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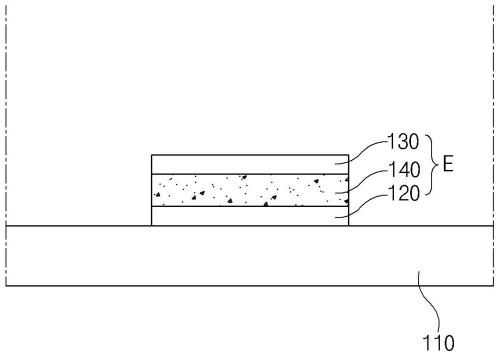
(54) 발명의 명칭 **청색 형광 물질 및 이를 이용한 유기전계발광소자**

(57) 요 약

본 발명은 청색 형광 물질 및 이를 이용한 유기전계발광소자에 관한 것이다.

본 발명에 있어서, 디페닐아민 유도체가 1,6-파이렌에 치환된 구조로서 페닐기에는 수소, 플로린, C1-C6의 치환 또는 비치환된 알킬기, C6~C30의 치환 또는 비치환된 방향족 그룹 또는 C6~C30의 치환 또는 비치환된 이형고리그룹으로부터 선택되는 물질이 치환되고, 특히 이중 두개는 플로린이며, 아민에는 C6~C30의 치환 또는 비치환된 방향족 그룹 또는 C6~C30의 치환 또는 비치환된 이형고리그룹으로부터 선택되는 물질이 치환됨으로써, 색순도와 발광효율 및 발광수명이 향상되는 것이 특징이다.

대 표 도 - 도2



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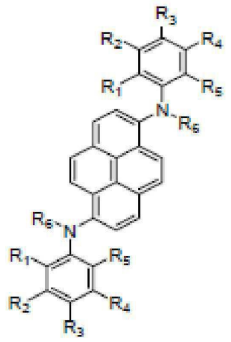
특허청구의 범위

청구항 1

전자 또는 정공을 전달할 수 있는 호스트물질과;

하기 화학식으로 표시되는 도펀트 물질을 포함하는 청색 형광 물질.

화학식



(상기 화학식에서, R1, R2, R3, R4, R5는 수소, 플로린, C1-C6의 치환 또는 비치환된 알킬기, C6~C30의 치환 또는 비치환된 방향족 그룹 또는 C6~C30의 치환 또는 비치환된 이형고리그룹으로부터 선택되는 물질 중 어느 하나이고, R1, R2, R3, R4, R5 중 두개는 플로린이며, R6는 C6~C30의 치환 또는 비치환된 방향족 그룹 또는 C6~C30의 치환 또는 비치환된 이형고리그룹 중 선택되는 어느 하나이다.)

청구항 2

제 1 항에 있어서,

상기 C1~C6의 알킬기는 메틸(methyl), 에틸(ethyl), n-프로필(n-propyl), i-프로필(i-propyl), n-부틸(n-butyl), i-부틸(i-butyl) 및 t-부틸(t-butyl) 중 어느 하나인 것을 특징으로 하는 청색 형광 물질.

청구항 3

제 1 항에 있어서,

상기 방향족 그룹은 치환 또는 비치환된 페닐(phenyl), 바이페닐(biphenyl), 나프틸(naphthyl), 페난스렌(phenanthrene), 터페닐(terphenyl), 플루오레닐(fluorenyl) 중 어느 하나인 것을 특징으로 하는 청색 형광 물질.

청구항 4

제 3 항에 있어서,

상기 방향족 그룹의 치환체는 메틸(methyl), 에틸(ethyl), n-프로필(n-propyl), i-프로필(i-propyl), n-부틸(n-butyl), i-부틸(i-butyl) 및 t-부틸(t-butyl)과, 중수소, 시아닐(cyanyl), 트리메틸실릴(trimethylsilyl), 플루오린(fluorine), 트리플루오로메틸(trifluoromethyl) 중 어느 하나인 것을 특징으로 하는 청색 형광 물질.

청구항 5

제 1 항에 있어서,

상기 이형고리 그룹은 퓨란(furan), 티오펜(thiophene), 피롤(pyrrole), 피리딘(pyridine), 피리미딘(pyrimidine) 중 어느 하나인 것을 특징으로 하는 청색 형광 물질.

청구항 6

제 1 항에 있어서,

상기 도펀트 물질은 상기 호스트물질과 상기 도펀트 물질 전체 중량 대비 0.1~20%인 것을 특징으로 하는 청색 형광 물질.

청구항 7

제 1 전극과;

상기 제 1 전극과 마주보는 제 2 전극과;

상기 제 1 및 제 2 전극 사이에 위치하며, 정공주입층, 정공수송층, 발광물질층, 전자수송층, 전자주입층을 포함하고, 상기 발광물질층은 제 1항 내지 제 6항 중 어느 하나를 포함하는 것을 특징으로 하는 유기전계발광소자.

명 세 서

발명의 상세한 설명

기 술 분 야

[0001] 본 발명은 청색 형광 물질 및 이를 사용하는 유기전계발광소자에 관한 것이다. 보다 구체적으로, 본 발명은 발광효율과 색순도가 높고 향상된 수명을 갖는 청색 형광 물질 및 이를 포함하여 이루어지는 유기전계발광소자에 관한 것이다.

배 경 기 술

[0002] 최근 표시장치의 대형화에 따라 공간 점유가 적은 평면표시소자의 요구가 증대되고 있는데, 이러한 평면표시소자 중 하나로서 유기발광다이오드(organic light emitting diode: OLED)라고도 불리는 유기전계발광소자의 기술이 빠른 속도로 발전하고 있으며, 이미 여러 시제품들이 발표된 바 있다.

[0003] 유기 전계 발광 소자는 전자 주입 전극(음극) 과 정공 주입 전극(양극) 사이에 형성된 발광물질층에 전하를 주입하면 전자와 정공이 쌍을 이룬 후 소멸하면서 빛을 내는 소자이다. 플라스틱 같은 휠 수 있는(flexible) 투명 기판 위에도 소자를 형성할 수 있을 뿐 아니라, 플라즈마 디스플레이 패널(Plasma Display Panel)이나 무기 전계발광(EL) 디스플레이에 비해 낮은 전압에서 (10V이하) 구동이 가능하고, 또한 전력 소모가 비교적 적으며, 색감이 뛰어나다는 장점이 있다. 또한 유기 전계 발광(EL) 소자는 녹색, 청색, 적색의 3가지 색을 나타낼 수가 있어 차세대 풍부한 색 디스플레이 소자로 많은 사람들의 많은 관심의 대상이 되고 있다. 여기서 유기전계발광소자를 제작하는 과정을 간단히 살펴보면,

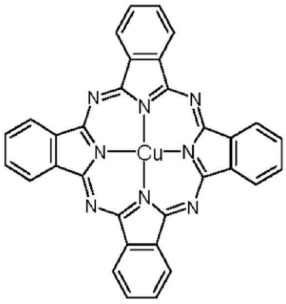
[0004] (1) 먼저, 투명기판 위에 인듐-틴-옥사이드(indium tin oxide; ITO)와 같은 물질을 증착하여 양극(anode)을 형성한다.

[0005] (2) 상기 양극 상에 정공주입층(HIL:hole injecting layer)을 형성한다. 정공주입층은 주로 하기 화학식1-1로 표시되는 구리 프탈로시아닌 (copper phthalocyanine(CuPc))을 10nm 내지 30nm 두께로 증착하여 형성된다.

[0006] (3) 다음, 상기 정공주입층 상에 정공수송층(HTL: hole transport layer)을 형성한다. 이러한 정공수송층은 4,4'-비스(bis)[N-(1-나프틸(naphtyl))-N-페닐아미노(phenylamino)]-바이페닐(biphenyl) (NPB)을 30nm 내지 60nm 정도 증착하여 형성된다.

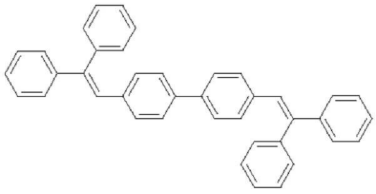
[0007] (4) 다음, 상기 정공수송층 상에 발광물질층 (EML: emitting material layer)을 형성한다. 상기 발광물질층은 호스트(host)와 도펀트(dopant)로 이루어지며, 하기 화학식1-2로 표시되는 DPVBi를 호스트 물질로 하고, 하기 화학식1-3으로 표시되는 BD-a를 도펀트로 1~10% 농도로 첨가하여, 20~40nm 정도 증착한다.

[0008] 화학구조식1-1



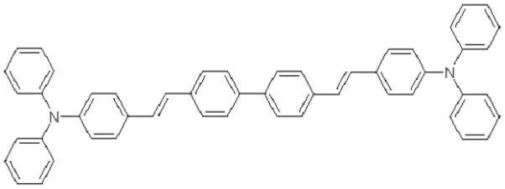
[0009]

[0010] 화학구조식1-2



[0011]

[0012] 화학구조식1-3



[0013]

[0014] (5) 다음, 상기 발광물질층 상에 전자수송층(ETL:electron transport layer) 및 전자주입층(EIL: electron injecting layer)을 연속적으로 형성한다. 이때, 상기 전자수송층은 tris(8-hydroxy-quinolate)aluminum (Alq3)로 이루어진다. 전자수송층과 전자주입층의 이중층 구조 대신에, 전자주입 운송층을 형성할 수 있다.

[0015] (6) 다음, 상기 전자주입층 상에 음극(cathode)을 형성하고, 마지막으로 상기 음극 상에 보호막을 형성한다.

[0016] 상기와 같은 구조에 있어 발광물질층은 청색, 녹색, 적색을 구현하여, 풀컬러의 화상을 구현하게 된다.

[0017] 유기 발광 다이오드의 유기 발광층을 형성하기 위한 다양한 유기 화합물이 알려져 있으며, 예를 들면, 미국특허 제6,455,720호는 2,2-(디아릴)비닐포스핀 (2,2-(Diarlyl)vinylphosphine) 화합물을 개시하고 있고, 미국특허 제 20070292714호는 중심부는 파이렌(pyrene) 구조를 가지며, 디페닐아민기(diphenylamino)가 말단에 치환된 청색 발광 화합물을 개시하고 있다. 또한 대한민국 특허공개 제2002-0070333호는 중심부는 디페닐안트라센 구조를 가지며, 아릴기가 말단에 치환된 청색 발광 화합물을 개시하고, 대한민국 특허공개 제2007-0023335호는 디파이렌 스피로(dipyrene-spiro)계 청색 발광 화합물을 개시하고 있다.

[0018] 하지만 수명, 발광효율 및 휘도가 충분하지 않다는 문제점이 있었다. 이는 도 1에 도시된 바와 같이, 청색의 색순도가 낮아서 진한 청색 구현이 어렵기 때문이며, 천연색의 풀컬러 디스플레이를 구현하는데 문제가 있다. 높은 전류 발광효율(Cd/A)을 얻기 위해서는 내부양자효율이 우수하여야 되나 높은 순도의 청색(CIE색좌표 y값이 작아질수록) 물질을 얻기 어려운 문제가 있다.

발명의 내용

해결 하고자하는 과제

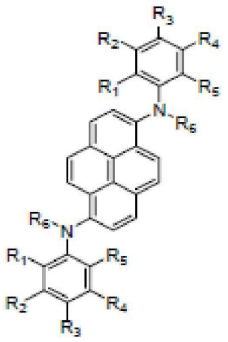
[0019] 본 발명은 고색순도, 고휘도를 구현하고 발광수명이 향상되며 저전압 구동이 가능한 유기전계발광소자용 청색 형광물질을 제공하고자 한다.

[0020] 또한, 상기 청색 형광물질을 이용하여 고색순도 및 고휘도의 영상을 구현할 수 있고 또한 제품 수명이 향상된 유기전계발광소자를 제공하고자 한다.

과제 해결수단

[0021] 상기한 과제를 해결하기 위해, 본 발명은 전자 또는 정공을 전달할 수 있는 호스트물질과; 하기 화학식으로 표시되는 도펀트 물질을 포함하는 청색 형광 물질.

[0022] 화학식



[0023]

[0024] (상기 화학식에서, R1, R2, R3, R4, R5는 수소, 플로린, C1-C6의 치환 또는 비치환된 알킬기, C6~C30의 치환 또는 비치환된 방향족 그룹 또는 C6~C30의 치환 또는 비치환된 이형고리그룹으로부터 선택되는 물질 중 어느 하나이고, R1, R2, R3, R4, R5 중 두개는 플로린이며, R6는 C6~C30의 치환 또는 비치환된 방향족 그룹 또는 C6~C30의 치환 또는 비치환된 이형고리그룹 중 선택되는 어느 하나이다.)

효 과

[0025] 본 발명의 청색 형광 물질은 고색순도, 고휘도를 구현하고 발광수명이 향상되는 효과를 갖는다. 특히, 페닐기에 두개의 플로린을 도입함으로써, 색감과 수명 두가지 요소를 모두 만족시킬 수 있도록 하는 것을 특징으로 한다.

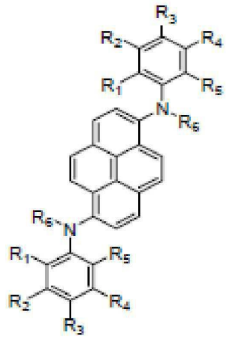
[0026] 또한, 상기 청색 형광물질을 이용하는 유기전계발광소자는 저전압하에서 고색순도 및 고휘도의 영상을 구현할 수 있고 또한 제품 수명이 향상되는 효과를 갖는다.

발명의 실시를 위한 구체적인 내용

[0027] 이하, 본 발명에 따른 청색 형광 물질의 구조 및 그 합성예와, 이를 이용한 유기전계발광소자에 대해 설명한다.

[0028] 본 발명의 실시예에 따른 청색 형광 물질은 디페닐아민 유도체가 1,6-파이렌에 치환된 구조로서 페닐기에는 수소, 플로린, C1-C6의 치환 또는 비치환된 알킬기, C6~C30의 치환 또는 비치환된 방향족 그룹 또는 C6~C30의 치환 또는 비치환된 이형고리그룹으로부터 선택되는 물질이 치환되고, 특히 이중 두개는 플로린이며, 아민에는 C6~C30의 치환 또는 비치환된 방향족 그룹 또는 C6~C30의 치환 또는 비치환된 이형고리그룹으로부터 선택되는 물질이 치환됨으로써, 색순도와 발광효율 및 발광수명이 향상되는 것이 특징이며, 아래 화학식2로 표시된다.

