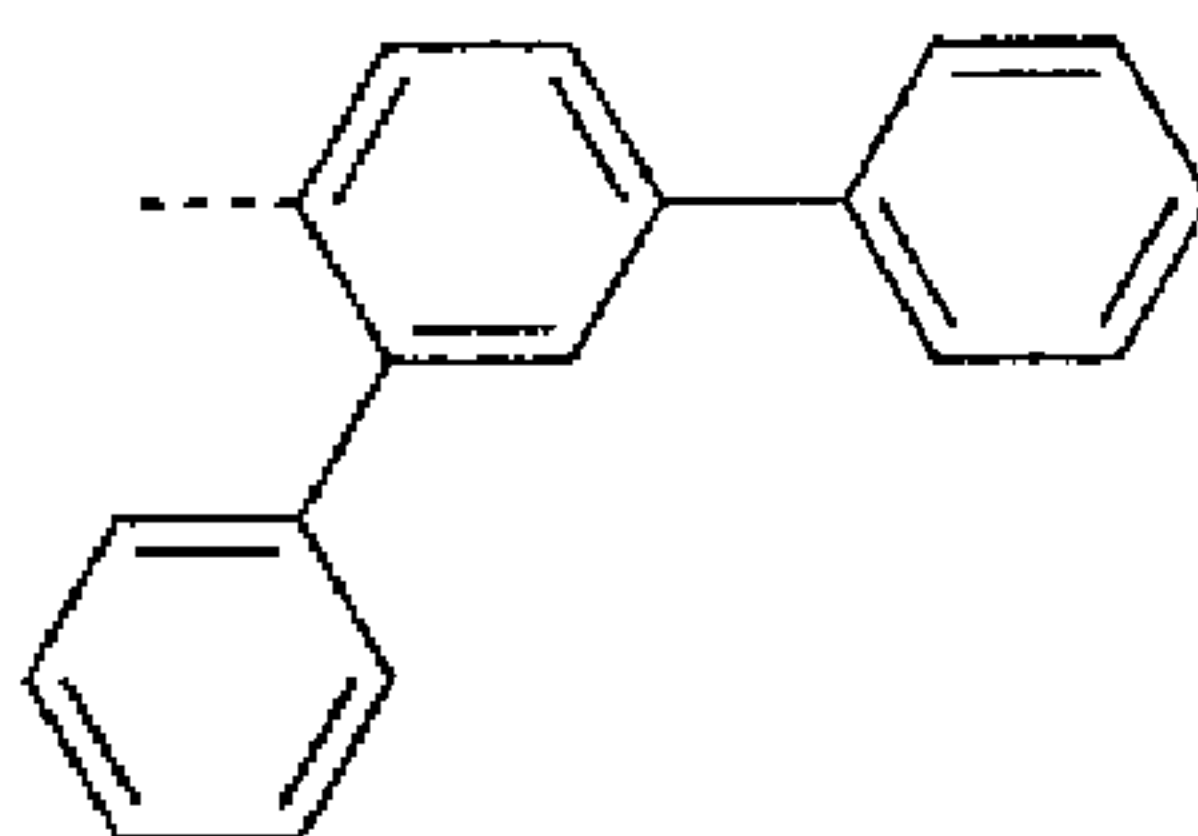
式(13)



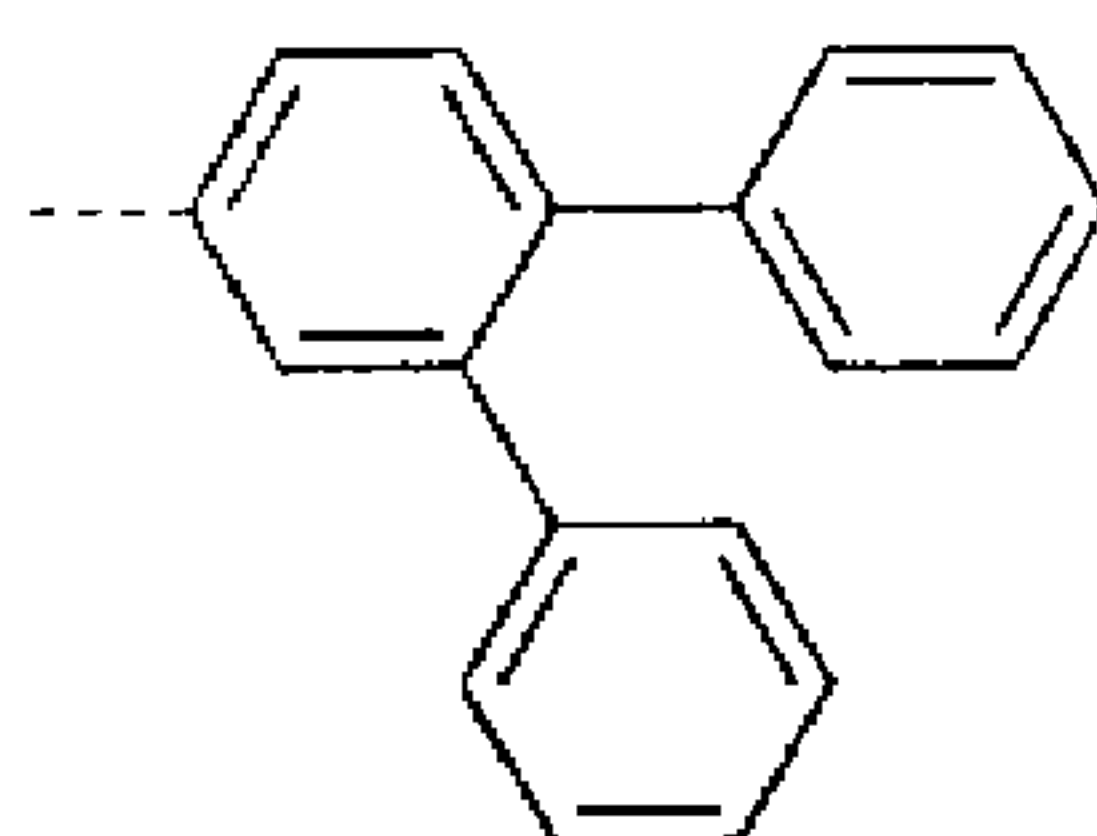
式(14)



