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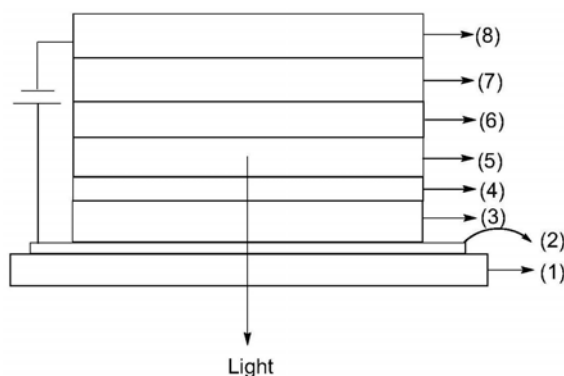
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(54)发明名称

有机电致发光材料、有机电致发光器件

(57)摘要

本发明涉及有机电致发光材料、有机电致发光器件,以及有机电致发光器件的制备方法。本发明的有机电致发光材料通过包含 $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 的有机化合物A和 $M(\text{LA})_x(\text{LB})_y(\text{LC})_z$ 的化合物B,从而具有在维持其他电子性能保持一定水平的基础上发光寿命提高和/或工作电压降低的优点。



1. 一种有机电致发光材料,其特征在于,其包含以下化合物:

至少一种 $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 的有机化合物A;和

式 $M(LA)_x(LB)_y(LC)_z$ 所示的化合物B,并且,

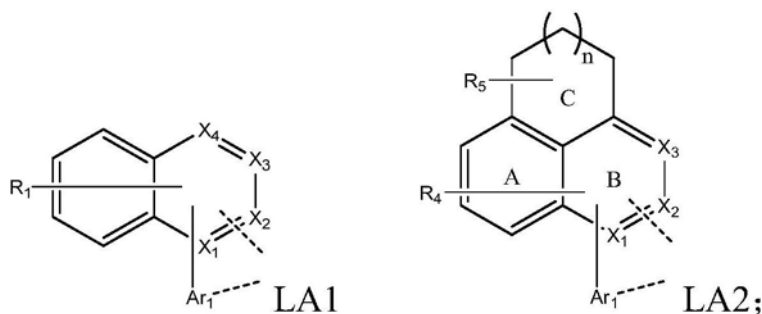
$E_T[B] - E_T[A]$ 的绝对值 $\leq 0.5\text{eV}$,其中 $E_T[B]$ 表示所述化合物B的三重态能级, $E_T[A]$ 表示所述有机化合物A的三重态能级,

式 $M(LA)_x(LB)_y(LC)_z$ 中,

M表示原子量大于40的金属元素;

x表示整数1、2或3,y表示整数0、1或2,z表示整数0、1或2,并且,x、y、z之和等于金属M的氧化价态;

LA为LA1或LA2:



R_1 选自: $C(R_a)_3$ 、具有1~8个碳原子取代基的反式-环己基、具有1~8个碳原子取代基的1,1'-双(反式-环己基)-4-取代基组成的组;

R_4 、 R_5 各自独立地选自氢原子、氘原子、链烷基、环烷基、杂烷基、芳烷基、烷氧基、芳氧基、氨基、硅烷基、链烯基、环烯基、杂烯基、炔基、芳基、杂环芳基组成的组;

取代基 R_1 为一个或者二个以上;

环A、环B上的取代基 R_4 为一个或者二个以上;

环C上的取代基 R_5 为一个或者二个以上;

X_1 、 X_2 、 X_3 、 X_4 各自独立地为碳或氮,并且 X_1 、 X_2 、 X_3 不同时为氮;

n表示 ≥ 0 的整数;

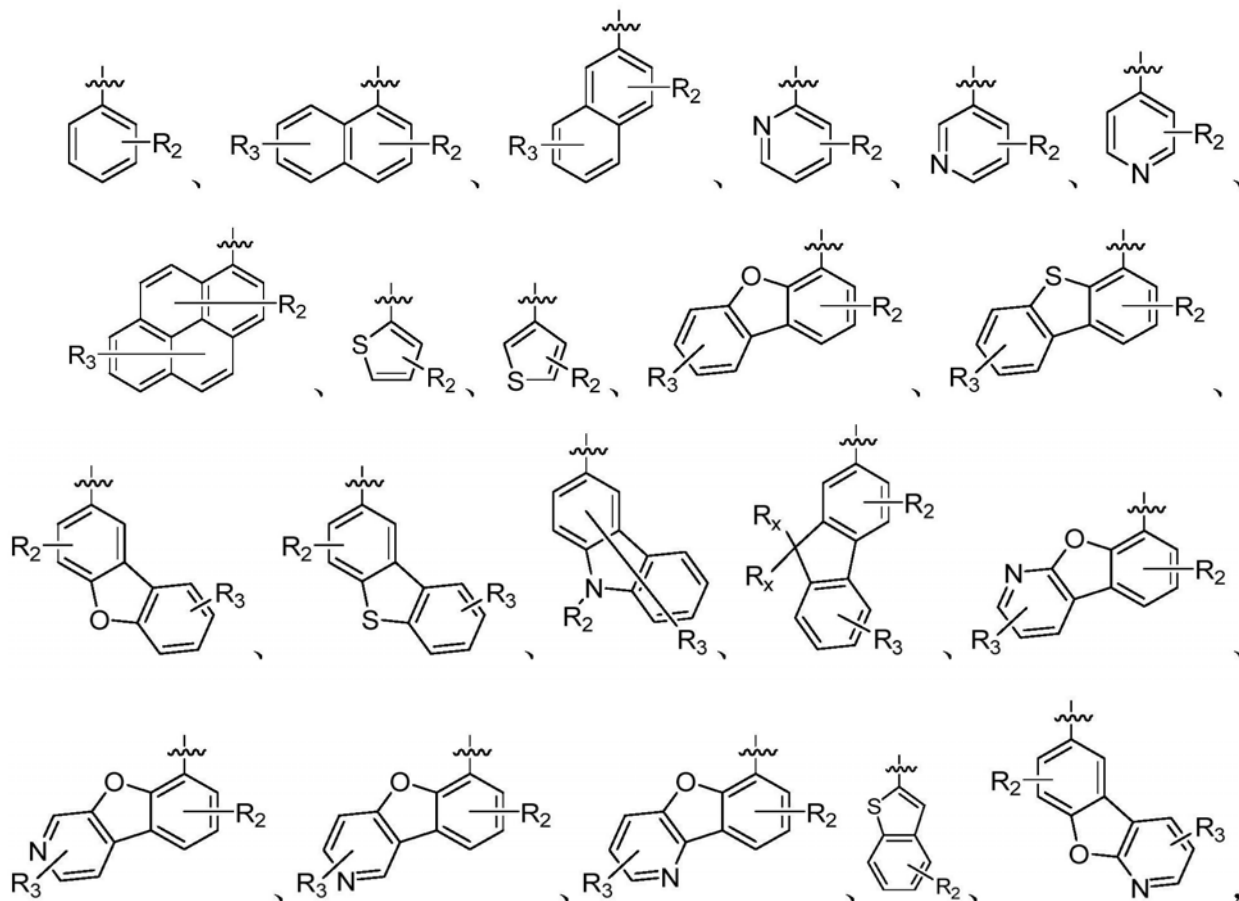
R_a 各自独立地选自具有 $C_1 \sim C_{40}$ 的直链烷基、具有 $C_1 \sim C_{40}$ 的直链杂烷基、具有 $C_3 \sim C_{40}$ 的支链或环状的烷基、具有 $C_3 \sim C_{40}$ 的支链或环状的杂烷基、具有 $C_2 \sim C_{40}$ 的烯基或炔基组成的组,且这些基团任选被一个或多个 R_6 取代,并且一个或多个非相邻的 $-CH_2-$ 基团任选被 $-R_6C=CR_6-$ 、 $-C \equiv C-$ 、 $-Si(R_6)_2-$ 、 $-Ge(R_6)_2-$ 、 $-Sn(R_6)_2-$ 、 $-C(=O)-$ 、 $-C(=S)-$ 、 $-C(=Se)-$ 、 $-C(=NR_6)-$ 、 $-P(=O)(R_6)-$ 、 $-S(O)-$ 、 $-S(O)_2-$ 、 $-N(R_6)-$ 、 $-O-$ 、 $-S-$ 或 $-C(ONR_6)-$ 代替,并且 R_a 中一个或多个氢原子任选被氘原子、卤素原子、腈基或硝基代替,其中两个以上的相邻的取代基 R_a 任选地接合或稠合形成单环或多环的脂族、芳族或杂芳族环系,所述环系任选被一个或多个基团 R_6 取代;

R_6 各自独立地选自氢原子、氘原子、卤素原子、腈基、硝基、具有 $C_1 \sim C_{40}$ 的直链烷基、具有 $C_1 \sim C_{40}$ 的直链杂烷基、具有 $C_3 \sim C_{40}$ 的支链或环状的烷基、具有 $C_3 \sim C_{40}$ 的支链或环状的杂烷基、具有 $C_2 \sim C_{40}$ 的烯基、炔基组成的组,所述 R_6 任选被一个或多个基团 R_m 取代,且 R_6 中一个或多个非相邻的 $-CH_2-$ 基团任选被 $-R_mC=CR_m-$ 、 $-C \equiv C-$ 、 $-Si(R_m)_2-$ 、 $-Ge(R_m)_2-$ 、 $-Sn(R_m)_2-$ 、 $-C(=O)-$ 、 $-C(=S)-$ 、 $-C(=Se)-$ 、 $-C(=NR_m)-$ 、 $-P(=O)(R_m)-$ 、 $-S(O)-$ 、 $-S(O)_2-$ 、 $-N(R_m)-$ 、 $-O-$ 、 $-S-$

或-C(ONR_m)-代替,并且R₆中一个或多个氢原子任选被氘原子、卤素原子、腈基或硝基代替,其中两个或更多个相邻的取代基R₆任选地接合或耦合形成单环或多环的脂族、芳族或杂芳族环系,所述环系任选被一个或多个基团R_m取代;

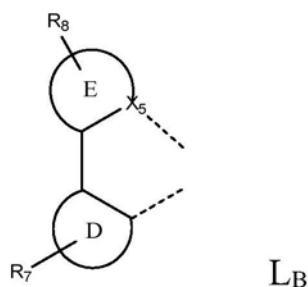
R_m选自氢原子、氘原子、氟原子、腈基、具有C₁~C₂₀的脂族烃基组成的组,其中一个或多个氢原子可被氘原子、卤素原子、或腈基代替,其中两个或更多个相邻的取代基R_m任选彼此形成单环或多环的脂族、芳族或杂芳族环系;

Ar₁选自下述基团组成的组:



R₂、R₃、R_x各自独立地选自氢原子、氘原子、卤原子、、氰基、碳原子总数为1~40的链烷基、碳原子总数为3~40的环烷基、碳原子总数为1~40的烷氧基、碳原子总数为2~40的直链烯烷基、碳原子总数为1~40的杂烷基、碳原子总数为2~40的环烯烷基组成的组;

L_B为:



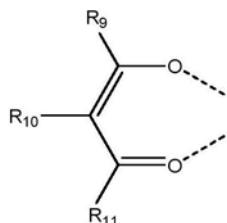
R₇、R₈各自独立地选自氢原子、氘原子、卤原子、链烷基、环烷基、杂烷基、芳烷基、烷氧基、芳氧基、氨基、硅烷基、链烯基、环烯基、杂烯基、炔基、芳基、杂环芳基组成的组;R₇、R₈中

相邻的基团之间任选地接合或稠合成五元环、六元环或稠多环； R_7 、 R_8 各自独立地为一个或者二个以上；

环D、环E各自独立地选自五元碳环、五元杂环、六元碳环、六元杂环组成的组；

X_5 为氮或碳；

L_C 为：



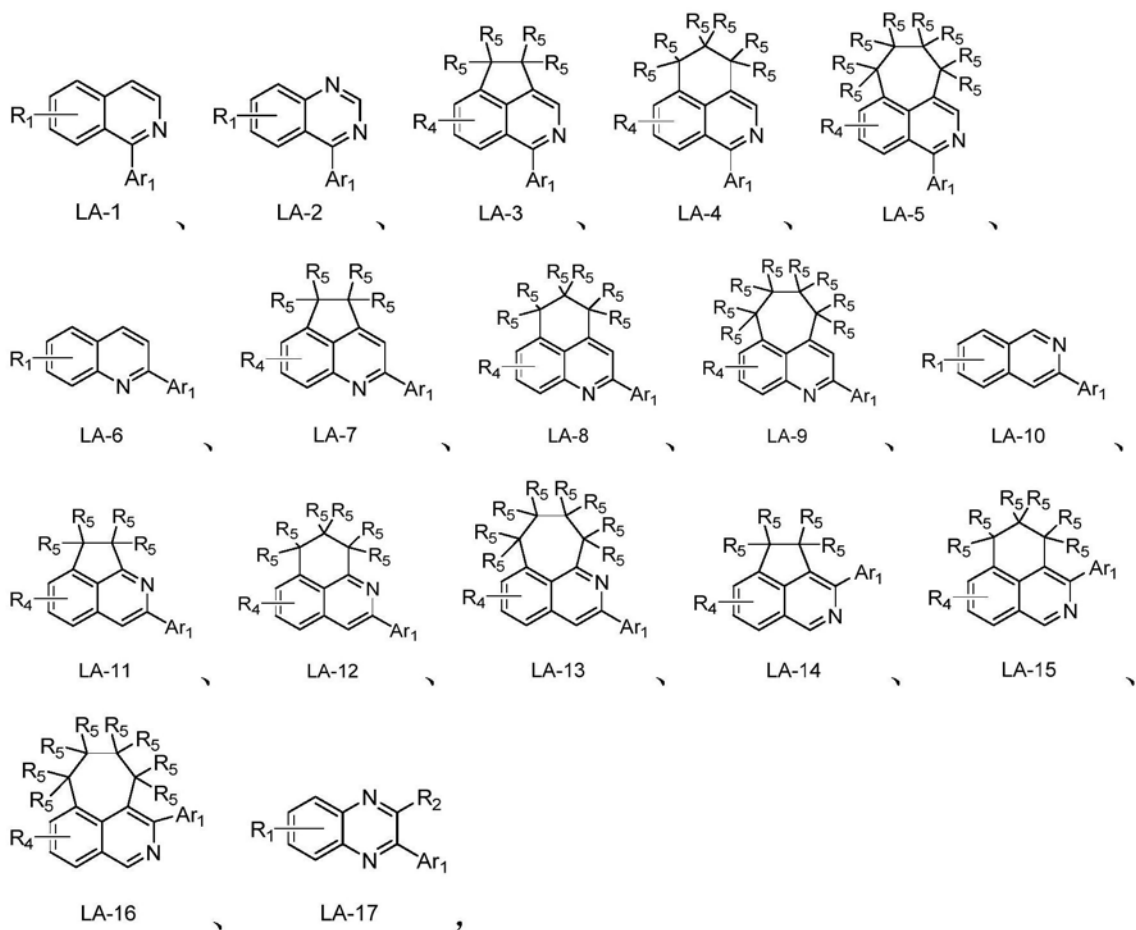
式 L_C ；

R_9 、 R_{10} 、 R_{11} 各自独立地选自氢原子、氘原子、卤素原子、链烷基、环烷基、杂烷基、芳烷基、烷氧基、芳氧基、氨基、硅烷基、链烯基、环烯基、杂烯基、炔基、芳基、杂环芳基组成的组； R_9 、 R_{10} 、 R_{11} 中相邻的基团之间任选地接合或稠合成五元环、六元环或稠多环。

2. 根据权利要求1所述的有机电致发光材料，其特征在于，所述有机化合物A与所述化合物B的质量百分比为99:1~80:20，优选为99:1~90:10，特别优选为99:1~95:5。

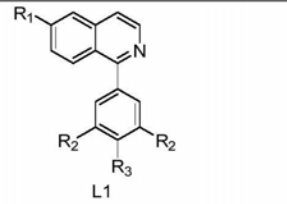
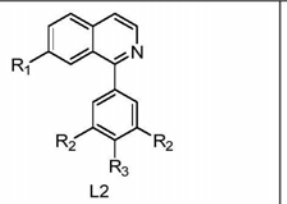
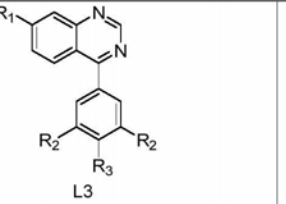
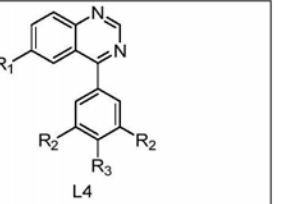
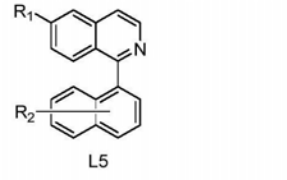
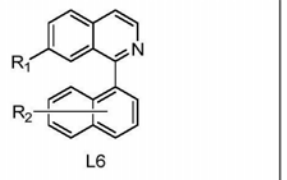
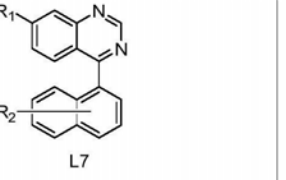
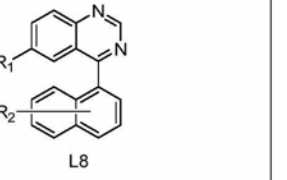
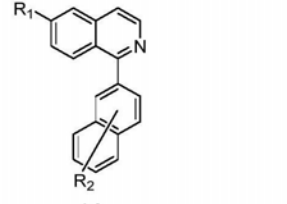
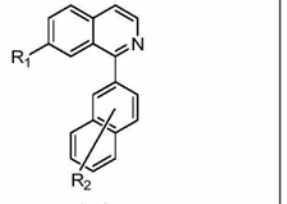
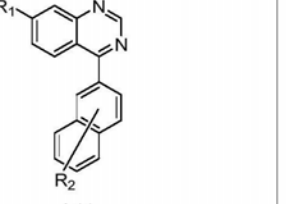
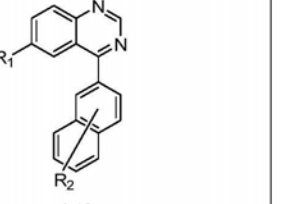
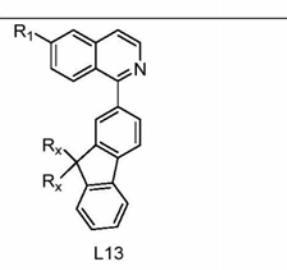
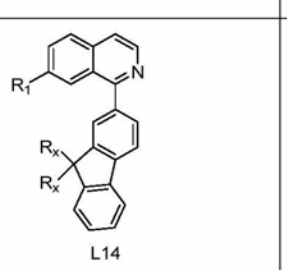
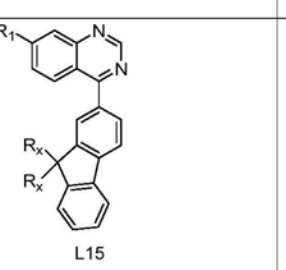
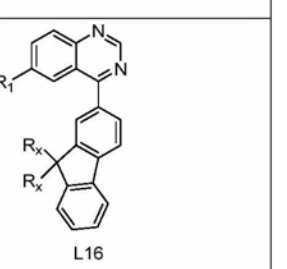
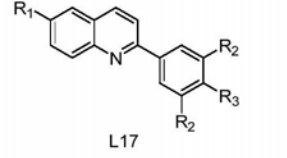
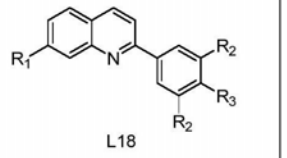
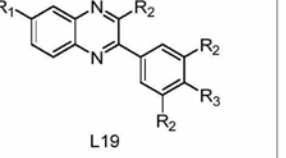
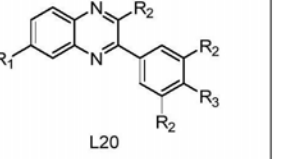
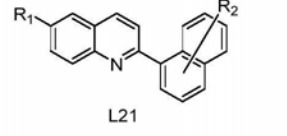

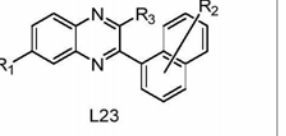
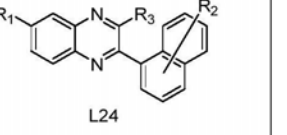
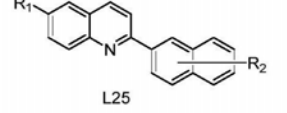
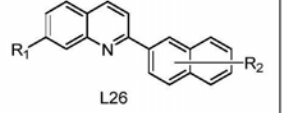
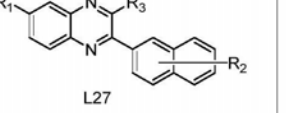
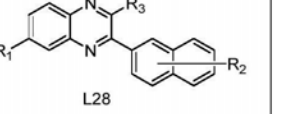
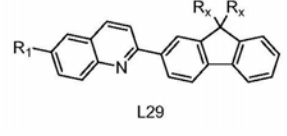
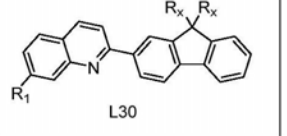
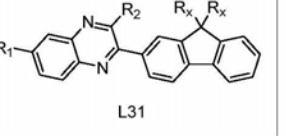
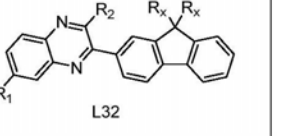
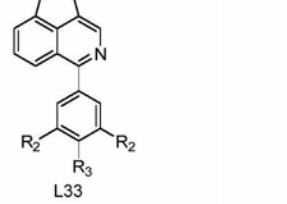
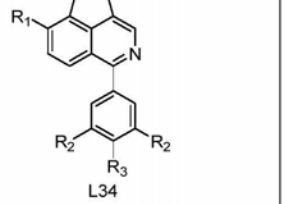
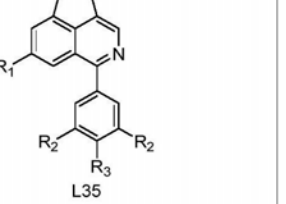
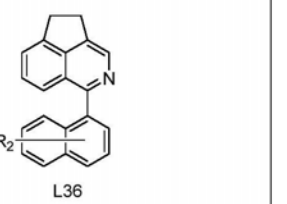
3. 根据权利要求1或2所述的有机电致发光材料，其特征在于，所述金属M为Ir或Pt；所述式 $M(LA)_x(LB)_y(LC)_z$ 所示的化合物B为Ir(LA)(LB)(LC)、Ir(LA)₂(LB)、Ir(LA)(LB)₂、Ir(LA)₂(LC)、Ir(LA)₃、Pt(LA)(LB)或Pt(LA)(LC)。

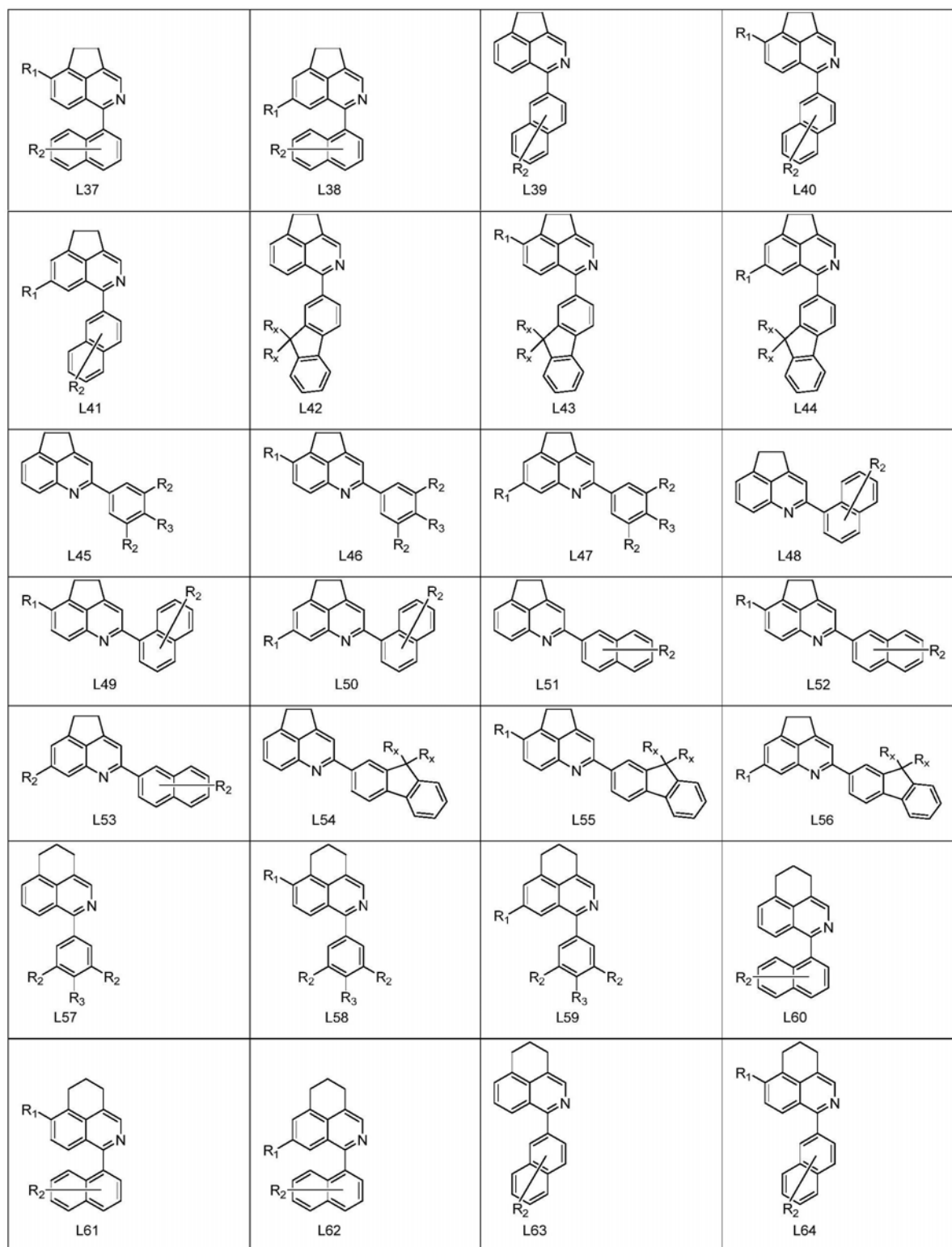
4. 根据权利要求1所述的有机电致发光材料，其特征在于，所述LA选自LA-1~LA-17组成的组，

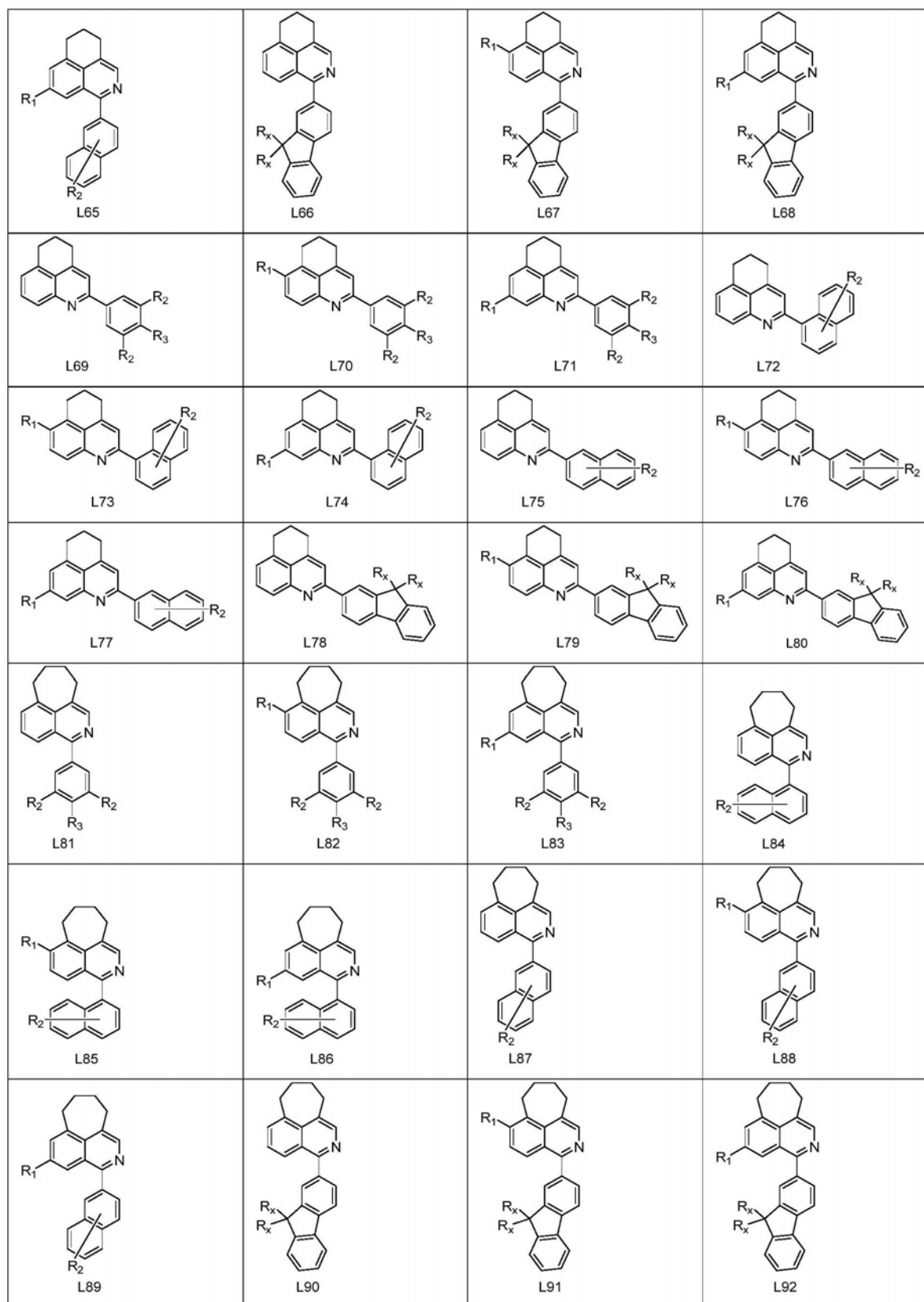


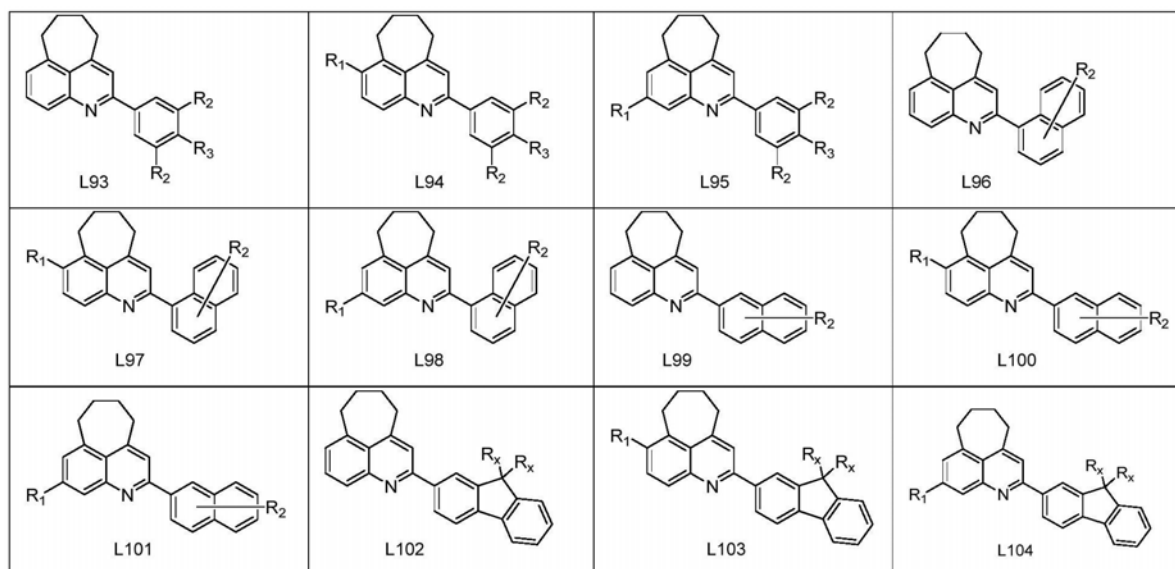
其中R₁、R₂、R₄、R₅、Ar₁的含义与权利要求1中的含义相同。

5. 根据权利要求4所述的有机电致发光材料,其特征在于,所述LA选自下述的L1~L104组成的组,

 L1	 L2	 L3	 L4
 L5	 L6	 L7	 L8
 L9	 L10	 L11	 L12
 L13	 L14	 L15	 L16
 L17	 L18	 L19	 L20
 L21	 L22	 L23	 L24
 L25	 L26	 L27	 L28
 L29	 L30	 L31	 L32
 L33	 L34	 L35	 L36