[0029] 화학식2



[0030]

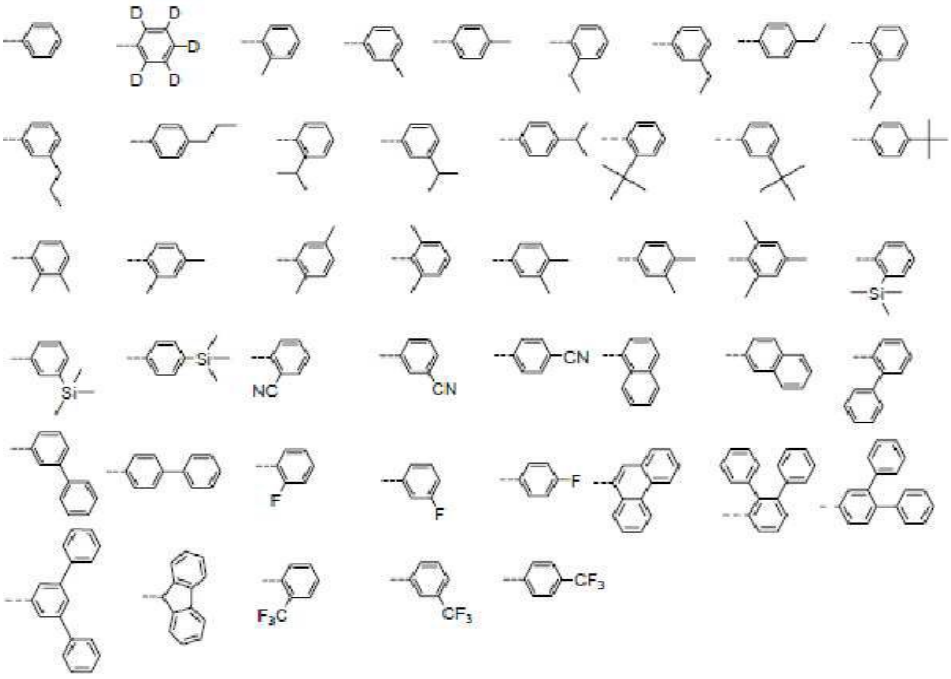
[0031] 즉, 상기 화학식2에서 페닐기의 R1, R2, R3, R4, R5는 수소, 플로린, C1~C6의 치환 또는 비치환된 알킬기, C6~C30의 치환 또는 비치환된 방향족 그룹, 이형고리 그룹에서 선택되고, R1, R2, R3, R4, R5 중 두 개는 프로린에서 선택되며, R6는 C6~C30의 치환 또는 비치환된 방향족 그룹, C6~C30의 치환 또는 비치환된 이형고리 그룹에서 선택된다.

[0032] 보다 구체적으로, C1~C6의 알킬기는 메틸(methyl), 에틸(ethyl), n-프로필(n-propyl), i-프로필(i-propyl), n-부틸(n-butyl), i-부틸(i-butyl) 및 t-부틸(t-butyl) 중 어느 하나일 수 있고, C6~30의 방향족 그룹은 치환 또는 비치환된 페닐(phenyl), 바이페닐(biphenyl), 나프틸(naphthyl), 페난스렌(phenanthrene), 터페닐(terphenyl), 플루오레닐(fluorenyl)일 수 있으며, 상기 방향족 그룹의 치환체는 메틸(methyl), 에틸(ethyl), n-프로필(n-propyl), i-프로필(i-propyl), n-부틸(n-butyl), i-부틸(i-butyl) 및 t-부틸(t-butyl) 등과 같은 C1~C6 의 알킬 그룹(alkyl)과, 중수소, 시아닐(cyanyl), 트리메틸실릴(trimethylsilyl), 플루오린(fluorine), 트리플루오로메틸(trifluoromethyl)일 수 있다.

[0033] 본 발명에서는 파이렌(pyrene)의 1,6 위치에 치환 또는 비치환된 방향족 그룹, 이형고리 그룹이 포함된 디플루오로페닐과 치환 또는 비치환된 방향족 그룹, 이형고리 그룹을 포함하는 아민기를 도입하여, 발광효율 및 색순도가 높고 수명이 향상된 것을 특징으로 하는 청색 형광화합물을 개발하였다. 즉, 파이렌의 1,6 위치에 페닐아민 유도체가 도입되어 수명, 발광효율 및 색순도가 향상되고, 특히 2개의 플로린이 페닐아민 유도체에 치환됨으로써 청색의 색감과 수명이 동시에 최적화된다.

[0034] 상기 화학식2에서 R1, R2, R3, R4, R5, R6로 선택될 수 있는 C6~C30의 치환 또는 비치환된 방향족 그룹은 하기 화학식3에서 선택될 수 있다.

[0035] 화학식3

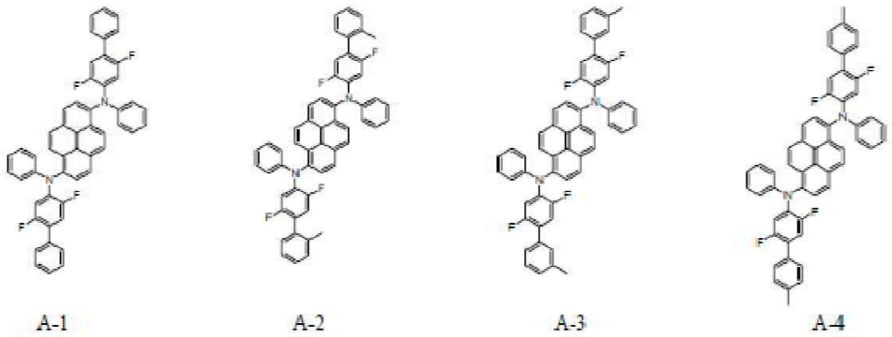


[0036]

[0037] 또한, 상기 화학식2에서 R1, R2, R3, R4, R5, R6로 선택될 수 있는 C6~C30의 치환 또는 이형고리 그룹은 퓨란(furan), 티오펜(thiophene), 피롤(pyrrole), 피리딘(pyridine), 피리미딘(pyrimidine) 등일 수 있다.

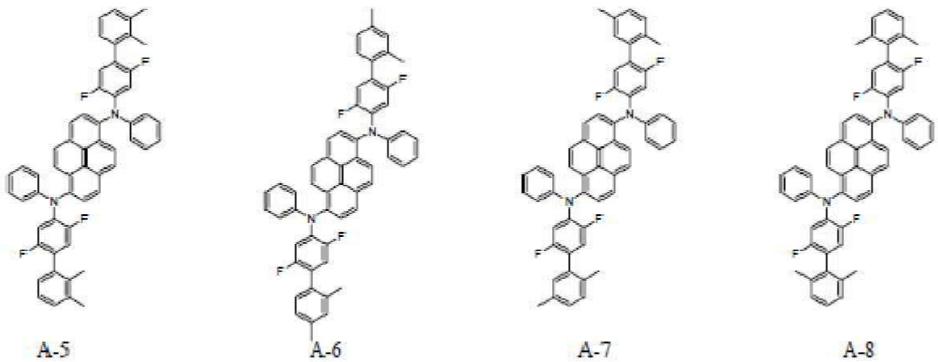
[0038] 결과적으로, 상기 화학식2는 하기 화학식4에 표시된 다수의 물질 중 어느 하나이다. 설명의 편의를 위해 각 물질에 A-1 내지 A-336의 번호를 부여하였다.

[0039] 화학식4



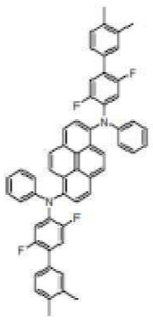
A-1 A-2 A-3 A-4

[0040]

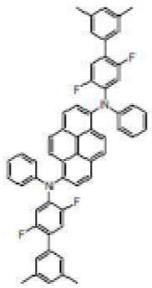


A-5 A-6 A-7 A-8

[0041]



A-9



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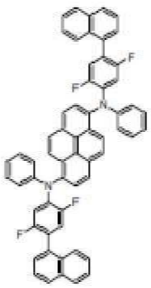
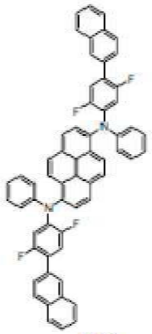


A-11



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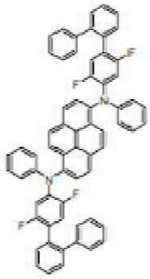

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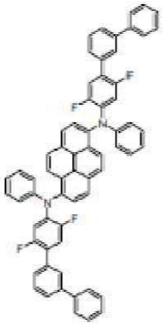

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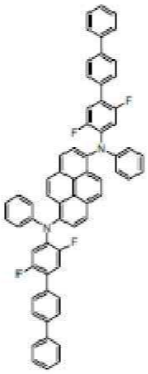

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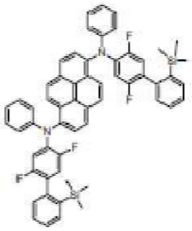

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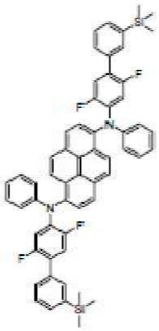
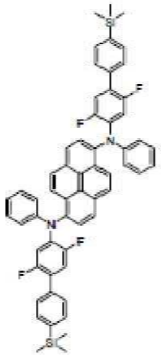


A-17



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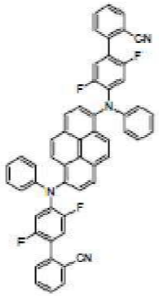

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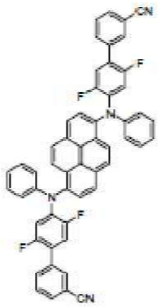

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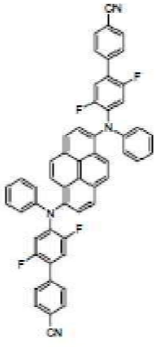

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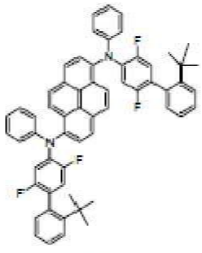

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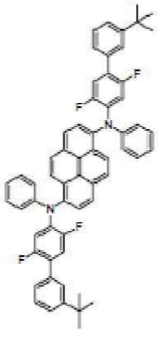

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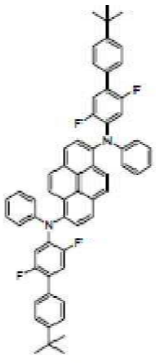

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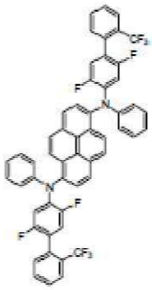

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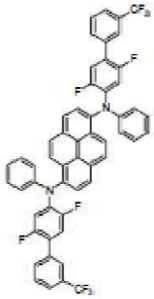

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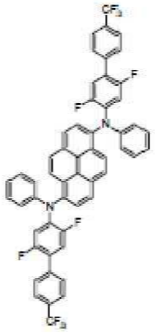

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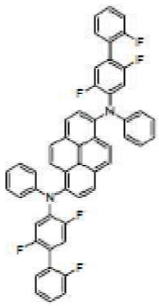

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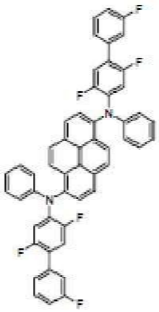
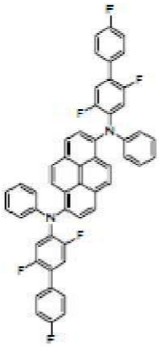
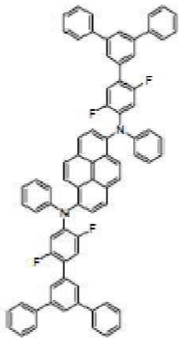


A-29



A-30



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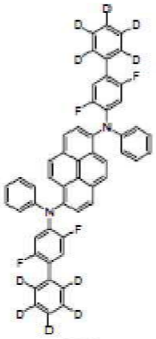

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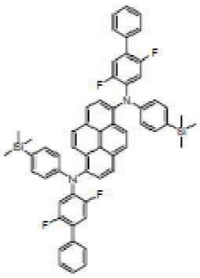
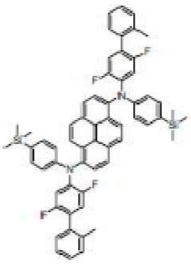
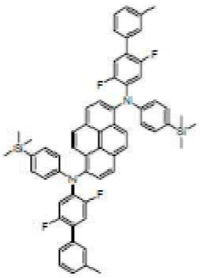


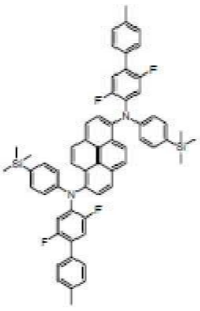
A-33



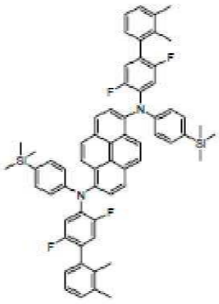
A-34



A-35



A-36



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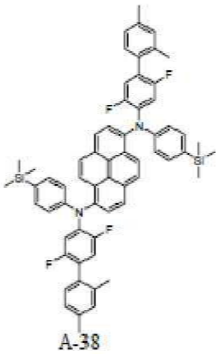
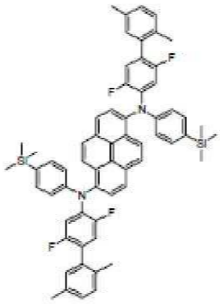
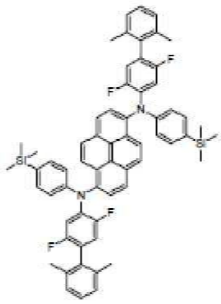


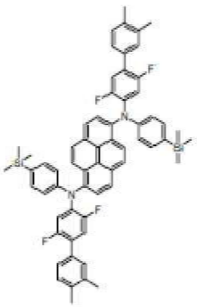
A-38



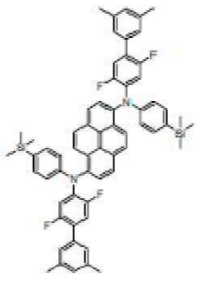
A-39



A-40



A-41



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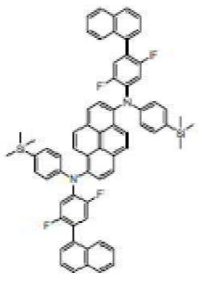
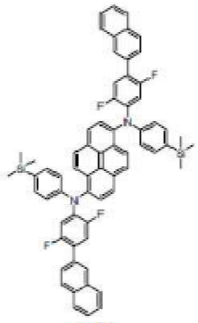
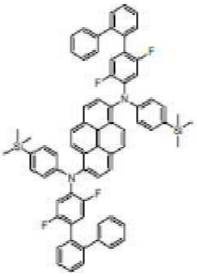