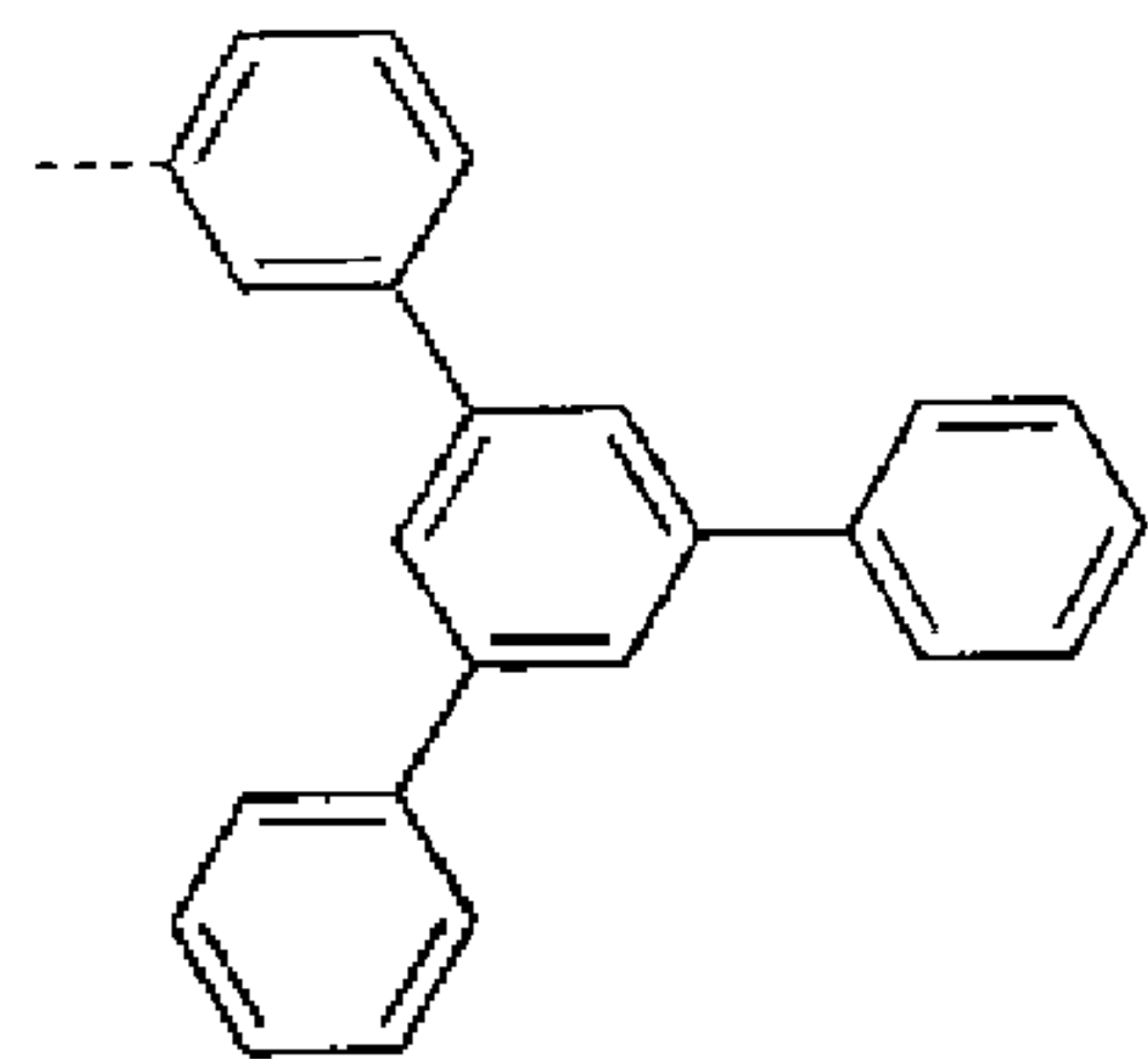
式(15)



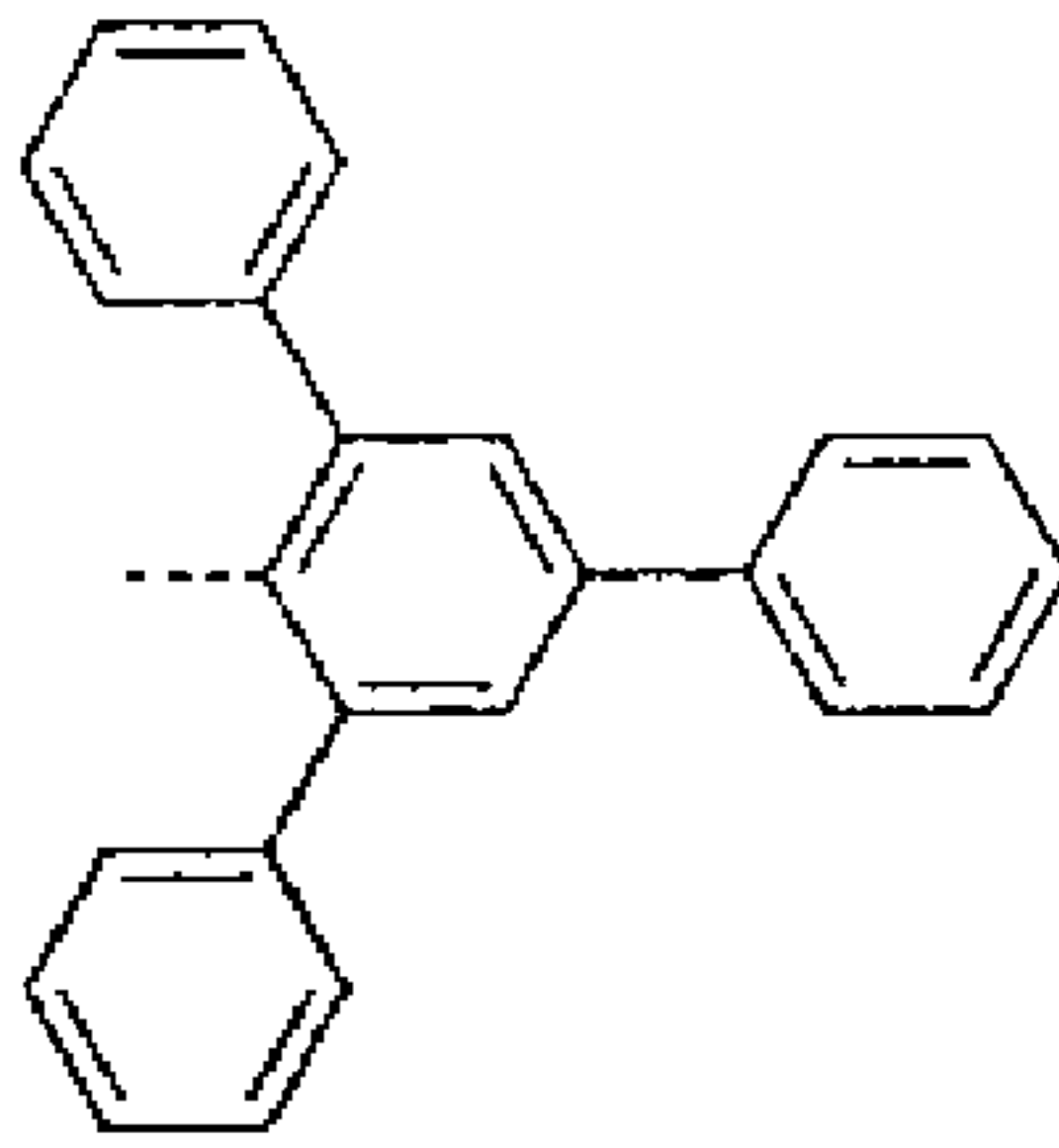
式(16)



