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(54) **ORGANIC COMPOUND AND ORGANIC ELECTROLUMINESCENT ELEMENT COMPRISING SAME**

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(57)

**ABSTRACT**

The present invention relates to a novel organic compound, and an organic electroluminescent element having improved characteristics, such as luminous efficiency, driving voltage, and lifespan, by containing the novel organic compound in one or more organic material layers.

**ORGANIC COMPOUND AND ORGANIC  
ELECTROLUMINESCENT ELEMENT  
COMPRISING SAME**

TECHNICAL FIELD

[0001] The present invention relates to an organic compound and an organic electroluminescent element comprising the same.

BACKGROUND ART

[0002] In an organic electroluminescent element, the application of a voltage across two opposite electrodes induces the injection of holes from the anode and electrons from the cathode into an organic layer. The injected holes and electrons recombine with each other to generate excitons which then return to the ground state, emitting light. The materials for use in the organic layer can be classified as luminescent materials, hole injection materials, hole transport materials, electron transport materials, and electron injection materials according to functions.

[0003] Widely known are NPB, BCP and Alq<sub>3</sub> as materials for hole injection, hole transport and electron transport, and anthracene derivatives and Ir-bearing metal complexes, such as Firpic, Ir(ppy)<sub>3</sub>, (acac)Ir(btp)<sub>2</sub> etc., as luminescent materials.

[0004] However, not only are such materials poor in thermal stability due to their low glass transition temperatures, but also organic electroluminescent elements having the materials introduced into organic layers thereof exhibit only an unsatisfactory level of current efficiency and lifespan because the materials are of low triplet energy.

DISCLOSURE

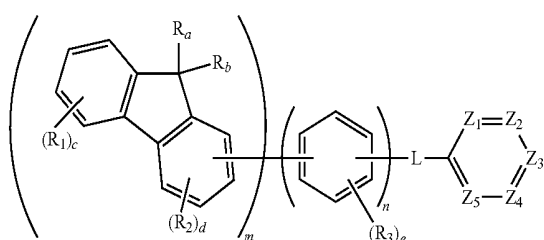
Technical Problem

[0005] In order to solve the problems encountered in related art, the present invention provides an organic compound that can impart an organic electroluminescent element with an improvement in driving voltage, current efficiency, and lifespan.

[0006] Also, the present invention provides an organic electroluminescent element comprising the organic compound.

Technical Solution

[0007] In order to accomplish the above purposes thereof, the present invention provides a compound represented by the following Formula 1:



[0008] wherein,

[0009]  $R_a$  and  $R_b$  may be the same or different from each other and are each independently a C<sub>1</sub>-C<sub>40</sub> alkyl group or a C<sub>6</sub>-C<sub>60</sub> aryl group, or combine with each other to form a fused ring,

[0010]  $R_1$  to  $R_3$  may be the same or different from each other and are each independently selected from the group consisting of a hydrogen, a deuterium, a halogen, a cyano group, a nitro group, an amino group, a C<sub>1</sub>-C<sub>40</sub> alkyl group, a C<sub>2</sub>-C<sub>40</sub> alkenyl group, a C<sub>2</sub>-C<sub>40</sub> alkynyl group, a C<sub>3</sub>-C<sub>40</sub> cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a C<sub>6</sub>-C<sub>60</sub> aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a C<sub>1</sub>-C<sub>40</sub> alkyloxy group, a C<sub>6</sub>-C<sub>60</sub> aryloxy group, a C<sub>1</sub>-C<sub>40</sub> alkylsilyl group, a C<sub>6</sub>-C<sub>60</sub> arylsilyl group, a C<sub>1</sub>-C<sub>40</sub> alkylboron group, a C<sub>6</sub>-C<sub>60</sub> arylboron group, a C<sub>1</sub>-C<sub>40</sub> phosphine group, a C<sub>1</sub>-C<sub>40</sub> phosphine oxide group, and a C<sub>6</sub>-C<sub>60</sub> arylamine group, or provided that adjacent ones of  $R_1$  to  $R_3$  may combine with each other (in detail, combination between adjacent  $R_1$ 's, between adjacent  $R_2$ 's, between adjacent  $R_3$ 's, or between  $R_1$  and  $R_2$ ) to form a fused ring,

[0011]  $L$  is selected from the group consisting of a single bond, a C<sub>6</sub>-C<sub>18</sub> arylene group and a heteroarylene group having 5 to 18 nuclear atoms,

[0012]  $Z_1$  to  $Z_5$  may be the same or different and are each independently N or C( $R_4$ ), and provided that  $Z_1$  to  $Z_5$  include at least one N, and when C( $R_4$ ) is present in a plural number, they are optionally the same as or different from each other,

[0013]  $c$  and  $e$  are each an integer of 0 to 4,

[0014]  $d$  is an integer of 0 to 3,

[0015]  $m$  and  $n$  are each an integer of 1 to 3,

[0016]  $R_4$  is selected from the group consisting of a hydrogen, a deuterium, a halogen, a cyano group, a nitro group, an amino group, a C<sub>1</sub>-C<sub>40</sub> alkyl group, a C<sub>2</sub>-C<sub>40</sub> alkenyl group, a C<sub>2</sub>-C<sub>40</sub> alkynyl group, a C<sub>3</sub>-C<sub>40</sub> cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a C<sub>6</sub>-C<sub>60</sub> aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a C<sub>1</sub>-C<sub>40</sub> alkyloxy group, a C<sub>6</sub>-C<sub>60</sub> aryloxy group, a C<sub>1</sub>-C<sub>40</sub> alkylsilyl group, a C<sub>6</sub>-C<sub>60</sub> arylsilyl group, a C<sub>1</sub>-C<sub>40</sub> alkylboron group, a C<sub>6</sub>-C<sub>60</sub> arylboron group, a C<sub>1</sub>-C<sub>40</sub> phosphine group, a C<sub>1</sub>-C<sub>40</sub> phosphine oxide group, and a C<sub>6</sub>-C<sub>60</sub> arylamine group, or bonded to an adjacent substituent (in detail, adjacent  $R_4$ 's are bonded to each other) to form a fused ring,

[0017] the alkyl and aryl groups of  $R_a$  and  $R_b$ ; the alkyl, alkenyl, alkynyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, alkyloxy, aryloxy, alkylsilyl, arylsilyl, alkylboron, arylboron, phosphine, phosphine oxide, and arylamine groups of  $R_1$  to  $R_4$ ; and the arylene and heteroarylene groups of  $L$  may be optionally each independently unsubstituted or substituted with at least one selected from the group consisting of a deuterium, a halogen, a cyano group, a nitro group, an amino group, a C<sub>1</sub>-C<sub>40</sub> alkyl group, a C<sub>2</sub>-C<sub>40</sub> alkenyl group, a C<sub>2</sub>-C<sub>40</sub> alkynyl group, a C<sub>3</sub>-C<sub>40</sub> cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a C<sub>6</sub>-C<sub>60</sub> aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a C<sub>1</sub>-C<sub>40</sub> alkyloxy group, a C<sub>6</sub>-C<sub>60</sub> aryloxy group, a C<sub>1</sub>-C<sub>40</sub> alkylsilyl group, a C<sub>6</sub>-C<sub>60</sub> arylsilyl group, a C<sub>1</sub>-C<sub>40</sub> alkylboron group, a C<sub>6</sub>-C<sub>60</sub> arylboron group, a C<sub>1</sub>-C<sub>40</sub> phosphine group, a C<sub>1</sub>-C<sub>40</sub> phosphine oxide group, and a C<sub>6</sub>-C<sub>60</sub> arylamine group, and provided that when the substituent is present in a plural number, they are optionally the same or different from each other.

[0018] In addition, the present invention provides an organic electroluminescent element comprising an anode, a

cathode, and at least one organic layer interposed therebetween, wherein at least one of the organic layer comprises the compound represented by Formula 1.

#### Advantageous Effects

[0019] Having excellent thermal stability and emitting properties, the compound, represented by Formula 1, of the present invention can be available for use in an organic layer of an organic electroluminescent element. Particularly when used as a material for a light-emitting layer or an auxiliary electron transport layer, the compound, represented by Formula 1, of the present invention can impart excellent emission performance, low driving voltage, high efficiency and long lifespan to the organic electroluminescent element, thereby allowing for the fabrication of a full-color display panel improved in performance and lifespan.

#### MODE FOR INVENTION

[0020] Below, a detailed description is given of the present invention.

[0021] 1. Organic Compound

[0022] The organic compound of the present invention has a framework, represented by Formula 1, in which a fluorene moiety is bonded to a 6-membered heterocyclic ring through a linker (phenylene, biphenylene or terphenylene).

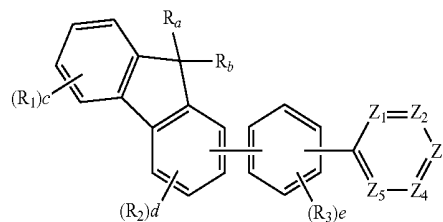
[0023] The fluorene moiety serves as an electron donor group (EDG) with high electron donating ability. When the fluorene moiety is connected via a linker to a 6-membered heterocyclic ring that serves as an electron withdrawing group (EWG) with high electron withdrawing ability (e.g., pyridine, pyrimidine, triazine, etc.), the overall molecule exhibits a bipolar property. Accordingly, the compound of the present invention can improve hole-electron recombination.

[0024] In addition, since the linker, e.g., phenylene, or biphenylene or terphenylene, functions to minimize interaction between the electron donor group and the electron withdrawing group, the compound of the present invention into which the linker is introduced has a wide bandgap and a high triplet energy. Hence, the compound of the present invention, if applied to an organic layer, minimizes the diffusion of excitons to adjacent other organic layers. An organic electroluminescent element comprising such an organic layer can be improved in light emission efficiency and lifespan, compared to that comprising an organic layer lacking the linker. Further, with the introduction of a linker thereto, the compound of the present invention has a higher molecular weight than those lacking the linker, thus improving in thermal stability.

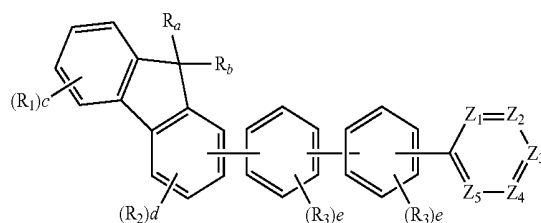
[0025] Such effects may be more intensified when bonds between an electron donor group and a linker, between linkers, and between a linker and an electron drawing group are more twisted structure formed thereof.

[0026] The compound, represented by Formula 1, of the present invention may be embodied by one of the compounds represented by the following Formulas 2 to 4:

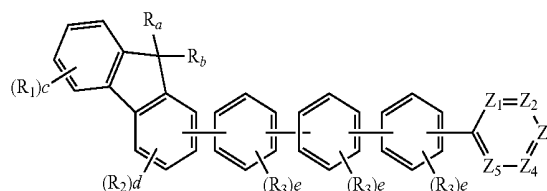
[Formula 2]



[Formula 3]



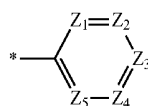
[Formula 4]



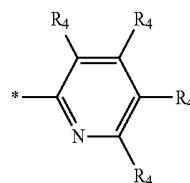
[0027] wherein,

[0028]  $R_a$ ,  $R_b$ ,  $R_1$  to  $R_3$ ,  $Z_1$  to  $Z_5$ , c, d, and e are the same as defined in Formula 1.

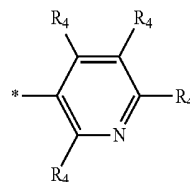
[0029] In the compound represented by Formula 1 of the present invention, the structure (substituent) represented by



(\* is a site where to bond with L) is particularly embodied by one of the structures (substituents) represented by the following C-1 to C-15.

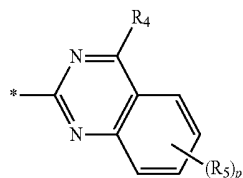
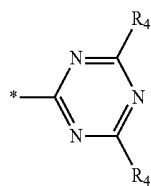
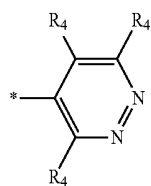
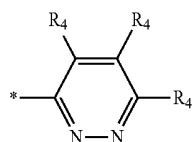
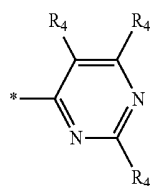
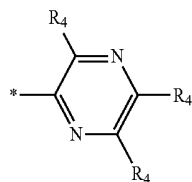
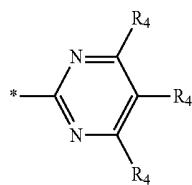
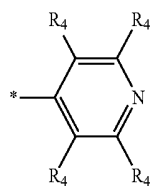


C-1



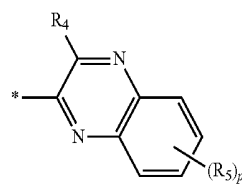
C-2

-continued



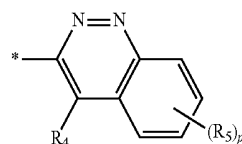
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C-3



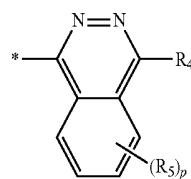
C-11

C-4



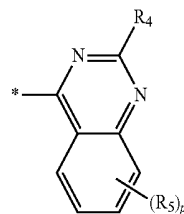
C-12

C-5



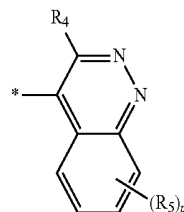
C-13

C-6



C-14

C-7



C-15

C-8

[0030] wherein,

[0031] R<sub>4</sub> is the same as defined in Formula 1 and a plurality of R<sub>4</sub>'s are the same or different,[0032] R<sub>5</sub> is selected from the group consisting of a hydrogen, a deuterium, a halogen, a cyano group, a nitro group, a C<sub>1</sub>-C<sub>40</sub> alkyl group, a C<sub>2</sub>-C<sub>40</sub> alkenyl group, a C<sub>2</sub>-C<sub>40</sub> alkynyl group, a C<sub>3</sub>-C<sub>40</sub> cycloalkyl group, a heterocycloalkyl group having 3 to nuclear atoms, a C<sub>6</sub>-C<sub>60</sub> aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a C<sub>6</sub>-C<sub>60</sub> aryloxy group, a C<sub>1</sub>-C<sub>40</sub> alkyloxy group, a C<sub>6</sub>-C<sub>60</sub> arylamine group, a C<sub>1</sub>-C<sub>40</sub> alkylsilyl group, a C<sub>1</sub>-C<sub>40</sub> alkylboron group, a C<sub>6</sub>-C<sub>60</sub> arylboron group, a C<sub>6</sub>-C<sub>60</sub> arylphosphine group, a C<sub>6</sub>-C<sub>60</sub> arylphosphine oxide group, and a C<sub>6</sub>-C<sub>60</sub> arylsilyl group, or combines with an adjacent substituent (in detail, combination between adjacent R<sub>5</sub>'s or between R<sub>4</sub> and R<sub>5</sub>) to form a fused ring,

C-9

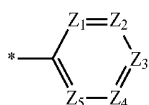
[0033] p is an integer of 1 to 4,

C-10

[0034] the alkyl, alkenyl, alkynyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, aryloxy, alkyloxy, arylamine, alkylsilyl, alkylboron, arylboron, arylphosphine, arylphosphine oxide and arylsilyl groups of R<sub>5</sub> may be each independently unsubstituted or substituted with at least one selected from the group consisting of a deuterium, a halogen, a cyano group, a nitro group, a C<sub>1</sub>-C<sub>40</sub> alkyl group, a C<sub>2</sub>-C<sub>40</sub> alkenyl group, a C<sub>2</sub>-C<sub>40</sub> alkynyl group, a C<sub>6</sub>-C<sub>60</sub> aryl

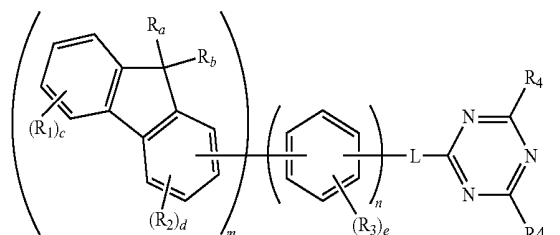
group, a heteroaryl group having 5 to 60 nuclear atoms, a C<sub>6</sub>-C<sub>60</sub> aryloxy group, a C<sub>1</sub>-C<sub>40</sub> alkyloxy group, a C<sub>6</sub>-C<sub>60</sub> arylamine group, a C<sub>3</sub>-C<sub>40</sub> cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a C<sub>1</sub>-C<sub>40</sub> alkylsilyl group, a C<sub>1</sub>-C<sub>40</sub> alkylboron group, a C<sub>6</sub>-C<sub>60</sub> arylboron group, a C<sub>6</sub>-C<sub>60</sub> arylphosphine group, a C<sub>6</sub>-C<sub>60</sub> arylphosphine oxide group, and a C<sub>6</sub>-C<sub>60</sub> arylsilyl group, and provided that when the substituent is present in a plural number, they are optionally the same or different from each other.

[0035] Here, the structure represented by

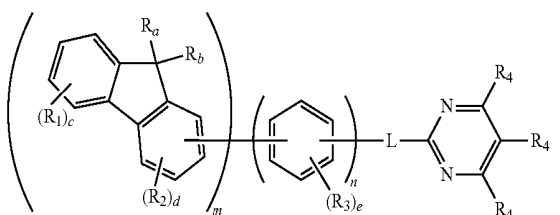


is more particularly the structure represented by C-4, C-6, or C-9. In greater detail, the compound, represented by Formula 1, of the present invention may be those represented by the following Formulas 5 to 7:

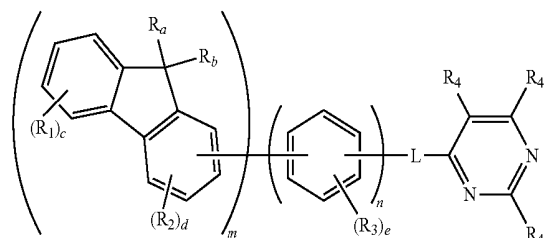
[Formula 5]



[Formula 6]



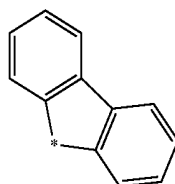
[Formula 7]



[0036] wherein,

[0037] R<sub>a</sub>, R<sub>b</sub>, R<sub>1</sub> to R<sub>4</sub>, L, c, d, e, m, and n are the same as defined in Formula 1, respectively. Here, considering properties of organic electroluminescent device, it is preferred that R<sub>4</sub>'s in the compound represented by Formula 5 are the same. That is, identical R<sub>4</sub>'s particularly give a symmetrical structure to the compound. In the compounds represented by Formulas 6 and 7, it is preferred that at least two of the plural R<sub>4</sub>'s are different from each other.

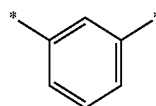
[0038] When account is taken of properties of organic electroluminescent device, it is preferred that R<sub>a</sub> and R<sub>b</sub> in the compound represented Formula 1 of the present invention are each independently a methyl or a phenyl, or bond each other to form a fused ring represented by



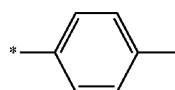
(\* is a site where to bond).

[0039] In the compound represented by Formula 1, R<sub>1</sub> to R<sub>3</sub> are each independently selected from the group consisting of hydrogen, deuterium, a C<sub>1</sub>-C<sub>40</sub> alkyl group, a C<sub>6</sub>-C<sub>60</sub> aryl group, a heteroaryl group having 5 to 60 nuclear atoms, and a C<sub>6</sub>-C<sub>60</sub> arylamine group. In addition, m and n are each an integer of 1 to 3, and preferably m is 1 and n is 1 or 2.

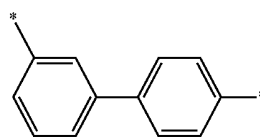
[0040] In the compound represented by Formula 1 of the present invention, L may be preferably a single bond, phenylene, or biphenylene. In detail, the linker L is preferably selected from the group consisting of the structures represented by the following L-1 to L-7 (\* is a site where to bond), more preferably the structure represented by L-6.



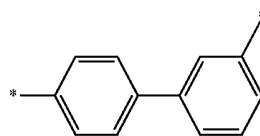
L-1



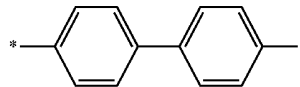
L-2



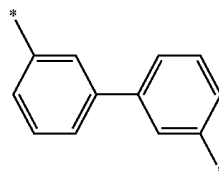
L-3



L-4

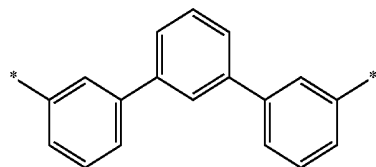


L-5



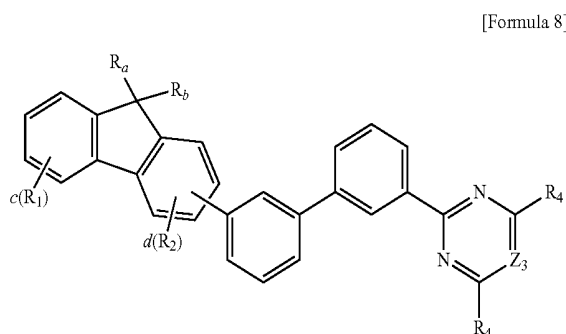
L-6

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L-7

[0041] When the linker L is the structure represented by L-6, the compound, represented by Formula 1, of the present invention may be embodied by the compound represented by the following Formula 8:

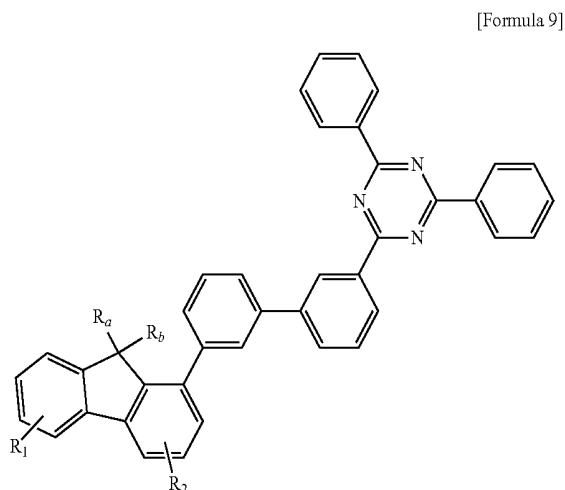


[Formula 8]

[0042] wherein,

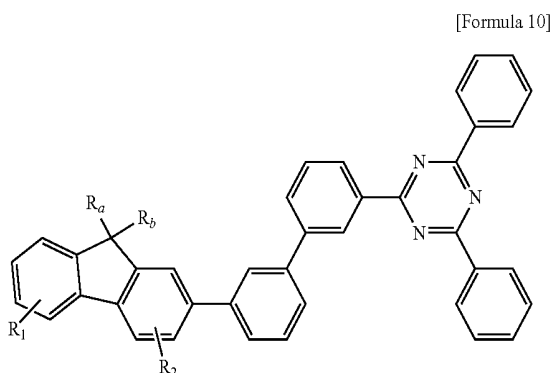
[0043]  $R_a$ ,  $R_b$ ,  $R_1$ ,  $R_2$ ,  $R_4$ ,  $Z_3$ ,  $c$ , and  $d$  are the same as defined in Formula 1, respectively.

[0044] In greater detail, the compound, represented by Formula 1, of the present invention may be further embodied by the compounds represented by the following Formulas 9 to 12:



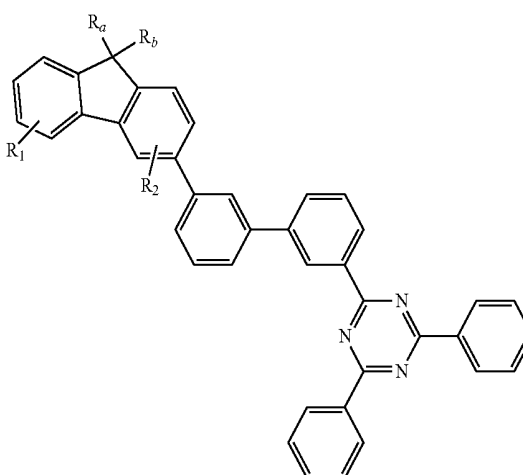
[Formula 9]

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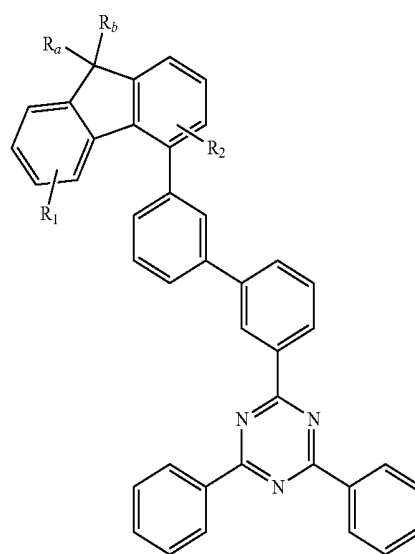


[Formula 10]

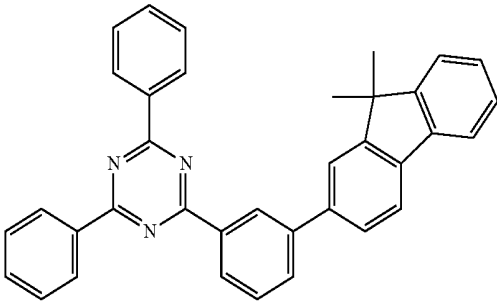
[Formula 11]



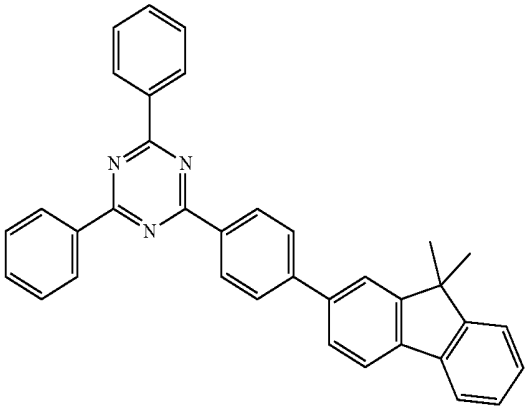
[Formula 12]



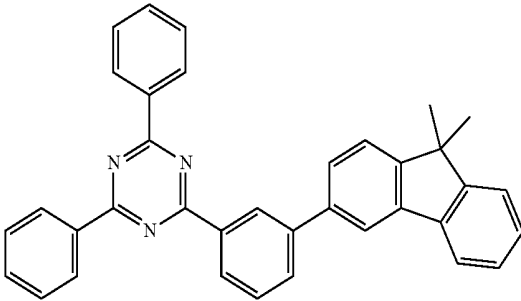
[0045] Concrete examples of the compound, represented by Formula 1, of the present invention include, but are not limited to, the following Compounds 1 to 366:



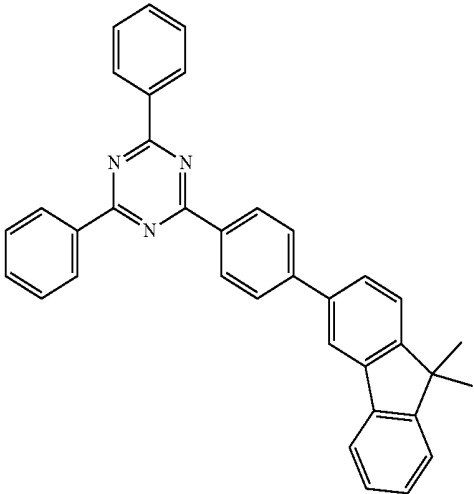
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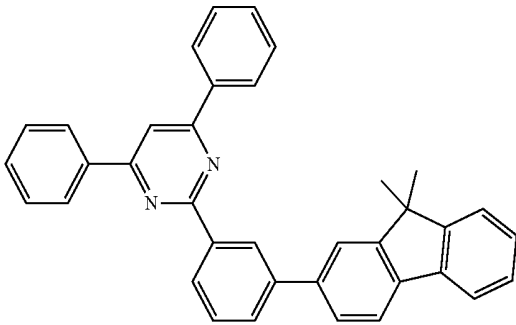
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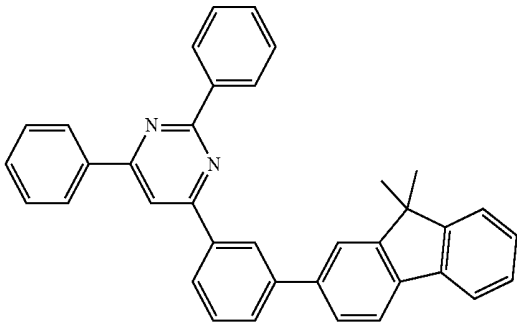
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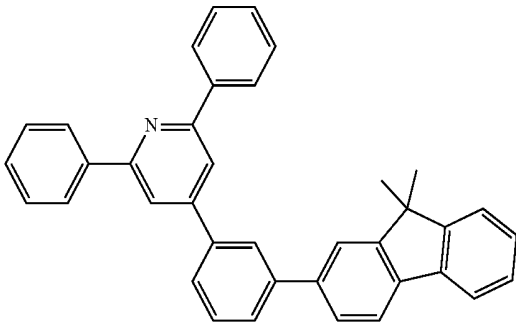
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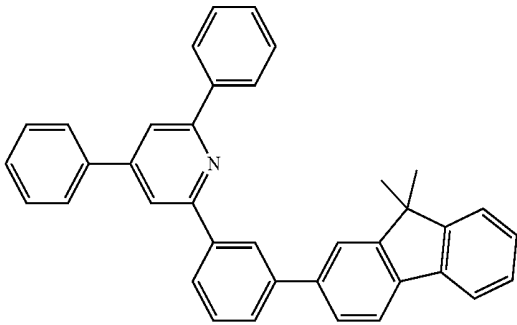
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6



7

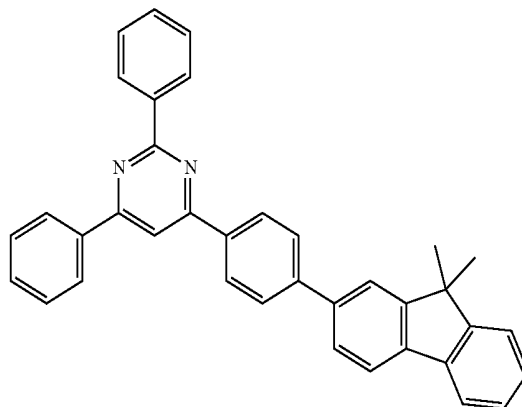
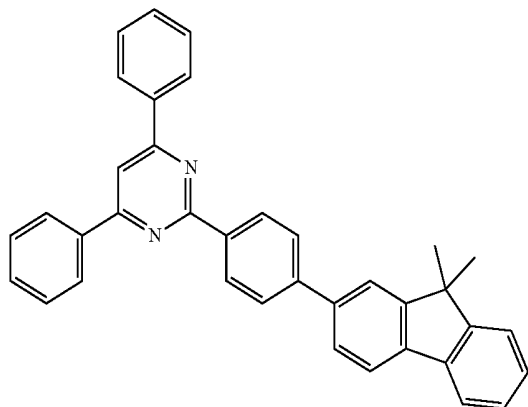


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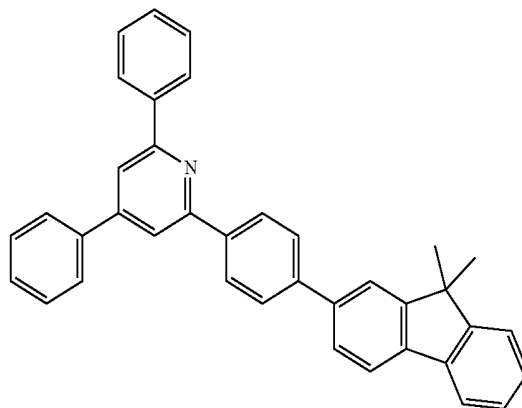
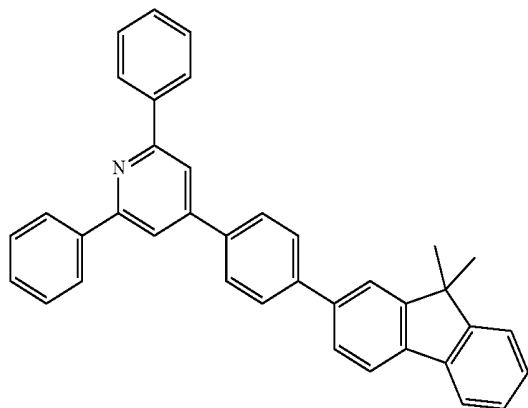
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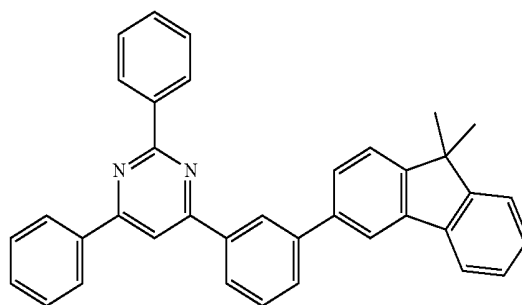
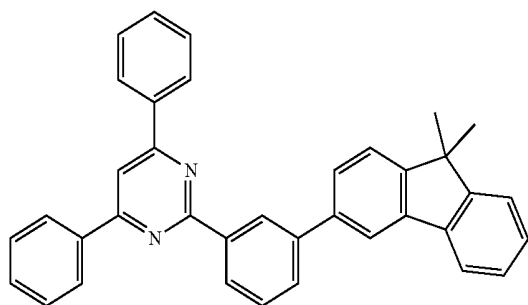
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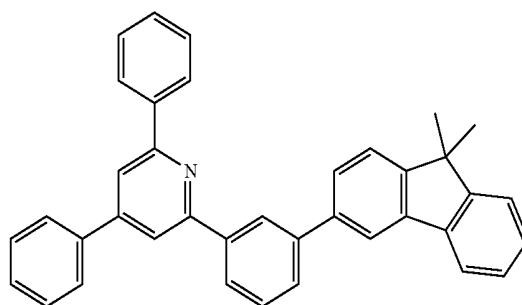
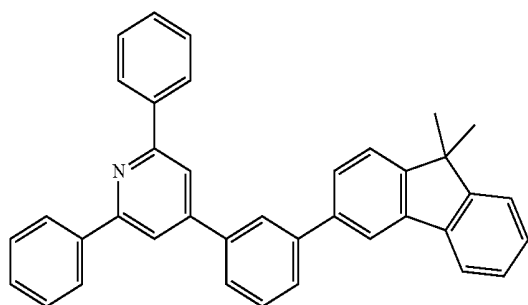
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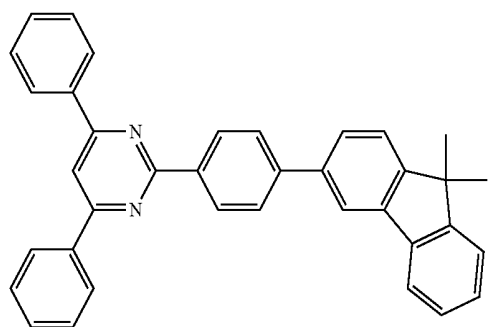