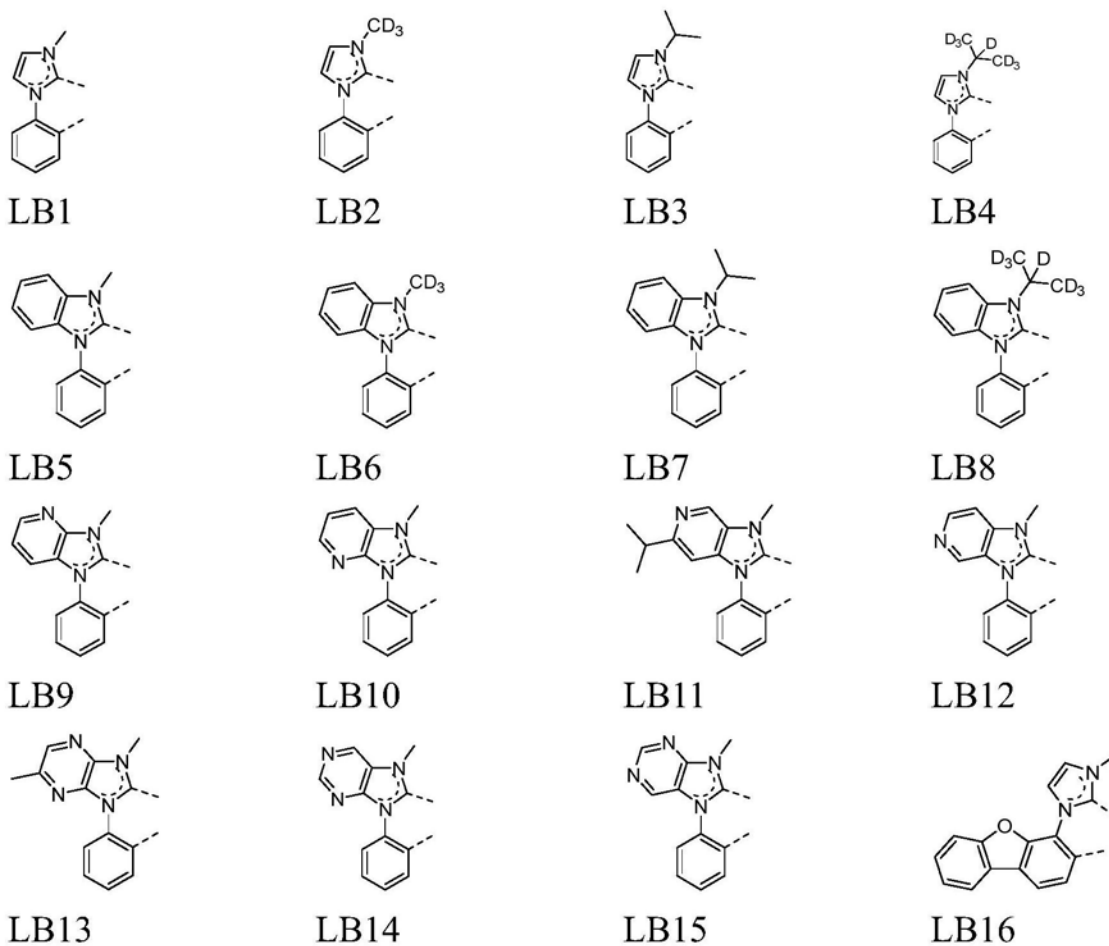


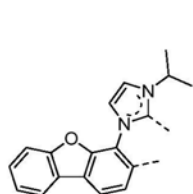




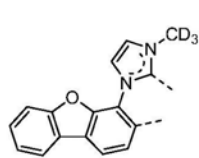
其中R₁、R₂、R₃、R_x的含义与权利要求1中的含义相同。

6. 根据权利要求1所述的有机电致发光材料, 其特征在于, 所述LB选自下述的LB1~LB44组成的组,

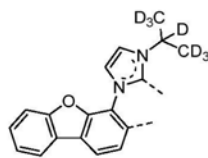




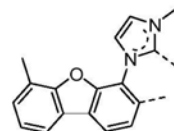
LB17



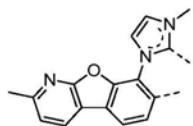
LB18



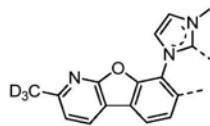
LB19



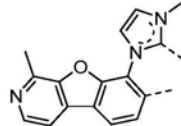
LB20



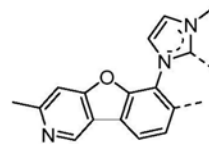
LB21



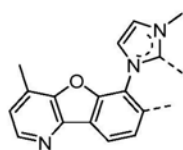
LB22



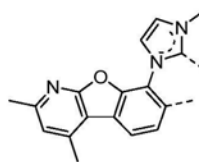
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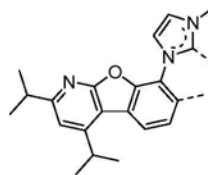
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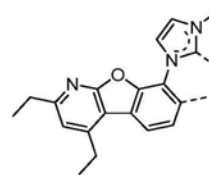
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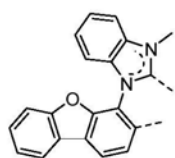
LB26



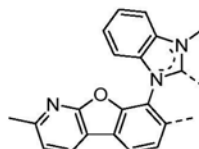
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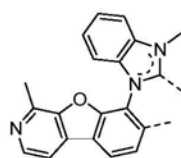
LB28



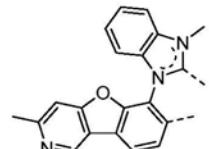
LB29



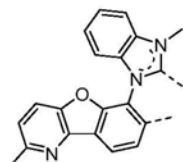
LB30



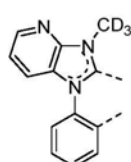
LB31



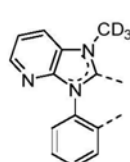
LB32



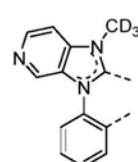
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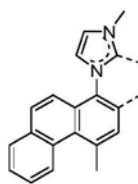
LB34



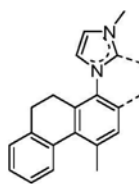
LB35



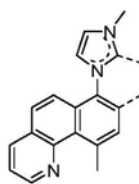
LB36



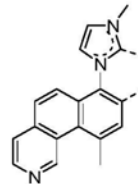
LB37



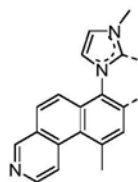
LB38



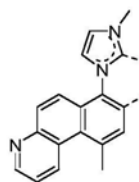
LB39



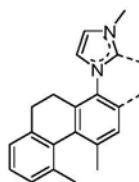
LB40



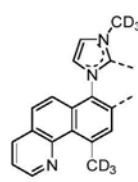
LB41



LB42

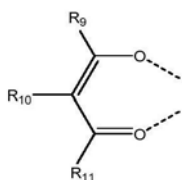


LB43



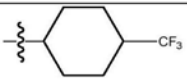
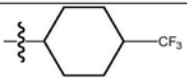



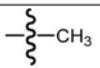

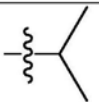
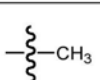
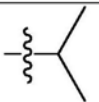
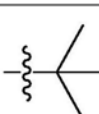
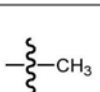
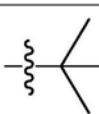
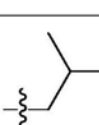
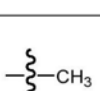
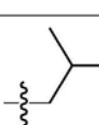
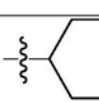
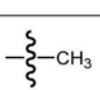
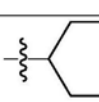

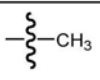


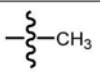

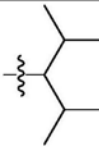
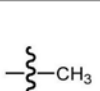
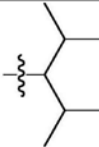

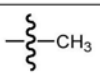

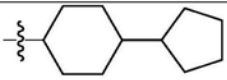
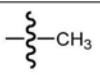
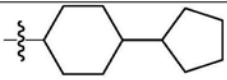

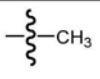


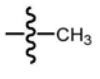


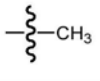


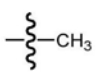










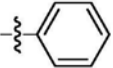

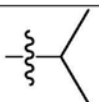
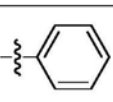
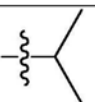
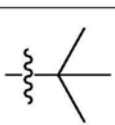
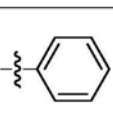
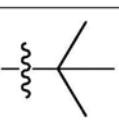
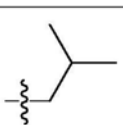
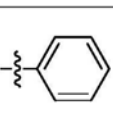
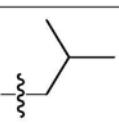
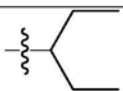
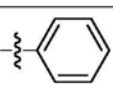
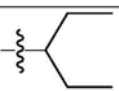
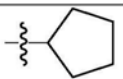
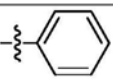
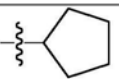
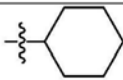
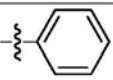

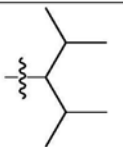
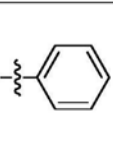
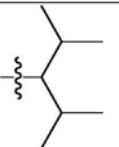

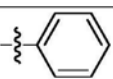


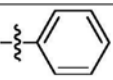

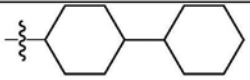
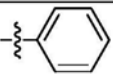
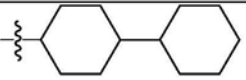

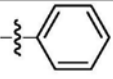


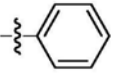


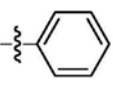

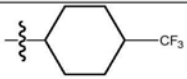
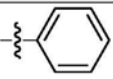
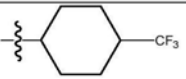
LB44。

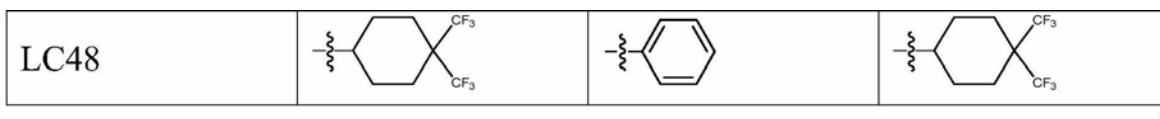
7. 根据权利要求1所述的有机电致发光材料,其特征在于,所述LC选自下述的LC1~LC48组成的组,



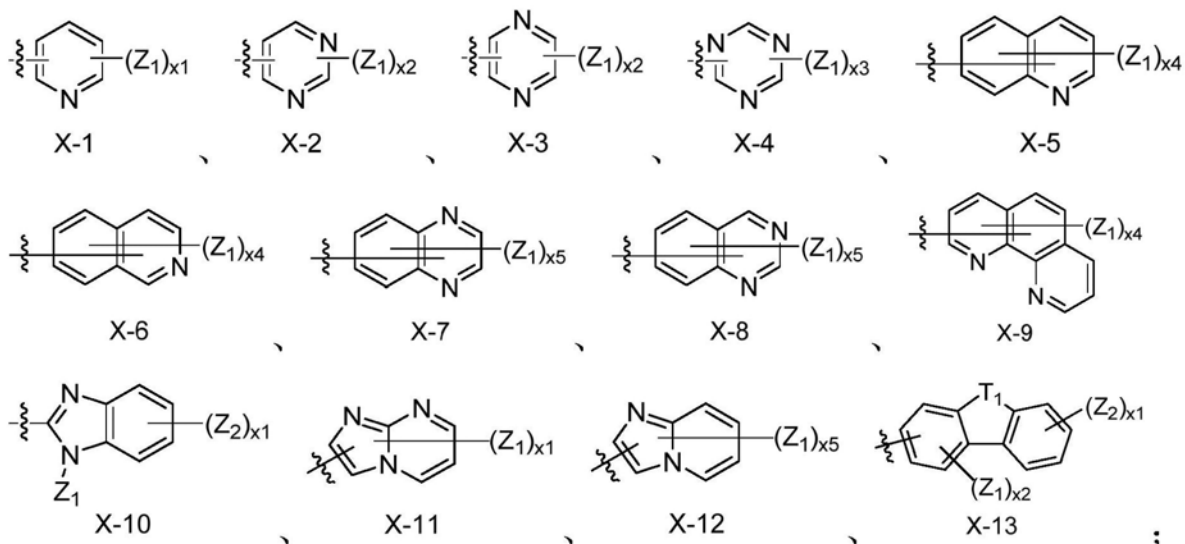
化合物 L _C	R ₉	R ₁₀	R ₁₁
LC1		H	
LC2		H	
LC3		H	
LC4		H	
LC5		H	
LC6		H	
LC7		H	
LC8		H	
LC9		H	
LC10		H	
LC11		H	
LC12		H	
LC13		H	

LC14		H	
LC15		H	
LC16		H	
LC17			
LC18			
LC19			
LC20			
LC21			
LC22			
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LC35			
LC36			
LC37			
LC38			
LC39			
LC40			
LC41			
LC42			
LC43			
LC44			
LC45			
LC46			
LC47			



8. 根据权利要求1所述的有机电致发光材料,其特征在于,所述 $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 的有机化合物A含有至少一个选自下述的式X-1~X-13所示基团组成的组中的基团,

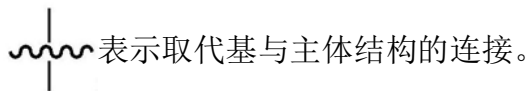


其中:

Z_1 、 Z_2 各自独立地选自氘、卤原子、羟基、腈基、硝基、氨基、脒基、胍基、脞基、羧基、羧酸盐基、磺酸基、磺酸盐基、磷酸基、磷酸盐基、 C_1 - C_{60} 的链烷基、 C_2 - C_{60} 的链烯基、 C_2 - C_{60} 的炔基、 C_1 - C_{60} 的烷氧基、 C_3 - C_{60} 的环烷烃基、 C_3 - C_{60} 的环烯烃基、 C_6 - C_{60} 的芳基、 C_6 - C_{60} 的稠环芳基、 C_6 - C_{60} 的芳氧基、 C_6 - C_{60} 芳硫醚基、 C_2 - C_{60} 的杂环芳基组成的组;

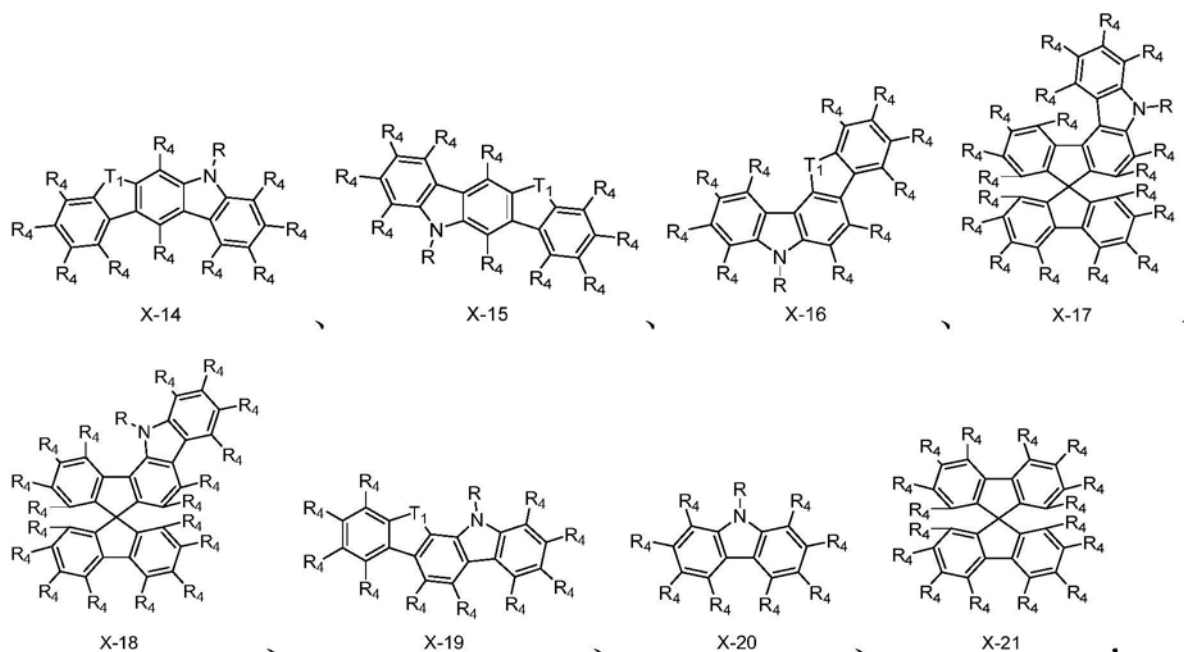
x_1 表示1-4的整数; x_2 表示1-3的整数; x_3 表示1或2; x_4 表示1-6的整数; x_5 表示1-5的整数;

T_1 选自 $-B(R')-$ 、 $-N(R')-$ 、 $-P(R')-$ 、 $-O-$ 、 $-S-$ 、 $-Se-$ 、 $-S(=O)-$ 、 $-S(O_2)-$ 、 $-C(R'R'')$ 、 $-Si(R'R'')$ 或 $-Ge(R'R'')$;并且 R' 、 R'' 各自独立地选自 C_1 - C_{60} 链烷基、 C_2 - C_{60} 链烯基、 C_2 - C_{60} 炔基、 C_1 - C_{60} 烷氧基、 C_3 - C_{60} 环烷烃基、 C_3 - C_{60} 环烯烃基、 C_6 - C_{60} 芳基、含有 C_1 - C_{10} 烷基的 C_6 - C_{60} 芳基、含有 C_1 - C_{10} 烷基的 C_6 - C_{60} 芳氧基、含有 C_1 - C_{10} 烷基的 C_6 - C_{60} 芳硫基组成的组; R' 、 R'' 任选稠合或接合形成环;



9. 根据权利要求8所述的有机电致发光材料,其特征在于,所述 $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 的有机化合物A含有选自式X-1~X-13基团组成的组中的至少一个基团与茚并咔唑基团、吡咯并咔唑基团或咔唑基团直接或经由桥连基团键合而成的基团,其中所述茚并咔唑、吡咯并咔唑、咔唑基团任选被一个或多个 Ar_1 基团取代,并且 Ar_1 的含义与权利要求1中的含义相同;

所述茚并咔唑基团、吡咯并咔唑基团、咔唑基团选自下述的式X-14~X-21所示的结构组成的组,



其中 R_4 各自独立地选自氢原子、氘原子、链烷基、环烷基、杂烷基、芳烷基、烷氧基、芳氧基、氨基、硅烷基、链烯基、环烯基、杂烯基、炔基、芳基、杂环芳基组成的组；

R表示与所述X-1~X-13连接的桥键或桥连基团，所述桥键或桥连基团与所述X-1~X-13连接；

T_1 的含义与其在权利要求8中的含义相同。

10. 一种有机电致发光器件，其特征在于，含有权利要求1~9的任一项所述的有机电致发光材料。

11. 一种制造权利要求10所述的有机电致发光器件的方法，其特征在于，利用升华方法来施加至少一个层，和/或利用有机气相沉积的方法或载气升华来施加至少一个层，和/或、从溶液中通过旋涂或借助于印刷方法来施加至少一个层。

有机电致发光材料、有机电致发光器件

技术领域

[0001] 本发明涉及有机电致发光器件领域。更具体地，涉及包含至少两种材料的混合物的有机电致发光器件。

背景技术

[0002] 例如在US4539507、US5151629、EP0676461和W09827136中描述了其中将有机半导体用作功能材料的有机电致发光器件的结构。此处使用的发光材料越来越多地是显示磷光而不是荧光的有机金属络合物(M.A.Baldo等, Appl. Phys. Lett. 1999, 75, 4~6)。出于量子力学原因，利用有机金属化合物作为磷光发光体可实现高达4倍的能量和功率效率增加。然而，一般来说，三重态发光的有机电致发光器件仍然需要改进，例如在效率、工作电压和寿命等方面仍需要改进。这特别适用于在相对长波区域发光、例如发红光的OLED。

[0003] 磷光OLED的特性不仅由使用的三重态发光体决定，使用的其它材料，特别是基质材料，在此处也是特别重要的。

[0004] 因此，寻找掺杂材料与基质良好协同配合而获得的发光效率、工作电压、寿命等方面改进的有机发光材料是亟待解决的问题。

发明内容

[0005] 为了解决现有技术中存在的问题之一，本发明人等经过深入研究后发现，通过采用本发明的含有至少一种 $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 的有机化合物A；和式 $M(LA)_x(LB)_y(LC)_z$ 所示的化合物B的有机电致发光材料，将其用于有机电致发光器件中，能够获得寿命提高和/或工作电压降低的有机电致发光器件。

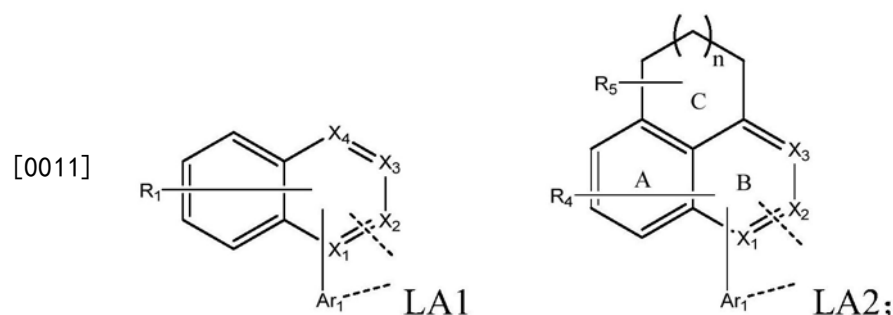
[0006] 其中， $E_T[B] - E_T[A]$ 的绝对值 $\leq 0.5\text{eV}$ ， $E_T[B]$ 表示化合物B的三重态能级， $E_T[A]$ 表示有机化合物A的三重态能级，

[0007] 式 $M(LA)_x(LB)_y(LC)_z$ 中，

[0008] M表示原子量大于40的金属元素；

[0009] x表示整数1、2或3，y表示整数0、1或2，z表示整数0、1或2，并且，x、y、z之和等于金属M的氧化价态；

[0010] LA为LA1或LA2：



[0012] R_1 选自： $C(R_a)_3$ 、具有1~8个碳原子取代基的反式-环己基、具有1~8个碳原子取代

基的1,1'-双(反式-环己基)-4-取代基组成的组;

[0013] R_4 、 R_5 各自独立地选自氢原子、氘原子、链烷基、环烷基、杂烷基、芳烷基、烷氧基、芳氧基、氨基、硅烷基、链烯基、环烯基、杂烯基、炔基、芳基、杂环芳基组成的组;

[0014] 取代基 R_1 为一个或者二个以上;

[0015] 环A、环B上的取代基 R_4 为一个或者二个以上;

[0016] 环C上的取代基 R_5 为一个或者二个以上;

[0017] X_1 、 X_2 、 X_3 、 X_4 各自独立地为碳或氮,并且 X_1 、 X_2 、 X_3 不同时为氮;

[0018] n 表示 ≥ 0 的整数;

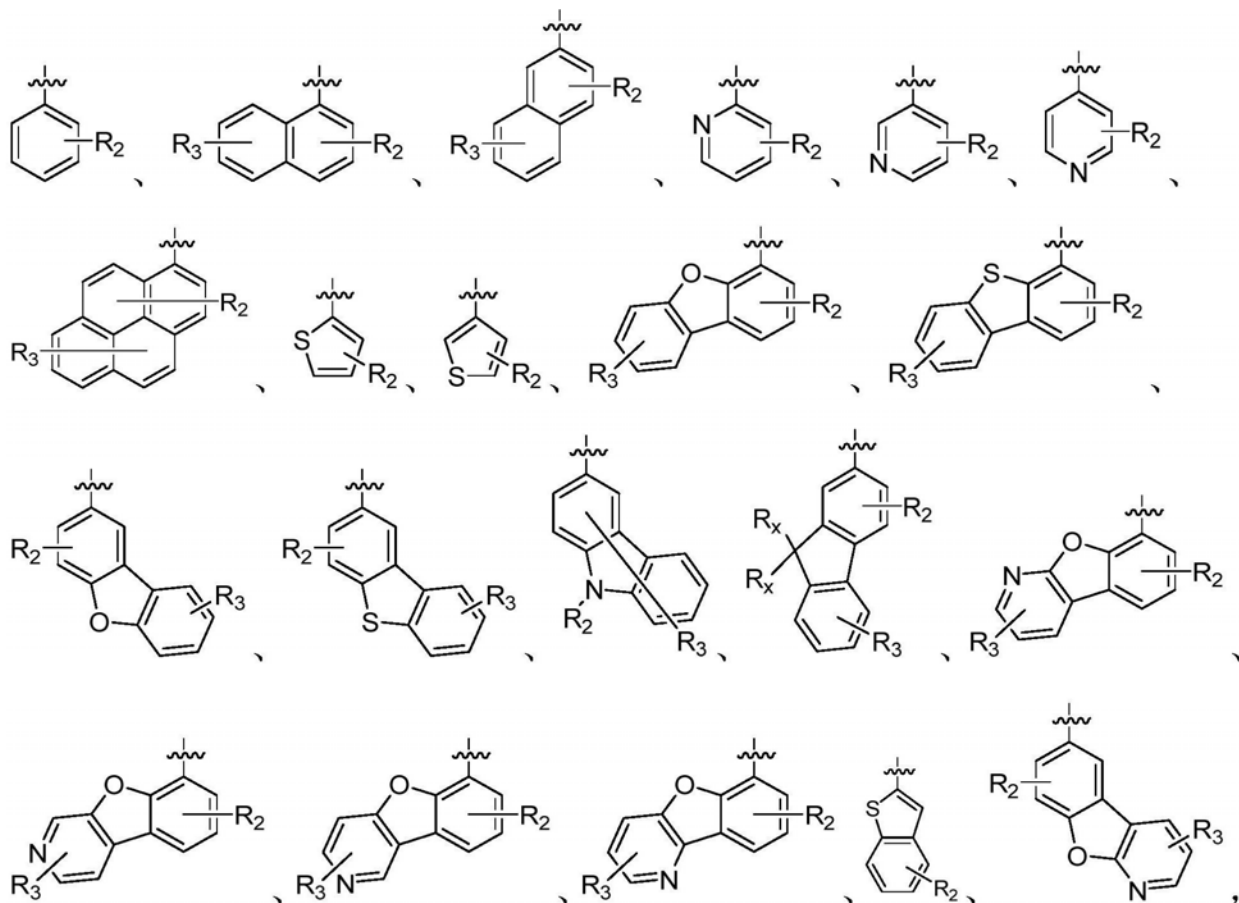
[0019] R_a 各自独立地选自具有 $C_1 \sim C_{40}$ 的直链烷基、具有 $C_1 \sim C_{40}$ 的直链杂烷基、具有 $C_3 \sim C_{40}$ 的支链或环状的烷基、具有 $C_3 \sim C_{40}$ 的支链或环状的杂烷基、具有 $C_2 \sim C_{40}$ 的烯基或炔基组成的组,且这些基团任选被一个或多个 R_6 取代,并且一个或多个非相邻的 $-CH_2-$ 基团任选被 $-R_6C=CR_6-$ 、 $-C\equiv C-$ 、 $-Si(R_6)_2-$ 、 $-Ge(R_6)_2-$ 、 $-Sn(R_6)_2-$ 、 $-C(=O)-$ 、 $-C(=S)-$ 、 $-C(=Se)-$ 、 $-C(=NR_6)-$ 、 $-P(=O)(R_6)-$ 、 $-S(O)-$ 、 $-S(O)_2-$ 、 $-N(R_6)-$ 、 $-O-$ 、 $-S-$ 或 $-C(ONR_6)-$ 代替,并且 R_a 中一个或多个氢原子任选被氘原子、卤素原子、腈基或硝基代替,其中两个以上的相邻的取代基 R_a 任选地接合或稠合形成单环或多环的脂族、芳族或杂芳族环系,所述环系任选被一个或多个基团 R_6 取代;