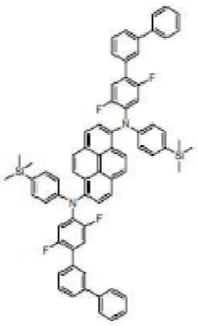
A-43



A-44



A-45



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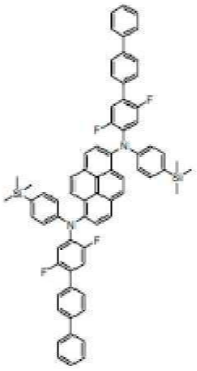

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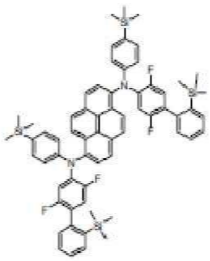

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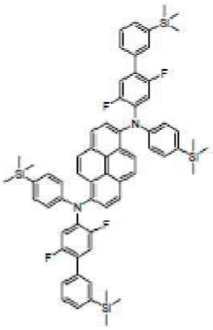

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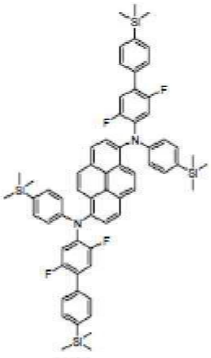

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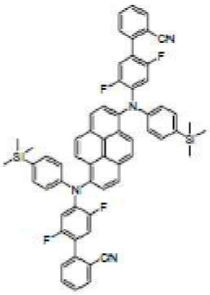

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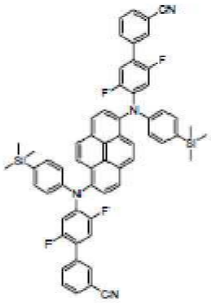

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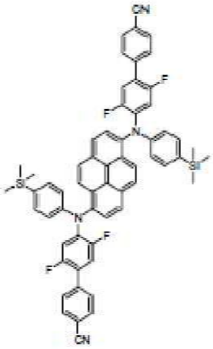

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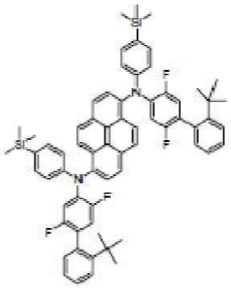

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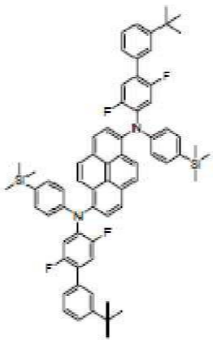

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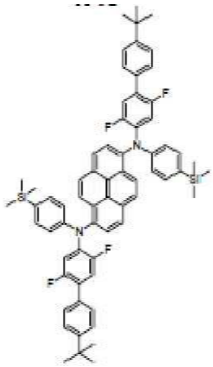

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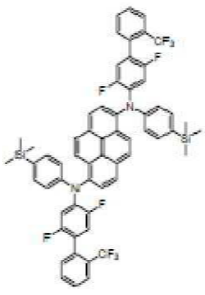

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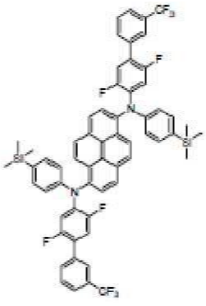

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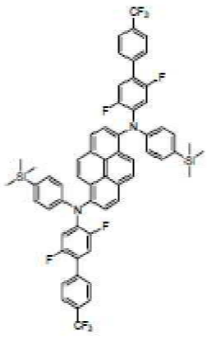

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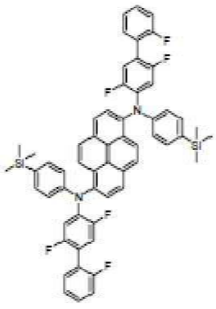

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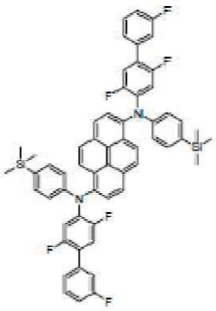

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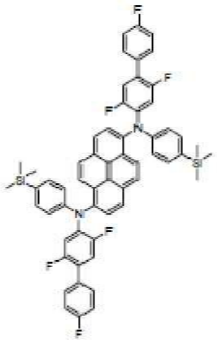

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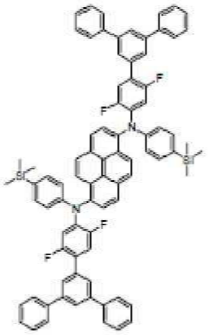

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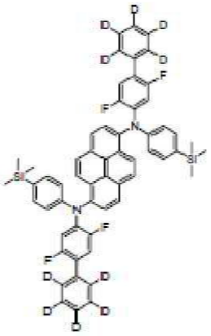

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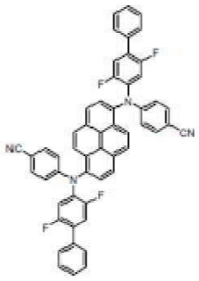

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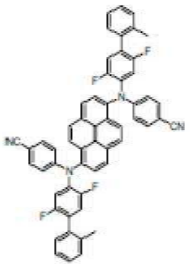

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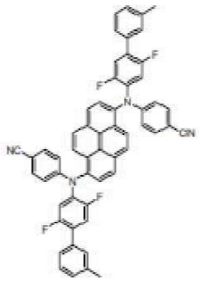

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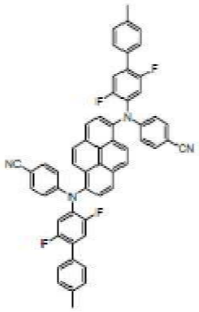

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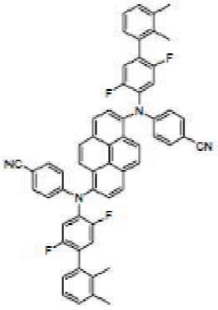

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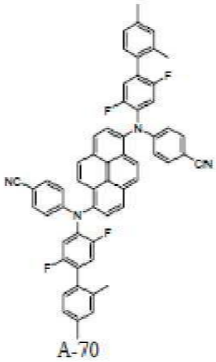

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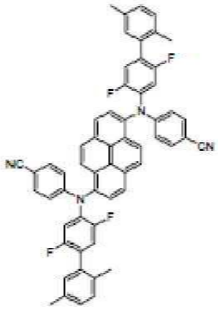

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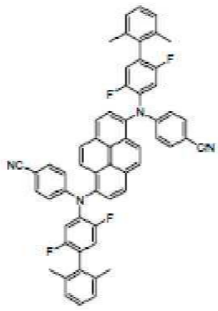

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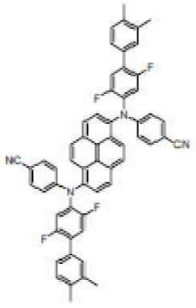

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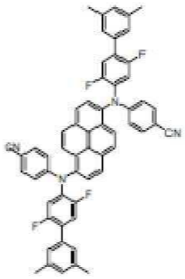

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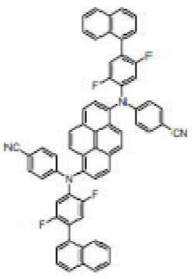

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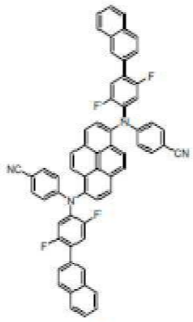

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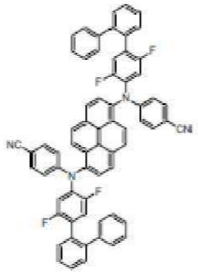

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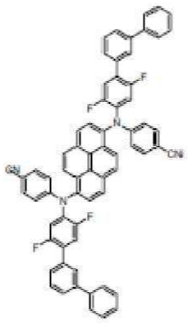

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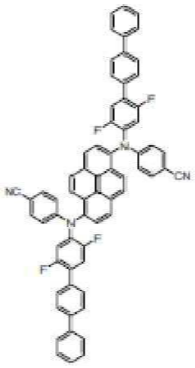

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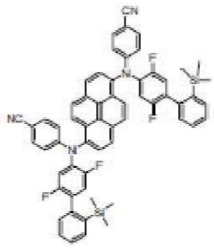

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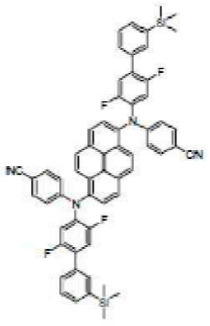

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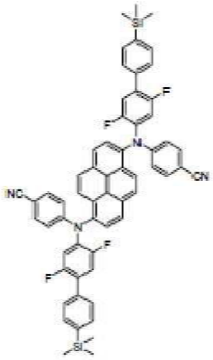

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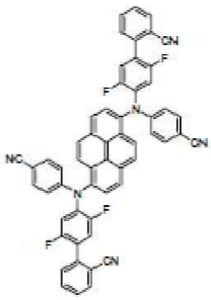

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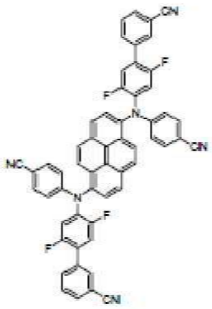

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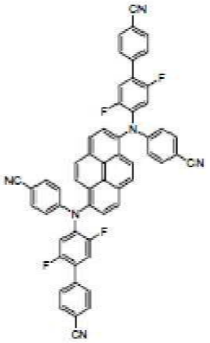

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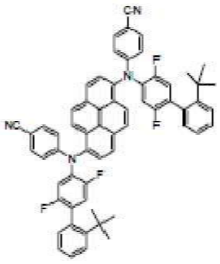

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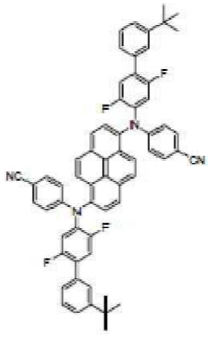

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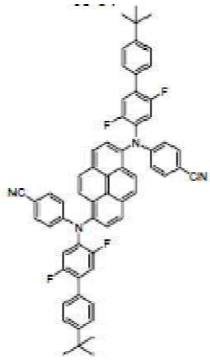

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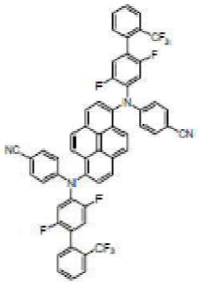

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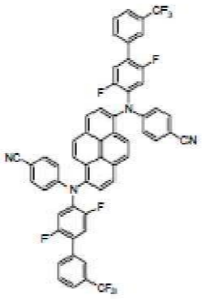

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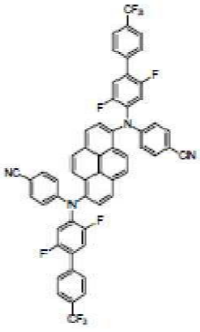

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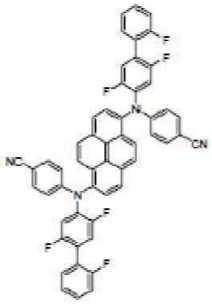

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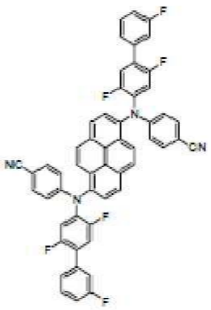

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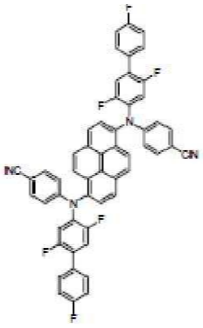

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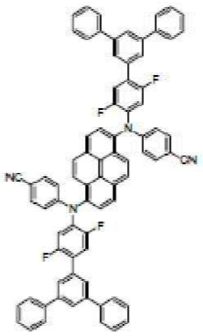

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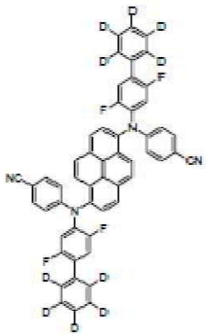

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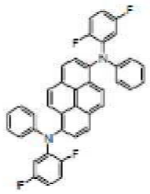

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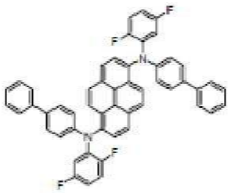

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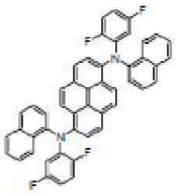

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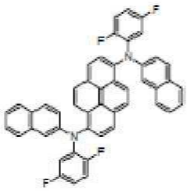

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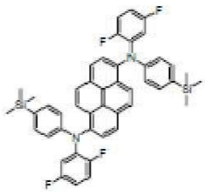

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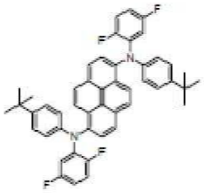

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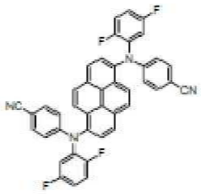

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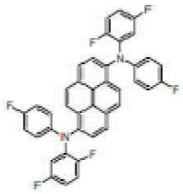

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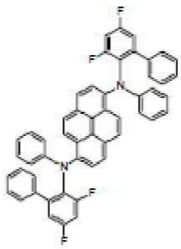

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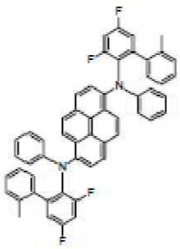

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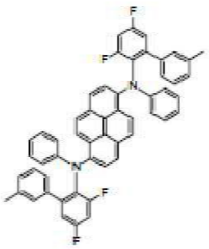

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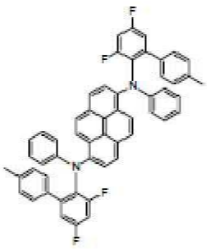