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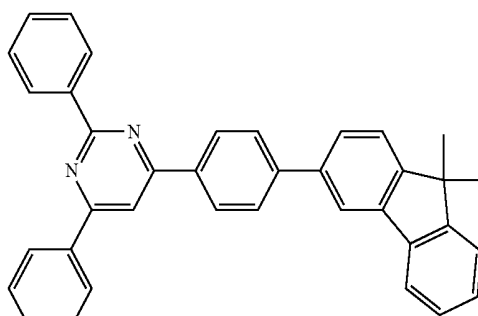
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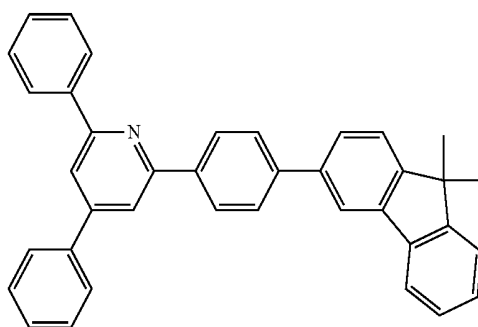
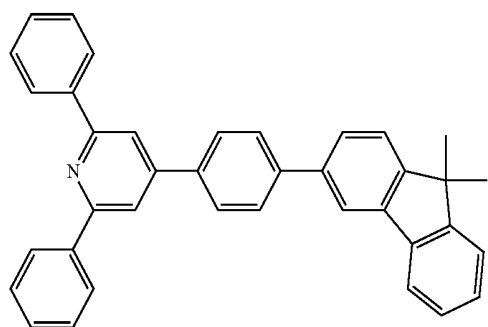


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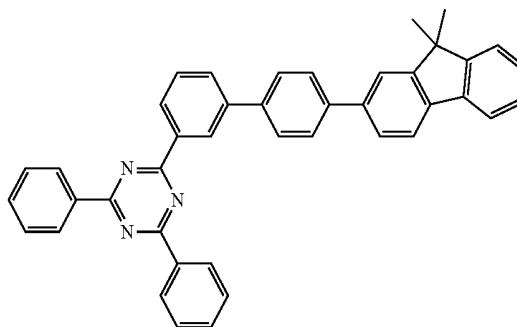
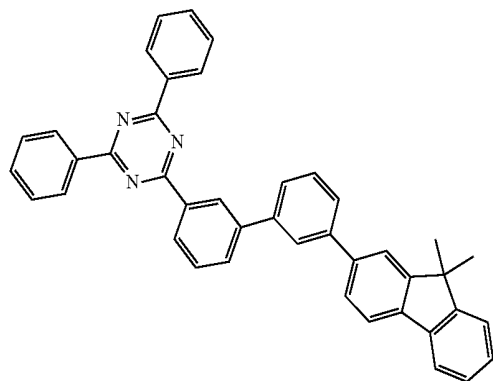
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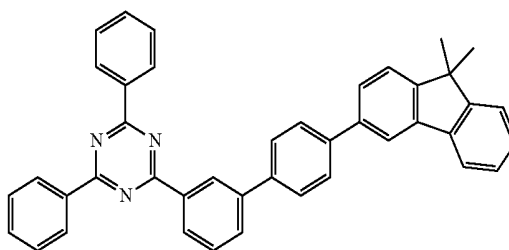
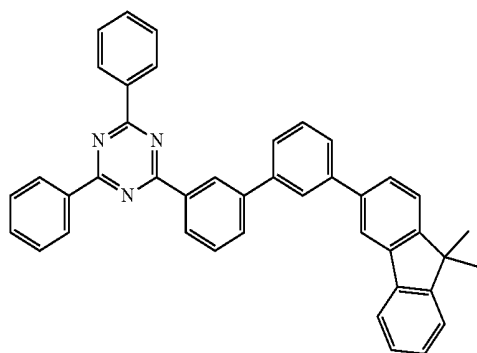
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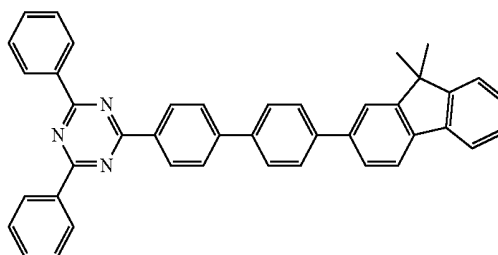
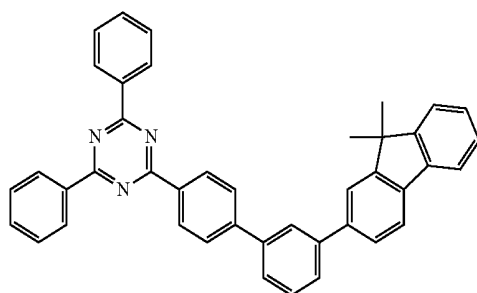
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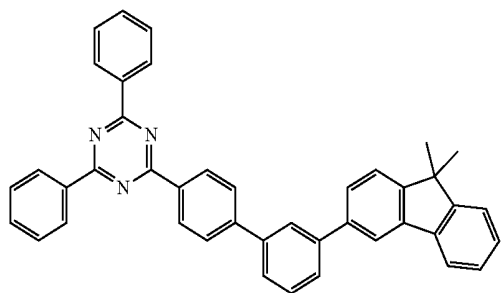


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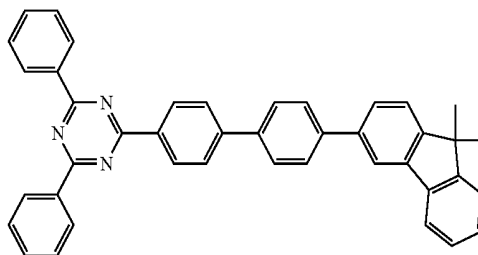
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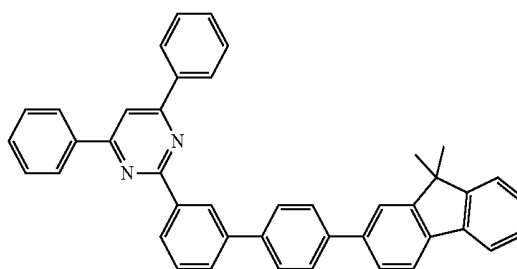
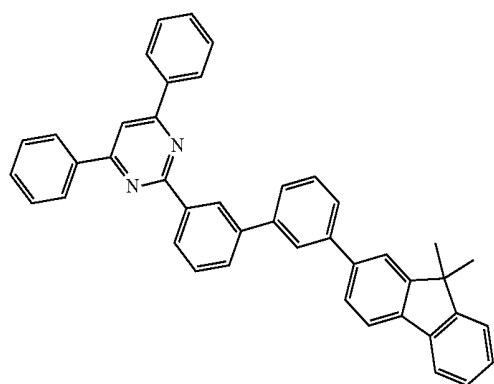


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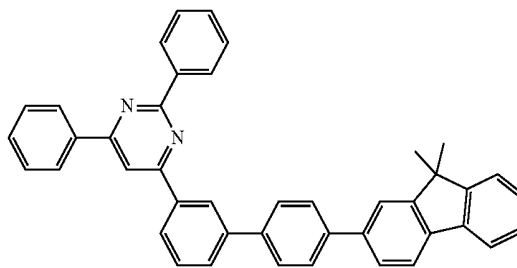
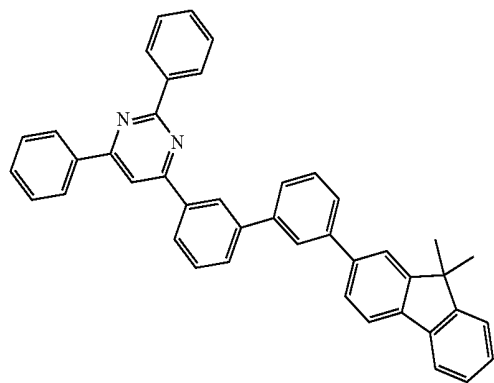
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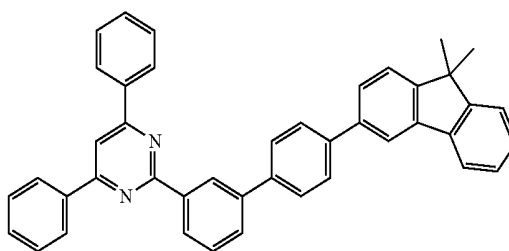
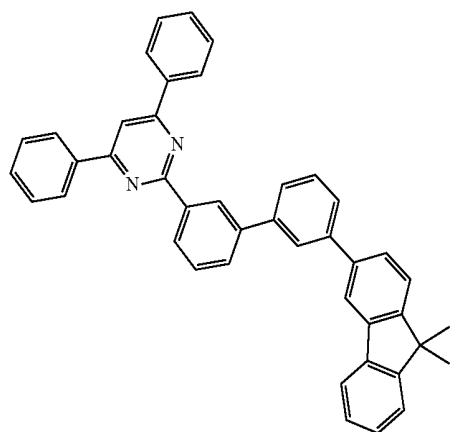
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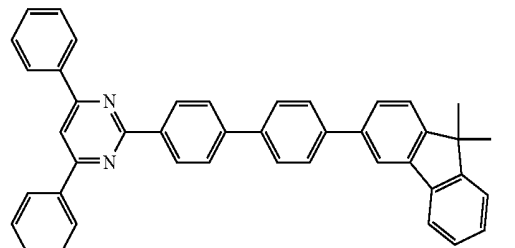
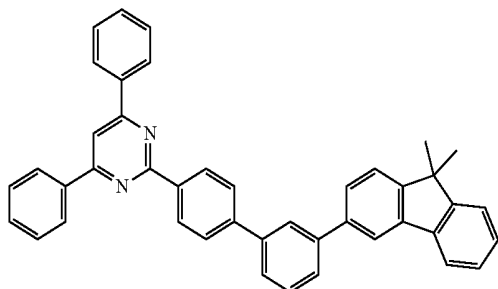
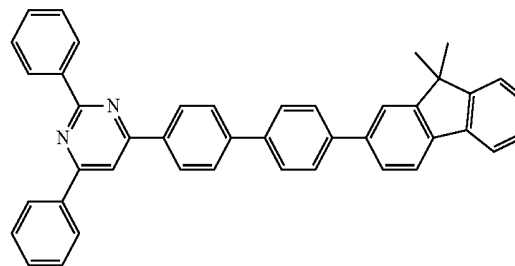
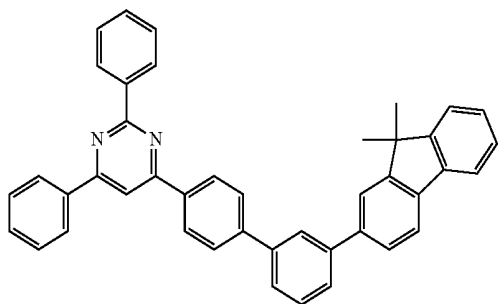
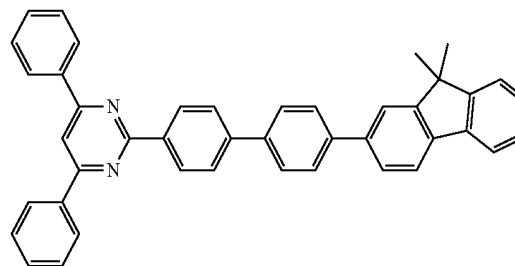
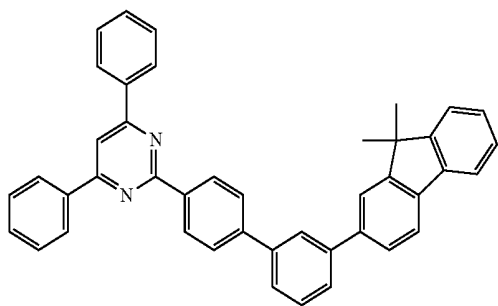
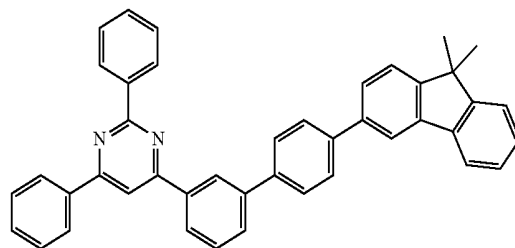
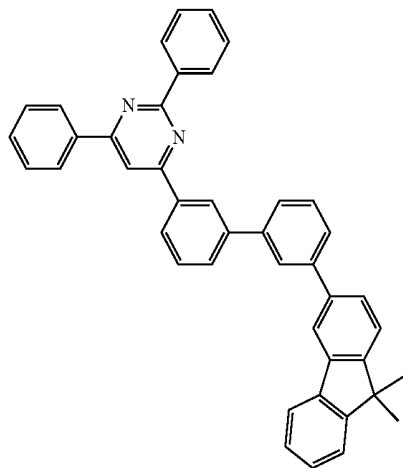


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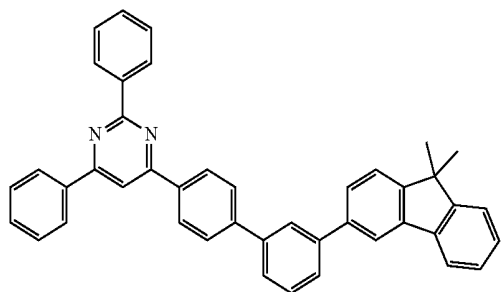
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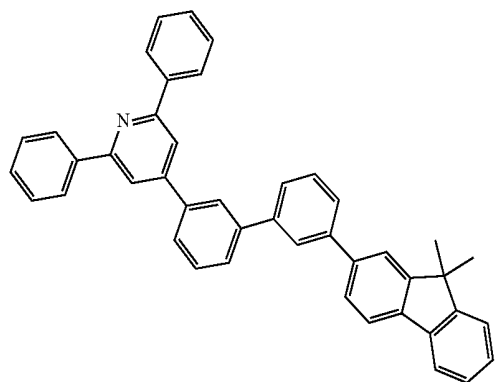
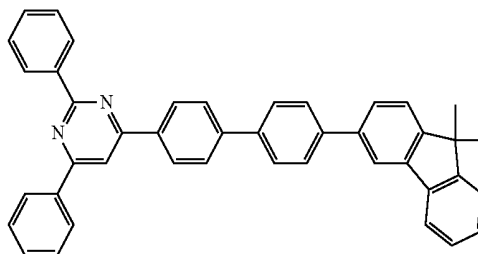


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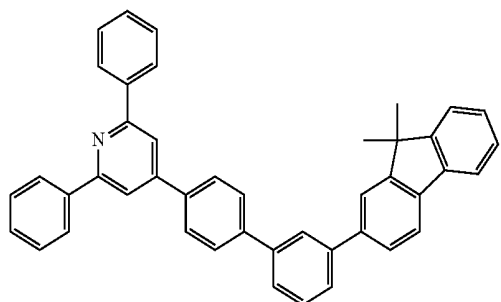
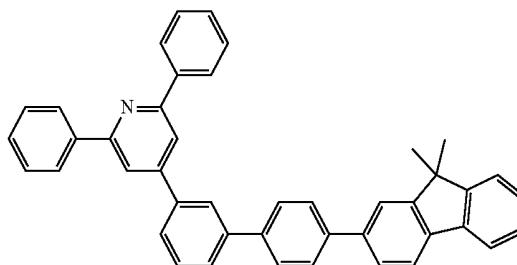
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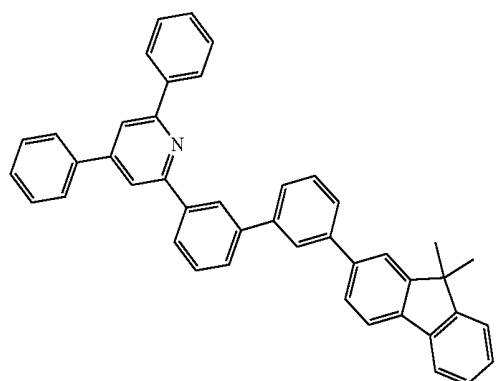
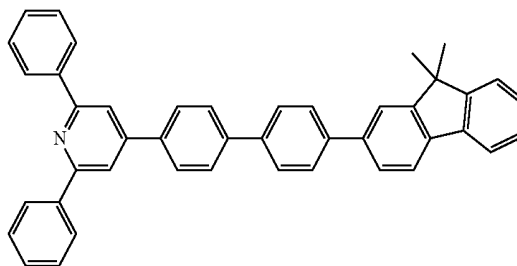
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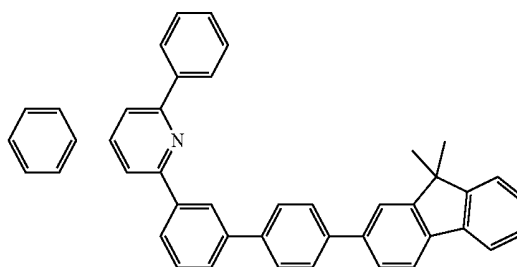
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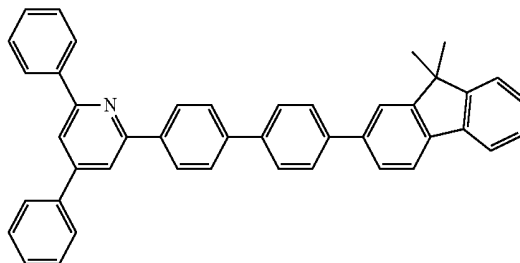
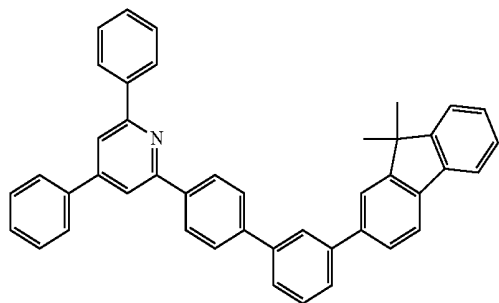
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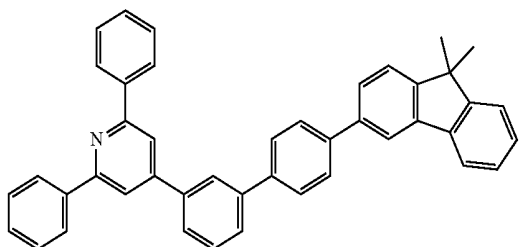
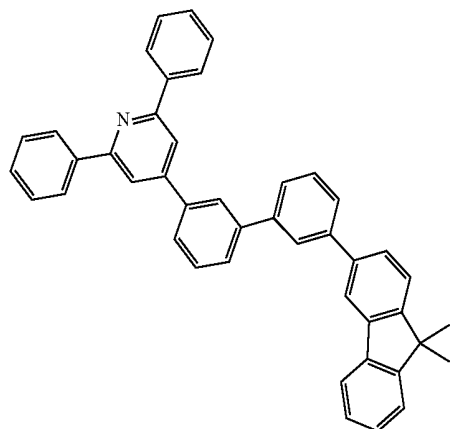
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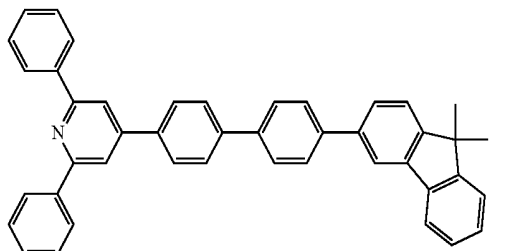
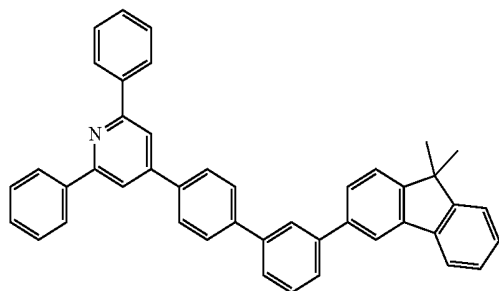
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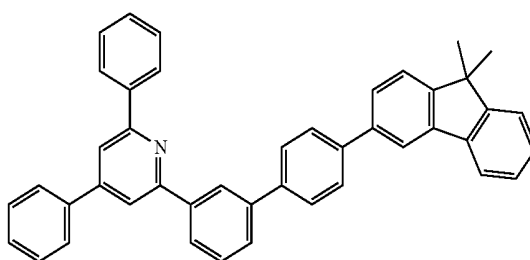
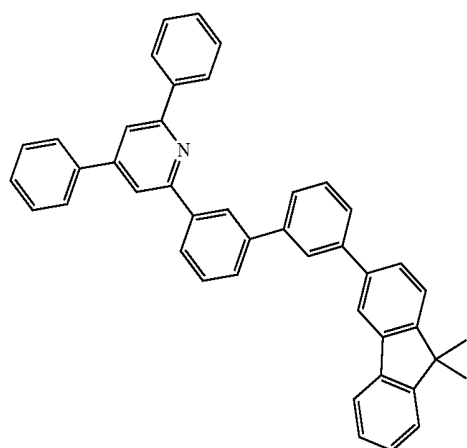
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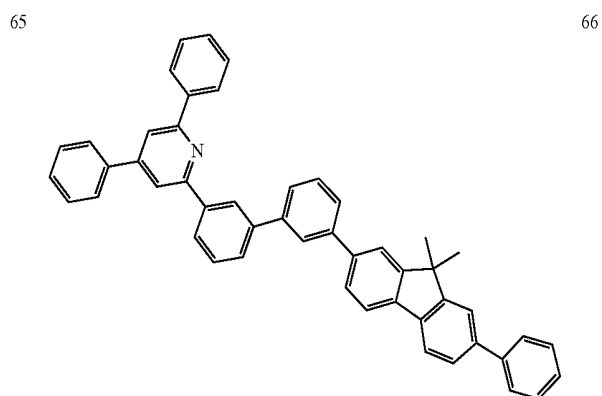
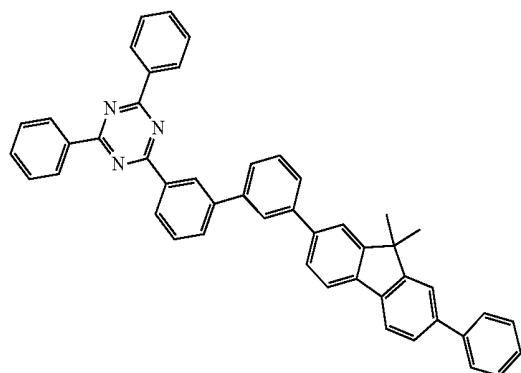
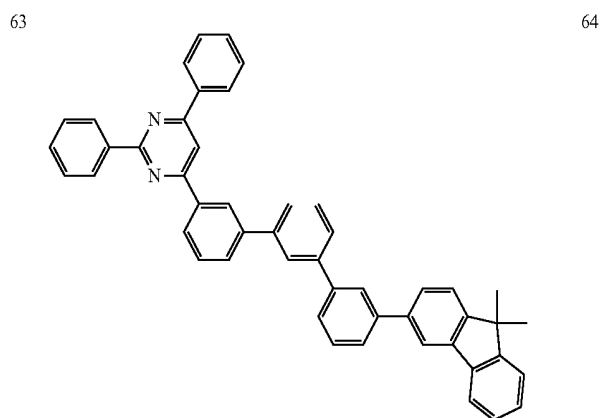
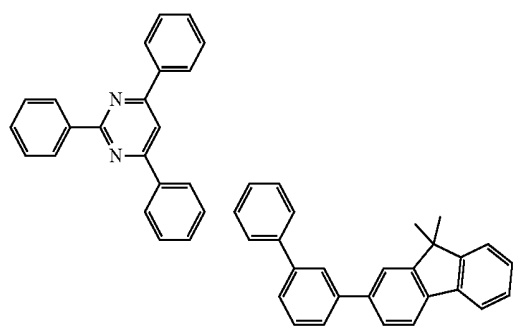
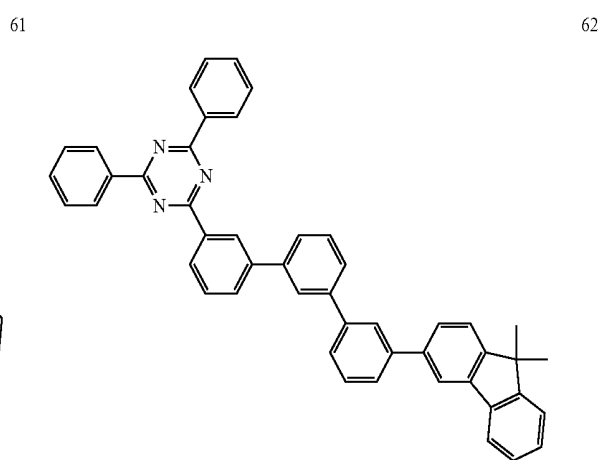
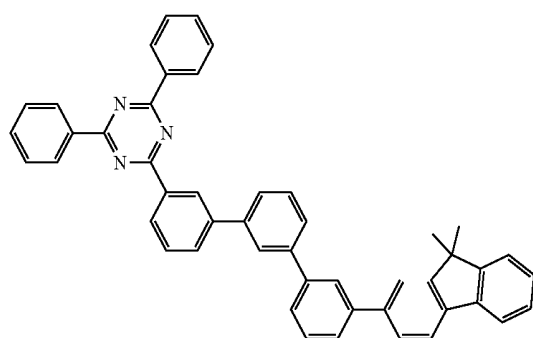
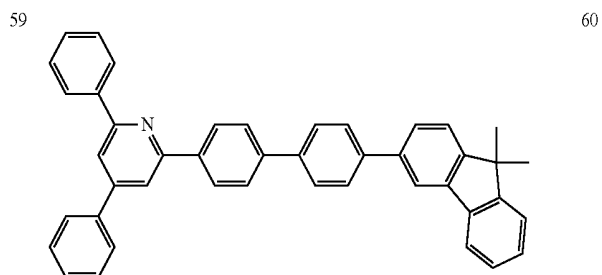
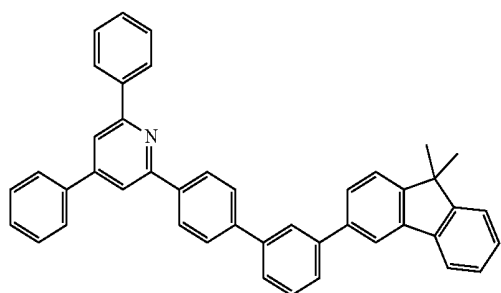