[0020] R_6 各自独立地选自氢原子、氘原子、卤素原子、腈基、硝基、具有 $C_1 \sim C_{40}$ 的直链烷基、具有 $C_1 \sim C_{40}$ 的直链杂烷基、具有 $C_3 \sim C_{40}$ 的支链或环状的烷基、具有 $C_3 \sim C_{40}$ 的支链或环状的杂烷基、具有 $C_2 \sim C_{40}$ 的烯基、炔基组成的组,所述 R_6 任选被一个或多个基团 R_m 取代,且 R_6 中一个或多个非相邻的 $-CH_2-$ 基团任选被 $-R_mC=CR_m-$ 、 $-C\equiv C-$ 、 $-Si(R_m)_2-$ 、 $-Ge(R_m)_2-$ 、 $-Sn(R_m)_2-$ 、 $-C(=O)-$ 、 $-C(=S)-$ 、 $-C(=Se)-$ 、 $-C(=NR_m)-$ 、 $-P(=O)(R_m)-$ 、 $-S(O)-$ 、 $-S(O)_2-$ 、 $-N(R_m)-$ 、 O 、 S 或 $CONR_m$ 代替,并且 R_6 中一个或多个氢原子任选被氘原子、卤素原子、腈基或硝基代替,其中两个或更多个相邻的取代基 R_6 任选地接合或稠合形成单环或多环的脂族、芳族或杂芳族环系,所述环系任选被一个或多个基团 R_m 取代;

[0021] R_m 选自氢原子、氘原子、氟原子、腈基、具有 $C_1 \sim C_{20}$ 的脂族烃基组成的组,其中一个或多个氢原子可被氘原子、卤素原子或腈基代替,其中两个或更多个相邻的取代基 R_m 任选彼此形成单环或多环的脂族、芳族或杂芳族环系;

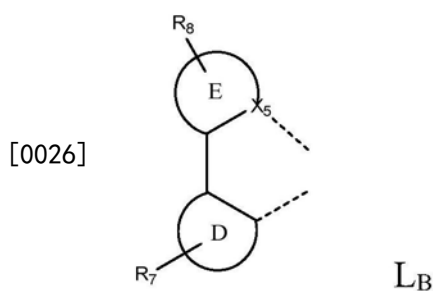
[0022] Ar_1 选自下述基团组成的组:

[0023]



[0024] R_2 、 R_3 、 R_x 各自独立地选自氢原子、氘原子、卤原子、氰基、碳原子总数为1~40的链烷基、碳原子总数为3~40的环烷基、碳原子总数为1~40的烷氧基、碳原子总数为2~40的直链烯基、碳原子总数为1~40的杂烷基、碳原子总数为2~40的环烯基组成的组；

[0025] L_B 为:

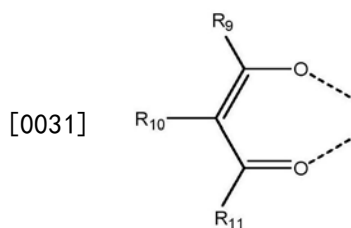


[0027] R₇、R₈各自独立地选自氢原子、氘原子、卤原子、链烷基、环烷基、杂烷基、芳烷基、烷氧基、芳氧基、氨基、硅烷基、链烯基、环烯基、杂烯基、炔基、芳基、杂环芳基组成的组；R₇、R₈中相邻的基团之间任选地接合或稠合成五元环、六元环或稠多环；R₇、R₈各自独立地为一个或者二个以上；

[0028] 环D、环E各自独立地选自五元碳环、五元杂环、六元碳环、六元杂环组成的组；

[0029] X₅为氮或碳；

[0030] L_C 为:



式 Lc;

[0032] R_9 、 R_{10} 、 R_{11} 各自独立地选自氢原子、氘原子、卤素原子、链烷基、环烷基、杂烷基、芳烷基、烷氧基、芳氧基、氨基、硅烷基、链烯基、环烯基、杂烯基、炔基、芳基、杂环芳基组成的组; R_9 、 R_{10} 、 R_{11} 中相邻的基团之间任选地接合或稠合成五元环、六元环或稠多环。

[0033] 本发明的有益效果如下:

[0034] 本发明的有机电致发光材料通过包含 $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 的有机化合物A和 $M(\text{LA})_x(\text{LB})_y(\text{LC})_z$ 的化合物B,从而具有在维持其他电子性能保持一定水平的基础上发光寿命提高和/或工作电压降低的优点。利用本发明的有机电致发光材料获得的本发明的有机电致发光器件从而也具有发光寿命提高和/或工作电压降低的优点。

附图说明

[0035] 下面结合附图对本发明的具体实施方式作进一步详细的说明。

[0036] 图1中示出本发明的有机电致发光元件的一个底部发光例子的示意构成图。

[0037] 图2中示出本发明的有机电致发光元件的一个顶部发光例子的示意构成图。

[0038] 图1、图2中,有机电致发光元件具有基板1、阳极2、阴极8,以及配置于阳极2与阴极8之间的层3~7。其中,在阴极8与发光层5之间配置有空穴阻挡/电子传输层6和电子注入层7,在发光层5与阳极2之间配置有空穴注入3和空穴传输/电子阻挡层4。

具体实施方式

[0039] 为了更清楚地说明本发明,下面结合优选实施例和附图对本发明做进一步的说明。附图中相似的部件以相同的附图标记进行表示。本领域技术人员应当理解,下面所具体描述的内容是说明性的而非限制性的,不应以此限制本发明的保护范围。

[0040] 对于本发明中的数值范围,应理解为具体公开了该范围的上限和下限以及它们之间的每个中间值。在任何陈述值或陈述范围内的中间值以及任何其他陈述值或在所述范围内的中间值之间的每个较小的范围也包括在本发明内。这些较小范围的上限和下限可独立地包括或排除在范围内。

[0041] 除非另有说明,否则本文使用的所有技术和科学术语具有本发明所述领域的常规技术人员通常理解的含义。虽然本发明仅描述了优选的方法和材料,但是在本发明的实施或测试中也可以使用与本文所述相似或等同的任何方法和材料。本说明书中提到的所有文献通过引用并入,用以公开和描述与本文所述文献相关的方法和/或材料。在与任何并入的文献冲突时,以本说明书的内容为准。除非另有说明,否则“%”为基于重量的百分数。

[0042] [有机电致发光材料]

[0043] 本发明的有机电致发光材料包含以下化合物:

[0044] 1) 至少一种 $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 的有机化合物A;和

[0045] 2) 至少一种 $M(\text{LA})_x(\text{LB})_y(\text{LC})_z$ 所示的化合物B,

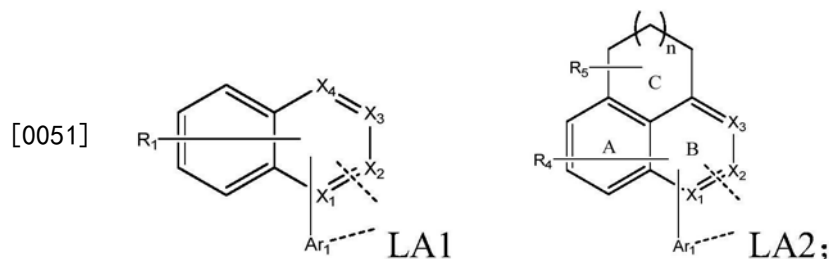
[0046] 其中,三重态能级 $E_T[B]-E_T[A]$ 绝对值 $\leq 0.5\text{eV}$,其中 $E_T[B]$ 是化合物B的三重态能级, $E_T[A]$ 表示化合物A的三重态能级。

[0047] 其中以下适用于所用的符号和标记:

[0048] M表示原子量大于40的金属元素;

[0049] x表示整数1、2或3,y表示整数0、1或2,z表示整数0、1或2,并且,x、y、z之和等于金属M的氧化价态;

[0050] LA为LA1或LA2:



[0052] R_1 选自: $C(R_a)_3$ 、具有1~8个碳原子取代基的反式-环己基、具有1~8个碳原子取代基的1,1'-双(反式-环己基)-4-取代基组成的组;

[0053] R_4 、 R_5 各自独立地选自氢原子、氘原子、链烷基、环烷基、杂烷基、芳烷基、烷氧基、芳氧基、氨基、硅烷基、链烯基、环烯基、杂烯基、炔基、芳基、杂环芳基组成的组;

[0054] 取代基 R_1 为一个或者二个以上;

[0055] 环A、环B上的取代基 R_4 为一个或者二个以上;

[0056] 环C上的取代基 R_5 为一个或者二个以上;

[0057] X_1 、 X_2 、 X_3 、 X_4 各自独立地为碳或氮,并且 X_1 、 X_2 、 X_3 不同时为氮;

[0058] n表示 ≥ 0 的整数;

[0059] R_a 各自独立地选自具有 $C_1\sim C_{40}$ 的直链烷基、具有 $C_1\sim C_{40}$ 的直链杂烷基、具有 $C_3\sim C_{40}$ 的支链或环状的烷基、具有 $C_3\sim C_{40}$ 的支链或环状的杂烷基、具有 $C_2\sim C_{40}$ 的烯基或炔基组成的组,且这些基团任选被一个或多个 R_6 取代,并且一个或多个非相邻的 $-CH_2-$ 基团任选被 $-R_6C=CR_6-$ 、 $-C\equiv C-$ 、 $-Si(R_6)_2-$ 、 $-Ge(R_6)_2-$ 、 $-Sn(R_6)_2-$ 、 $-C(=O)-$ 、 $-C(=S)-$ 、 $-C(=Se)-$ 、 $-C(=NR_6)-$ 、 $-P(=O)(R_6)-$ 、 $-S(O)-$ 、 $-S(O_2)-$ 、 $-N(R_6)-$ 、 $-O-$ 、 $-S-$ 或 $-C(ONR_6)-$ 代替,并且 R_a 中一个或多个氢原子任选被氘原子、卤素原子、腈基或硝基代替,其中两个以上的相邻的取代基 R_a 任选地接合或稠合形成单环或多环的脂族、芳族或杂芳族环系,所述环系任选被一个或多个基团 R_6 取代;

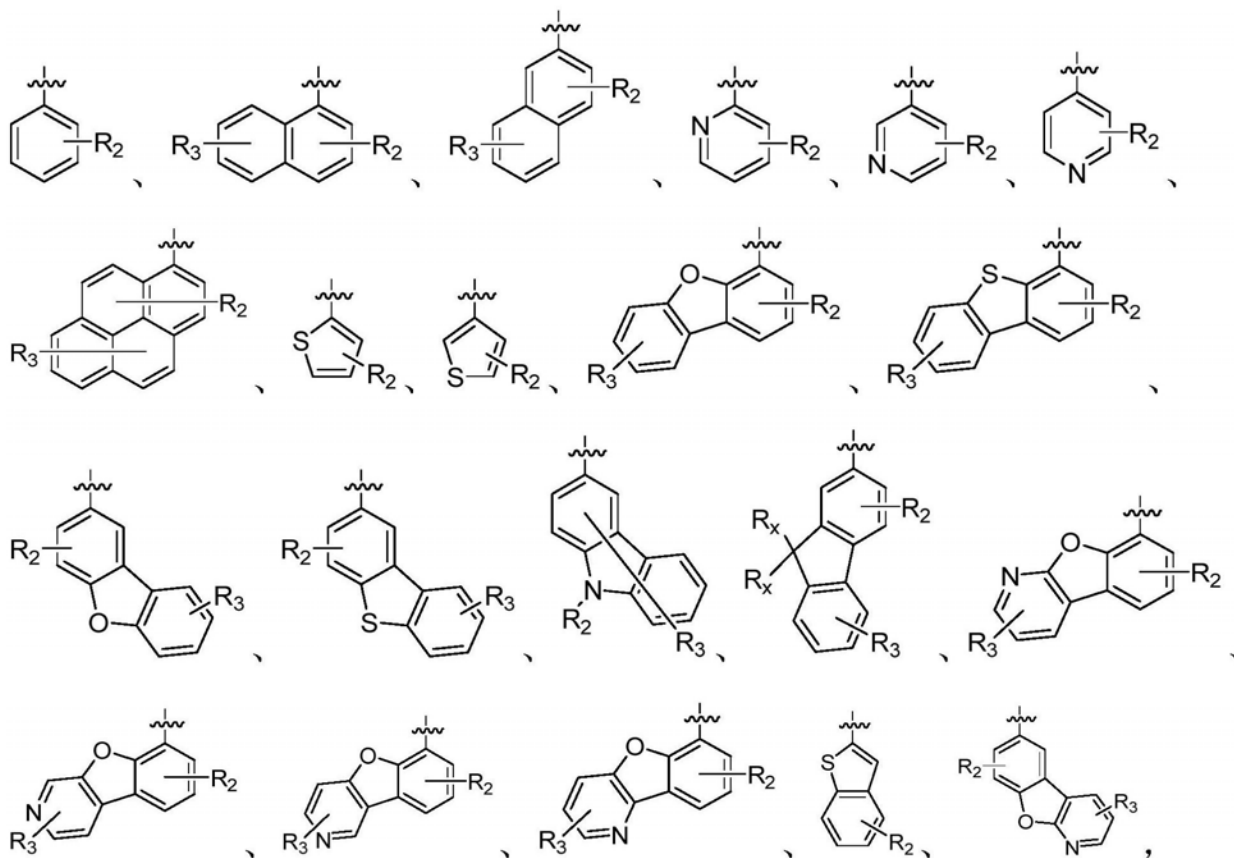
[0060] R_6 各自独立地选自氢原子、氘原子、卤素原子、腈基、硝基、具有 $C_1\sim C_{40}$ 的直链烷基、具有 $C_1\sim C_{40}$ 的直链杂烷基、具有 $C_3\sim C_{40}$ 的支链或环状的烷基、具有 $C_3\sim C_{40}$ 的支链或环状的杂烷基、具有 $C_2\sim C_{40}$ 的烯基、炔基组成的组,所述 R_6 任选被一个或多个基团 R_m 取代,且 R_6 中一个或多个非相邻的 $-CH_2-$ 基团任选被 $-R_mC=CR_m-$ 、 $-C\equiv C-$ 、 $-Si(R_m)_2-$ 、 $-Ge(R_m)_2-$ 、 $-Sn(R_m)_2-$ 、 $-C(=O)-$ 、 $-C(=S)-$ 、 $-C(=Se)-$ 、 $-C(=NR_m)-$ 、 $-P(=O)(R_m)-$ 、 $-S(O)-$ 、 $-S(O_2)-$ 、 $-N(R_m)-$ 、 $-O$ 、 S 或 $CONR_m$ 代替,并且 R_6 中一个或多个氢原子任选被氘原子、卤素原子、腈基或硝基代替,其中两个或更多个相邻的取代基 R_6 任选地接合或稠合形成单环或多环的脂族、芳族或杂芳族环系,所述环系任选被一个或多个基团 R_m 取代;

[0061] R_m 选自氢原子、氘原子、氟原子、腈基、具有 $C_1\sim C_{20}$ 的脂族烃基组成的组,其中一个

或多个氢原子可被氘原子、卤素原子或腈基代替,其中两个或更多个相邻的取代基 R_m 任选彼此形成单环或多环的脂族、芳族或杂芳族环系;

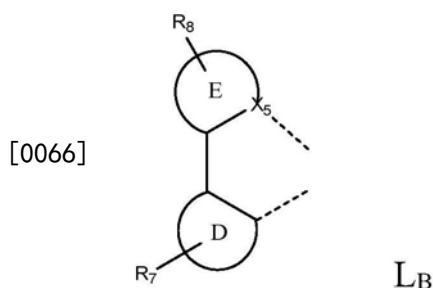
[0062] Ar_1 选自下述基团中的任意一种:

[0063]



[0064] R_2 、 R_3 、 R_x 各自独立地选自氢原子、氘原子、卤原子、氰基、碳原子总数为1~40的链烷基、碳原子总数为3~40的环烷基、碳原子总数为1~40的烷氧基、碳原子总数为2~40的直链烯基、碳原子总数为1~40的杂烷基、碳原子总数为2~40的环烯基组成的组;

[0065] L_B 为:

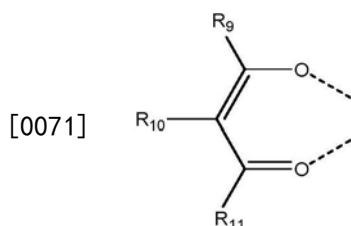


[0067] R_7 、 R_8 各自独立地选自氢原子、氘原子、卤原子、链烷基、环烷基、杂烷基、芳烷基、烷氧基、芳氧基、氨基、硅烷基、链烯基、环烯基、杂烯基、炔基、芳基、杂环芳基组成的组; R_7 、 R_8 中相邻的基团之间任选地接合或稠合成五元环、六元环或稠多环; R_7 、 R_8 各自独立地为一个或者二个以上;

[0068] 环D、环E各自独立地选自五元碳环、五元杂环、六元碳环、六元杂环组成的组;

[0069] X_5 为氮或碳;

[0070] Lc为:



式 Lc;

[0072] R_9 、 R_{10} 、 R_{11} 各自独立地选自氢原子、氘原子、卤素原子、链烷基、环烷基、杂烷基、芳烷基、烷氧基、芳氧基、氨基、硅烷基、链烯基、环烯基、杂烯基、炔基、芳基、杂环芳基组成的组; R_9 、 R_{10} 、 R_{11} 中相邻的基团之间任选地接合或稠合成五元环、六元环或稠多环;

[0073] 本发明中的基团中,在为芳基的情况下,其含有6~60个碳原子。本发明中的杂芳基是含有2~60个碳原子和至少一个杂原子、碳原子和杂原子的总和至少是5的芳香族基团。所述杂原子优选选自N、O或S。此处的芳基或杂芳基被认为是指简单的芳族环,即苯、萘等,或简单的杂芳族环,如吡啶、嘧啶、噻吩等,或稠合的芳基或杂芳基,如蒽、菲、喹啉、异喹啉等。通过单键彼此连接的芳族环,例如联苯,相反地不在本发明的芳基或杂芳基的范围内,而属于本发明的芳族环系。

[0074] 本发明中,芳族环系或杂芳族环系是指多个芳基或杂芳基以及任选具有的C、N、O或S等非芳族单元连接形成的环系基团。例如,两个或更多个芳基被例如短的烷基连接的体系。另外,诸如茛、9,9'-螺二茛、9,9'-二芳基茛、三芳基胺、二芳基醚等的体系也被认为是本发明意义上的芳族环系。

[0075] 对于本发明意义上的含有1~40个碳原子并且其中单独的氢原子或 $-CH_2-$ 基团任选被取代基取代的脂族烃基或者烷基或者烯基或炔基可以列举出,例如如下基团:甲基、乙基、正丙基、异丙基、正丁基、异丁基、仲丁基、叔丁基、2-甲基丁基、正戊基、仲戊基、新戊基、环戊基、正己基、新己基、环己基、正庚基、环庚基、正辛基、环辛基、2-乙基己基、环己烯基、庚烯基、环庚烯基、辛烯基、环辛烯基、乙炔基、丙炔基、丁炔基、戊炔基、己炔基、庚炔基或辛炔基。作为烷氧基,优选具有1~40个碳原子的烷氧基,作为这样的基团,可以列举出例如甲氧基、三氟甲氧基、乙氧基、正丙氧基、异丙氧基、正丁氧基、异丁氧基、仲丁氧基、叔丁氧基、正戊氧基、仲戊氧基、2-甲基丁氧基、正己氧基、环己氧基、正庚氧基、环庚氧基、正辛氧基、环辛氧基、2-乙基己氧基、五氟乙氧基、2,2,2-三氟乙氧基等。作为杂烷基,优选具有1~40个碳原子的烷基,其中单独的氢原子或 $-CH_2-$ 基团任选被氧、硫、卤素原子取代,作为这样的基团,可以列举出例如烷氧基、烷硫基、氟代的烷氧基、氟代的烷硫基。这些基团中,优选甲氧基、乙氧基、正丙氧基、异丙氧基、正丁氧基、异丁氧基、仲丁氧基、叔丁氧基、甲硫基、乙硫基、正丙硫基、异丙硫基、正丁硫基、异丁硫基、仲丁硫基、叔丁硫基、三氟甲硫基、三氟甲氧基、五氟乙氧基、五氟乙硫基、2,2,2-三氟乙氧基、2,2,2-三氟乙硫基、乙烯氧基、乙烯硫基、丙烯氧基、丙烯硫基、丁烯氧基、丁烯硫基、戊烯氧基、戊烯硫基、环戊烯氧基、环戊烯硫基、己烯氧基、己烯硫基、环己烯氧基、环己烯硫基、乙炔氧基、乙炔硫基、丙炔氧基、丙炔硫基、丁炔氧基、丁炔硫基、戊炔氧基、戊炔硫基、己炔氧基、己炔硫基。

[0076] 作为本发明的环烷基,可以列举出例如环丙基、环丁基、环戊基、环己基;作为本发明的环烯基,可以列举出例如环丁烯基、环戊烯基、环己烯基、环庚基、环庚烯基,其中一个或多个 $-CH_2-$ 基团任选被上述基团代替;此外,一个或多个氢原子任选被氘原子、卤素原子

或腓基代替。

[0077] 本发明的芳族或杂芳族环原子,在每种情况下还可被上述基团R1、R4或R5取代的芳族或杂芳族环系,特别是指衍生自如下物质的基团:苯、萘、蒽、苯并蒽、菲、芘、**蒎**、花、荧蒽、并四苯、并五苯、苯并芘、联苯、偶苯、三联苯、三聚苯、茚、螺二茚、二氢菲、二氢芘、四氢芘、顺式或反式茚并茚、顺式或反式茚并吡啶、顺式或反式吡啶并吡啶、三聚茚、异三聚茚、螺三聚茚、螺异三聚茚、呋喃、苯并呋喃、异苯并呋喃、二苯并呋喃、噻吩、苯并噻吩、异苯并噻吩、二苯并噻吩、吡咯、吡啶、异吡啶、吡啶、吡啶、喹啉、异喹啉、吡啶、菲啶、苯并[5,6]喹啉、苯并[6,7]喹啉、苯并[7,8]喹啉、吩噻嗪、吩噻嗪、吡啶、吡啶、咪唑、苯并咪唑、萘并咪唑、菲并咪唑、吡啶并咪唑、吡啶并咪唑、喹啉并咪唑、噻吩、苯并噻吩、萘并噻吩、蒽并噻吩、菲并噻吩、异噻吩、1,2-噻吩、1,3-噻吩、苯并噻吩、哒嗪、六氮杂苯并菲、苯并哒嗪、嘧啶、苯并嘧啶、喹啉、1,5-二氮杂蒽、2,7-二氮杂芘、2,3-二氮杂芘、1,6-二氮杂芘、1,8-二氮杂芘、4,5-二氮杂芘、4,5,9,10-四氮杂芘、吡啶、吩噻嗪、吩噻嗪、吩噻嗪、荧红环、萘啶、氮杂吡啶、苯并吡啶、吡啶、菲咯啉、1,2,3-三唑、1,2,4-三唑、苯并三唑、1,2,3-噁二唑、1,2,4-噁二唑、1,2,5-噁二唑、1,3,4-噁二唑、1,2,3-噻二唑、1,2,4-噻二唑、1,2,5-噻二唑、1,3,4-噻二唑、1,3,5-三嗪、1,2,4-三嗪、1,2,3-三嗪、四唑、1,2,4,5-四唑、1,2,3,4-四唑、1,2,3,5-四唑、嘌呤、蝶啶、吡啶和苯并噻二唑或者衍生自这些体系的组合的基团。

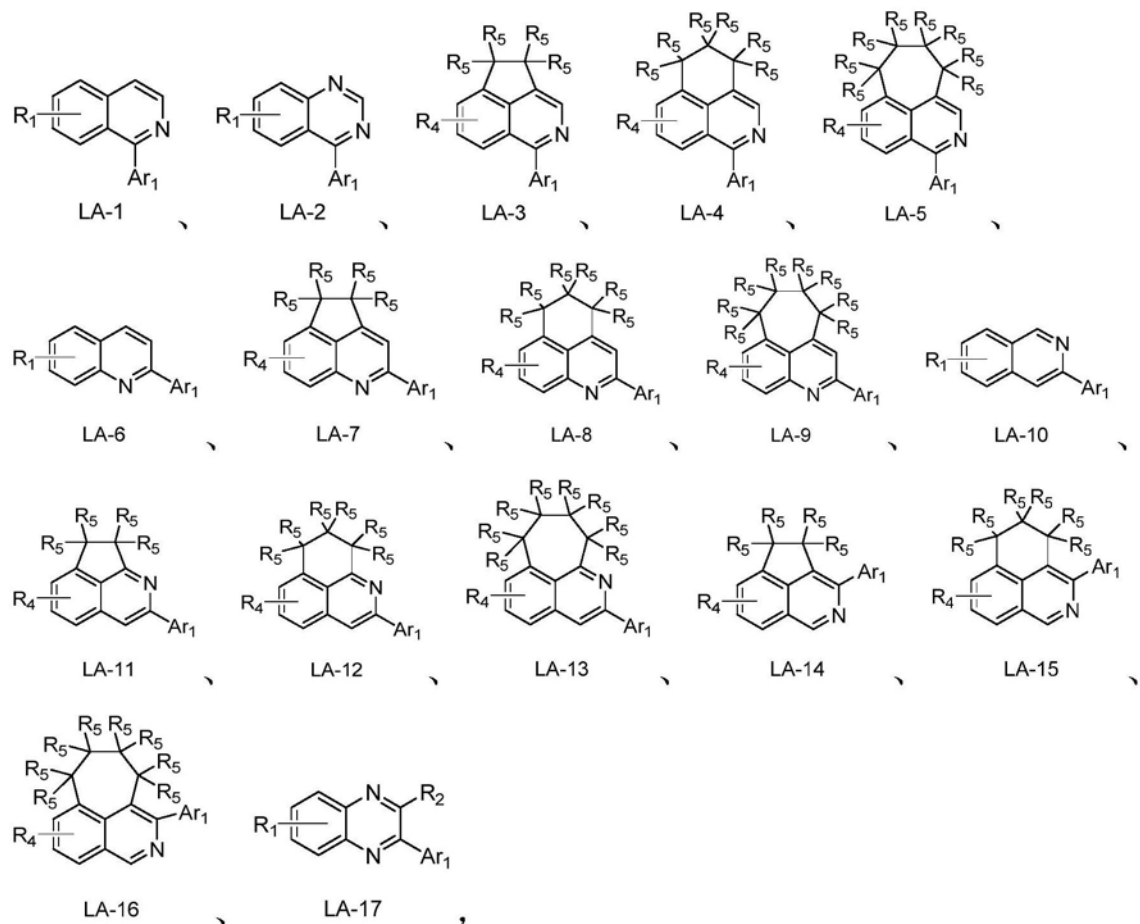
[0078] 对于本发明中的 $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 的有机化合物A, E_T 是指化合物的三重态能级。化合物的 E_T 值是通过如下文实施例部分中描述的量子化学计算来确定的。

[0079] $[M(LA)_x(LB)_y(LC)_z]$ 所示化合物B]下面描述式 $M(LA)_x(LB)_y(LC)_z$ 所示化合物B的优选实施方式。

[0080] 在本发明的一个优选实施方式中,所述金属M优选为Ir或Pt,即,所述 $M(LA)_x(LB)_y(LC)_z$ 所示化合物B优选为 $Ir(LA)(LB)(LC)$ 、 $Ir(LA)_2(LB)$ 、 $Ir(LA)(LB)_2$ 、 $Ir(LA)_2(LC)$ 、 $Ir(LA)_3$ 、 $Pt(LA)(LB)$ 或 $Pt(LA)(LC)$ 。

[0081] 所述LA优选选自LA-1~LA-17组成的组,

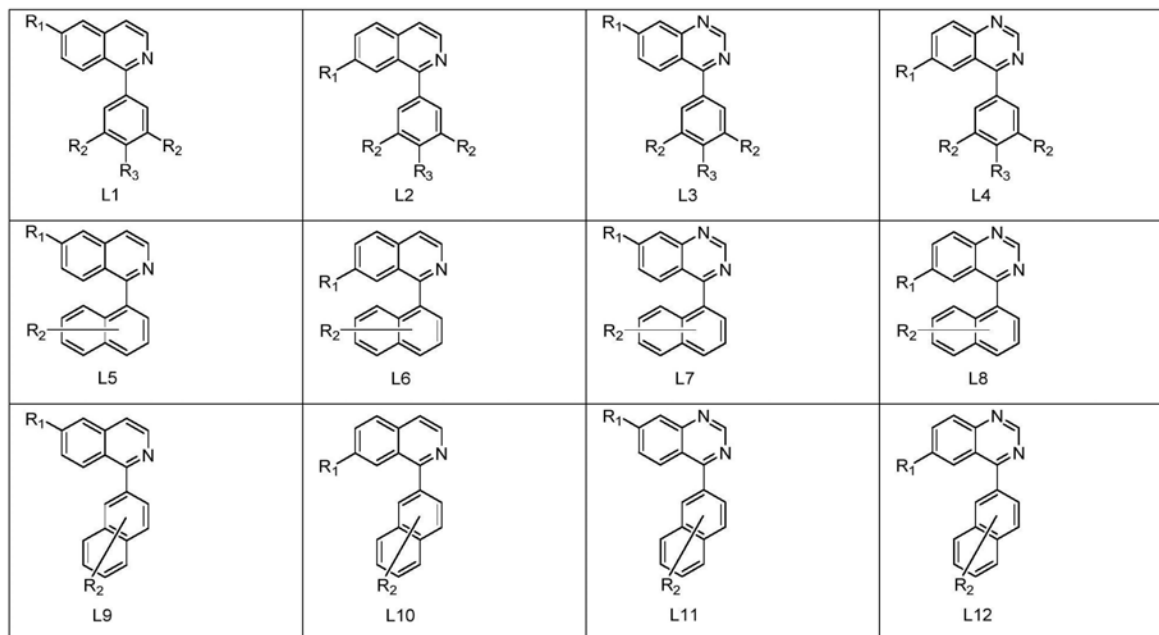
[0082]



