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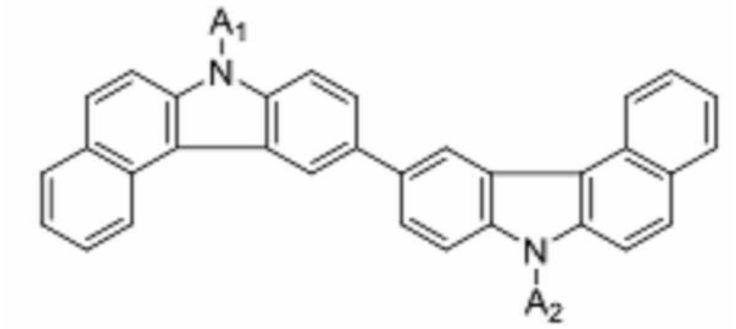
(54) 발명의 명칭 **적색 인광 호스트 물질 및 이를 이용한 유기전계발광소자**

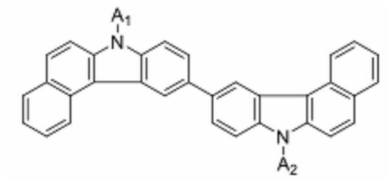
(57) 요 약

본 발명은 하기 화학식으로 표시되며, A1 및 A2 각각은 치환 또는 비치환된 방향족 그룹 물질, 치환 또는 비치환
(뒷면에 계속)

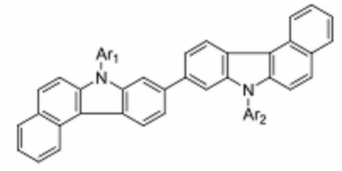
대 표 도



된 이형고리 그룹 물질, 또는 치환 또는 비치환된 방향족 그룹 물질에서 선택되는 것이 특징인 유기전계발광소자용 적색 인광 호스트 물질을 제공한다.



또한, 본 발명은 하기 화학식으로 표시되며, Ar1 및 Ar2 각각은 치환 또는 비치환된 방향족 그룹 물질, 치환 또는 비치환된 이형고리 그룹 물질, 또는 치환 또는 비치환된 방향족 그룹 물질에서 선택되는 것이 특징인 유기전계발광소자용 적색 인광 호스트 물질을 제공한다.



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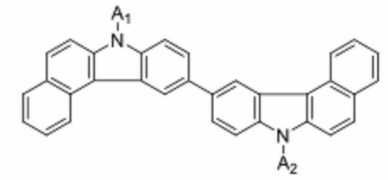
명 세 서

청구범위

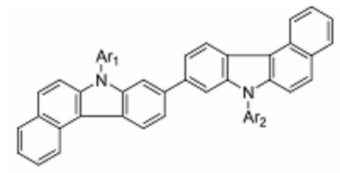
청구항 1

하기 화학식으로 표시되며, A1 및 A2 각각은 피리딘일(pyridinyl), 비피리딘일(bipyridinyl), 퀴놀린일(quinolinyl), 이소퀴놀린일(isoquinolinyl), 퀴녹살린일 (quinoxalinyl), 터피리딘일(terpyridinyl), 페난스롤린일(phenanthrolinyl)을 포함하는 치환 또는 비치환된 이형고리기 그룹에서 선택되는 것이 특징인 유기전계발광소자용 적색 인광 호스트 물질.



청구항 2

하기 화학식으로 표시되며, Ar1 및 Ar2 각각은 피리딘일(pyridinyl), 비피리딘일(bipyridinyl), 퀴놀린일(quinolinyl), 이소퀴놀린일(isoquinolinyl), 퀴녹살린일 (quinoxalinyl), 터피리딘일(terpyridinyl), 페난스롤린일(phenanthrolinyl)을 포함하는 치환 또는 비치환된 이형고리기 그룹에서 선택되는 것이 특징인 유기전계발광소자용 적색 인광 호스트 물질.



청구항 3

삭제

청구항 4

삭제

청구항 5

삭제

청구항 6

제 1 항 또는 제 2 항에 있어서,

상기 상기 이형고리기 그룹의 치환체는 C1~C20의 아릴(aryl), C1~C20의 알킬(alkyl), C1~C20의 알콕시(alkoxy) 할로겐(halogen), 시아노(cyano), 실릴(silyl) 중에서 선택되는 것이 특징인 적색 인광 호스트 물질.

청구항 7

제 1 전극과;

상기 제 1 전극과 마주보는 제 2 전극과;

상기 제 1 및 제 2 전극 사이에 위치하는 발광물질층을 포함하고,

상기 발광물질층은 제 1 항 또는 제 2 항의 적색 인광 호스트 물질로 이루어지는 것이 특징인 유기전계발광소자.

청구항 8

삭제

청구항 9

제 7 항에 있어서,

상기 적색 인광 호스트 물질은 비극성 용매에 용해 가능하며 코팅 공정에 의해 형성되는 것이 특징인 유기전계발광소자.

발명의 설명

기 술 분 야

[0001] 본 발명은 적색 인광 호스트 물질 및 이를 사용하는 유기전계발광소자에 관한 것이다. 보다 구체적으로, 본 발명은 용해가 가능하며 휘도 및 발광효율이 뛰어난 적색 인광 호스트 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 하기 화학식1-2로 표시되는 4,4'-bis[N-(1-naphtyl)-N-phenylamino]-biphenyl (NPD)을 30nm 내지 60nm 정도 증착하여 형성된다.

[0007] (4) 다음, 상기 정공수송층 상에 발광물질층 (EML: emitting material layer)을 형성한다. 이때 필요에 따라 도펀트(dopant)를 첨가한다.

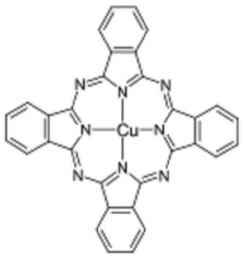
[0008] 예를 들어, 발광물질층은 적색 발광층 및 녹색 발광층, 청색 발광층이 하나의 픽셀을 구성하여 여러가지 계조(grayscale)을 표현하게 된다. 예를 들어, 적색(green) 발광층은, 하기 화학식1-3으로 표시되는 4, 4′ -N, N′ -dicarbazolbiphenyl (CBP)를 30nm 내지 60nm의 두께로 증착하며 불순물(dopant)로는 하기 화학식 1-4 또는 1-5

로 표시되는 이리듐 복합체가 주로 이용된다.

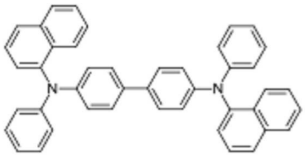
[0009] (5) 다음, 상기 발광물질층 상에 전자수송층(ETL:electron transport layer) 및 전자주입층(EIL: electron injecting layer)을 연속적으로 형성한다. 이때, 상기 전자수송층은 하기 화학식1-6으로 표시되는 tris(8-hydroxy-quinolate)aluminum (Alq3)로 이루어진다.

[0010] (6) 다음, 상기 전자주입층 상에 음극(cathode)을 형성하고, 마지막으로 상기 음극 상에 보호막을 형성한다.

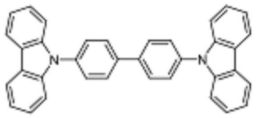
[0011] 화학식1-1

[0012] 

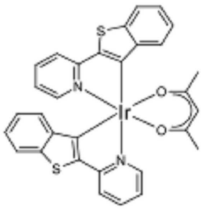
[0013] 화학식1-2

[0014] 

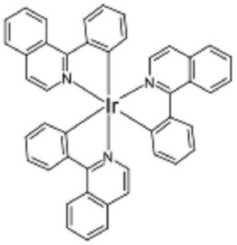
[0015] 화학식1-3

[0016] 

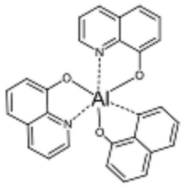
[0017] 화학식1-4

[0018] 

[0019] 화학식1-5

[0020] 

[0021] 화학식1-6

[0022] 

[0023] 상기와 같은 구조에 있어 발광물질층은 청색, 녹색, 적색을 구현하여, 풀컬러의 화상을 구현하게 된다.

[0024] 발광 재료의 경우 양쪽 전극에서부터 주입된 전자와 정공의 재결합에 의해 여기자가 형성되며, 일중항 여기자의 경우 형광, 삼중항 여기자의 경우 인광에 관여하게 된다. 인광재료에 관여하는 생성확율이 75%인 삼중항 여기자의 경우 생성확율이 25%인 일중항 여기자를 사용하는 형광재료보다 뛰어난 발광효율을 보인다. 이러한 인광재료 중 적색 인광 재료는 형광재료에 비해 매우 높은 발광효율을 가질 수 있으므로 유기전계발광소자의 효율을 높이는 중요한 방법으로 많이 연구되고 있다.

[0025] 인광 재료를 이용하기 위해서는 높은 발광효율, 높은 색순도, 긴 발광수명이 요구되며, 이중 적색의 경우 도 1과 같이 색순도가 높아질수록(CIE 색좌표 X값이 커질수록) 시감도가 떨어지기 때문에, 동일한 내부양자효율로는 높은 발광효율을 얻기 어려운 문제가 있다. 이에 따라 우수한 색순도(CIE색순도 X=0.65이상)와 높은 발광효율을 가지는 적색 인광 물질의 개발이 요구되고 있다.

[0026] 한편, 적색 인광 호스트 물질로는 CBP 또는 금속 복합체(metal complex) 등이 사용되고 있으나, 이러한 물질들은 용해도가 좋지 않아 증착 공정을 통해 형성되어야 하므로 공정 효율이 떨어지는 단점을 갖는다.

[0027] 특히 대면적 소자를 형성하는데 큰 한계를 갖는다.

발명의 내용

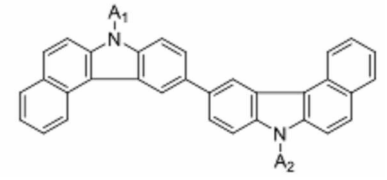
해결하려는 과제

[0028] 본 발명은 용해도가 뛰어나 용액 공정이 가능하고, 휘도 및 발광효율이 뛰어난 적색 인광 호스트 물질을 제공하고자 한다.

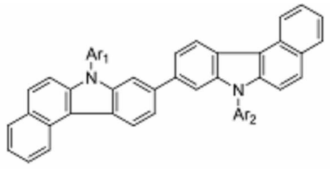
[0029] 또한, 상기 적색 인광 호스트 물질을 이용하여 고휘도의 영상을 구현할 수 있는 대면적 유기전계발광소자를 제공하고자 한다.

과제의 해결 수단

[0030] 위와 같은 과제의 해결을 위해, 본 발명은 하기 화학식으로 표시되며, A1 및 A2 각각은 치환 또는 비치환된 방향족 그룹 물질, 치환 또는 비치환된 이형고리 그룹 물질, 또는 치환 또는 비치환된 방향족 그룹 물질에서 선택되는 것이 특징인 유기전계발광소자용 적색 인광 호스트 물질을 제공한다.

[0031] 

[0032] 또한, 본 발명은 하기 화학식으로 표시되며, Ar1 및 Ar2 각각은 치환 또는 비치환된 방향족 그룹 물질, 치환 또는 비치환된 이형고리 그룹 물질, 또는 치환 또는 비치환된 방향족 그룹 물질에서 선택되는 것이 특징인 유기전계발광소자용 적색 인광 호스트 물질을 제공한다.



[0033]

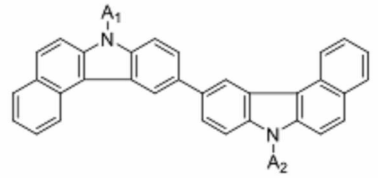
[0034] 상기 방향족 그룹 물질은 페닐(phenyl), 나프틸(naphthyl), 바이페닐(biphenyl), 터페닐(terphenyl), 페난스렌닐(phenanthrenyl)을 포함하는 것이 특징이다.

[0035] 상기 이형고리 그룹 물질은 피리딘일(pyridinyl), 비피리딘일(bipyridinyl), 퀴놀린일(quinolinyl), 이소퀴놀린일(isoquinolinyl), 퀴녹살린일 (quinoxalinyl), 터피리딘일(terpyridinyl), 페난스롤린일(phenanthrolinyl)을 포함하는 것이 특징이다.

[0036] 상기 지방족 그룹 물질은 C1~C20의 아릴(aryl), C1~C20의 알킬(alkyl)을 포함하는 것이 특징이다.

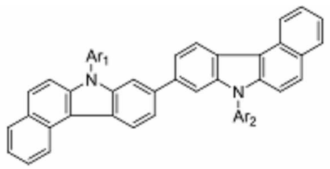
[0037] 상기 방향족 그룹 물질, 상기 이형고리 그룹 물질 및 상기 방향족 그룹 물질 각각의 치환체는 C1~C20의 아릴(aryl), C1~C20의 알킬(alkyl), C1~C20의 알콕시(alkoxy) 할로겐(halogen), 시아노(cyano), 실릴(silyl) 중에서 선택되는 것이 특징이다.

[0038] 다른 관점에서, 본 발명은 제 1 전극과; 상기 제 1 전극과 마주보는 제 2 전극과; 상기 제 1 및 제 2 전극 사이에 위치하는 발광물질층을 포함하고, 상기 발광물질층은, 하기 화학식으로 표시되며, A1 및 A2 각각은 치환 또는 비치환된 방향족 그룹 물질, 치환 또는 비치환된 이형고리 그룹 물질, 또는 치환 또는 비치환된 방향족 그룹 물질에서 선택되는 것이 특징인 적색 인광 호스트 물질로 이루어지는 것이 특징인 유기전계발광소자를 제공한다.



[0039]

[0040] 또한, 본 발명은 제 1 전극과; 상기 제 1 전극과 마주보는 제 2 전극과; 상기 제 1 및 제 2 전극 사이에 위치하는 발광물질층을 포함하고, 상기 발광물질층은, 하기 화학식으로 표시되며, Ar1 및 Ar2 각각은 치환 또는 비치환된 방향족 그룹 물질, 치환 또는 비치환된 이형고리 그룹 물질, 또는 치환 또는 비치환된 방향족 그룹 물질에서 선택되는 것이 특징인 적색 인광 호스트 물질로 이루어지는 것이 특징인 유기전계발광소자를 제공한다.



[0041]

[0042] 상기 적색 인광 호스트 물질은 비극성 용매에 용해 가능하며 코팅 공정에 의해 형성되는 것이 특징이다.

발명의 효과

[0043] 본 발명의 적색 인광 호스트 물질은 용해도가 뛰어나기 때문에, 용액 공정에 의해 필름 형성이 가능한 장점을 갖는다. 이에 따라 대면적 유기전계발광소자의 제조가 용이해지게 된다.

[0044] 또한, 상기 적색 인광 호스트 물질을 이용하는 유기전계발광소자는 고휘도의 영상을 구현할 수 있고 또한 전력 소모가 감소되는 효과를 갖는다.

도면의 간단한 설명

[0045] 도 1a 및 도 1b는 본 발명의 실시예에 따른 적색 인광 호스트 물질의 PL 스펙트럼을 도시한 그래프이다.

도 2는 본 발명의 실시예에 따른 유기전계발광소자의 개략적인 단면도이다.

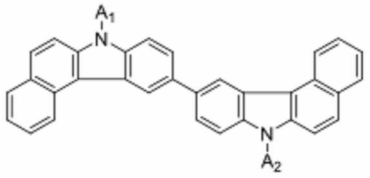
발명을 실시하기 위한 구체적인 내용

[0046] 이하, 본 발명에 따른 적색 인광 호스트 물질의 구조 및 그 합성예와, 이를 이용한 유기전계발광소자에 대해 설명한다.

[0047] -제 1 실시예-

[0048] 본 발명의 제 1 실시예에 따른 적색 인광 호스트 물질은 3,4 benzo carbazol이 para 위치로 결합되고, carbazol의 질소에 방향족 그룹, 이형고리 그룹 또는 지방족 그룹으로부터 선택된 물질이 치환됨으로써, 솔루블한 특성을 갖는 것이 특징이며, 하기 화학식2로 표시된다.

[0049] 화학식2

[0050] 

[0051] 여기서, A1 및 A2 각각은 치환 또는 비치환된 방향족 그룹 물질, 치환 또는 비치환된 이형고리 그룹 물질, 또는 치환 또는 비치환된 방향족 그룹 물질에서 선택된다. A1과 A2가 같은 경우 대칭 구조를 가지며, 이와 달리 A1과 A2가 다른 경우 비대칭적 구조를 갖는다.

[0052] 예를 들어, 상기 방향족 그룹 물질은 페닐(phenyl), 나프틸(naphthyl), 바이페닐(biphenyl), 터페닐(terphenyl), 페난스렌닐(phenanthrenyl)을 포함하는 것이 특징이다.

[0053] 또한, 상기 이형고리 그룹 물질은 피리딘일(pyridinyl), 비피리딘일(bipyridinyl), 퀴놀린일(quinolinyl), 이소퀴놀린일(isoquinolinyl), 퀴녹살린일 (quinoxalinyl), 터피리딘일(terpyridinyl), 페난스롤린일(phenanthrolinyl)을 포함하는 것이 특징이다.

[0054] 또한, 상기 지방족 그룹 물질은 C1~C20의 아릴(aryl), C1~C20의 알킬(alkyl)을 포함하는 것이 특징이다.

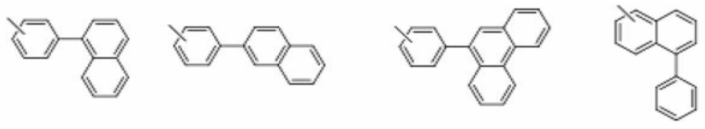
[0055] 또한, 상기 방향족 그룹 물질, 상기 이형고리 그룹 물질 및 상기 방향족 그룹 물질 각각의 치환체는 C1~C20의 아릴(aryl), C1~C20의 알킬(alkyl), C1~C20의 알콕시(alkoxy) 할로겐(halogen), 시아노(cyano), 실릴(silyl) 중에서 선택되는 것이 특징이다. 예를 들어, 상기 치환체는 메틸(methyl), 에틸(ethyl), 프로필(propyl), 이소프로필(isopropyl), 부틸(t-butyl), 메톡시(methoxy), 에톡시(ethoxy), 부톡시(butoxy), 트리메틸실릴(trimethylsilyl), 불소, 염소 중 어느 하나일 수 있다.

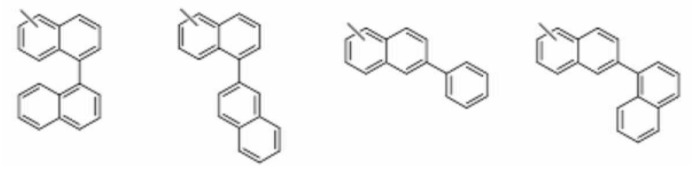
[0056] 이와 같은 적색 인광 호스트 물질은, 카바졸(carbazol)의 3,4 benzo carbazol이 para 위치로 결합되고, carbazol의 질소에 방향족 그룹, 이형고리 그룹 또는 지방족 그룹으로부터 선택된 물질이 치환됨으로써, 솔루블한 특성을 갖게 된다. 또한, 고휘도 및 고효율의 장점을 갖게 된다.

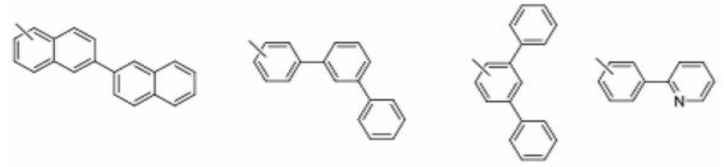
[0057] 예를 들어, 상기 A1 및 A2 각각은 아래 화학식3으로 표시되는 다수의 물질군으로부터 선택될 수 있다.

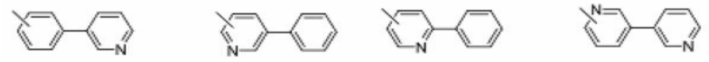
[0058] 화학식3

[0059] 

[0060] 

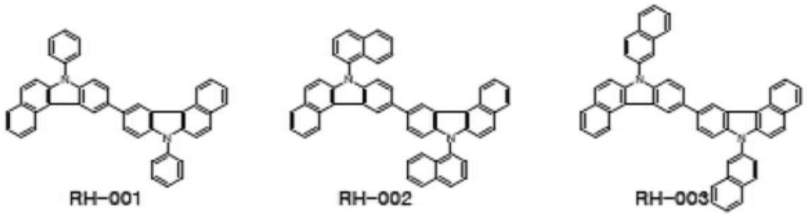
[0061] 

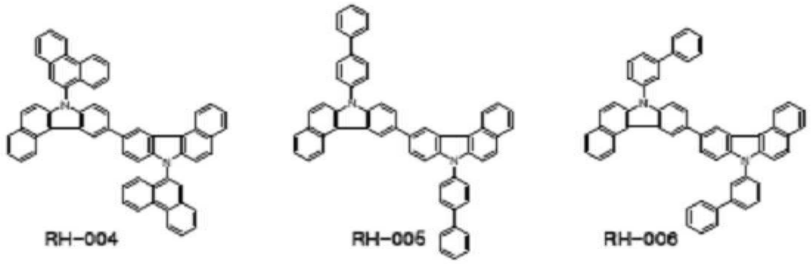
[0062] 

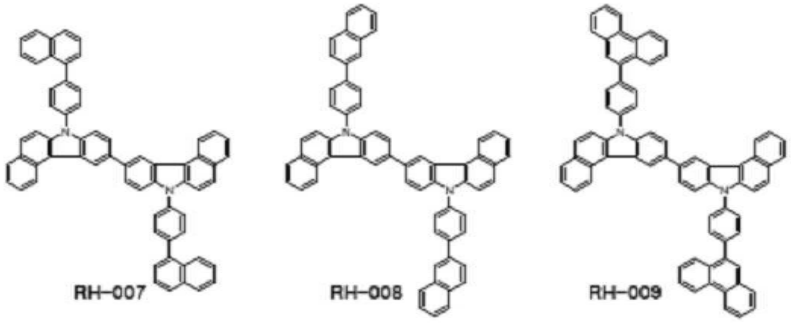
[0063] 

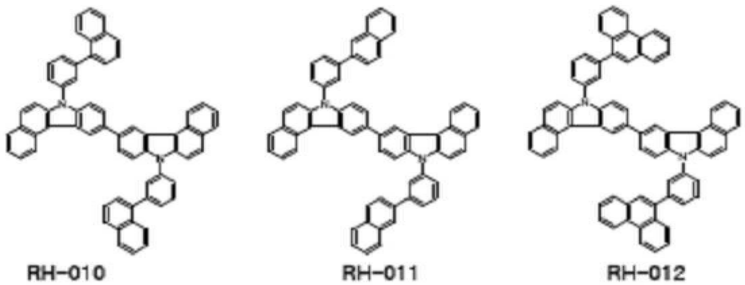
[0064] 상기 A1 및 A2의 선택에 따라, 상기 화학식2의 적색 인광 호스트 물질은 하기 화학식4에 표시된 다수의 물질 중 어느 하나가 된다. 여기서, 설명의 편의를 위해 각 물질 하단에 RH001~RH309의 기호를 부여하였다.