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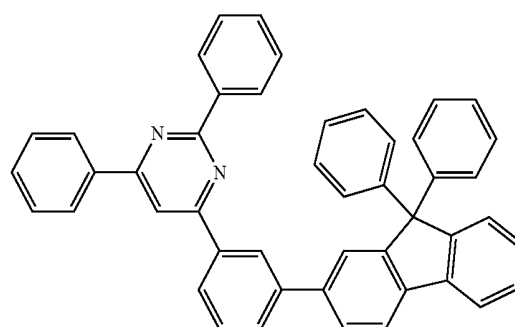
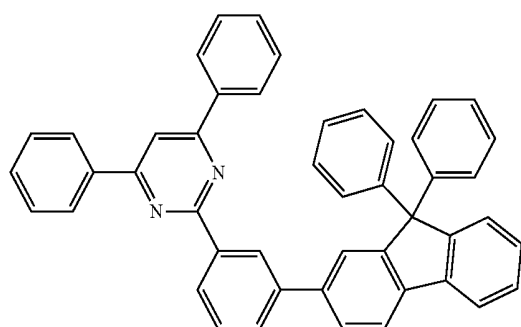
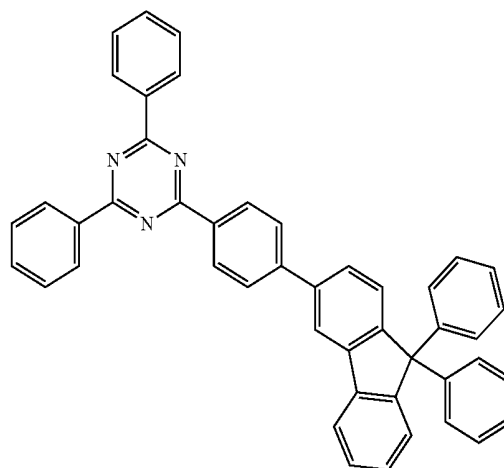
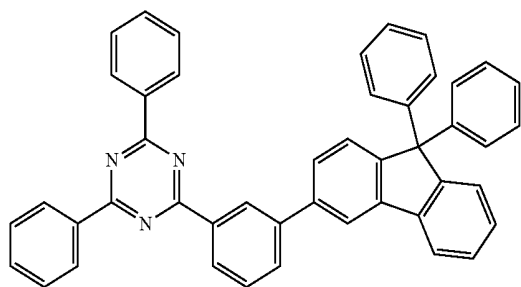
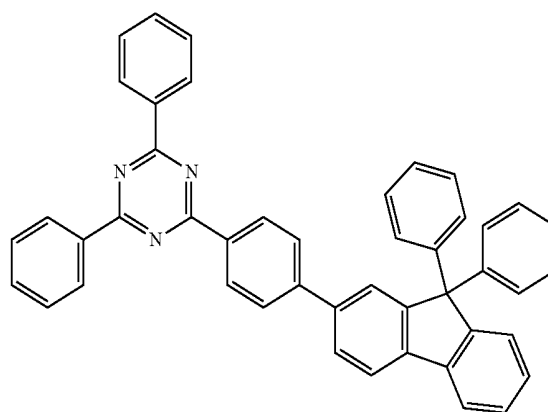
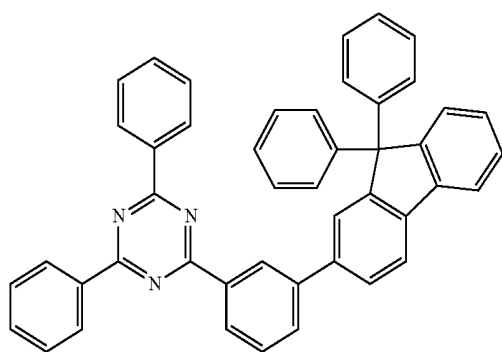
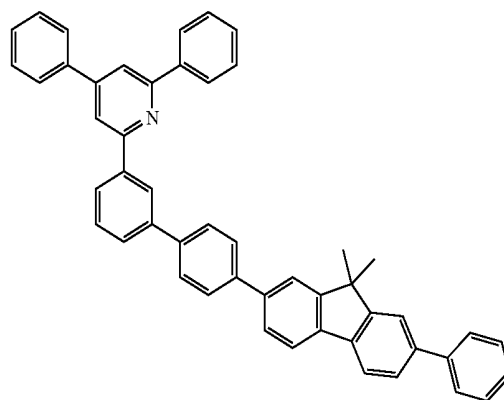
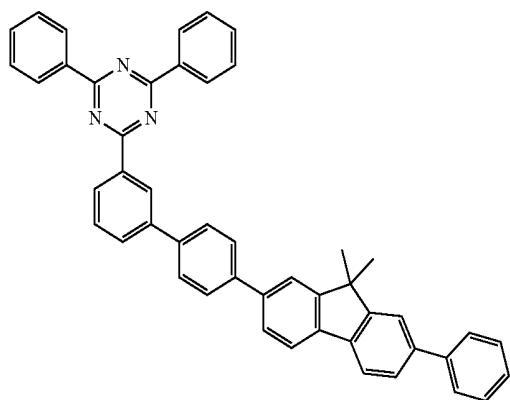
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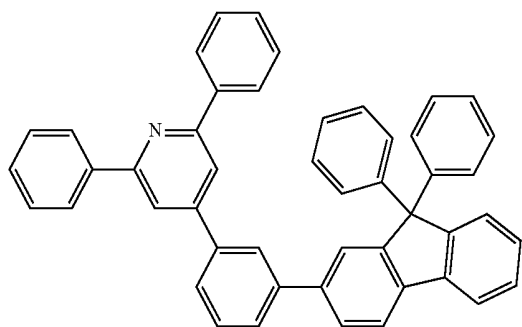
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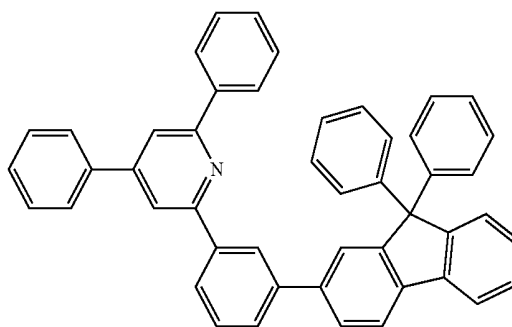
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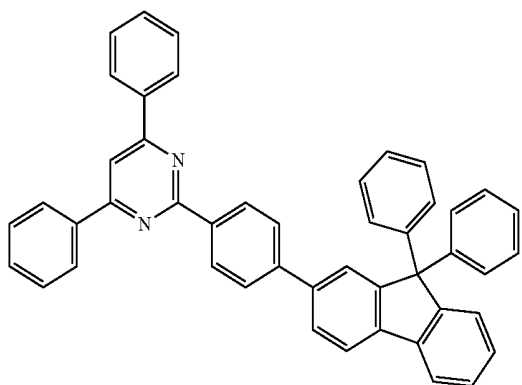
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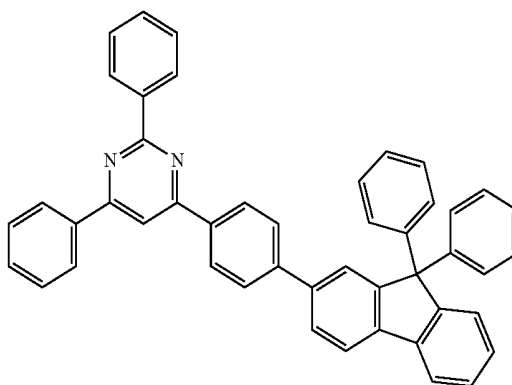
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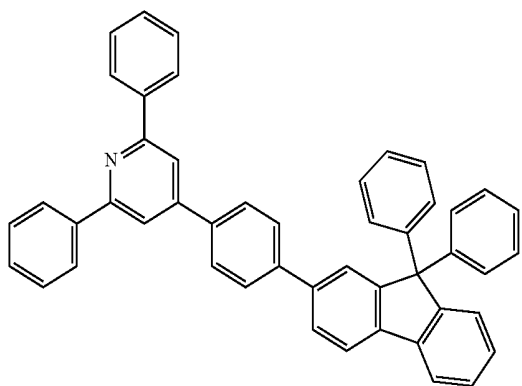
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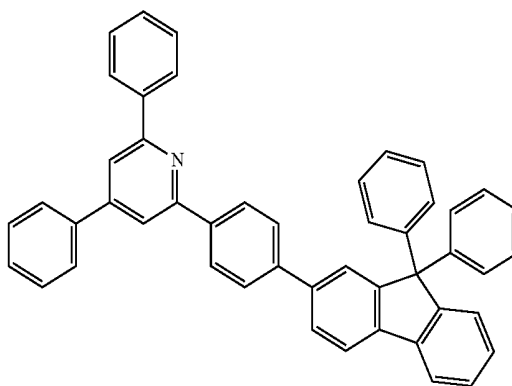
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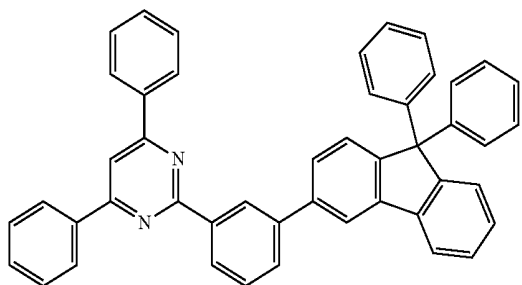
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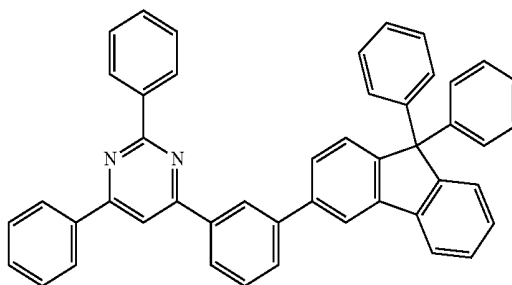
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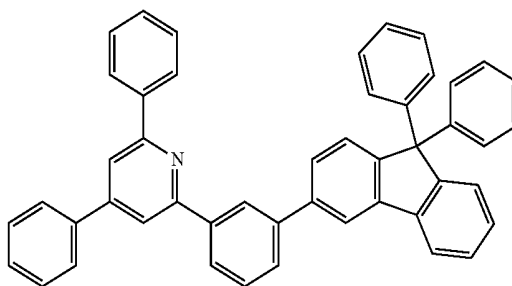
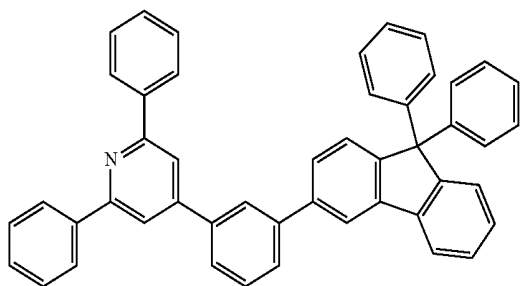
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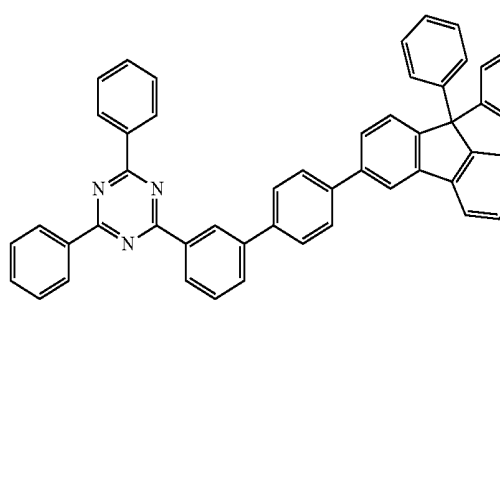
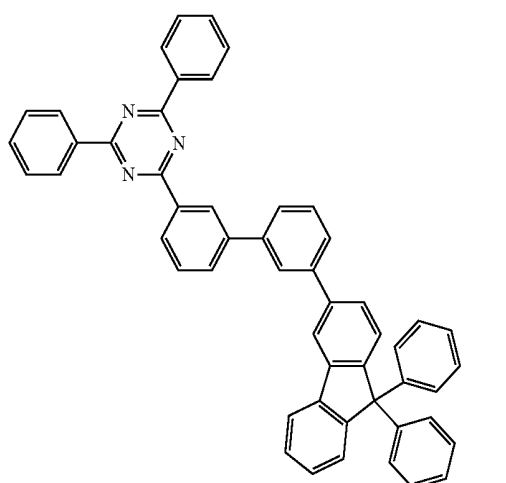
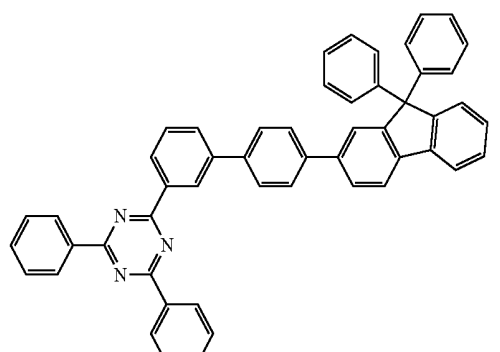
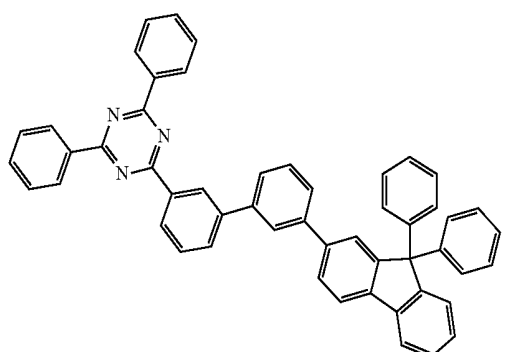
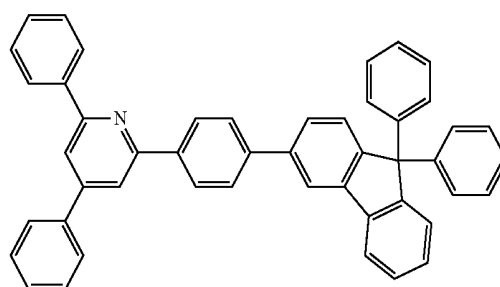
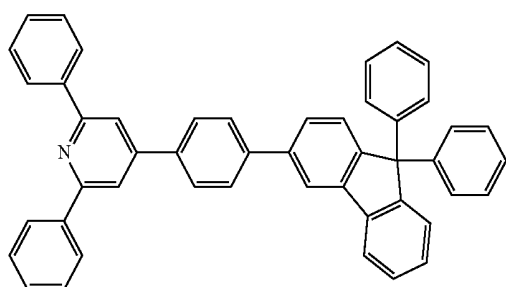
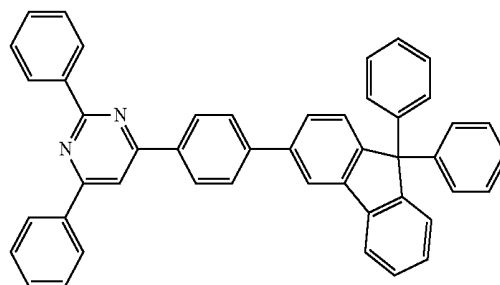
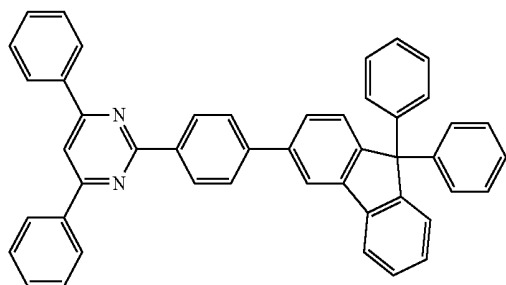
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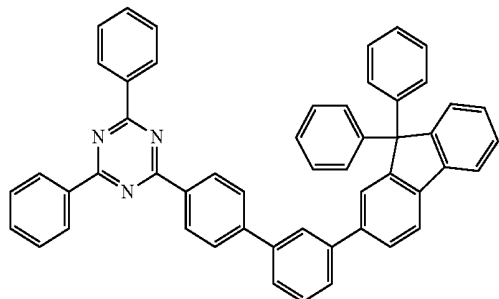


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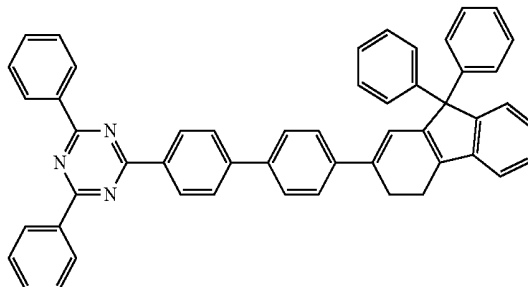


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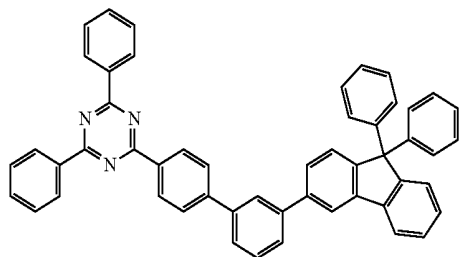
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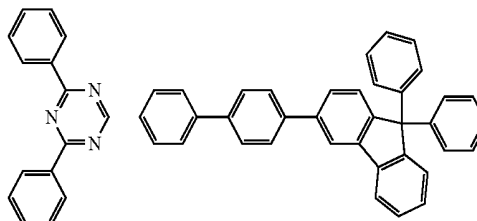
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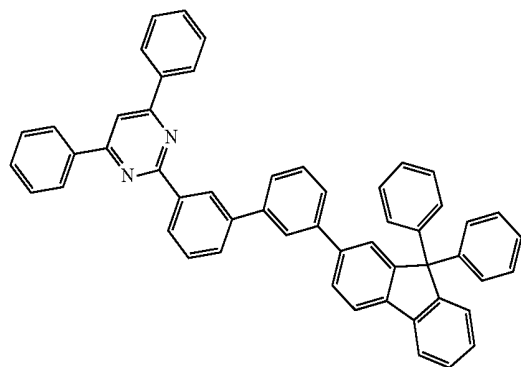
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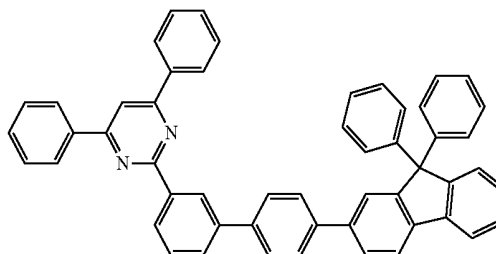
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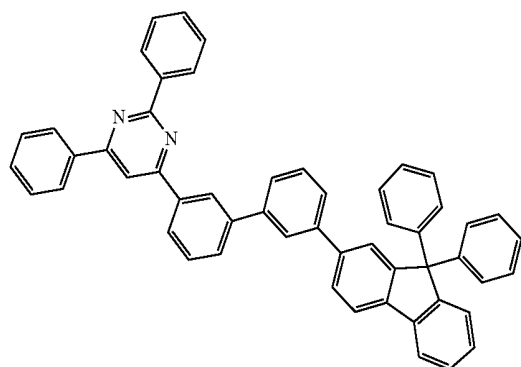
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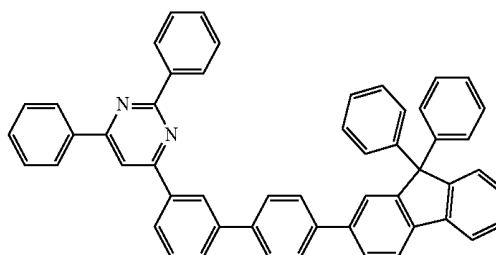
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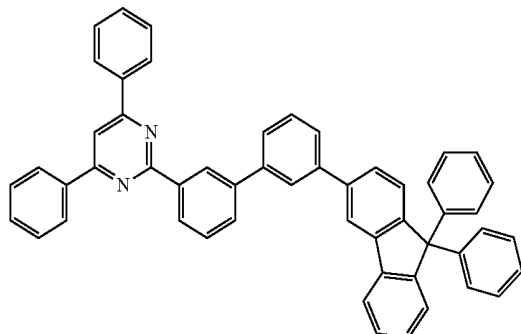


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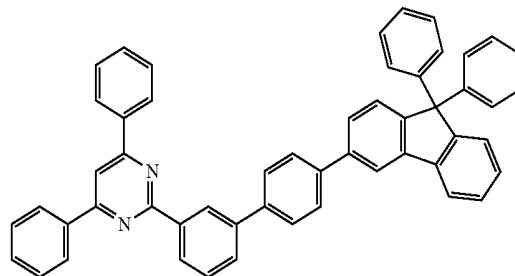


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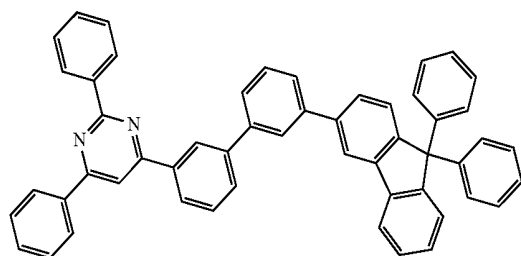
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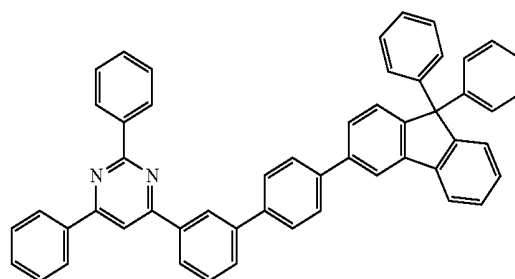
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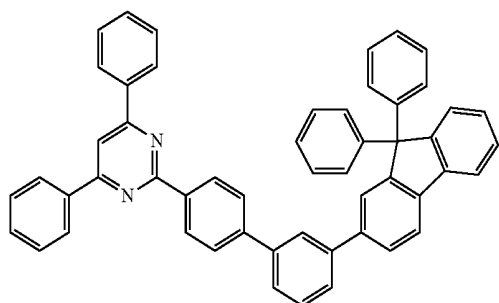
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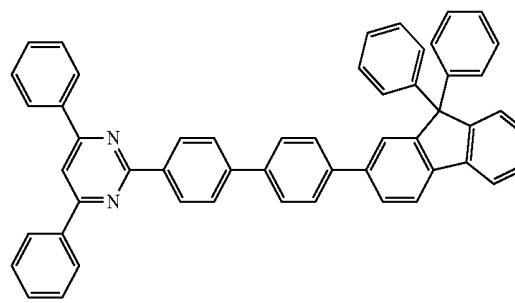
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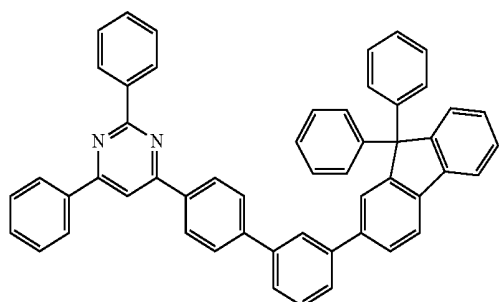
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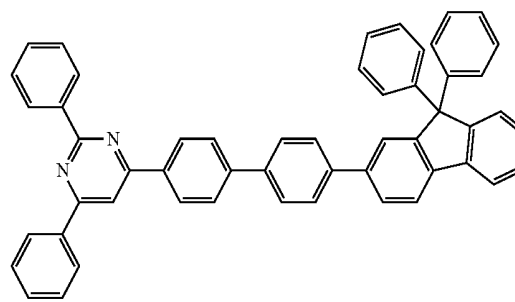
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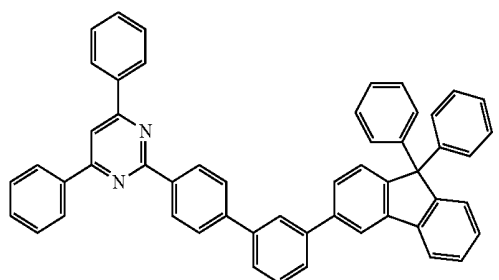
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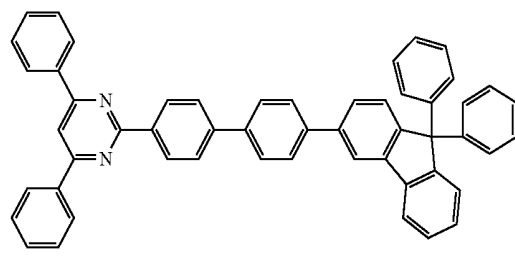
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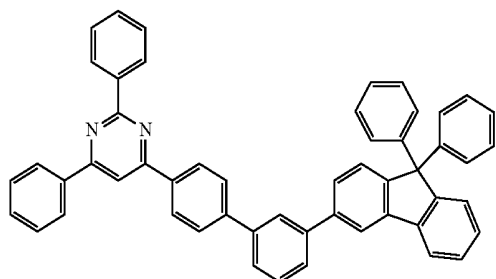


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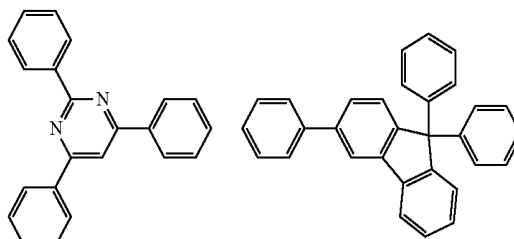


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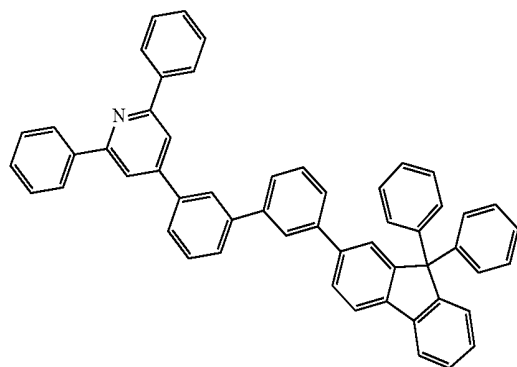
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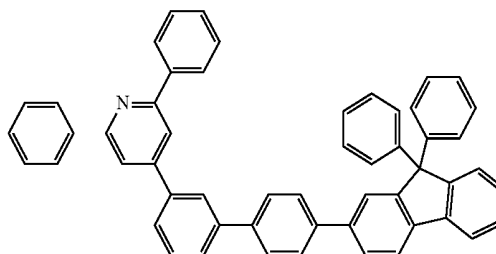
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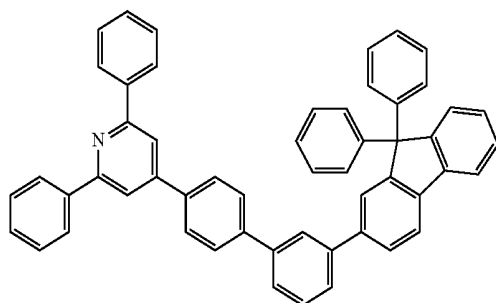
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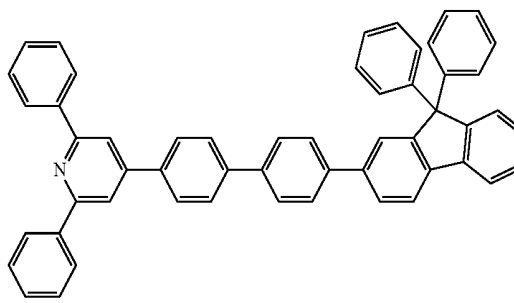
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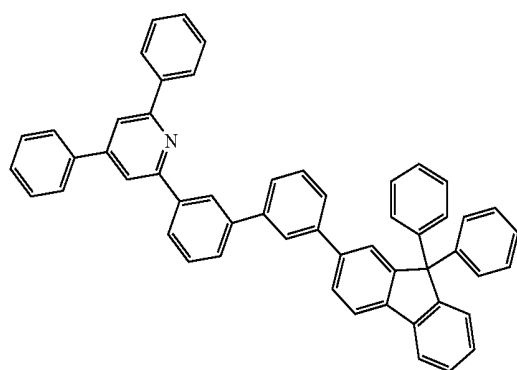
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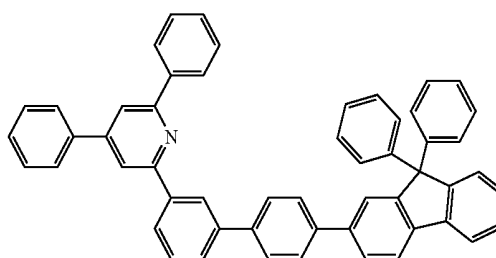
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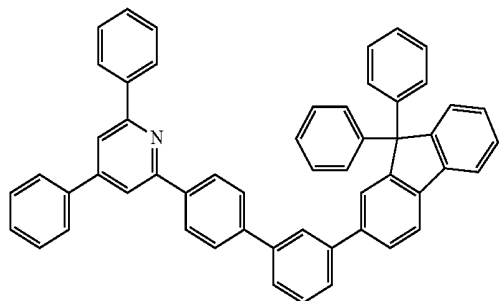


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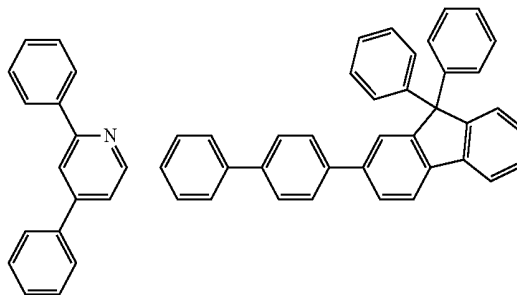


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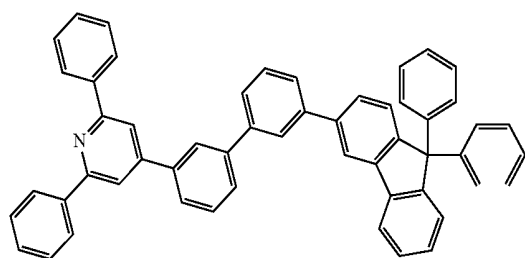
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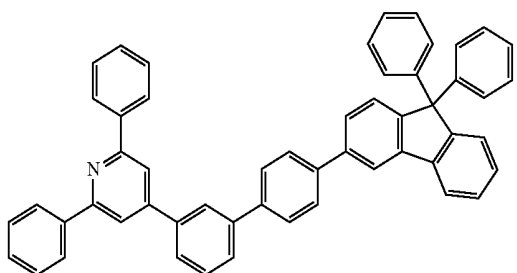
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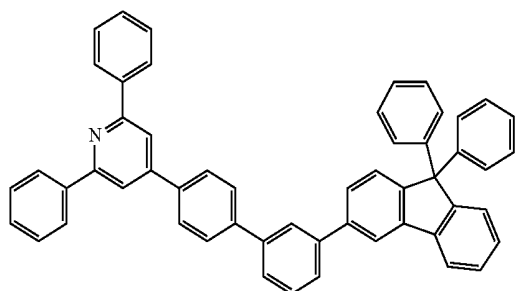
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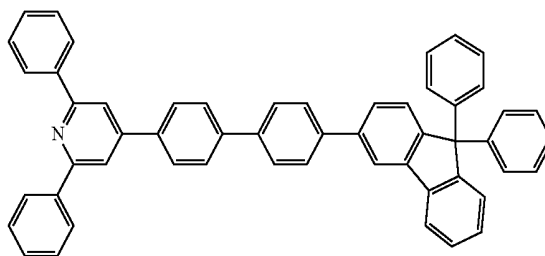
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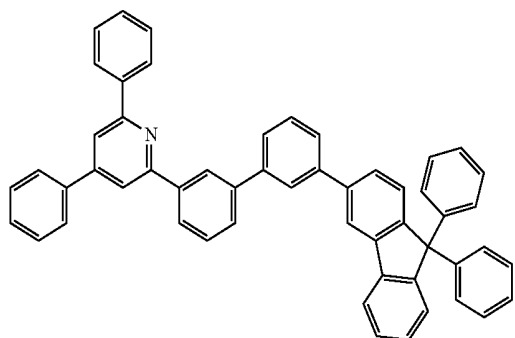
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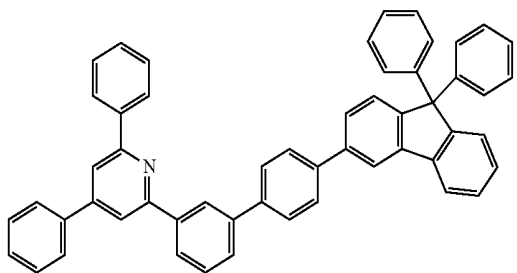
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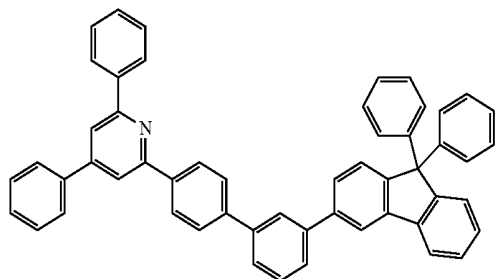
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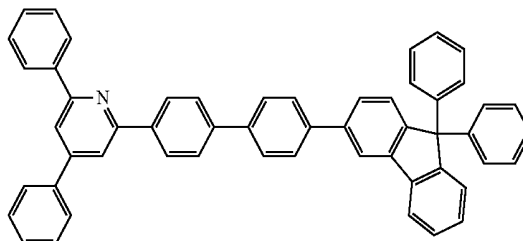
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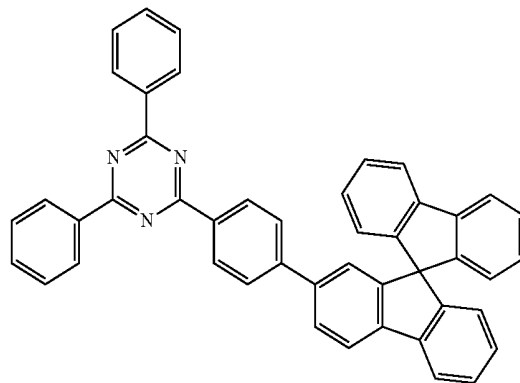
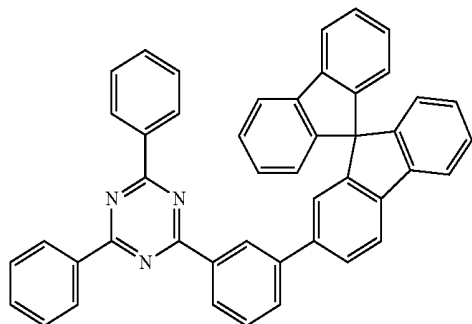
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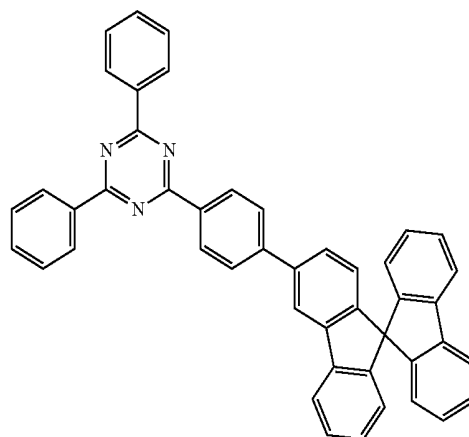
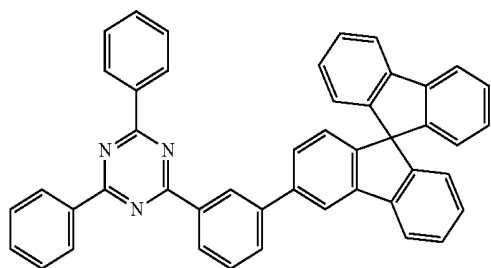
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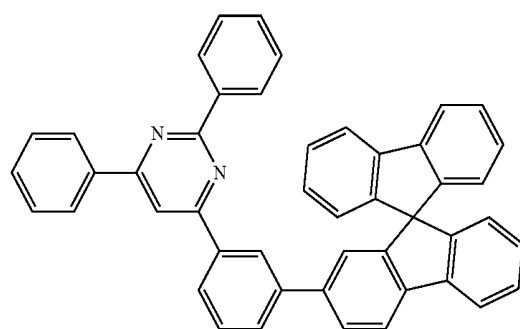
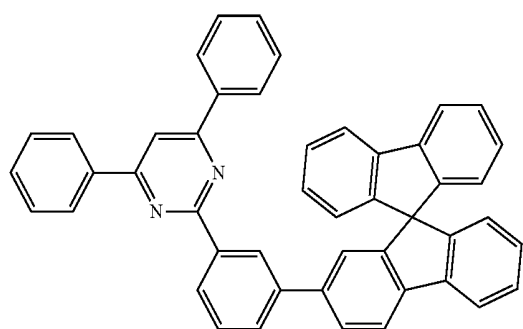
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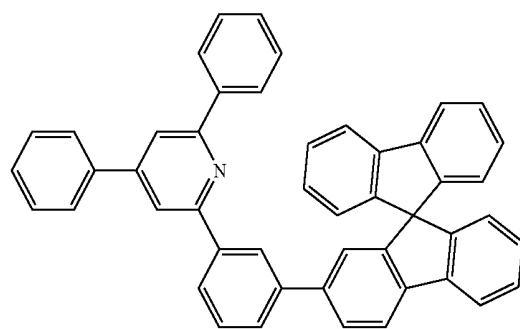
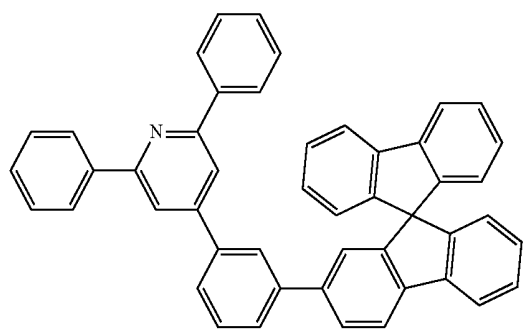
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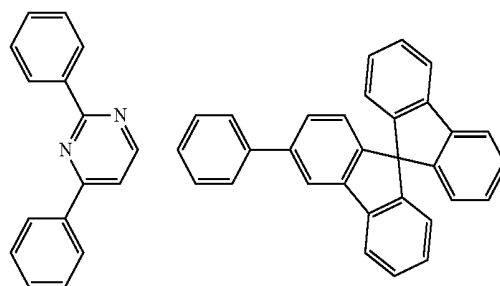
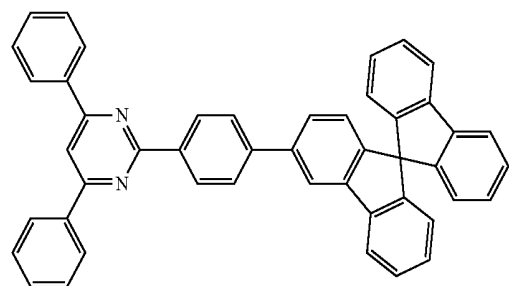
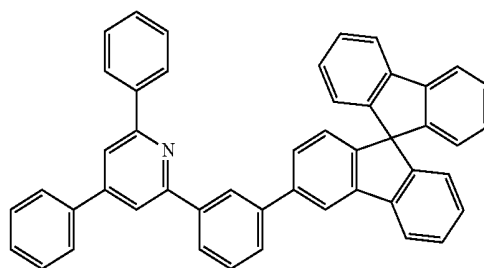
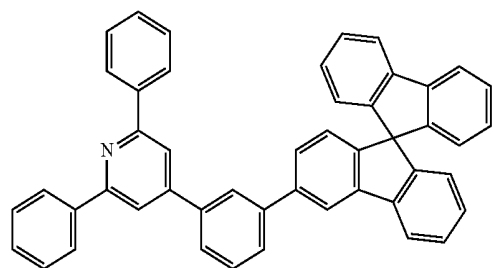
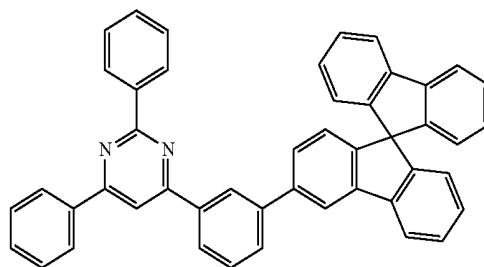
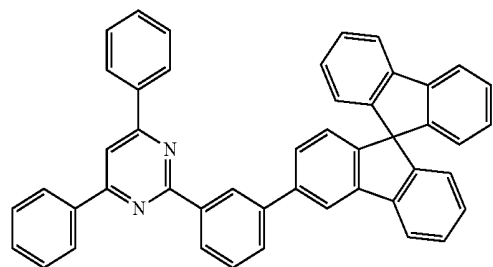
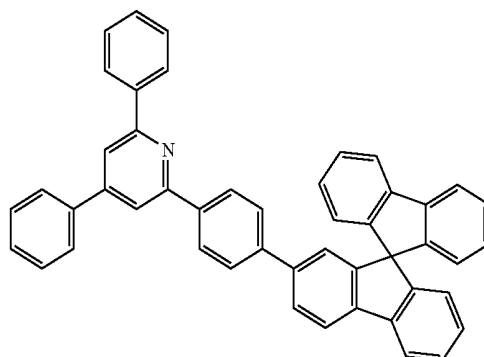
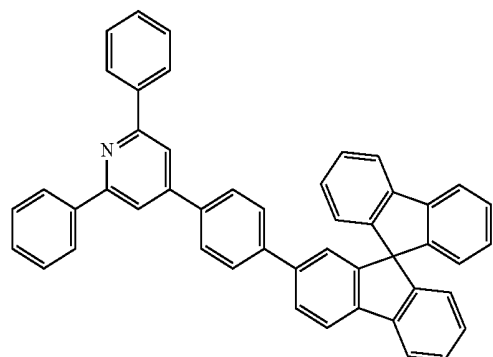
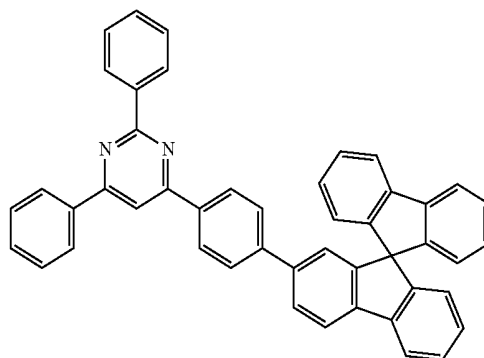
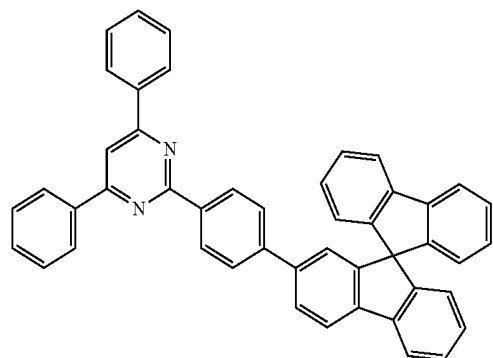