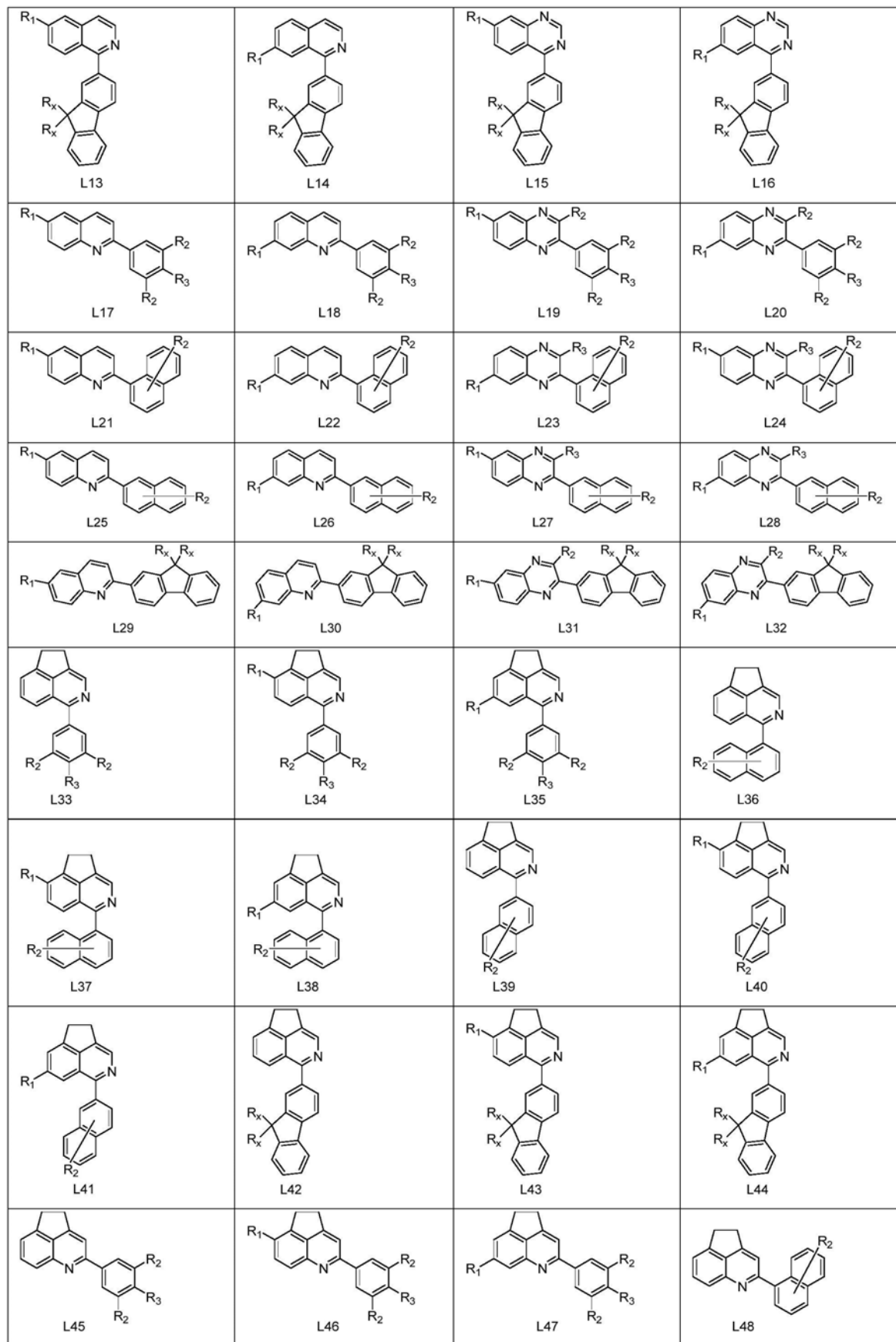
[0083] 其中所用的 R_1 、 R_2 、 R_4 、 R_5 、 Ar_1 具有上文给出的含义,上述 R_1 、 R_2 、 R_4 、 R_5 、 Ar_1 各自相同或不相同。

[0084] 在本发明的一个优选实施方式中,所述LA特别优选选自如下的L1~L104所示的化合物组成的组,

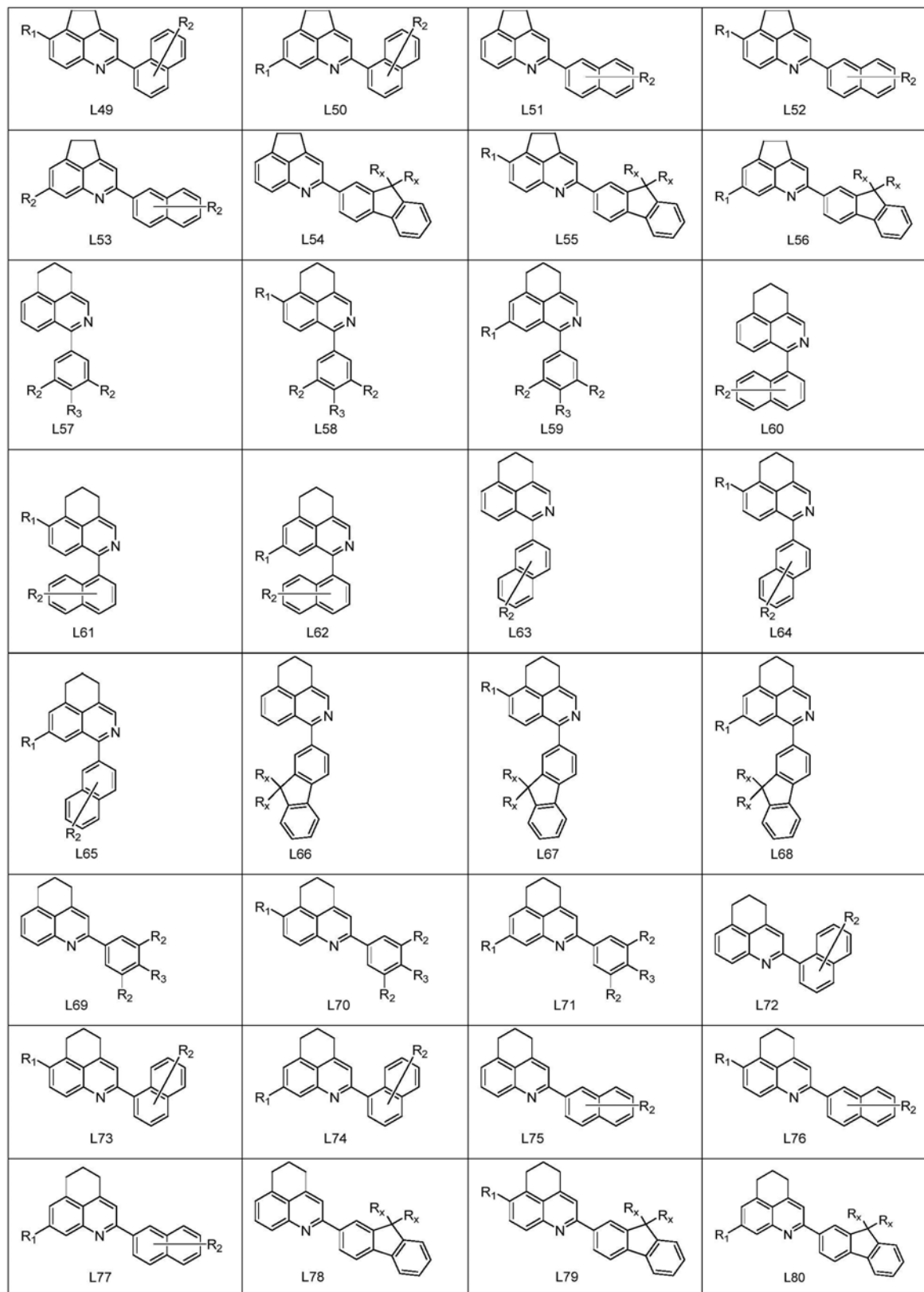
[0085]



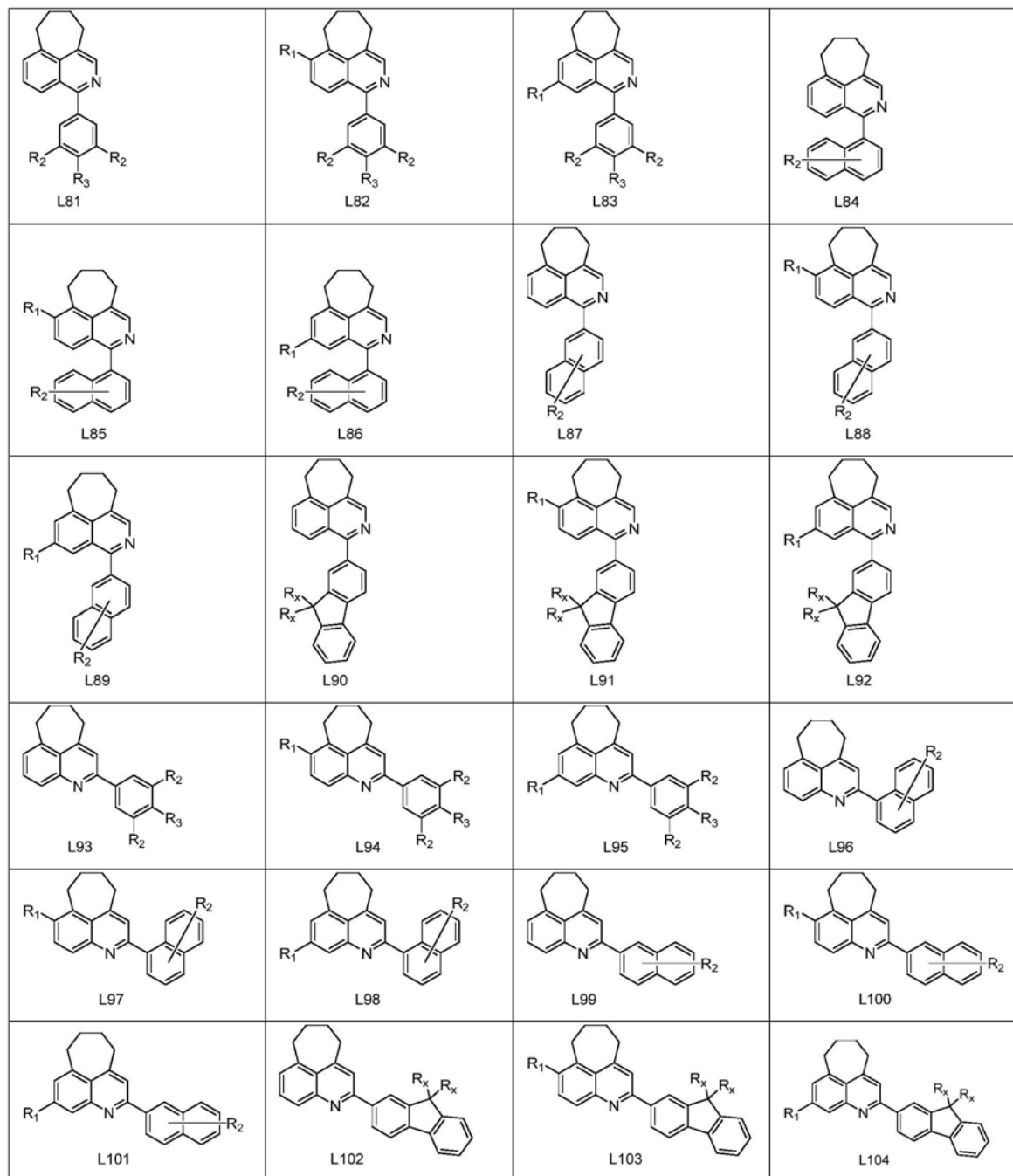
[0086]



[0087]

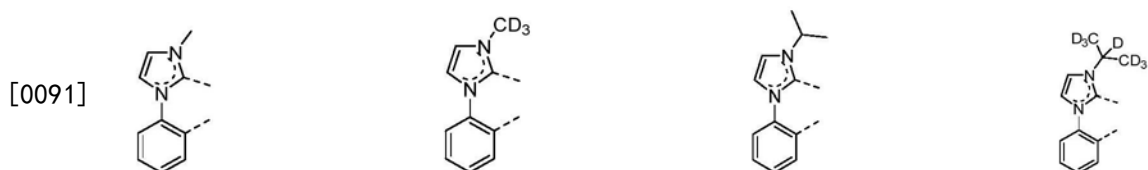


[0088]

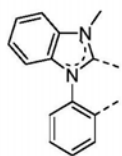


[0089] 其中所用的 R_1 、 R_2 、 R_3 、 R_x 具有上文给出的含义,上述 R_1 、 R_2 、 R_3 、 R_x 各自相同或不相同。

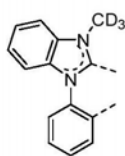
[0090] 在本发明的一个优选实施方式中,所述LB选自下述的LB1~LB44所示的化合物组成的组,



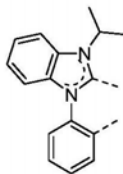
LB1



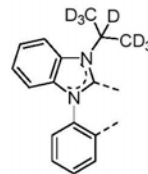
LB2



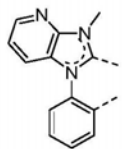
LB3



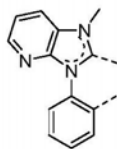
LB4



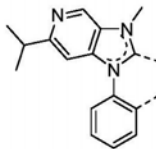
LB5



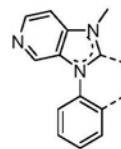
LB6



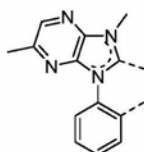
LB7



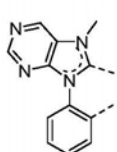
LB8



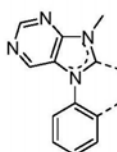
LB9



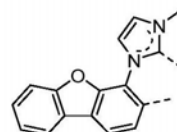
LB10



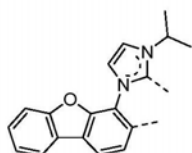
LB11



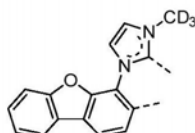
LB12



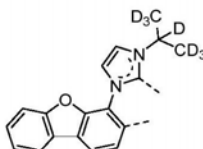
LB13



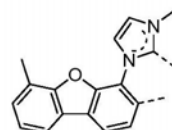
LB14



LB15

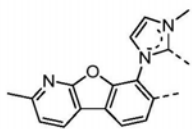


LB16

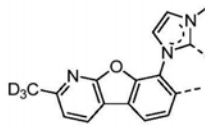


[0092]

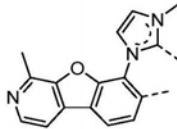
LB17



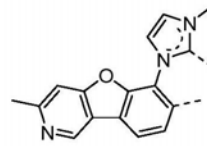
LB18



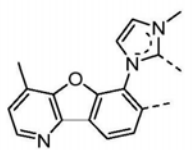
LB19



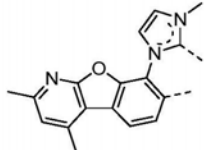
LB20



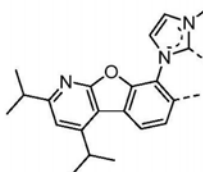
LB21



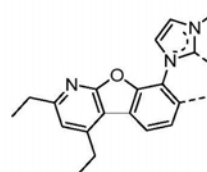
LB22



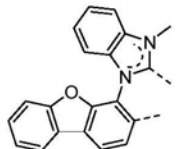
LB23



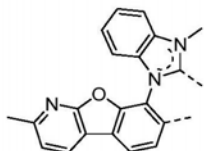
LB24



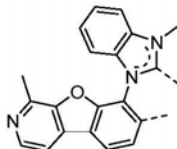
LB25



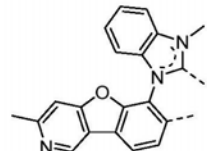
LB26



LB27



LB28



LB29



LB30

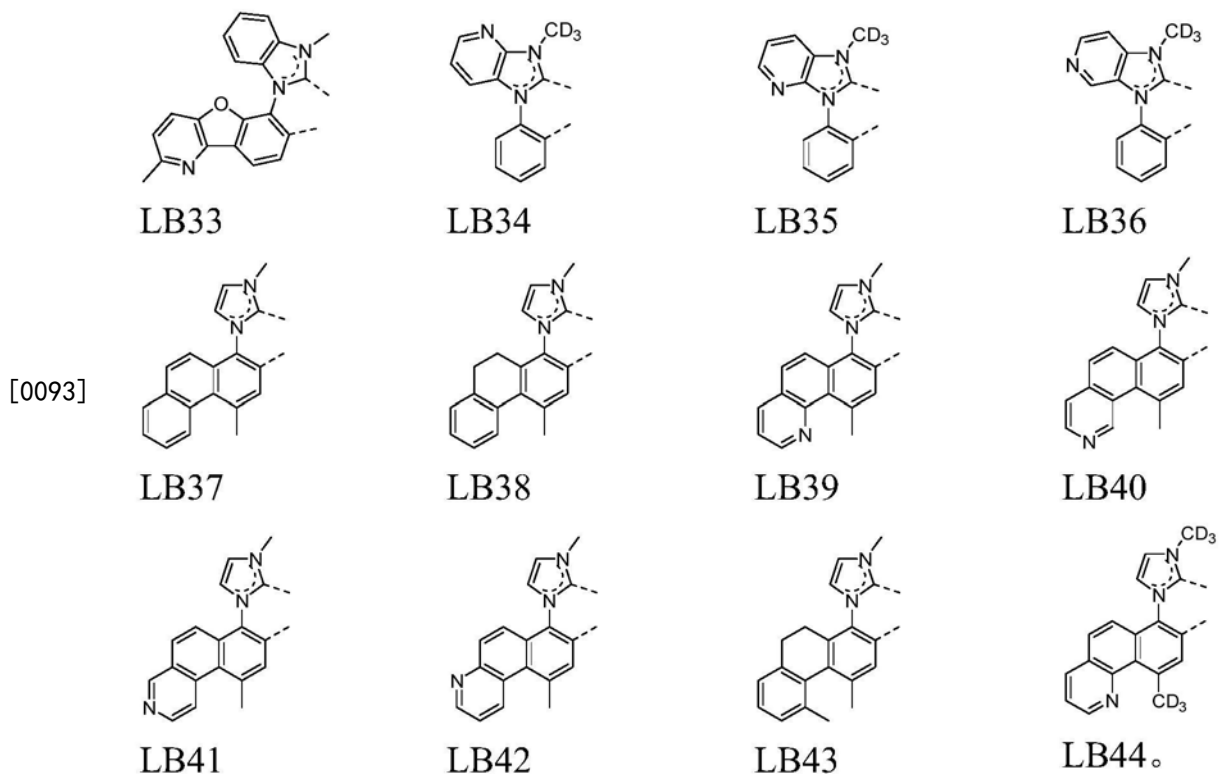


LB31

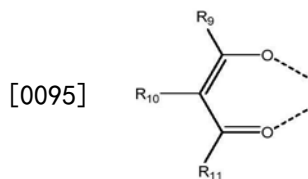


LB32



















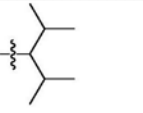
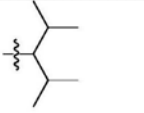
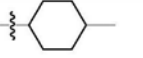
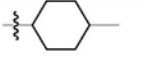
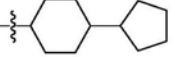
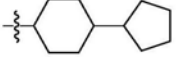
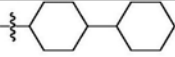





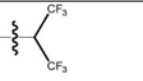
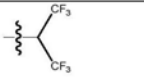


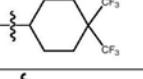

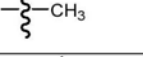
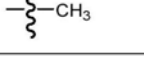
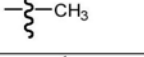
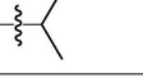
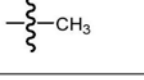
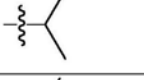

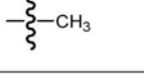

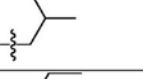
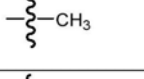
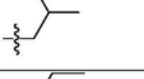

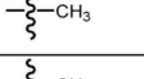


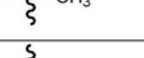

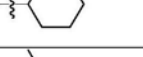
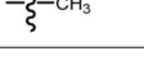

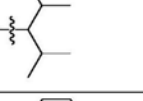
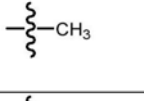
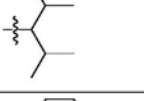
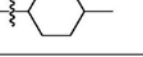
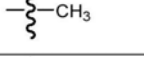
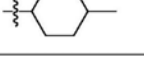
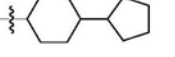
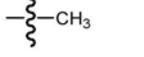
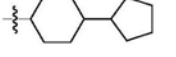
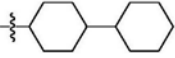
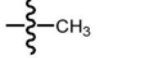
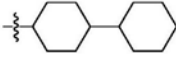

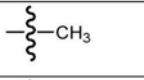


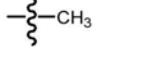

[0094] 在本发明的一个优选实施方式中,所述LC选自下述的LC1~LC48所示的化合物组成的组,



[0096]

化合物 Lc	R ₉	R ₁₀	R ₁₁
LC1	 -CH ₃	H	 -CH ₃
LC2		H	
LC3		H	
LC4		H	
LC5		H	
LC6		H	
LC7		H	

[0097]

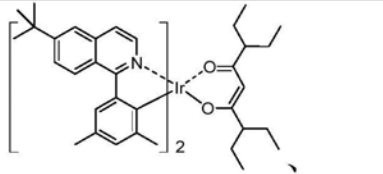
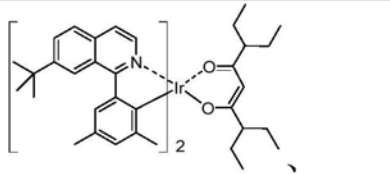
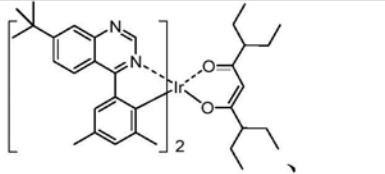
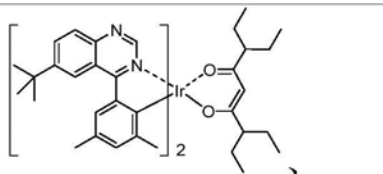
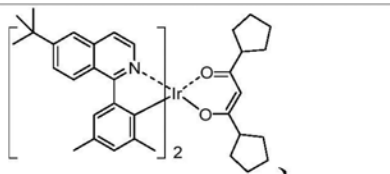
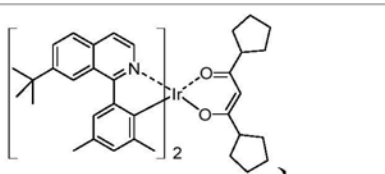
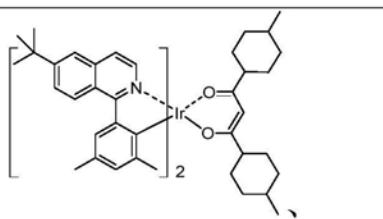
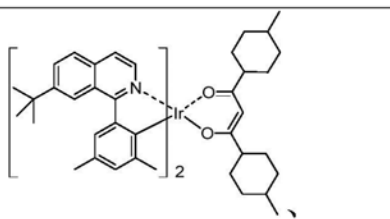
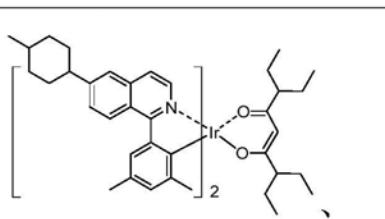
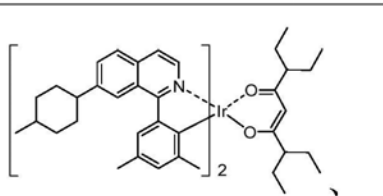
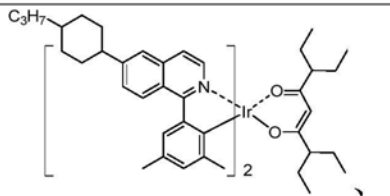
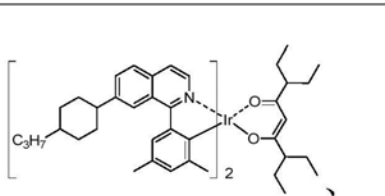
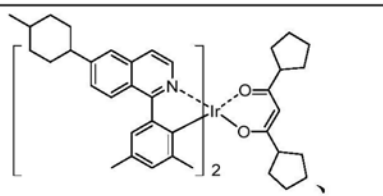
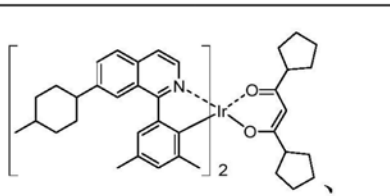
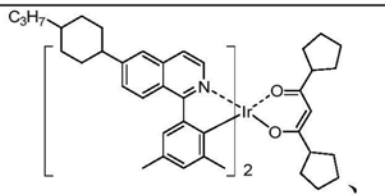
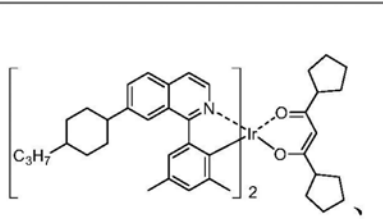
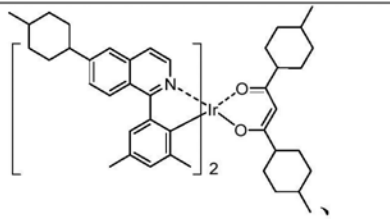
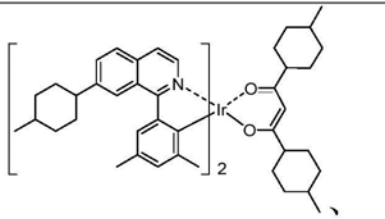
LC8		H	
LC9		H	
LC10		H	
LC11		H	
LC12		H	
LC13		H	
LC14		H	
LC15		H	
LC16		H	
LC17			
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[0098]

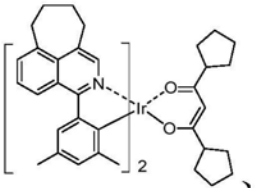
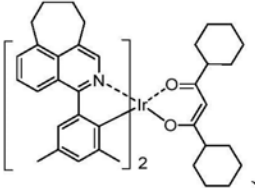
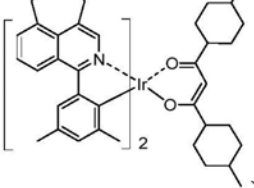
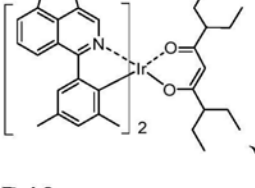
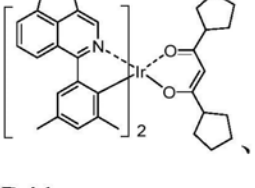
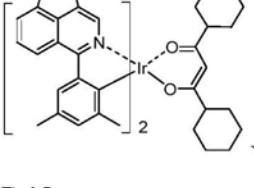
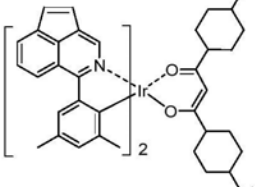
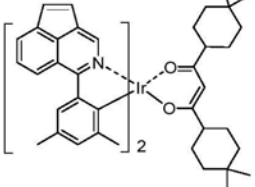
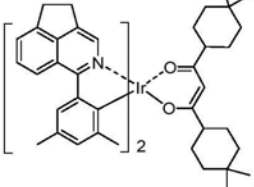
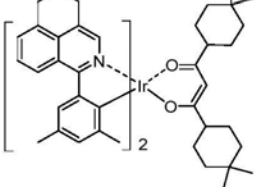
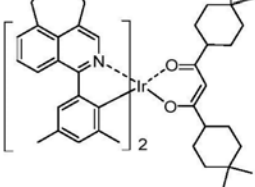
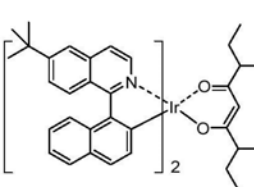
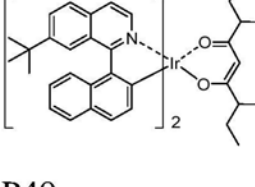
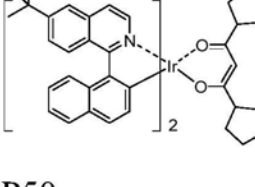
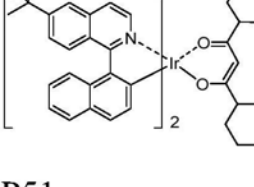
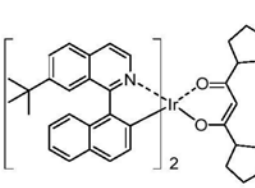
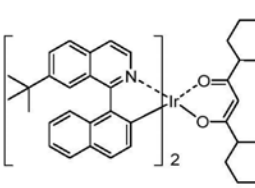
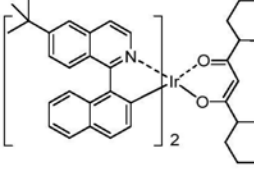
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LC47			
LC48			

[0099] 根据上述实施方式的优选化合物M(LA)_x(LB)_y(LC)_z的实例是下表所示的化合物:

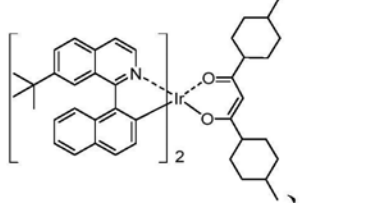
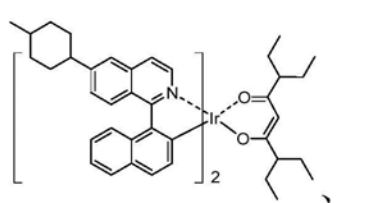
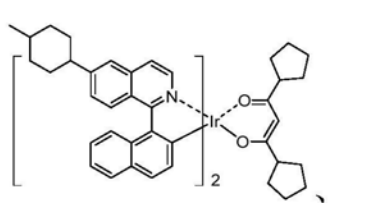
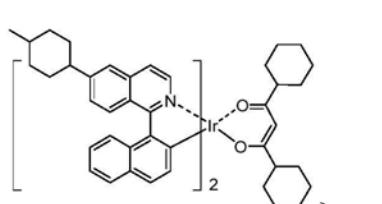
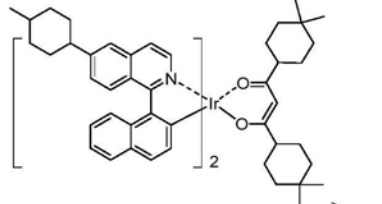
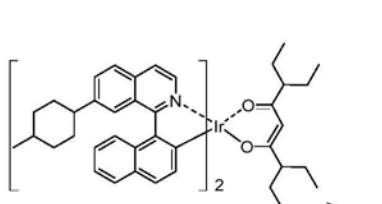
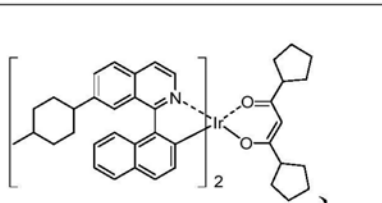
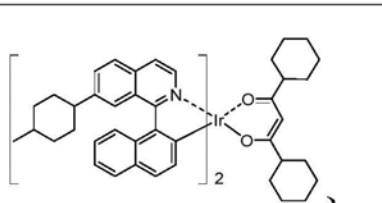
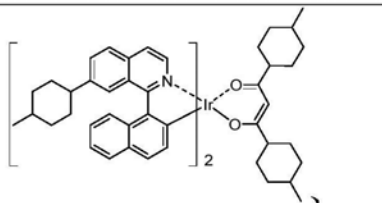
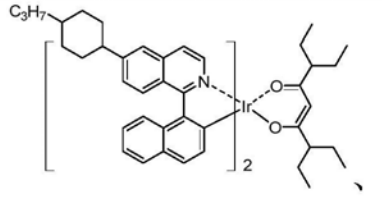
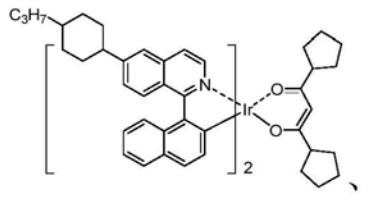
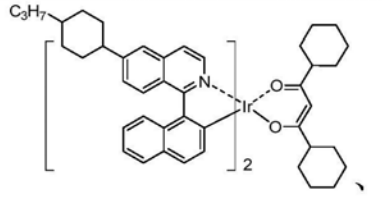
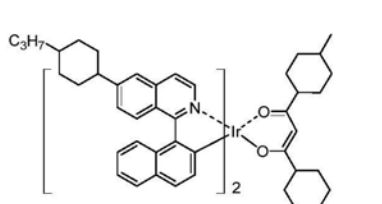
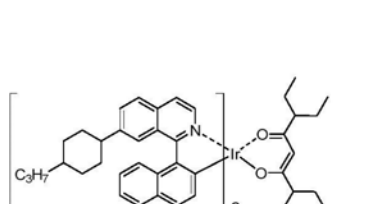
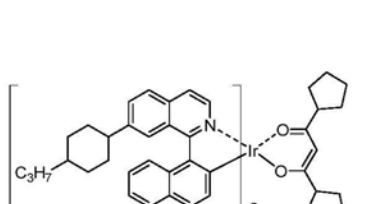
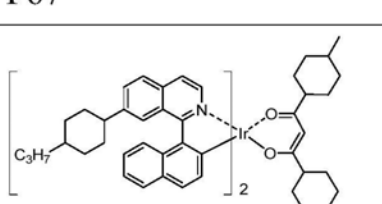
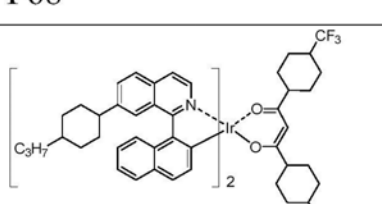
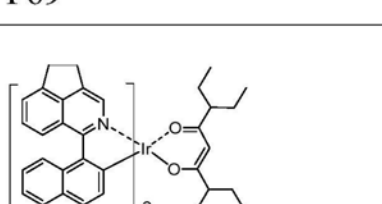
[0100]

 <p>P01</p>	 <p>P02</p>	 <p>P03</p>
 <p>P04</p>	 <p>P05</p>	 <p>P06</p>
 <p>P07</p>	 <p>P08</p>	 <p>P09</p>
 <p>P10</p>	 <p>P11</p>	 <p>P12</p>
 <p>P13</p>	 <p>P14</p>	 <p>P15</p>
 <p>P16</p>	 <p>P17</p>	 <p>P18</p>

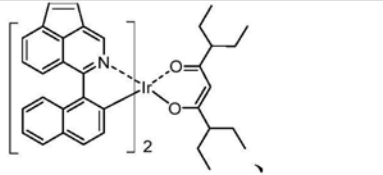
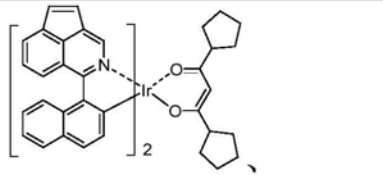
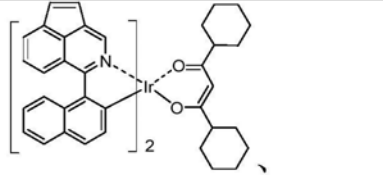
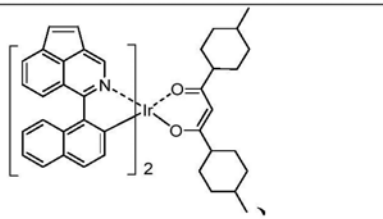
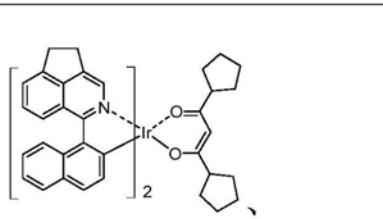
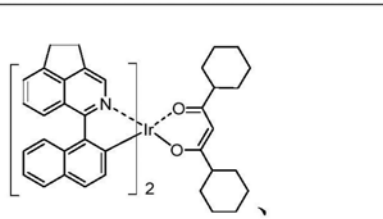
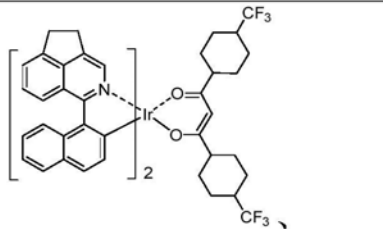
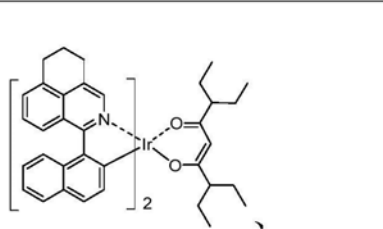
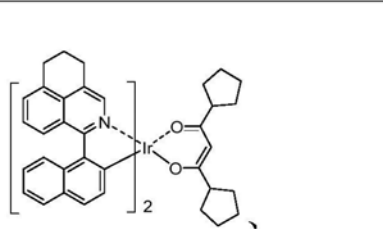
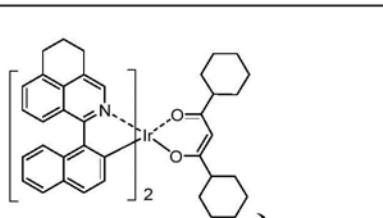
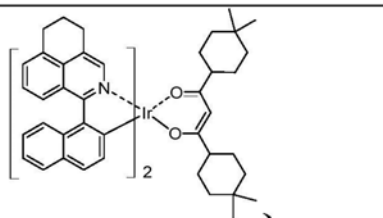
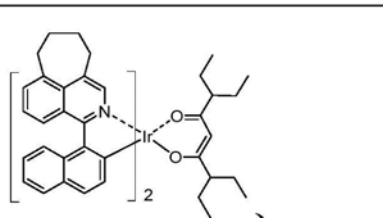
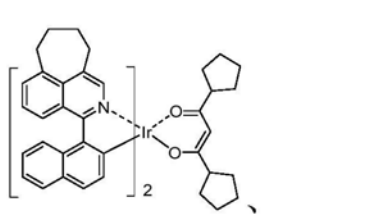
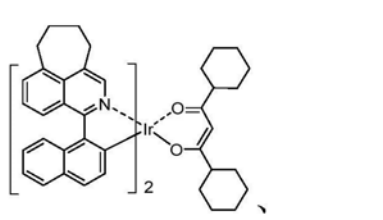
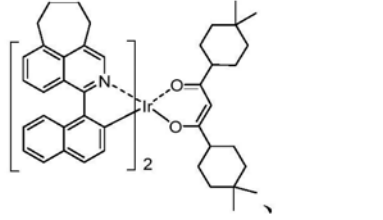
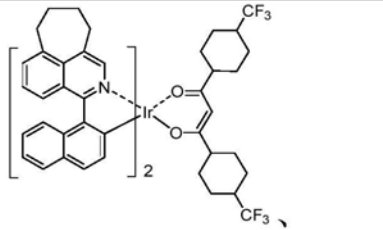
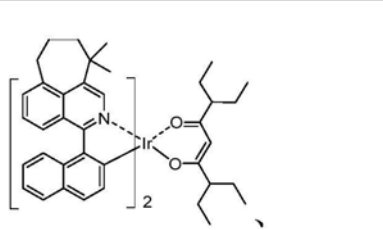
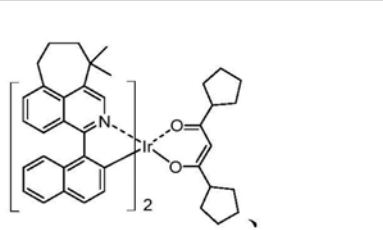
[0102]

 <p>P37</p>	 <p>P38</p>	 <p>P39</p>
 <p>P40</p>	 <p>P41</p>	 <p>P42</p>
 <p>P43</p>	 <p>P44</p>	 <p>P45</p>
 <p>P46</p>	 <p>P47</p>	 <p>P48</p>
 <p>P49</p>	 <p>P50</p>	 <p>P51</p>
 <p>P52</p>	 <p>P53</p>	 <p>P54</p>

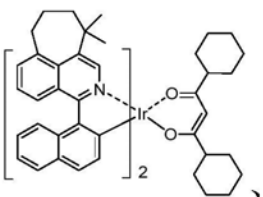
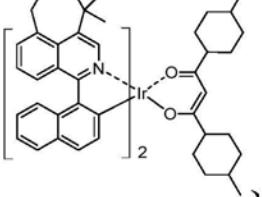
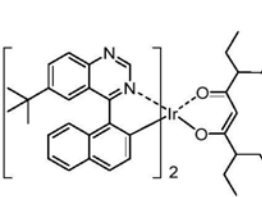
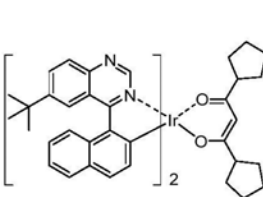
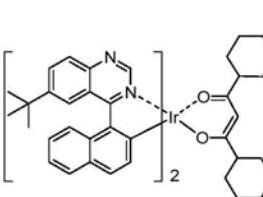
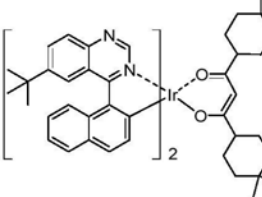
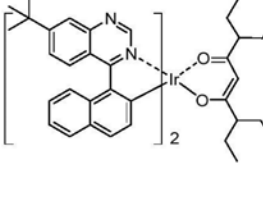
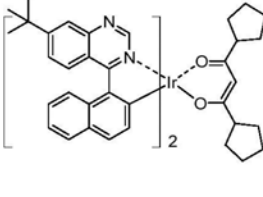
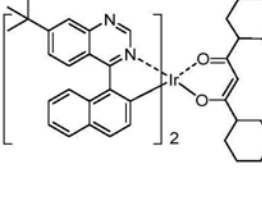
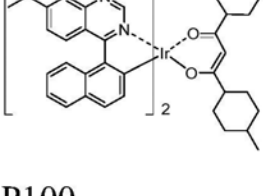
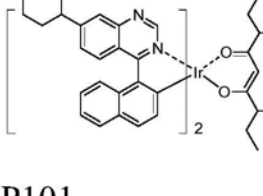
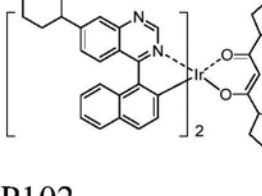
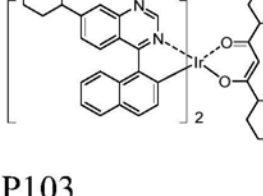
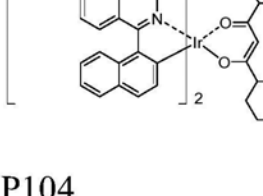
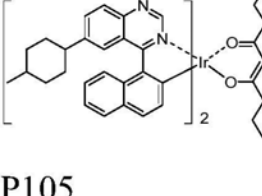
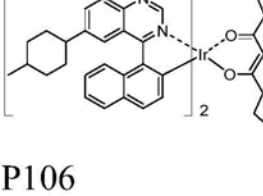
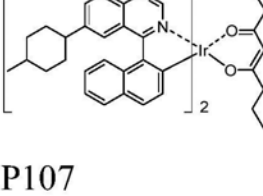
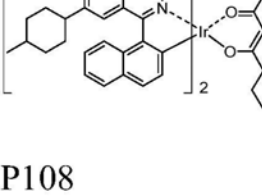
[0103]

 <p>P55</p>	 <p>P56</p>	 <p>P57</p>
 <p>P58</p>	 <p>P59</p>	 <p>P60</p>
 <p>P61</p>	 <p>P62</p>	 <p>P63</p>
 <p>P64</p>	 <p>P65</p>	 <p>P66</p>
 <p>P67</p>	 <p>P68</p>	 <p>P69</p>
 <p>P70</p>	 <p>P71</p>	 <p>P72</p>

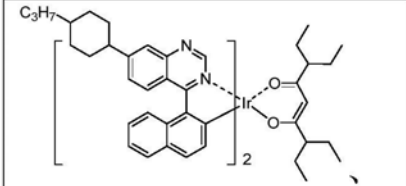
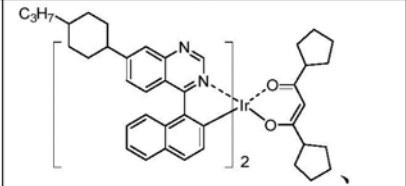
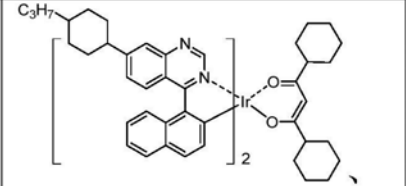
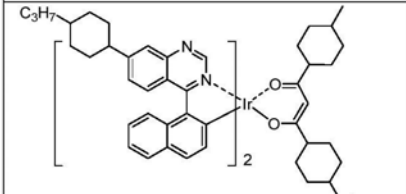
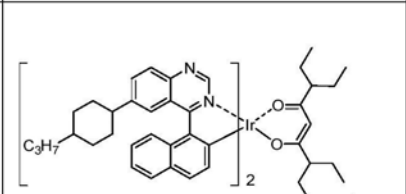
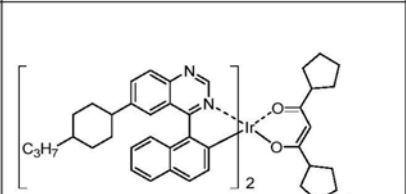
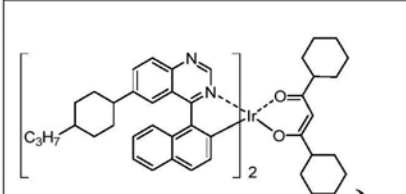
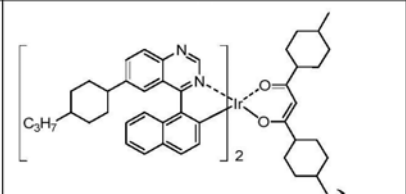
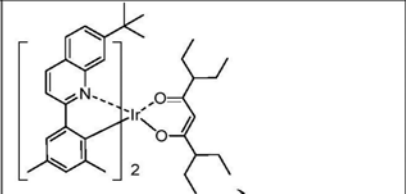
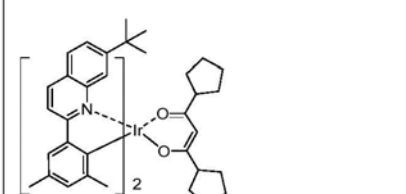
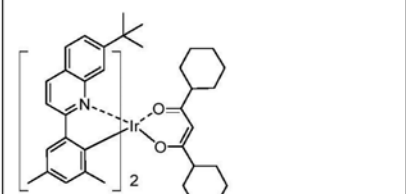
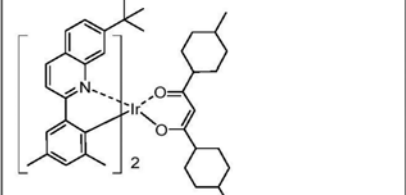
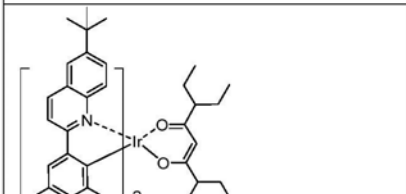
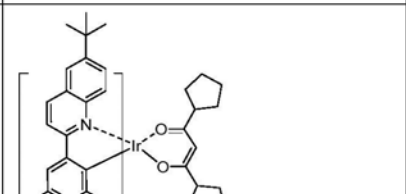
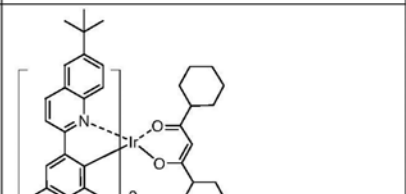
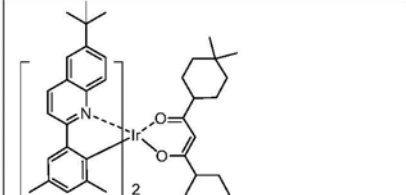
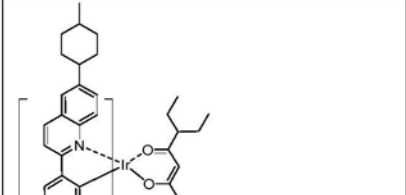
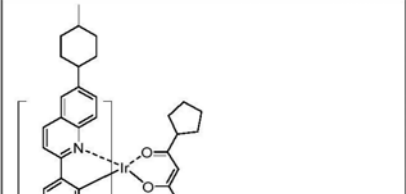
[0104]

 <p>P73</p>	 <p>P74</p>	 <p>P75</p>
 <p>P76</p>	 <p>P77</p>	 <p>P78</p>
 <p>P79</p>	 <p>P80</p>	 <p>P81</p>
 <p>P82</p>	 <p>P83</p>	 <p>P84</p>
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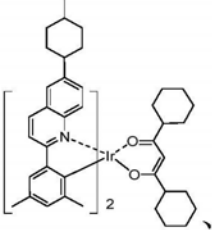
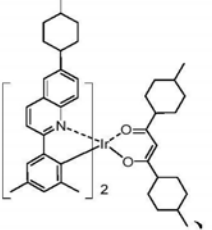
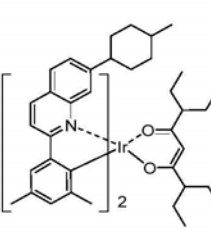
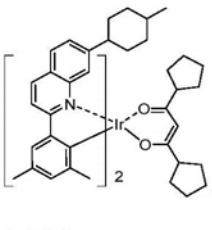
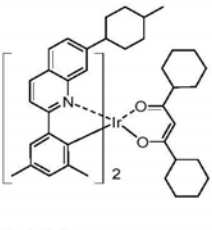
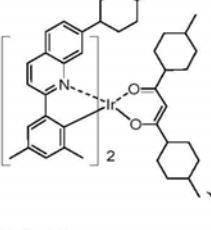
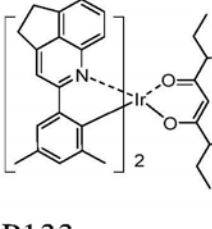
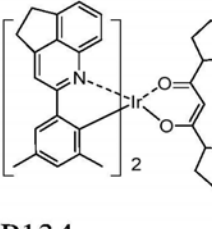
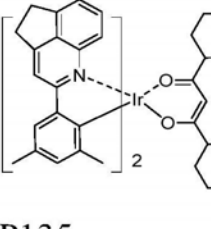
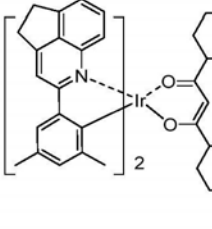
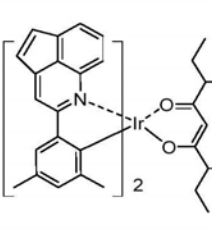
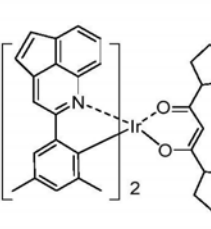
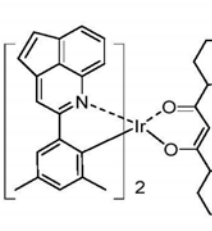
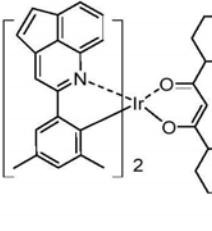
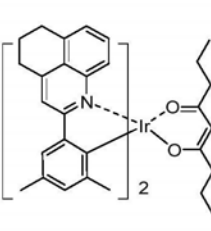
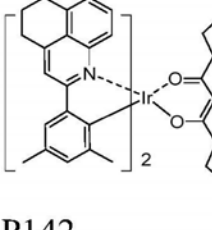
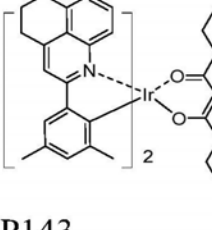
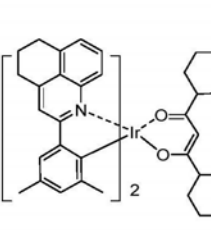
[0105]

 <p>P91</p>	 <p>P92</p>	 <p>P93</p>
 <p>P94</p>	 <p>P95</p>	 <p>P96</p>
 <p>P97</p>	 <p>P98</p>	 <p>P99</p>
 <p>P100</p>	 <p>P101</p>	 <p>P102</p>
 <p>P103</p>	 <p>P104</p>	 <p>P105</p>
 <p>P106</p>	 <p>P107</p>	 <p>P108</p>

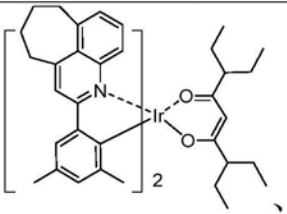
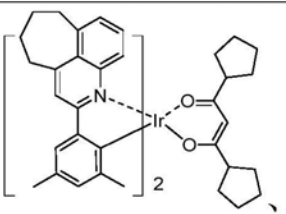
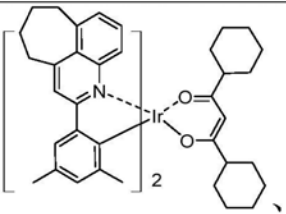
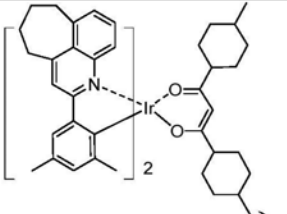
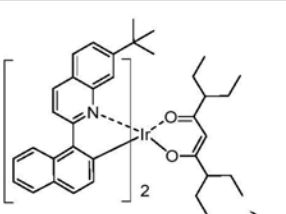
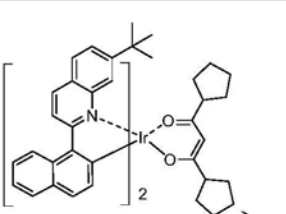
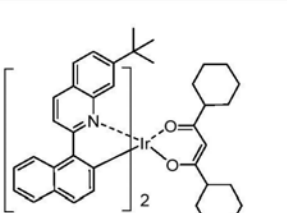
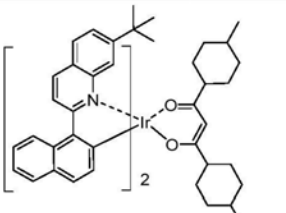
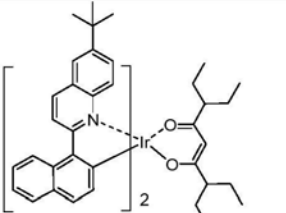
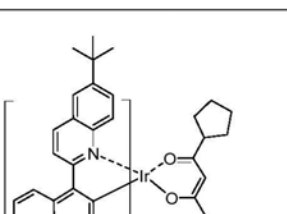
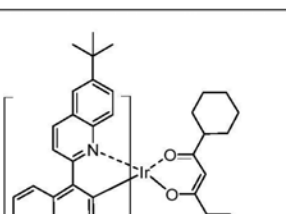
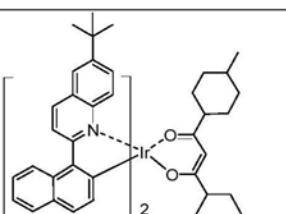
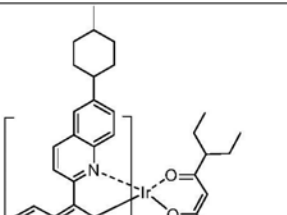
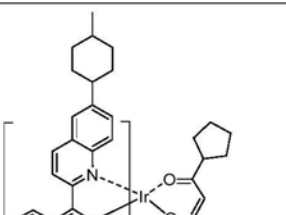
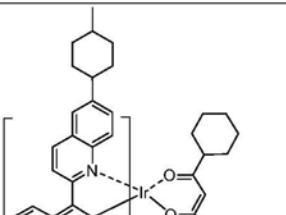
[0106]

 <p>P109</p>	 <p>P110</p>	 <p>P111</p>
 <p>P112</p>	 <p>P113</p>	 <p>P114</p>
 <p>P115</p>	 <p>P116</p>	 <p>P117</p>
 <p>P118</p>	 <p>P119</p>	 <p>P120</p>
 <p>P121</p>	 <p>P122</p>	 <p>P123</p>
 <p>P124</p>	 <p>P125</p>	 <p>P126</p>

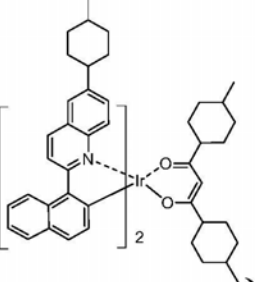
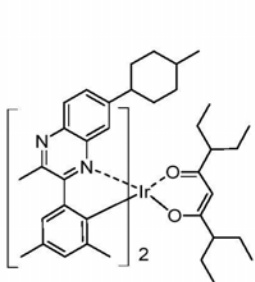
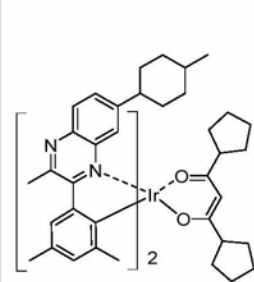
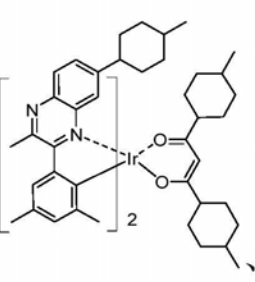
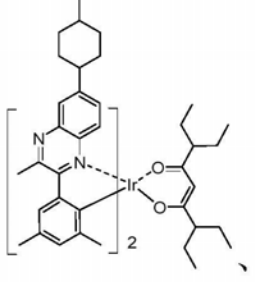
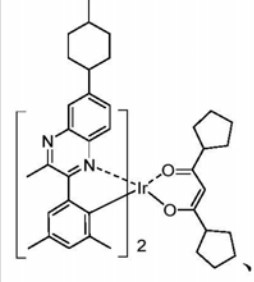
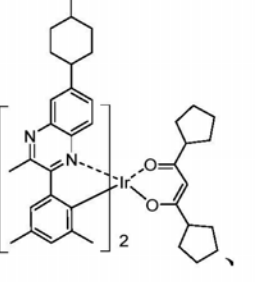
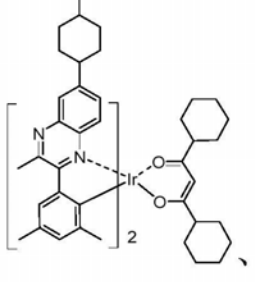
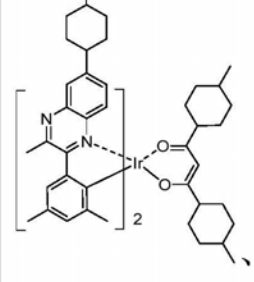
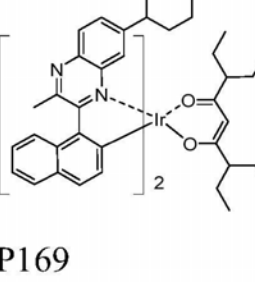
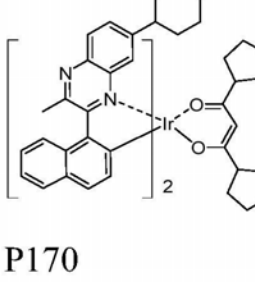
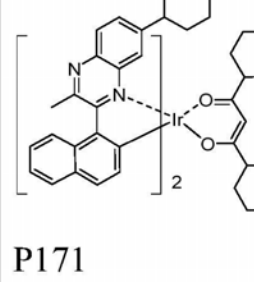
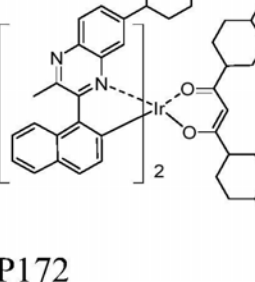
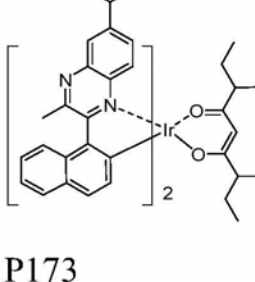
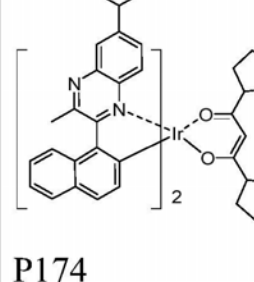
[0107]