[0065] 화학식4

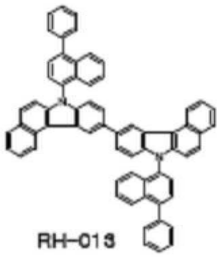
[0066] 

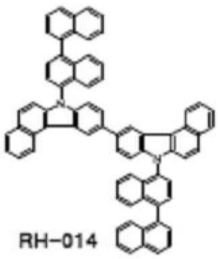
[0067] 

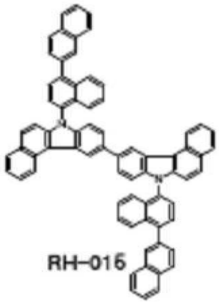
[0068] 

[0069] 

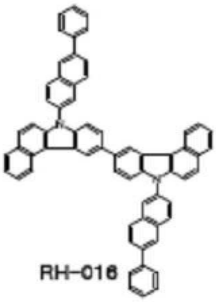
[0070]

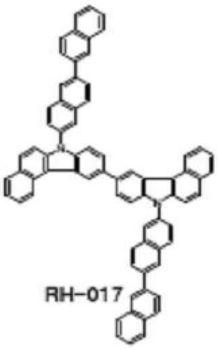

RH-013

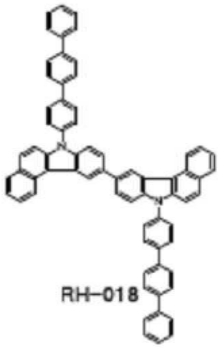

RH-014


RH-015

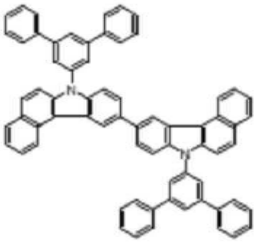
[0071]

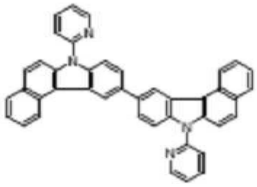

RH-016

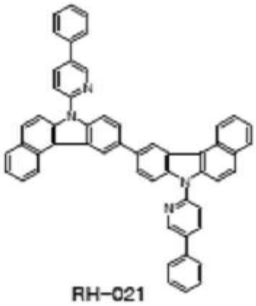

RH-017


RH-018

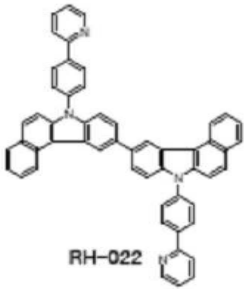
[0072]

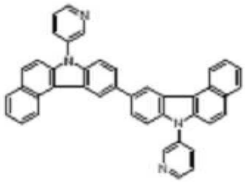

RH-019

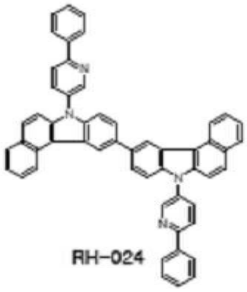

RH-020


RH-021

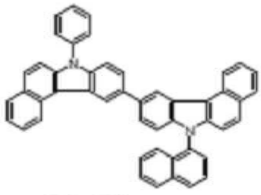
[0073]

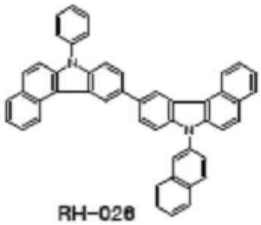

RH-022

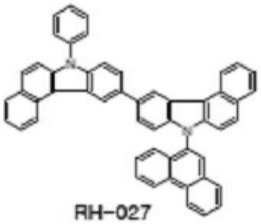

RH-023

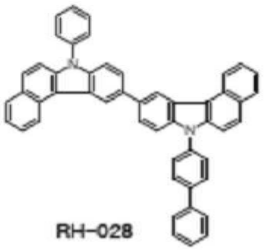

RH-024

[0074]


RH-025


RH-026


RH-027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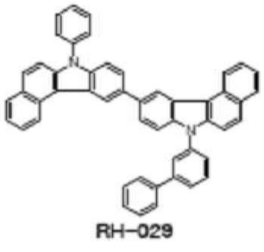
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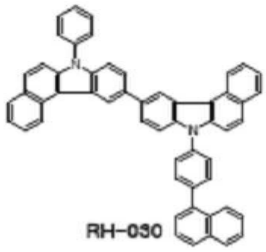
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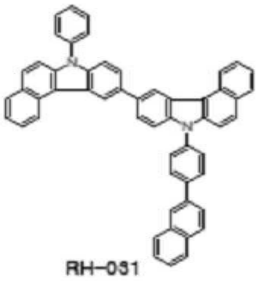
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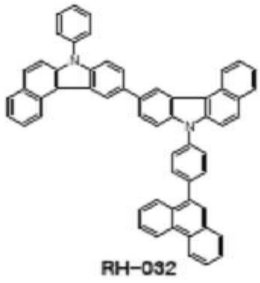
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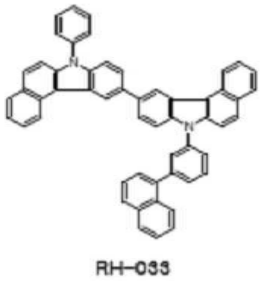
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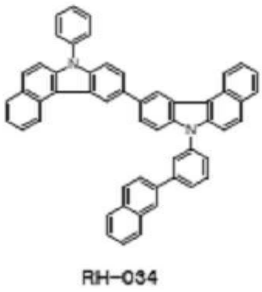
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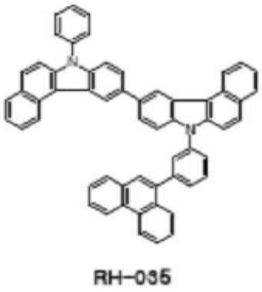
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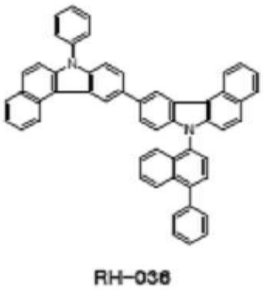
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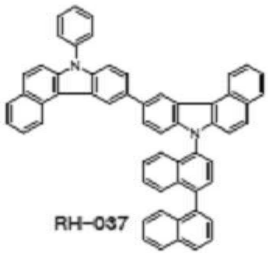
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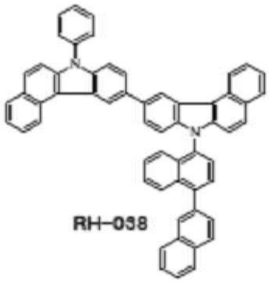
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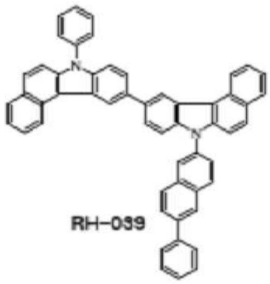
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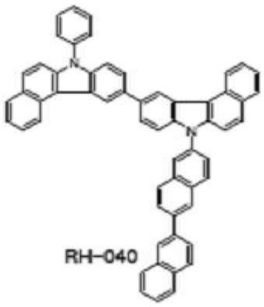
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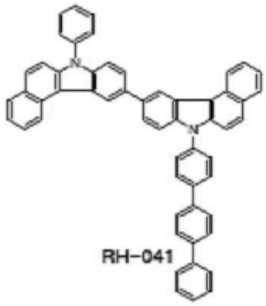
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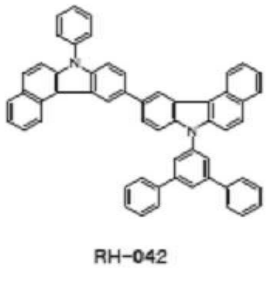
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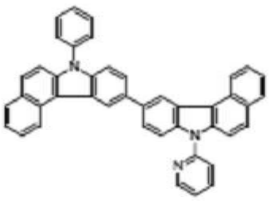

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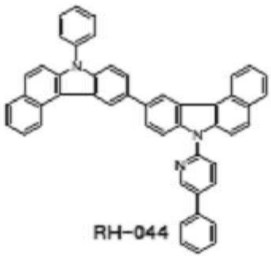

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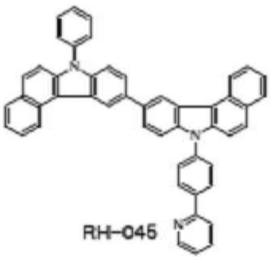

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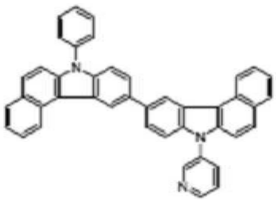

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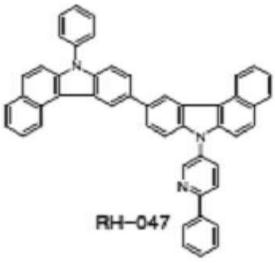

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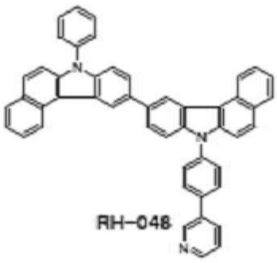

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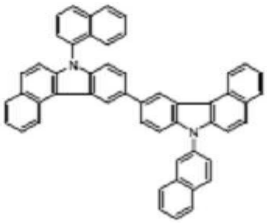

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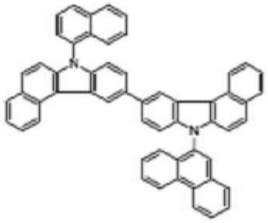

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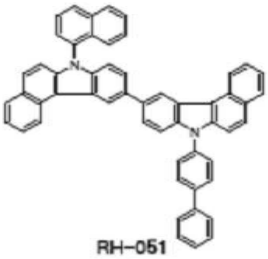

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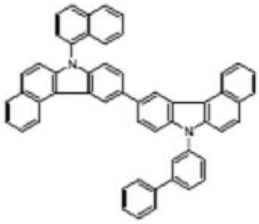

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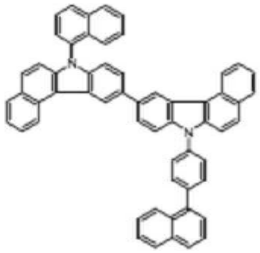

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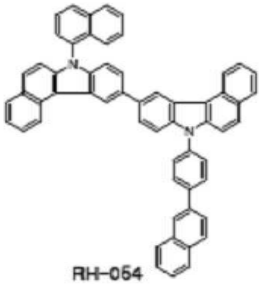

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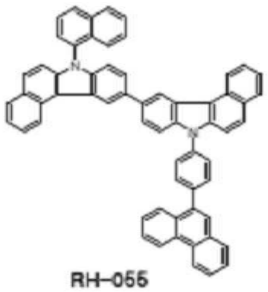

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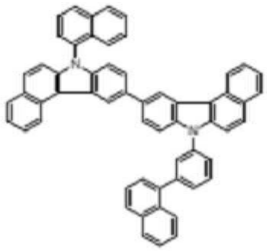

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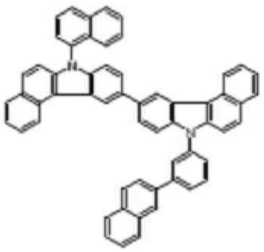

RH-057

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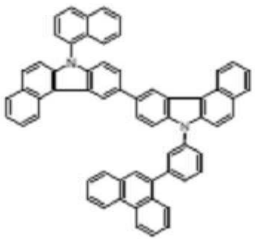
[0085]



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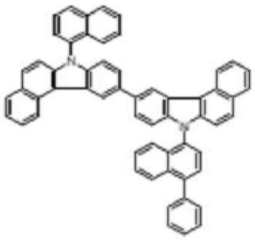

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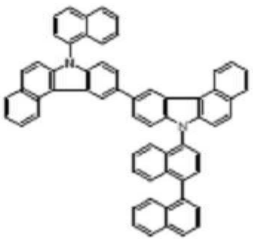

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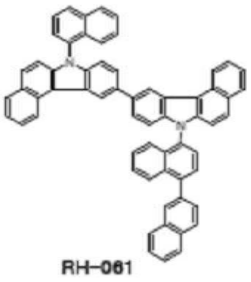

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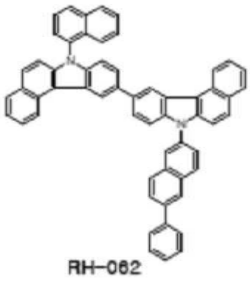

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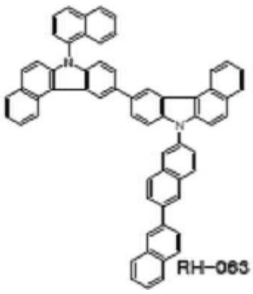

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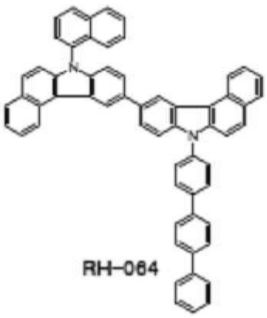

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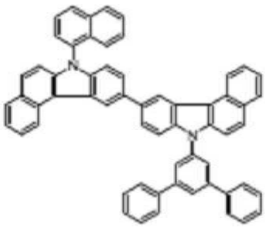

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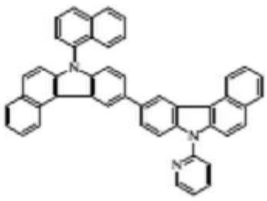

RH-066

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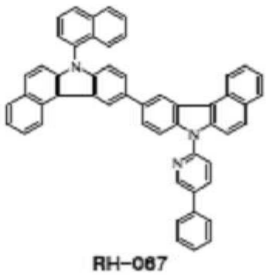

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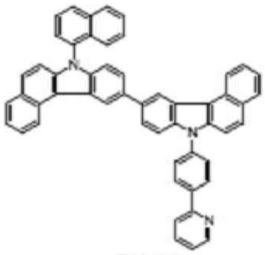

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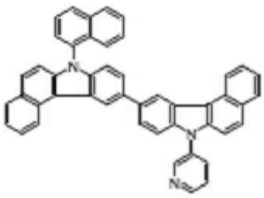

RH-069

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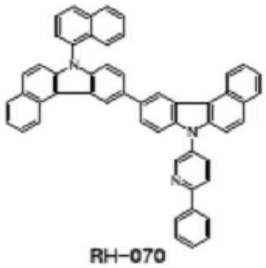

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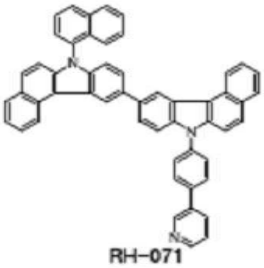

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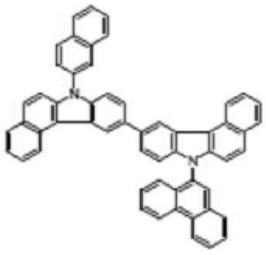

RH-072

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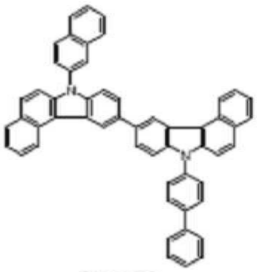
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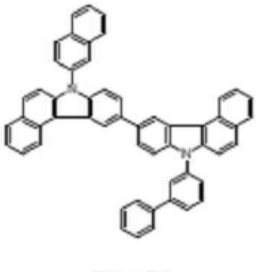
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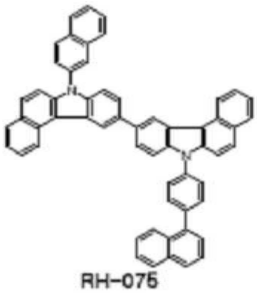
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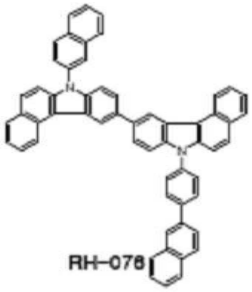
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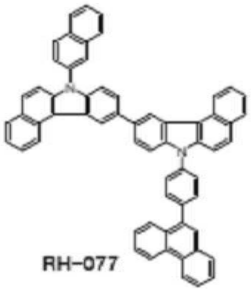
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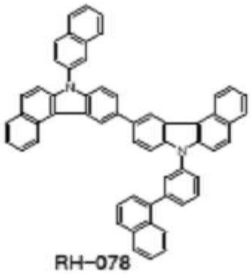
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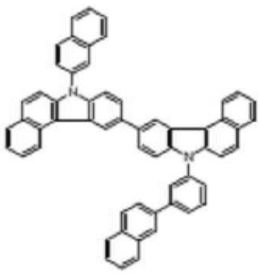
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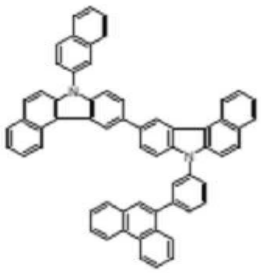
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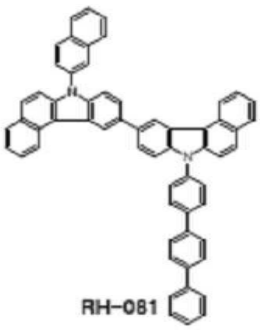
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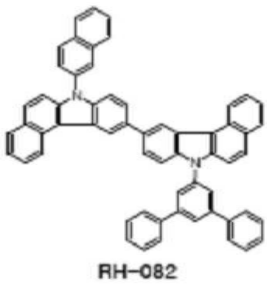
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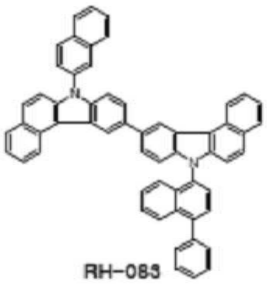
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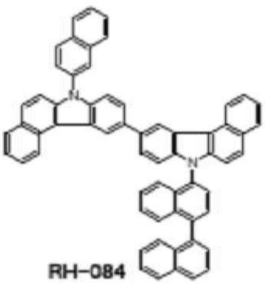
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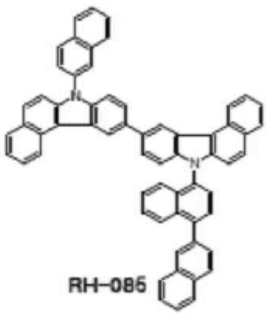
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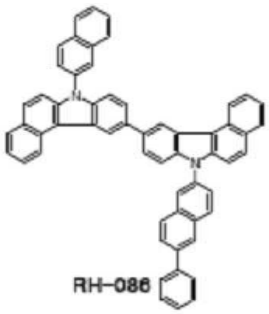
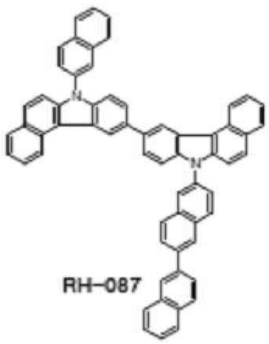

RH-086


RH-087

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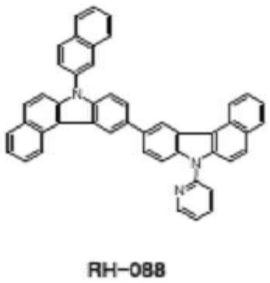

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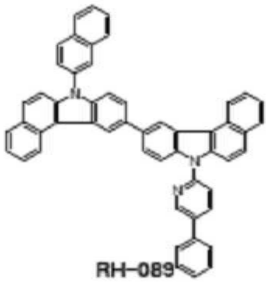

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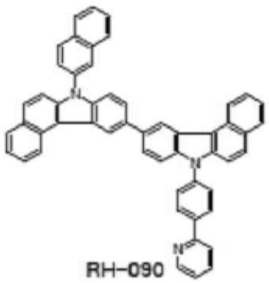

RH-090

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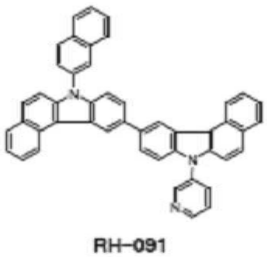

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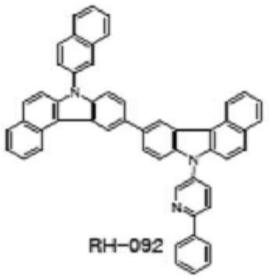

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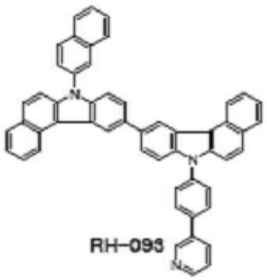
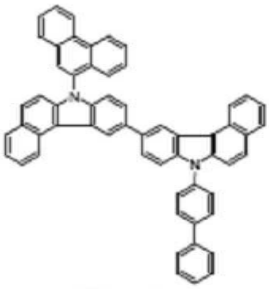


RH-093

[0097]



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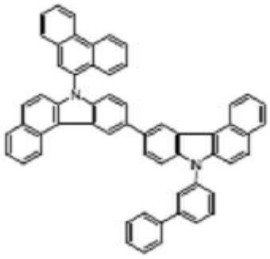

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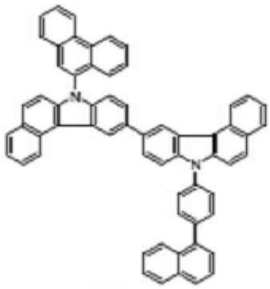

RH-096

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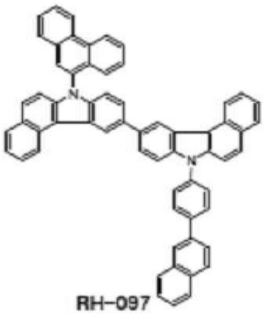

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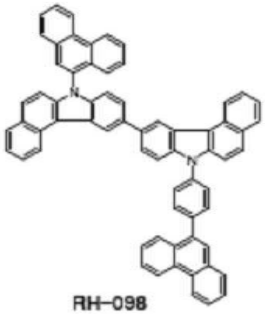

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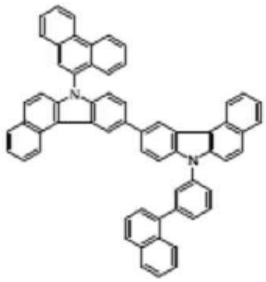

RH-099

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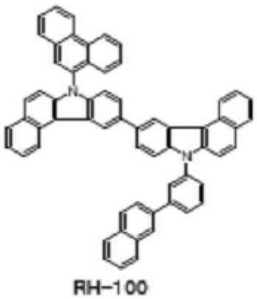