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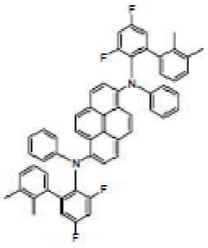

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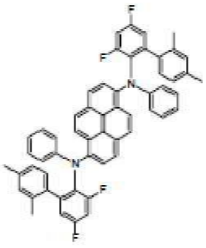

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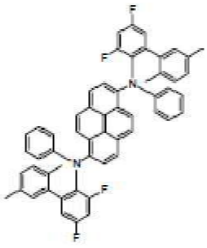

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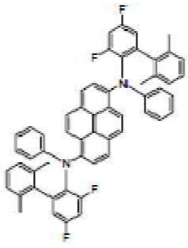

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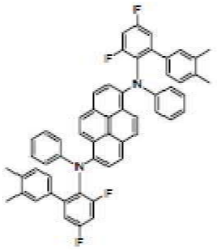

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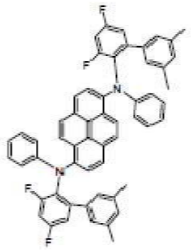

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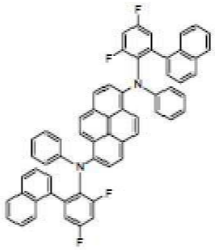

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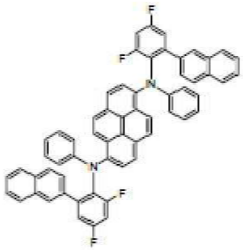

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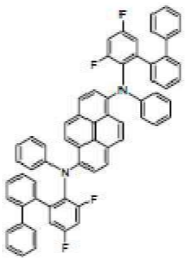

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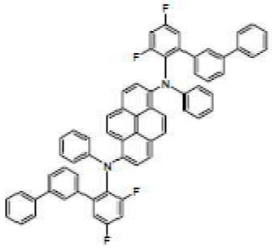

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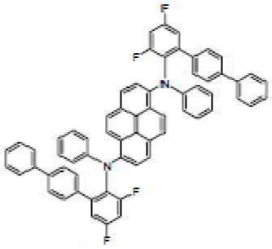

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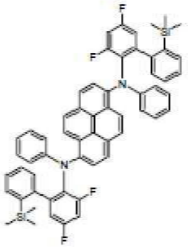

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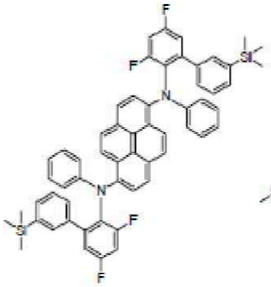

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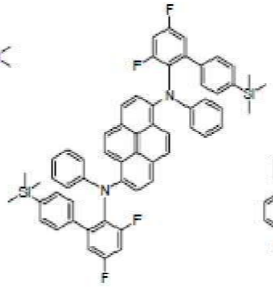

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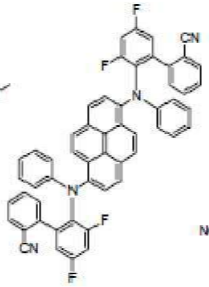

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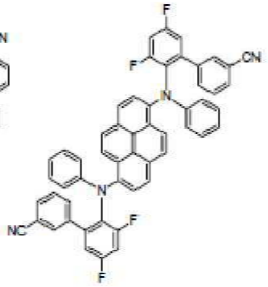

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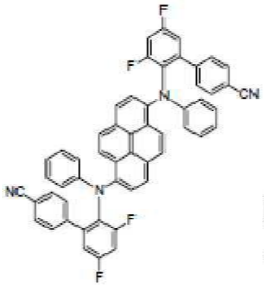

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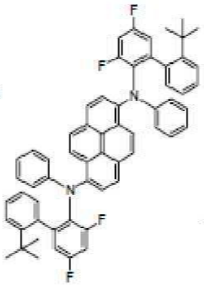

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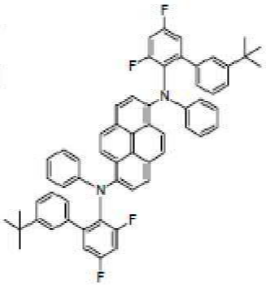

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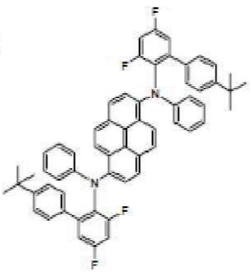

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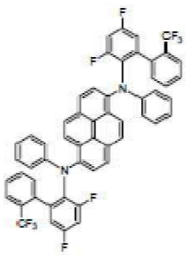

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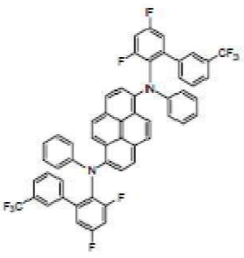

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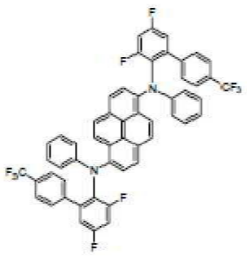

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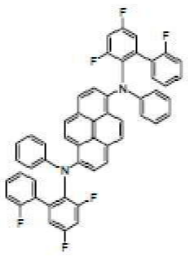

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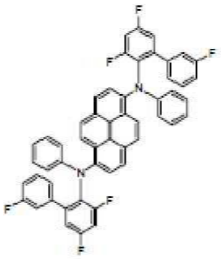

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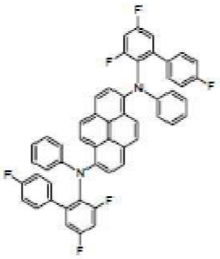

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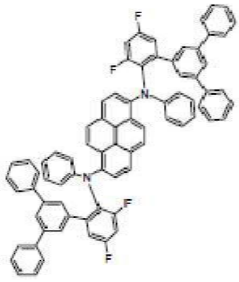

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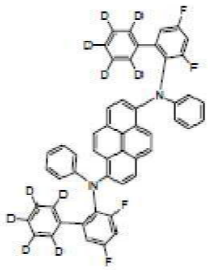

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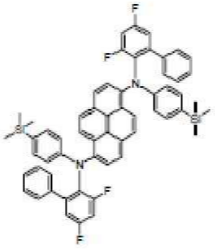

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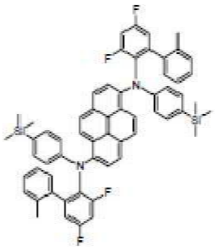

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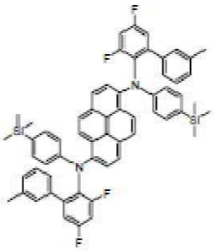

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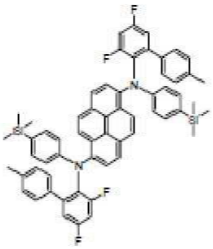

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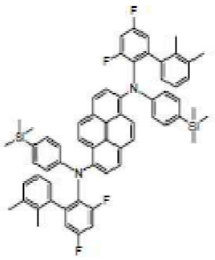

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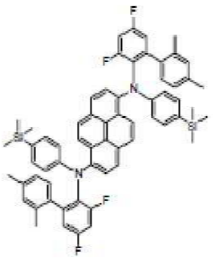

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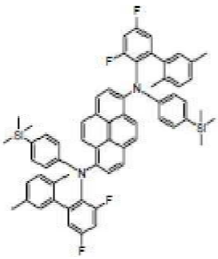

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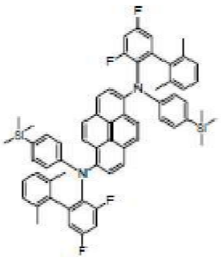

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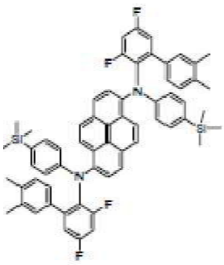

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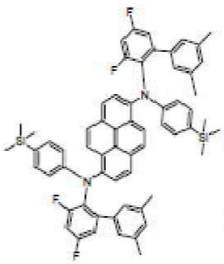

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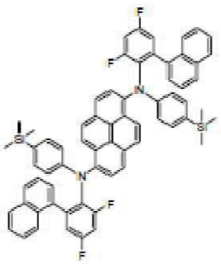

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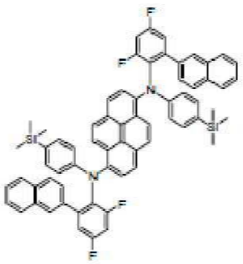

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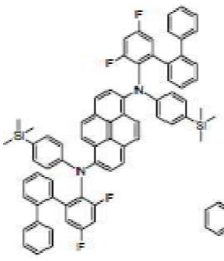

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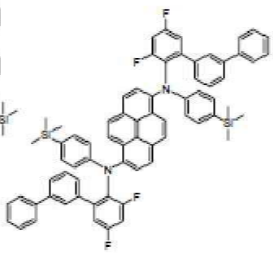

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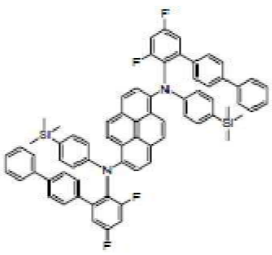

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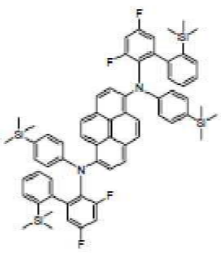

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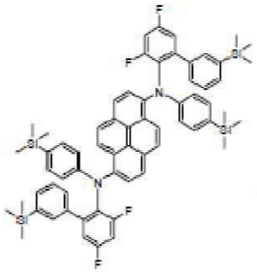

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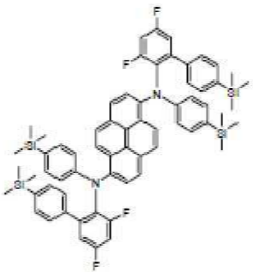

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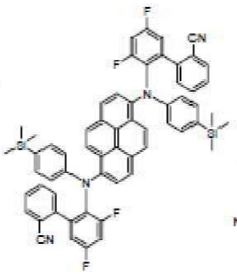

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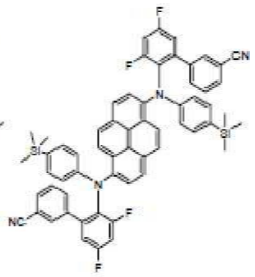

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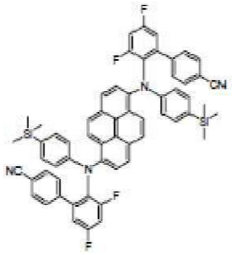

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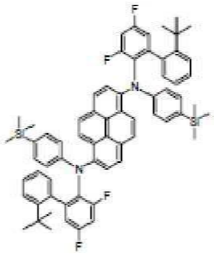

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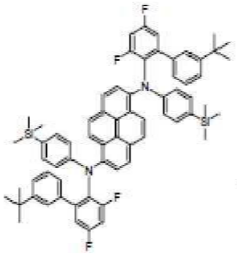

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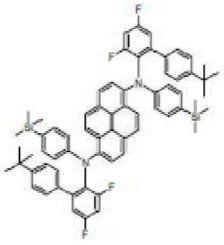

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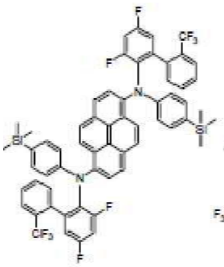

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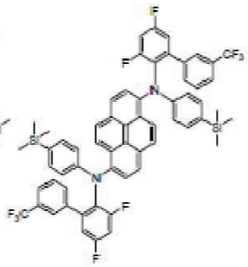

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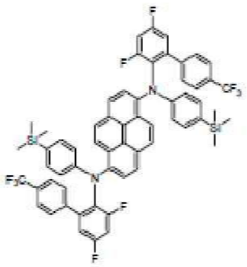

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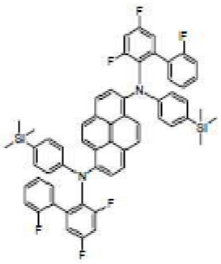

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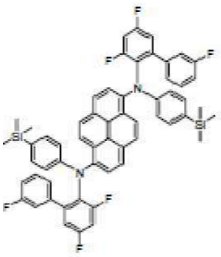

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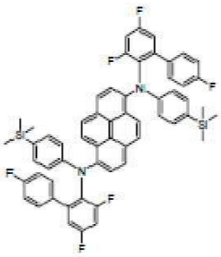

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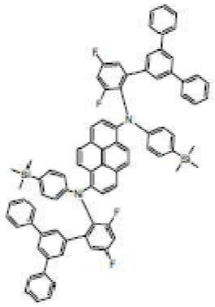

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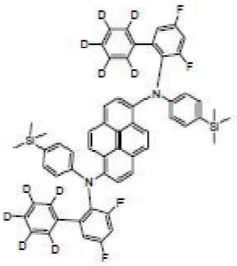

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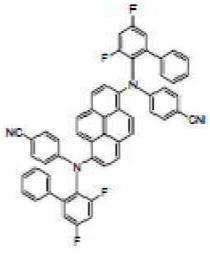

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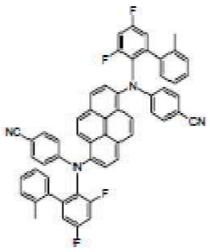

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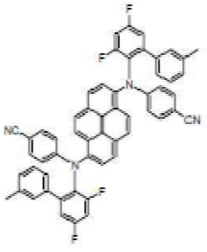

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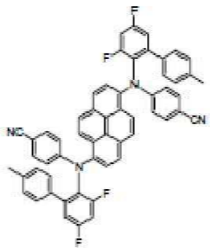

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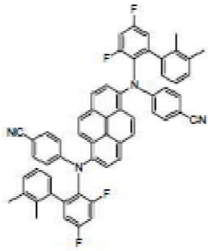

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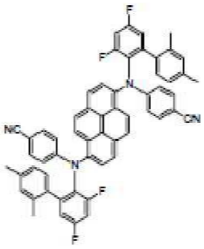

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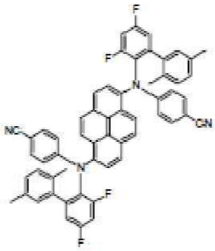

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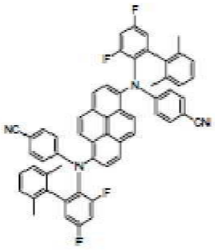

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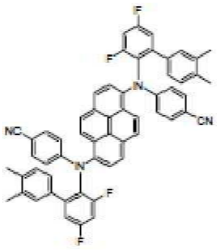