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 P130	 P131	 P132
 P133	 P134	 P135
 P136	 P137	 P138
 P139	 P140	 P141
 P142	 P143	 P144

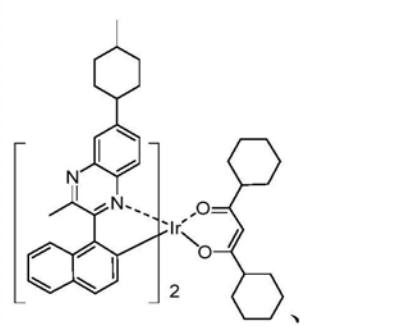
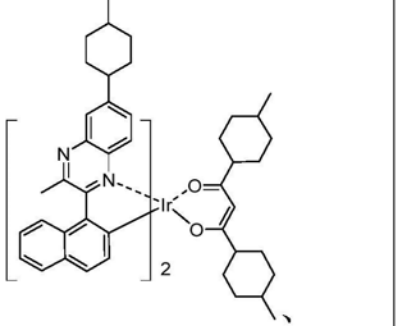
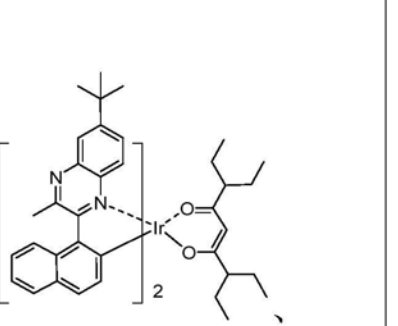
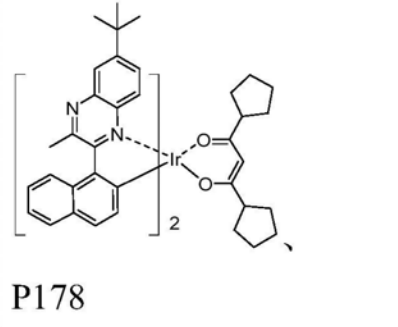
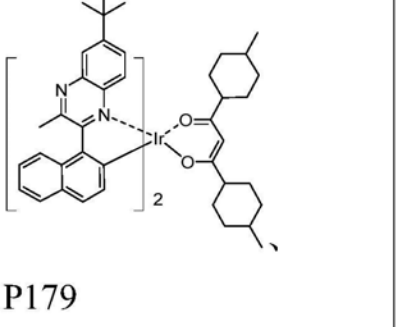
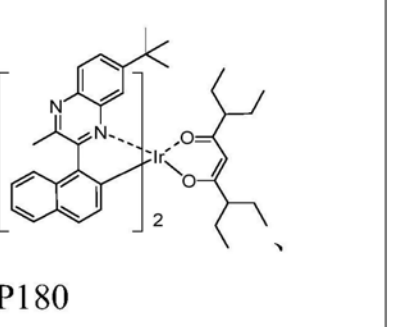
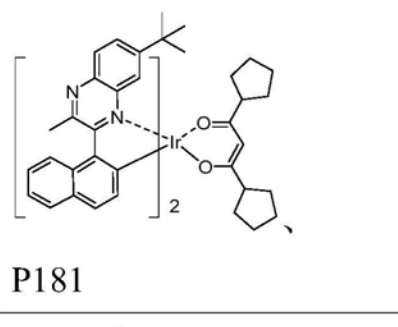
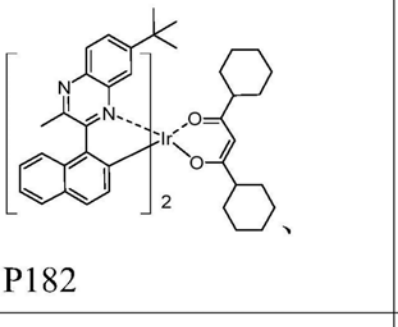
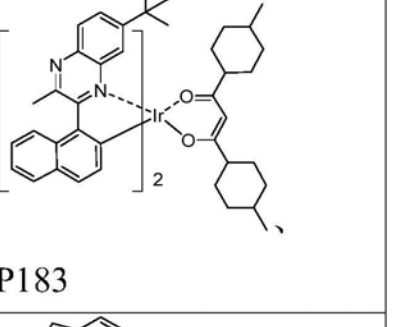
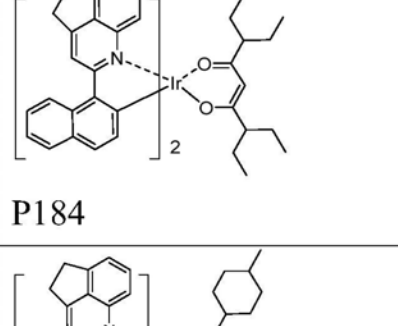
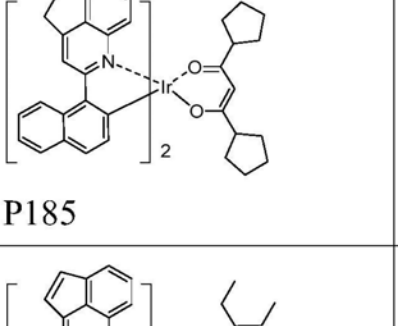
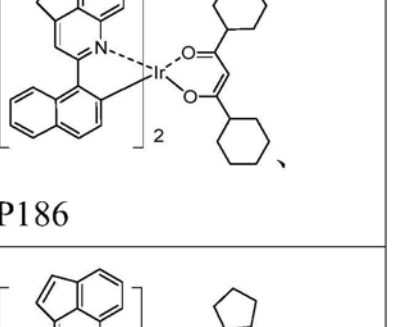
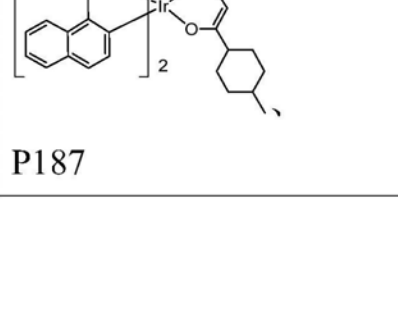
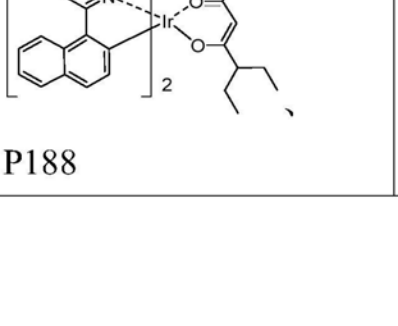
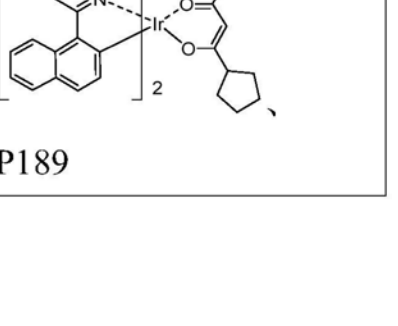
[0108]

 <p>P145</p>	 <p>P146</p>	 <p>P147</p>
 <p>P148</p>	 <p>P149</p>	 <p>P150</p>
 <p>P151</p>	 <p>P152</p>	 <p>P153</p>
 <p>P154</p>	 <p>P155</p>	 <p>P156</p>
 <p>P157</p>	 <p>P158</p>	 <p>P159</p>

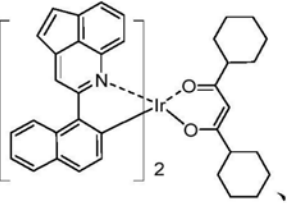
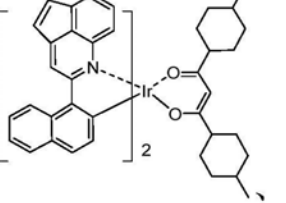
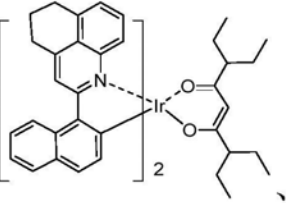
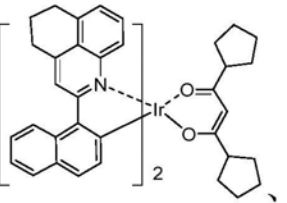
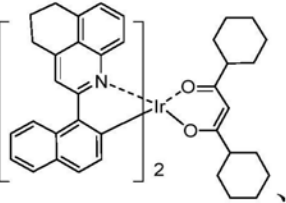
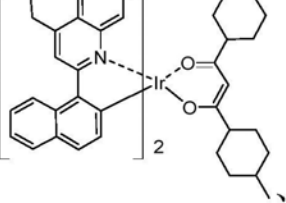
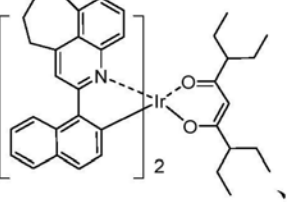
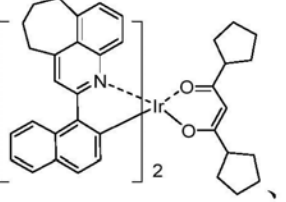
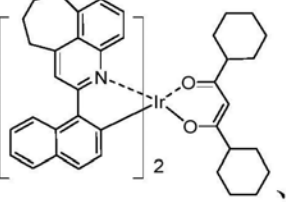
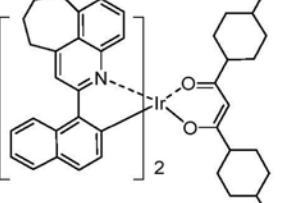
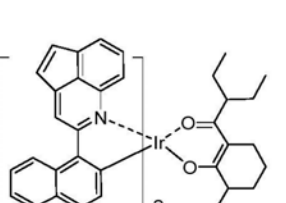
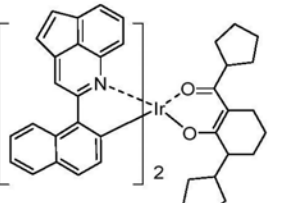
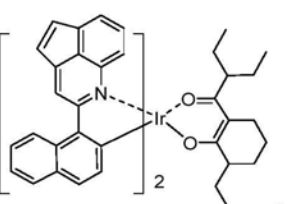
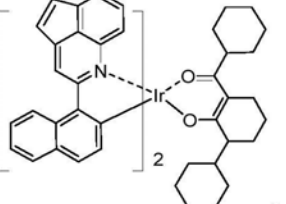
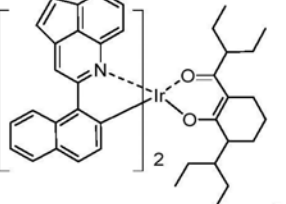
[0109]

 P160	 P161	 P162
 P163	 P164	 P165
 P166	 P167	 P168
 P169	 P170	 P171
 P172	 P173	 P174

[0110]

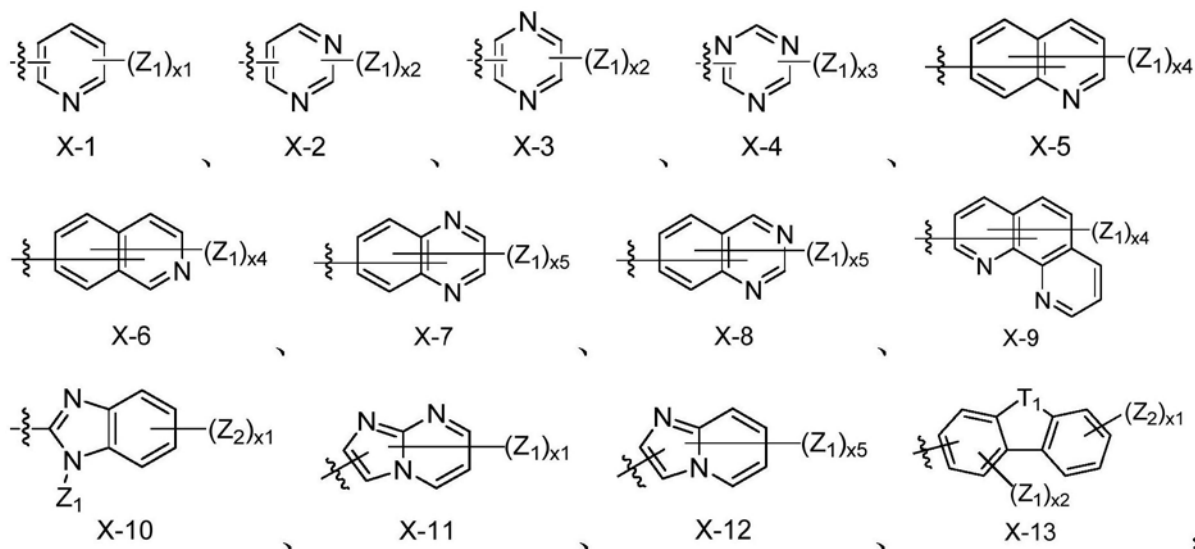
 <p>P175</p>	 <p>P176</p>	 <p>P177</p>
 <p>P178</p>	 <p>P179</p>	 <p>P180</p>
 <p>P181</p>	 <p>P182</p>	 <p>P183</p>
 <p>P184</p>	 <p>P185</p>	 <p>P186</p>
 <p>P187</p>	 <p>P188</p>	 <p>P189</p>

[0111]

 <p>P190</p>	 <p>P191</p>	 <p>P192</p>
 <p>P193</p>	 <p>P194</p>	 <p>P195</p>
 <p>P196</p>	 <p>P197</p>	 <p>P198</p>
 <p>P199</p>	 <p>P200</p>	 <p>P201</p>
 <p>P202</p>	 <p>P203</p>	 <p>P204</p>

[0112] [3.0eV>E_T≥2.0eV的有机化合物A][0113] 下文描述根据本发明的3.0eV>E_T≥2.0eV的有机化合物A的实施方式。[0114] 在本发明中,优选的所述3.0eV>E_T≥2.0eV的有机化合物A含有至少一个式X-1~X-13基团组成的组。

[0115]




[0116] 其中，

[0117] Z₁、Z₂各自独立地表示氢、氘、卤原子、羟基、腈基、硝基、氨基、脒基、胍基、脞基、羧基、羧酸盐基、磺酸基、磺酸盐基、磷酸基、磷酸盐基、C₁-C₆₀的链烷基、C₂-C₆₀的链烯基、C₂-C₆₀的炔基、C₁-C₆₀的烷氧基、C₃-C₆₀的环烷烃基、C₃-C₆₀的环烯烃基、C₆-C₆₀的芳基、C₆-C₆₀的稠环芳基、C₆-C₆₀的芳氧基、C₆-C₆₀芳硫醚基、C₂-C₆₀的杂环芳基组的组；

[0118] x₁表示1-4的整数；x₂表示1-3的整数；x₃表示1或2；x₄表示1-6的整数；x₅表示1-5的整数；

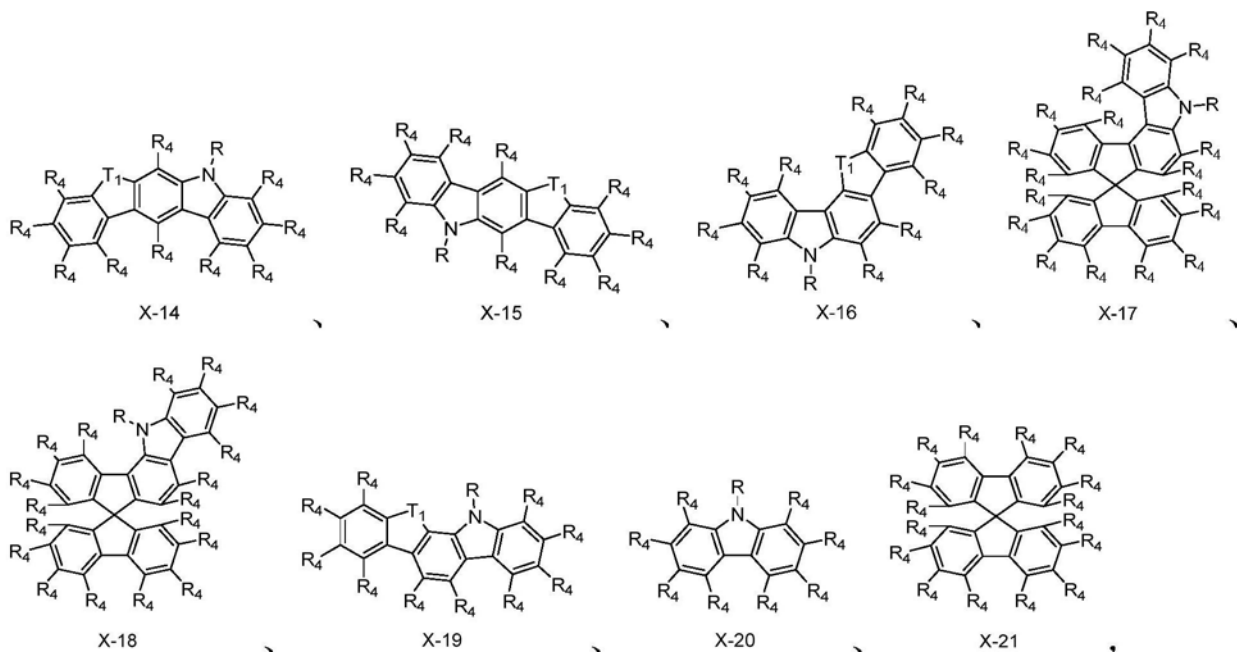
[0119] T₁选自-B(R')-、-N(R')-、-P(R')-、-O-、-S-、-Se-、-S(=O)-、-S(O₂)-、-C(R'R'')-、-Si(R'R'')-或-Ge(R'R'')-；并且R'、R''各自独立地选自C₁-C₆₀链烷基、C₂-C₆₀链烯基、C₂-C₆₀炔基、C₁-C₆₀烷氧基、C₃-C₆₀环烷烃基、C₃-C₆₀环烯烃基、C₆-C₆₀芳基、含有C₁-C₁₀烷基的C₆-C₆₀芳基、含有C₁-C₁₀烷基的C₆-C₆₀芳氧基、含有C₁-C₁₀烷基的C₆-C₆₀芳硫基组成的组；R'、R''任选稠合或接合形成环；

[0120]  表示取代基与主体结构的连接。

[0121] 在本发明的一个优选实施方式中，所述3.0eV>E_T≥2.0eV的有机化合物A含有选自式X-1~X-13所示基团组成的组中的至少一个基团与茚并呋唑基团、吡啶并呋唑基团或呋唑基团直接地或经由桥连基团键合而成的基团，其中所述茚并呋唑或吡啶并呋唑或呋唑基团任选被一个或多个Ar₁基团取代，并且Ar₁具有上文中所限定的含义；

[0122] 所述茚并呋唑基团、吡啶并呋唑基团或呋唑基团优选选自下式X-14~X-21所示的结构组成的组，

[0123]

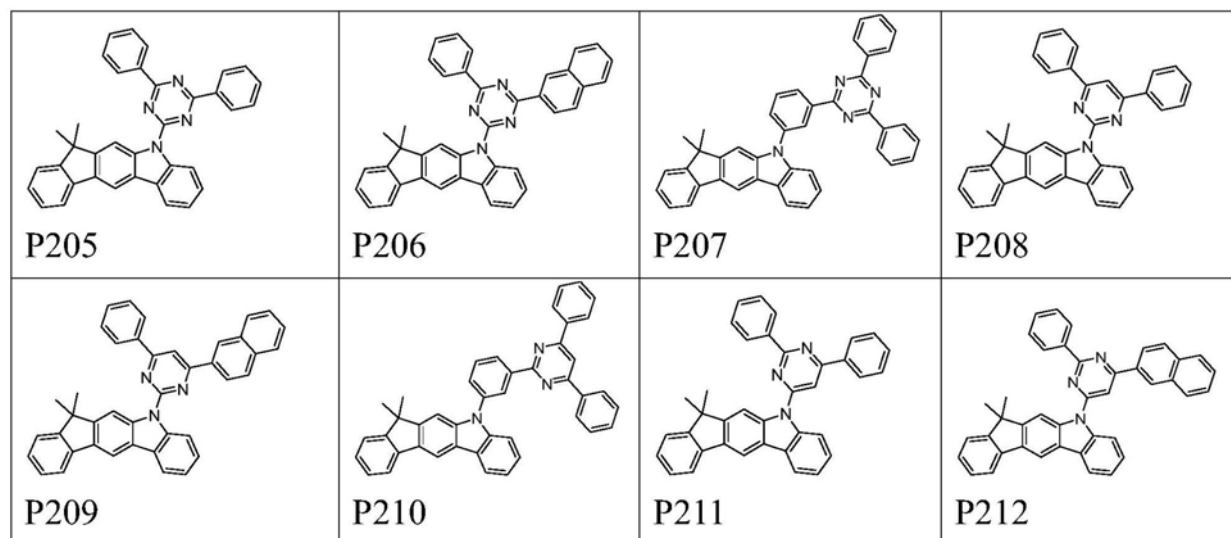


[0124] 其中 R_4 各自独立地选自氢原子、氘原子、链烷基、环烷基、杂烷基、芳烷基、烷氧基、芳氧基、氨基、硅烷基、链烯基、环烯基、杂烯基、炔基、芳基、杂环芳基组成的组。 R 表示与所述X-1~X-13连接的桥键或桥连基团,所述桥键或桥连基团与所述X-1~X-13连接;

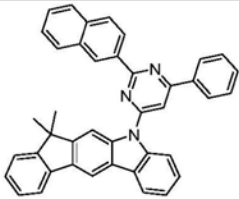
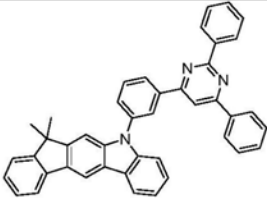
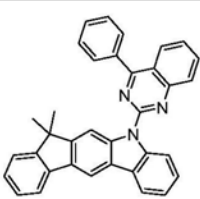
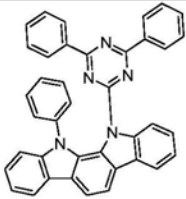
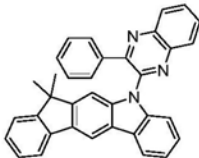
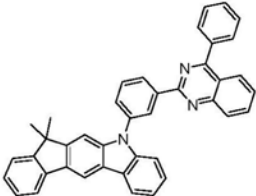
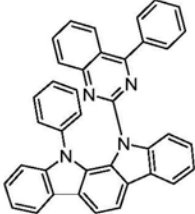
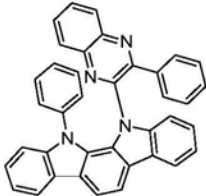
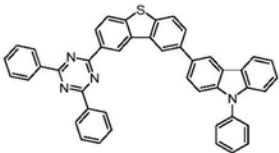
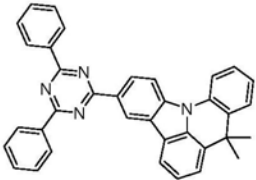
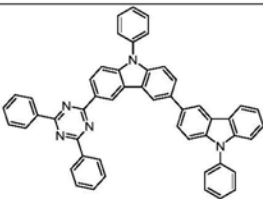
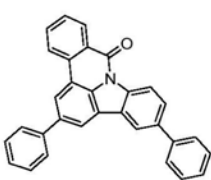
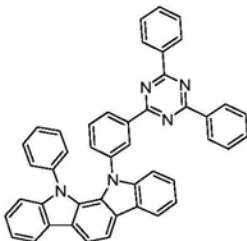
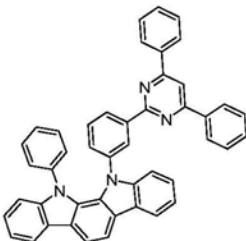
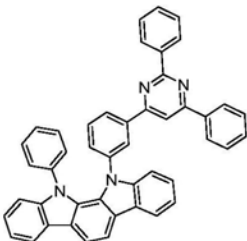
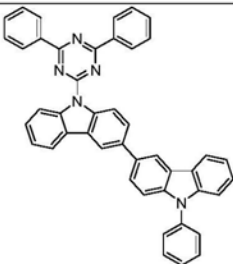
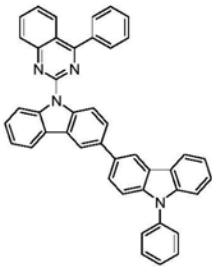
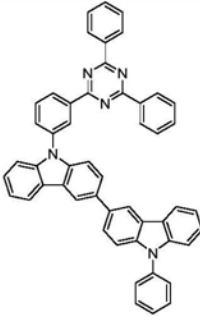
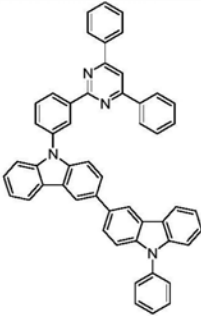
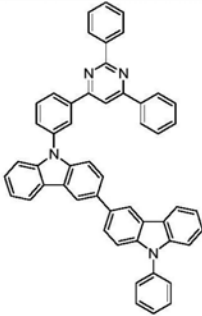
[0125] T_1 的含义与前述给出的含义相同。

[0126] 作为 $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 的有机化合物A的实例,可以列举出以下的P205~P380所示的化合物。

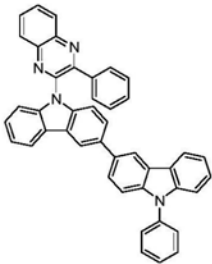
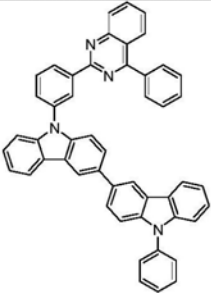
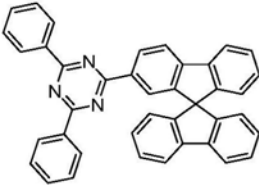
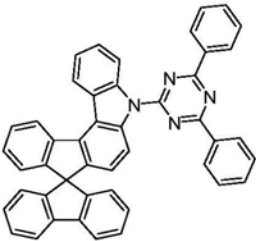
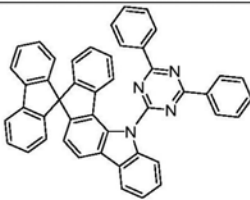
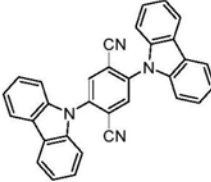
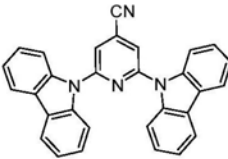
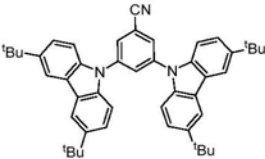
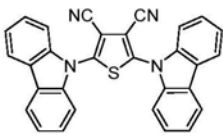
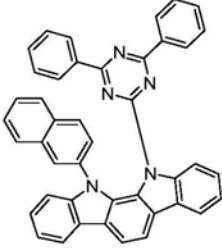
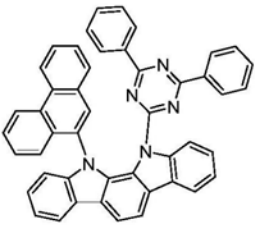
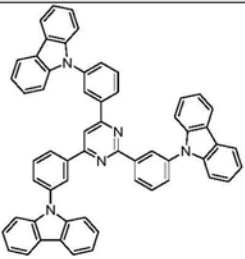
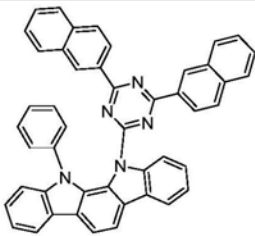
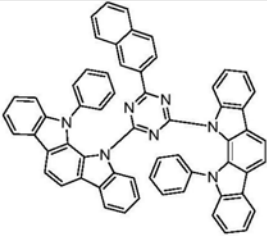
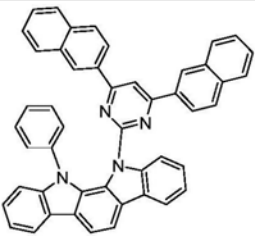
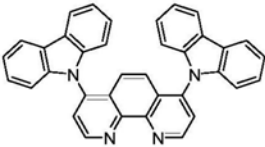
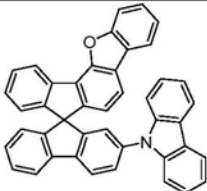
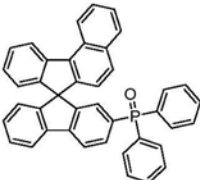
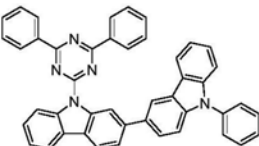
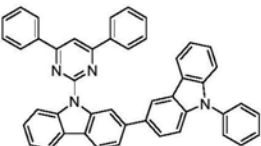
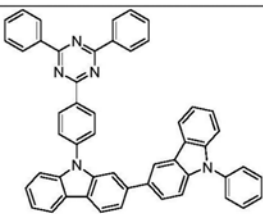
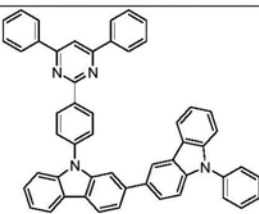
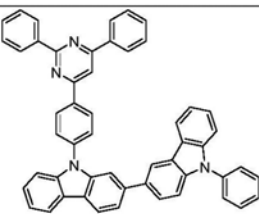
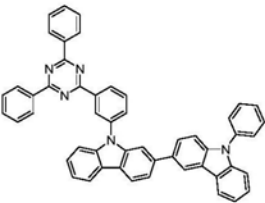
[0127]