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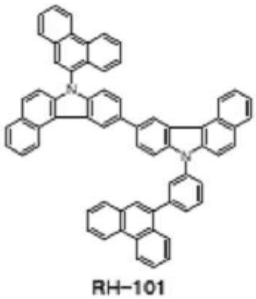
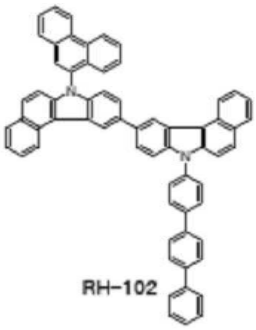
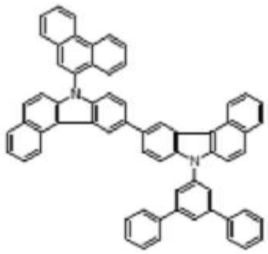


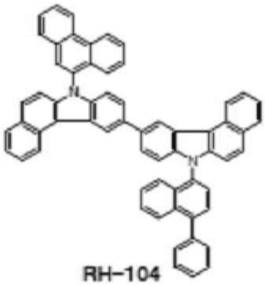
RH-101



RH-102

[0100]


RH-103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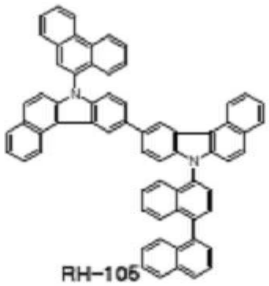
RH-105

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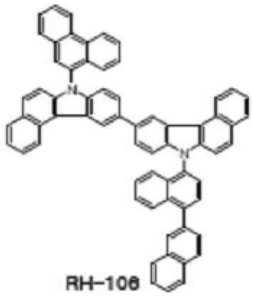
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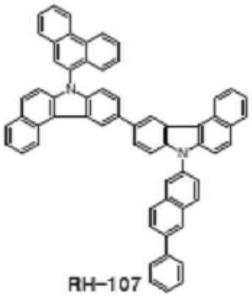
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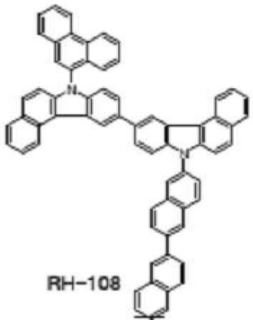
RH-108

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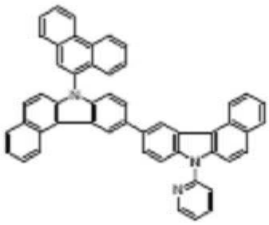
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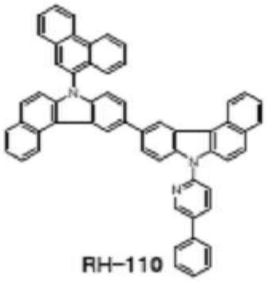
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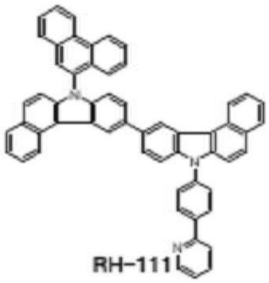
RH-111

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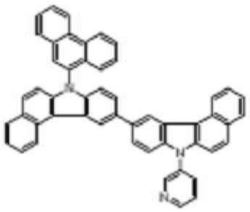
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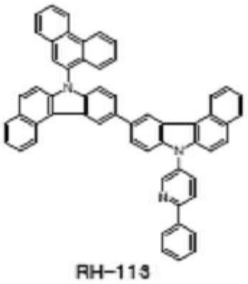
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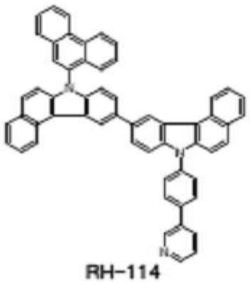
RH-114

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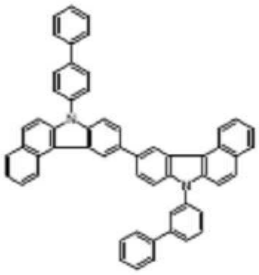
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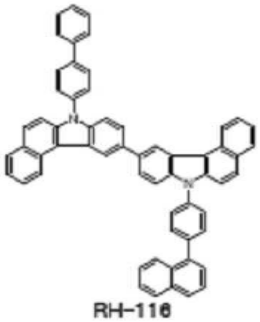
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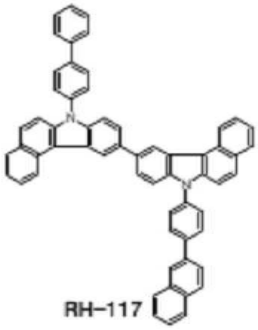
RH-117

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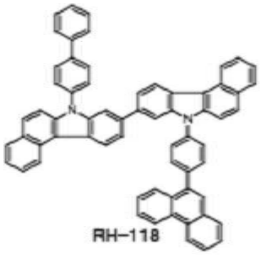
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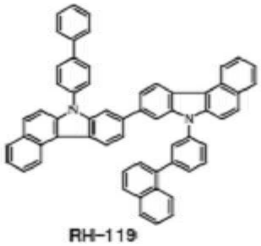
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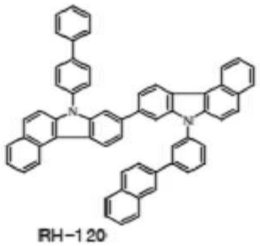
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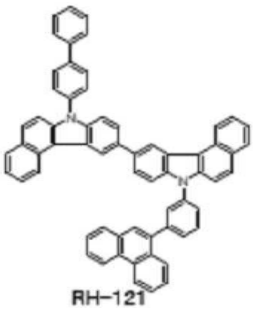
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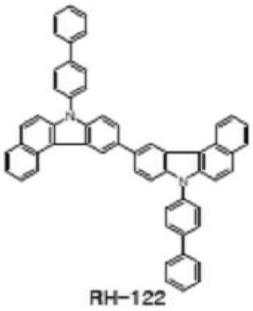
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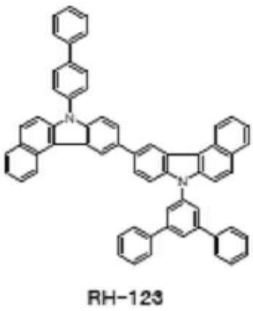
RH-123

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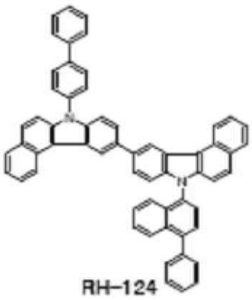
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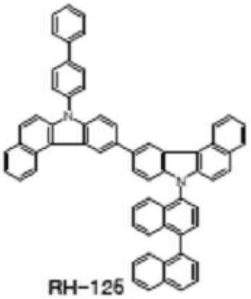
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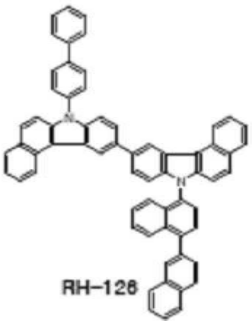
RH-126

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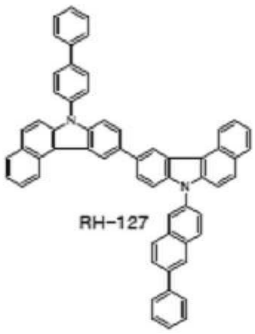
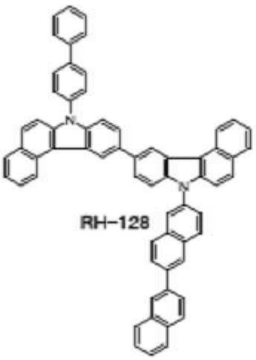

RH-127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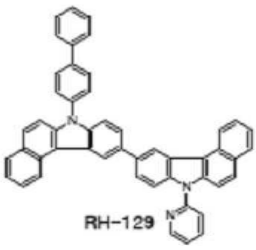
RH-129

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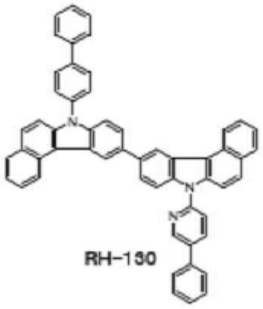
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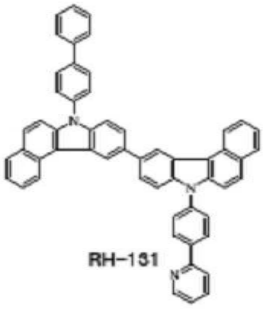
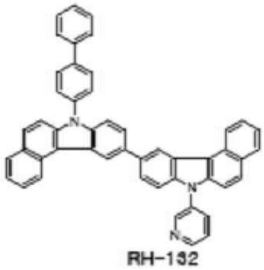

RH-131


RH-132

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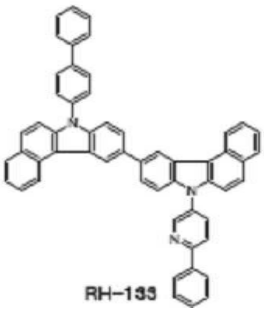
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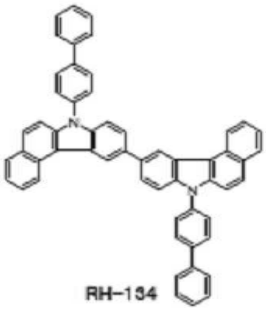
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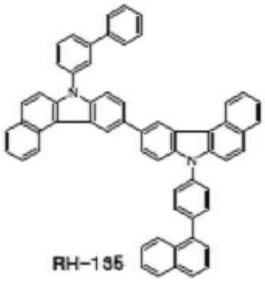
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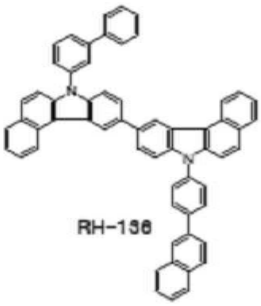
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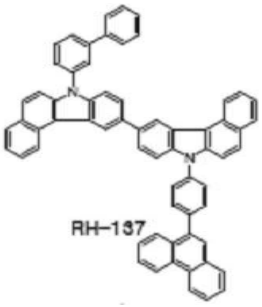
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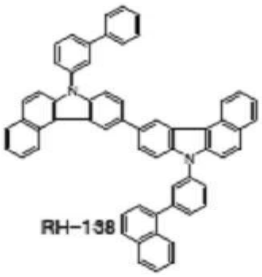
RH-138

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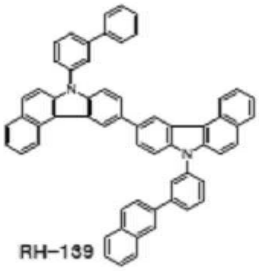
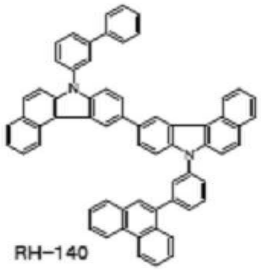

RH-139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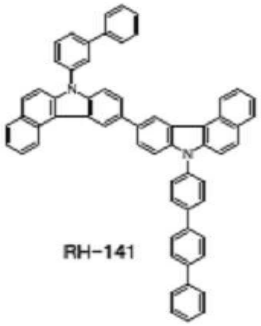
RH-141

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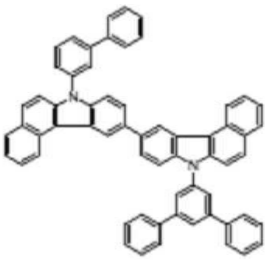
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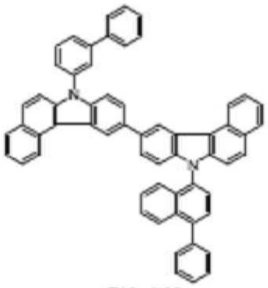
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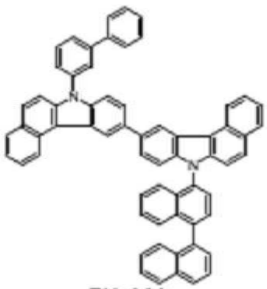
RH-144

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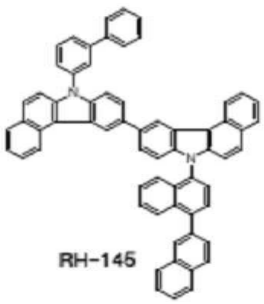
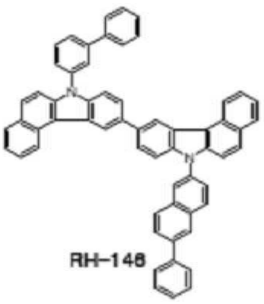
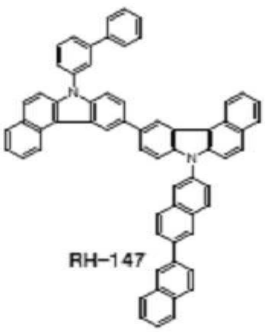
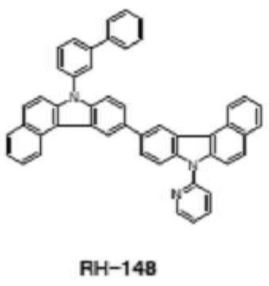

RH-145

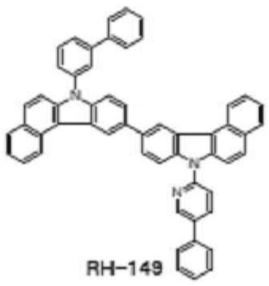

RH-146


RH-147

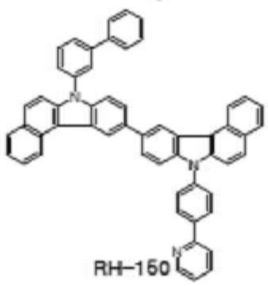
[0115]



RH-148

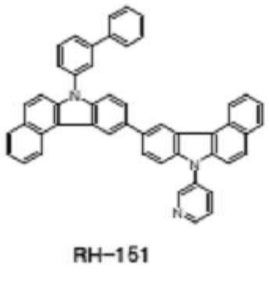


RH-149

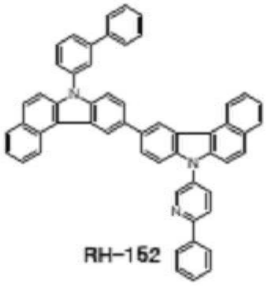


RH-150

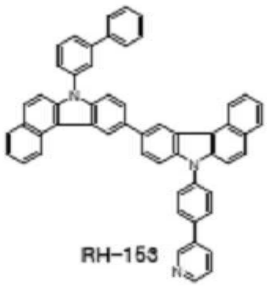
[0116]



RH-151

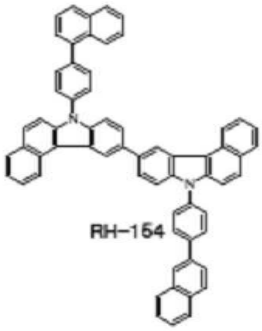


RH-152

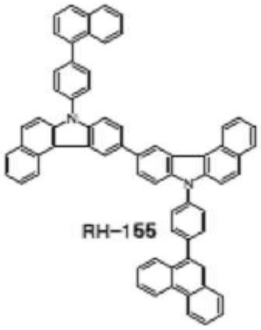


RH-153

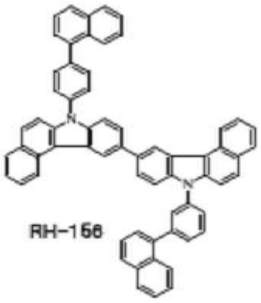
[0117]



RH-154

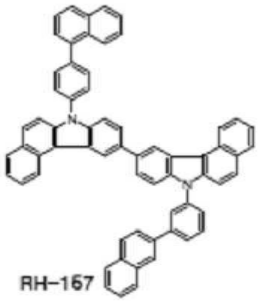


RH-155

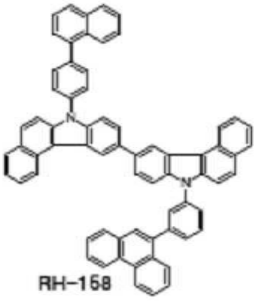


RH-156

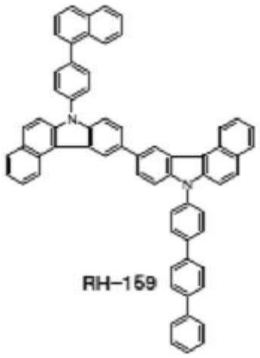
[0118]



RH-157



RH-158



RH-159

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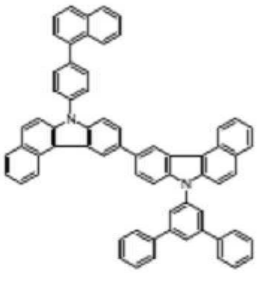
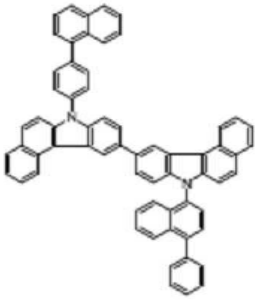
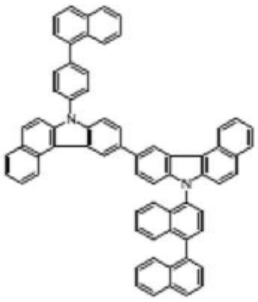


RH-160

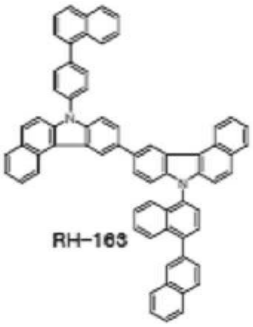


RH-161



RH-162

[0120]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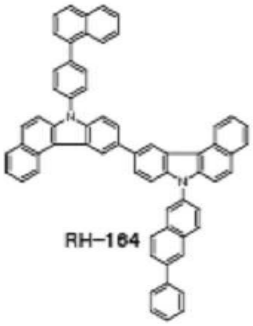
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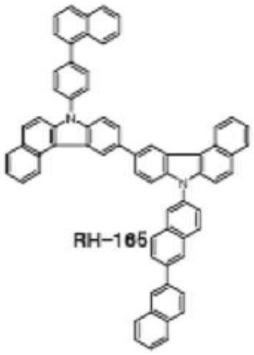
RH-165

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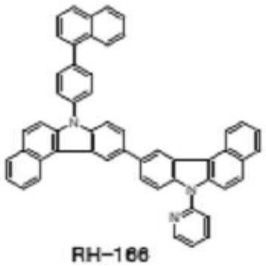
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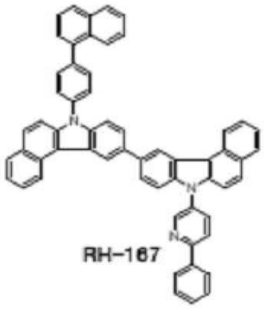
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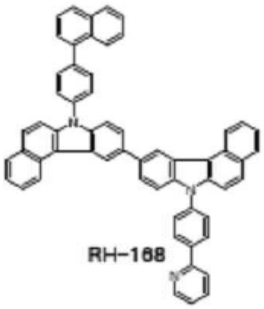
RH-168

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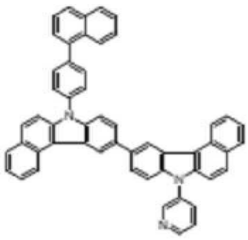
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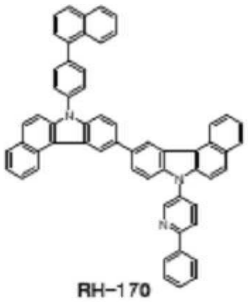
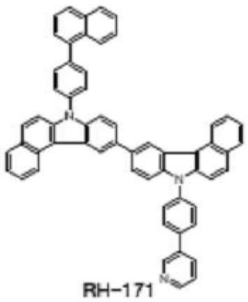

RH-170


RH-171

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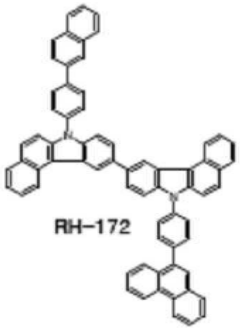
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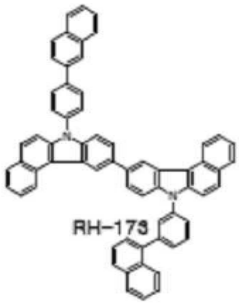
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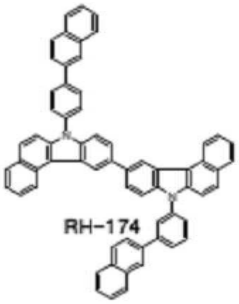
RH-174

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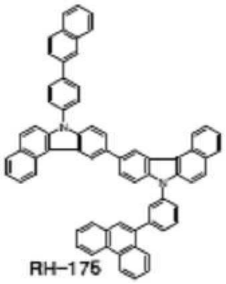
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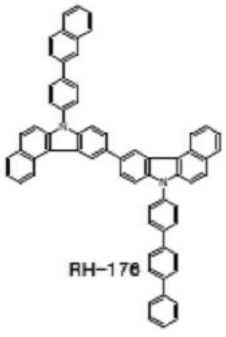
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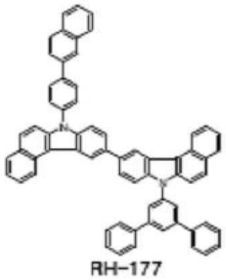
RH-177

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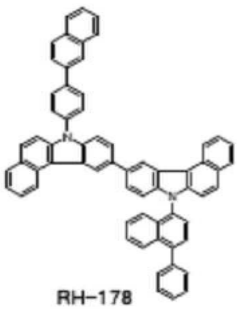
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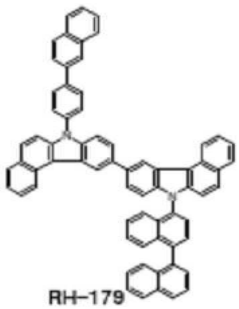
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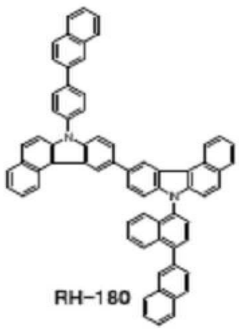
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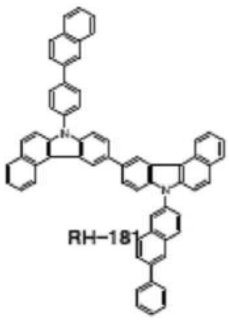
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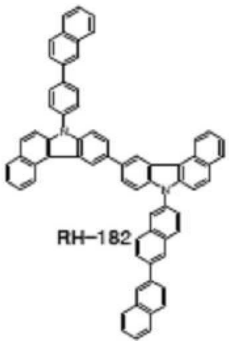
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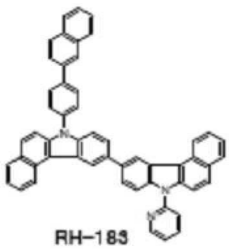
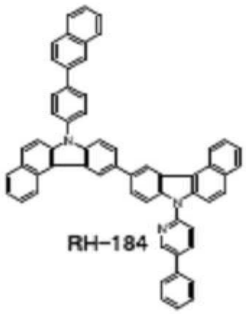