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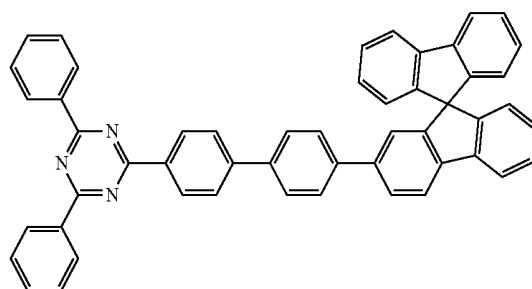
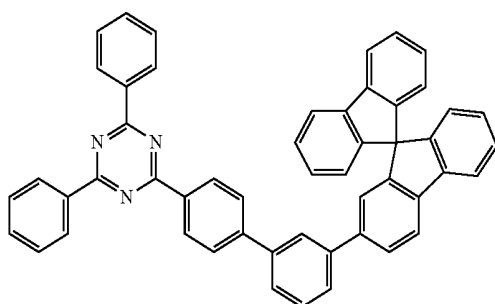
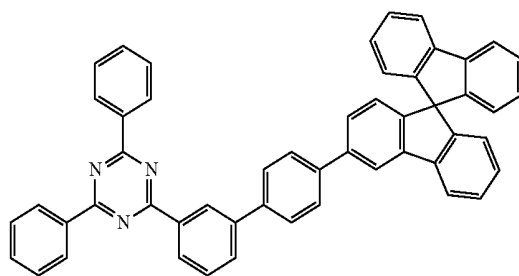
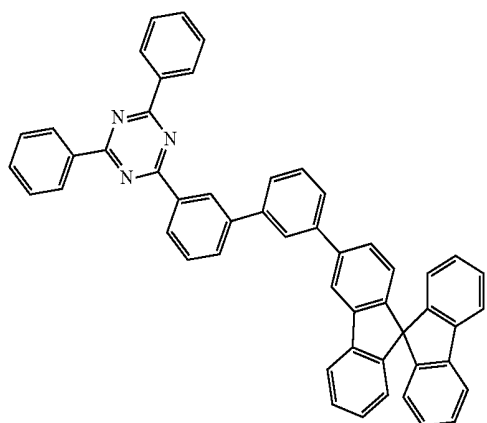
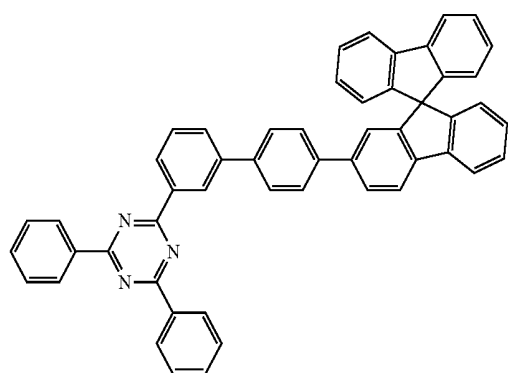
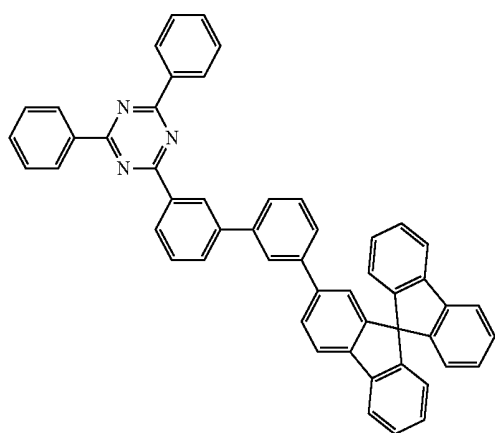
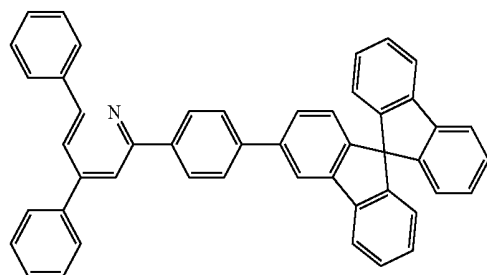
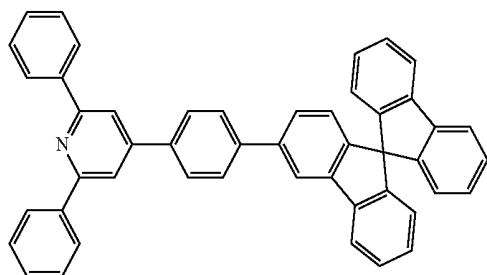
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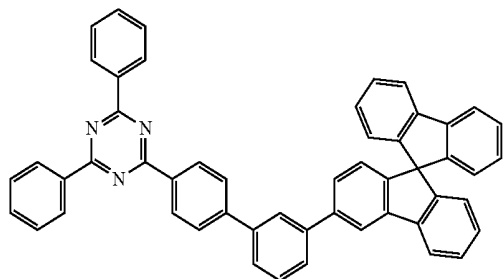


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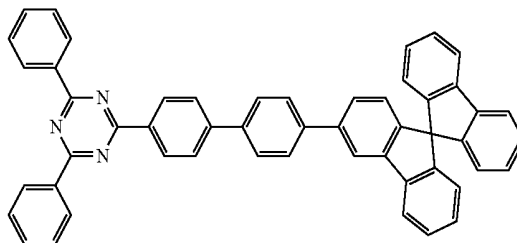


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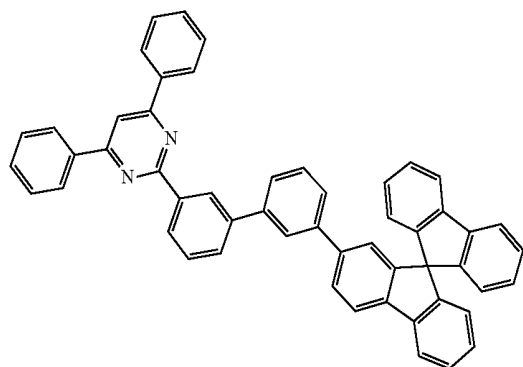
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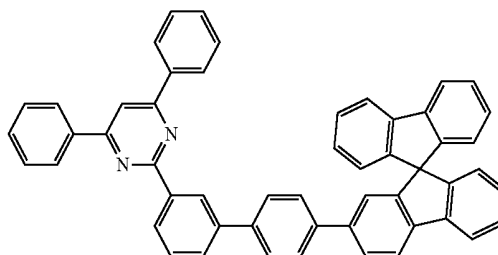
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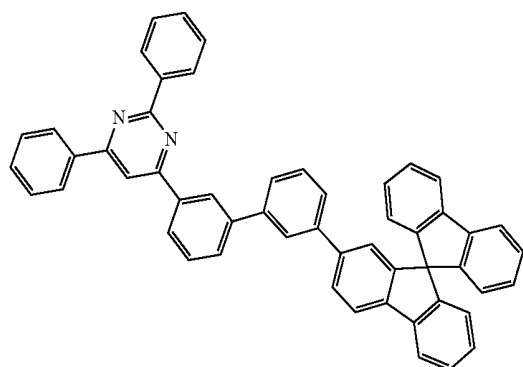
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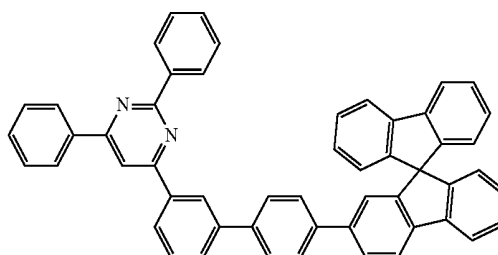
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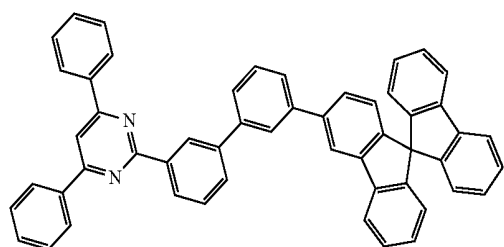
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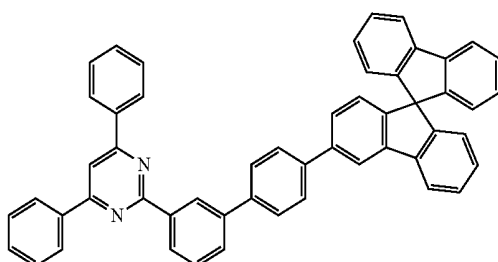
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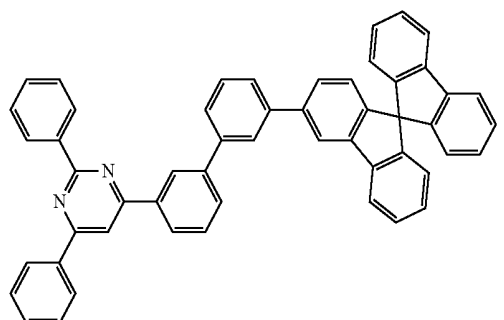
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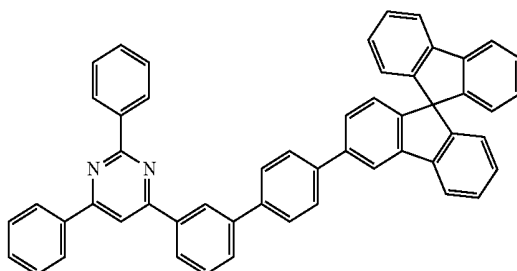
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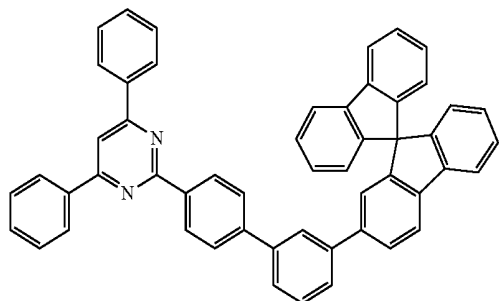


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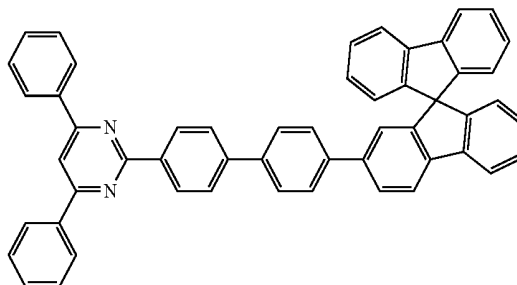


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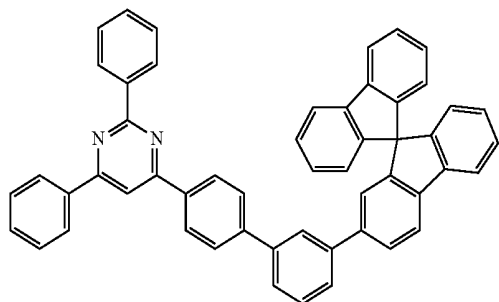
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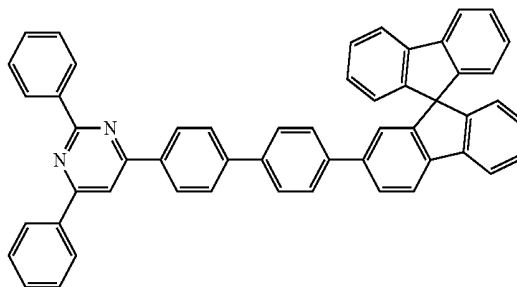
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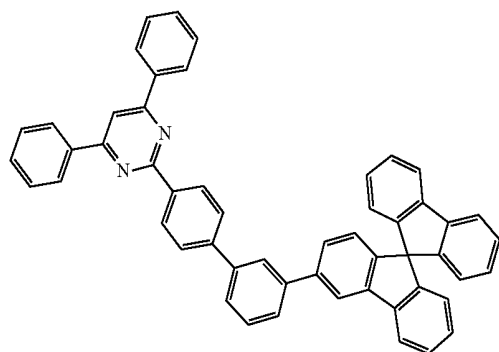
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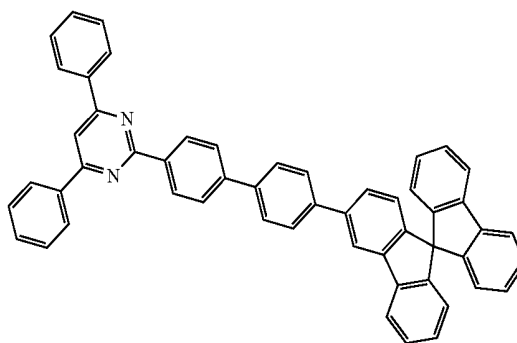
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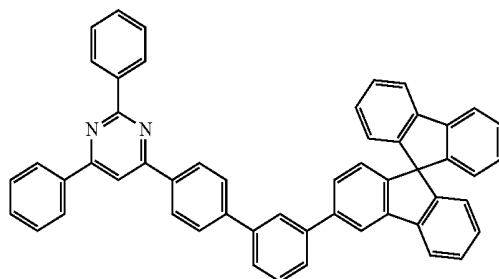
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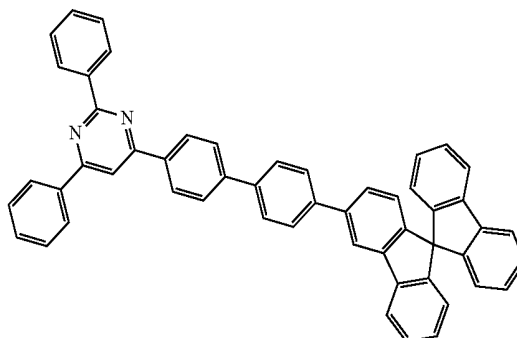
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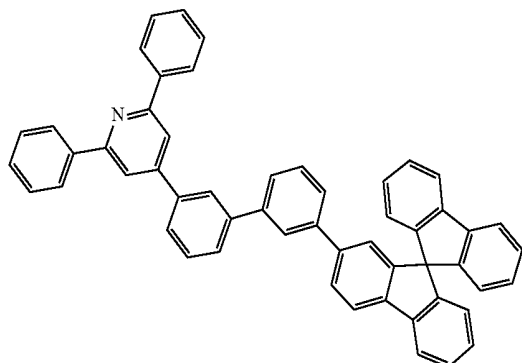


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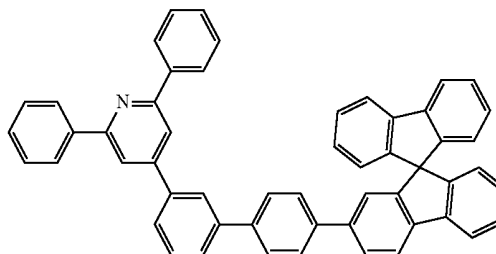


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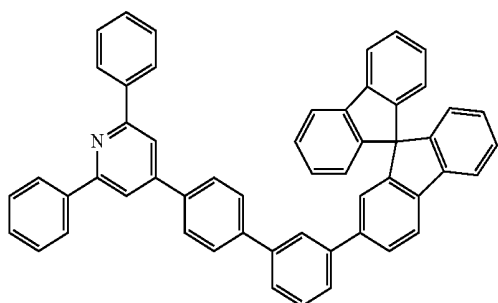
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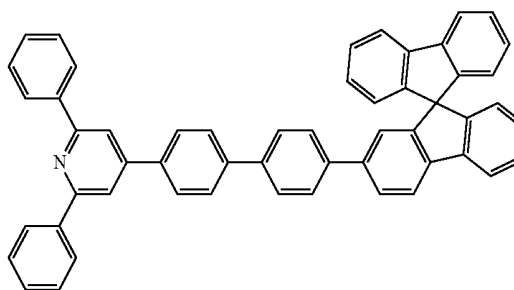
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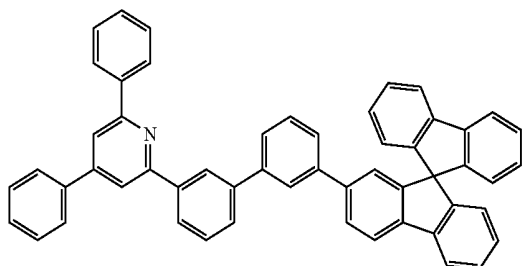
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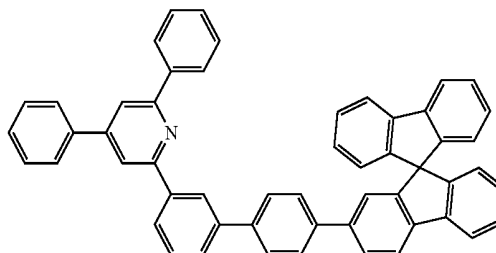
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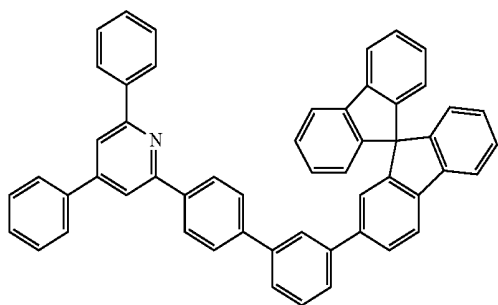
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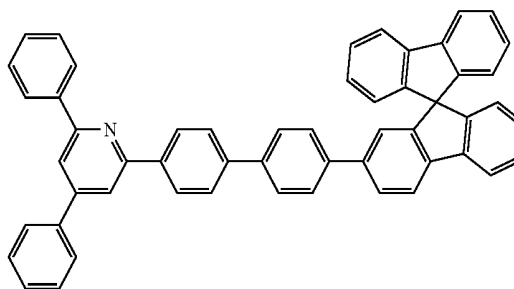
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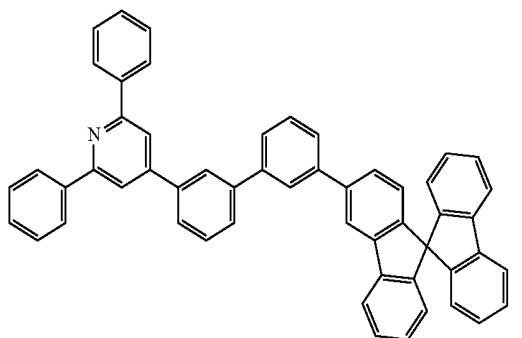
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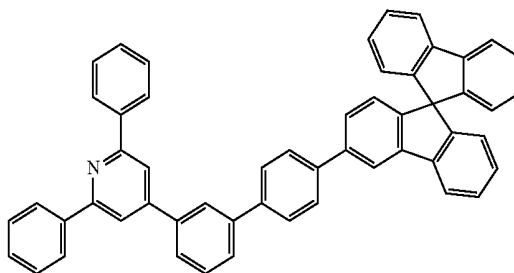
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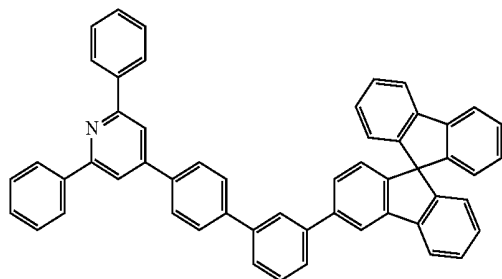


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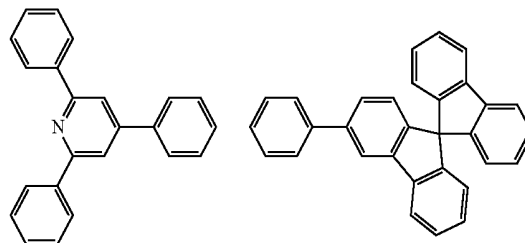


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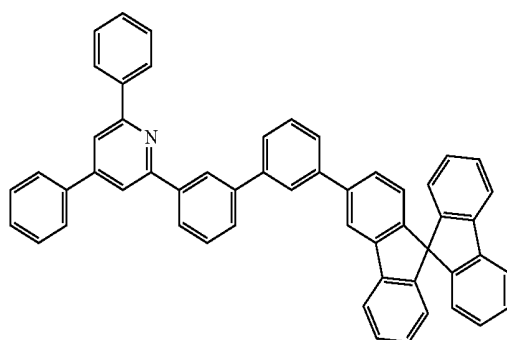
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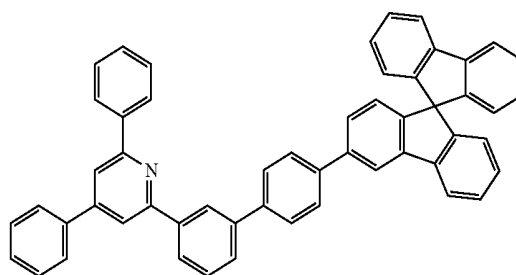
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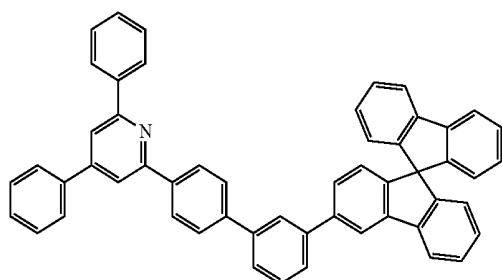
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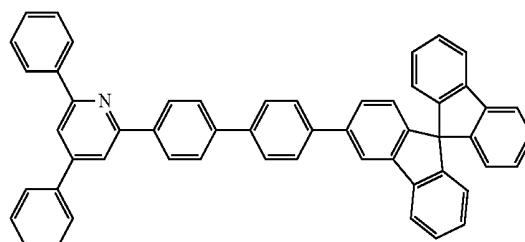
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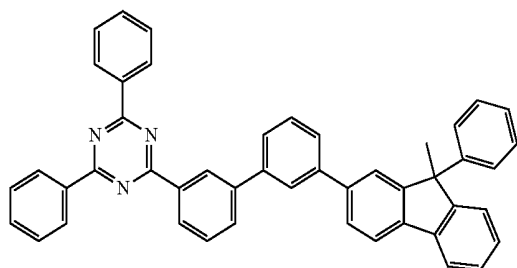
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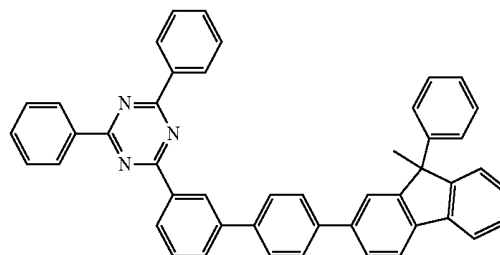
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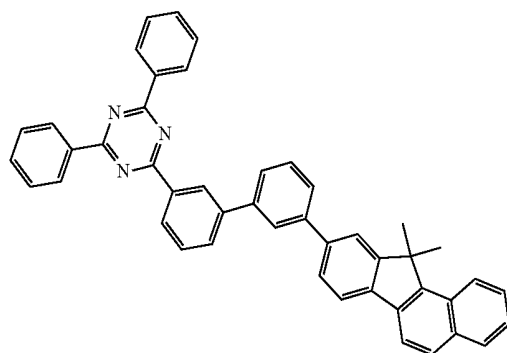
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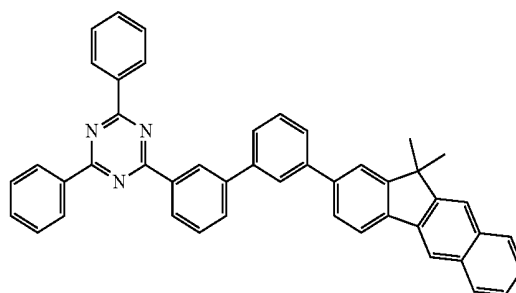
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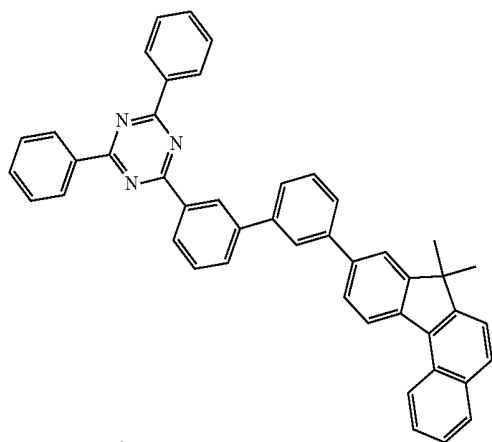
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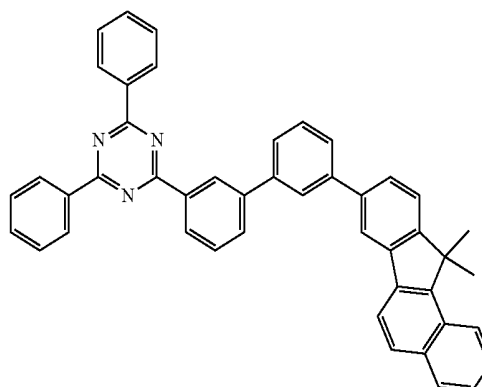
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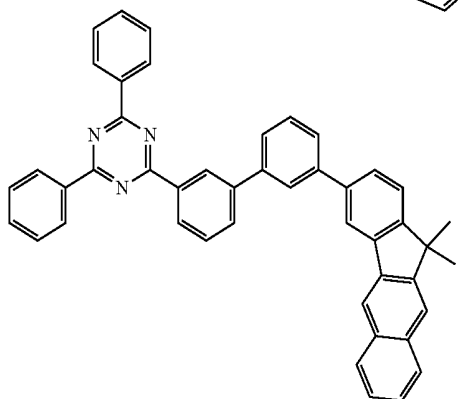
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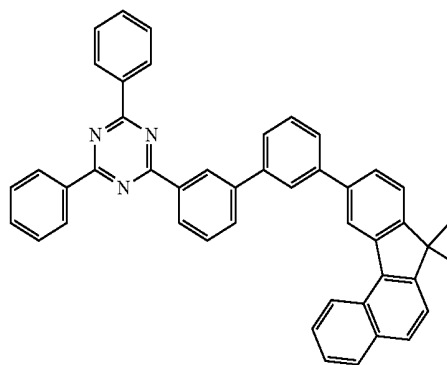
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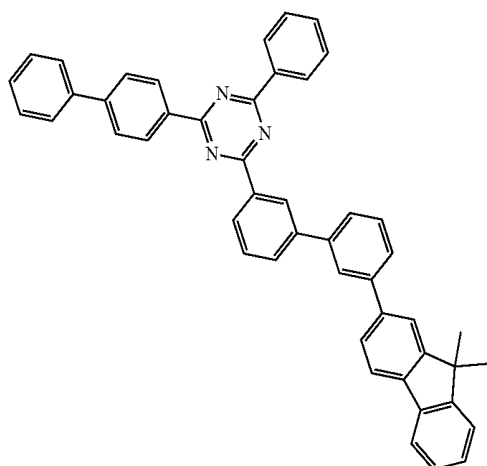
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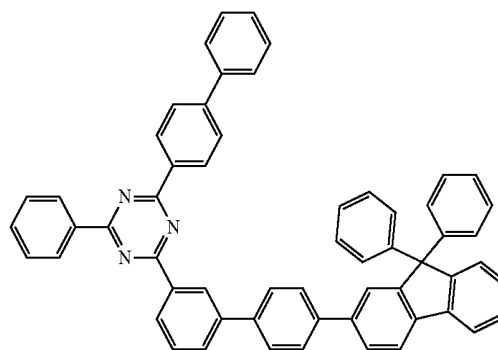
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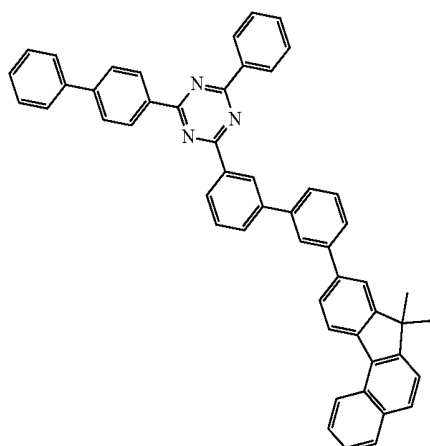
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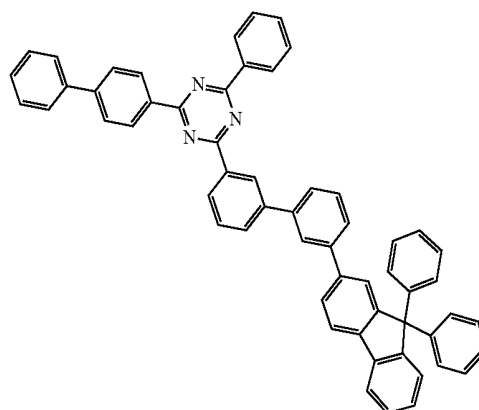
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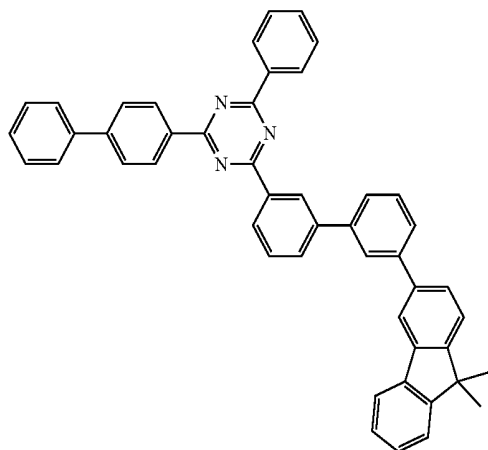


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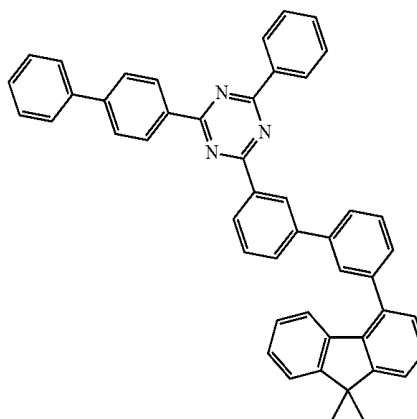