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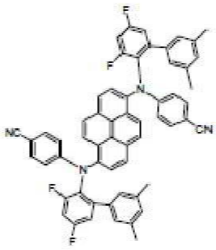

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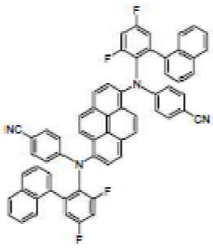

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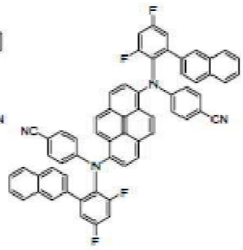

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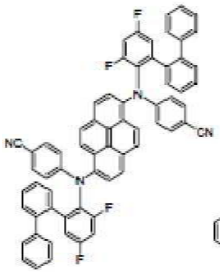

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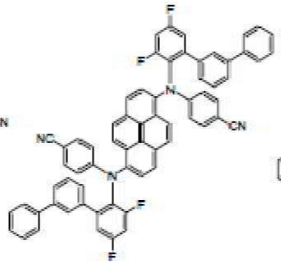

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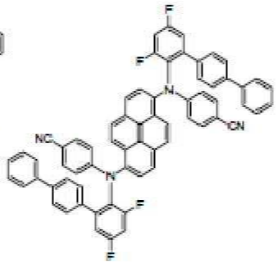

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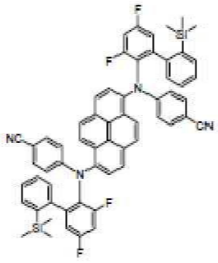

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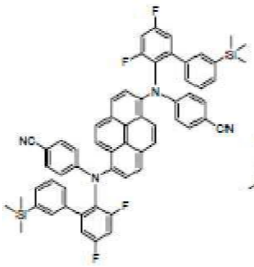

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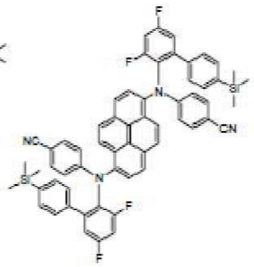

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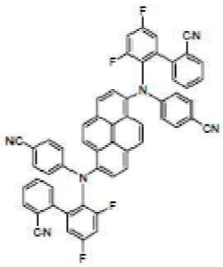

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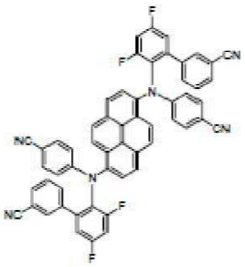

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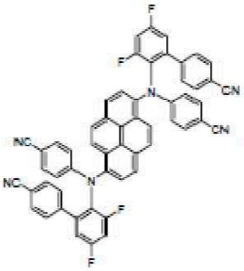

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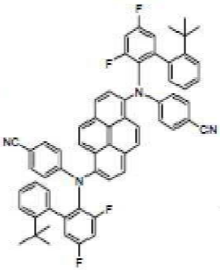

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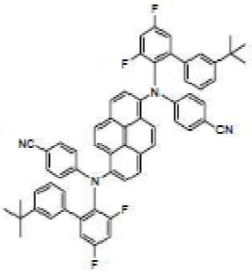

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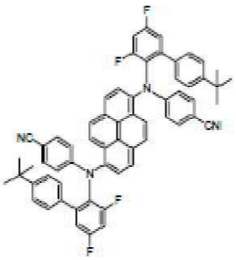

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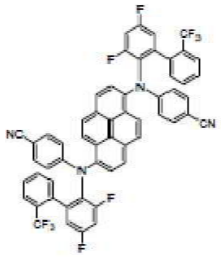

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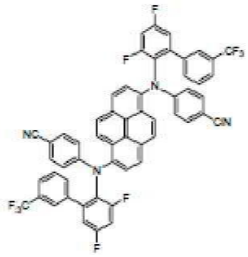

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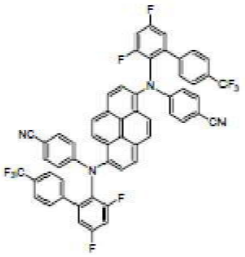

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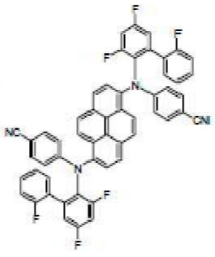

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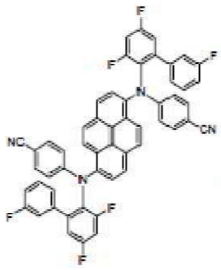

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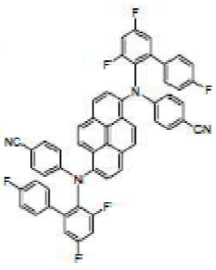

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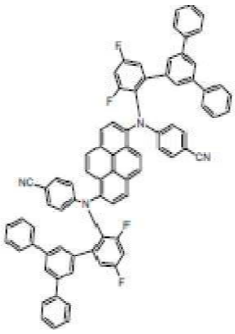

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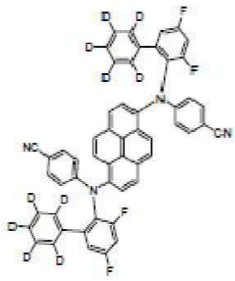

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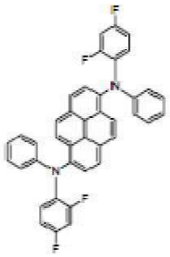

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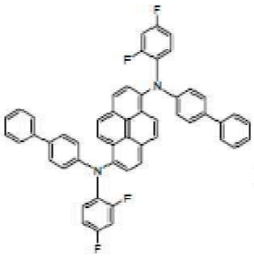

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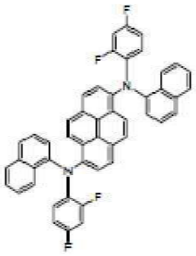

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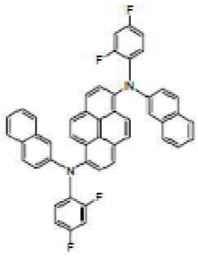

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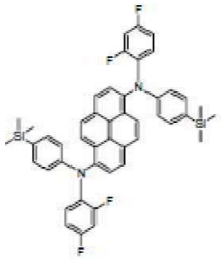

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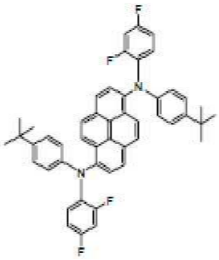

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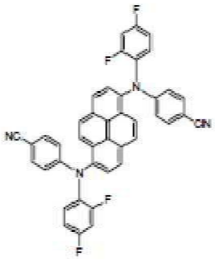

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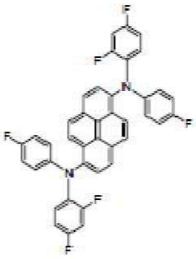

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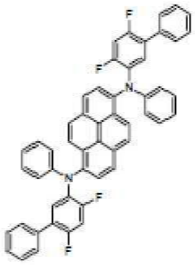

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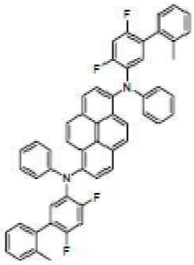

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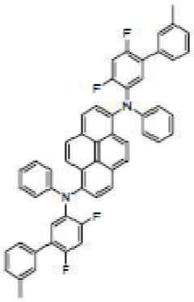

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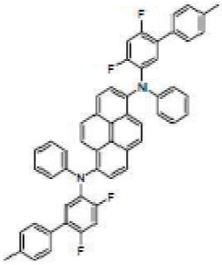

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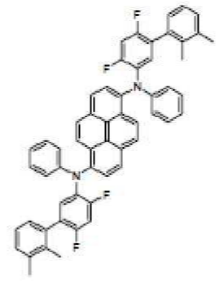

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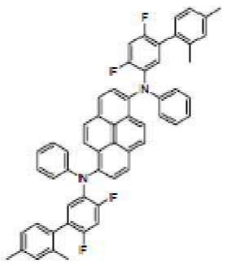

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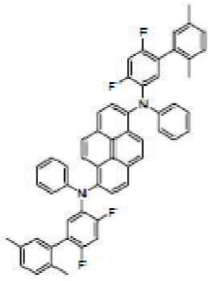

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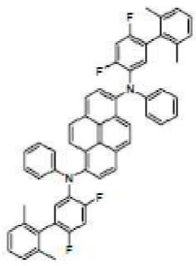

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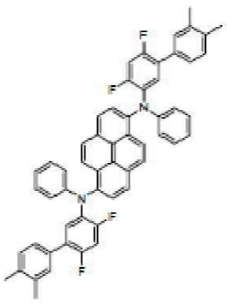

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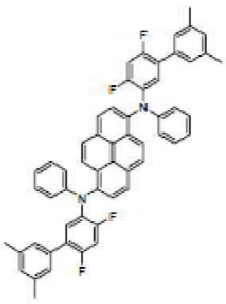

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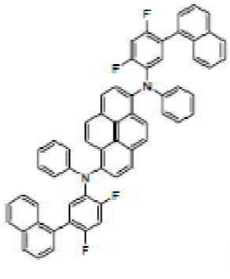

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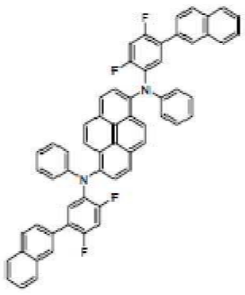

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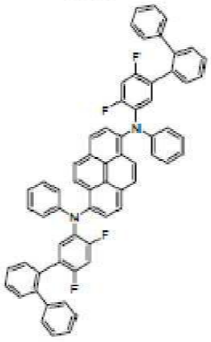

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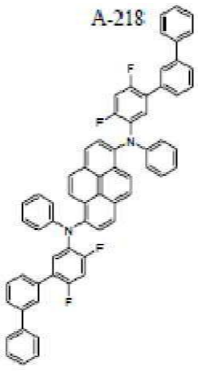

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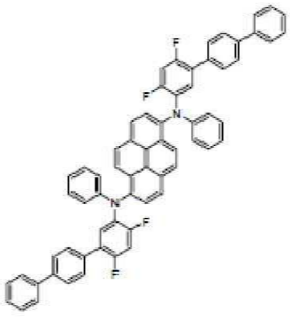

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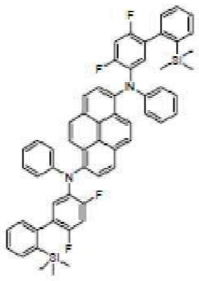

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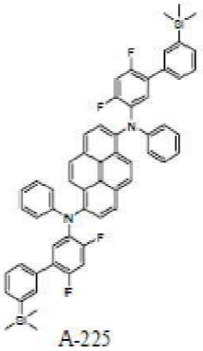

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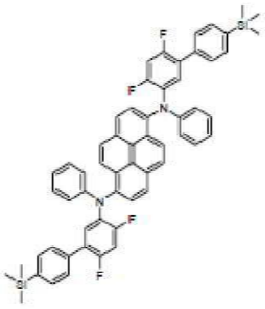

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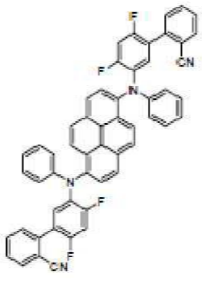

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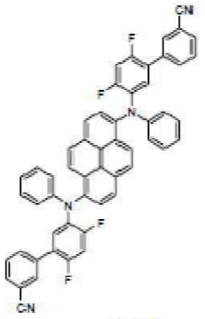

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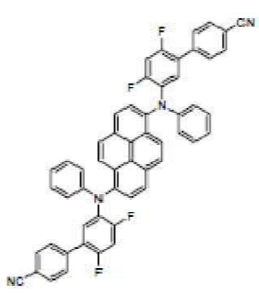

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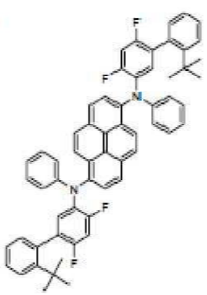

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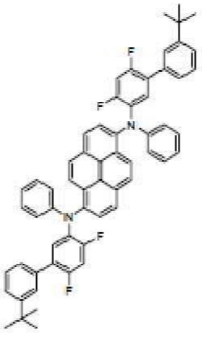

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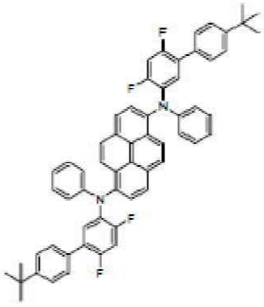

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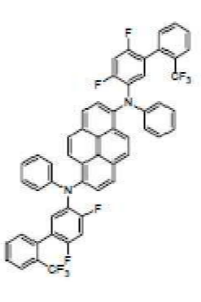

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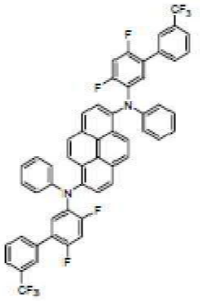

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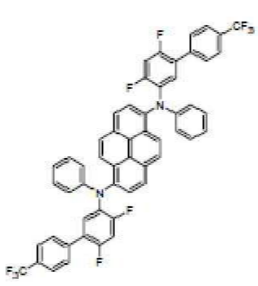

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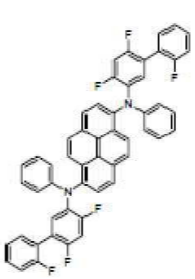

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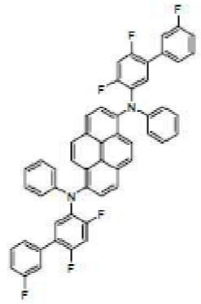

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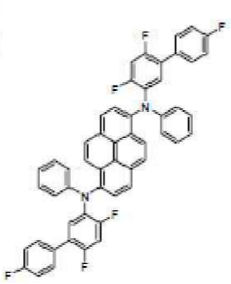

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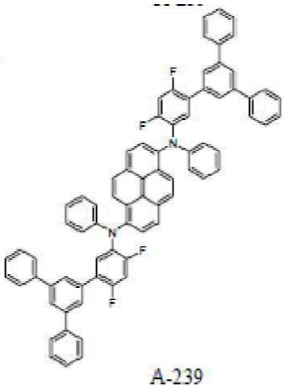