RH-183

[0127]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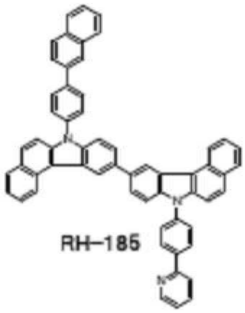
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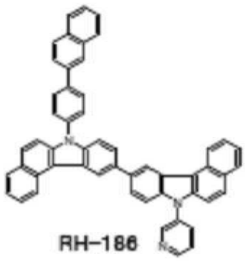
RH-186

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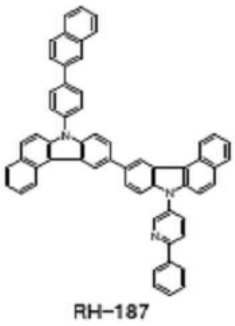
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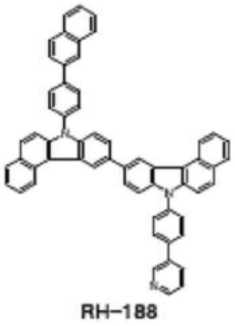
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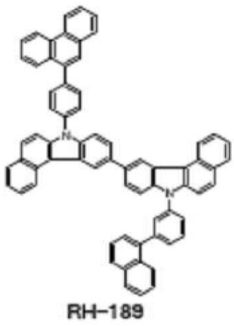
RH-189

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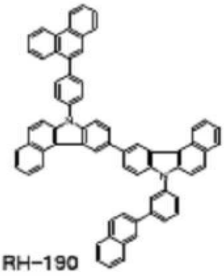
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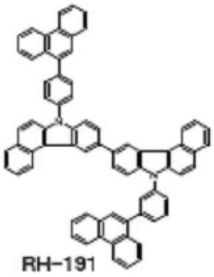
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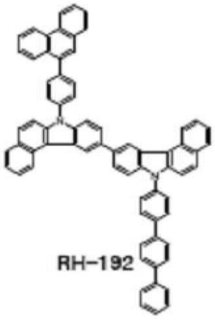
RH-192

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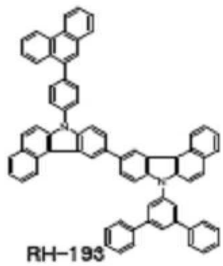
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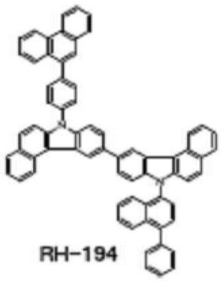
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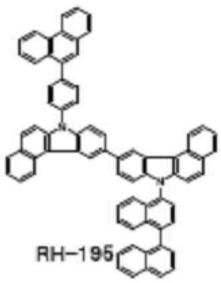
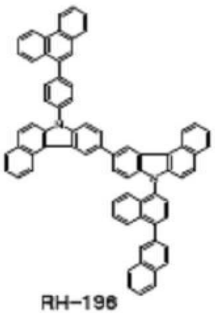

RH-195

[0131]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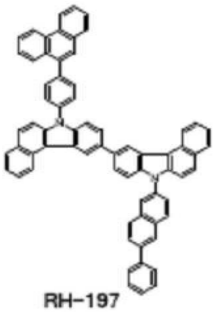
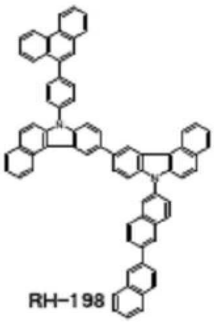
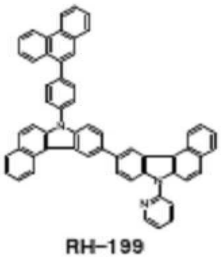

RH-197


RH-198

[0132]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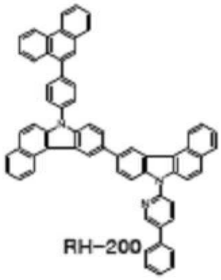
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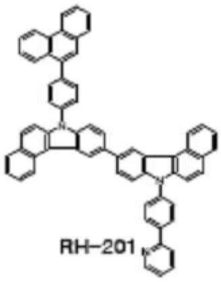
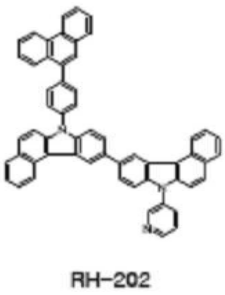

RH-201

[0133]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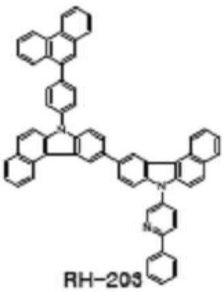
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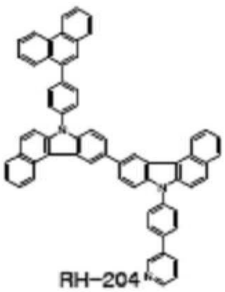
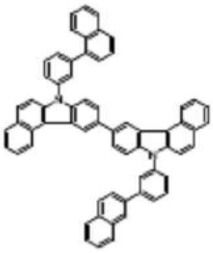

RH-204

[0134]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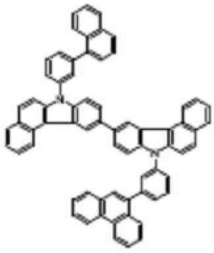
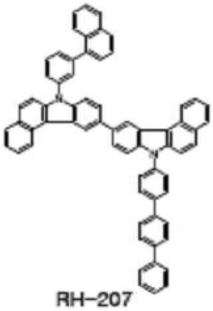

RH-206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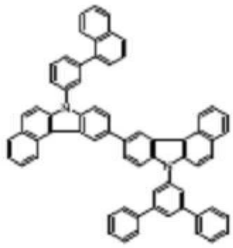
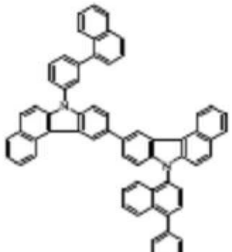
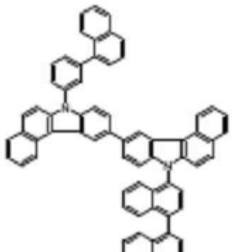


RH-208

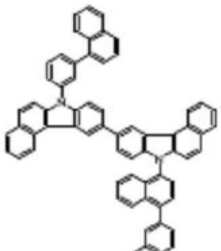


RH-209



RH-210

[0135]



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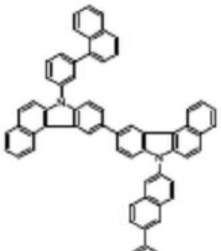
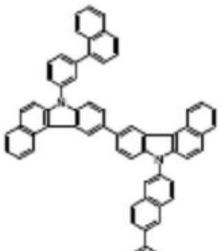
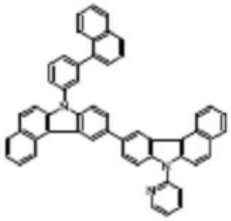


RH-212

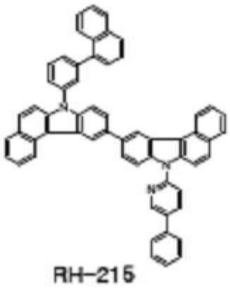


RH-213

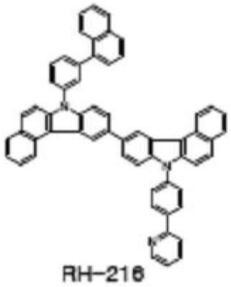
[0136]



RH-214



RH-215



RH-216

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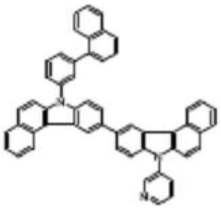
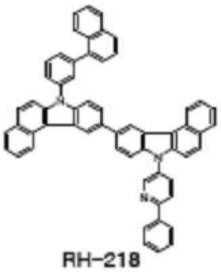
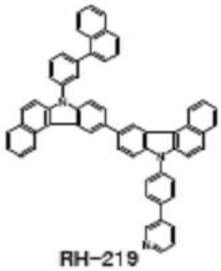


RH-217

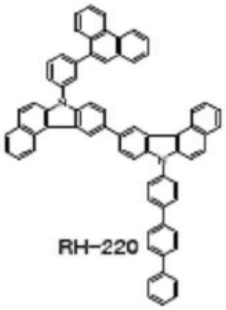


RH-218



RH-219

[0138]



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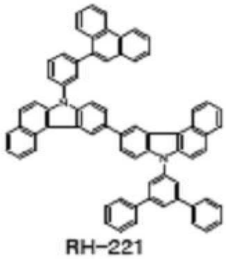
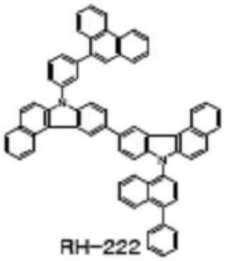


RH-221



RH-222

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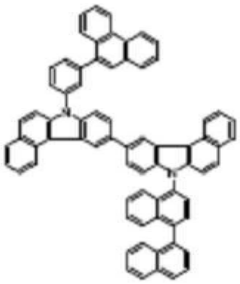
[0140] 
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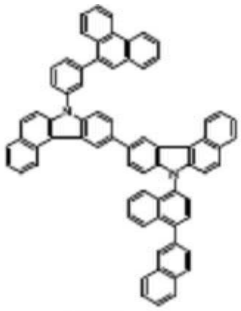
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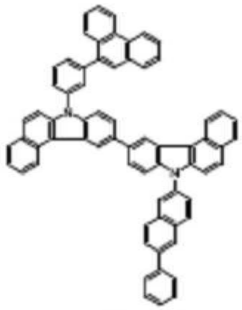
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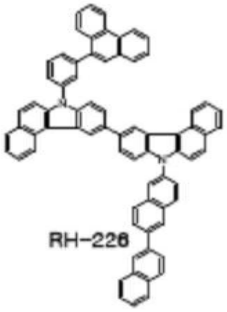
[0141] 
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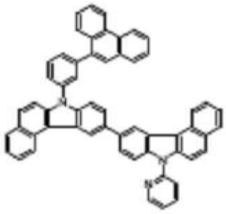
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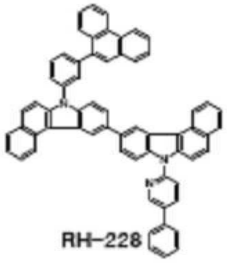
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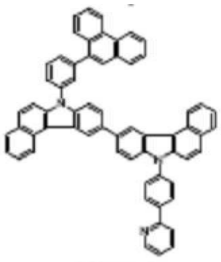
[0142] 
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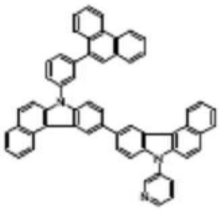
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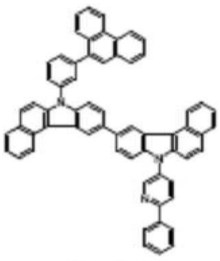
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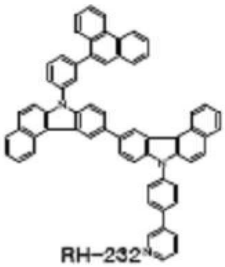
[0143] 
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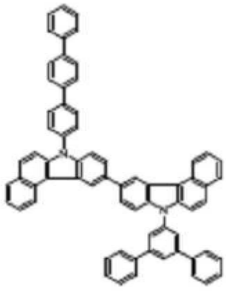
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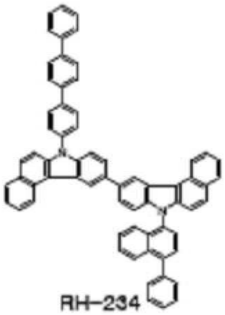
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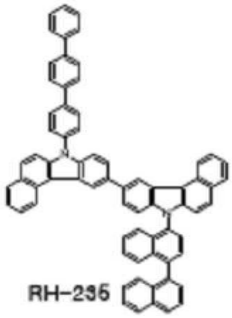
[0144] 
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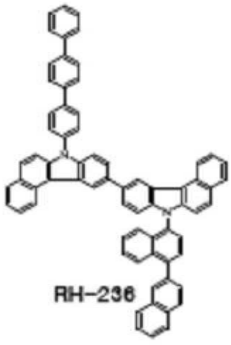
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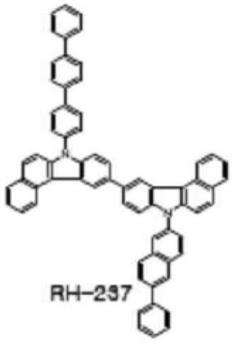
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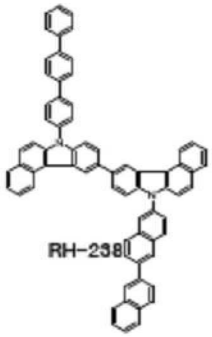
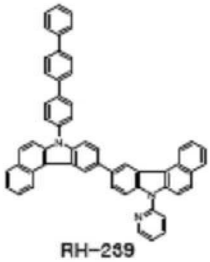
[0145] 
RH-238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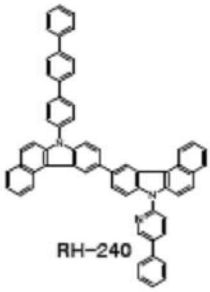
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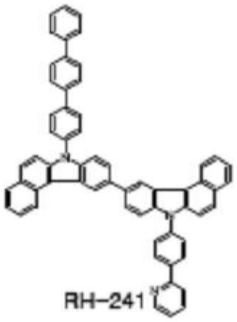
[0146] 
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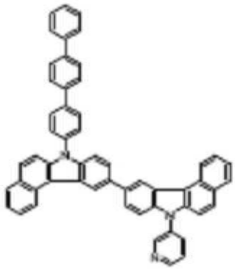
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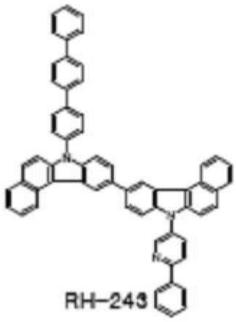
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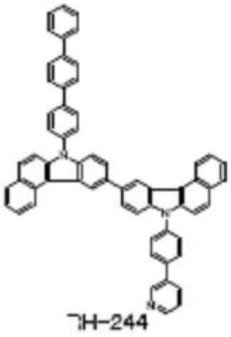
[0147] 
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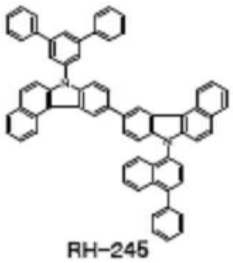
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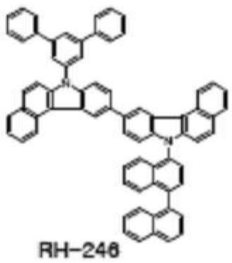
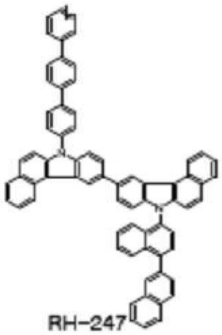

RH-246

[0148] 
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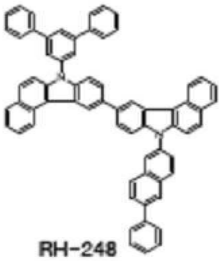
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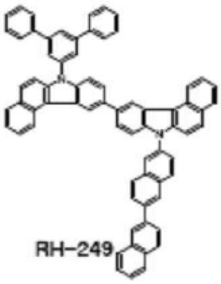
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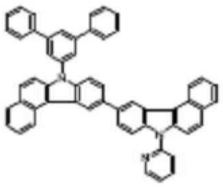
[0149] 
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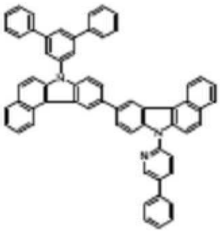
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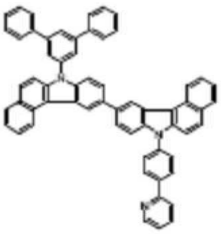
RH-252

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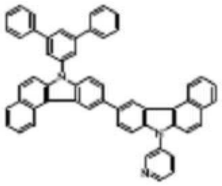
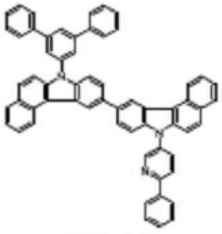
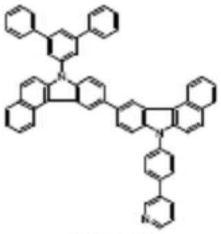


RH-253

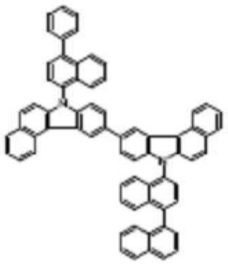


RH-254

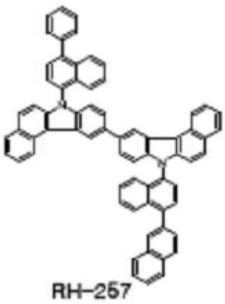


RH-255

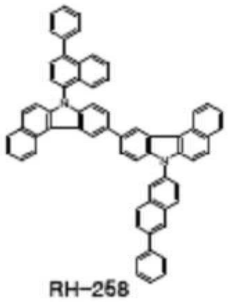
[0151]



RH-256

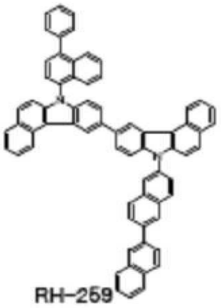


RH-257

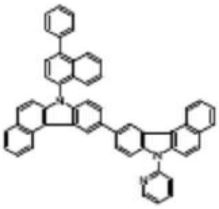


RH-258

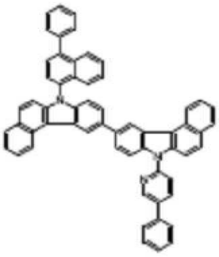
[0152]



RH-259

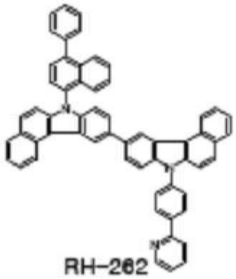


RH-260

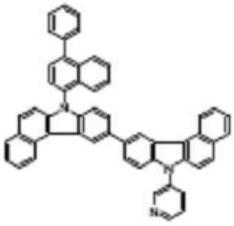


RH-261

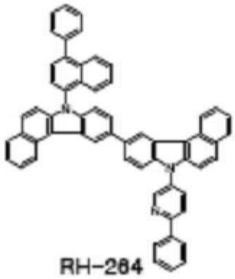
[0153]



RH-262

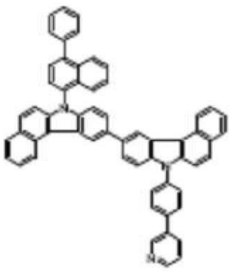


RH-263

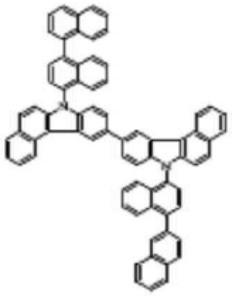


RH-264

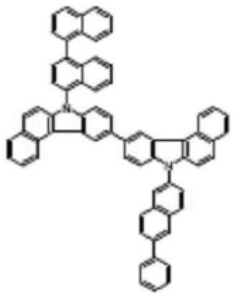
[0154]



RH-265

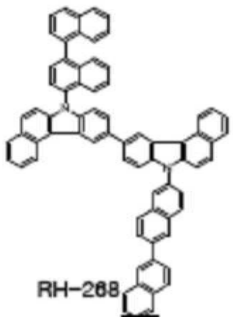


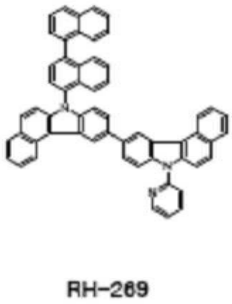
RH-266

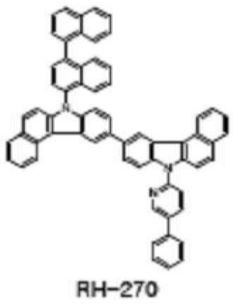


RH-267

[0155]


RH-268


RH-269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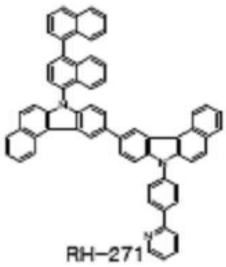
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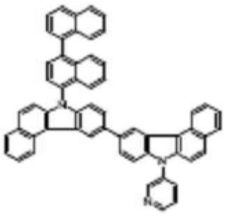
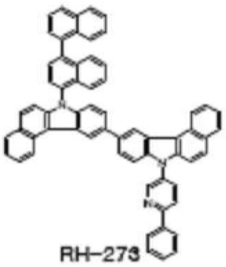
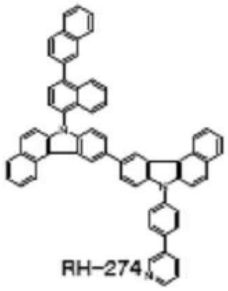

RH-272


RH-273

[0157]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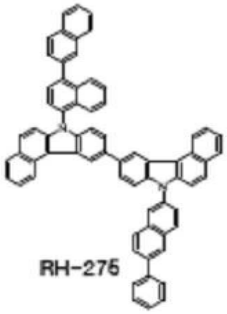
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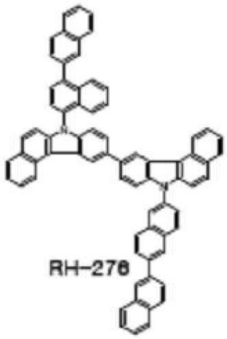
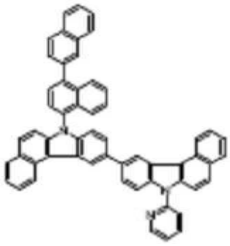