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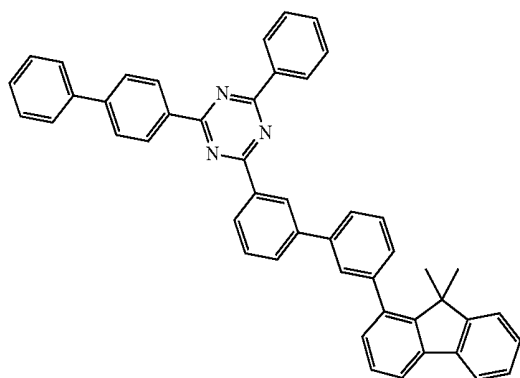
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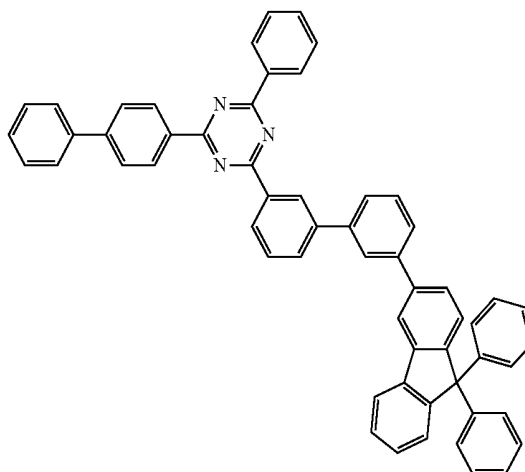
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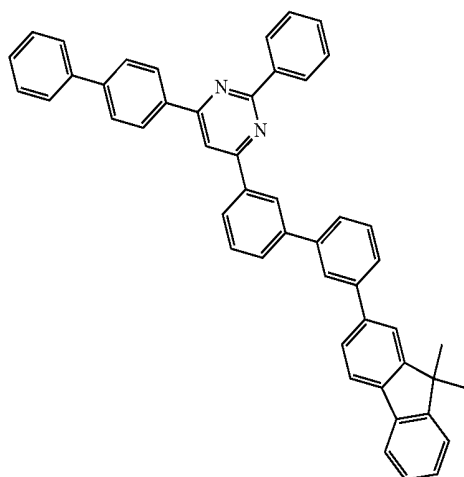
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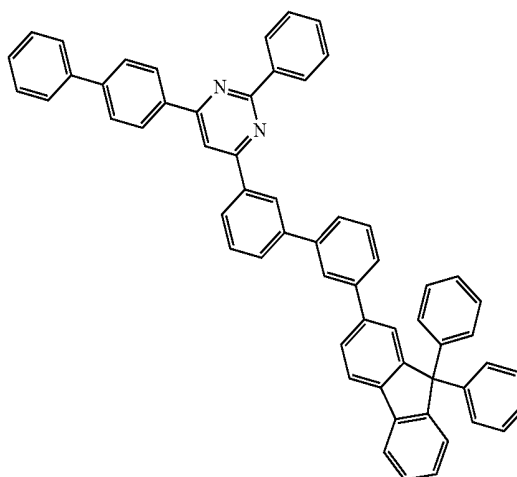
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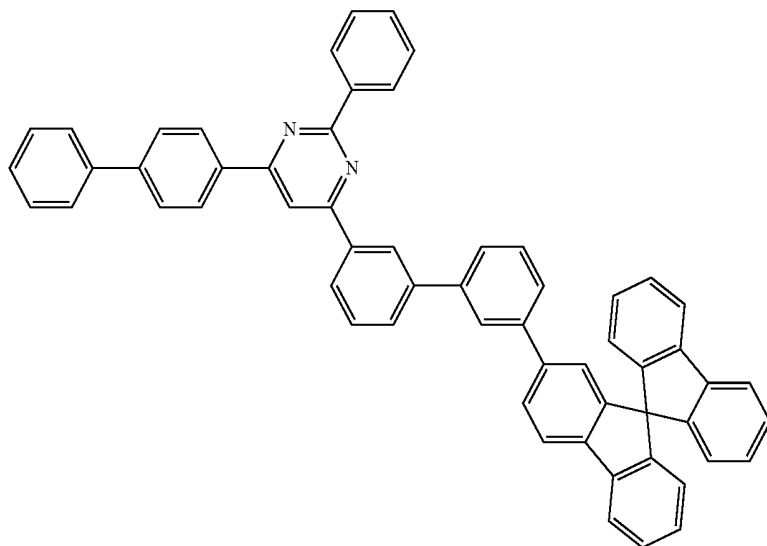


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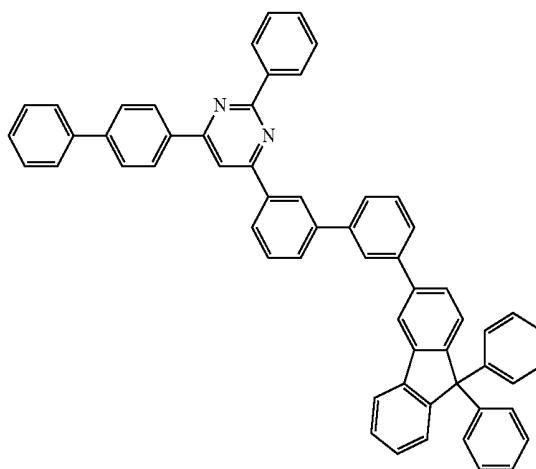
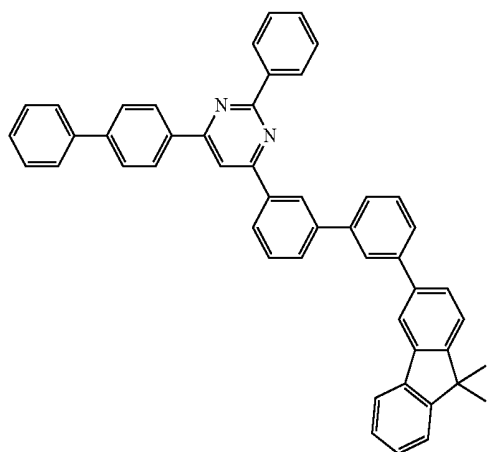
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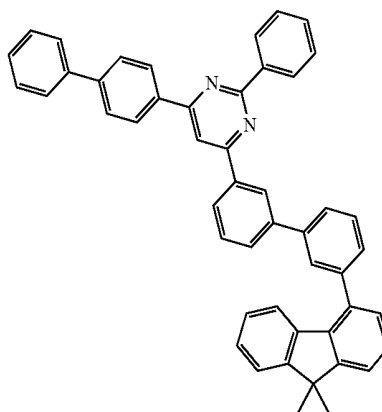
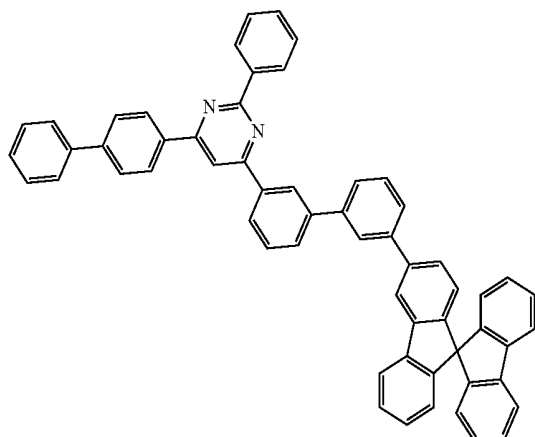
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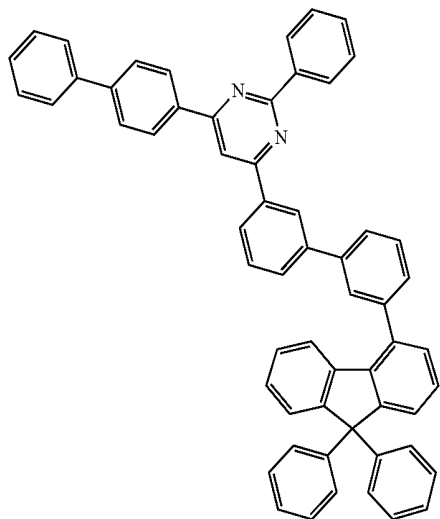
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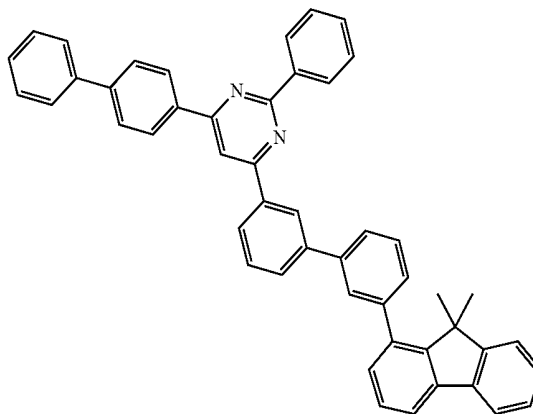


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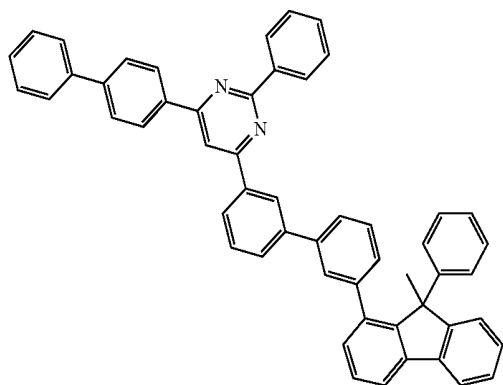
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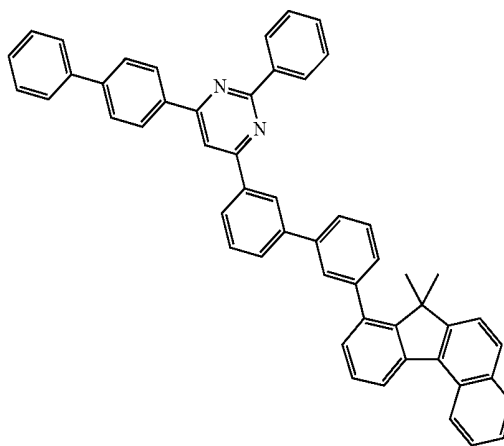
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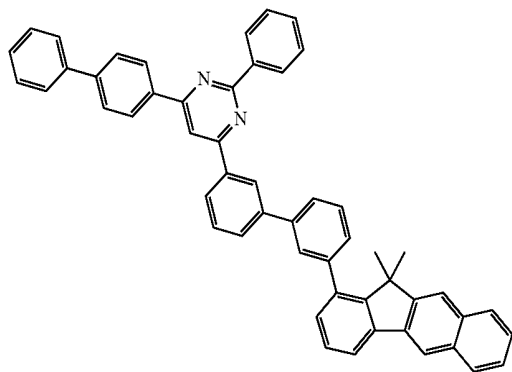
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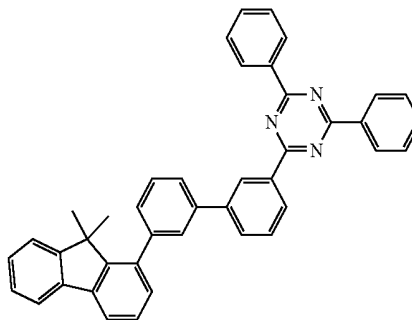
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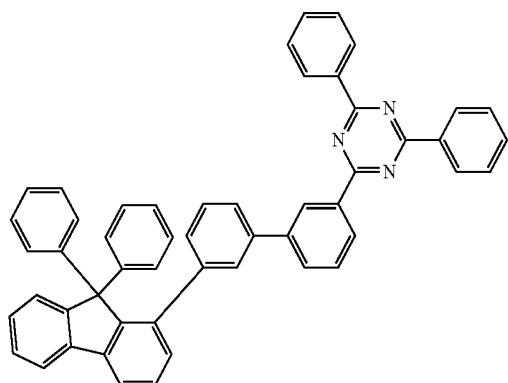
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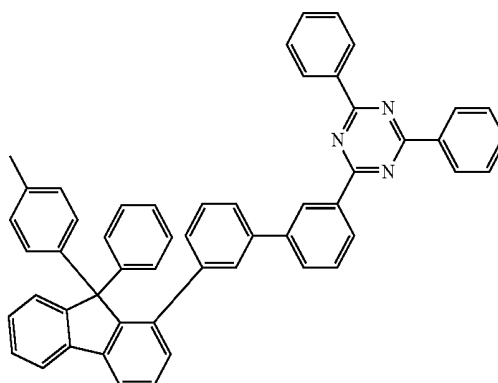
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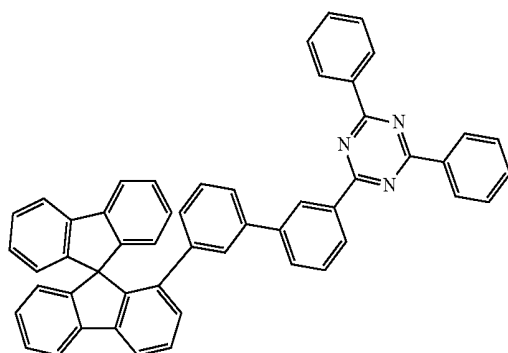
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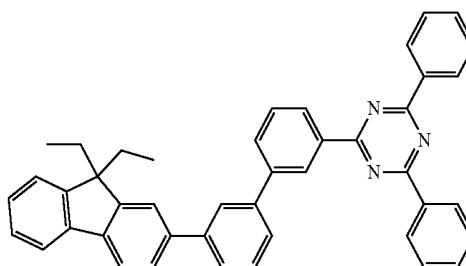
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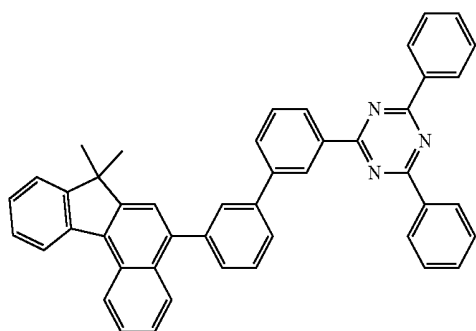
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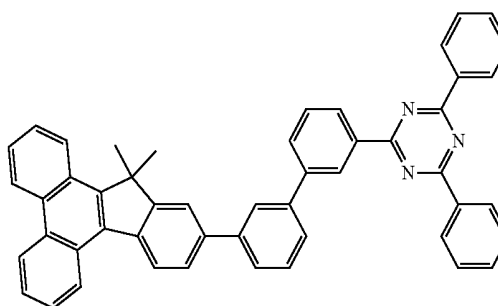
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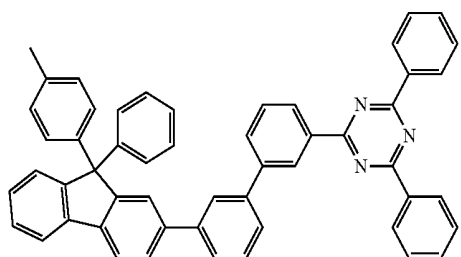
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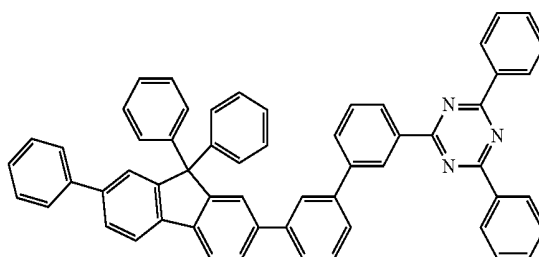
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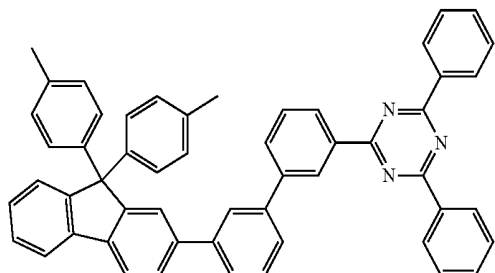
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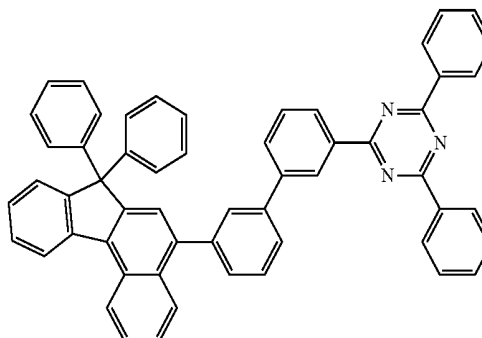
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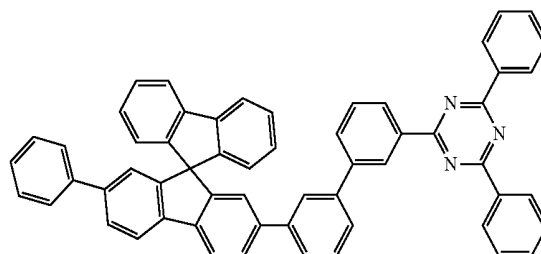
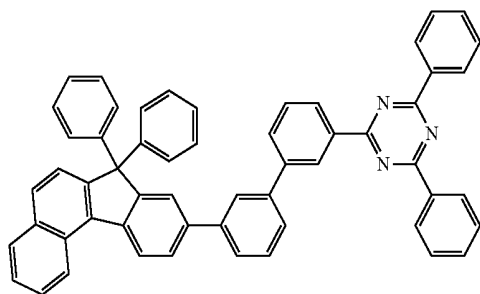


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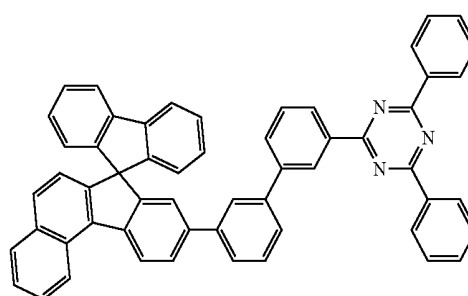
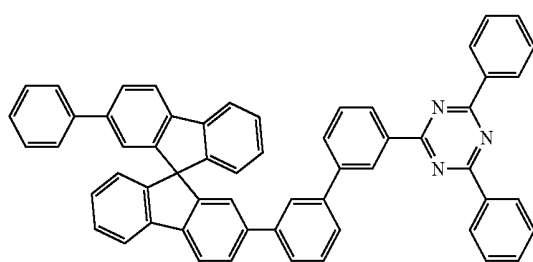
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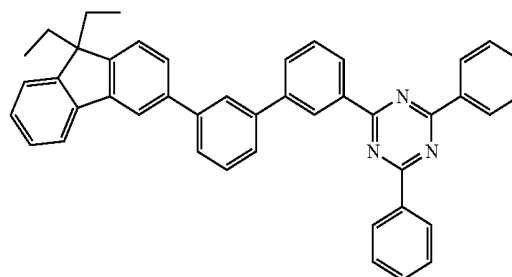
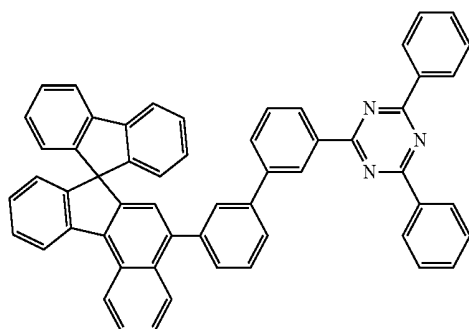
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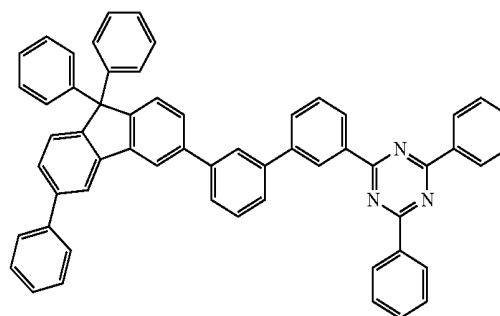
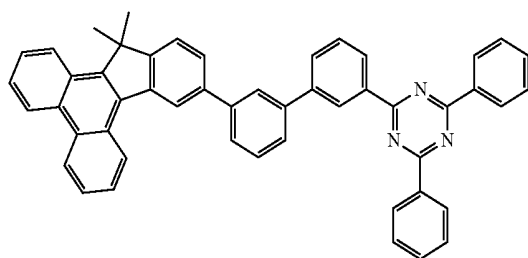
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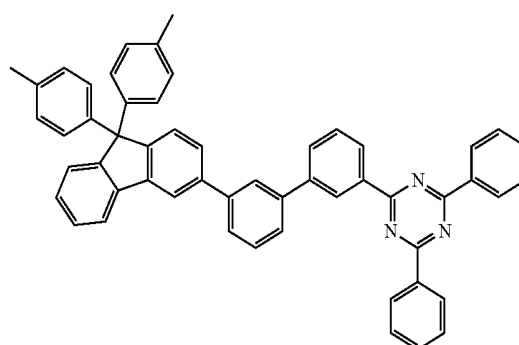
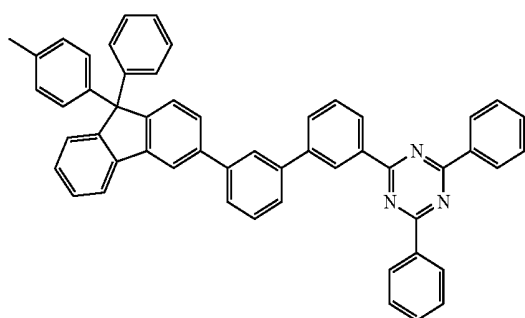
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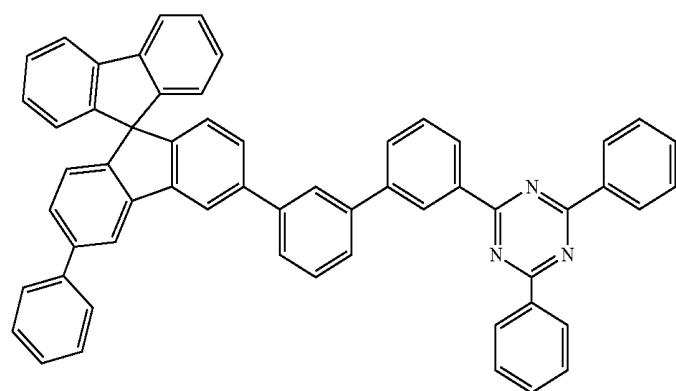
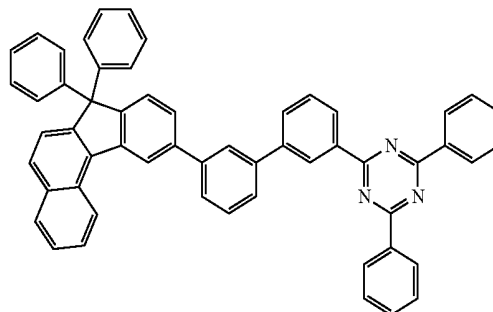
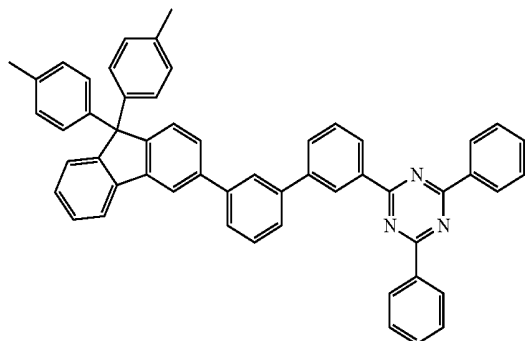
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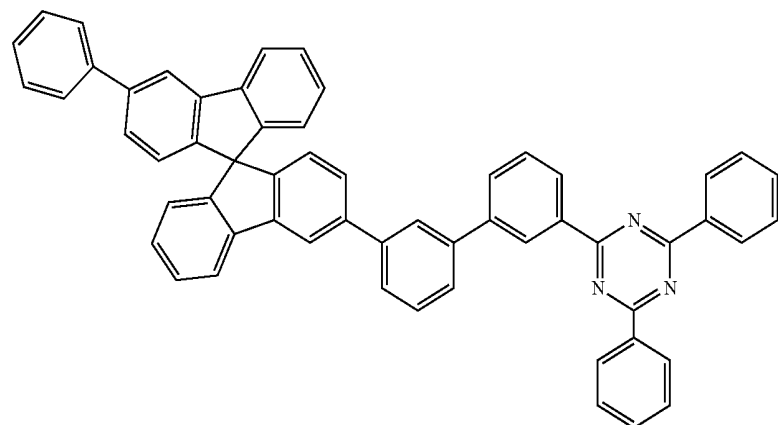
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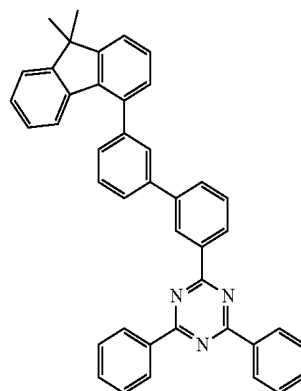
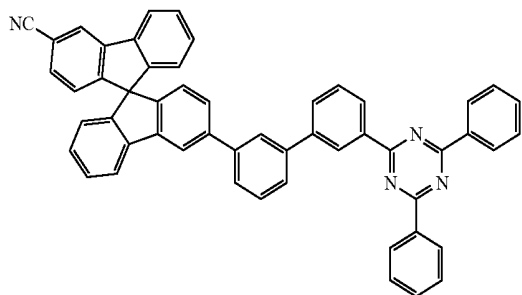
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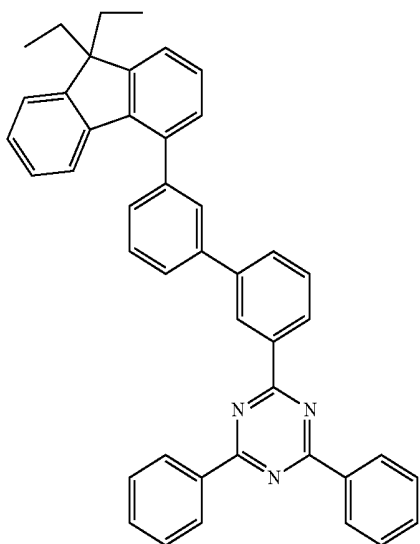
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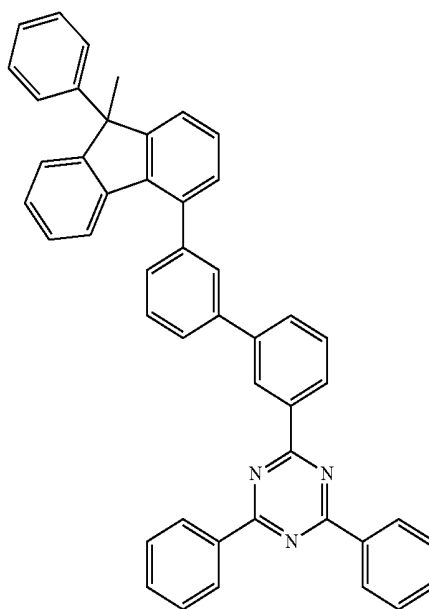


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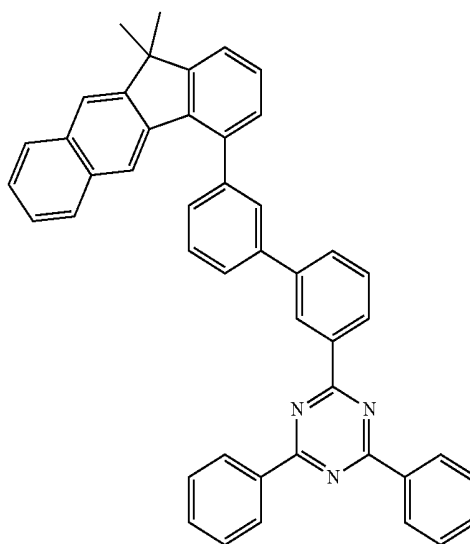
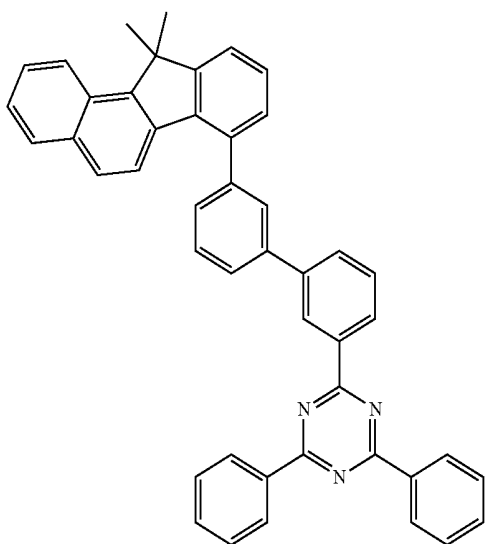
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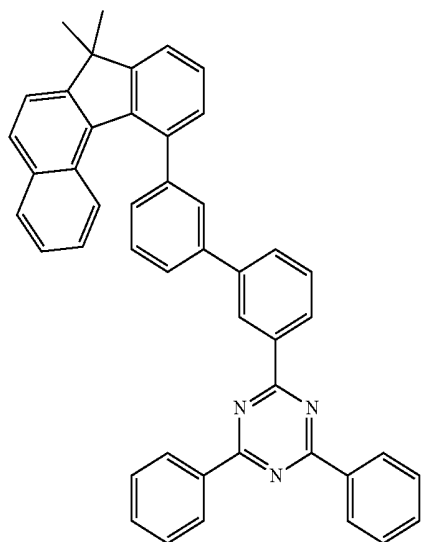


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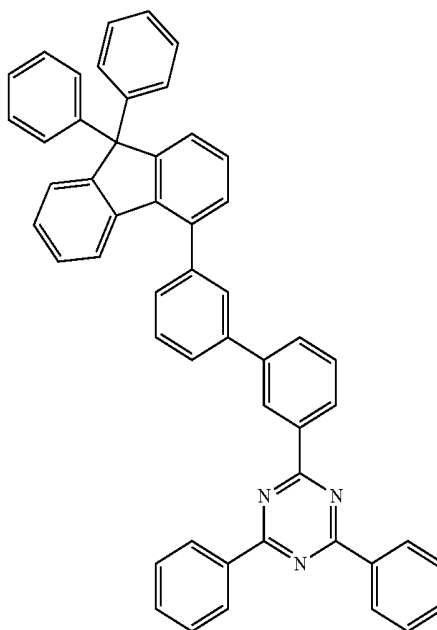


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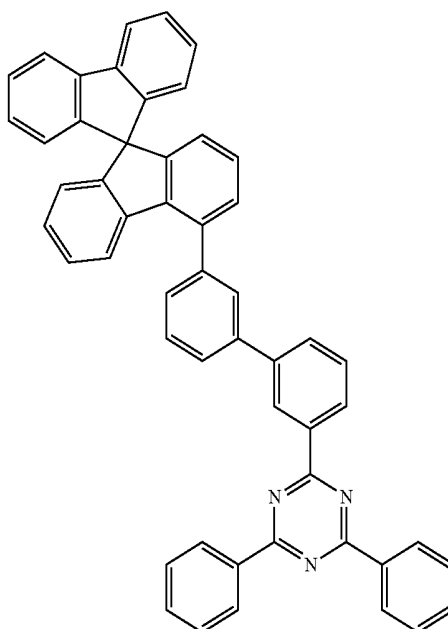
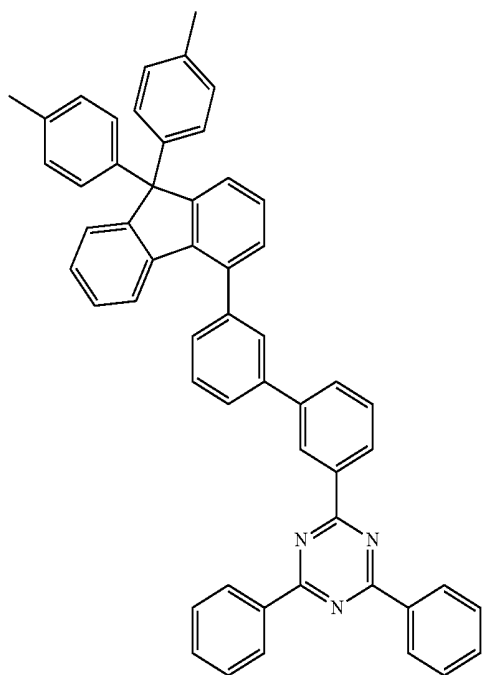
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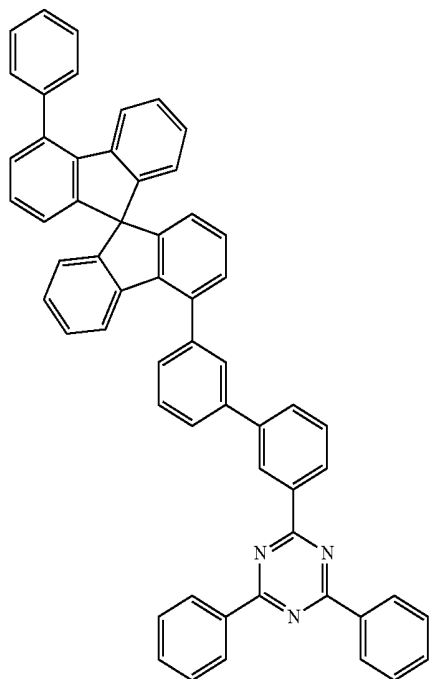


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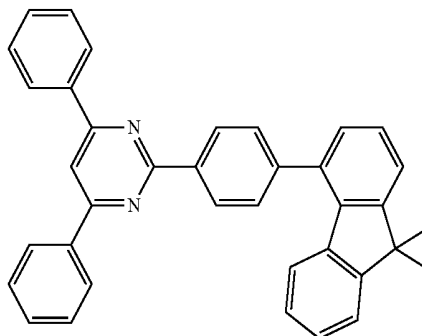