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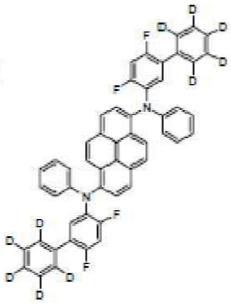

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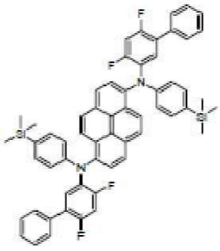

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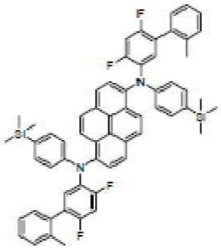

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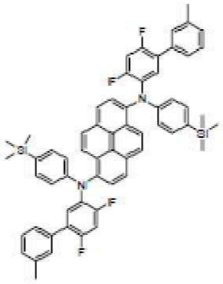

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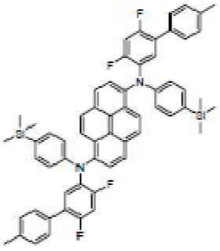

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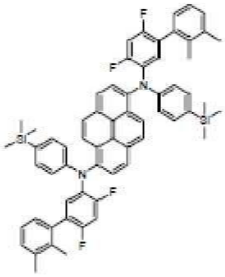

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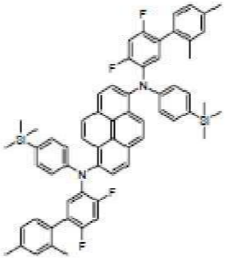

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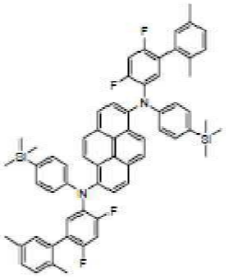

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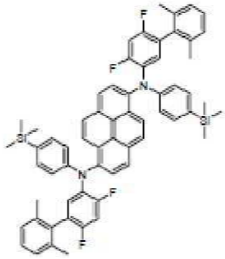

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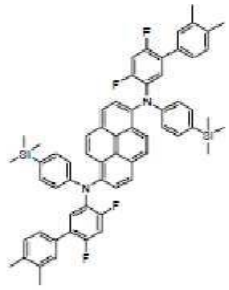

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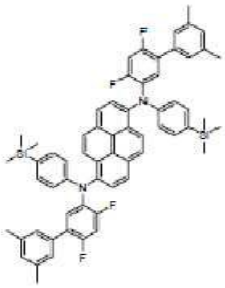

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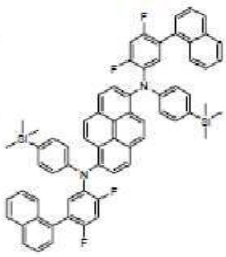

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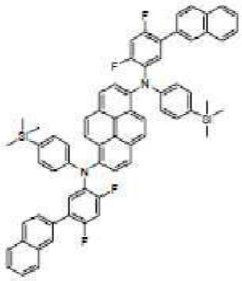

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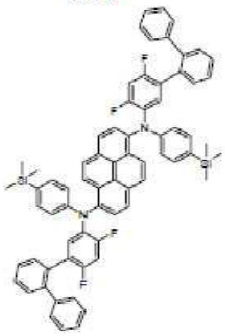

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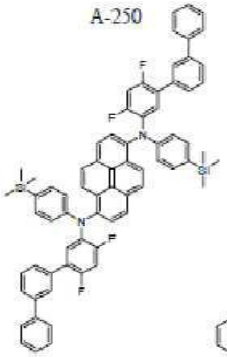

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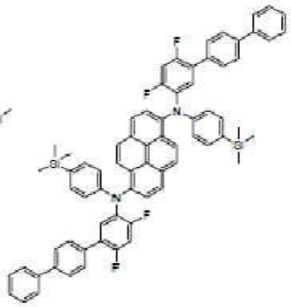

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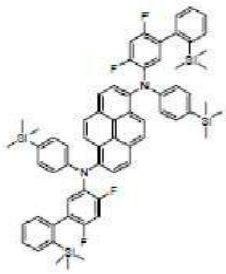

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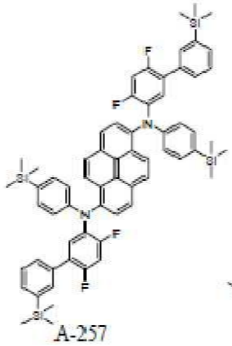

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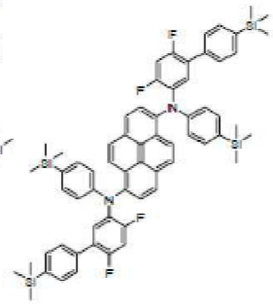

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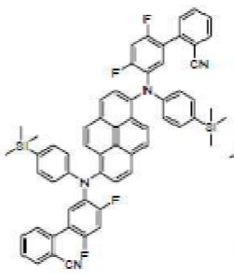

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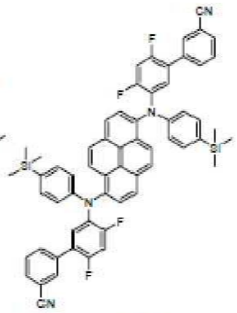

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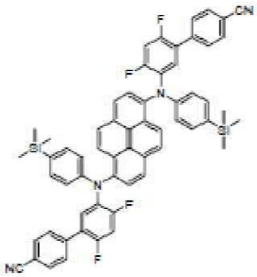

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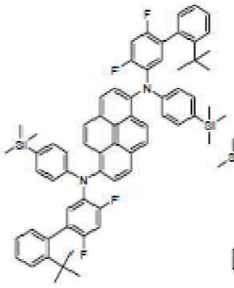

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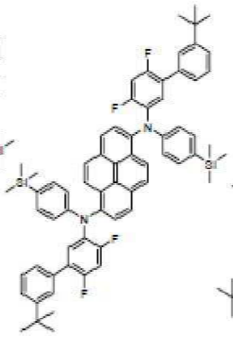

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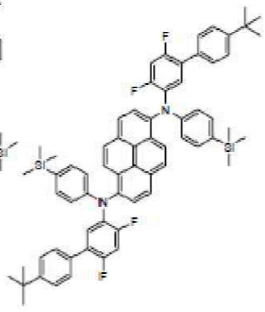

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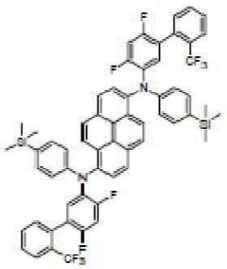

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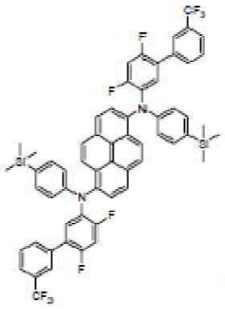

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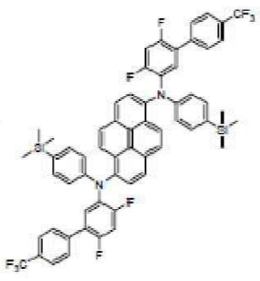

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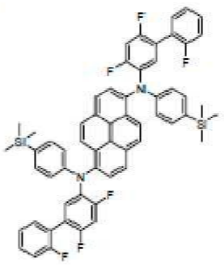

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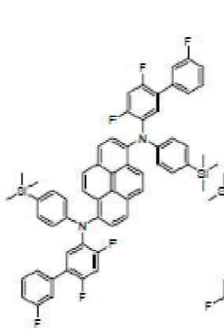

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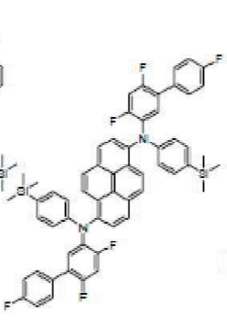

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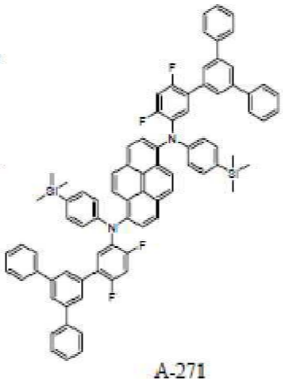

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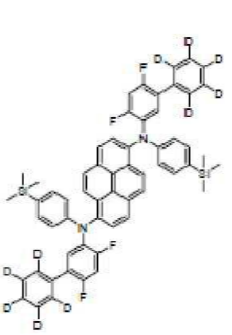

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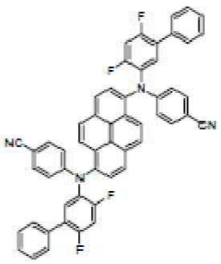

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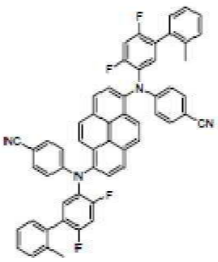

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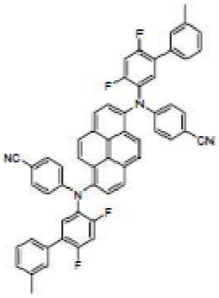

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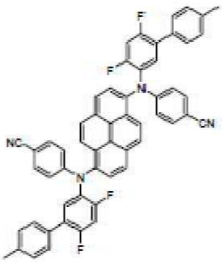

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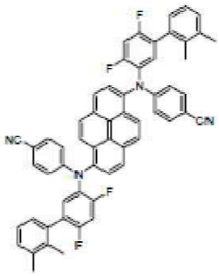

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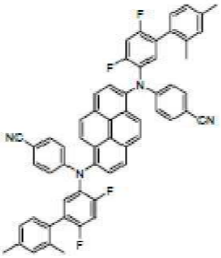

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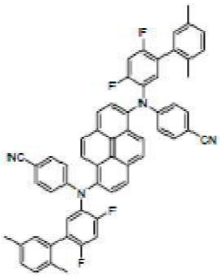

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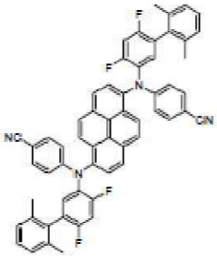

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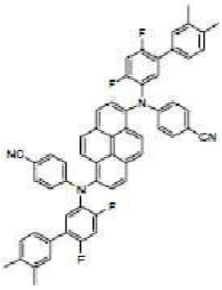

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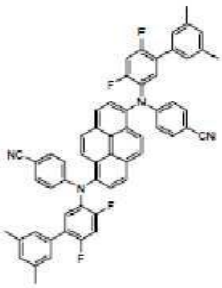

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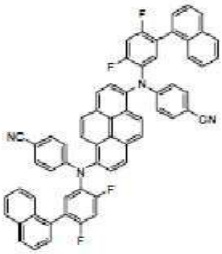

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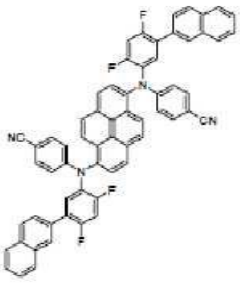

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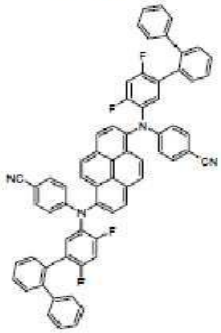

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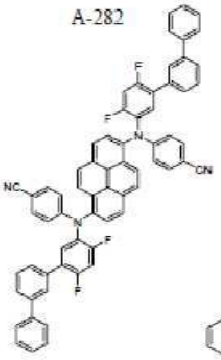

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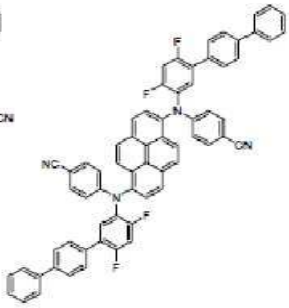

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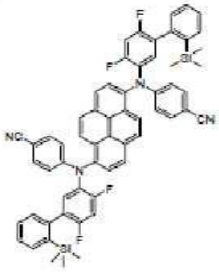

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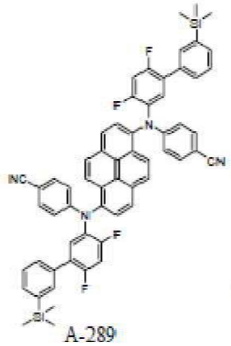

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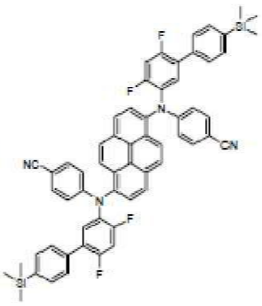

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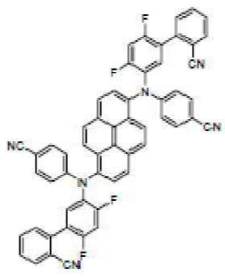

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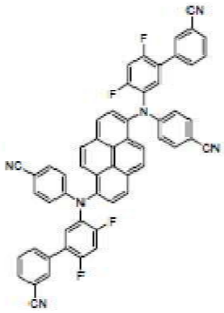

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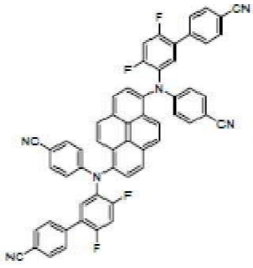

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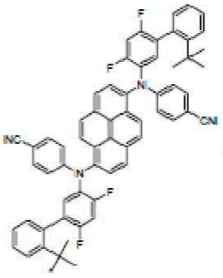

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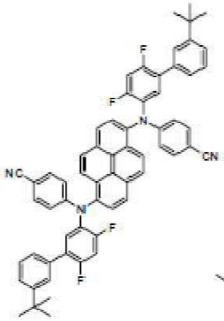

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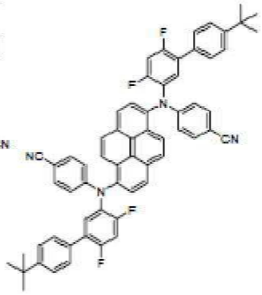

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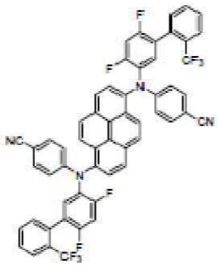

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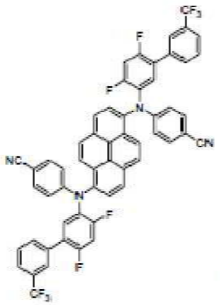