RH-276

[0158]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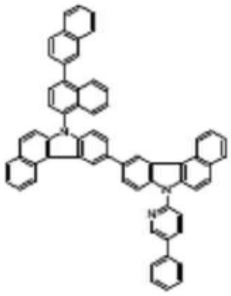
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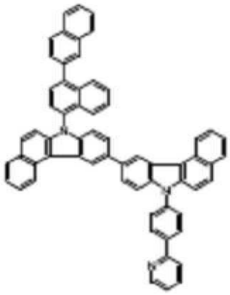
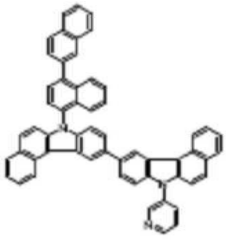

RH-279

[0159]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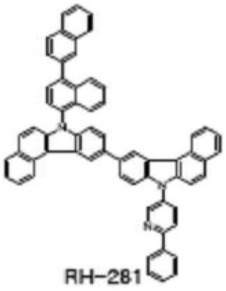
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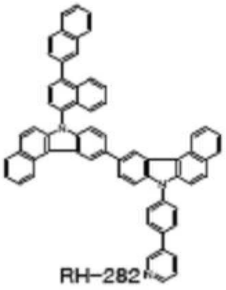
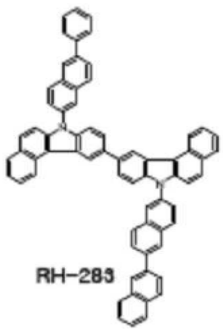
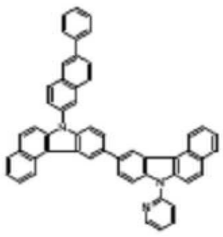

RH-282

[0160]


RH-283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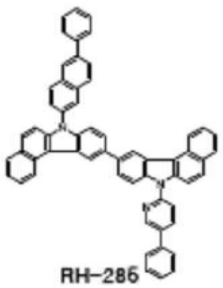
RH-285

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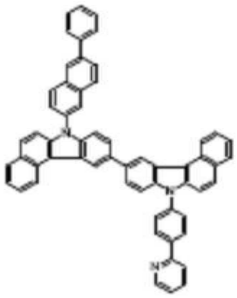
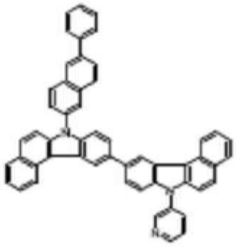
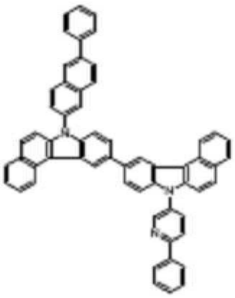
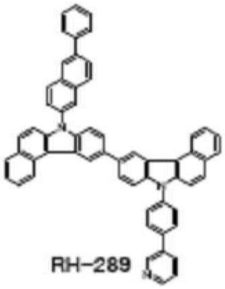
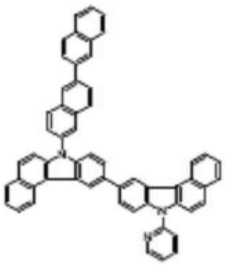

RH-286

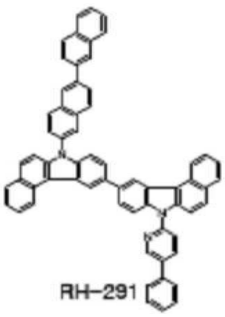

RH-287


RH-288

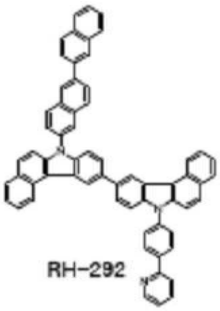
[0162]


RH-289


RH-290


RH-291

[0163]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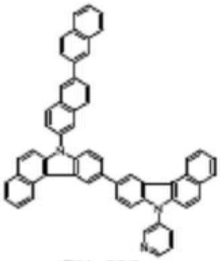
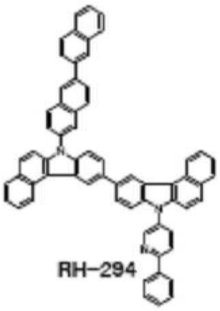
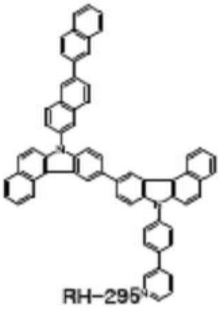

RH-293


RH-294

[0164]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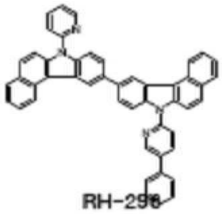
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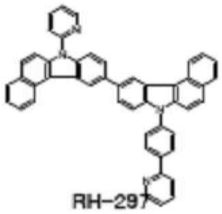
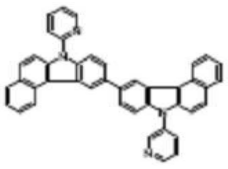
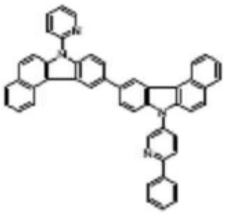
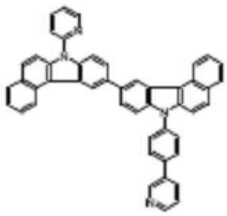

RH-297



RH-298

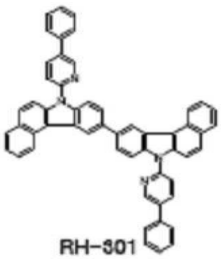


RH-299

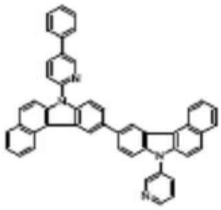


RH-300

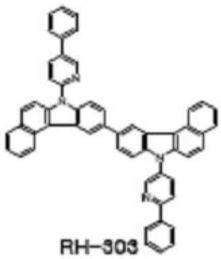
[0165]



RH-301

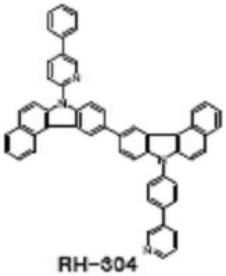


RH-302

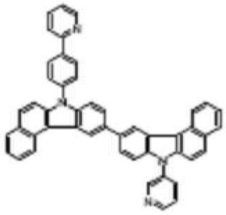


RH-303

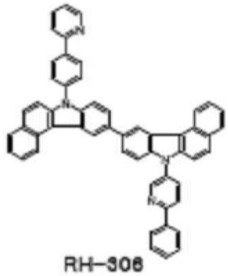
[0166]



RH-304

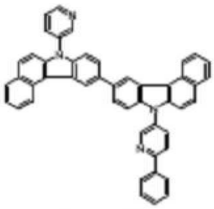


RH-305

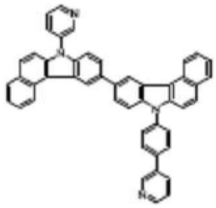


RH-306

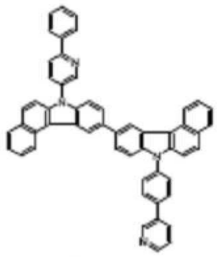
[0167]



RH-307



RH-308



RH-309

[0168]

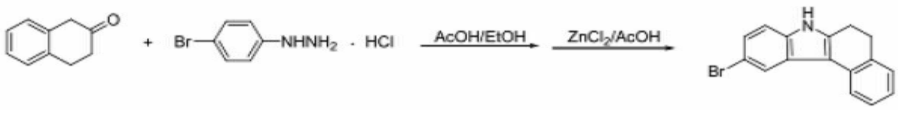
[0169] 이하에서는, 본 발명에 따른 유기전계발광소자용 적색 인광 호스트 물질 중, 상기 화학식4에서 RH-001로 표기된 적색 인광 호스트 물질을 예로 들어 합성예을 설명한다.

[0170] 합성예

[0171] 1. 3-bromo-dihydrobenzo[3,4]carbazole의 합성

[0172] 3-bromo-dihydrobenzo[3,4]carbazole은 아래와 같은 반응식1에 의해 합성된다.

[0173] 반응식1



[0174]

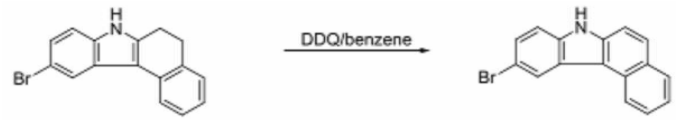
[0175] 구체적으로, 2구 둥근 플라스크 (2-round flask)에 β-teralone(25g, 0.17mol), 4-bromophenylhydrazinuim

chloride(38.2g, 0.17mol)와 acetic acid를 ethanol에 넣고 1시간 동안 환류시킨다. 온도를 상온(room temperature)으로 내린 다음, 여과(filtering)하고 용매를 증발(evaporating)시킨다. 여기에 zinc chloride(58g, 0.42mol)와 acetic acid를 넣고, 30분동안 환류시킨다. 온도를 상온으로 내린 다음 용매를 증발시키고, MC/PE로 석출(precipitation)하여 3-bromo-dihydrobenzo[3,4]carbazole (35.5g, yield:70%)를 얻었다.

[0176] 2. 3-bromobenzo[3,4]carbazole의 합성

[0177] 3-bromobenzo[3,4]carbazole은 아래와 같은 반응식2에 의해 합성된다.

[0178] 반응식2

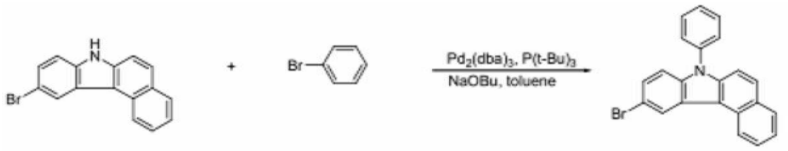
[0179] 

[0180] 구체적으로, 2구 둥근 플라스크에 3-bromodihydrobenzo[3,4]carbazole(20g, 0.07mol), 2,3-dichloro-5,6-dicyanobenzoquinone(19. 8g, 0.09mol)와 benzene을 넣고 상온에서 3시간 동안 교반(stirring)한다. Ethyl acetate로 추출(extraction)하고, 용매를 증발시킨 후, silica gel column으로 정제(purification)하여 3-bromobenzo[3,4]carbazole (15.9g, yield:80%)를 얻었다.

[0181] 3. 3-bromo-9-phenylbenzo[3,4]carbazole의 합성

[0182] 3-bromo-9-phenylbenzo[3,4]carbazole은 아래와 같은 반응식3에 의해 합성된다.

[0183] 반응식3

[0184] 

[0185] 구체적으로, 2구 둥근 플라스크에 3-bromobenzo[3,4]carbazole(5g, 0.017mol), bromobenzene(4g, 0.025mol), Pd2(dba)3 (0.42g, 0.046mol%), P(t-Bu)3(0.14g, 0.069mol%), NaOBu(2.4g, 0.025mol)와 toluene을 넣고 130℃에서 6시간 동안 환류시킨다. 온도를 상온으로 냉각한 다음, methylene chloride로 추출하고 용매를 증발시킨 후, silica gel column으로 정제하여 3-bromo-9-phenylbenzo[3,4]carbazole(5g, yield :80%)을 얻었다.

[0186] 4. 9-phenybenzo[3,4]carbazole-3-boronic acid의 합성

[0187] 9-phenybenzo[3,4]carbazole-3-boronic acid는 아래와 같은 반응식4에 의해 합성된다.

[0188] 반응식4

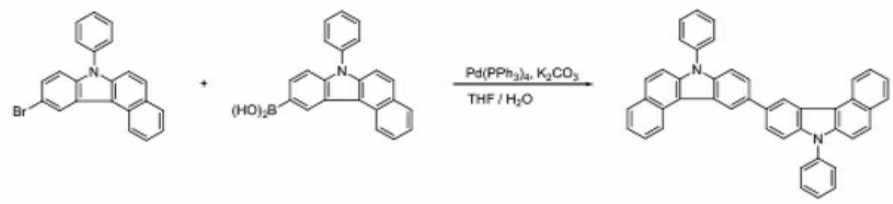
[0189] 

[0190] 구체적으로, 2구 둥근 플라스크에 3-bromo-9-phenylbenzo[3,4]carbazole (10g, 0.026mol)과 100mL의 ether를 넣고 교반시킨다. Dry-ice bath로 온도를 -78℃로 내린 다음, 2.5M n-BuLi(11.8mL, 0.03mol)를 천천히 떨어뜨리고 상온에서 1시간 동안 교반시킨다. 다시 dry-ice bath로 온도를 -78℃로 내린 다음 triethylborate(10.1g, 0.05mol)를 천천히 떨어뜨리고 상온에서 4시간 동안 교반시킨다. 100mL의 2N HCl를 넣고 quenching한 다음, 용매를 증발시킨다. 생성된 결정을 여과하고, 증류수와 hexane으로 3-4회 세정(washing)하여 9-phenylbenzo[3,4]carbazole-3-boronic acid acid(6.1g, yield :70%)을 얻었다.

[0191] 5. RH-001의 합성

[0192] 화학식4에서 RH-001로 표시된 적색 인광 호스트 물질은 아래와 같은 반응식5에 의해 합성된다.

[0193] 반응식5



[0194]

[0195] 구체적으로, 이구 둥근 플라스크에 3-bromo-9-phenylbenzo[3,4]carbazole(2g, 5.4mmol), 9-phenylbenzo[3,4]carbazole-3-boronic acid (1.8g, 5.4mmol), Pd(PPh3)4를 THF/H2O(20mL/20mL)에 넣고 8시간 동안 환류시킨다. TLC(Thin-Layer Chromatography)로 반응 확인 후 온도를 상온으로 내린 다음, methylene chloride로 추출하고 용매를 증발시킨 후, silica gel column으로 정제하여 RH-001(2.2g, yield :70%)을 얻었다.

[0196] 이하, 상기한 본 발명의 제 1 실시예에 따른 적색 인광 호스트 물질을 이용하여 유기전계발광소자를 제작하는 실험예1 내지 실험예5을 통해, 본 발명에 의한 적색 인광 호스트 물질 및 이를 이용한 유기전계발광소자의 성능을 비교 설명한다.

[0197] 실험예1

[0198] 기판 상에 인듐-틴-옥사이드(ITO)층의 발광 면적이 3mm X 3mm 크기가 되도록 패터닝한 후 세정하였다. 상기 ITO층 CuPC (650Å), NPD(400Å), 상기 화학식4에서 RH-002로 표시된 적색 인광 호스트 물질에 상기 화학식1-4로 RD-1로 표시된 도펀트를 5% 첨가한 발광층 (200Å), Alq3(350Å), LiF(5Å), Al(1000Å)의 순서로 성막하였다.

[0199] 0.9mA에서 1670cd/m2(5.4V)를 나타내었으며 이때 CIE x = 0.658, y = 0.339를 나타내었다.

[0200] 실험예2

[0201] 기판 상에 인듐-틴-옥사이드(ITO)층의 발광 면적이 3mm X 3mm 크기가 되도록 패터닝한 후 세정하였다. 상기 ITO층 CuPC (650Å), NPD(400Å), 상기 화학식4에서 RH-003으로 표시된 적색 인광 호스트 물질에 상기 화학식1-4로 RD-1로 표시된 도펀트를 5% 첨가한 발광층 (200Å), Alq3(350Å), LiF(5Å), Al(1000Å)의 순서로 성막하였다.

[0202] 0.9mA에서 1780cd/m2(5.5V)를 나타내었으며 이때 CIE x = 0.659, y = 0.338를 나타내었다.

[0203] 실험예3

[0204] 기판 상에 인듐-틴-옥사이드(ITO)층의 발광 면적이 3mm X 3mm 크기가 되도록 패터닝한 후 세정하였다. 상기 ITO층 CuPC (650Å), NPD(400Å), 상기 화학식4에서 RH-006으로 표시된 적색 인광 호스트 물질에 상기 화학식1-4로 RD-1로 표시된 도펀트를 5% 첨가한 발광층 (200Å), Alq3(350Å), LiF(5Å), Al(1000Å)의 순서로 성막하였다.

[0205] 0.9mA에서 1752cd/m2(5.3V)를 나타내었으며 이때 CIE x = 0.658, y = 0.340를 나타내었다.

[0206] 실험예4

[0207] 기판 상에 인듐-틴-옥사이드(ITO)층의 발광 면적이 3mm X 3mm 크기가 되도록 패터닝한 후 세정하였다. 상기 ITO층 CuPC (650Å), NPD(400Å), 상기 화학식4에서 RH-019로 표시된 적색 인광 호스트 물질에 상기 화학식1-4로 RD-1로 표시된 도펀트를 5% 첨가한 발광층 (200Å), Alq3(350Å), LiF(5Å), Al(1000Å)의 순서로 성막하였다.

[0208] 0.9mA에서 1724cd/m2(5.5V)를 나타내었으며 이때 CIE x = 0.658, y = 0.339를 나타내었다.

[0209] 실험예5

[0210] 기판 상에 인듐-틴-옥사이드(ITO)층의 발광 면적이 3mm X 3mm 크기가 되도록 패터닝한 후 세정하였다. 상기 ITO층 PEDOT:PSS (800Å, spin coating : 3000 rpm, baking condition : 120 ℃ for 1hr), 상기 화학식4에서 RH-003으로 표시된 적색 인광 호스트 물질에 상기 화학식1-4로 RD-1로 표시된 도펀트를 2% 첨가한 발광층 (250Å, 3000 rpm, baking condition : 100 ℃ for 30min)로 스핀코팅 한 다음, Alq3(350Å), LiF(5Å) , Al(1000Å)의 순서로 성막하였다.

[0211] 0.9mA에서 1593cd/m2(6.5V)를 나타내었으며 이때 CIE x = 0.658, y = 0.340를 나타내었다.

[0212] 비교예1

[0213] 기판 상에 인듐-틴-옥사이드(ITO)층의 발광 면적이 3mm X 3mm 크기가 되도록 패터닝한 후 세정하였다. 상기 ITO층 CuPC (650Å), NPD(400Å), 상기 화학식1-3으로 표시된 CBP에 상기 화학식1-4로 RD-1로 표시된 도펀트를 5% 첨가한 발광층 (200Å), Alq3(350Å), LiF(5Å), Al(1000Å)의 순서로 성막하였다.

[0214] 0.9mA에서 780cd/m2(7.5V)를 나타내었으며 이때 CIE x = 0.651, y = 0.329를 나타내었다.

[0215] 상술한 실험예1 내지 실험예5와 비교예1의 비교결과를 아래 표1에 나타내었다. 여기서 전압의 단위는 V, 전류의 단위는 mA, 휘도의 단위는 cd/m2, 전류효율의 단위는 cd/A, 전력효율의 단위는 lm/W이다.

표 1

[0216]

	전압	전류	휘도	전류효율	전력효율	CIE(X)	CIE(Y)
실시예1	5.4	0.9	1670	16.7	9.7	0.658	0.339
실시예2	5.5	0.9	1780	17.8	10.1	0.659	0.338
실시예3	5.3	0.9	1752	17.5	10.4	0.658	0.340
실시예4	5.5	0.9	1724	17.2	9.3	0.658	0.339
실시예5	6.5	0.9	1593	15.9	9.1	0.658	0.340
비교예	7.5	0.9	780	7.8	3.3	0.659	0.329

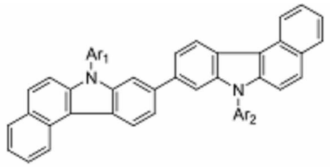
[0217] 표1에서 알 수 있는 바와 같이, 실험예1 내지 실험예5는 전류효율이 뛰어나고, 낮은 구동 전압에서 높은 휘도의 빛을 발광하므로 소모 전력이 감소된다.

[0218] 특히, 실험예5는 액상에서 코팅 방법에 의해 발광층을 형성한 것이며, 구동 전압, 휘도 등에 있어 우수한 효과를 갖는다. 따라서 본 발명의 적색 인광 호스트 물질은 코팅 방법에 의해 대면적 소자의 제조가 가능하다.

[0219] -제 2 실시예-

[0220] 본 발명의 제 2 실시예에 따른 적색 인광 호스트 물질은 3,4 benzo carbazol이 meta 위치로 결합되고, carbazol의 질소에 방향족 그룹, 이형고리 그룹 또는 지방족 그룹으로부터 선택된 물질이 치환됨으로써, 솔루블한 특성을 갖는 것이 특징이며, 하기 화학식5로 표시된다.

[0221] 화학식5

[0222] 

[0223] 여기서, Ar1 및 Ar2 각각은 치환 또는 비치환된 방향족 그룹 물질, 치환 또는 비치환된 이형고리 그룹 물질, 또는 치환 또는 비치환된 방향족 그룹 물질에서 선택된다. Ar1과 Ar2가 같은 경우 대칭 구조를 가지며, 이와 달리 Ar1과 Ar2가 다른 경우 비대칭적 구조를 갖는다.

[0224] 예를 들어, 상기 방향족 그룹 물질은 페닐(phenyl), 나프틸(naphthyl), 바이페닐(biphenyl), 터페닐(terphenyl), 페난스렌닐(phenanthrenyl)을 포함하는 것이 특징이다.

[0225] 또한, 상기 이형고리 그룹 물질은 피리딘일(pyridinyl), 비피리딘일(bipyridinyl), 퀴놀린일(quinolinyl), 이소퀴놀린일(isoquinolinyl), 퀴녹살린일 (quinoxalinyl), 터피리딘일(terpyridinyl), 페난스롤린일(phenanthrolinyl)을 포함하는 것이 특징이다.

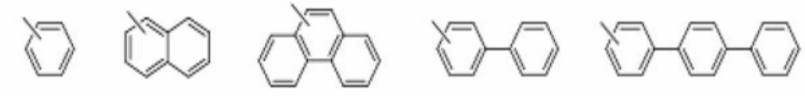
[0226] 또한, 상기 지방족 그룹 물질은 C1~C20의 아릴(aryl), C1~C20의 알킬(alkyl)을 포함하는 것이 특징이다.

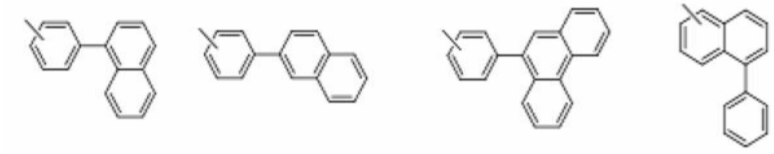
[0227] 또한, 상기 방향족 그룹 물질, 상기 이형고리 그룹 물질 및 상기 방향족 그룹 물질 각각의 치환체는 C1~C20의 아릴(aryl), C1~C20의 알킬(alkyl), C1~C20의 알콕시(alkoxy) 할로겐(halogen), 시아노(cyano), 실릴(silyl) 중에서 선택되는 것이 특징이다. 예를 들어, 상기 치환체는 메틸(methyl), 에틸(ethyl), 프로필(propyl), 이소프로필(isopropyl), 부틸(t-butyl), 메톡시(methoxy), 에톡시(ethoxy), 부톡시(butoxy), 트리메틸실릴(trimethylsilyl), 불소, 염소 중 어느 하나일 수 있다.