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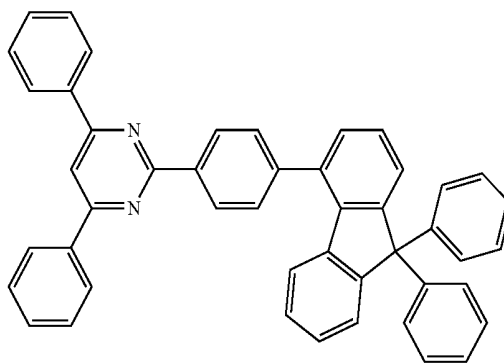
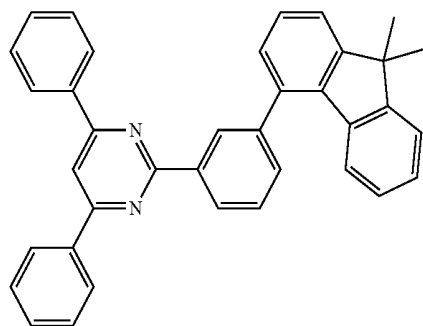
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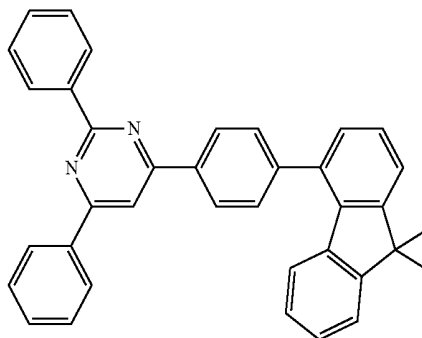
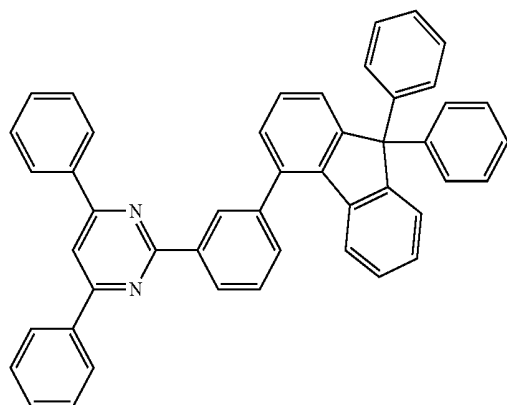
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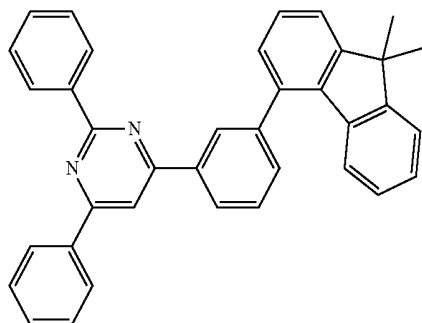
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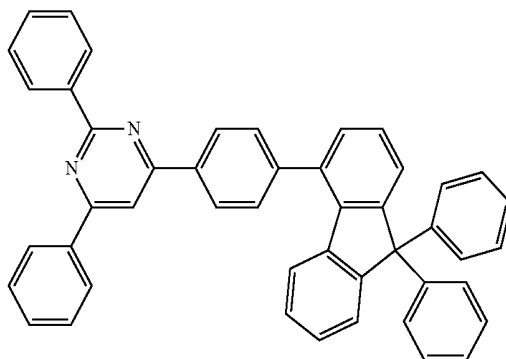


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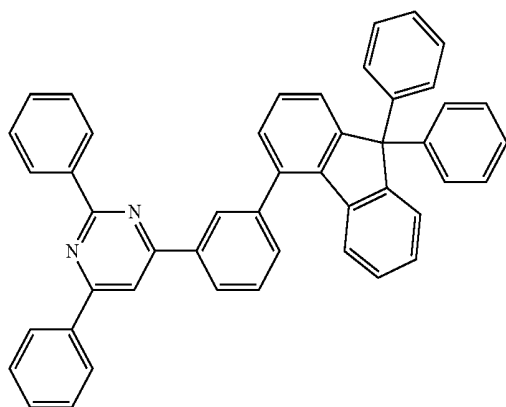
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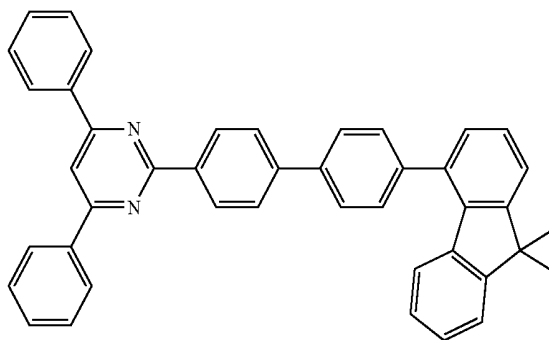
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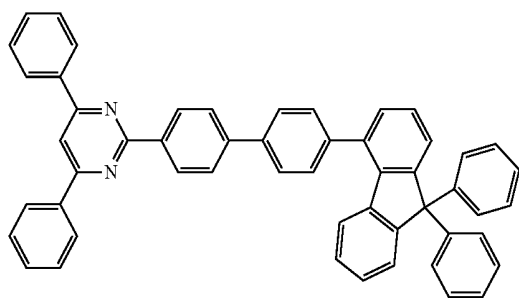
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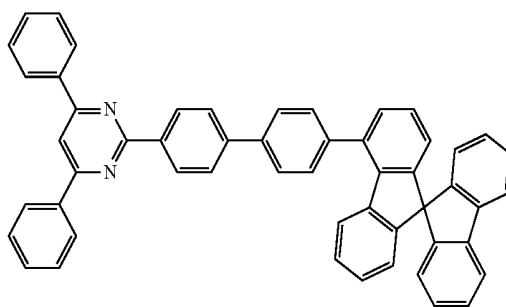
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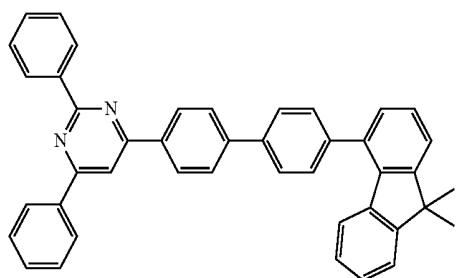
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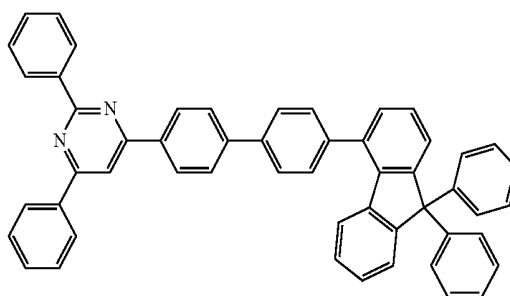
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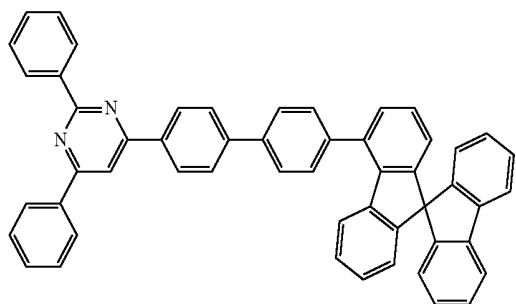


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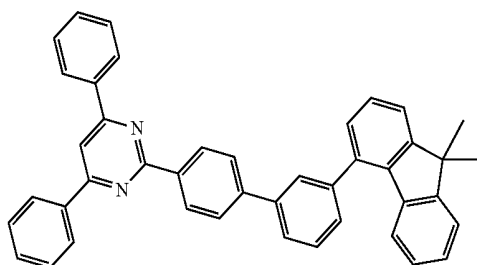


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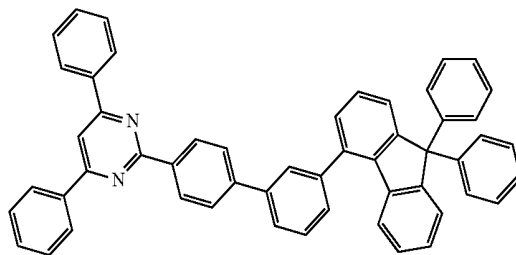
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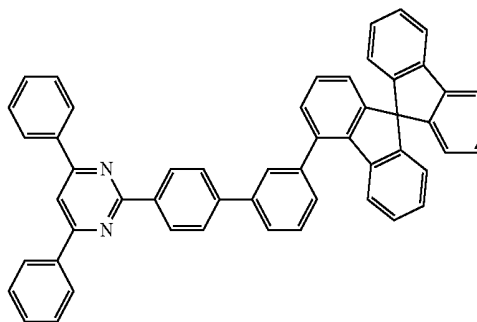
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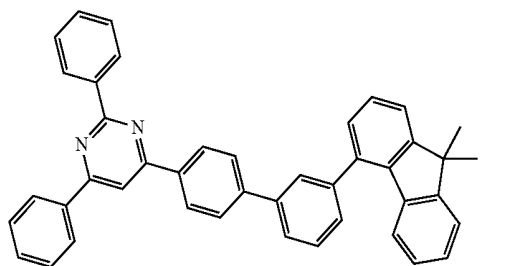
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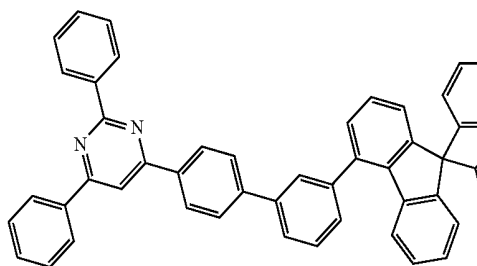
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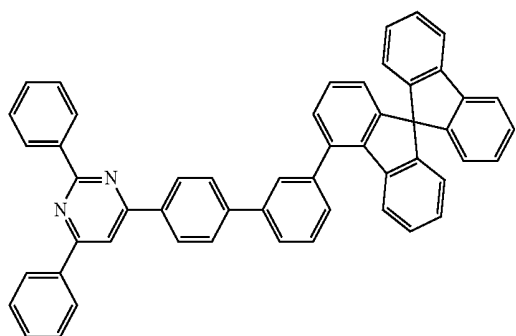
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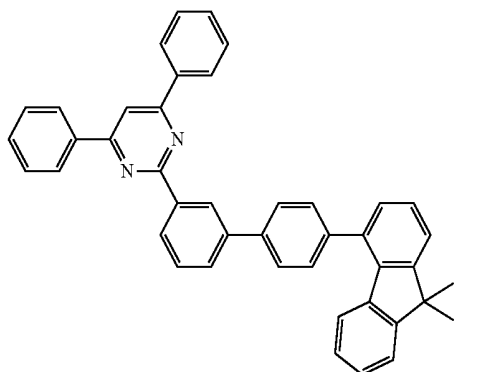
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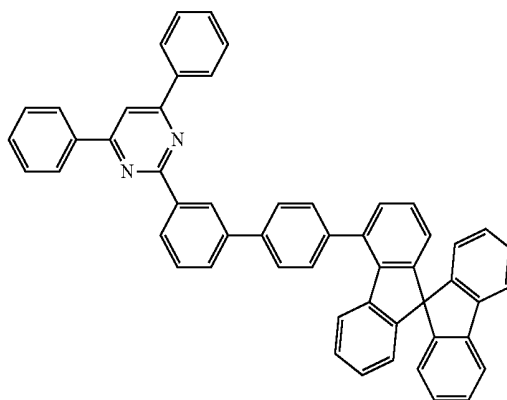
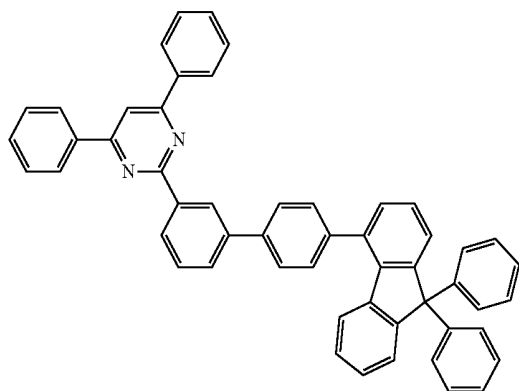


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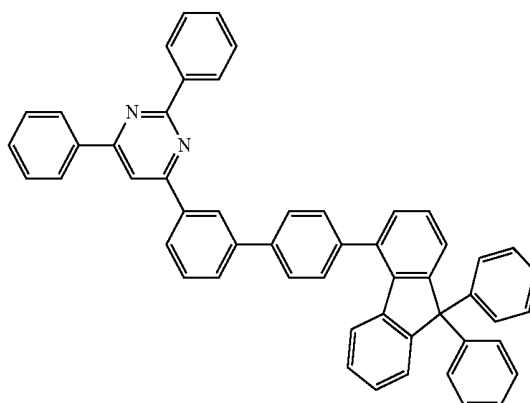
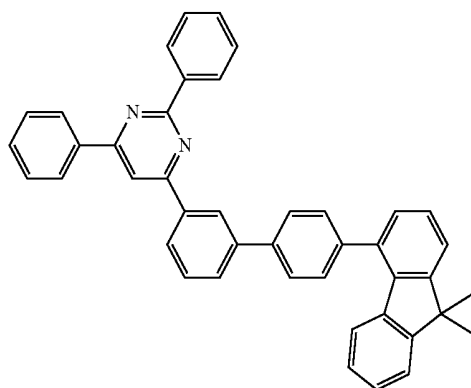
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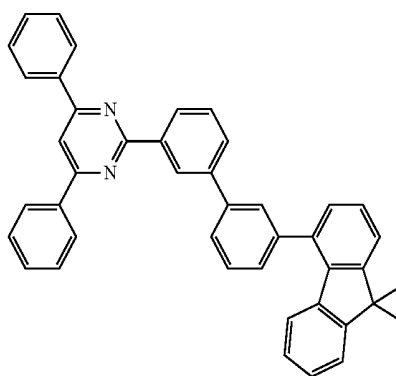
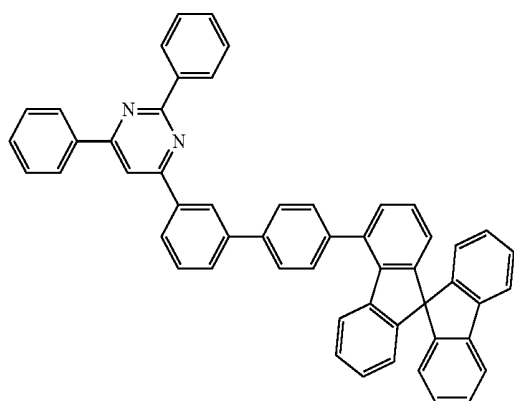
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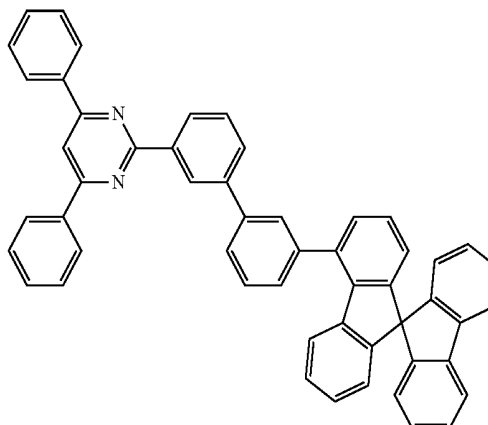
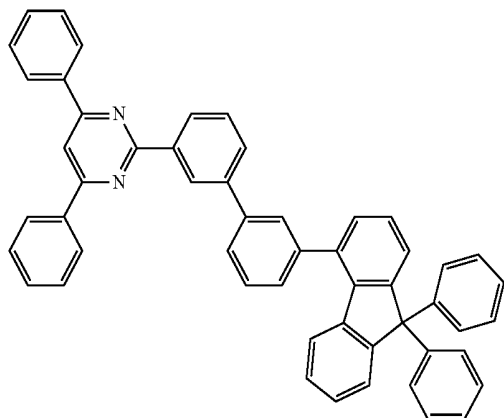
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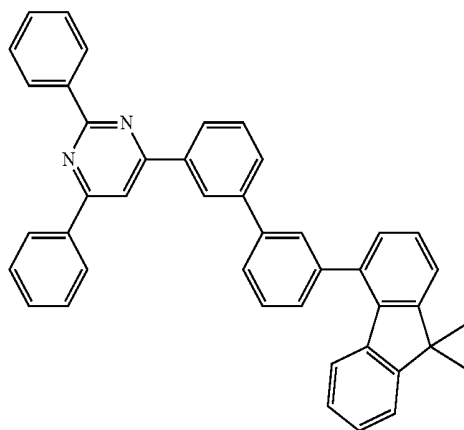
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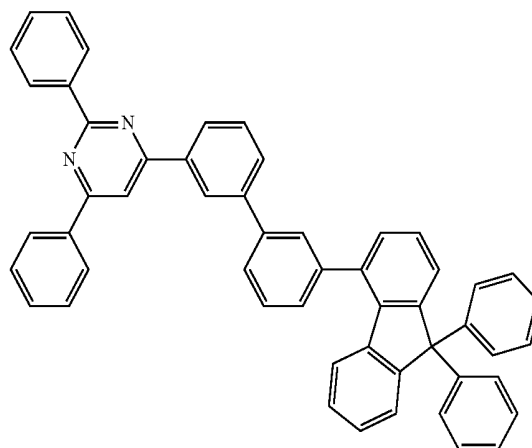


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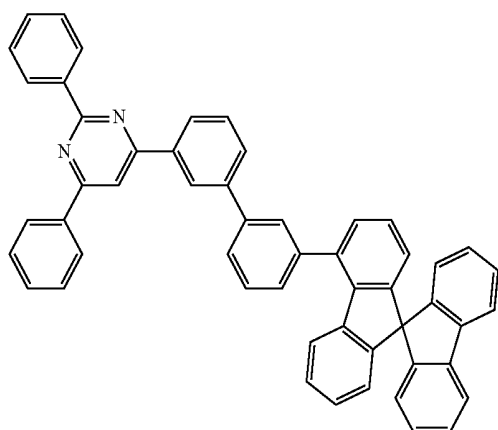
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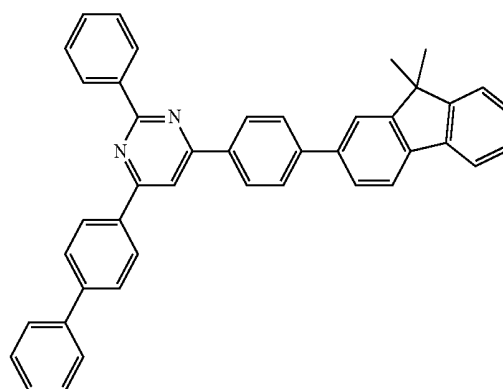
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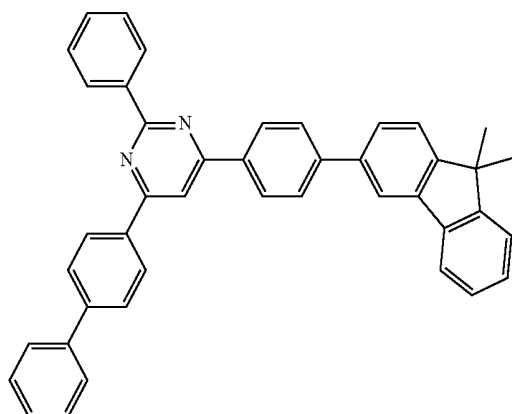
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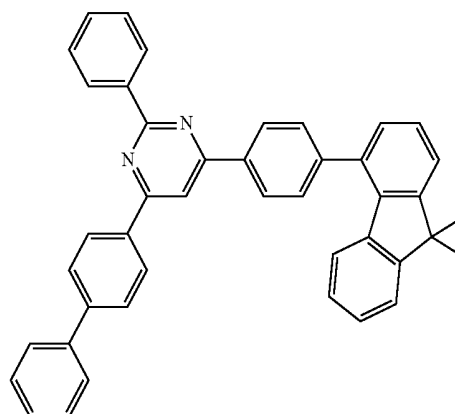
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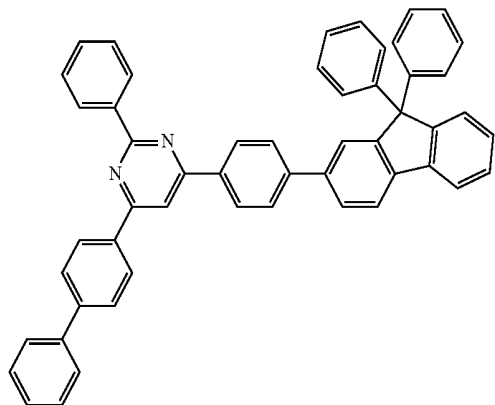


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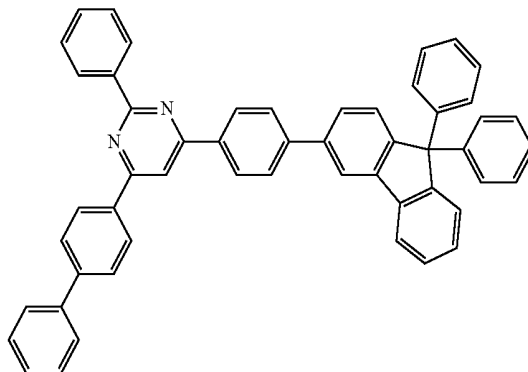


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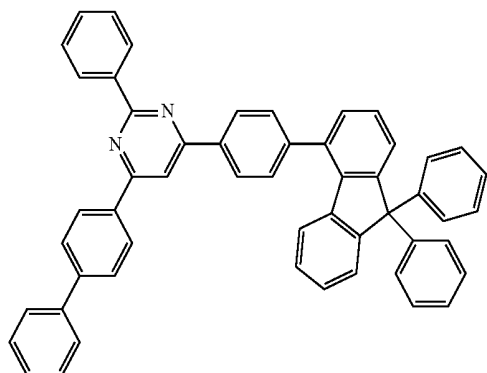
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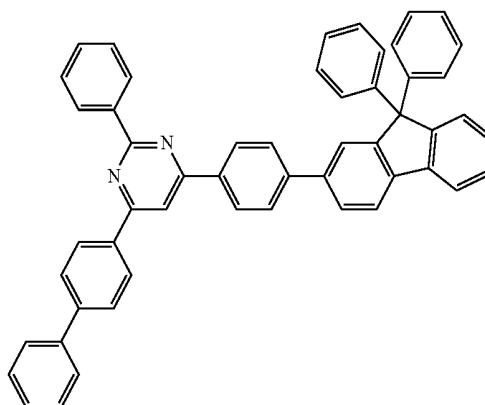
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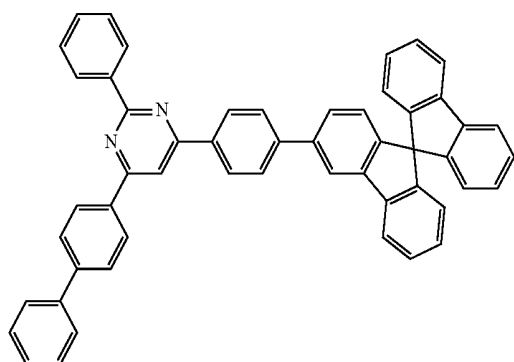
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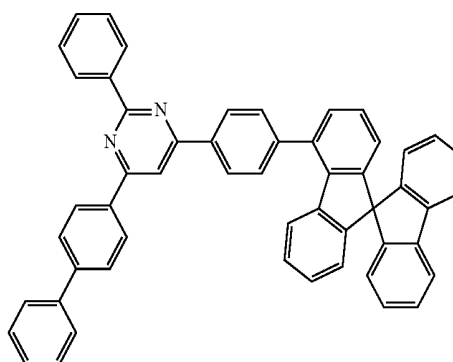
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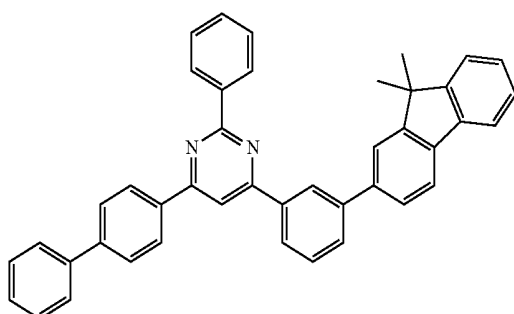
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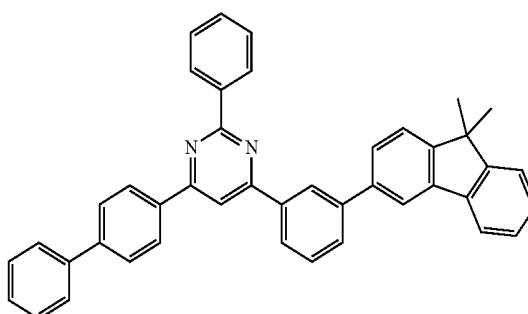
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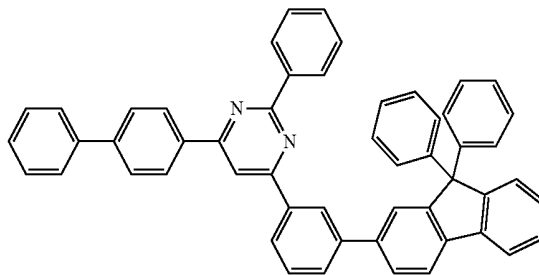
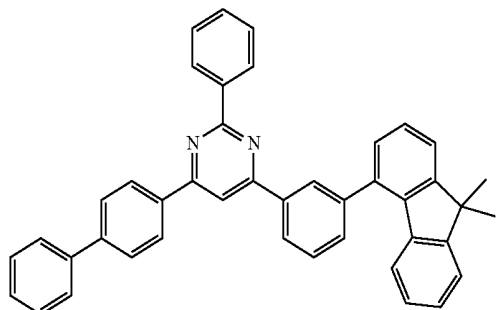
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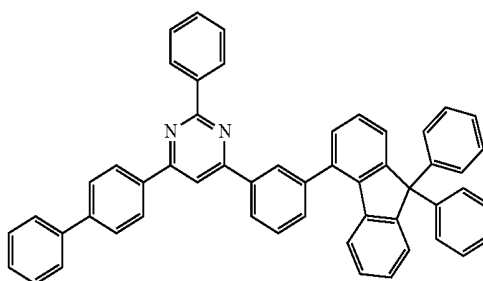
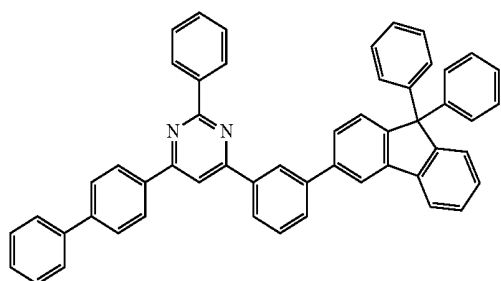
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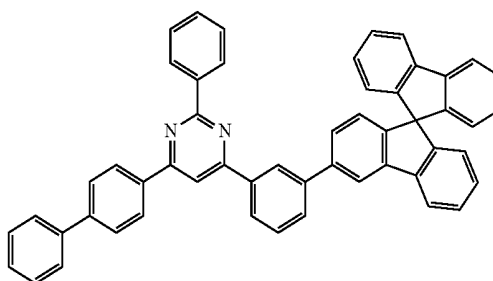
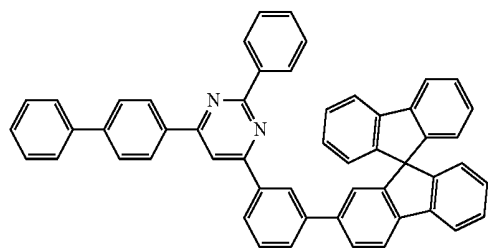
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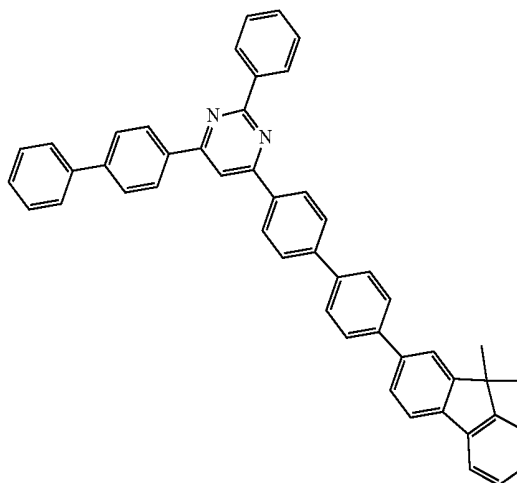
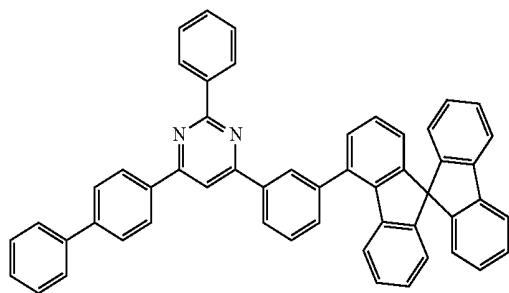
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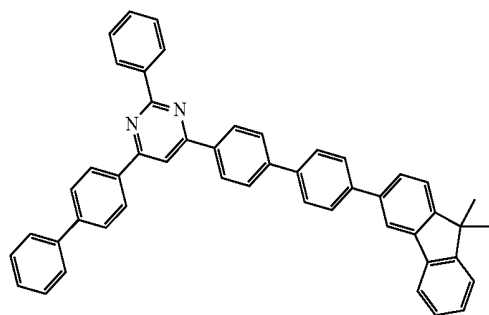
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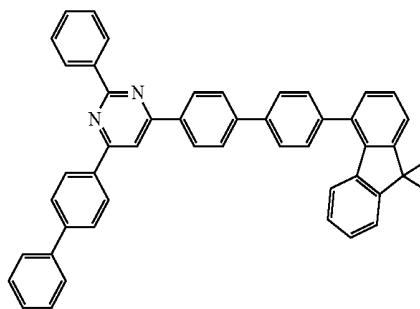


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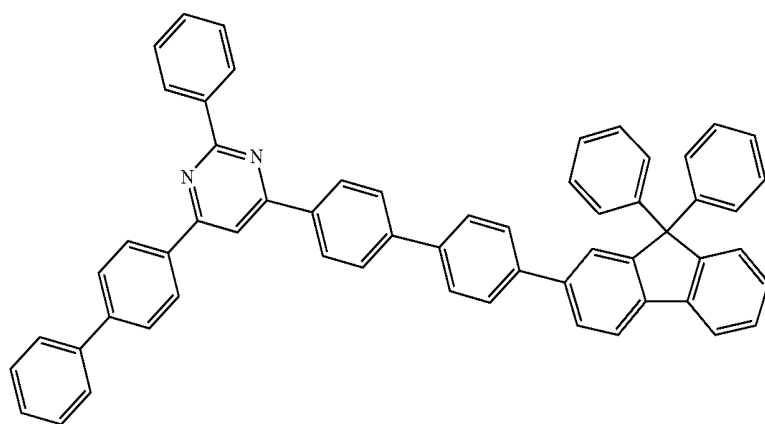
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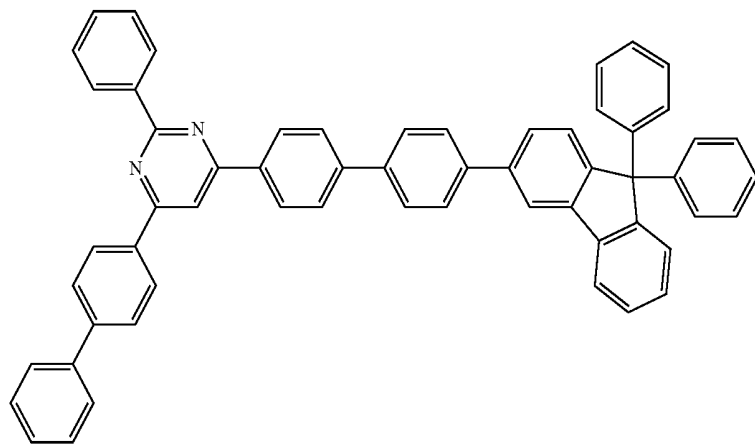
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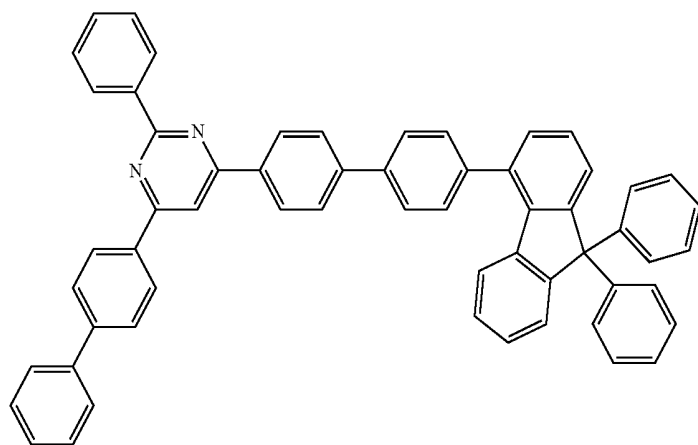
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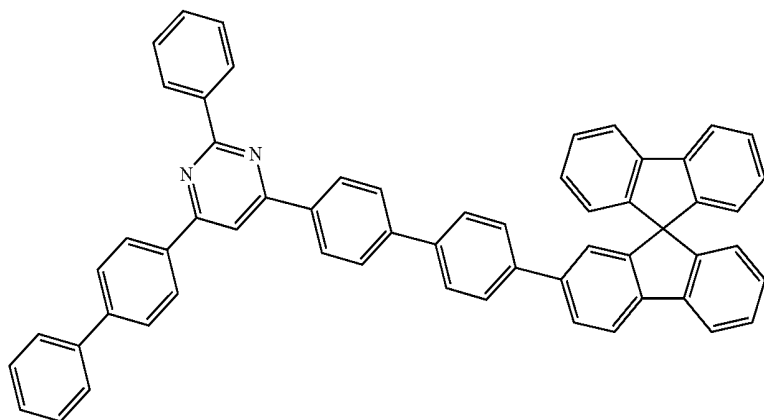