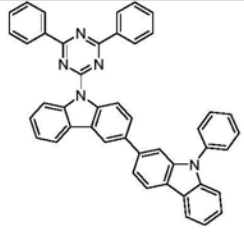
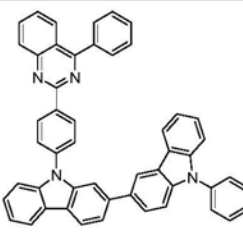
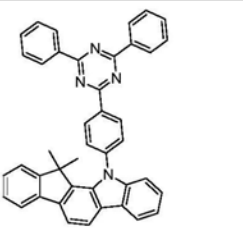
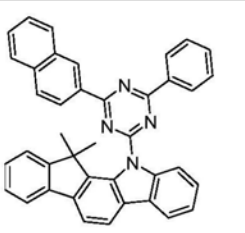
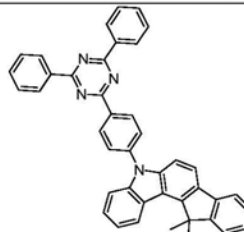
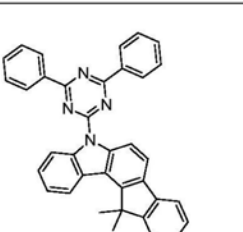
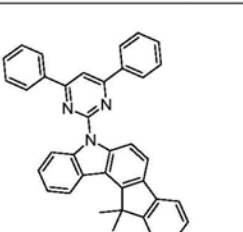
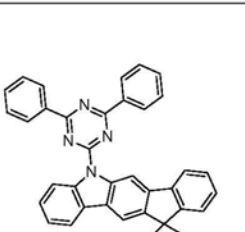
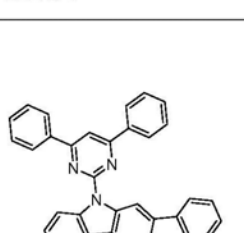
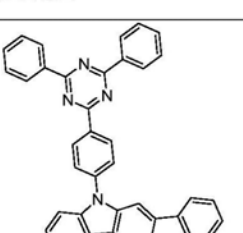
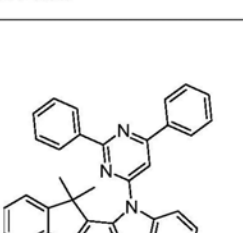
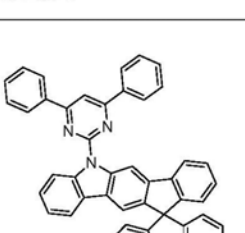
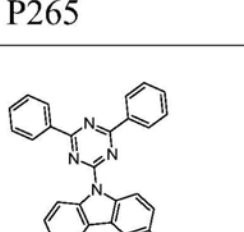
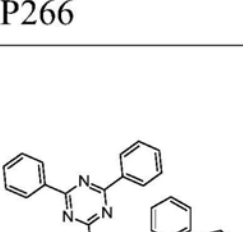
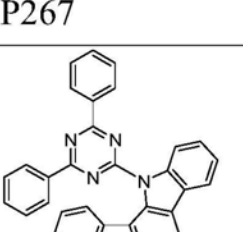
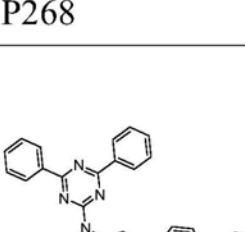
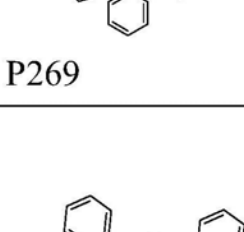
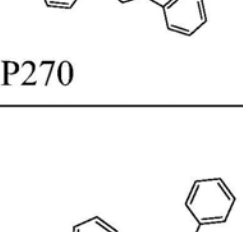
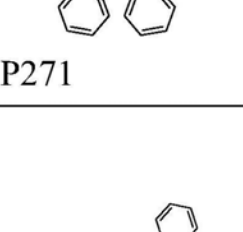
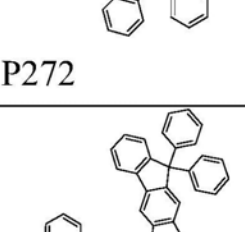
[0128]

 <p>P213</p>	 <p>P214</p>	 <p>P215</p>	 <p>P216</p>
 <p>P217</p>	 <p>P218</p>	 <p>P219</p>	 <p>P220</p>
 <p>P221</p>	 <p>P222</p>	 <p>P223</p>	 <p>P224</p>
 <p>P225</p>	 <p>P226</p>	 <p>P227</p>	 <p>P228</p>
 <p>P229</p>	 <p>P230</p>	 <p>P231</p>	 <p>P232</p>

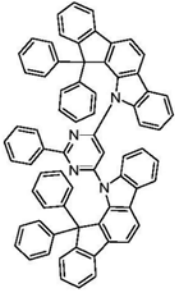
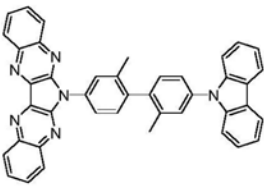
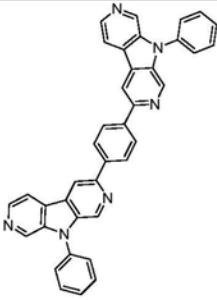
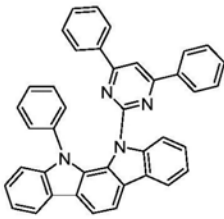
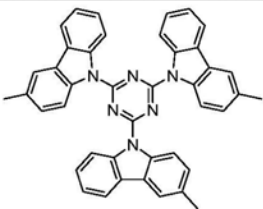
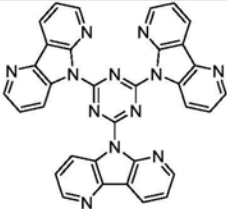
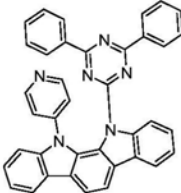
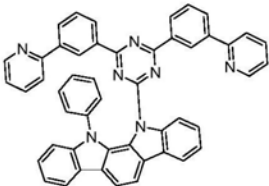
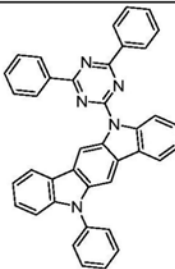
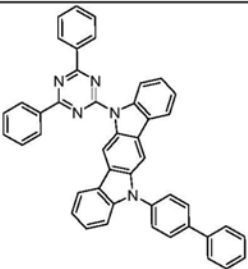
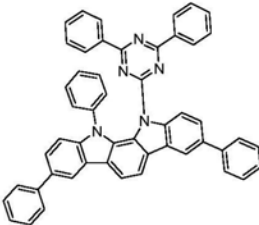
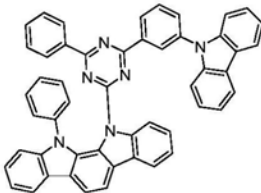
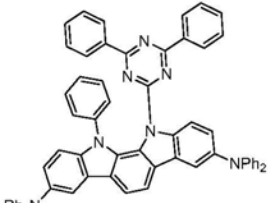
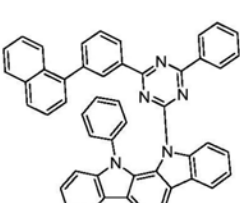
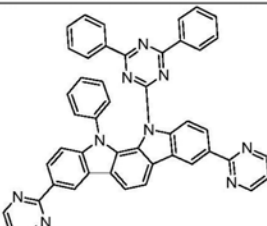
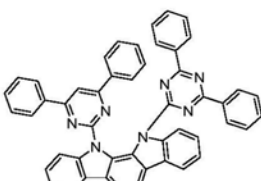
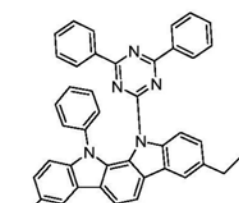
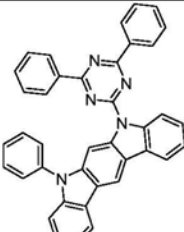
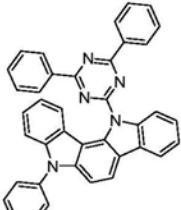
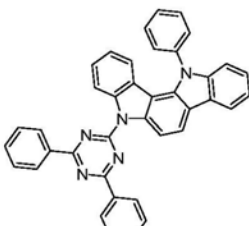
[0129]

			
P233	P234	P235	P236
			
P237	P238	P239	P240
			
P241	P242	P243	P244
			
P245	P246	P247	P248
			
P249	P250	P251	P252
			
P253	P254	P255	P256

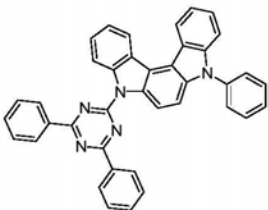
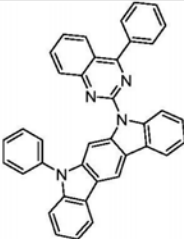
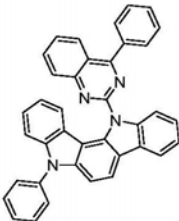
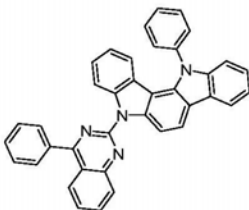
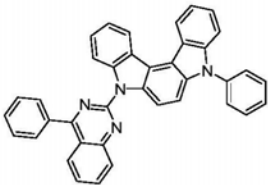
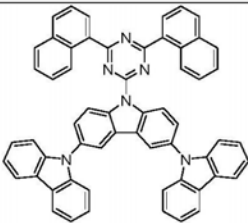
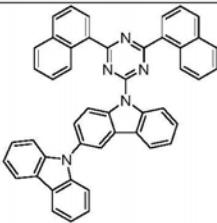
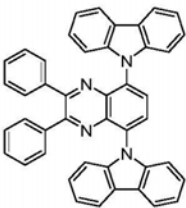
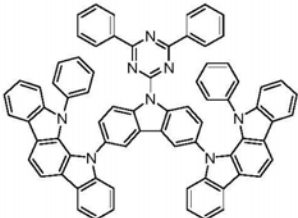
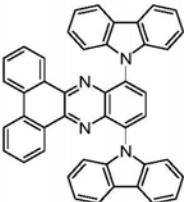
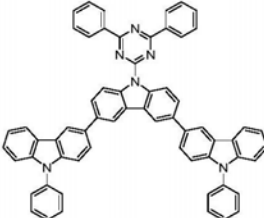
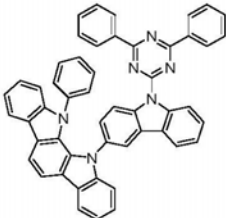
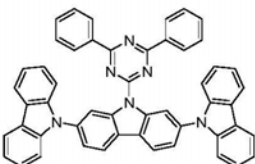
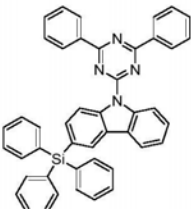
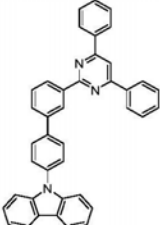
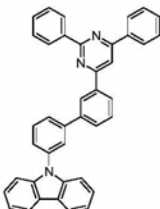
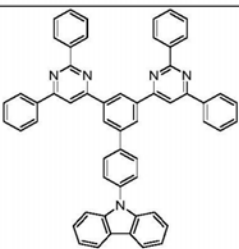
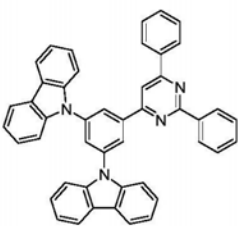
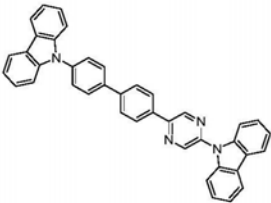
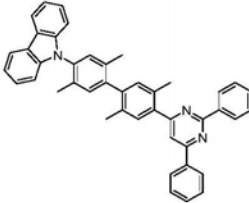
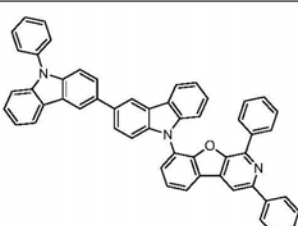
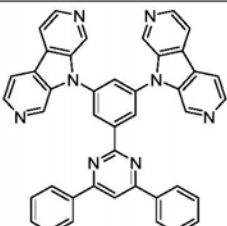
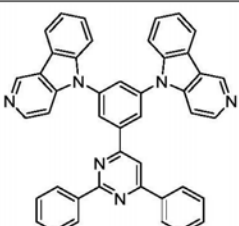
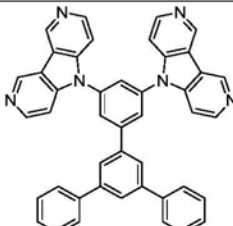
[0130]

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 P273	 P274	 P275	 P276

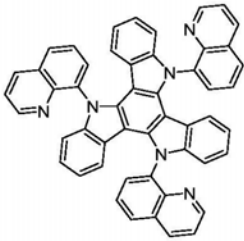
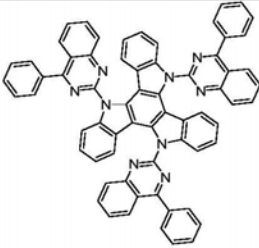
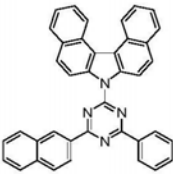
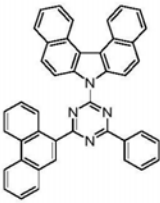
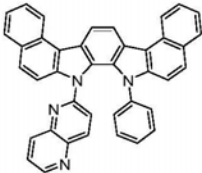
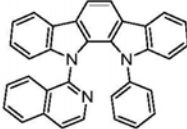
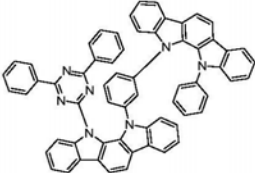
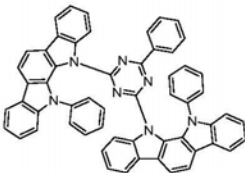
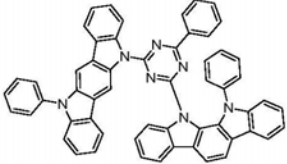
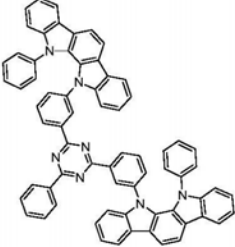
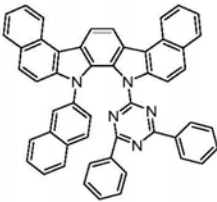
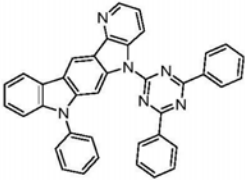
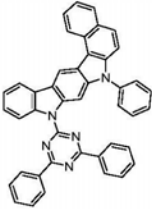
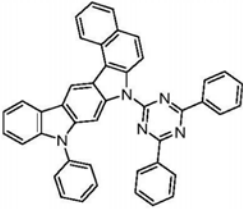
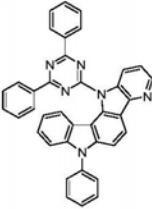
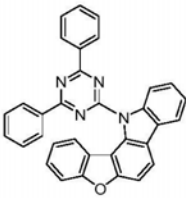
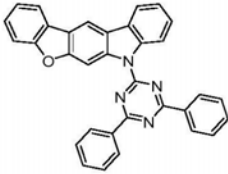
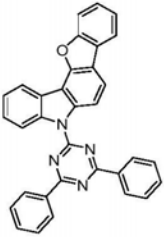
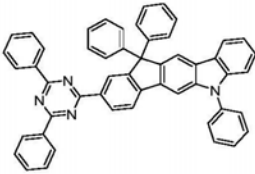
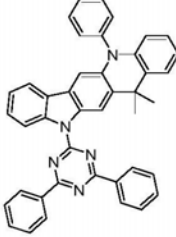
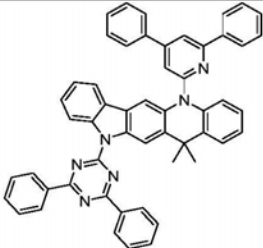
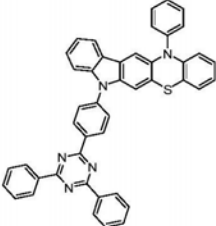
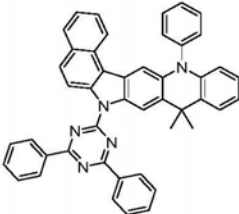
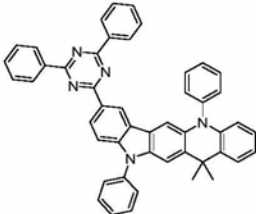
[0131]

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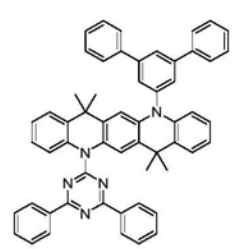
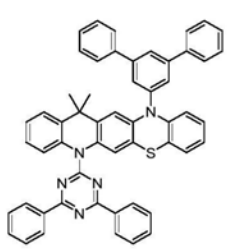
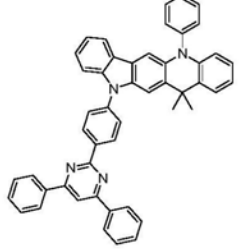
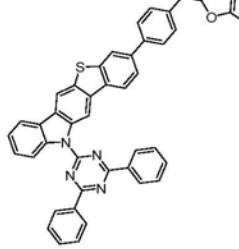
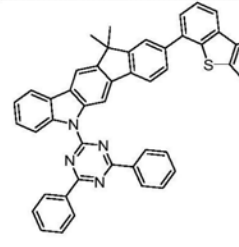
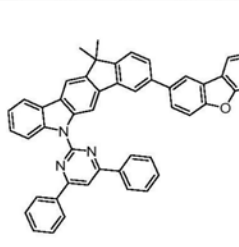
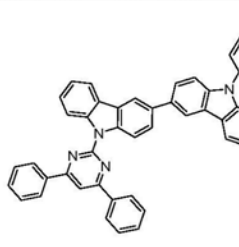
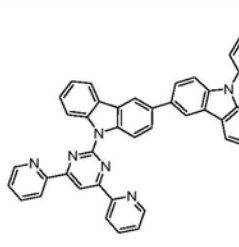
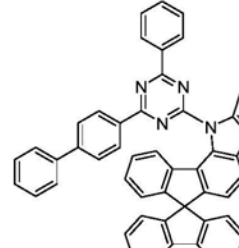
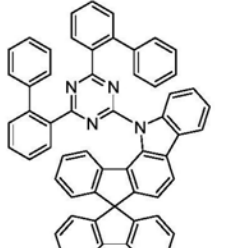
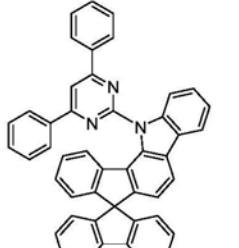
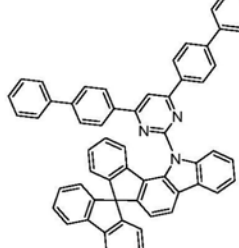
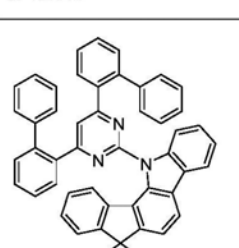
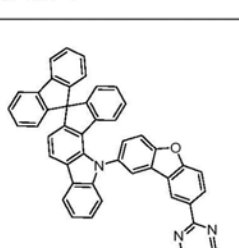
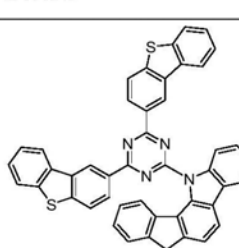
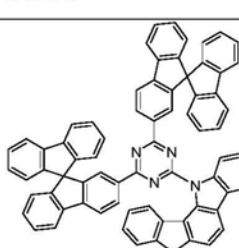
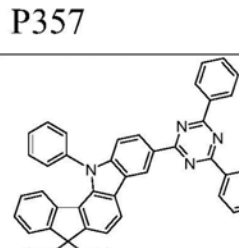
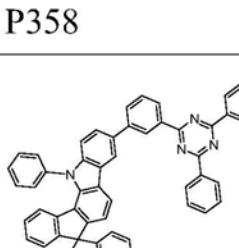
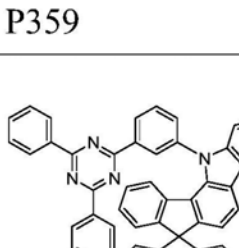
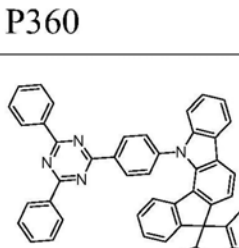
[0132]

 P297	 P298	 P299	 P300
 P301	 P302	 P303	 P304
 P305	 P306	 P307	 P308
 P309	 P310	 P311	 P312
 P313	 P314	 P315	 P316
 P317	 P318	 P319	 P320

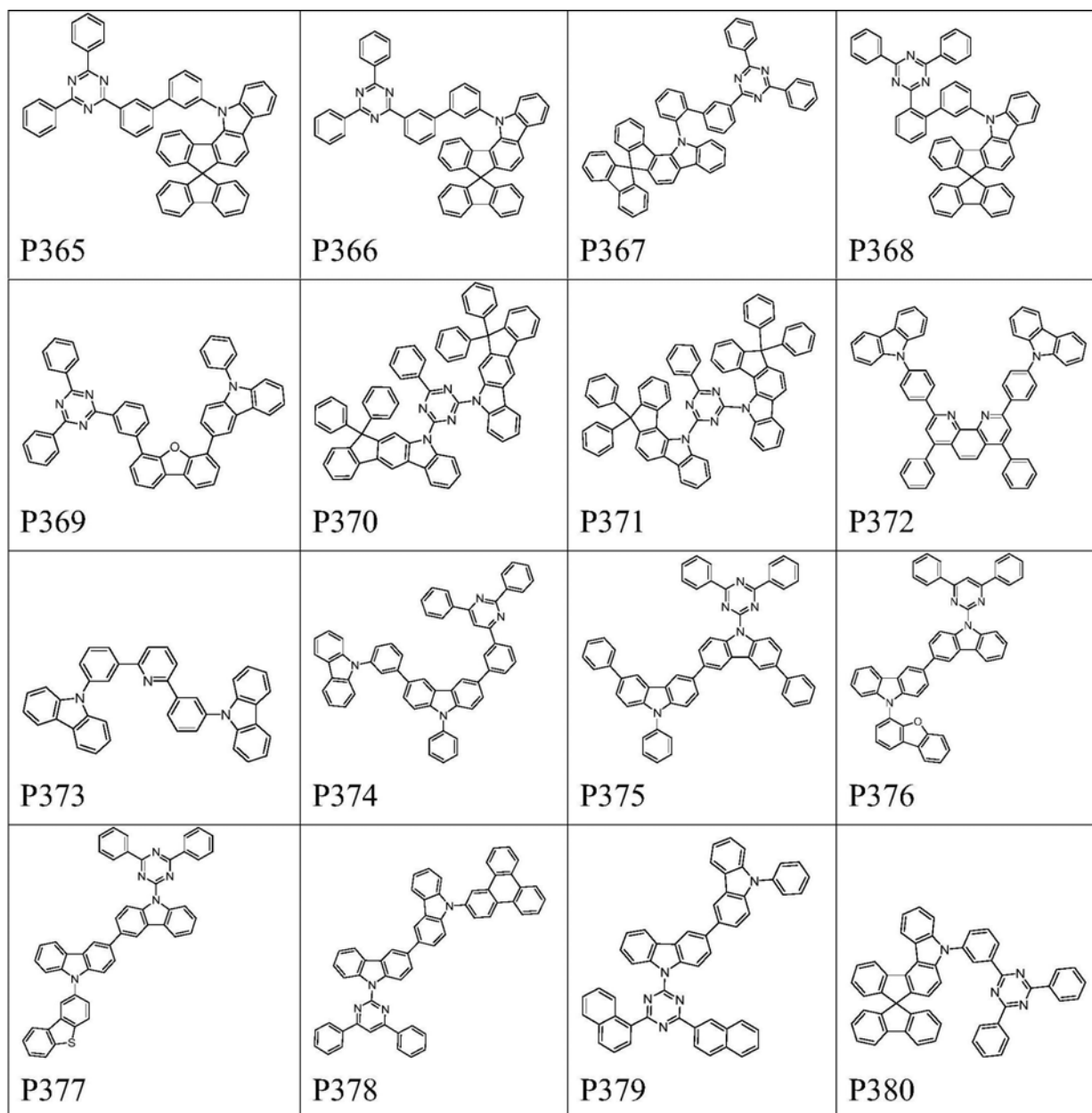
[0133]

 P321	 P322	 P323	 P324
 P325	 P326	 P327	 P328
 P329	 P330	 P331	 P332
 P333	 P334	 P335	 P336
 P337	 P338	 P339	 P340
 P341	 P342	 P343	 P344

[0134]

 P345	 P346	 P347	 P348
 P349	 P350	 P351	 P352
 P353	 P354	 P355	 P356
 P357	 P358	 P359	 P360
 P361	 P362	 P363	 P364

[0135]



[0136] 作为本发明的包含 $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 的有机化合物A和 $M(LA)_x(LB)_y(LC)_z$ 所示的化合物B的有机电致发光材料,可以在有机电致发光器件中作为例如空穴注入材料、空穴传输材料或者封装层材料等,优选在有机电致发光器件中作为发光层使用。在作为发光层的情况下,优选是磷光发光层,其中, $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 的有机化合物A作为基质材料, $M(LA)_x(LB)_y(LC)_z$ 所示的化合物B作为掺杂材料,在两者的共同参与下发磷光。

[0137] 作为掺杂材料的所述 $M(LA)_x(LB)_y(LC)_z$ 所示的化合物B与作为基质材料的 $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 的有机化合物A共同作用作为磷光发光层的情况下, $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 的有机化合物A的三重态能级优选不会显著小于或大于所述化合物 $M(LA)_x(LB)_y(LC)_z$ 的三重态能级,三重态能级 $E_T[A] - E_T[B]$ 的绝对值优选 $\leq 0.2\text{eV}$,特别优选 $\leq 0.15\text{eV}$,非常特别优选 $\leq 0.1\text{eV}$ 。其中 $E_T[B]$ 是金属配合物 $M(LA)_x(LB)_y(LC)_z$ 的三重态能级, $E_T[A]$ 是基质材料 $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 的化合物的三重态能级。如果发光层中包含多于两种的基质材料,则上述关系优选也适用。

于其它的基质材料。

[0138] 作为 $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 的有机化合物A与 $M(\text{LA})_x(\text{LB})_y(\text{LC})_z$ 所示的化合物B的配合比率,优选 $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 的有机化合物A与 $M(\text{LA})_x(\text{LB})_y(\text{LC})_z$ 所示的化合物的比率介于99:1~80:20之间,优选介于99:1~90:10之间,特别优选介于99:1~95:5之间。

[0139] 所述有机电致发光器件包含阴极、阳极和至少一个发光层。除了这些层之外,它还可以包含其它的层,例如,在一个实施方式中,可以包含一个或多个空穴注入层、空穴传输层、空穴阻挡层、电子传输层、电子注入层、激子阻挡层、电子阻挡层和/或电荷产生层。具有例如激子阻挡功能的中间层同样可引入两个发光层之间。然而,应当指出,这些层中的每个并非必须都存在。此处所述有机电致发光器件可包含一个发光层,或者可包含多个发光层。即,将能够发磷光的多种发光化合物用于所述发光层中。特别优选具有三个发光层的体系,其中所述三个层分别显示蓝色、绿色、红色发光。如果存在多于一个的发光层,则根据本发明,这些层中的至少一个包含含有 $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 的有机化合物A和式 $M(\text{LA})_x(\text{LB})_y(\text{LC})_z$ 所示的化合物的本发明的有机电致发光材料。

[0140] 在本发明的另一个实施方式中,本发明的有机电致发光器件不包含单独的空穴注入层和/或空穴传输层和/或空穴阻挡层和/或电子传输层,即发光层与空穴注入层或阳极直接相邻,和/或发光层与电子传输层或电子注入层或阴极直接相邻的情况,如在例如W02005053051中所述的。

[0141] 本发明的有机电致发光器件的其它层中,特别是在空穴注入和空穴传输层中以及在电子注入和电子传输层中,所有材料可以按照根据现有技术通常所使用的方式来使用。本领域普通技术人员因此将能够在不付出创造性劳动的情况下与根据本发明的发光层组合使用关于有机电致发光器件所知的所有材料。

[0142] 此外优选如下的有机电致发光器件,其借助于升华方法施加一个或多个层,其中在真空升华装置中在低于 10^{-5} 毫巴、优选低于 10^{-6} 毫巴的初压下通过气相沉积来施加所述材料。所述初压还可能甚至更低,例如低于 10^{-7} 毫巴。

[0143] 此外,优选如下的有机电致发光器件,其借助于有机气相沉积方法或借助于载气升华来施加一个或多个层,其中,在 10^{-5} 毫巴至1巴之间的压力下施加所述材料。该方法的特别的例子是有机蒸气喷印方法,其中所述材料通过喷嘴直接施加,因此是结构化的。

[0144] 此外优选如下的有机电致发光器件,其通过利用溶液进行例如旋涂,或借助于任何所希望的印刷方法例如丝网印刷、柔性版印刷、平版印刷、光引发热成像、热转印、喷墨印刷或喷嘴印刷来产生一个或多个层。可溶性化合物,例如通过适当的取代获得可溶性化合物。这些方法也特别适于低聚物、树枝状大分子和聚合物。此外可行的是混合方法,其中例如从溶液中施加一个或多个层并且通过气相沉积施加一个或多个另外的层。

[0145] 这些方法是本领域普通技术人员通常已知的,并且他们可以在不付出创造性劳动的情况下将其应用于包含根据本发明的化合物的有机电致发光器件。

[0146] 此外,本发明还涉及制造根据本发明的有机电致发光器件的方法,其借助于升华方法来施加至少一个层,和/或借助于有机气相沉积方法或借助于载气升华来施加至少一个层,和/或从溶液中通过旋涂或借助于印刷方法来施加至少一个层。

[0147] 本发明的有机电致发光材料中,还任选包含其它化合物。本发明的有机电致发光材料可以为例如液相,通过旋涂或通过印刷方法进行处理。作为这样的液相,可以为例如溶