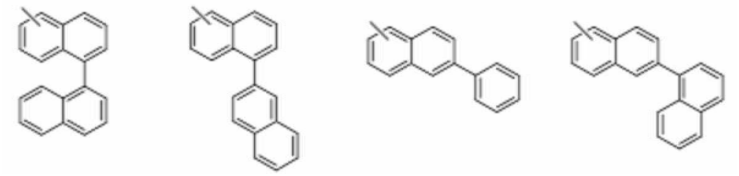
[0228] 이와 같은 적색 인광 호스트 물질은, 카바졸(carbazol)의 3,4 benzo carbazol이 meta 위치로 결합되고, carbazol의 질소에 방향족 그룹, 이형고리 그룹 또는 지방족 그룹으로부터 선택된 물질이 치환됨으로써, 솔루블한 특성을 갖게 된다. 또한, 고휘도 및 고효율의 장점을 갖게 된다.

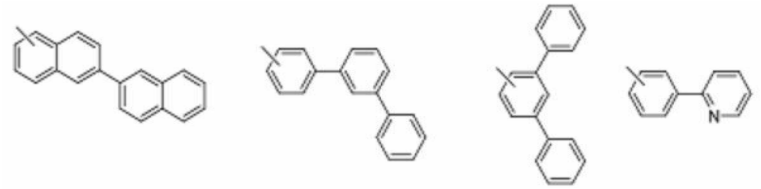
[0229] 예를 들어, 상기 Ar1 및 Ar2 각각은 아래 화학식6으로 표시되는 다수의 물질군으로부터 선택될 수 있다.

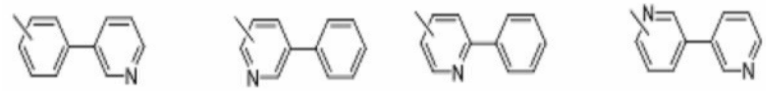
[0230] 화학식6

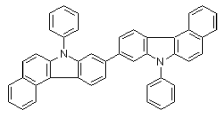
[0231] 

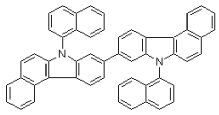
[0232] 

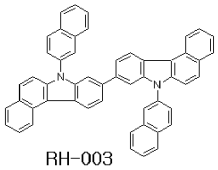
[0233] 

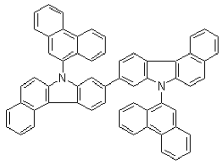
[0234] 

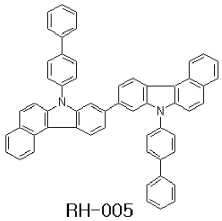
[0235] 

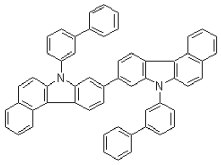

RH-001

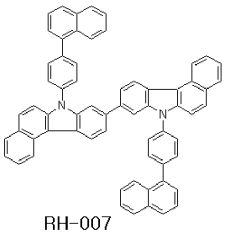

RH-002

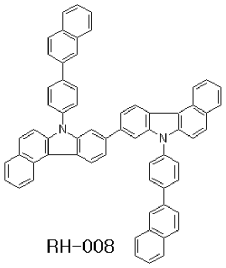

RH-003

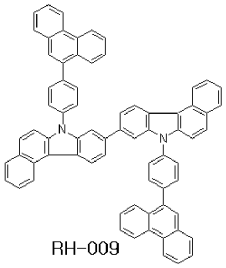

RH-004


RH-005


RH-006


RH-007

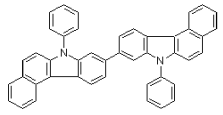

RH-008

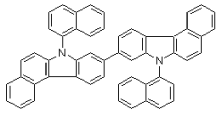

RH-009

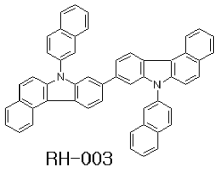
[0236]

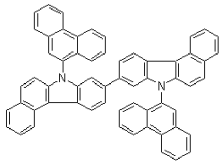
[0237] 상기 Ar1 및 Ar2의 선택에 따라, 상기 화학식5의 적색 인광 호스트 물질은 하기 화학식7에 표시된 다수의 물질 중 어느 하나가 된다. 여기서, 설명의 편의를 위해 각 물질 하단에 RH001~RH308의 기호를 부여하였다.

[0238] 화학식7


RH-001


RH-002


RH-003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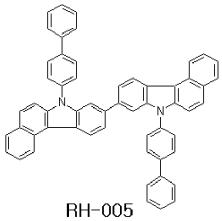
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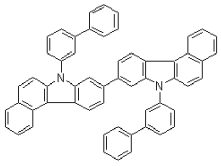
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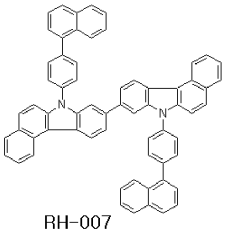
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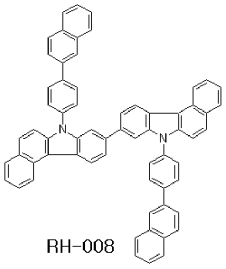
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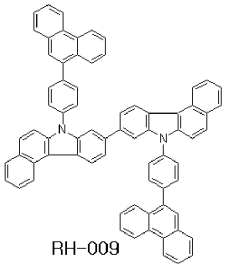
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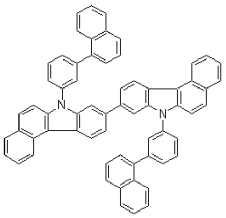

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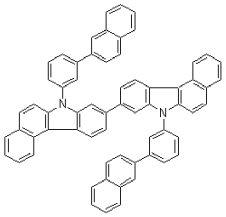

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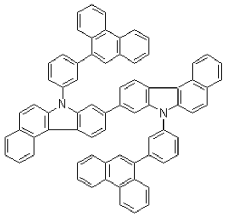

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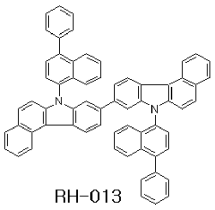

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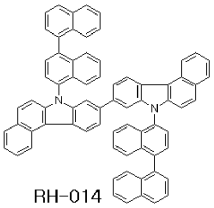

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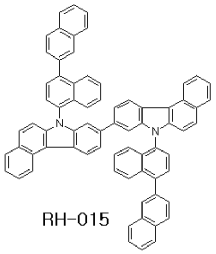

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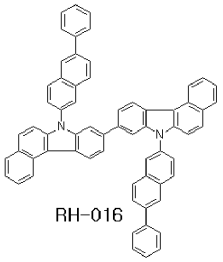

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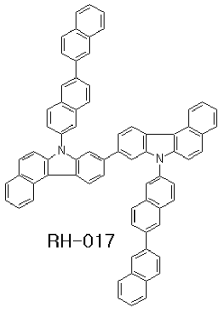

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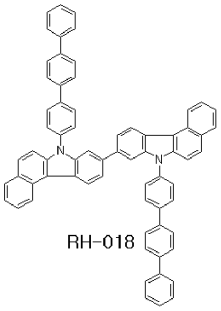
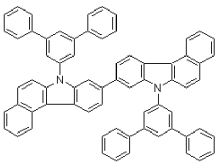


RH-018

[0240]

[0241]



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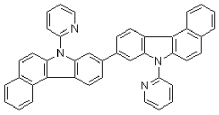

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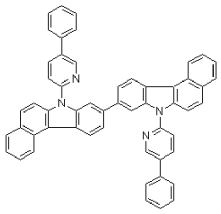

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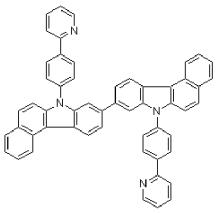

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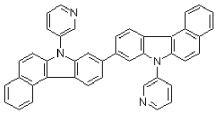

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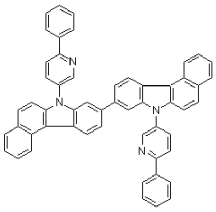

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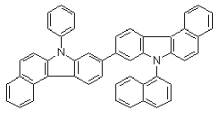

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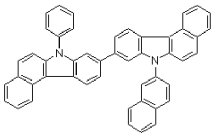

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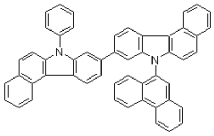

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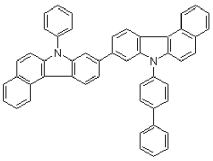

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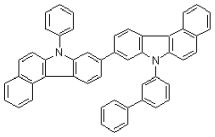

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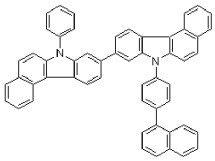

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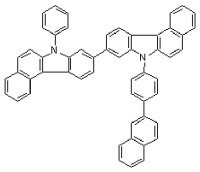

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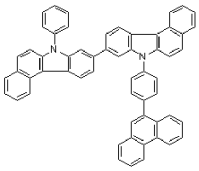

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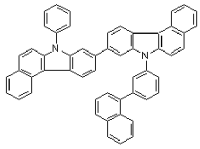

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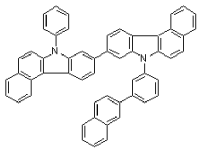

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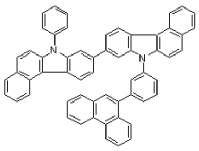

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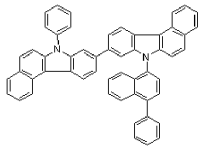

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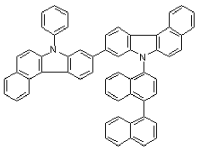

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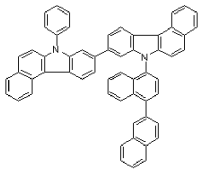

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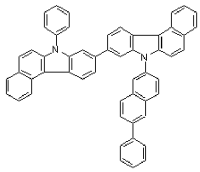

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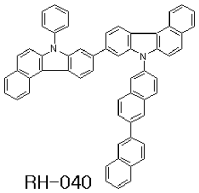

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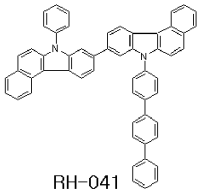

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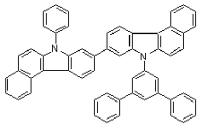

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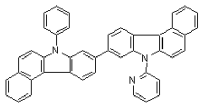

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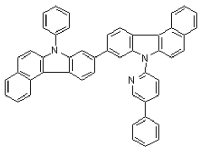

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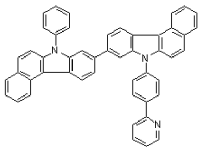

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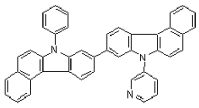

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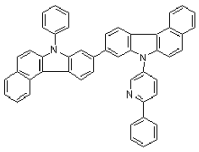

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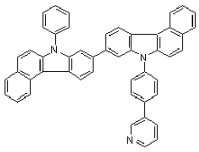

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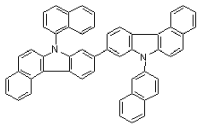

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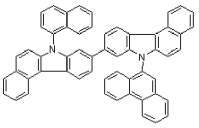

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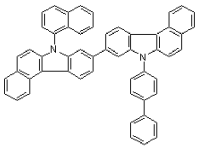

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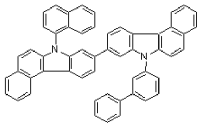

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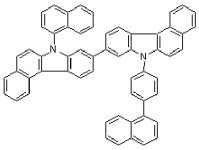

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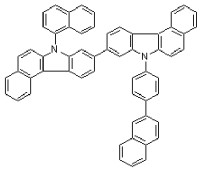
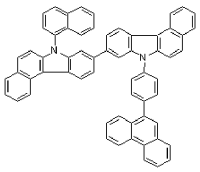


RH-054

[0243]

[0244]



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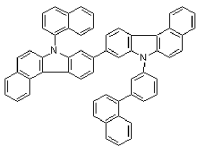
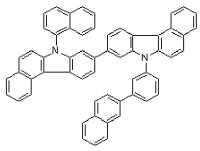
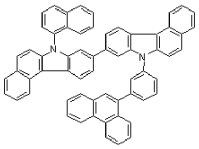


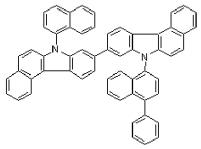
RH-056



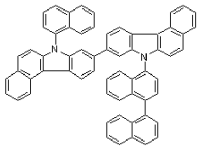
RH-057



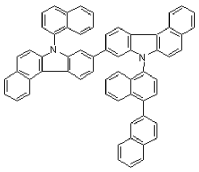
RH-058



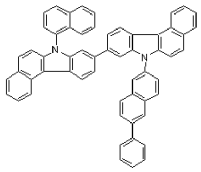
RH-059



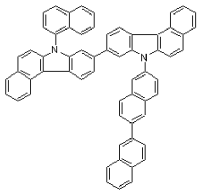
RH-060



RH-061



RH-062



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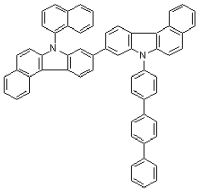

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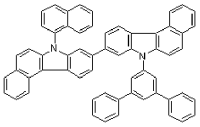

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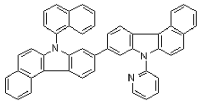
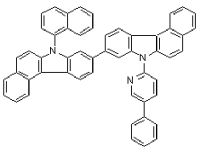


RH-066

[0245]



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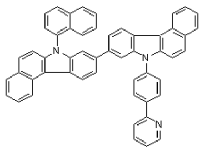

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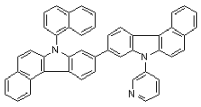

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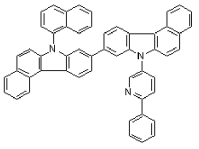

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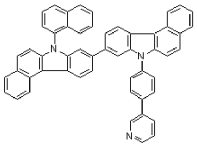

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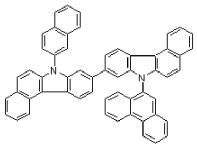

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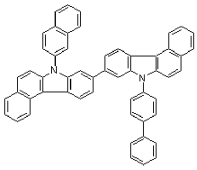

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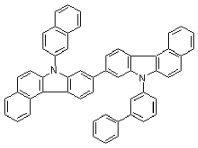

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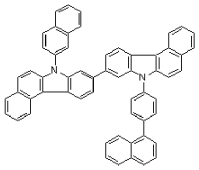

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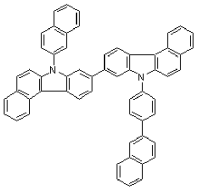

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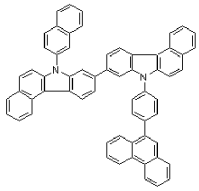

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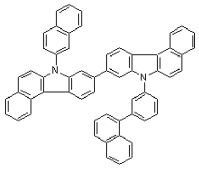

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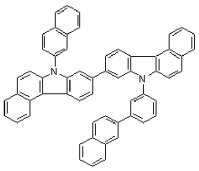

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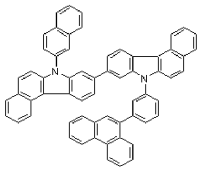

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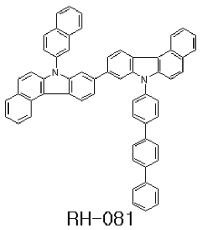

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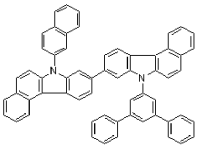

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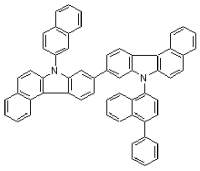

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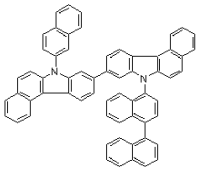

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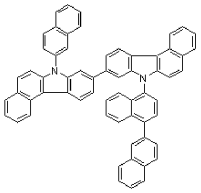

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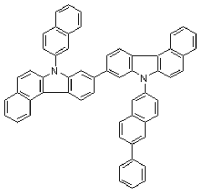

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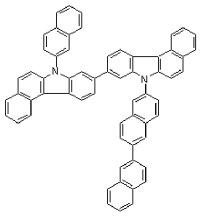

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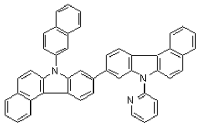

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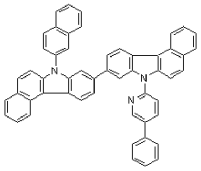

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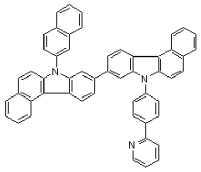
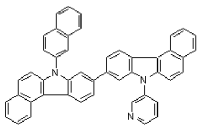


RH-090

[0246]

[0247]



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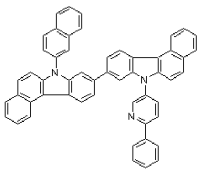

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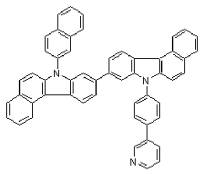

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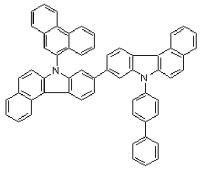

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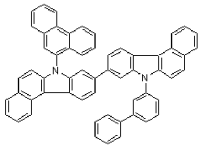

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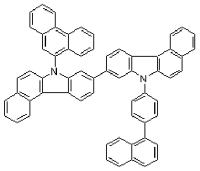

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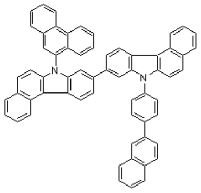

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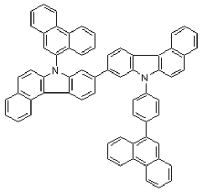

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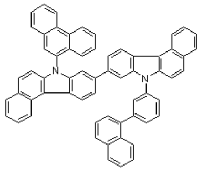

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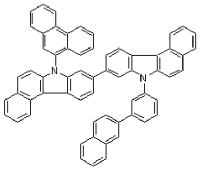

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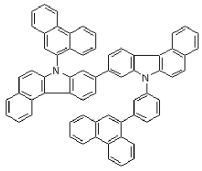

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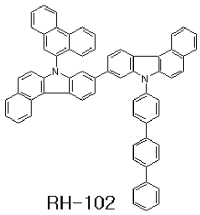
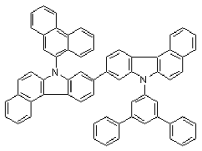
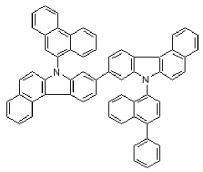


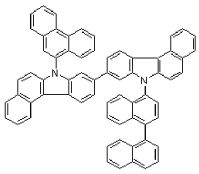
RH-102



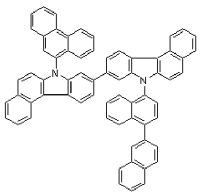
RH-103



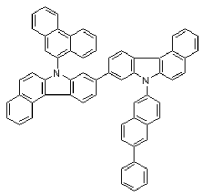
RH-104



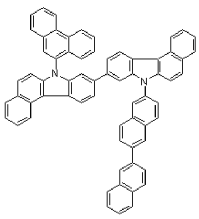
RH-105



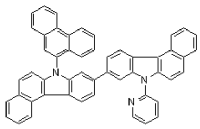
RH-106



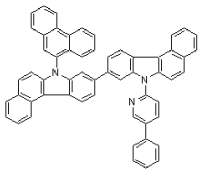
RH-107



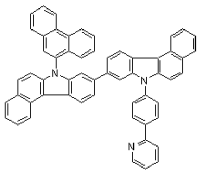
RH-108



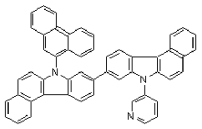
RH-109



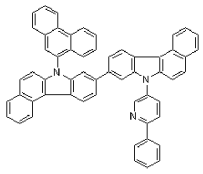
RH-110



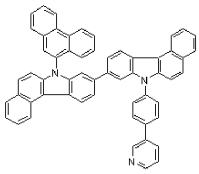
RH-111



RH-112



RH-113



RH-114

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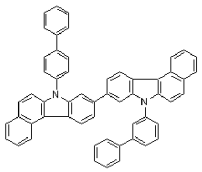
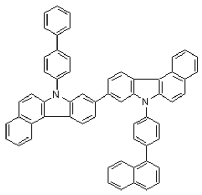
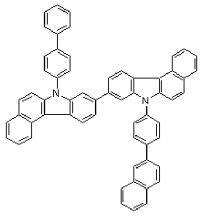


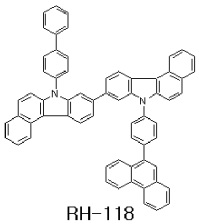
RH-115



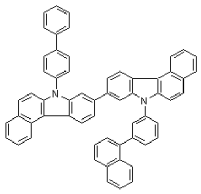
RH-116



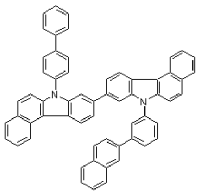
RH-117



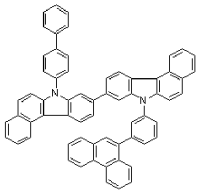
RH-118



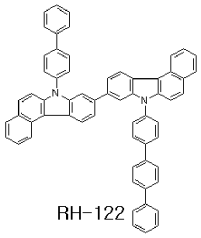
RH-119



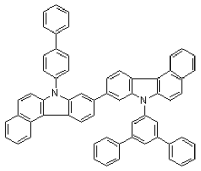
RH-120



RH-121



RH-122



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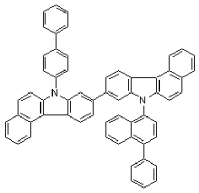

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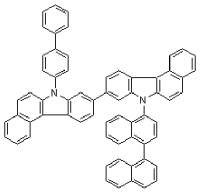

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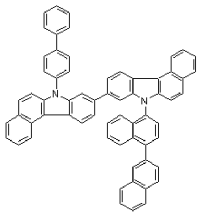