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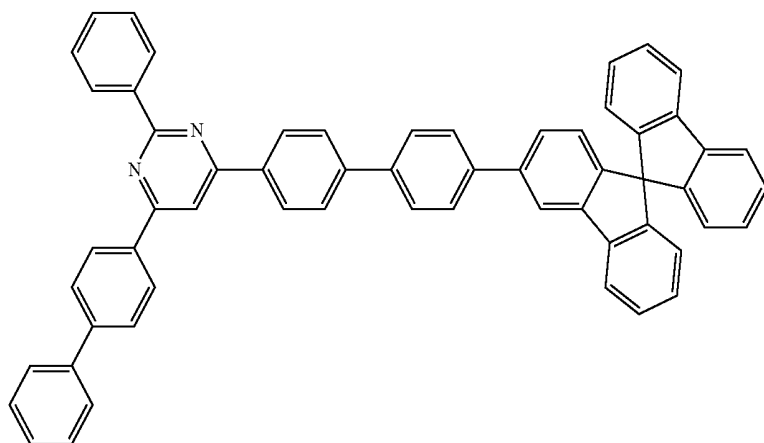


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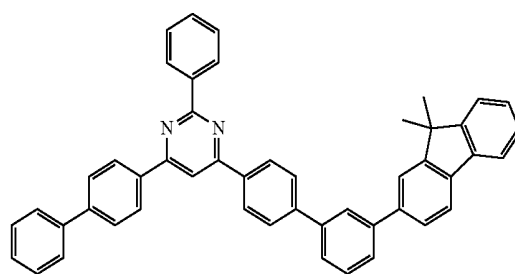
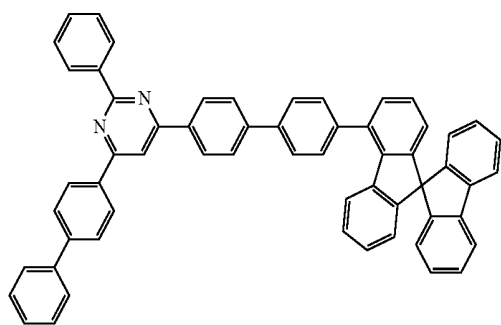


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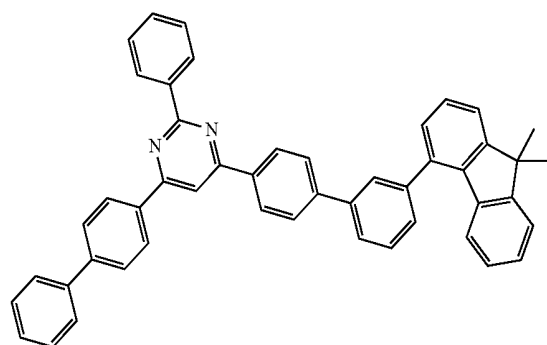
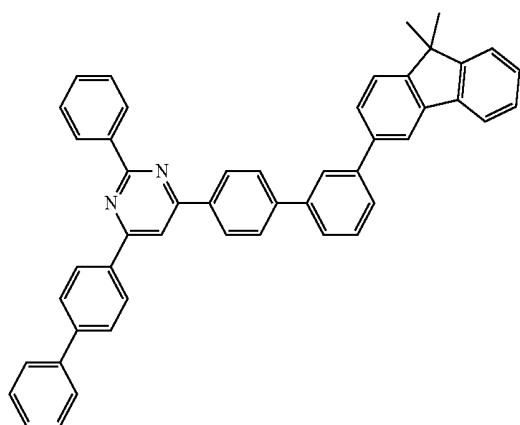
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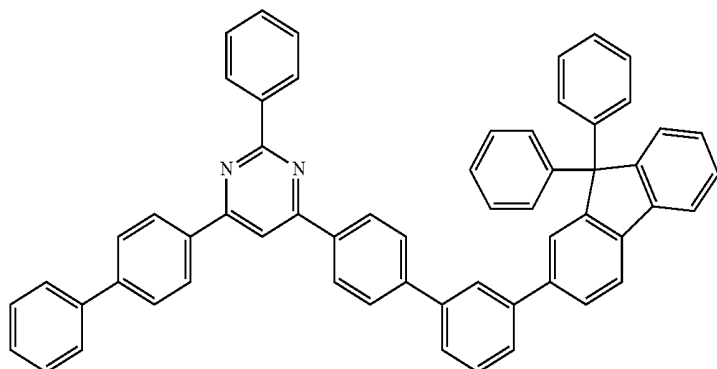
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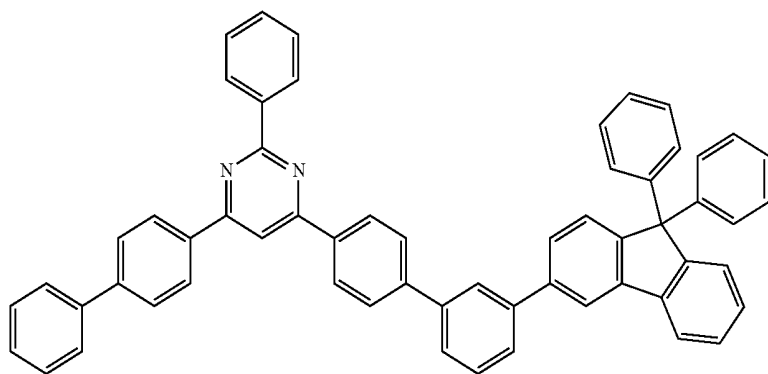


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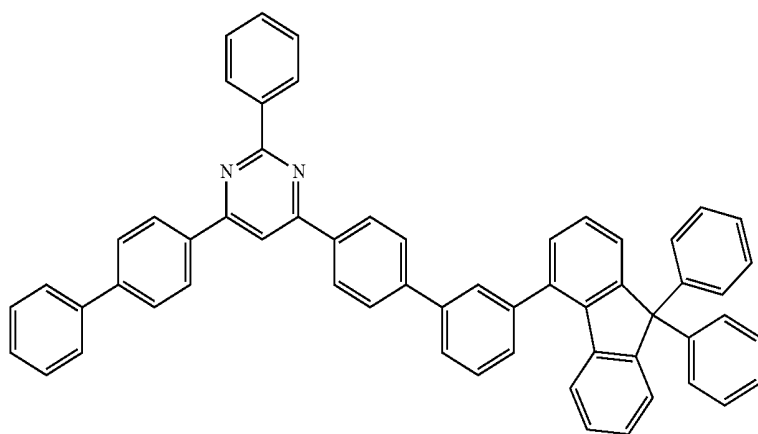
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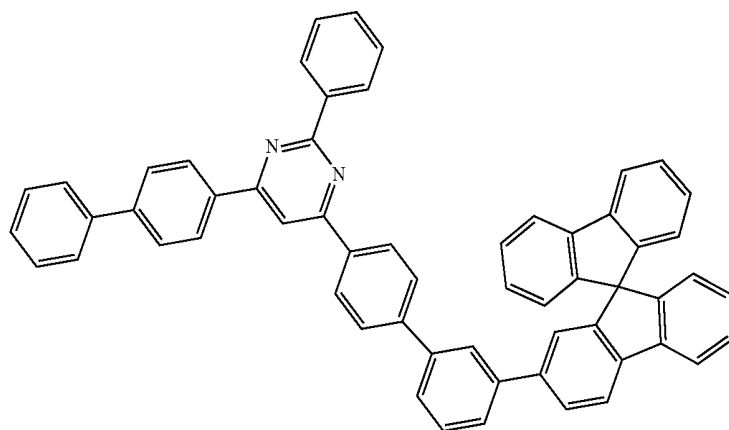
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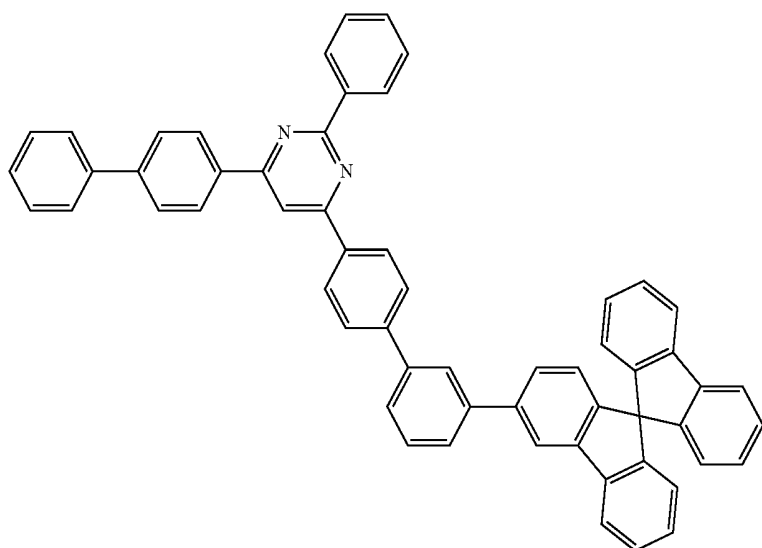


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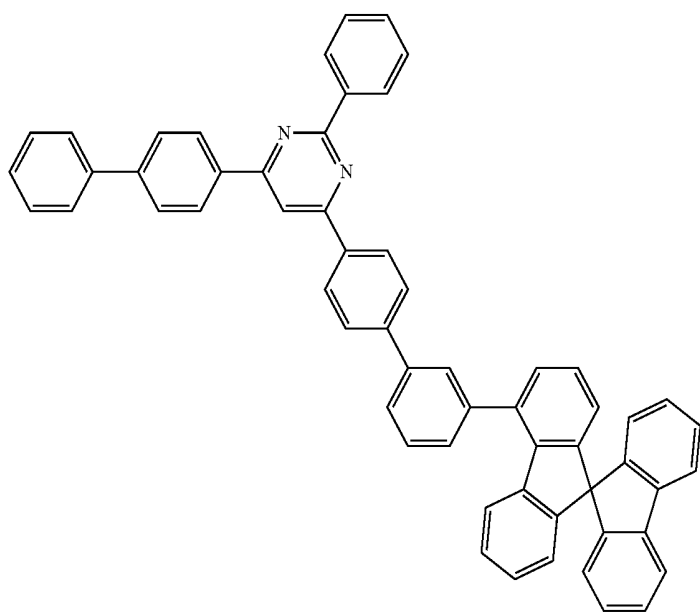


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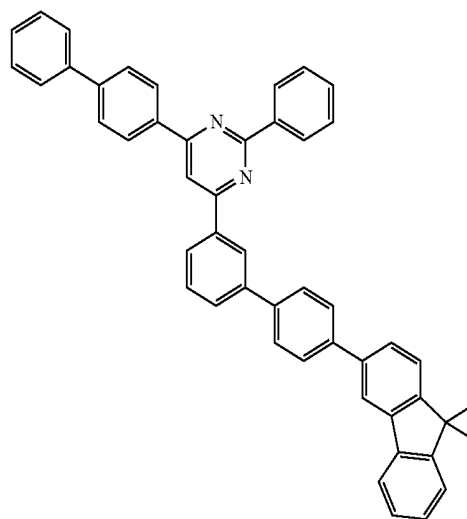
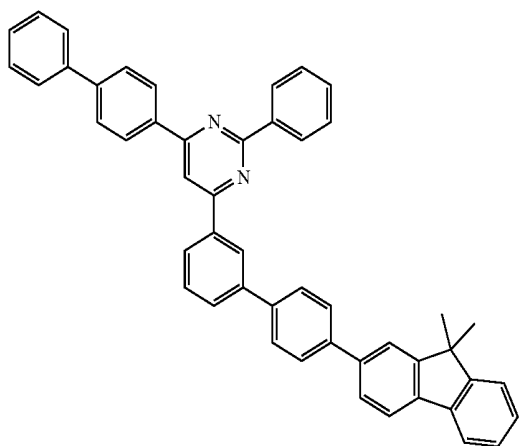


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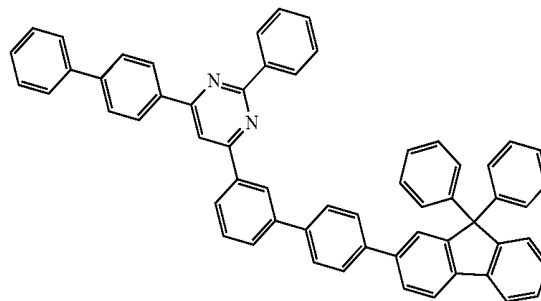
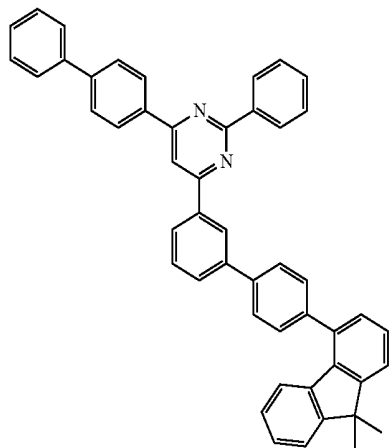
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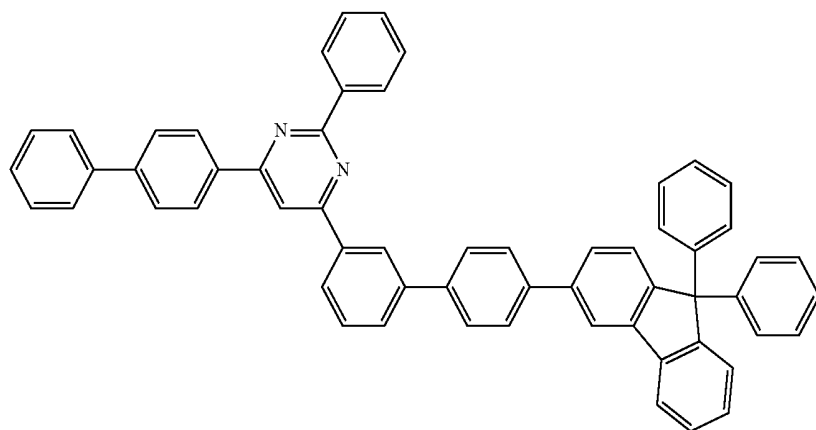


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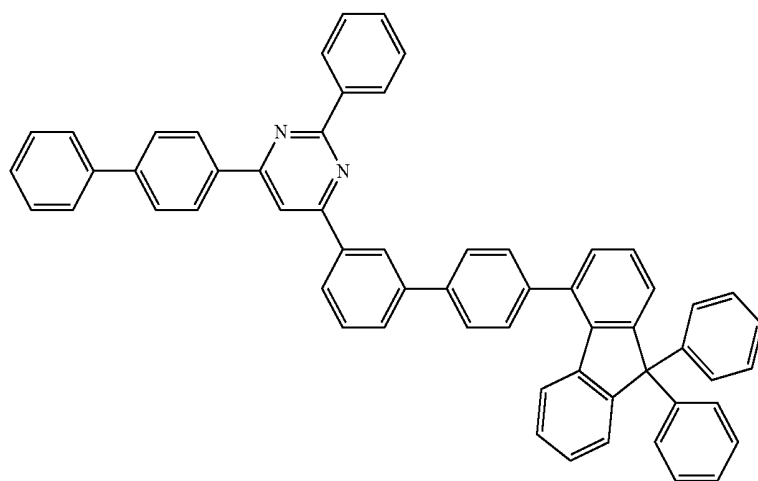
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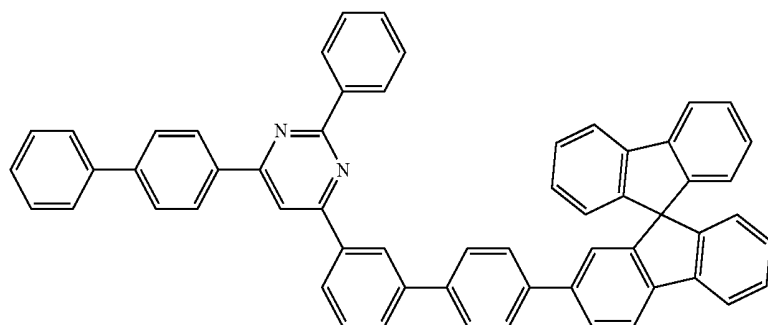
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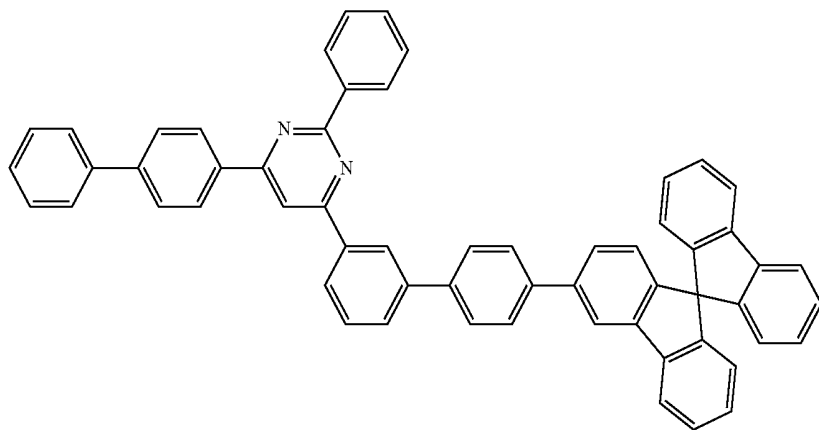


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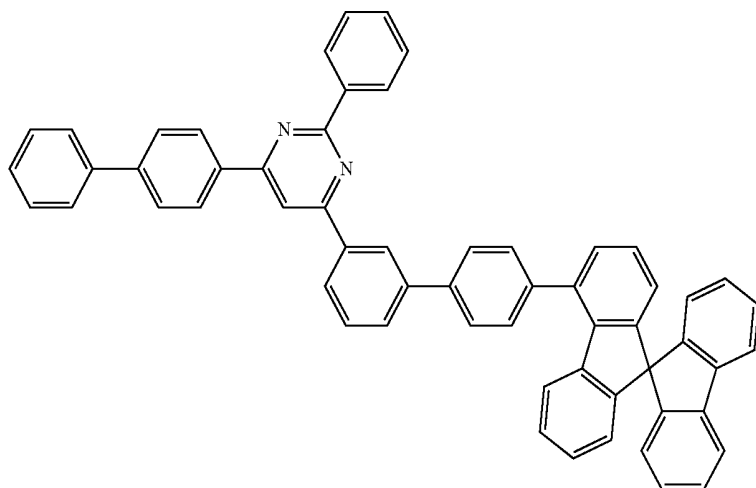


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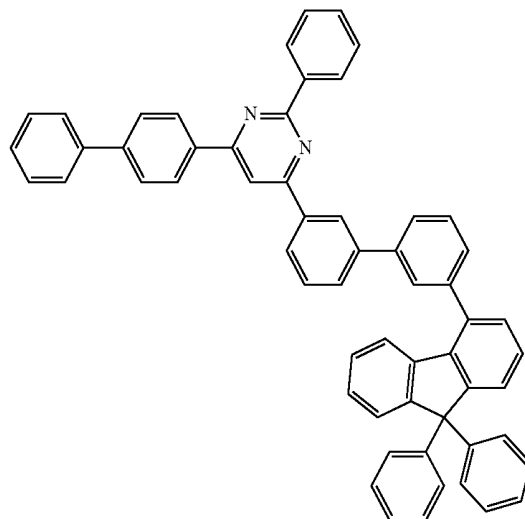
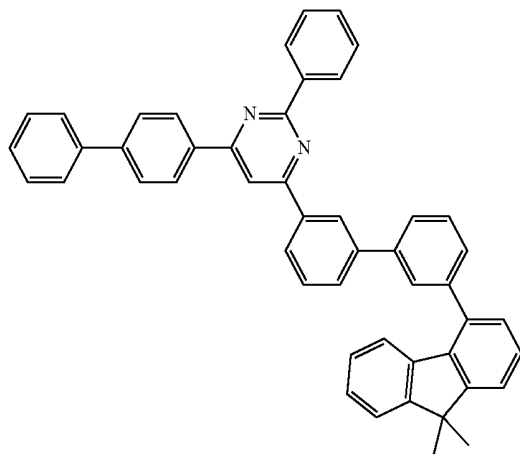


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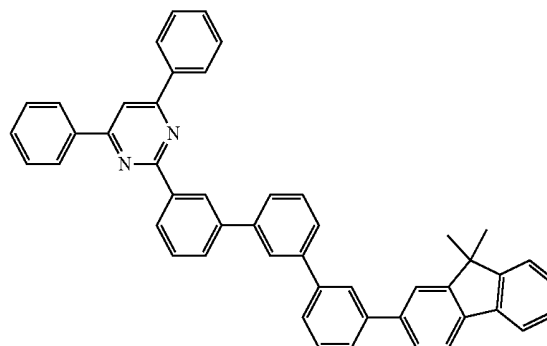
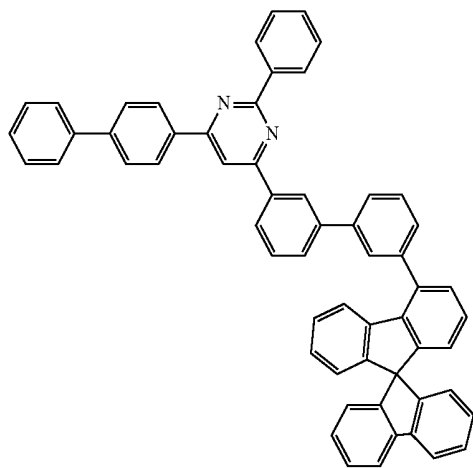
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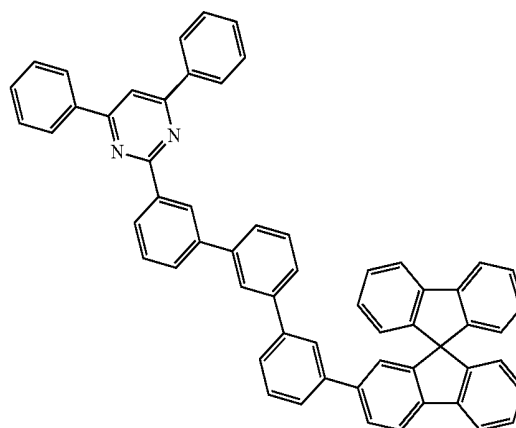
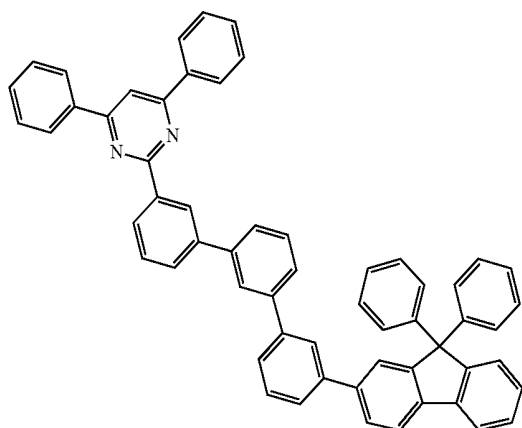
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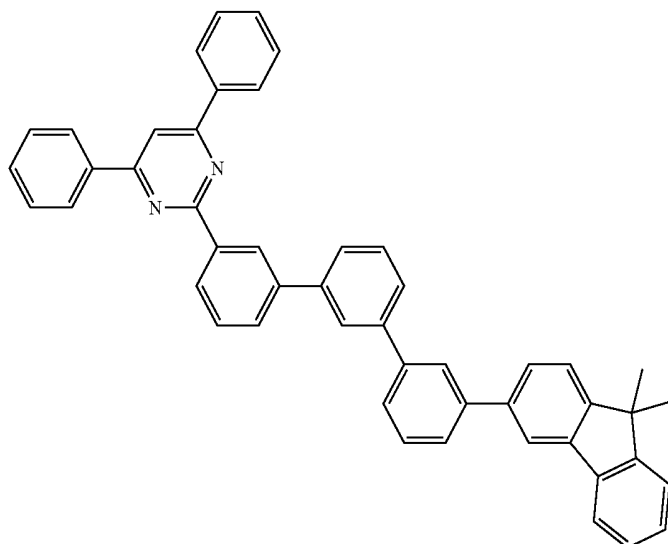


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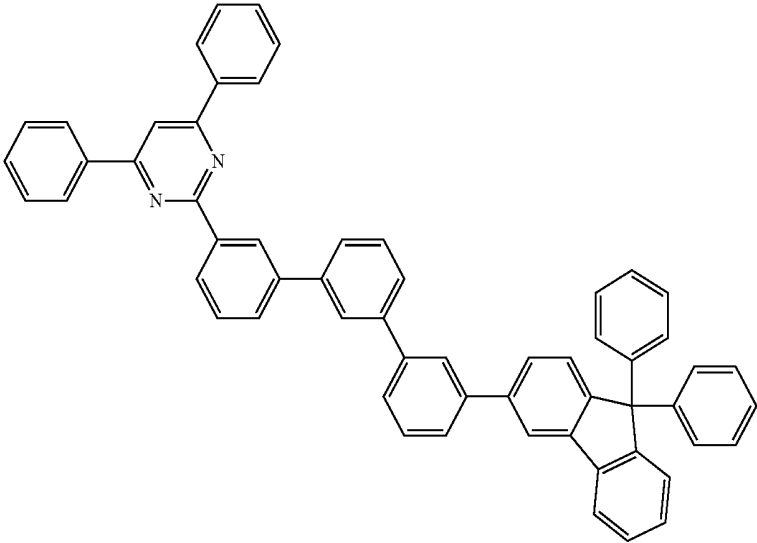


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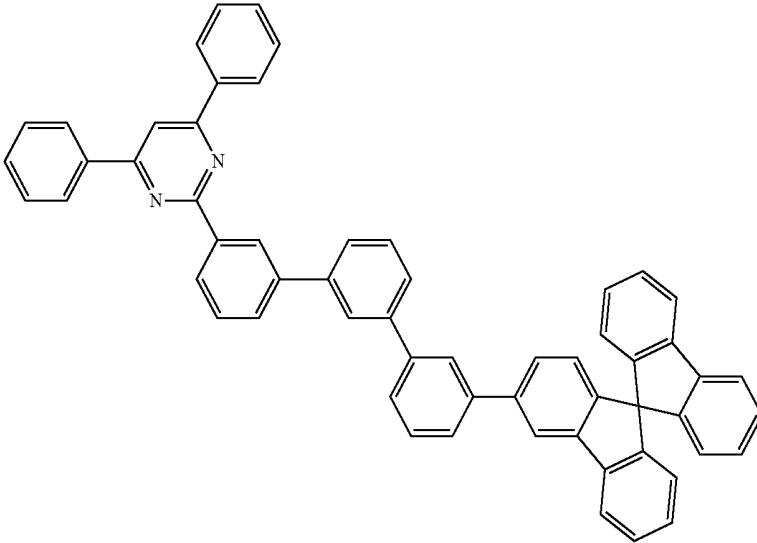


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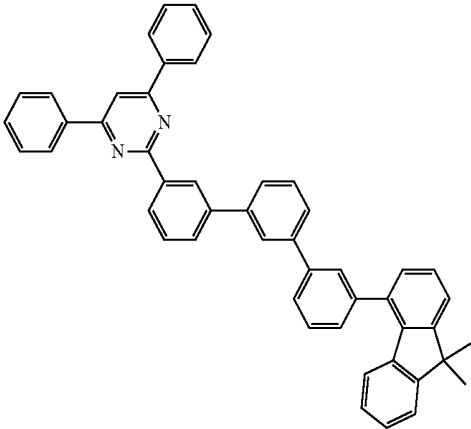
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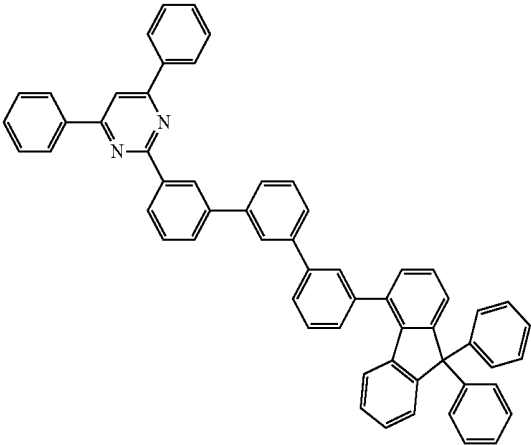
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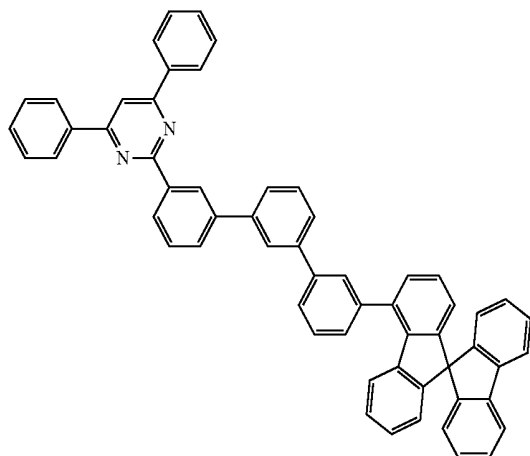


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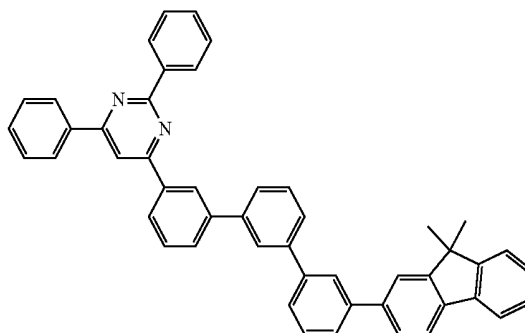


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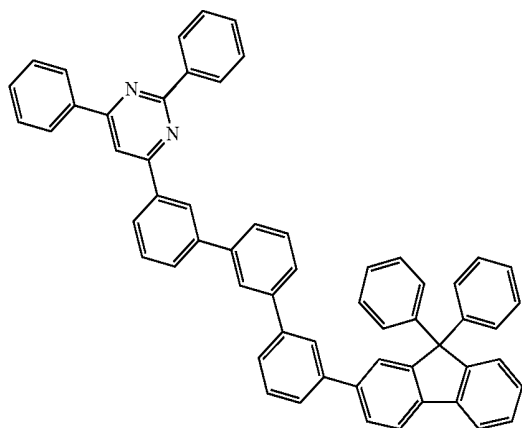
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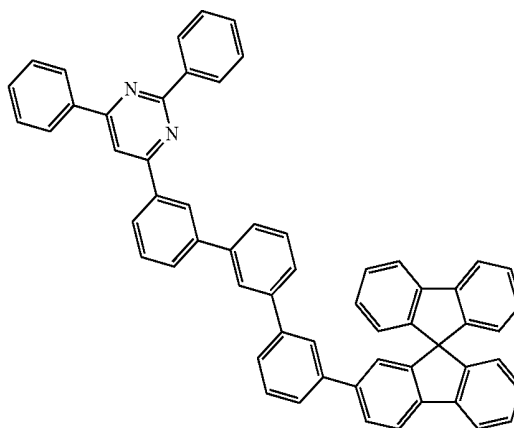
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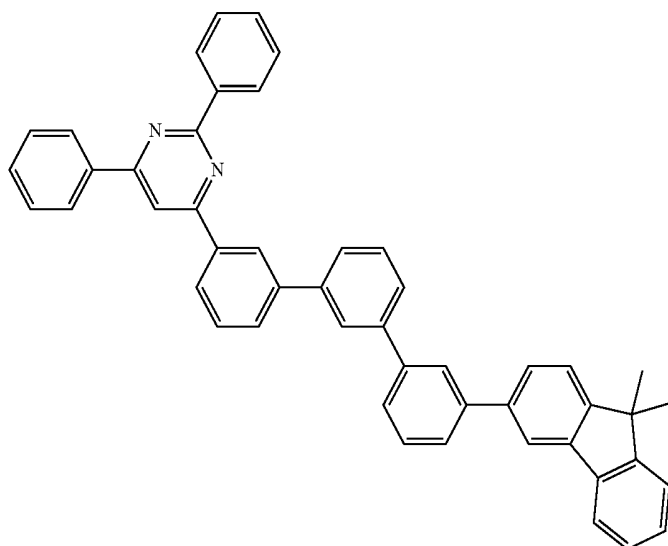
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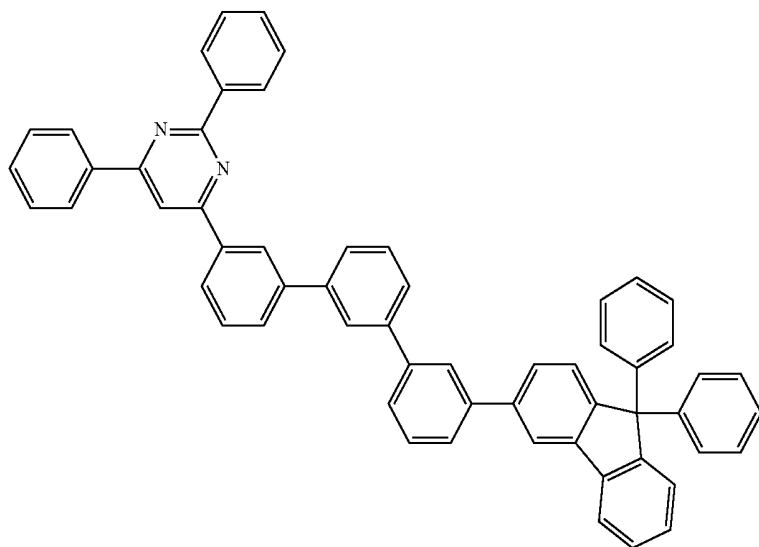