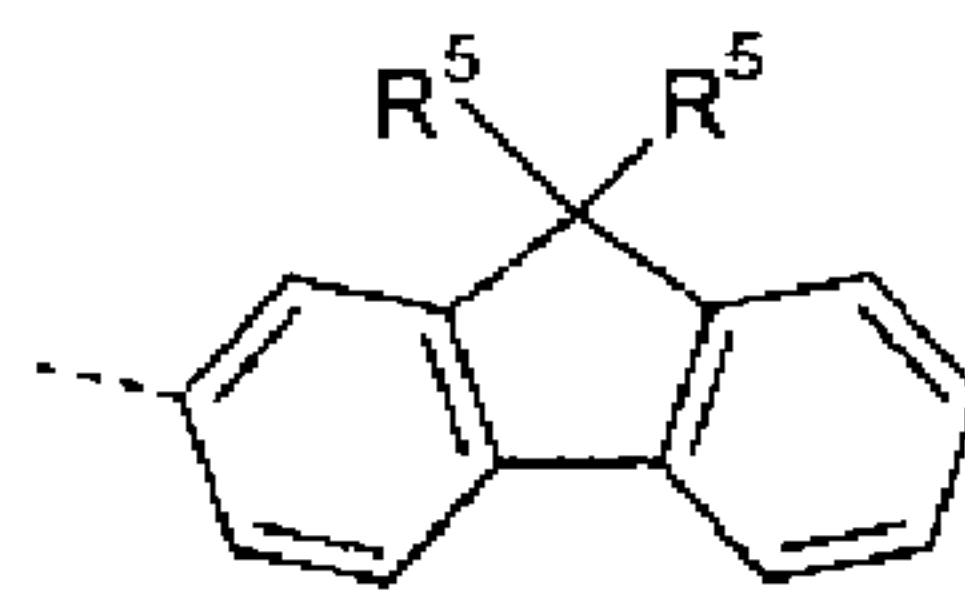
式(17)



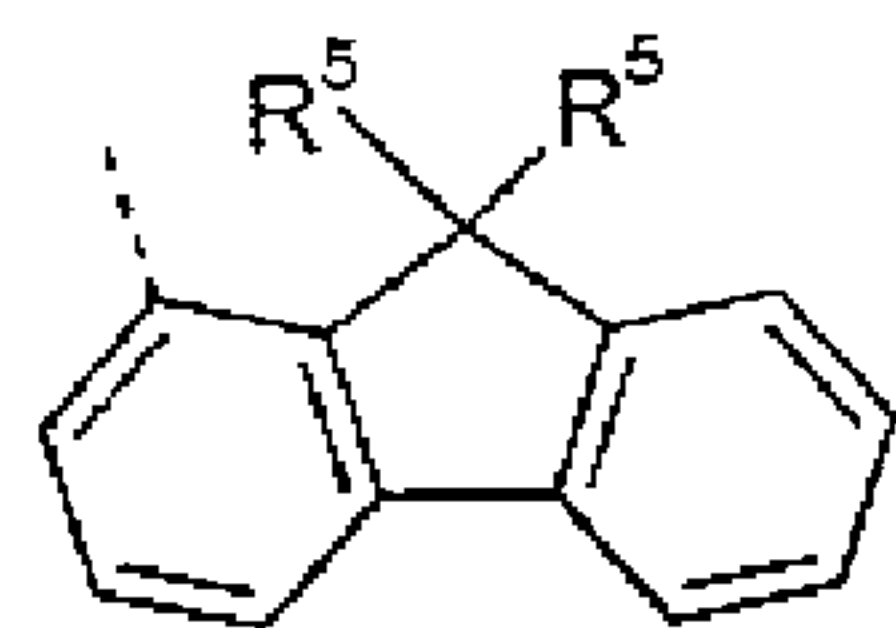
式(18)



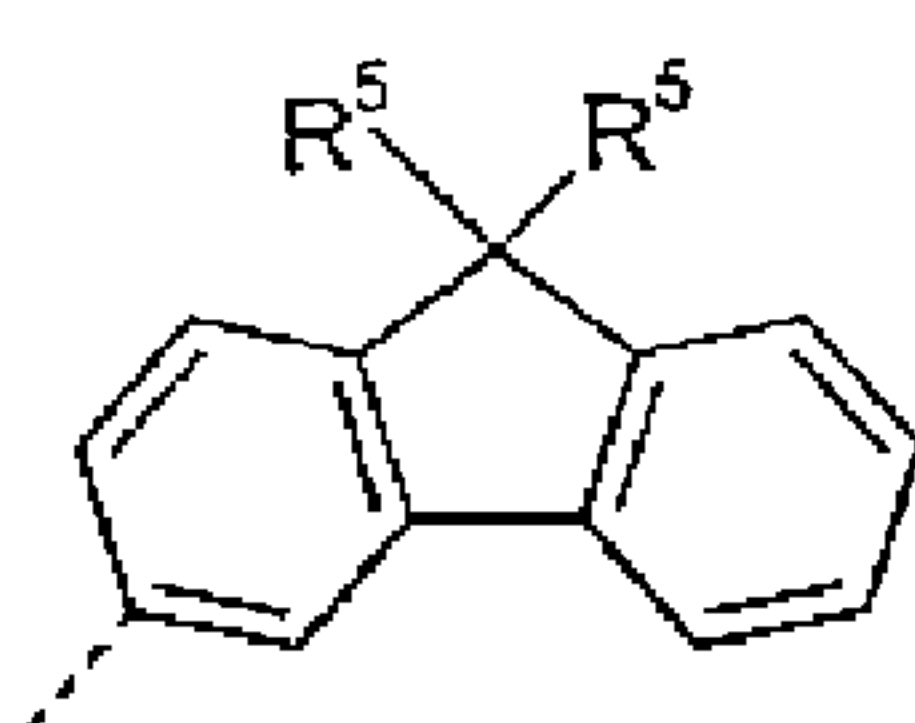
式(19)