液、分散体或乳液的形式。作为形成液相所用的溶剂,可优选使用两种或更多种溶剂的混合物。合适并且优选的溶剂例如是甲苯,苯甲醚,邻二甲苯、间二甲苯或对二甲苯、苯甲酸甲酯、均三甲苯、萘满、邻二甲氧基苯、四氢呋喃、甲基四氢呋喃、四氢吡喃、氯苯、二噁烷、苯氧基甲苯、特别是3-苯氧基甲苯、(-)-葑酮、1,2,3,5-四甲基苯、1,2,4,5-四甲基苯、1-甲基萘、2-甲基苯并噻唑、2-苯氧基乙醇、2-吡咯烷酮、3-甲基苯甲醚、4-甲基苯甲醚、3,4-二甲基苯甲醚、3,5-二甲基苯甲醚、苯乙酮、 α -萜品醇、苯并噻唑、苯甲酸丁酯、异丙苯、环己醇、环己酮、环己基苯、十氢化萘、十二烷基苯、苯甲酸乙酯、茚满、苯甲酸甲酯、1-甲基吡咯烷酮、对甲基异丙基苯、苯乙醚、1,4-二异丙基苯、二苄醚、二乙二醇丁基甲基醚、三乙二醇丁基甲基醚、二乙二醇二丁基醚、三乙二醇二甲基醚、二乙二醇单丁基醚、三丙二醇二甲基醚、四乙二醇二甲基醚、2-异丙基萘、戊苯、己苯、庚苯、辛苯、1,1-双(3,4-二甲基苯基)乙烷、或这些溶剂的混合物等。

[0148] 下述实施例对OLED材料及元件进行性能测试的测试仪器及方法如下:

[0149] OLED元件性能检测条件:

[0150] 亮度和色度坐标:使用光谱扫描仪PhotoResearch PR-715测试;

[0151] 电流密度和起亮电压:使用数字源表Keithley 2420测试;

[0152] 功率效率:使用NEWPORT 1931-C测试;

[0153] 寿命测试:使用LTS-1004AC寿命测试装置。

[0154] 实施例1

[0155] 化合物的三重态能级 E_T 的确定方法

[0156] 经由量子化学计算来确定所述材料的三重态能级。为此使用“Gaussian09W”软件。为了计算 $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 的有机化合物A的 E_T ,首先利用“基态/半经验/默认自旋/AM1/电荷0/自旋单重态”方法进行几何结构优化,随后基于基态优化的几何结构进行能量计算,此处使用具有“6-31G(d)基集的TD-SCF/DFT/默认自旋/B3LYP”方法,此处电荷0/自旋单重态。对于 $M(LA)_x(LB)_y(LC)_z$ 所示的化合物B,经由“基态/Hartree-Fock/默认自旋/LanL2MB/电荷0/自旋单重态”方法进行几何结构优化。与如上文所述的基质有机物类似地方法进行能量计算,其中差异为:将“LanL2DZ”基集用于金属原子并且将“6-31G(d)”基集用于配体。能量计算得到材料的三重态能级 T_1 ,被定义为由量子化学计算产生的最低能量三重态的能量。由此确定化合物的三重态能级 E_T 值。为了本申请的目的,这个值被视为所述材料的 E_T 值。

[0157] 下述的表1中列出了部分 $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 所示的化合物A的三重态能级 $E_T(A)$:

[0158] 表1:部分 $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 所示的化合物A的三重态能级 $E_T(A)$

[0159]

材料	T_1 (eV)	材料	T_1 (eV)
P205	2.69	P244	2.64

[0160]

P207	2.72	P248	2.40
P221	2.84	P249	2.69
P223	2.80	P250	2.40
P224	2.71	P275	2.32
P229	2.94	P280	2.79
P230	2.72	P281	2.61
P237	2.72	P317	2.70
P369	2.83	P363	2.72

[0161] 下述的表2中列出了部分 $M(LA)_x(LB)_y(LC)_z$ 所示化合物的三重态能级 $E_T(B)$ ：[0162] 表2：部分 $M(LA)_x(LB)_y(LC)_z$ 所示化合物的三重态能级 $E_T(B)$

[0163]

材料	T_1 (eV)	材料	T_1 (eV)
P01	2.35	P11	2.24
P02	2.37	P12	2.26
P05	2.39	P21	2.14
P07	2.40	P26	2.28
P09	2.28	P36	2.29
P10	2.29	P40	1.98

[0164] 实施例2

[0165] OLED器件的制造：

[0166] 实施例R1～R25的预处理：为改进处理，将已涂覆有厚度为50nm的结构化ITO的清洁玻璃板，涂覆20nm的PEDOT:PSS，通过旋涂的方式从水溶液中施加。随后通过在180℃下加热将样品干燥10分钟。这些涂覆玻璃板形成施加OLED的基底。

[0167] 实施例R26～R63的预处理：将已涂覆有厚度为50nm的结构化ITO的清洁玻璃板用氧等离子体处理130秒。这些经过等离子体处理的玻璃板形成施加OLED的基底。所述基底在涂覆前保持在真空下。在等离子体处理后10分钟内开始涂覆。

[0168] 实施例R64～R101的预处理：将已涂覆有厚度为50nm的结构化ITO的清洁玻璃板用氧等离子体处理130秒并且随后用氩等离子体处理150秒。这些经过等离子体处理的玻璃板形成施加OLED的基底。所述基底在涂覆前保持在真空下。在等离子体处理后10分钟内开始涂覆。

[0169] 所述OLED基本上具有以下层结构：基底/空穴传输层(HTL)/任选的中间层(IL)/电子阻挡层(EBL)/发光层(EML)/任选的空穴阻挡层(HBL)/电子传输层(ETL)/任选的电子注入层(EIL)和最后的阴极。所述阴极由厚度为100nm的铝层形成。所述OLED的确切结构示于表3中。制造OLED所需的材料示于表5中。

[0170] 通过在真空腔室中进行热气相沉积来施加所有材料。此处的发光层由至少一种 $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 的有机化合物A形成的基质材料(主体材料)和 $M(LA)_x(LB)_y(LC)_z$ 所示的

化合物B(发光掺杂剂)构成,通过共蒸发使所述发光掺杂剂与所述一种或多种基质材料以特定的质量比例混合。此处例如P323:P01(95%:5%)的表达是指,材料P323以95%的质量比例存在于该层中,P01以5%的比例存在于该层中。类似地,所述电子传输层也可由两种材料的混合物构成。

[0171] 通过标准方法表征所述OLED。为此目的,测定电致发光光谱、电流效率(cd/A)、功率效率(lm/W)和根据呈现朗伯发射特征的电流/电压/发光密度特征线(I-V-L)计算的作为发光密度函数的外量子效率(EQE,%),以及寿命。在1000cd/m²的发光密度下测定电致发光光谱,并且计算颜色坐标CIE(1931) x和y值。表3中的表达T95是指发光器件的寿命在对应于发光度已经降至其初始值的95%后的时间。

[0172] 各种OLED的数据总结于表4中。实施例R1~R101示出本发明的OLED的数据。

[0173] 下文更详细地解释一些实施例以示例本发明的OLED的优点。

[0174] 本发明的有机电致发光材料在磷光OLED的发光层中的用途,根据本发明的组合物组合使用能够实现良好的外量子效率。此外,在寿命方面获得高于两倍的优异改进。特别是,利用化合物P242与P02的组合,获得优异的寿命(实施例R65),并且利用P323和P11获得优异的效率(实施例R70)。

[0175] 此外,利用各种 $3.0\text{eV} > \text{ET} \geq 2.0\text{eV}$ 的化合物和磷光发光体 $\text{M}(\text{LA})_x(\text{LB})_y(\text{LC})_z$ 的组合物,获得优异的性能数据,其表明根据本发明的层的广泛适用性。

[0176] 表3:OLED器件的结构

[0177]

实施例	HIL 厚度	HTL 厚度	EBL 厚度	EML 厚度	HBL 厚度	ETL 厚度	EIL 厚度
R1	HATCN 2 nm	HT1 100Å	HT2 100Å	P205:P01 (98%:2%) 300 Å	—	ET1:LiQ (50%:50%) 300 Å	—
R2	HATCN 2 nm	HT1 100Å	HT2 100Å	P205:P01 (98%:2%) 300 Å	P205 100 Å	ET1:LiQ (50%:50%) 300 Å	—
R3	HATCN 2 nm	HT1 100Å	HT2 100Å	P205:P01 (98%:2%) 300 Å	—	ET1:LiQ (50%:50%) 300 Å	LiF 10 Å
R4	HATCN 2 nm	HT1 100Å	HT2 100Å	P216:P02 (98%:2%) 300 Å	—	ET1:LiQ (50%:50%) 300 Å	—
R5	HATCN 2 nm	HT1 100Å	HT2 100Å	P219:P05 (98%:2%) 300 Å	P205 100 Å	ET1:LiQ (50%:50%) 300 Å	—
R6	HATCN 2 nm	HT1 100Å	HT2 100Å	P219:P07 (98%:2%) 300 Å	—	ET1:LiQ (50%:50%) 300 Å	LiF 10 Å
R7	HATCN 2 nm	HT1 100Å	HT2 100Å	P219:P09 (98%:2%) 300 Å	—	ET1:LiQ (50%:50%) 300 Å	—
R8	HATCN 2 nm	HT1 100Å	HT2 100Å	P220:P10 (98%:2%) 300 Å	P205 100 Å	ET1:LiQ (50%:50%) 300 Å	—
R9	HATCN 2 nm	HT1 100Å	HT2 100Å	P236:P11 (98%:2%) 300 Å	—	ET1:LiQ (50%:50%) 300 Å	LiF 10 Å

[0178]

R10	HATCN 2 nm	HT1 100Å	HT2 100Å	P237:P12 (98%:2%) 300 Å	—	ET1:LiQ (50%:50%) 300 Å	—
R11	HATCN 2 nm	HT1 100Å	HT2 100Å	P242:P21 (98%:2%) 300 Å	P205 100 Å	ET1:LiQ (50%:50%) 300 Å	—
R12	HATCN 2 nm	HT1 100Å	HT2 100Å	P247:P26 (98%:2%) 300 Å	—	ET1:LiQ (50%:50%) 300 Å	LiF 10 Å
R13	HATCN 2 nm	HT1 100Å	HT2 100Å	P257:P36 (98%:2%) 300 Å	—	ET1:LiQ (50%:50%) 300 Å	—
R14	HATCN 2 nm	HT1 100Å	HT2 100Å	P260:P40 (98%:2%) 300 Å	P205 100 Å	ET1:LiQ (50%:50%) 300 Å	—
R15	HATCN 2 nm	HT1 100Å	HT2 100Å	P260:P47 (98%:2%) 300 Å	—	ET1:LiQ (50%:50%) 300 Å	LiF 10 Å
R16	HATCN 2 nm	HT1 100Å	HT2 100Å	P266:P49 (98%:2%) 300 Å	—	ET1:LiQ (50%:50%) 300 Å	—
R17	HATCN 2 nm	HT1 100Å	HT2 100Å	P274:P56 (98%:2%) 300 Å	P205 100 Å	ET1:LiQ (50%:50%) 300 Å	—
R18	HATCN 2 nm	HT1 100Å	HT2 100Å	P283:P60 (98%:2%) 300 Å	—	ET1:LiQ (50%:50%) 300 Å	LiF 10 Å
R19	HATCN 2 nm	HT1 100Å	HT2 100Å	P285:P64 (98%:2%) 300 Å	—	ET1:LiQ (50%:50%) 300 Å	—

[0179]

R20	HATCN 2 nm	HT1 100Å	HT2 100Å	P317:P68 (98%:2%) 300 Å	P205 100 Å	ET1:LiQ (50%:50%) 300 Å	—
R21	HATCN 2 nm	HT1 100Å	HT2 100Å	P317:P70 (98%:2%) 300 Å	—	ET1:LiQ (50%:50%) 300 Å	LiF 10 Å
R22	HATCN 2 nm	HT1 100Å	HT2 100Å	P323:P77 (98%:2%) 300 Å	—	ET1:LiQ (50%:50%) 300 Å	—
R23	HATCN 2 nm	HT1 100Å	HT2 100Å	P334:P80 (98%:2%) 300 Å	P205 100 Å	ET1:LiQ (50%:50%) 300 Å	—
R24	HATCN 2 nm	HT1 100Å	HT2 100Å	P351:P89 (98%:2%) 300 Å	—	ET1:LiQ (50%:50%) 300 Å	LiF 10 Å
R25	HATCN 2 nm	HT1 100Å	HT2 100Å	P380:P101 (98%:2%) 300 Å	—	ET1:LiQ (50%:50%) 300 Å	—
R26	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P219:P01 (98%:2%) 300 Å	P205 100 Å	ET2:LiQ (50%:50%) 300 Å	—
R27	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT3 100Å	P220:P02 (98%:2%) 300 Å	—	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R28	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P236:P05 (98%:2%) 300 Å	—	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R29	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P242:P07 (98%:2%) 300 Å	—	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å

[0180]

R30	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P247:P09 (98%:2%) 300 Å	—	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R31	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P257:P10 (98%:2%) 300 Å	—	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R32	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P260:P11 (98%:2%) 300 Å	—	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R33	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P266:P12 (98%:2%) 300 Å	—	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R34	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P274:P21 (98%:2%) 300 Å	—	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R35	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P283:P26 (98%:2%) 300 Å	—	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R36	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P285:P36 (98%:2%) 300 Å	—	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R37	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P317:P40 (98%:2%) 300 Å	—	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R38	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P205:P47 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R39	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P216:P49 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å

[0181]

R40	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P219:P56 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R41	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P220:P60 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R42	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P236:P64 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R43	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P237:P68 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R44	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P242:P70 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R45	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P247:P77 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R46	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P257:P80 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R47	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P260:P89 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R48	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P266:P101 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R49	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P274:P109 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å

[0182]

R50	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P283:P117 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R51	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P285:P121 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R52	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P317:P125 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R53	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P323:P129 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R54	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P334:P141 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R55	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P351:P145 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R56	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P380:P161 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R57	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P205:P164 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R58	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P216:P173 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R59	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P219:P180 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å

[0183]

R60	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P220:P184 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R61	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P236:P192 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R62	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P236:P196 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R63	HT1+F4 (97%:3%) 2 nm	HT1 100Å	HT2 100Å	P237:P203 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R64	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT2 100Å	P242:P01 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R65	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P242:P02 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R66	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT2 100Å	P205:P05 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R67	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT2 100Å	P216:P07 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R68	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT2 100Å	P219:P09 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R69	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT2 100Å	P220:P10 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å

[0184]

R70	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P323:P11 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R71	HT1+F4 (95%:5%) 2 nm	—	HT3 100Å	P236:P12 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R72	HT1+F4 (95%:5%) 2 nm	HT3 100Å	HT3 100Å	P237:P21 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R73	HT3+F4 (95%:5%) 2 nm	HT1 100Å	HT2 100Å	P242:P26 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R74	HT1+F4 (95%:5%) 2 nm	HT3 100Å	HT3 100Å	P247:P36 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R75	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P250:P40 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R76	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P255:P47 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R77	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P260:P49 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R78	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P265:P56 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R79	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P268:P60 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å

[0185]

R80	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P282:P64 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R81	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P285:P68 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R82	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P287:P70 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R83	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P290:P77 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R84	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P315:P80 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R85	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P317:P89 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R86	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P205:P101 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R87	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P216:P109 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R88	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P380:P117 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R89	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P351:P121 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å

[0186]

R90	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P205:P125 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R91	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P216:P129 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R92	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P219:P141 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R93	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P220:P145 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R94	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P236:P161 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R95	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P216:P164 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R96	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P219:P173 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R97	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P220:P180 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R98	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P236:P184 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R99	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P237:P192 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å

[0187]

R100	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P205:P196 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å
R101	HT1+F4 (95%:5%) 2 nm	HT1 100Å	HT3 100Å	P216:P203 (98%:2%) 300 Å	ET2 100Å	ET2:LiQ (50%:50%) 300 Å	LiF 10 Å

[0188] 所得红光器件的性能检测结果列于表4中。

[0189] 表4:

[0190]

实施例	@1000 尼特					色度坐标 1931 CIE (x, y)
	电压 (V)	EQE (%)	CE (Cd/A)	T85 (h)	PE (lm/W)	
R1	4.8	22.4	20.60	305.5	7.9	0.679, 0.319
R2	4.6	22.2	20.73	331.2	8.1	0.678, 0.320
R3	4.2	23.4	20.89	353.0	7.8	0.679, 0.320
R4	4.8	22.2	20.06	335.6	8.7	0.682, 0.319
R5	4.9	22.4	20.60	305.0	7.9	0.679, 0.319
R6	4.8	22.1	20.33	311.4	7.8	0.680, 0.319
R7	4.7	22.6	20.40	317.9	8.2	0.681, 0.320
R8	4.5	23.0	20.17	342.6	8.4	0.682, 0.317
R9	4.4	22.5	20.63	298.5	9.2	0.681, 0.318
R10	4.6	22.8	21.82	308.4	8.6	0.680, 0.317
R11	4.5	22.6	20.66	306.2	8.8	0.681, 0.318
R12	4.5	22.2	21.43	374.8	8.9	0.680, 0.319
R13	4.7	22.9	20.27	391.0	8.7	0.679, 0.318
R14	4.6	21.5	19.49	275.6	9.5	0.682, 0.317
R15	4.4	19.1	22.06	395.3	8.3	0.681, 0.318
R16	4.6	22.4	20.51	302.4	7.9	0.681, 0.317
R17	4.8	21.6	20.47	280.5	8.0	0.681, 0.319
R18	4.6	22.2	20.15	383.2	8.7	0.682, 0.319
R19	4.5	22.7	21.79	355.0	9.4	0.682, 0.320
R20	4.7	21.5	20.05	312.4	9.0	0.681, 0.319

[0191]

R21	4.6	22.0	21.38	378.4	7.8	0.680, 0.319
R22	4.7	22.6	20.86	306.8	8.8	0.681, 0.320
R23	4.8	21.4	19.92	294.3	8.0	0.679, 0.319
R24	4.2	22.3	20.88	396.7	8.9	0.680, 0.319
R25	4.6	21.9	20.73	374.0	9.6	0.682, 0.318
R26	4.0	26.4	23.50	411.2	12.5	0.681, 0.319
R27	3.9	25.8	22.92	317.9	11.4	0.682, 0.319
R28	4.0	27.2	24.34	372.2	11.8	0.682, 0.318
R29	3.8	25.9	23.06	355.0	11.9	0.681, 0.320
R30	4.1	26.7	23.68	339.4	12.2	0.681, 0.319
R31	3.7	28.3	25.24	375.2	12.9	0.681, 0.319
R32	3.9	25.7	22.95	322.5	11.5	0.681, 0.320
R33	3.6	27.9	24.72	259.5	11.0	0.682, 0.319
R34	3.4	26.8	23.74	395.1	12.7	0.681, 0.320
R35	3.6	26.5	23.42	308.8	11.6	0.682, 0.320
R36	3.5	25.5	23.68	346.4	11.8	0.681, 0.319
R37	3.9	25.9	23.05	306.5	11.6	0.682, 0.319
R38	3.7	27.2	24.24	344.8	11.9	0.681, 0.319
R39	3.5	26.4	23.55	297.6	11.4	0.682, 0.318
R40	3.6	27.2	24.38	366.0	12.2	0.683, 0.320
R41	3.8	26.9	23.76	362.3	12.0	0.681, 0.320
R42	3.6	26.6	23.58	326.6	12.6	0.682, 0.320
R43	3.5	27.6	24.68	322.3	13.2	0.682, 0.322
R44	3.8	27.4	24.54	298.5	12.5	0.681, 0.319
R45	4.0	26.8	23.64	325.8	11.6	0.682, 0.320
R46	3.7	25.7	22.85	374.0	12.5	0.682, 0.321
R47	4.0	26.9	23.70	320.6	11.8	0.682, 0.320
R48	3.8	26.6	23.57	315.8	12.6	0.682, 0.319
R49	3.5	27.7	24.72	318.0	13.6	0.682, 0.319
R50	4.0	27.0	24.51	380.2	13.2	0.681, 0.320

[0192]

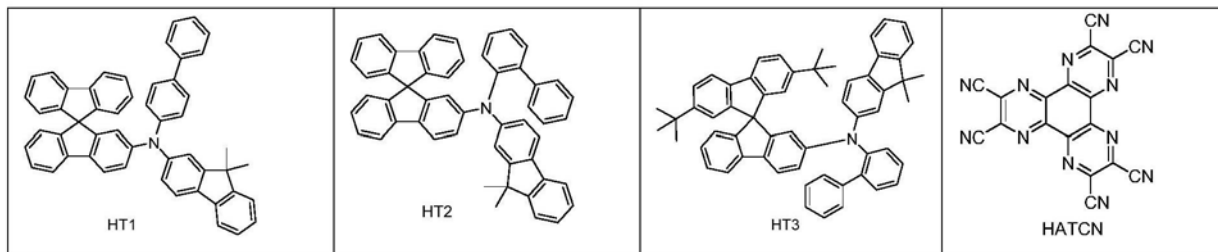
R51	3.8	26.8	23.60	355.3	11.5	0.682, 0.319
R52	3.5	27.2	24.56	309.5	12.8	0.681, 0.320
R53	3.9	26.4	23.46	387.1	12.0	0.682, 0.319
R54	3.8	26.9	23.65	362.0	11.6	0.682, 0.320
R55	4.0	25.8	22.90	320.8	12.7	0.681, 0.321
R56	4.0	25.6	22.83	348.3	12.4	0.682, 0.320
R57	3.7	27.0	24.57	353.5	13.5	0.682, 0.320
R58	3.8	26.9	23.62	324.2	11.5	0.680, 0.319
R59	4.0	26.2	23.33	375.0	11.8	0.682, 0.320
R60	3.9	27.1	24.60	362.1	13.4	0.681, 0.322
R61	3.7	27.5	24.68	350.6	13.6	0.682, 0.320
R62	3.7	27.0	24.59	329.0	13.3	0.681, 0.319
R63	3.8	27.4	24.66	376.8	11.6	0.682, 0.320
R64	3.4	27.7	24.72	320.8	13.8	0.682, 0.318
R65	3.5	27.8	24.86	418.3	13.9	0.681, 0.320
R66	3.4	27.3	24.64	307.6	11.6	0.682, 0.320
R67	3.4	27.6	24.70	326.5	14.2	0.681, 0.320
R68	3.6	27.5	24.69	379.0	13.5	0.682, 0.320
R69	3.5	27.4	24.86	307.6	13.9	0.681, 0.320
R70	3.4	27.9	24.92	388.0	14.5	0.680, 0.320
R71	3.6	26.8	23.48	297.8	11.7	0.682, 0.319
R72	4.1	27.5	24.65	343.4	13.5	0.679, 0.319
R73	3.5	27.4	24.82	227.9	13.7	0.681, 0.320
R74	3.4	27.8	24.88	385.2	14.4	0.680, 0.319
R75	3.5	27.7	24.73	377.8	13.9	0.679, 0.321
R76	3.4	27.0	24.58	321.6	13.0	0.679, 0.320
R77	3.5	27.5	24.67	369.0	13.9	0.680, 0.320
R78	3.6	27.3	24.65	389.2	13.6	0.679, 0.319
R79	3.5	27.2	24.67	319.0	13.7	0.681, 0.320
R80	3.4	27.6	24.80	337.9	14.1	0.682, 0.320

[0193]

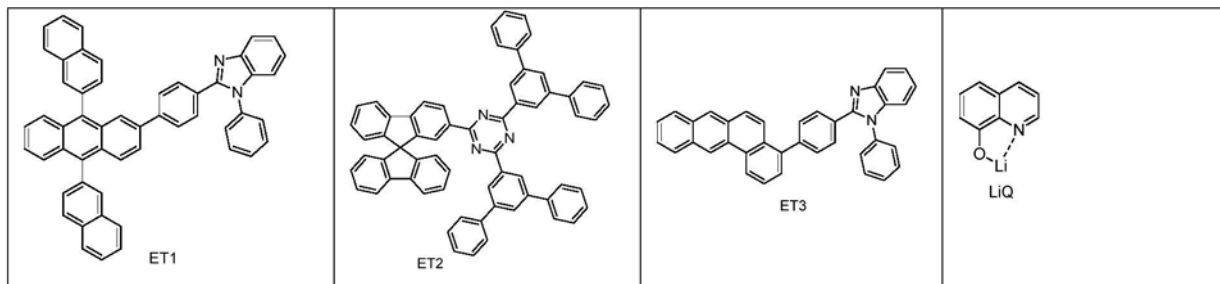
R81	3.4	27.8	24.89	265.4	14.4	0.681, 0.320
R82	3.7	27.0	24.61	322.5	13.2	0.682, 0.320
R83	3.5	27.4	24.70	375.0	13.8	0.681, 0.320
R84	3.6	27.3	24.62	358.0	13.2	0.682, 0.320
R85	3.4	27.7	24.76	329.7	14.0	0.681, 0.319
R86	3.5	27.5	24.69	385.6	13.8	0.682, 0.319
R87	3.6	27.4	24.68	309.0	13.7	0.680, 0.319
R88	3.4	27.6	24.73	394.3	13.9	0.681, 0.319
R89	3.5	27.2	24.62	302.7	13.1	0.682, 0.319
R90	3.6	27.5	24.64	346.0	13.3	0.683, 0.319
R91	3.6	27.4	24.67	342.1	13.7	0.681, 0.318
R92	3.5	27.3	24.64	325.5	13.5	0.682, 0.319
R93	3.6	27.2	24.67	307.6	13.2	0.681, 0.320
R94	3.7	27.0	24.55	385.2	13.4	0.682, 0.320
R95	3.6	26.8	23.60	317.4	11.5	0.681, 0.320
R96	3.7	27.5	24.84	389.9	13.4	0.682, 0.320
R97	3.6	26.7	23.58	302.7	11.2	0.681, 0.320
R98	3.7	26.5	23.27	287.6	11.0	0.682, 0.320
R99	3.6	27.6	24.73	382.0	13.2	0.681, 0.319
R100	3.8	26.4	23.49	297.2	11.4	0.682, 0.319
R101	3.9	25.8	22.31	246.5	9.8	0.683, 0.318

[0194] 表5:用于OLED材料的化合物结构式:

[0195]



[0196]



[0197] 由上可知,选用合适的具有三重态能级 $3.0\text{eV} > E_T \geq 2.0\text{eV}$ 的化合物与磷光发光体 $M(LA)_x(LB)_y(LC)_z$ 进行组合,制备成的红光元件,在元件发光亮度初始为1000尼特为基准的条件下,驱动电压低,外量子效率和电流效率提高,因此功耗降低、元件寿命得到了提高。

[0198] 显然,本发明的上述实施例仅仅是为清楚地说明本发明所作的举例,而并非是对本发明的实施方式的限定,对于所属领域的普通技术人员来说,在上述说明的基础上还可以做出其它不同形式的变化或变动,这里无法对所有的实施方式予以穷举,凡是属于本发明的技术方案所引伸出的显而易见的变化或变动仍处于本发明的保护范围之列。

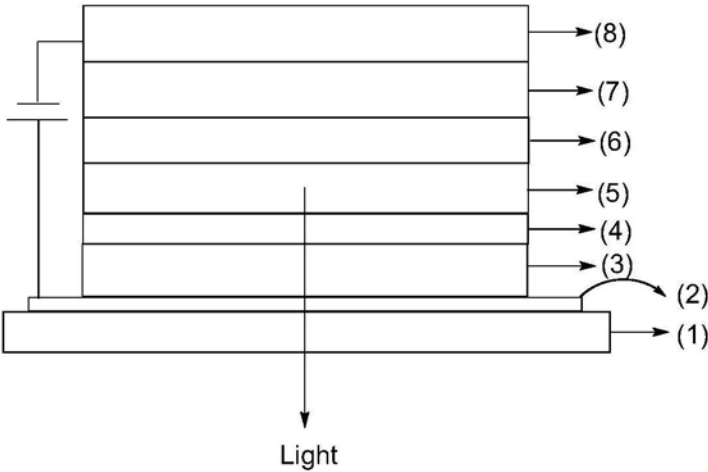


图1

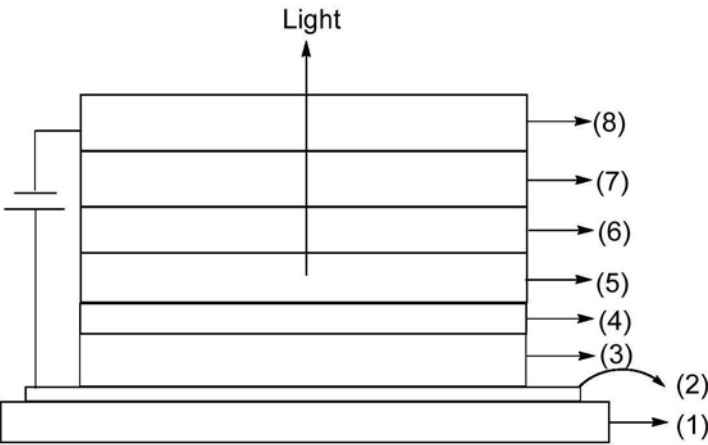


图2

专利名称(译)	有机电致发光材料、有机电致发光器件		
公开(公告)号	CN110144213A	公开(公告)日	2019-08-20
申请号	CN201910470842.6	申请日	2019-05-31
[标]发明人	曹建华 邵哲 隋岩 贾敏慧 王士波		
发明人	曹建华 邵哲 隋岩 贾敏慧 王士波 何伟壮		
IPC分类号	C09K11/06 C07F15/00 H01L51/50 H01L51/54 H01L51/56		
CPC分类号	C07F15/0033 C09K11/06 C09K2211/185 H01L51/0085 H01L51/5012 H01L51/56		
代理人(译)	刘敏 张峰		
外部链接	Espacenet SIPO		

摘要(译)

本发明涉及有机电致发光材料、有机电致发光器件，以及有机电致发光器件的制备方法。本发明的有机电致发光材料通过包含 $3.0\text{eV} > \text{ET} \geq 2.0\text{eV}$ 的有机化合物A和 $\text{M}(\text{LA})_x(\text{LB})_y(\text{LC})_z$ 的化合物B，从而具有在维持其他电子性能保持一定水平的基础上发光寿命提高和/或工作电压降低的优点。