RH-126

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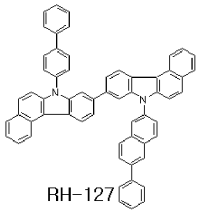
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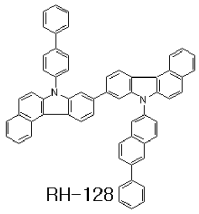
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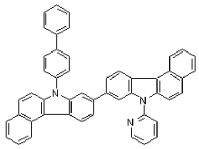
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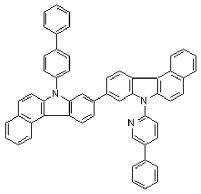
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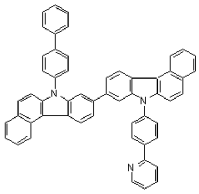
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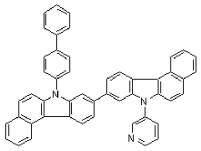
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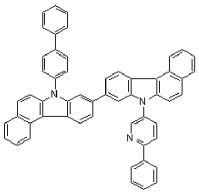
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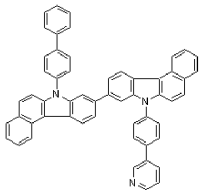
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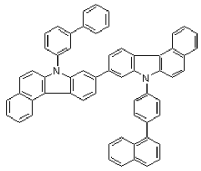
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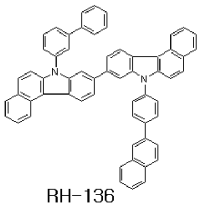
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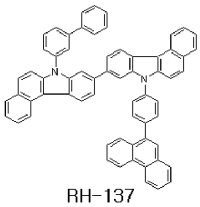
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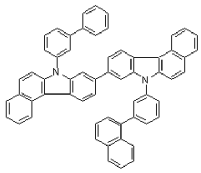
RH-138

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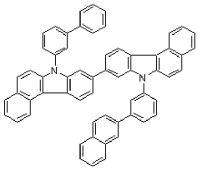

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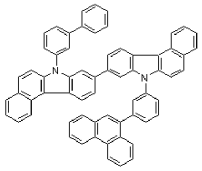

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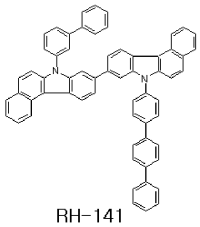

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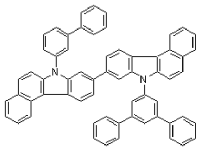

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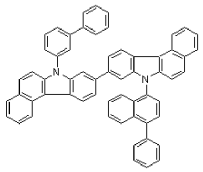

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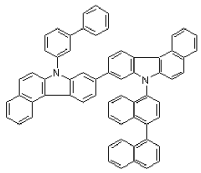

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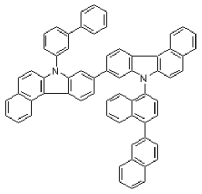

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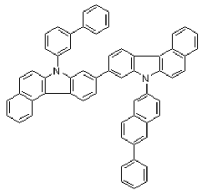

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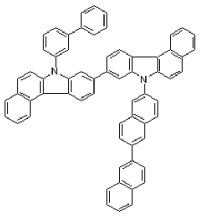

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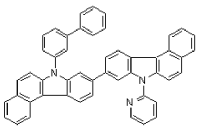

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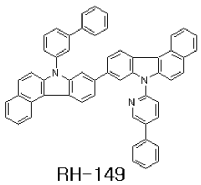

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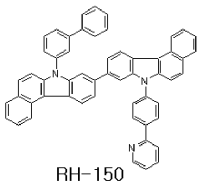

RH-150

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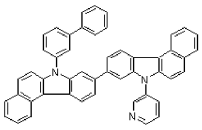

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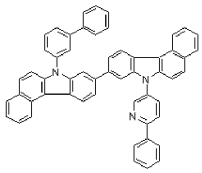

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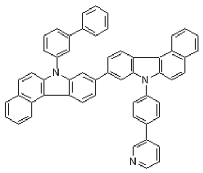

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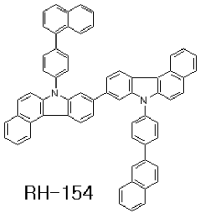

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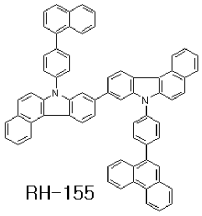

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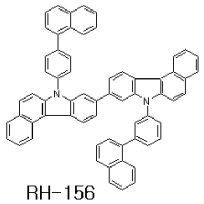

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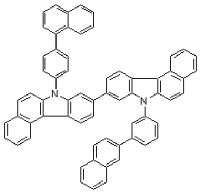

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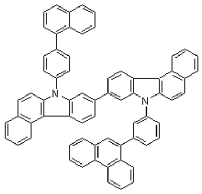

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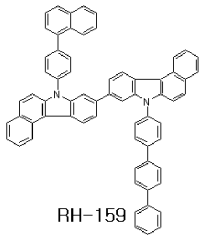

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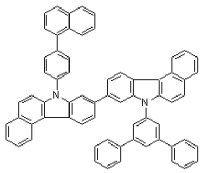

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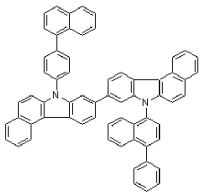

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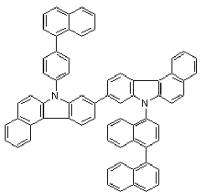

RH-162

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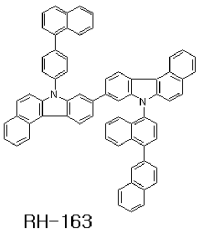
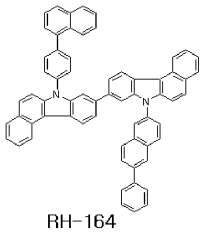
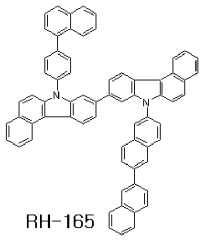
[0253]



RH-163



RH-164



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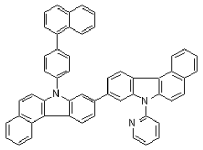

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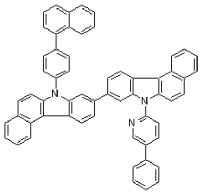

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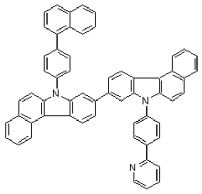

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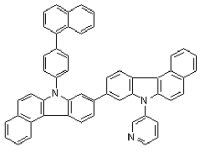

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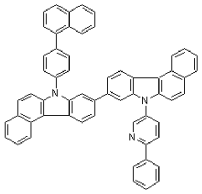

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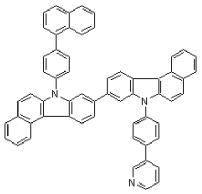

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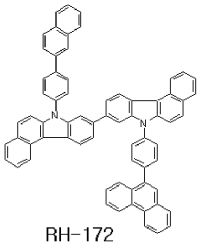

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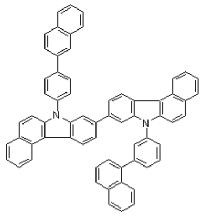

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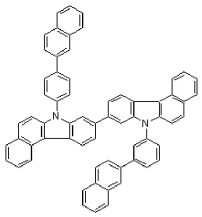
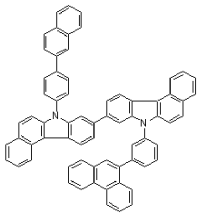
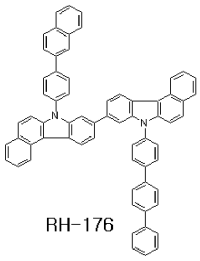


RH-174


RH-175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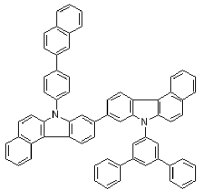
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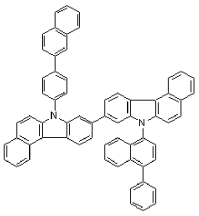
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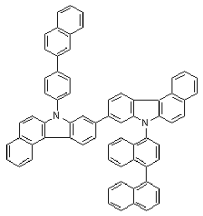
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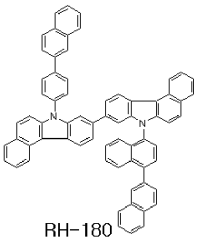
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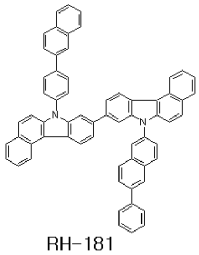
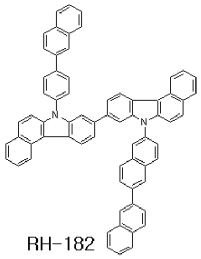
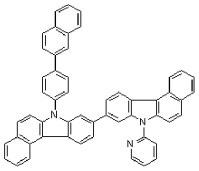

RH-181


RH-182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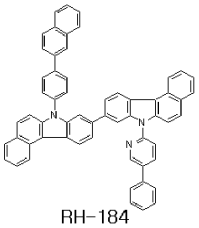
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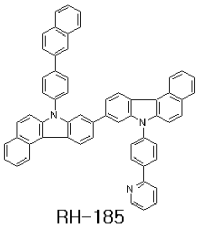
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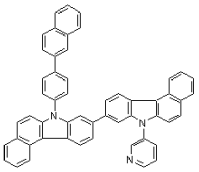
RH-186

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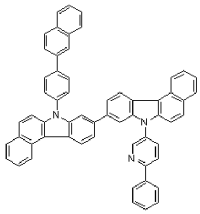
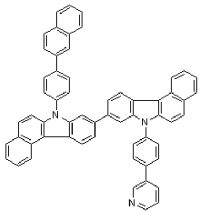


RH-187



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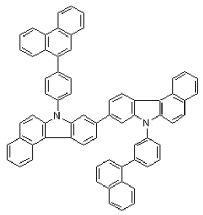

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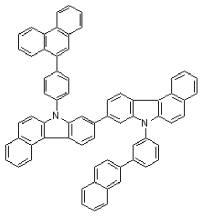

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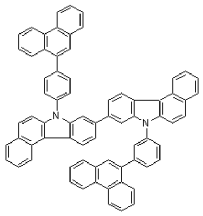

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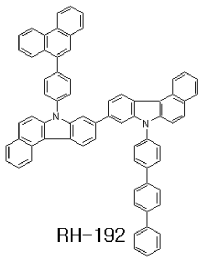

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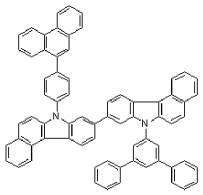

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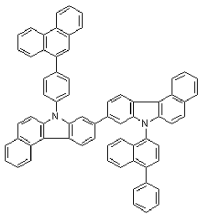

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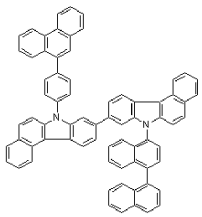

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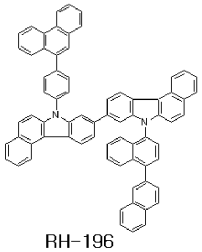

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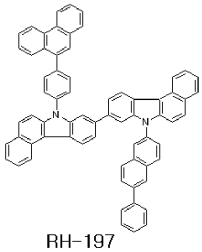

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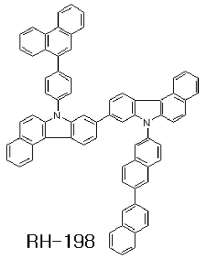

RH-198

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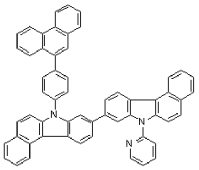
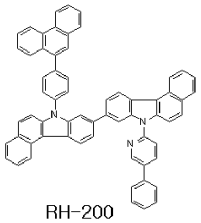


RH-199



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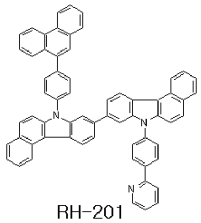

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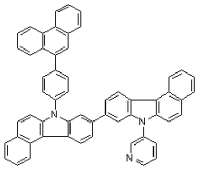

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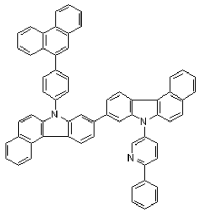

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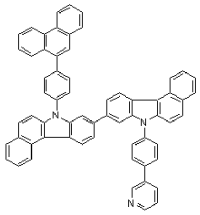

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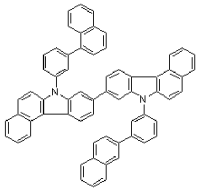

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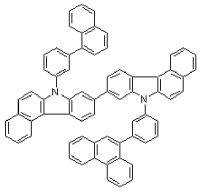

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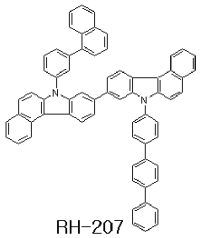

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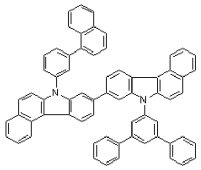

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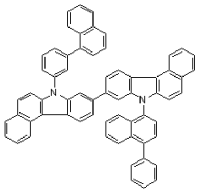

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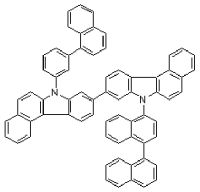

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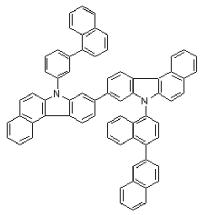

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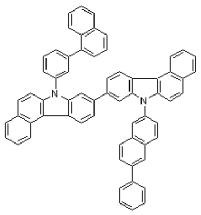

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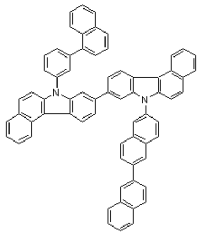

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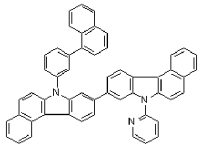

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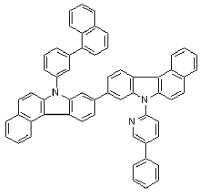

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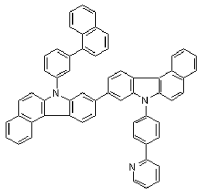

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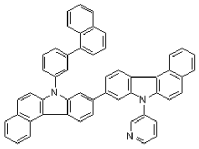

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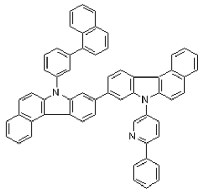

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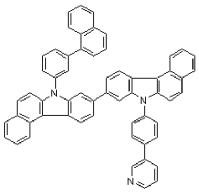

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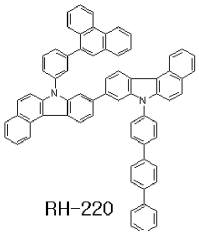

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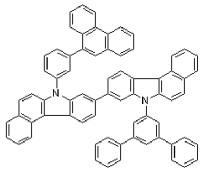

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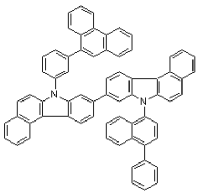

RH-222

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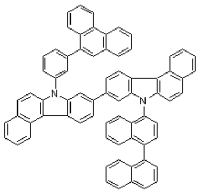

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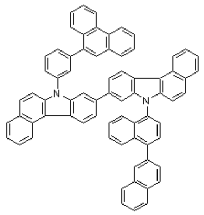

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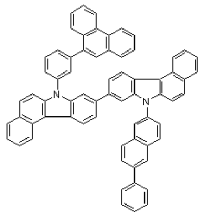
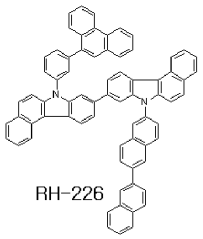


RH-225



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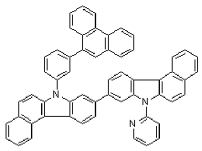
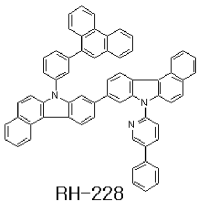


RH-227



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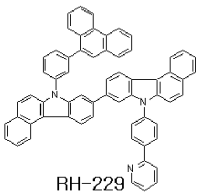

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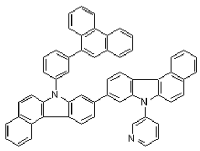

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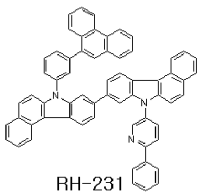

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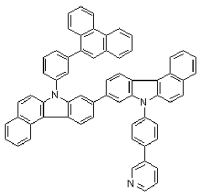

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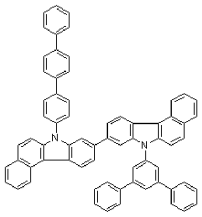

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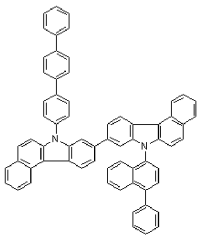
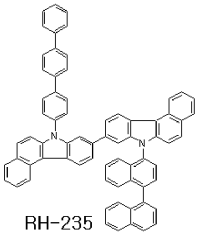


RH-234

[0258]

[0259]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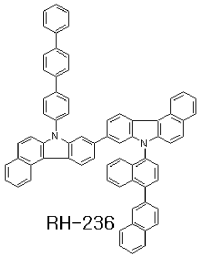
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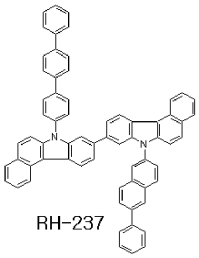
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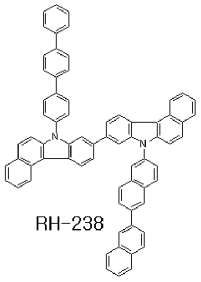
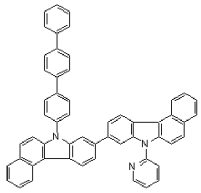

RH-238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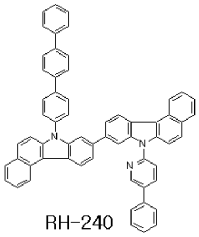
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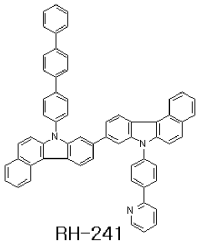
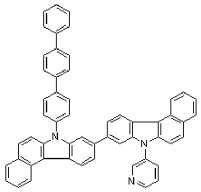

RH-241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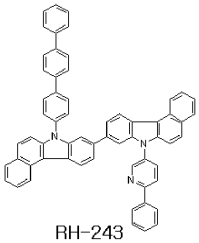
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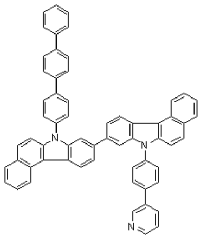

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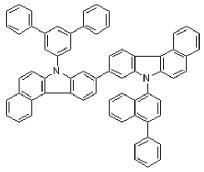

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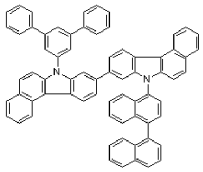

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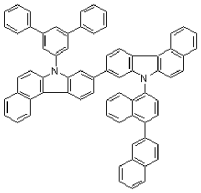

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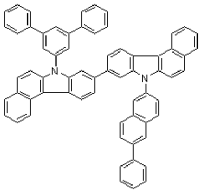

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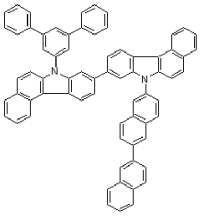

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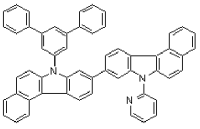

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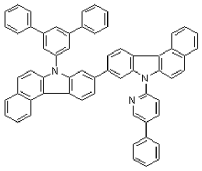

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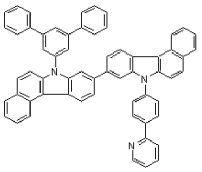

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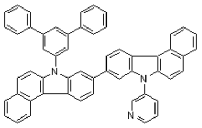

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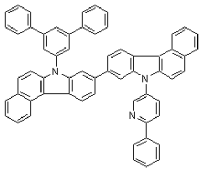

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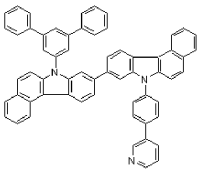

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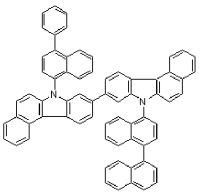

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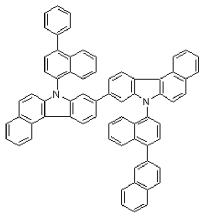

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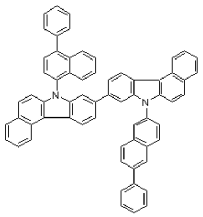

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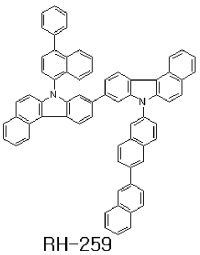

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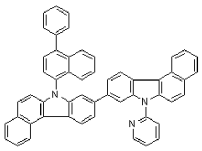

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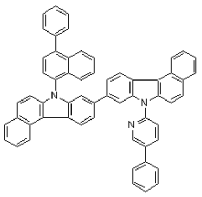

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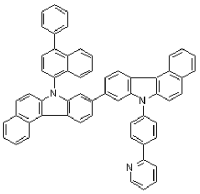

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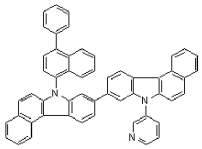

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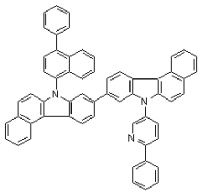

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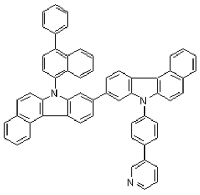

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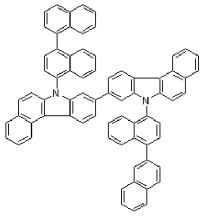

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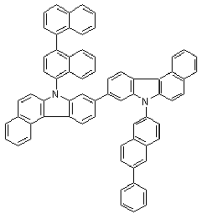

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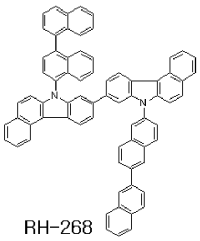

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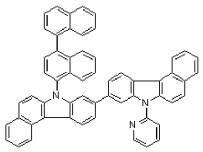

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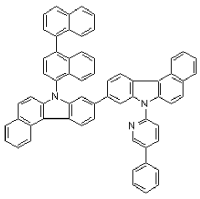

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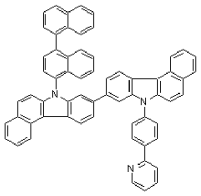

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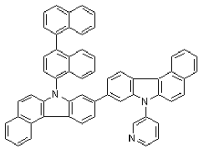

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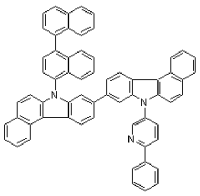

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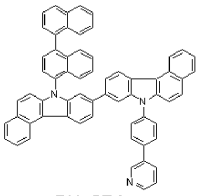