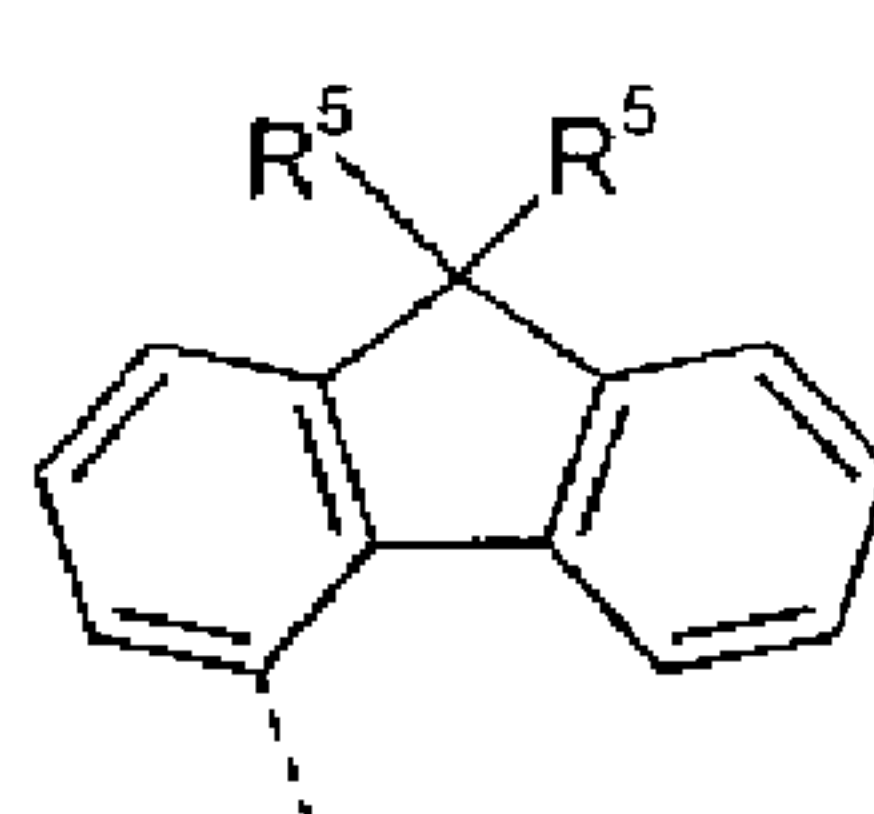
式(20)



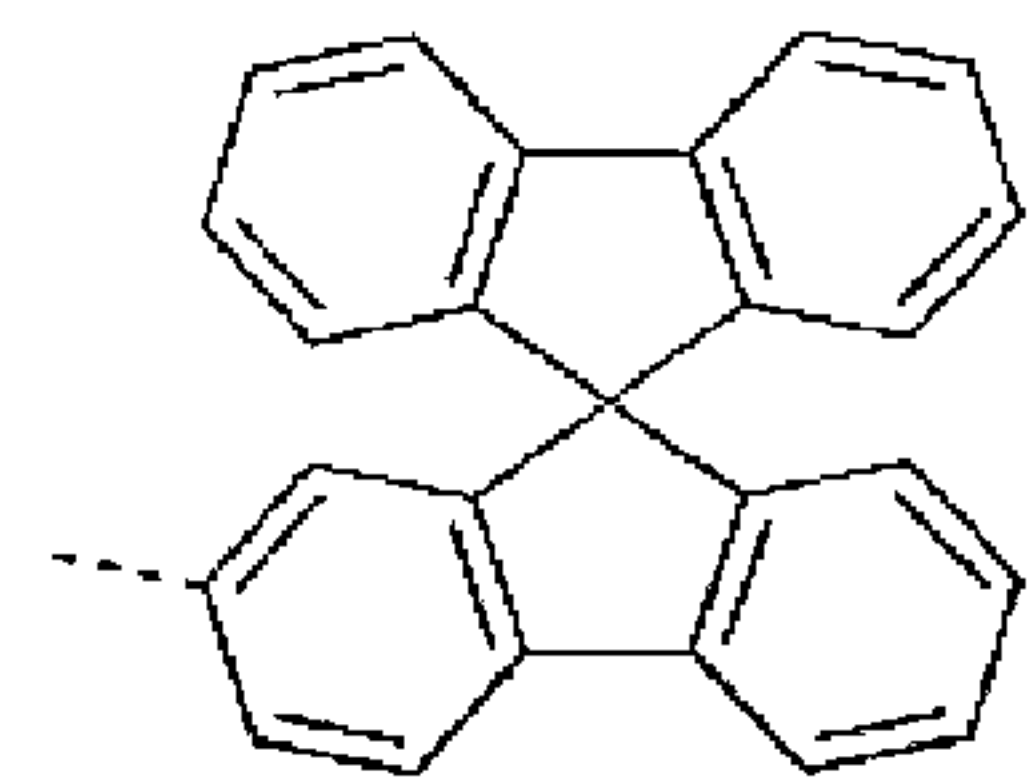
式(21)



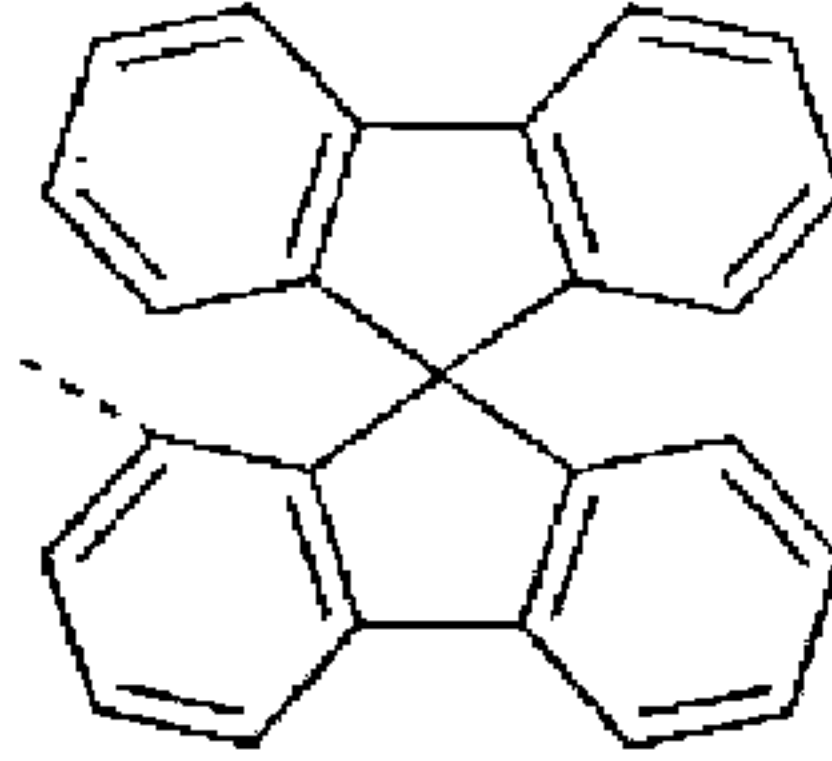
式(22)