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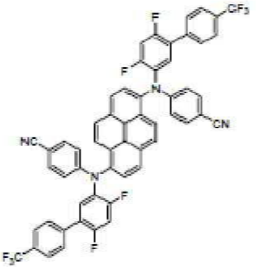

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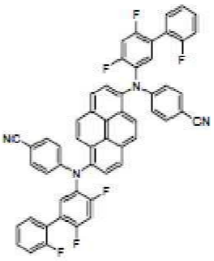

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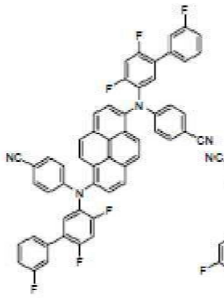

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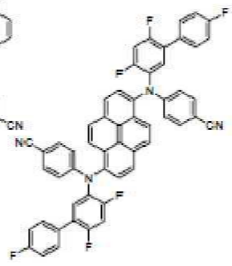

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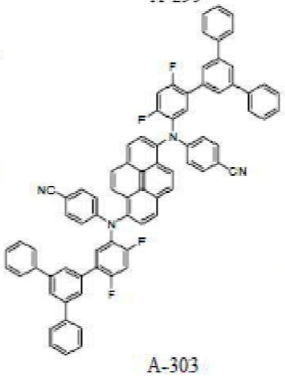

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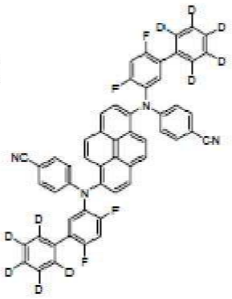

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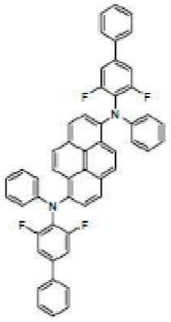

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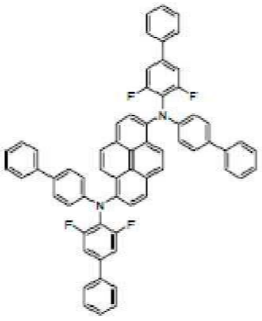

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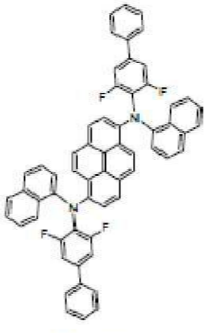

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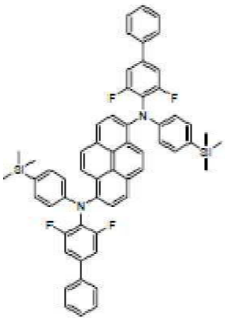
A-308



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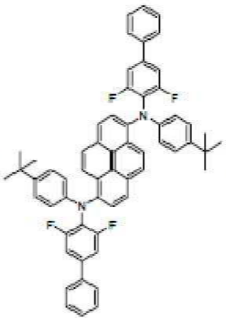

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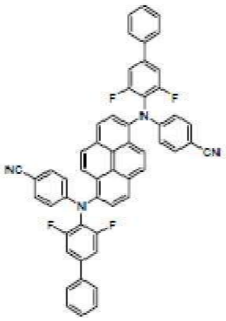

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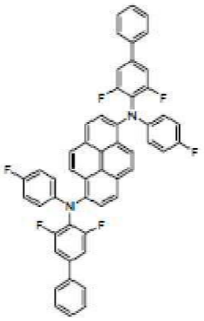

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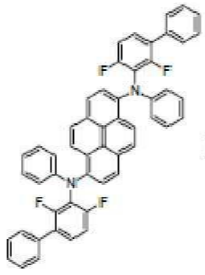

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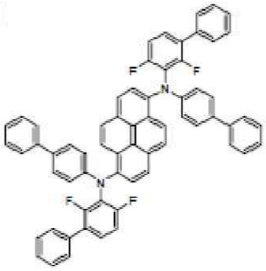

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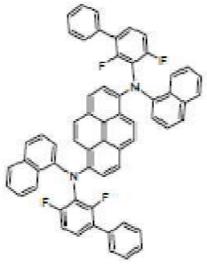

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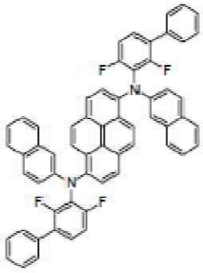

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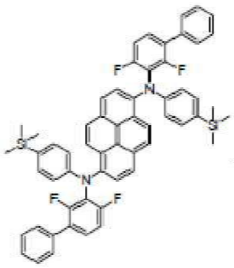

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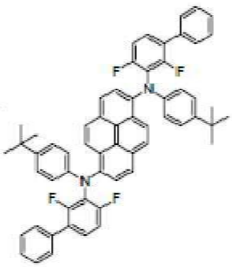

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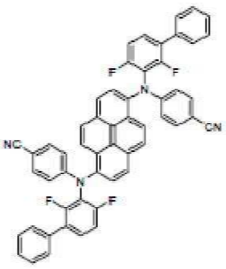

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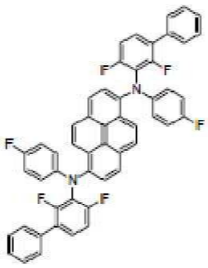

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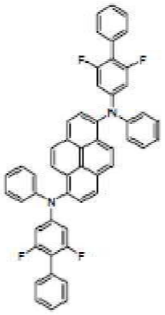

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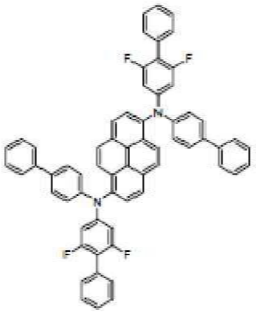

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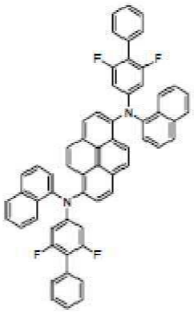

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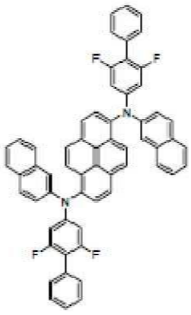

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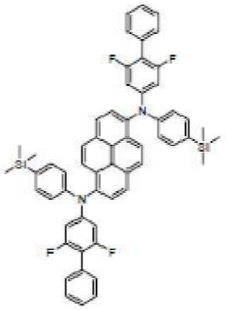

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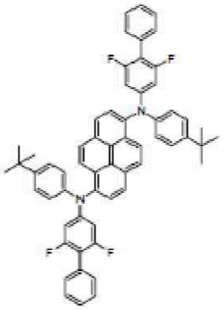

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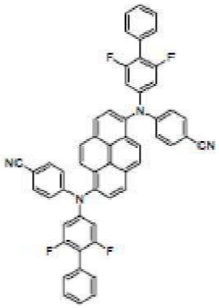

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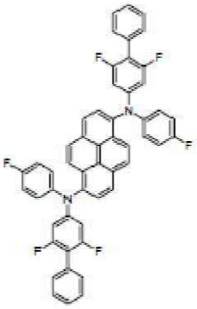

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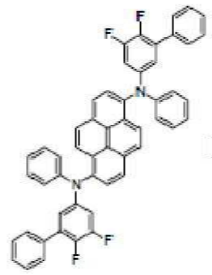

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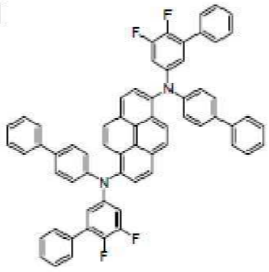

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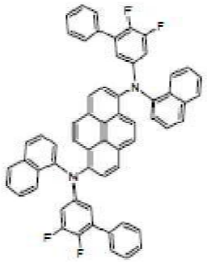

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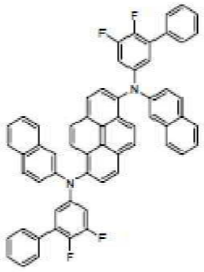

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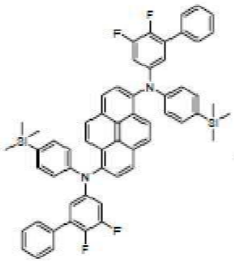

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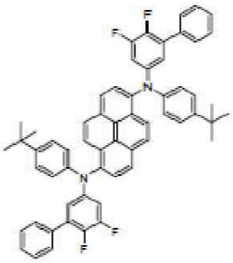

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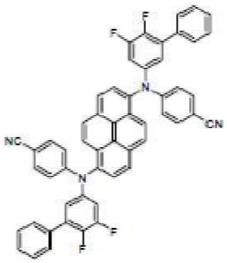

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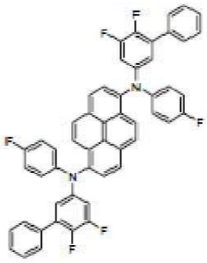


A-336

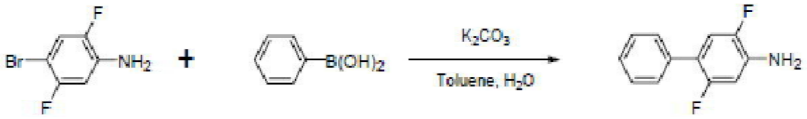
[0042] 이하에서는, 본 발명의 제 1 실시예에 따른 유기전계발광소자용 청색 형광 물질 중, 상기 화학식4에서 A-33으로 표시된 물질인 N1,N6-bis(4-phenyl-2,5-difluorophenyl)-N1,N6-di(4-trimethylsilylphenyl)pyrene-1,6-diamine을 예로 들어, 본 발명의 청색 형광물질의 합성예를 설명한다.

[0043] 합성예

[0044] (1) 4-phenyl-2,5-difluoroaniline의 합성

[0045] 4-phenyl-2,5-difluoroaniline 은 아래와 같은 반응식1에 의해 합성된다.

[0046] 반응식1

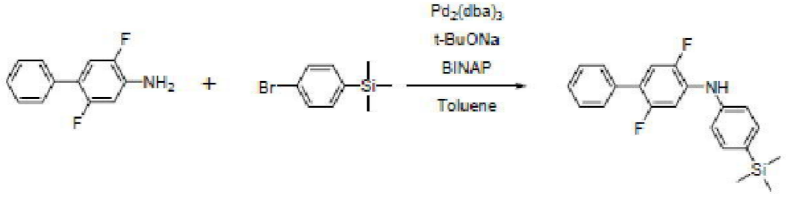
[0047] 

[0048] 구체적으로, 2구 둥근 바닥 플라스크에, 10mmol의 4-bromo-2,5-difluoroaniline, 12mmol의 benzeneboronic acid, 1 mmol의 tetrakis(triphenylphosphine) palladium(0)과 12g의 Potassium carbonate를, 30mL의 Toluene, 10mL의 H2O, 5mL의 ethanol에 녹인 후, 100 ℃의 bath에서 24시간 교반시킨 후 반응이 종료되면 Toluene을 제거 한 후 Dichloromethane과 물을 사용하여 추출한다. 이후 감압 증류하여 실리카겔 여과(silica gel column) 후 용매를 감압 증류하고 Dichloromethane과 petroleum ether를 사용하여 재결정 한다. 이후 여과(filtering)하여 2,5-difluoro-4-phenylaniline 결정 2.2g을 얻었다.

[0049] (2) 4-phenyl-2,5-difluoro-N-(4-trimethylsilylphenyl)benzenamine의 제조

[0050] 4-phenyl-2,5-difluoro-N-(4-trimethylsilylphenyl)benzenamine은 아래와 같은 반응식2에 의해 얻어진다.

[0051] 반응식2

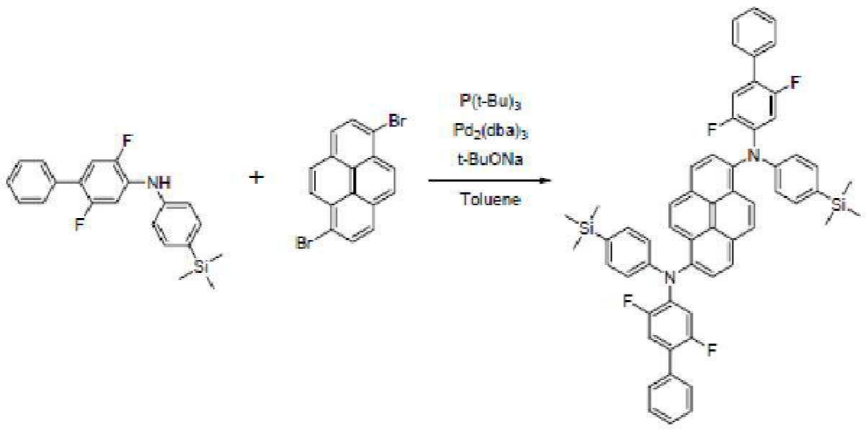
[0052] 

[0053] 이구 둥근 바닥 플라스크에 12mmol의 2,5-difluoro-4-phenylaniline, 10mmol의 4-bromo-trimethylsilylbenzene, 0.15mmol의 Tris(dibenzylideneacetone) dipalladium(0), 0.3mmol의 (±)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthalene과 14mmol의 Sodium tert-butoxide를, 30mL의 Toluene에 녹인 후, 100 ℃의 bath에서 24시간 교반시켰다. 반응이 종료되면 Toluene을 제거 한 후 Dichloromethane과 물을 사용하여 추출한 후 감압 증류하고 실리카겔 여과 후 용매를 감압 증류하였다. 이후 Dichloromethane과 petroleum ether를 사용하여 재결정하고 여과하여 4-phenyl-2,5-difluoro-N-(4-trimethylsilylphenyl)benzenamine 결정 2.6g을 얻었다.

[0054] (3) N1,N6-bis(4-phenyl-2,5-difluorophenyl)-N1,N6-di(4-trimethylsilylphenyl)pyrene-1,6-diamine의 제조

[0055] 상기 화학식 4에서 A-33으로 표시된 N1,N6-bis(4-phenyl-2,5-difluorophenyl)-N1,N6-di(4-trimethylsilylphenyl)pyrene-1,6-diamine은 아래와 같은 반응식3에 의해 얻어진다.