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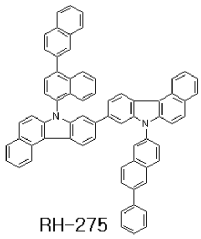

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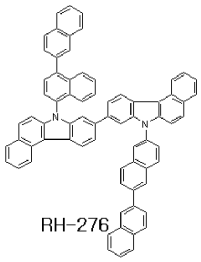

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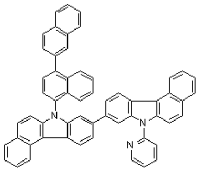

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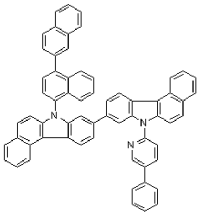

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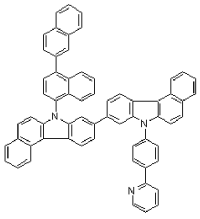

RH-279

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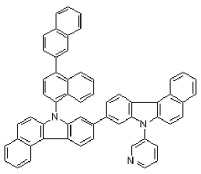

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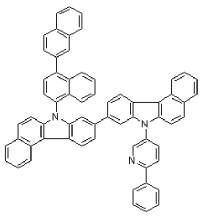

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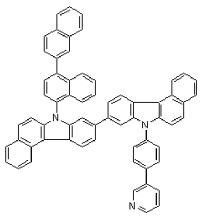

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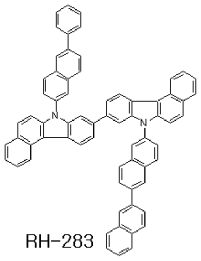
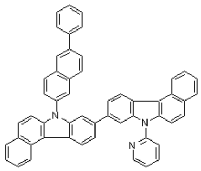


RH-283



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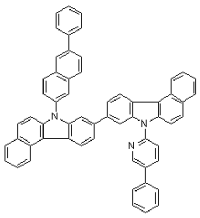

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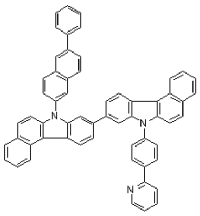

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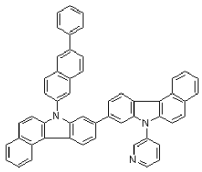

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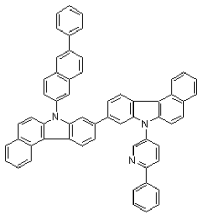

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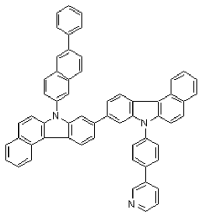

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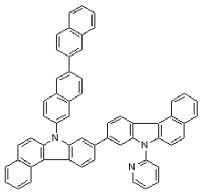

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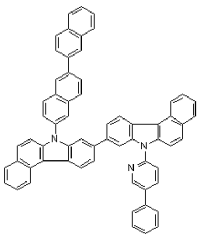

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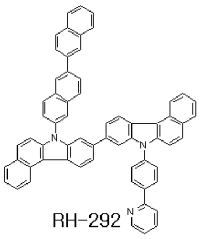
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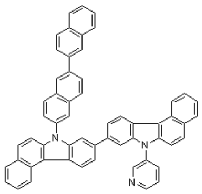
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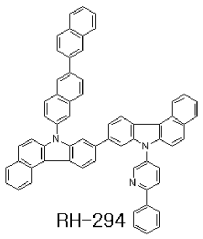
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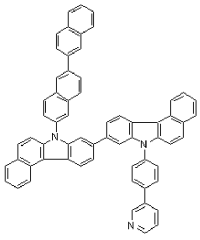
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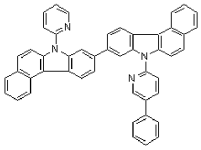
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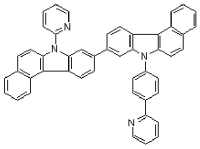
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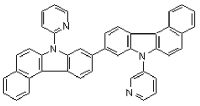
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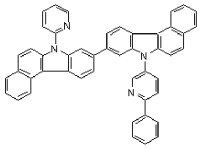
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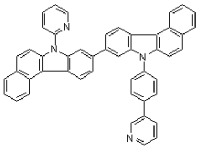
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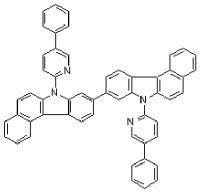
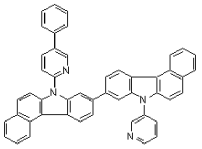
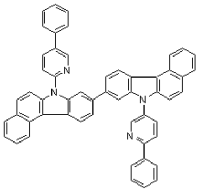
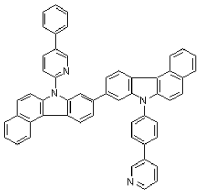
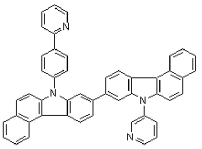
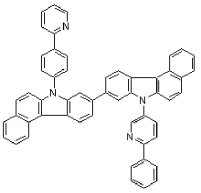

RH-301


RH-302

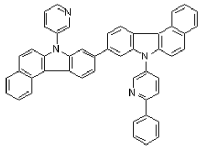

RH-303

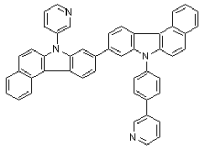

RH-304

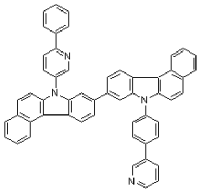

RH-305


RH-306

[0265]


RH-307


RH-308


RH-309

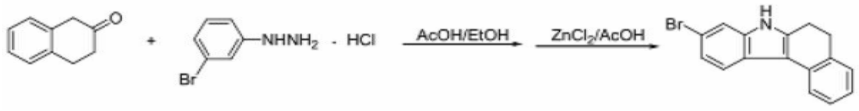
[0266] 이하에서는, 본 발명에 따른 유기전계발광소자용 적색 인광 호스트 물질 중, 상기 화학식7에서 RH-001로 표기된 적색 인광 호스트 물질을 예로 들어 합성예을 설명한다.

[0267] 합성예

[0268] 1. 2-bromo-dihydrobenzo[3,4]carbazole의 합성

[0269] 2-bromo-dihydrobenzo[3,4]carbazole은 아래와 같은 반응식6에 의해 합성된다.

[0270] 반응식6

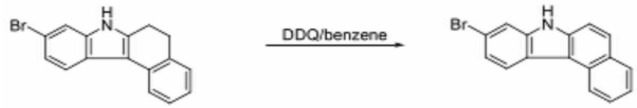
[0271] 

[0272] 구체적으로, 2구 둥근 플라스크에 β-teralone(25g, 0.17mol), 3-bromophenylhydrazinuim chloride(38.2g, 0.17mol)와 acetic acid를 ethanol에 넣고 1시간 동안 환류시킨다. 온도를 상온으로 내린 다음, 여과하고 용매를 증발시킨다. 여기에 zinc chloride(58g, 0.42mol)와 acetic acid를 넣고, 30분동안 환류시킨다. 온도를 상온으로 내린 다음 용매를 증발시키고, MC/PE로 석출(precipitation)하여 2-bromo-dihydrobenzo[3,4]carbazole (35.5g, yield:70%)를 얻었다.

[0273] 2. 2-bromobenzo[3,4]carbazole의 합성

[0274] 2-bromobenzo[3,4]carbazole은 아래와 같은 반응식7에 의해 합성된다.

[0275] 반응식7

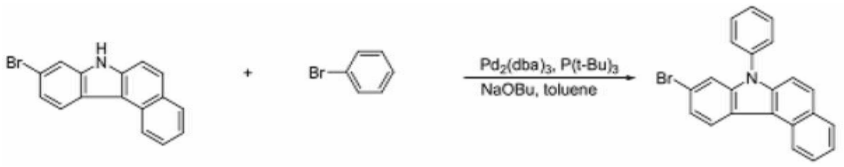
[0276] 

[0277] 구체적으로, 2구 둥근 플라스크에 2-bromodihydrobenzo[3,4]carbazole(20g, 0.07mol), 2,3-dichloro-5,6-dicyanobenzoquinone(19.8g, 0.09mol)와 benzene을 넣고 상온에서 3시간 동안 교반한다. Ethyl acetate로 추출하고, 용매를 증발시킨 후, silica gel column으로 정제하여 2-bromobenzo[3,4]carbazole (15.9g, yield:80%)를 얻었다.

[0278] 3. 2-bromo-9-phenylbenzo[3,4]carbazole의 합성

[0279] 2-bromo-9-phenylbenzo[3,4]carbazole은 아래와 같은 반응식8에 의해 합성된다.

[0280] 반응식8

[0281] 

[0282] 구체적으로, 2구 둥근 플라스크에 2-bromobenzo[3,4]carbazole(5g, 0.017mol), bromobenzene(4g, 0.025mol), Pd2(dba)3 (0.42g, 0.046mol%), P(t-Bu)3(0.14g, 0.069mol%), NaOBu(2.4g, 0.025mol)와 toluene을 넣고 130℃에서 6시간 동안 환류시킨다. 온도를 상온으로 냉각한 다음, methylene chloride로 추출하고 용매를 증발시킨 후, silica gel column으로 정제하여 2-bromo-9-phenylbenzo[3,4]carbazole(5g, yield :80%)을 얻었다.

[0283] 4. 9-phenybenzo[3,4]carbazole-2-boronic acid의 합성

[0284] 9-phenybenzo[3,4]carbazole-2boronic acid는 아래와 같은 반응식9에 의해 합성된다.

[0285] 반응식9

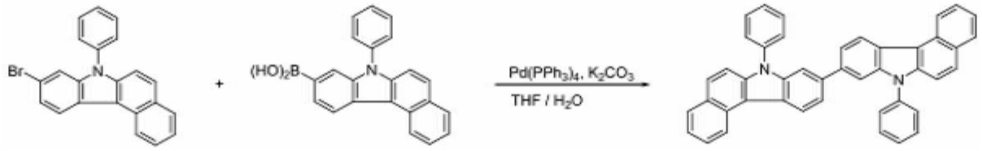
[0286] 

[0287] 구체적으로, 2구 둥근 플라스크에 2-bromo-9-phenylbenzo[3,4]carbazole (10g, 0.026mol)과 100mL의 ether를 넣고 교반시킨다. Dry-ice bath로 온도를 -78℃로 내린 다음, 2.5M n-BuLi(11.8mL, 0.03mol)를 천천히 떨어뜨리고 상온에서 1시간 동안 교반시킨다. 다시 dry-ice bath로 온도를 -78℃로 내린 다음 triethylborate(10.1g, 0.05mol)를 천천히 떨어뜨리고 상온에서 4시간 동안 교반시킨다. 100mL의 2N HCl를 넣고 quenching한 다음, 용매를 증발시킨다. 생성된 결정을 여과하고, 증류수와 hexane으로 3-4회 세정하여 9-phenylbenzo[3,4]carbazole-2-boronic acid acid(6.1g, yield :70%)을 얻었다.

[0288] 5. RH-001의 합성

[0289] 화학식7에서 RH-001로 표시된 적색 인광 호스트 물질은 아래와 같은 반응식10에 의해 합성된다.

[0290] 반응식10

[0291] 

[0292] 구체적으로, 이구 둥근 플라스크에 2-bromo-9-phenylbenzo[3,4]carbazole(2g, 5.4mmol), 9-phenylbenzo[3,4]carbazole-2-boronic acid (1.8g, 5.4mmol), Pd(PPh3)4를 THF/H2O(20mL/20mL)에 넣고 8시간 동안 환류시킨다. TLC(Thin-Layer Chromatography)로 반응 확인 후 온도를 상온으로 내린 다음, methylene chloride로 추출하고 용매를 증발시킨 후, silica gel column으로 정제하여 RH-001(2.2g, yield :70%)을 얻었다.

[0293] 이하, 상기한 본 발명의 제 2 실시예에 따른 적색 인광 호스트 물질을 이용하여 유기전계발광소자를 제작하는 실험예6 내지 실험예10을 통해, 본 발명에 의한 적색 인광 호스트 물질 및 이를 이용한 유기전계발광소자의 성능을 비교 설명한다.

[0294] 실험예6

[0295] 기판 상에 인듐-틴-옥사이드(ITO)층의 발광 면적이 3mm X 3mm 크기가 되도록 패터닝한 후 세정하였다. 상기 ITO층 CuPC (650Å), NPD(400Å), 상기 화학식7에서 RH-002로 표시된 적색 인광 호스트 물질에 상기 화학식1-4로 RD-1로 표시된 도펀트를 5% 첨가한 발광층 (200Å), Alq3(350Å), LiF(5Å), Al(1000Å)의 순서로 성막하였다.

[0296] 0.9mA에서 1534cd/m2(5.4V)를 나타내었으며 이때 CIE x = 0.657, y = 0.339를 나타내었다.

[0297] 실험예7

[0298] 기판 상에 인듐-틴-옥사이드(ITO)층의 발광 면적이 3mm X 3mm 크기가 되도록 패터닝한 후 세정하였다. 상기 ITO층 CuPC (650Å), NPD(400Å), 상기 화학식7에서 RH-003으로 표시된 적색 인광 호스트 물질에 상기 화학식1-4로 RD-1로 표시된 도펀트를 5% 첨가한 발광층 (200Å), Alq3(350Å), LiF(5Å), Al(1000Å)의 순서로 성막하였다.

[0299] 0.9mA에서 1866cd/m2(5.6V)를 나타내었으며 이때 CIE x = 0.659, y = 0.338를 나타내었다.

[0300] 실험예8

[0301] 기판 상에 인듐-틴-옥사이드(ITO)층의 발광 면적이 3mm X 3mm 크기가 되도록 패터닝한 후 세정하였다. 상기 ITO층 CuPC (650Å), NPD(400Å), 상기 화학식7에서 RH-006으로 표시된 적색 인광 호스트 물질에 상기 화학식1-4로 RD-1로 표시된 도펀트를 5% 첨가한 발광층 (200Å), Alq3(350Å), LiF(5Å), Al(1000Å)의 순서로 성막하였다.

[0302] 0.9mA에서 1776cd/m2(5.2V)를 나타내었으며 이때 CIE x = 0.654, y = 0.342를 나타내었다.

[0303] 실험예9

[0304] 기판 상에 인듐-틴-옥사이드(ITO)층의 발광 면적이 3mm X 3mm 크기가 되도록 패터닝한 후 세정하였다. 상기 ITO 층 CuPC (650Å), NPD(400Å), 상기 화학식7에서 RH-019로 표시된 적색 인광 호스트 물질에 상기 화학식1-4로 RD-1로 표시된 도펀트를 5% 첨가한 발광층 (200Å), Alq3(350Å), LiF(5Å), Al(1000Å)의 순서로 성막하였다.

[0305] 0.9mA에서 1734cd/m2(5.6V)를 나타내었으며 이때 CIE x = 0.658, y = 0.339를 나타내었다.

[0306] 실험예10

[0307] 기판 상에 인듐-틴-옥사이드(ITO)층의 발광 면적이 3mm X 3mm 크기가 되도록 패터닝한 후 세정하였다. 상기 ITO 층 PEDOT:PSS (800Å, spin coating : 3000 rpm, baking condition : 120 ℃ for 1hr), 상기 화학식7에서 RH-003으로 표시된 적색 인광 호스트 물질에 상기 화학식1-4로 RD-1로 표시된 도펀트를 2% 첨가한 발광층 (250 Å, 3000 rpm, baking condition : 100 ℃ for 30min)로 스핀코팅 한 다음, Alq3(350Å), LiF(5Å) , Al(1000 Å)의 순서로 성막하였다.

[0308] 0.9mA에서 1623cd/m2(6.9V)를 나타내었으며 이때 CIE x = 0.659, y = 0.338를 나타내었다.

[0309] 비교예2

[0310] 기판 상에 인듐-틴-옥사이드(ITO)층의 발광 면적이 3mm X 3mm 크기가 되도록 패터닝한 후 세정하였다. 상기 ITO 층 CuPC (650Å), NPD(400Å), 상기 화학식1-3으로 표시된 CBP에 상기 화학식1-4로 RD-1로 표시된 도펀트를 5% 첨가한 발광층 (200Å), Alq3(350Å), LiF(5Å), Al(1000Å)의 순서로 성막하였다.

[0311] 0.9mA에서 780cd/m2(7.5V)를 나타내었으며 이때 CIE x = 0.651, y = 0.329를 나타내었다.

[0312] 상술한 실험예6 내지 실험예10과 비교예2의 비교결과를 아래 표2에 나타내었다. 여기서 전압의 단위는 V, 전류의 단위는 mA, 휘도의 단위는 cd/m2, 전류효율의 단위는 cd/A, 전력효율의 단위는 lm/W이다.

표 2

[0313]

	전압	전류	휘도	전류효율	전력효율	CIE(X)	CIE(Y)
실시예1	5.4	0.9	1534	15.3	8.9	0.657	0.339
실시예2	5.6	0.9	1866	18.6	10.4	0.659	0.338
실시예3	5.2	0.9	1776	17.7	10.7	0.654	0.342
실시예4	5.6	0.9	1734	17.3	9.7	0.658	0.339
실시예5	6.9	0.9	1623	16.2	7.4	0.659	0.338
비교예	7.5	0.9	780	7.8	3.3	0.659	0.329

[0314] 표2에서 알 수 있는 바와 같이, 실험예6 내지 실험예10은 전류효율이 뛰어나고, 낮은 구동 전압에서 높은 휘도의 빛을 발광하므로 소모 전력이 감소된다.

[0315] 특히, 실험예10은 액상에서 코팅 방법에 의해 발광층을 형성한 것이며, 구동 전압, 휘도 등에 있어 우수한 효과를 갖는다. 따라서 본 발명의 적색 인광 호스트 물질은 코팅 방법에 의해 대면적 소자의 제조가 가능하다.

[0316] 상기한 적색 인광 호스트 물질을 포함하여 이루어지는 유기전계발광소자에 대한 일 실시예를 도 2에 도시하였다.

[0317] 도시한 바와 같이, 유기전계발광소자는 서로 마주보는 제 1 및 제 2 기판(미도시)과, 상기 제 1 및 제 2 기판(미도시) 사이에 형성되어 있는 유기발광다이오드(E)를 포함한다.

[0318] 상기 유기발광다이오드(E)는 양극 역할을 하는 제 1 전극(110), 음극 역할을 하는 제 2 전극(130) 및 상기 제 1 및 제 2 전극(110, 130) 사이에 형성되는 유기발광층(120)으로 이루어진다.

[0319] 상기 제 1 전극(110)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(120)은 적색, 녹색, 청색은 유기발광패턴으로 이루어진다.

[0320] 상기 유기발광층(120)은 발광효율을 극대화하기 위해, 다중층 구조 즉, 제 1 전극(110)으로부터 순차적으로 정공주입층(hole injection layer; HTL) (121), 정공수송층(hole transporting layer; HIL) (122), 발광물질층(emitting material layer; EML) (123), 전자수송층(electron transporting layer)(124) 및 전자주입층(electron injection layer)(125)으로 이루어진다.

[0321] 여기서, 상기 발광물질층(123)은 상기 화학식2 또는 상기 화학식5로 표시된 적색 인광 호스트 물질을 포함하여 이루어진다. 상기 적색 인광 호스트 물질이 약 1~10wt%로 용매, 예를 들어 자일렌(xylene)에 용해되고, 도펀트가 약 1~10wt% 첨가되어 발광물질층 용액이 제조된다. 상기 발광물질층 용액을 코팅하여 상기 발광물질층(123)을 형성하게 된다. 특히 본 발명의 적색 인광 호스트 물질은 비극성(non-polar) 용매에 대한 용해도가 우수하다. 만약 극성 용매를 이용하여 코팅 공정이 진행되면 핫 플레이트(hot plate) 등을 이용하여 용매를 증발시키는 경우 용매가 잔존하여 결합으로 작용할 수 있게 된다. 그러나 비극성 용매를 이용할 경우 이러한 문제가 발생하지 않는다. 상기 발광물질층(123)은 녹색, 청색 발광물질층을 더욱 포함할 수 있다.

[0322] 이와 같은 구성의 유기전계발광소자는 발광물질층 용액을 코팅하여 상기 발광물질층(123)을 형성하기 때문에, 대면적 유기전계발광소자의 제조에 장점을 갖는다. 또한, 고휘도의 영상을 구현할 수 있고, 또한 발광효율이 향상되어 저전력구동이 가능하여 소모전력이 감소되는 장점을 갖는다.

[0323] 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.

부호의 설명

[0324] 110: 제 1 전극

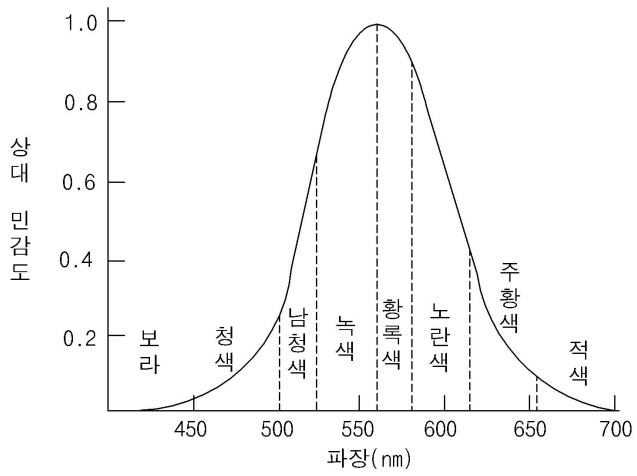
120: 유기발광층

123: 발광물질층

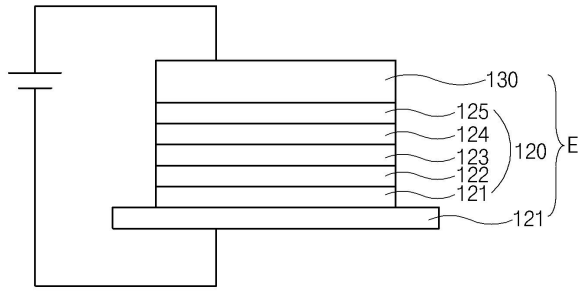
130: 제 2 전극

도면

도면1



도면2



专利名称(译)	标题：红色磷光主体材料和使用其的有机电致发光器件		
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摘要(译)

本发明由下式表示：其中A 1和A 2各自选自取代或未取代的芳族基团材料，取代或未取代的脂族环基团材料，或取代或未取代的芳族基团材料。提供了一种用于发光器件的红色磷光主体材料。 此外，本发明由下式表示：其中Ar 1和Ar 2各自选自取代或未取代的芳族基团材料，取代或未取代的脂族环基团材料，或取代或未取代的芳族基团材料。提供了一种用于有机电致发光器件的红色磷光主体材料。