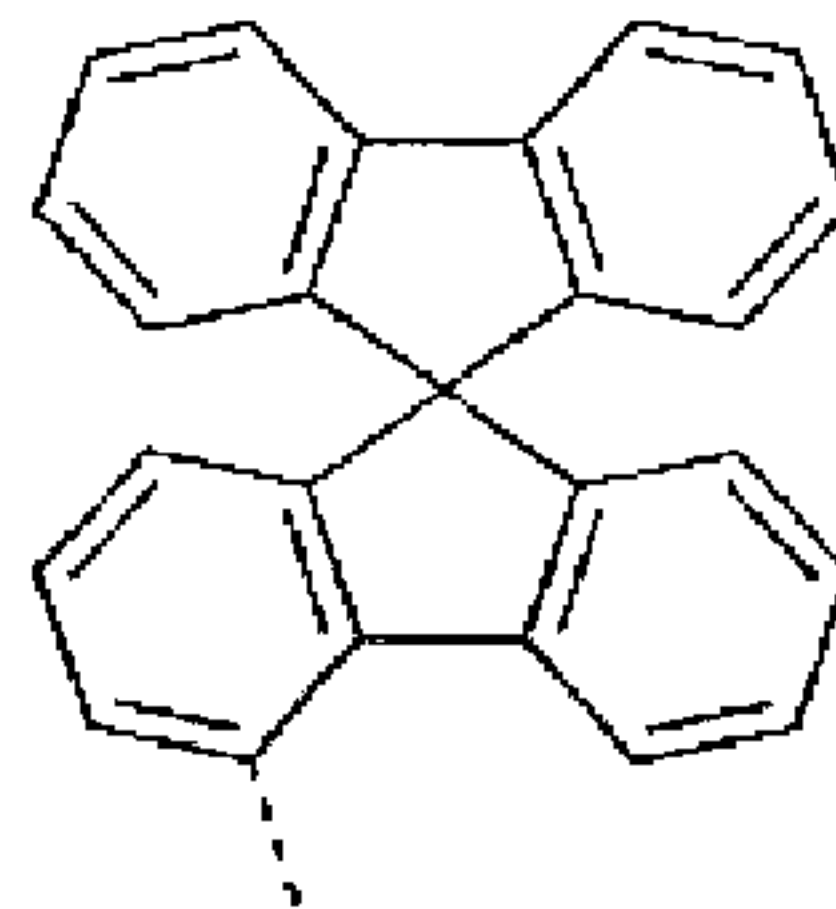
式(23)



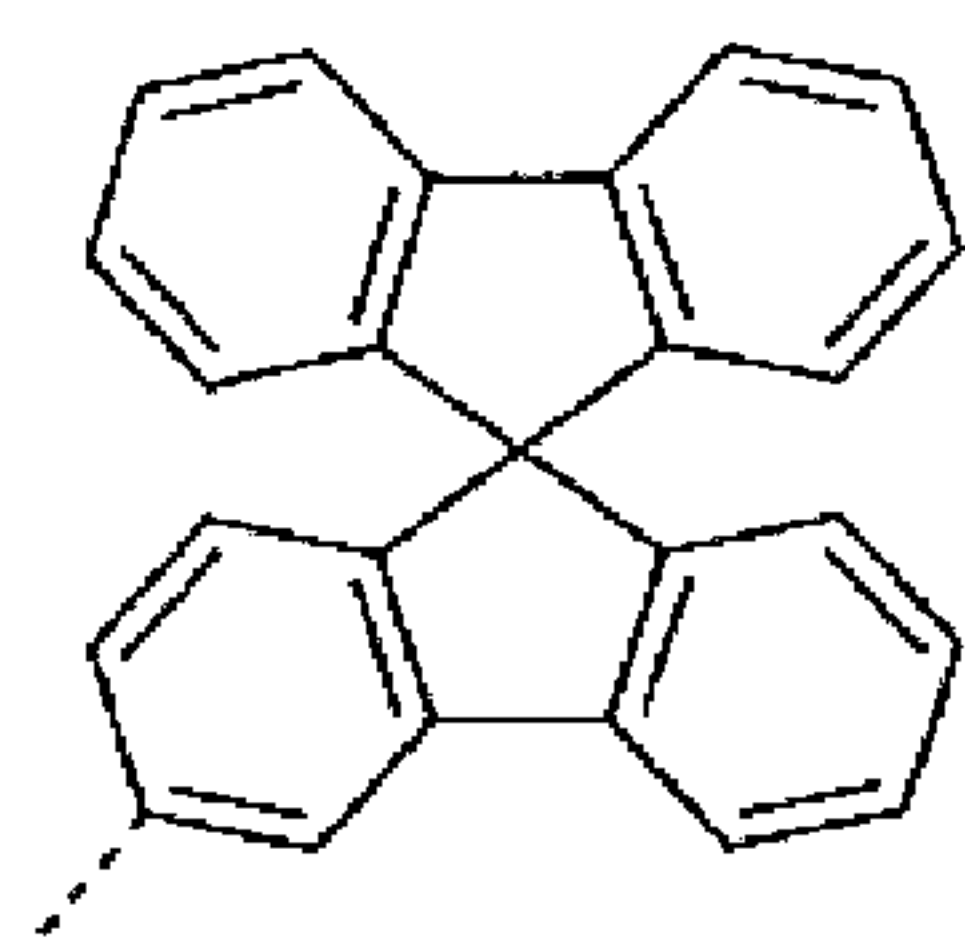
式(24)



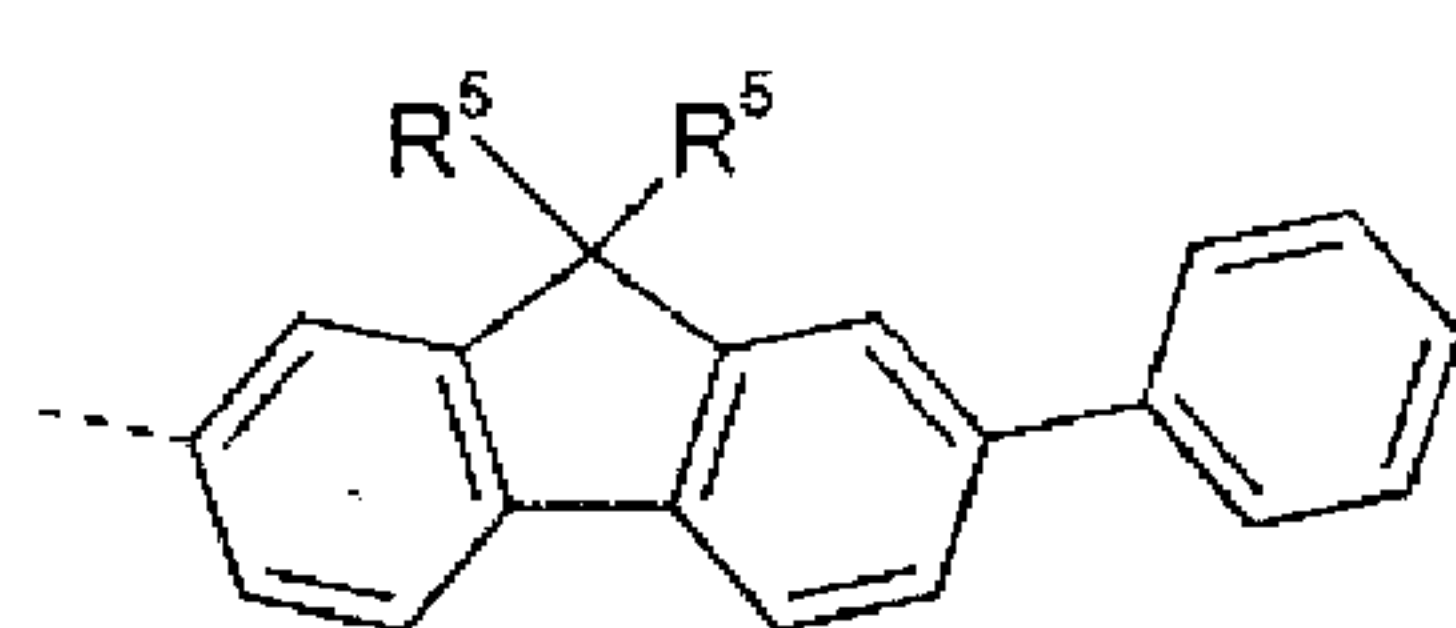
式(25)