[0056] 반응식3



[0057]

[0058] 이구 둥근 바닥 플라스크에 6mmol의 4-phenyl-2,5-difluoro-N-(4-trimethylsilylphenyl)benzenamine, 5mmol의 1,6-dibromopyrene, 0.075mmol의 Tris(dibenzylideneacetone) dipalladium(0), 0.15mmol의 tri-tert-butylphosphine과 7mmol의 Sodium tert-butoxide를, 15mL의 Toluene에 녹인 후 , 100 ℃의 bath에서 24시간 교반시켰다. 반응이 종료되면 Toluene을 제거 한 후 Dichloromethane과 물을 사용하여 추출한 후 감압하고 실리카겔 여과 후 용매를 감압 증류하였다. 이후 Dichloromethane과 acetone를 사용하여 재결정을 하고 여과한 후, 열정제를 실시하여 N1,N6-bis(4-phenyl-2,5-difluorophenyl)-N1,N6-di(4-trimethylsilylphenyl)pyrene-1,6-diamine을 얻었다.

[0059] 이하, 상기한 본 발명의 실시예에 따른 청색 형광 물질을 이용하여 유기전계발광소자를 제작하는 실험예1 내지 실험예4와, 종래의 청색 형광 물질을 이용하여 유기전계발광소자를 제작하는 비교예를 통해, 본 발명에 의한 청색 형광 물질 및 이를 이용한 유기전계발광소자의 성능을 비교 설명한다.

[0060] 실험예1

[0061] 기판 상에 인듐-틴-옥사이드(ITO)층의 발광 면적이 3mm X 3mm 크기가 되도록 patterning한 후 세정하였다. 상기 기판을 진공 챔버에 장착한 후 공정압력이 1X10-6torr가 되도록 한 후 상기 ITO층 위에 CuPC 약 200Å, NPD 약 400Å, 호스트물질인 DPVBi에 상기 화학식4에서 A-33으로 물질을 도펀트로 약 4% 첨가하여 약 200Å, Alq3 약 350Å, LiF 약 5Å, Al 약 1000Å의 두께로 순차 적층하였다.

[0062] 실험결과, 10mA/cm^2에서 427cd/m^2(3.34V)를 나타내었으며 이때 CIE x = 0.141, y = 0.096를 나타내었다.

[0063]

[0064] 실험예2

[0065] 기판 상에 인듐-틴-옥사이드(ITO)층의 발광 면적이 3mm X 3mm 크기가 되도록 patterning한 후 세정하였다. 상기 기판을 진공 챔버에 장착한 후 공정압력이 1X10-6torr가 되도록 한 후 상기 ITO층 위에 CuPC 약 650Å, NPD 약 400Å, 호스트 물질인 DPVBi에 상기 화학식4에서 A-44로 표시된 물질을 도펀트로 약 4% 첨가하여 약 200Å,

Alq3 약350Å, LiF 약 5Å, Al 약 1000Å의 두께로 순차 적층하였다.

[0066] 실험결과, 10mA/cm^2에서 458cd/m^2(3.49V)를 나타내었으며 이때 CIE x = 0.130, y = 0.095를 나타내었다.

[0067] 실험예3

[0068] 기판 상에 인듐-틴-옥사이드(ITO)층의 발광 면적이 3mm X 3mm 크기가 되도록 patterning한 후 세정하였다. 상기 기판을 진공 챔버에 장착한 후 공정압력이 1X10-6torr가 되도록 한 후 상기 ITO층 위에 CuPC 약 200Å, NPD 약 400Å, 호스트 물질인 DPVBi에 상기 화학식4에서 A-47로 표시된 물질을 도펀트로 약 4% 첨가하여 약 200Å, Alq3 약 350Å, LiF 약 5Å, Al 약 1000Å의 두께로 순차 적층하였다.

[0069] 실험결과, 10mA/cm^2에서 492cd/m^2(3.3V)를 나타내었으며 이때 CIE x = 0.143, y = 0.092를 나타내었다.

[0070] 실험예4

[0071] 기판 상에 인듐-틴-옥사이드(ITO)층의 발광 면적이 3mm X 3mm 크기가 되도록 패터닝한 후 세정하였다. 상기 기판을 진공 챔버에 장착한 후 공정압력이 1X10-6torr가 되도록 한 후 상기 ITO층 위에 CuPC 약 200Å, NPD 약 400Å, 호스트물질인 DPVBi에 상기 화학식4에서 A-65로 표시된 물질을 도펀트로 약 4% 첨가하여 약 200Å , Alq3 약 350Å, LiF 약 5Å, Al 약 1000Å의 두께로 순차 적층하였다.

[0072] 실험결과, 10mA/cm^2에서 269cd/m^2(3.55V)를 나타내었으며 이때 CIE x = 0.15, y = 0.087를 나타내었다.

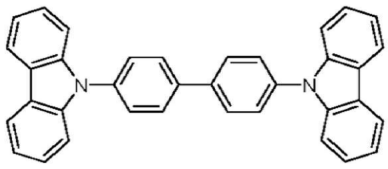
[0073] 비교예

[0074] 기판 상에 인듐-틴-옥사이드(ITO)층의 발광 면적이 3mm X 3mm 크기가 되도록 패터닝한 후 세정하였다. 상기 기판을 진공 챔버에 장착한 후 공정압력이 1X10-6torr가 되도록 한 후 유기물을 ITO위에 CuPC 약 200Å, NPD 약 400Å, 호스트물질인 DPVBi에 상기 화학식1-3으로 표시된 BD-a를 도펀트로 약 1% 첨가하여 약 200Å, Alq3 약 350Å, LiF 약 5Å, Al 약 1000Å의 두께로 순차 적층하였다.

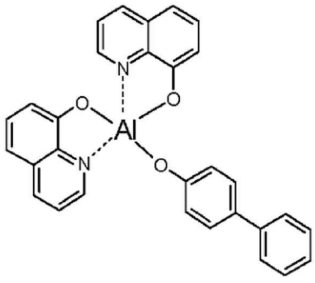
[0075] 실험결과, 10mA/cm^2에서 526 cd/m^2(6.7 V)를 나타내었으며 이때 CIE x = 0.136, y = 0.188를 나타내었다.

[0076] 여기서, 상기 CuPC와 상기 DPVBi 각각은 상기 화학식1-1 및 상기 화학식1-2로 표시되며, 상기 NPD는 하기 화학식5-1로 표시되고, 상기 Alq3는 하기 화학식5-2로 표시된다.

[0077] 화학식5-1

[0078] 

[0079] 화학식5-2

[0080] 

[0081] 상술한 실험예1 내지 실험예4와 비교예의 비교결과를 아래 표1에 나타내었다. 여기서 전압의 단위는 V, 전류의 단위는 mA/cm^2, 휘도의 단위는 cd/m^2이다.

[0082] 표1

[0083]

	전압	전류	휘도	CIE(X)	CIE(Y)
실험예1	3.34	10	427	0.141	0.096
실험예2	3.49	10	458	0.143	0.095
실험예3	3.3	10	492	0.143	0.092
실험예4	3.55	10	269	0.141	0.096
비교예	6.7	10	526	0.136	0.188

[0084] 표1을 통해 알 수 있는 바와 같이, 실험예1 내지 실험예4에서는 발광효율 및 색순도가 향상되었다. 특히 비교예와 비교하여 볼 때, 저전압(약 3V 낮음)에서 구동이 가능하면서 CIE(Y) 값이 0.9정도 낮아져 색순도가 향상되었음을 알 수 있다.

[0085] 상기한 청색 형광 물질을 포함하여 이루어지는 유기전계발광소자의 유기발광다이오드에 대한 일 실시예를 도 2에 도시하였다.

[0086] 도시한 바와 같이, 유기전계발광소자는 제 1 기판(110), 상기 제 1 기판(110)과 마주보는 제 2 기판(미도시)과, 상기 제 1 기판(110)에 형성되어 있는 유기발광다이오드(E)를 포함한다.

[0087] 상기 유기발광다이오드(E)는 양극 역할을 하는 제 1 전극(120), 음극 역할을 하는 제 2 전극(130) 및 상기 제 1 및 제 2 전극(120, 130) 사이에 형성되는 유기발광층(140)으로 이루어진다. 도면에서는 제 1 전극(120)이 상기 제 1 기판(110)에 근접하여 위치하는 것을 보이고 있으나, 이와 달리 상기 제 2 전극(130)이 상기 제 1 기판(110)에 근접하여 위치할 수 있다.

[0088] 상기 제 1 전극(120)은 일함수 값이 비교적 높은 물질, 예를 들어, 인듐-틴-옥사이드(ITO)로 이루어지며, 상기 제 2 전극(130)은 일함수 값이 비교적 낮은 물질, 예를 들어, 알루미늄(Al) 또는 알루미늄 합금(AlNd)로 이루어진다. 또한, 상기 유기발광층(140)은 적색, 녹색, 청색은 유기발광패턴으로 이루어진다.

[0089] 도면에는 나타내지 않았지만, 상기 유기발광층(140)은 발광효율을 극대화하기 위해, 다중층 구조 즉, 제 1 전극(120) 하면으로부터 순차적으로 정공수송층(hole transporting layer; HTL), 정공주입층(hole injection layer; HIL), 발광물질층(emitting material layer; EML), 전자주입층(electron injection layer; EIL) 및 전자수송층(electron transporting layer; ETL)으로 형성될 수도 있다.

[0090] 여기서, 상기 발광물질층 중 청색 발광 패턴은 전자 및 정공을 전달할 수 있는 물질인 호스트에 상기 화학식2로 표시되는 물질 중 어느 하나를 도펀트로 첨가하여 이루어진다. 여기서 도펀트는 청색 형광 물질 전체 대비 약 0.1 중량% 내지 약 20 중량%로 첨가된다. 이때, 상기 호스트는 상기 화학식 1-2로 표시된 DPVBi일 수 있다.

[0091] 상기에서는 본 발명의 바람직한 실시예를 참조하여 설명하였지만, 해당 기술분야의 숙련된 당업자는 하기의 특허청구범위에 기재된 본 발명의 기술적 사상 및 영역으로부터 벗어나지 않는 범위 내에서 본 발명을 다양하게 수정 및 변경시킬 수 있음을 이해할 수 있을 것이다.

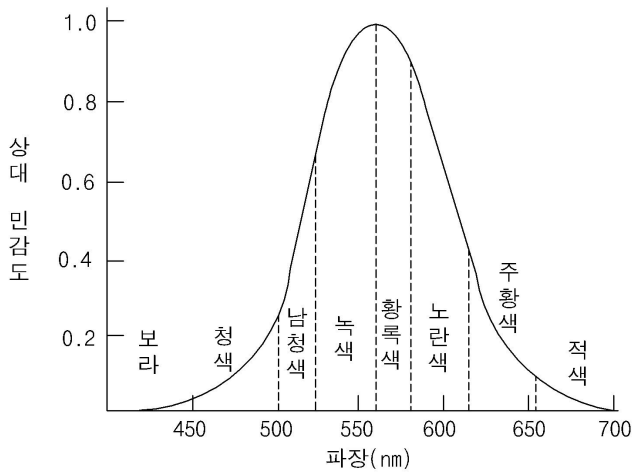
도면의 간단한 설명

[0092] 도 1은 유기전계발광소자의 색순도와 시감도(상대 민감도)의 관계를 보여주는 그래프이다.

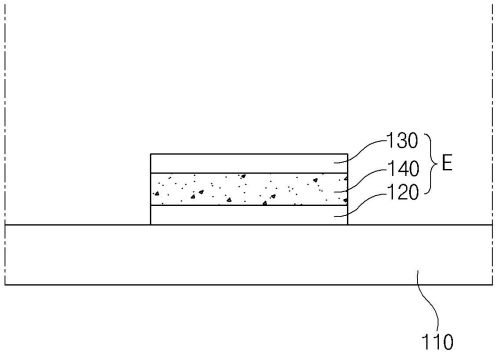
[0093] 도 2는 본 발명의 실시예에 따른 유기발광소자의 유기발광다이오드에 대한 개략적인 단면도이다.

도면

도면1


1.0
0.8
0.6
0.4
0.2
상대 민감도
보라
청색
남청색
녹색
황록색
노란색
주황색
적색
450
500
550
600
650
700
파장(nm)

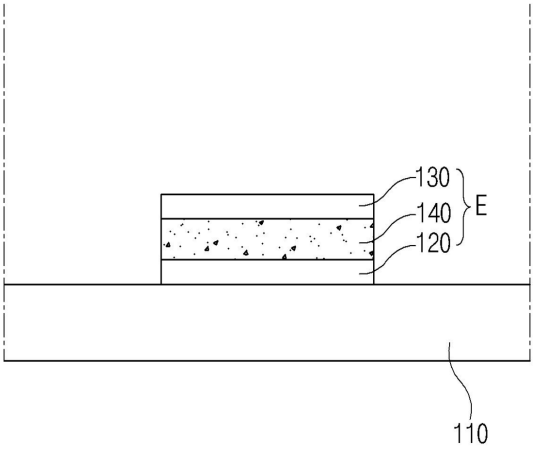
도면2


130
140
120
E
110

专利名称(译)	标题：蓝色磷光体和使用其的有机电致发光器件		
公开(公告)号	KR101294236B1	公开(公告)日	2013-08-07
申请号	KR1020090063117	申请日	2009-07-10
[标]申请(专利权)人(译)	乐金显示有限公司		
申请(专利权)人(译)	LG显示器有限公司		
当前申请(专利权)人(译)	LG显示器有限公司		
[标]发明人	LEE SEUNG JAE 이승재 CHA SOON WOOK 차순욱 SONG IN BUM 송인범 KIM JUNG KEUN 김중근 KIM DO HAN 김도한 PARK CHUN GUN 박춘건 BIN JONG KWAN 빈종관 CHO NAM SUNG 조남성		
发明人	이승재 차순욱 송인범 김중근 김도한 박춘건 빈종관 조남성		
IPC分类号	C09K11/06 C09K		
CPC分类号	C09K2211/1011 H05B33/18 H01L51/5012 C09K2211/1007 H01L51/006 H01L51/0054 H01L2251/308 H01L51/0094 C09K2211/1014 C09K11/06		
其他公开文献	KR1020110005516A		
外部链接	Espacenet		

摘要(译)

蓝色荧光材料和使用该蓝色荧光材料的有机电致发光器件技术领域 在本发明中，二苯胺衍生物被1,6-芘取代的结构被氢，氟，C1-C6取代。 或未取代的烷基，C6至C30的取代或未取代的芳族基团或取代或未取代的C6至C30释放高联盟 特别是其中两种是氟，并且胺包括C6-C30取代或未取代的胺。 取代或未取代的脂族基团或C6-C30的取代或未取代的脂族环状基团被取代， 光效率和发光寿命得到改善。 代表还 - 2


130
140
120
E
110