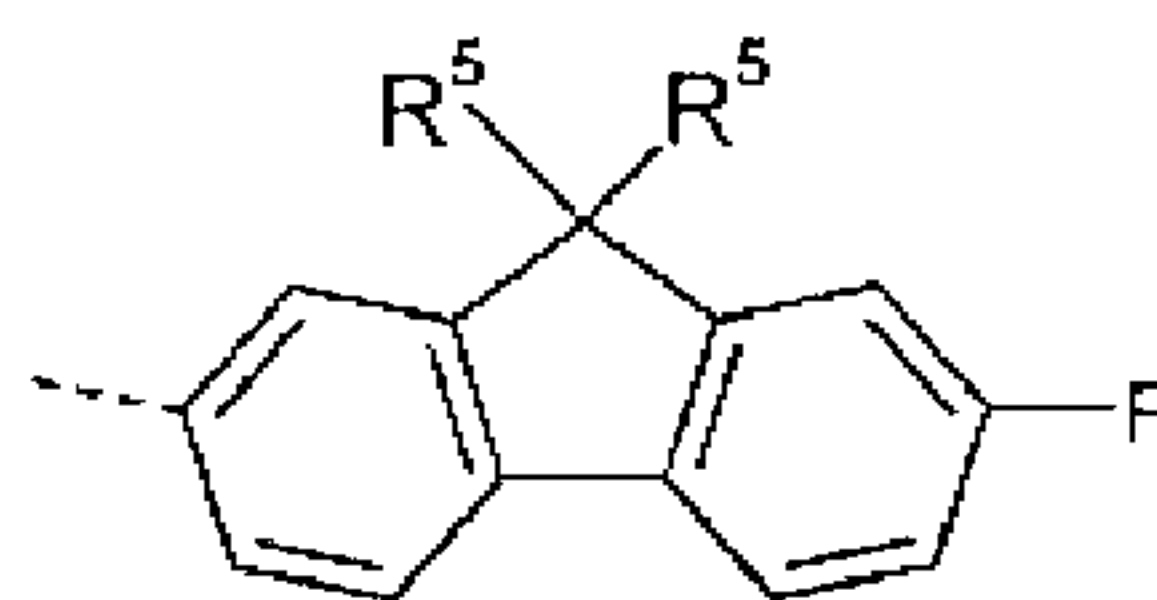
式(26)



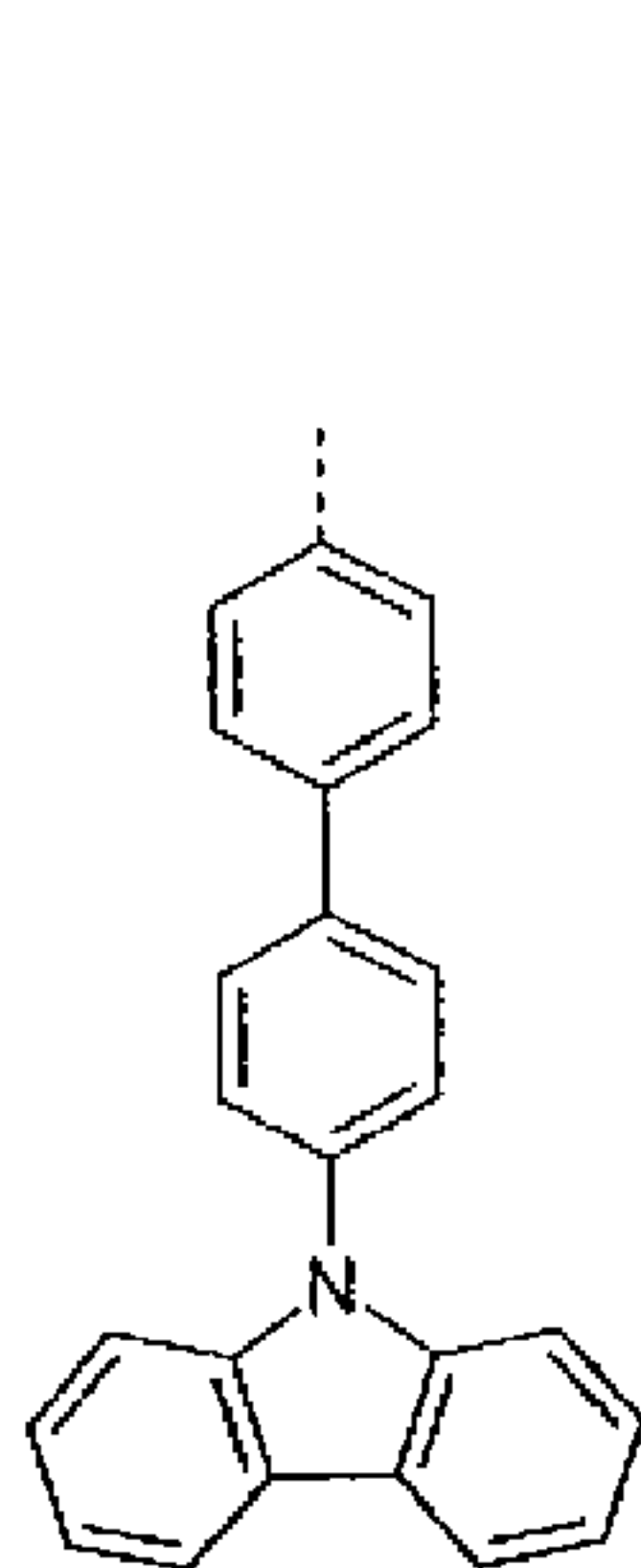
式(27)



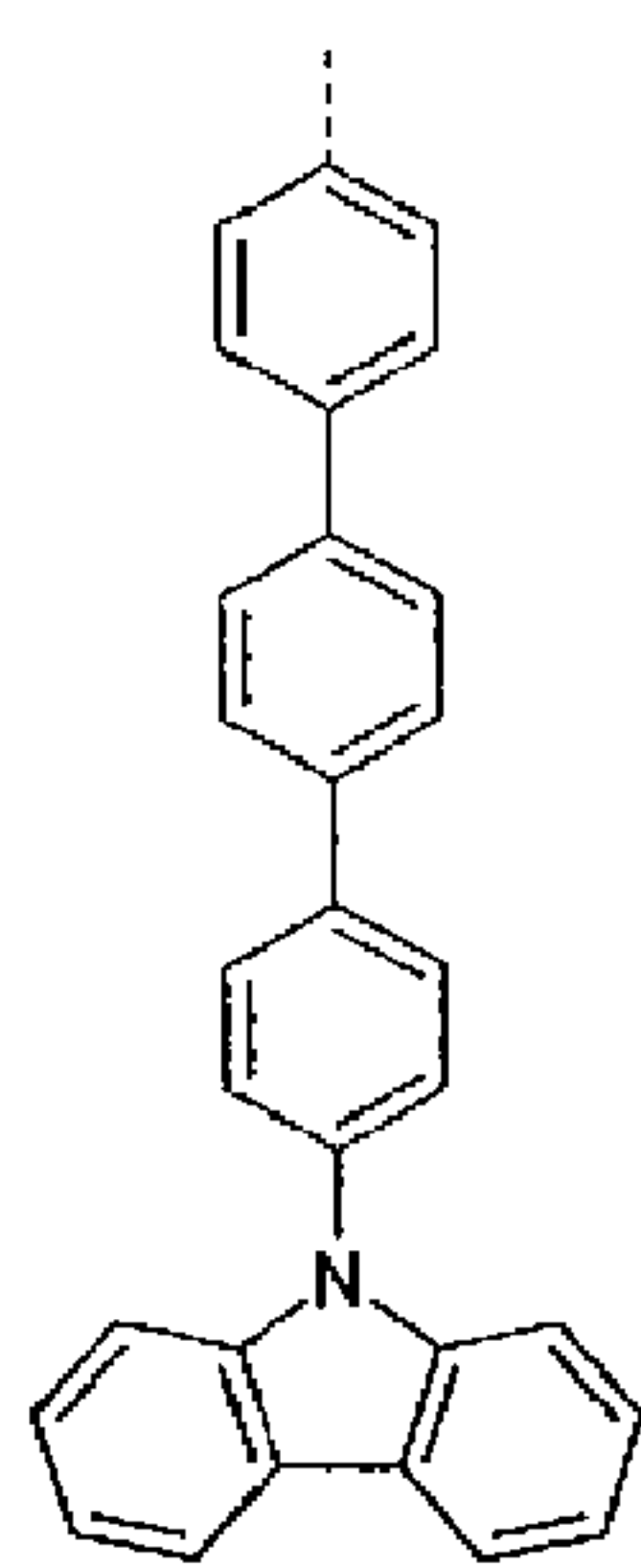
式(53)



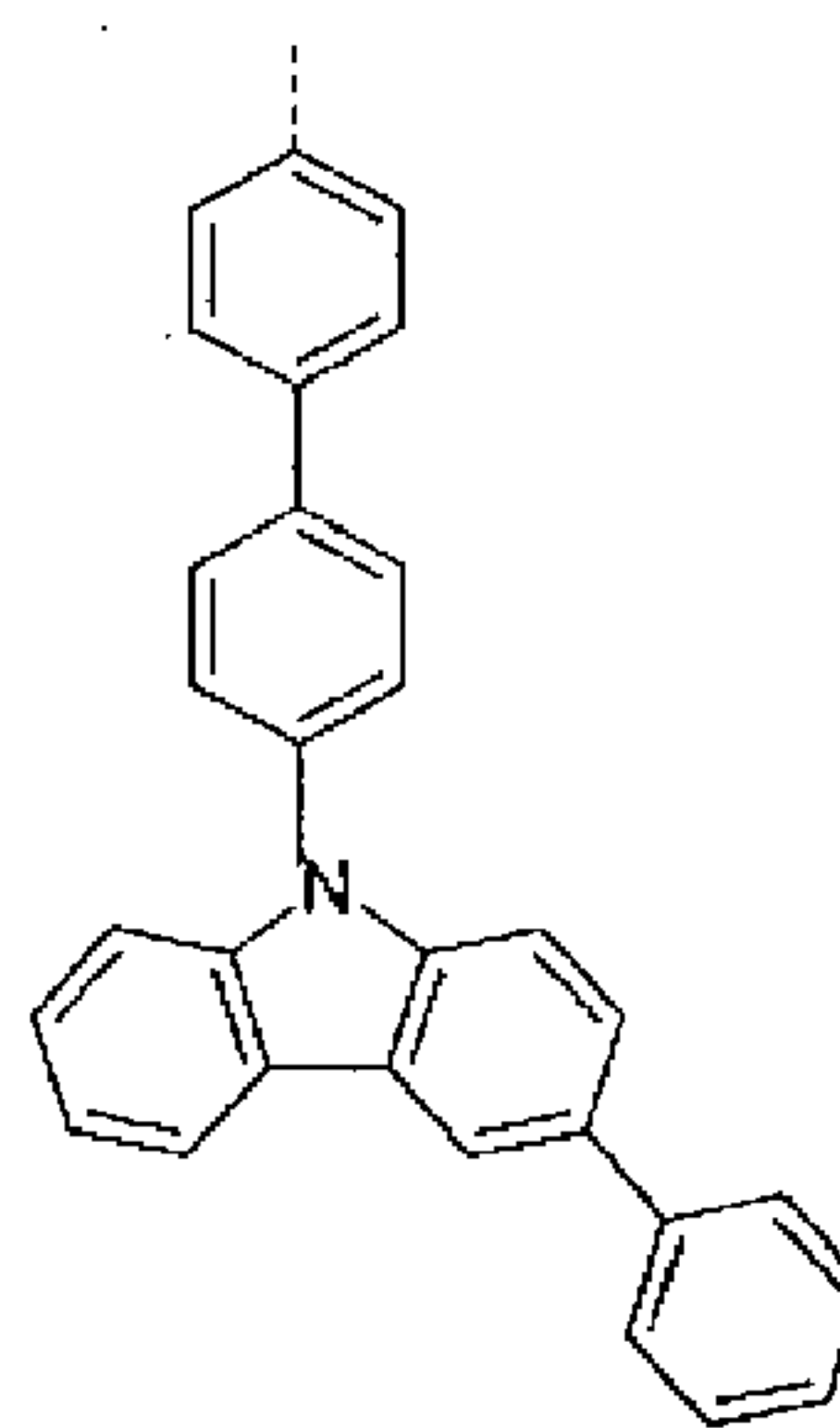
式(54)



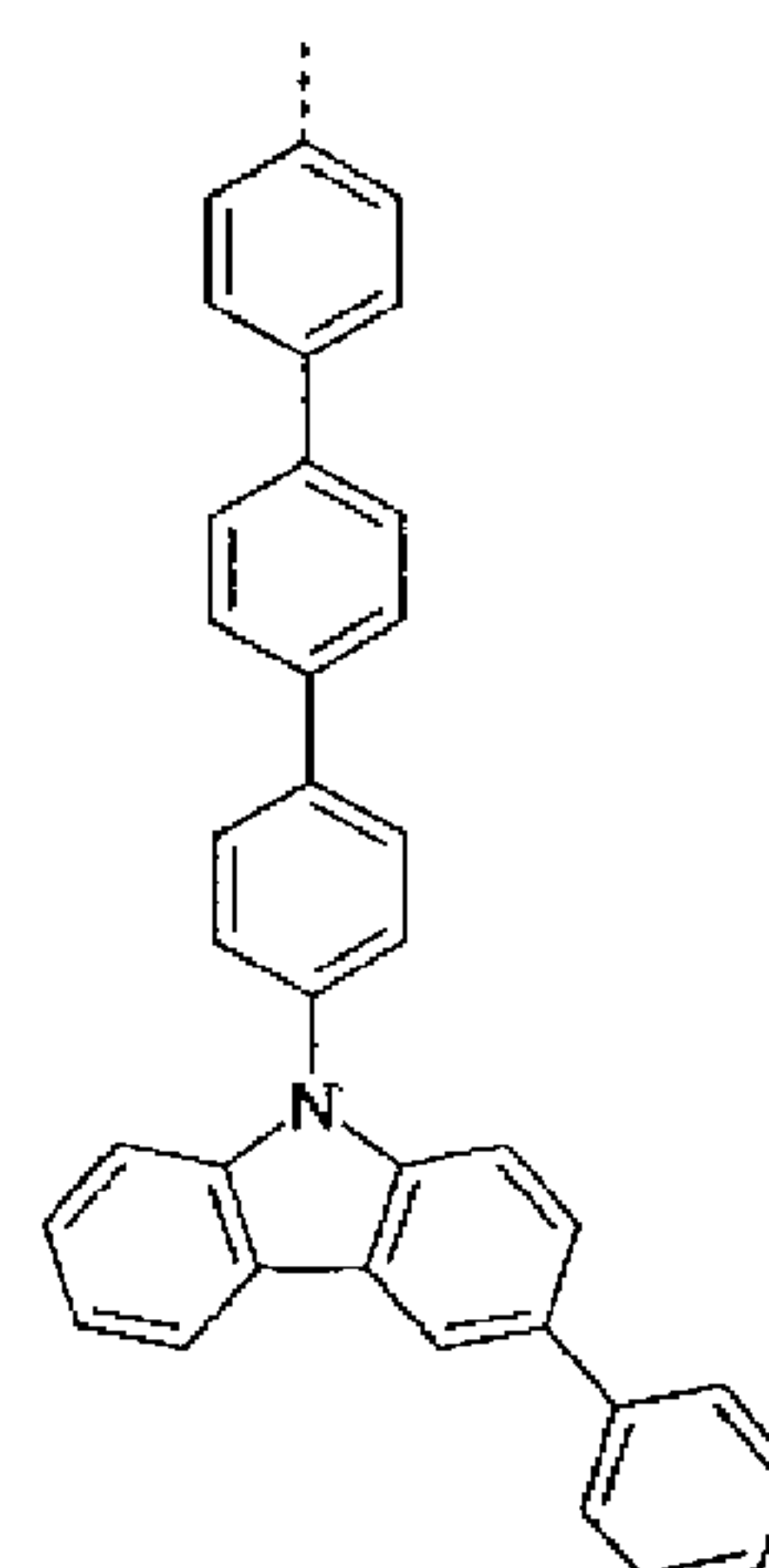
式(59)



式(60)



式(61)



式(62)

其中虛線鍵結指示至氮之鍵結，且該等基團可經一或多個 R^5 基團取代。

6. 如請求項5之化合物，其中 Ar^1 及 Ar^2 在每次出現時係相同或不同且係選自該等式(11)、(20)及(24)之基團，其可經一或多個 R^5 基團取代。
7. 如請求項1至4中任一項之化合物，其中該等 Ar^1 及 Ar^2 基團係經選擇為彼此不同。
8. 如請求項1至4中任一項之化合物，其中 R^1 至 R^4 在每次出現時係相同或不同且係選自由下列組成之群：H、F、CN；具有1至10個C原子之直鏈烷基或烷氧基或具有3至10個C原子之具支鏈或環狀

烷基或烷氧基，其每一者可經一或多個 R^6 基團取代，其中一或多個非毗鄰 CH_2 基團可經O替代且其中一或多個H原子可經F替代；具有6至24個芳族環原子之芳族或雜芳族環系統，在每一情形下，其可經一或多個 R^6 基團取代。

9. 如請求項1至4中任一項之化合物，其中鍵結至 Ar^1 或 Ar^2 或 Ar^S 之該 R^5 基團在每次出現時係相同或不同且係選自由下列組成之群：H、F、CN；具有1至10個C原子之直鏈烷基、具有3至10個C原子之具支鏈或環狀烷基或具有5至24個芳族環原子之芳族或雜芳族環系統，其每一者可經一或多個 R^6 基團取代。

10. 如請求項5之化合物，其中：

R^1 至 R^4 在每次出現時係相同或不同且係選自由下列組成之群：H、F、CN；具有1至10個C原子之直鏈烷基或烷氧基或具有3至10個C原子之具支鏈或環狀烷基或烷氧基，其每一者可經一或多個 R^6 基團取代，其中一或多個非毗鄰 CH_2 基團可經O替代且其中一或多個H原子可經F替代；具有6至24個芳族環原子之芳族或雜芳族環系統，在每一情形下，其可經一或多個 R^6 基團取代；

R^5 若該基團 R^5 係鍵結至 Ar^1 或 Ar^2 或 Ar^S ，則其每次出現時係相同或不同且係選自由下列組成之群：H、F、CN、具有1至10個C原子之直鏈烷基、具有3至10個C原子之具支鏈或環狀烷基或具有5至24個芳族環原子之芳族或雜芳族環系統，其每一者可經一或多個 R^6 基團取代；

或 R^5 在鍵結至該等式(20)至(23)、(53)及(54)中之碳橋時係相同或不同且係具有1至10個C原子之烷基，特定而言甲基，或苯基，其可經一或多個 R^6 基團取代；

R^6 在每次出現時係相同或不同且係選自由下列組成之群：H、具有1至10個C原子之直鏈烷基或具有3至10個C原子之具支鏈

或環狀烷基或具有6至24個C原子之芳族環系統；

i 係0；

m 係0或1；

n 係0或1；

r 係0或1；

s 係0或1。

11. 一種製備如請求項1至10中任一項之化合物之方法，其特徵在於藉由1-或3-或4-鹵化螺二萸與二芳基胺之間之C-N偶合反應來引入二芳基胺基。
12. 一種如請求項1至10中任一項之化合物在電子裝置中之用途。
13. 一種包含至少一種如請求項1至10中任一項之化合物之電子裝置，其係選自由下列組成之群：有機電致發光裝置、有機積體電路、有機場效電晶體、有機薄膜電晶體、有機發光電晶體、有機太陽能電池、有機染料敏化太陽能電池、有機光學偵測器、有機光感受器、有機場致猝滅裝置、發光電化學電池、有機雷射二極體及有機電漿子發射裝置。
14. 如請求項13之電子裝置，其係選自有機電致發光裝置，其中包含如請求項1至10中任一項之化合物作為電洞傳輸層或電洞注入層或激子阻擋層或電子阻擋層中之電洞傳輸材料，或包含該化合物作為發射層中用於螢光或磷光發射體之基質材料。