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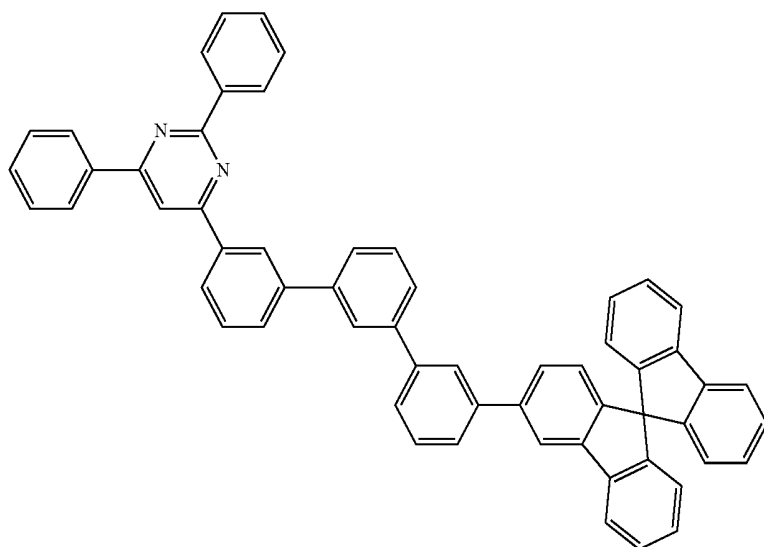


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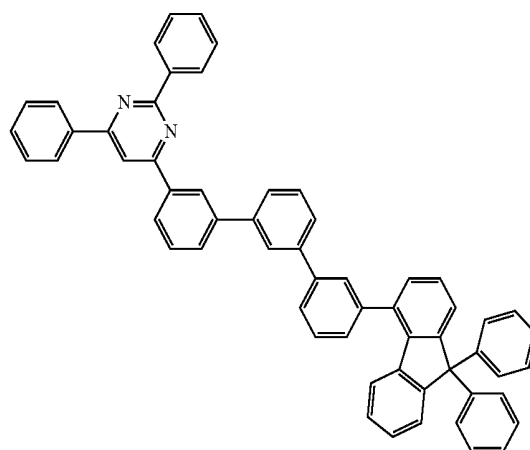
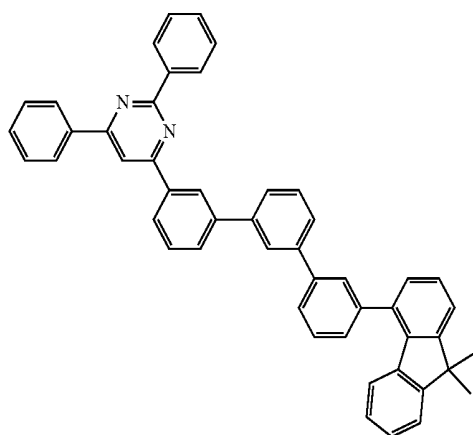


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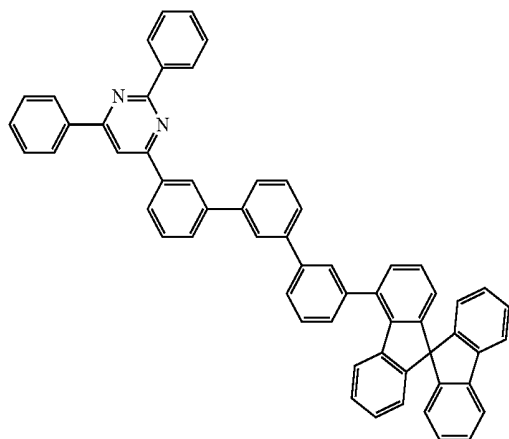
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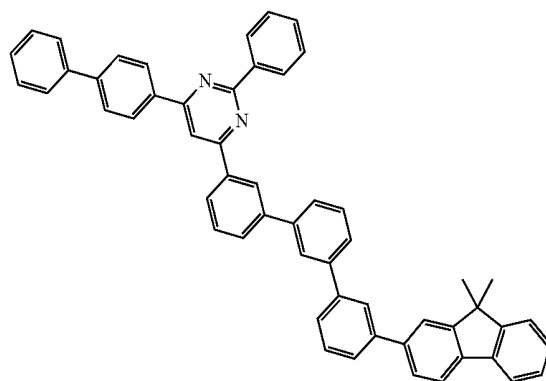


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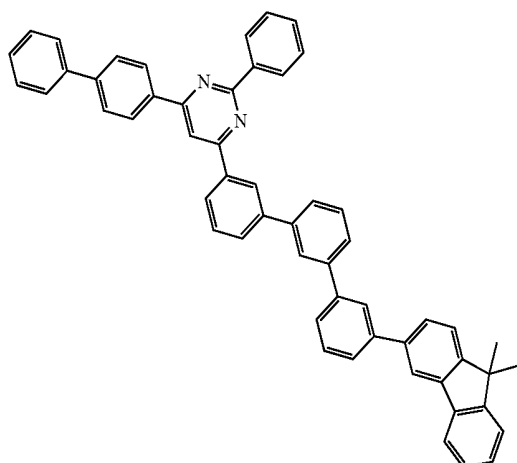
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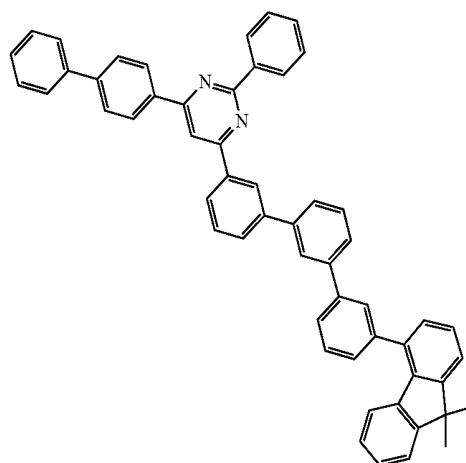
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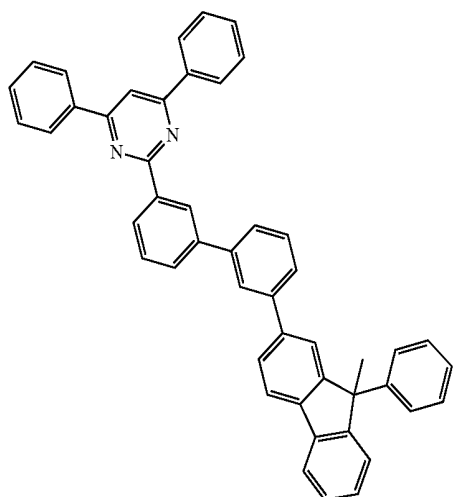
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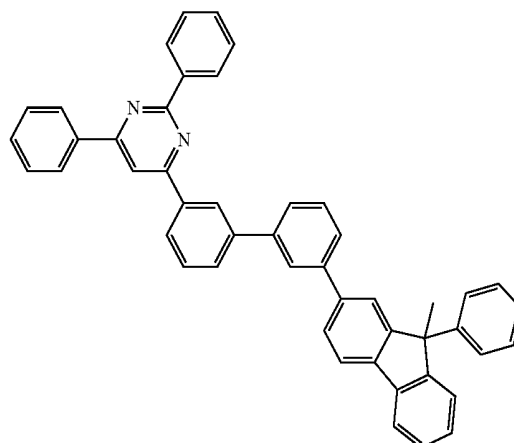
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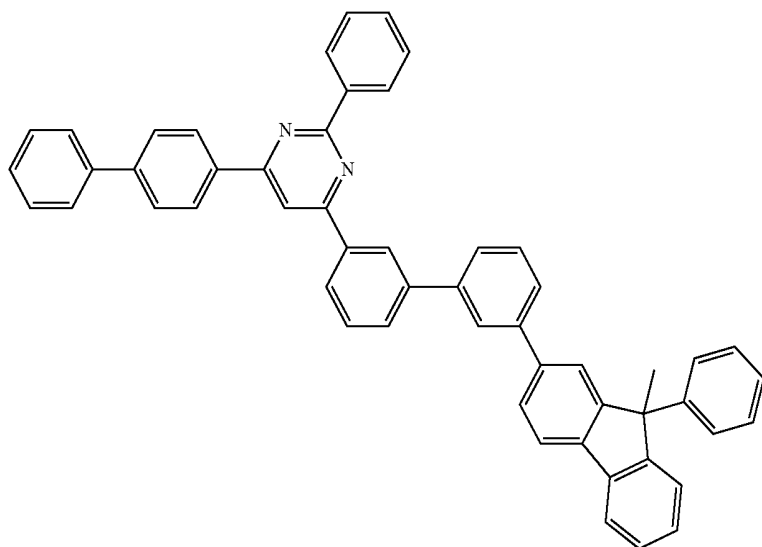


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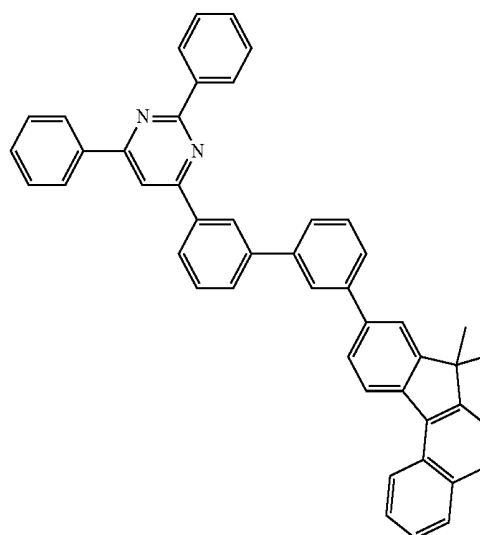
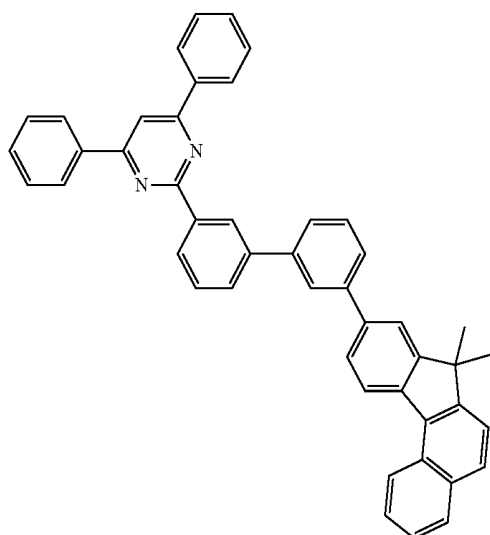
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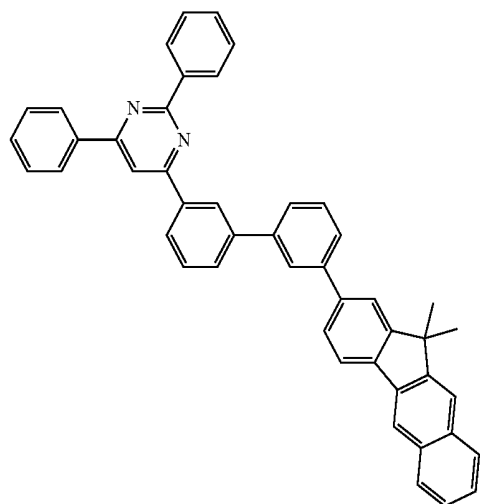
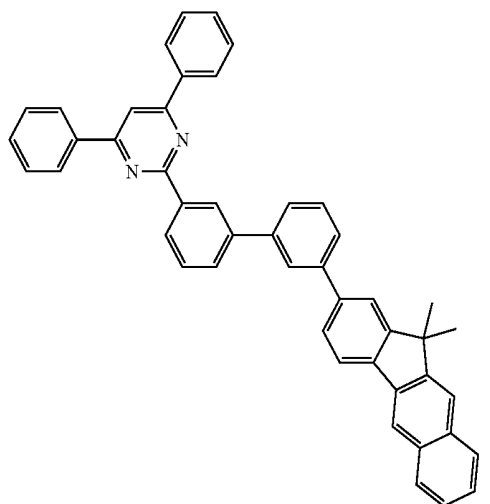
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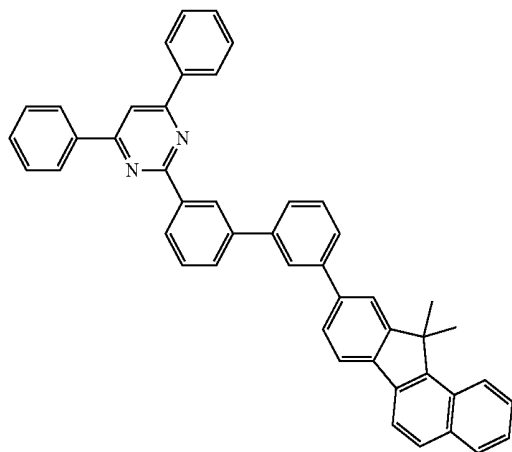
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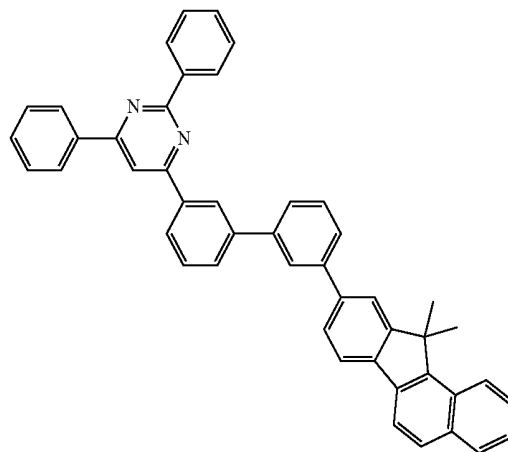


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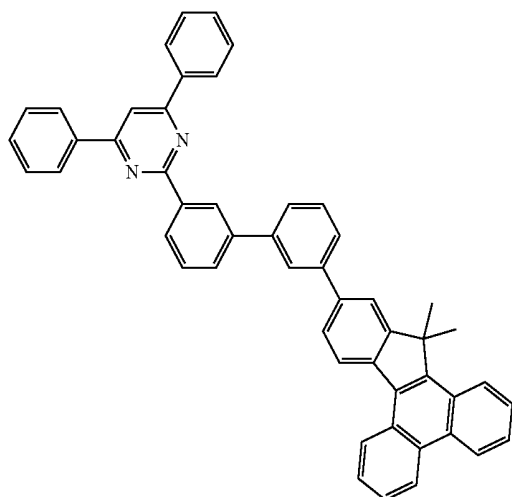
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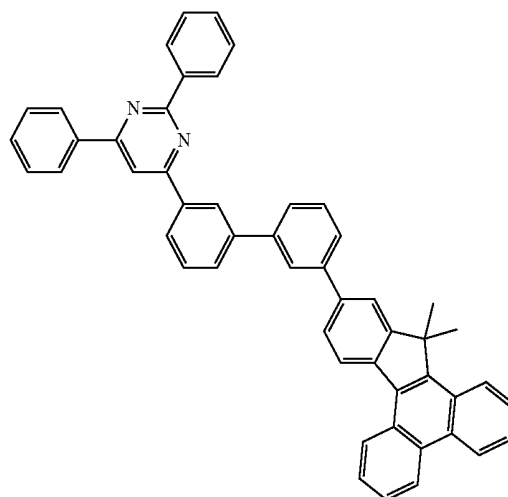
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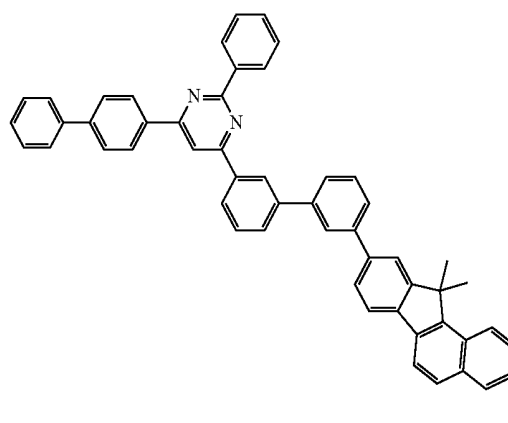
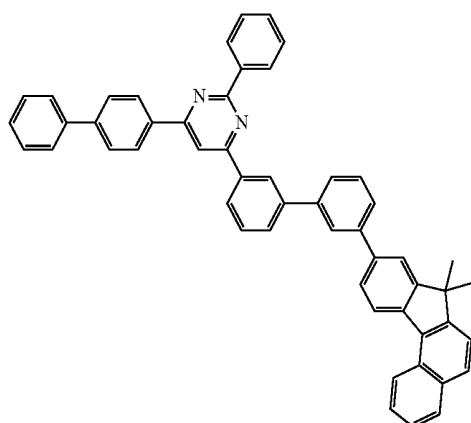
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[0046] As used herein, the term “alkyl” refers to a monovalent substituent derived from linear or branched saturated hydrocarbon of 1 to 40 carbon atoms, including, for example, methyl, ethyl, propyl, isobutyl, sec-butyl, pentyl, iso-amyl, hexyl, and the like.

[0047] As used herein, the term “alkenyl” refers to a monovalent substituent derived from a linear or branched

unsaturated hydrocarbon with one more carbon-carbon double bonds, as exemplified by vinyl, allyl, isopropenyl, 2-butenyl, and the like.

[0048] As used herein, the term “alkynyl” refers to a monovalent substituent derived from a linear or branched unsaturated hydrocarbon of 2 to 40 carbon atoms with at least one carbon-carbon triple bond, as exemplified by ethynyl, 2-propynyl, and the like.

**[0049]** As used herein, the term “aryl” denotes a monovalent substituent derived from an aromatic hydrocarbon of 6 to 60 carbon atoms with a single ring or a combination of two or more rings in which two or more rings may simply be pendant to each other or fused together, as exemplified by phenyl, naphthyl, phenantryl, anthryl, etc.

**[0050]** As used herein, the term “heteroaryl” denotes a monovalent substituent derived from a mono- or polyheterocyclic aromatic hydrocarbon of 5 to 60 nuclear atoms in which at least one, particularly one to three carbon atoms of the ring are substituted by a heteroatom such as N, O, S or Se. Two or more rings of the heteroaryl, if present, may simply be pendant to each other or fused together or to an aryl group. Examples include 6-membered monocyclic rings such as pyridyl, pyrazinyl, pyrimidinyl, pyridazinyl, and triazinyl, polycyclic rings such as phenoxathienyl, indoliziny, indolyl, purinyl, quinolyl, benzothiazole, and carbazoyl, 2-furanyl, N-imidazolyl, 2-ixosazolyl, 2-pyridinyl, and 2-pyrimidinyl.

**[0051]** As used herein, the term “aryloxy” refers to a monovalent substituent represented by RO— wherein R denotes an aryl of 6 to 60 carbon atoms, as exemplified by phenoxy, naphthoxy, diphenyloxy, etc.

**[0052]** As used herein, the term “alkyloxy” refers to a monovalent substituent represented by R'O— wherein R' means an alkyl of 1 to 40 carbon atoms and is construed to include a linear, branched or cyclic structure and examples of which include methoxy, ethoxy, n-propoxy, 1-propoxy, t-butoxy, n-butoxy, pentoxy, etc.

**[0053]** As used herein, the term “arylamine” refers to an amine substituted with an aryl of 6 to 60 carbon atoms.

**[0054]** As used herein, the term “cycloalkyl” refers to a monovalent substituent derived from a mono- or polycyclic non-aromatic hydrocarbon of 3 to 40 carbon atoms, examples of which include cyclopropyl, cyclopentyl, cyclohexyl, norbornyl, and adamantane.

**[0055]** As used herein, the term “heterocycloalkyl” refers to a monovalent substituent derived from a non-aromatic hydrocarbon of 3 to 40 nuclear atoms in which at least one, particularly one to three carbon atoms of the ring are substituted by a heteroatom such as N, O, S or Se and examples of which include morpholinem, piperazine, and the like.

**[0056]** As used herein, the term “alkylsilyl” refers to a silyl substituent substituted with an alkyl of 1 to 40 carbon atoms, and the term “arylsilyl” refers to a silyl group substituted with an aryl of 6 to 60 carbon atoms.

**[0057]** As used herein, the term “fused ring” refers to a fused aliphatic ring, a fused aromatic ring, a fused heteroaliphatic ring, a heteroaromatic ring, or a combination thereof.

**[0058]** 2. Organic Electroluminescent Element

**[0059]** The present invention provides an organic electroluminescent element comprising the compound represented by Formula 1.

**[0060]** In detail, the organic electroluminescent element of the present invention comprises an anode, a cathode, and at least one organic layer interposed therebetween wherein the at least one organic layer comprises the compound represented by Formula 1. Here, the compound may be a single kind or a combination of two or more different kinds.

**[0061]** The at least one organic layer may be selected from among a hole injection layer, a hole transport layer, an auxiliary light-emitting layer, an electron transport layer, an

electron injection layer, and a combination thereof, and may comprise the compound represented by Formula 1. In detail, the organic layer comprising the compound represented by Formula 1 is particularly a light-emitting layer or an auxiliary electron transport layer (interposed between a light-emitting layer and an electron transport layer).

**[0062]** Meanwhile, the light-emitting layer may comprise a host. Here, the host may be the compound represented by Formula 1, alone or in combination with other compounds. In addition, the light-emitting layer may comprise a dopant based on a metal complex compound, together with the host.

**[0063]** No particular limitations are imparted to the structure of the organic electroluminescent element of the present invention. For example, the organic electroluminescent element may have a structure in which a substrate, an anode, a hole injection layer, a hole transport layer, an auxiliary light-emitting layer, a light-emitting layer, an auxiliary electron transport layer, an electron transport layer, and a cathode are sequentially deposited. Here, an electron injection layer may be further deposited on the electron transport layer. Moreover, an insulation layer or an adhesive layer may be introduced into the interface between the electrode (cathode or anode) and the organic layer.

**[0064]** The organic electroluminescent element of the present invention can be fabricated using materials and methods known in the art, with the exception that at least one of the organic layers comprises the compound represented by Formula 1.

**[0065]** The organic layer may be formed using a vacuum deposition method or a solution coating method. Examples of the solution coating method include spin coating, dip coating, doctor blade coating, inkjet printing and a thermal transfer method, but are not limited thereto.

**[0066]** The substrate used for the fabrication of the organic electroluminescent element of the present invention is not particularly limited, and may be a silicon wafer, quartz, a glass plate, a metal plate, or a plastic film.

**[0067]** As for the anode, its material is not particularly limited, but may be a metal such as vanadium, chromium, copper, zinc, gold, etc., or an alloy thereof; a metal oxide such as zinc oxide, indium oxide, indium tin oxide (ITO), and indium zinc oxide (IZO); a combination of metal and oxide such as ZnO:Al or SnO<sub>2</sub>:Sb; a conductive polymer such as polythiophene, poly(3-methylthiophene), poly[3,4-(ethylene-1,2-dioxy)thiophene] (PEDT), polypyrrole or polyaniline; and carbon black.

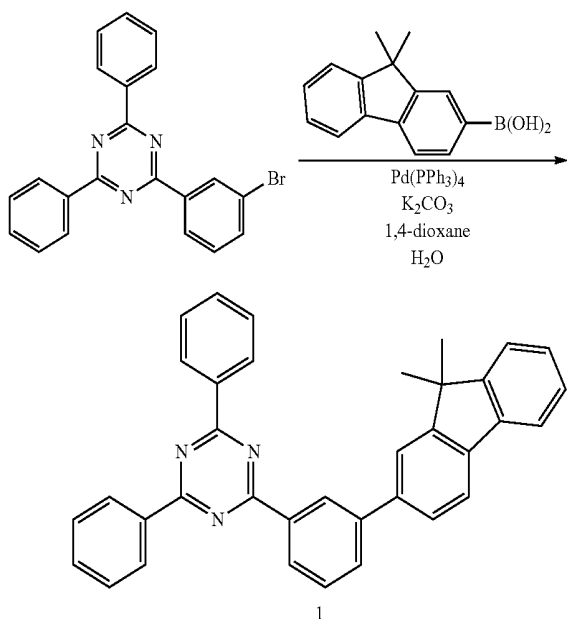
**[0068]** Although no particular limitations are imparted thereto, a material available for the cathode may be a metal such as magnesium, calcium, sodium, potassium, titanium, indium, yttrium, lithium, gadolinium, aluminum, silver, tin and lead, or an alloy thereof; or a multilayer material such as LiF/Al or LiO<sub>2</sub>/A.1.

**[0069]** In addition, the hole injection layer, the hole transport layer, the electron injection layer and the electron transport layer are not particularly limited, and may be made of conventional materials known in the art.

**[0070]** The present invention will be in greater detail described through the following examples that are set forth to illustrate, but are not to be construed as limiting the present invention.

Synthesis Example 1: Synthesis of Compound 1  
(2-(3-(9, 9-dimethyl-9H-fluoren-2-yl)phenyl)-4,6-diphenyl-1,3,5-triazine)

[0071]

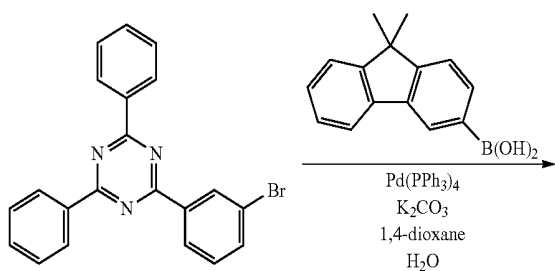


[0072] Under a nitrogen stream, 2-(3-bromophenyl)-4,6-diphenyl-[1,3,5]triazine (10.0 g, 0.026 mol), 9,9-dimethyl-9H-fluoren-2-yl-boronic acid (7.9 g, 0.033 mol), Pd(PPh<sub>3</sub>)<sub>4</sub> (0.95 g, 0.001 mol), and potassium carbonate (7.65 g, 0.078 mol) were mixed and then stirred under reflux with 1,4-dioxane (80 ml) and H<sub>2</sub>O (20 ml). After completion of the reaction, an organic layer was separated with methylene chloride, and dried over MgSO<sub>4</sub>. The solvent was removed from the dehydrated organic layer, followed by purification through column chromatography [hexane:MC=5:1 (v/v)] to afford Compound 1 (8.2 g, yield 63%).

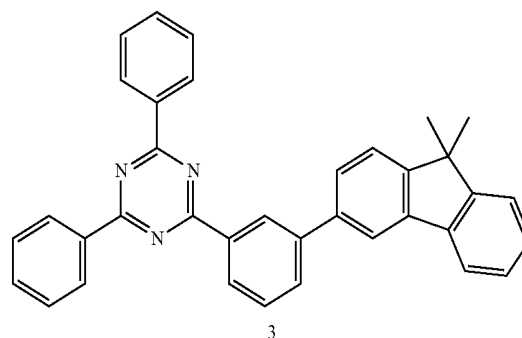
[0073] HRMS [M]<sup>+</sup>: 501.62

Synthesis Example 2: Synthesis of Compound 3  
(2-[3-(9,9-Dimethyl-9H-fluoren-3-yl)-phenyl]-4,6-diphenyl-[1,3,5]triazine)

[0074]



-continued

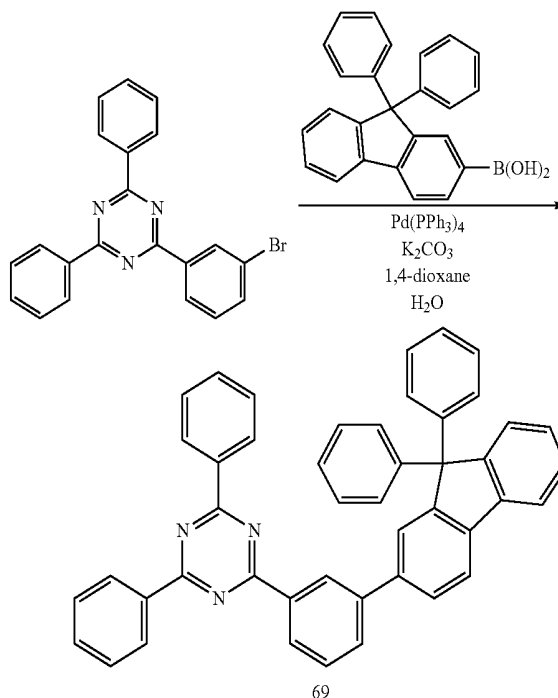


[0075] The same procedure was conducted as in Synthesis Example 1, with the exception of using 9,9-dimethyl-9H-fluoren-3-yl-boronic acid (7.9 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluoren-2-yl-boronic acid, to afford Compound 3.

[0076] HRMS [M]<sup>+</sup>: 501.62

Synthesis Example 3: Synthesis of Compound 69  
(2-[3-(9,9-Diphenyl-9H-fluoren-2-yl)-phenyl]-4,6-diphenyl-[1,3,5]triazine)

[0077]

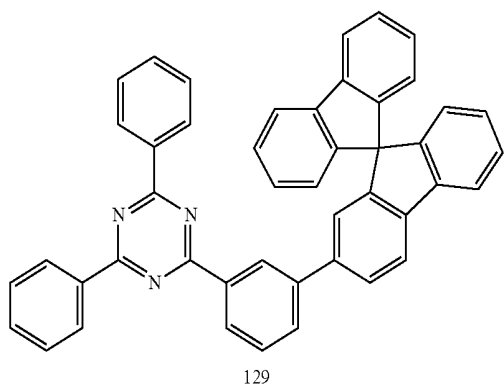
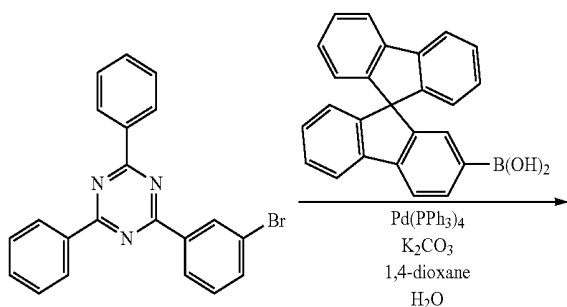


[0078] The same procedure was conducted as in Synthesis Example 1, with the exception of using (9,9-diphenyl-9H-fluoren-2-yl)-acid (11.9 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluoren-2-yl-boronic acid, to afford Compound 69.

[0079] HRMS [M]<sup>+</sup>: 625.76

Synthesis Example 4: Synthesis of Compound 129  
(2-[3-(9,9-Spiro[9H-fluorene]-2-yl)-phenyl]-4,6-diphenyl-[1,3,5]triazine)

[0080]

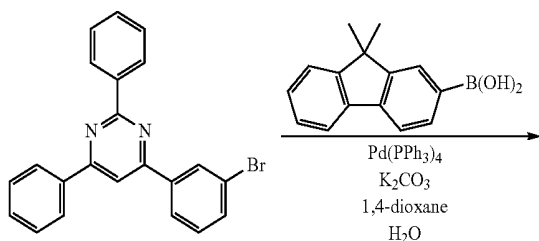


[0081] The same procedure was conducted as in Synthesis Example 1, with the exception of using 9,9'-spiro[9H-fluorene]-2-yl-boronic acid (11.88 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluorene-2-yl-boronic acid, to afford Compound 129.

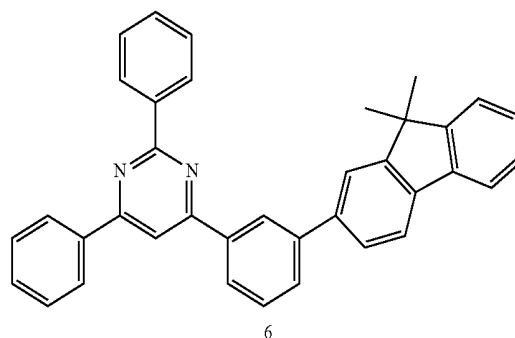
[0082] HRMS [M]<sup>+</sup>: 623.74

Synthesis Example 5: Synthesis of Compound 6  
(4-[3-(9,9-Dimethyl-9H-fluorene-2-yl)-phenyl]-2,6-diphenyl-pyrimidine)

[0083]



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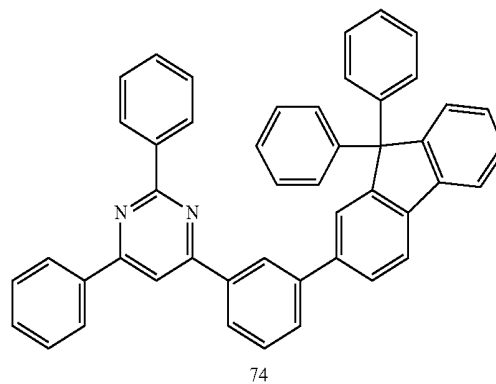
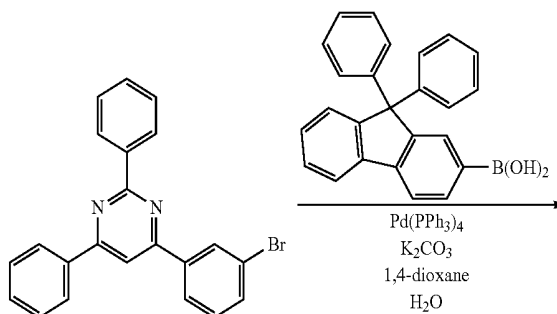


[0084] The same procedure was conducted as in Synthesis Example 1, with the exception of using 4-(3-bromophenyl)-2,6-diphenyl-pyrimidine (10.0 g, 0.026 mol) instead of 2-(3-bromophenyl)-4,6-diphenyl-[1,3,5]triazine, to afford Compound 6.

[0085] HRMS [M]<sup>+</sup>: 500.63

Synthesis Example 6: Synthesis of Compound 74  
(4-[3-(9,9-Diphenyl-9H-fluorene-2-yl)-phenyl]-2,6-diphenyl-pyrimidine)

[0086]

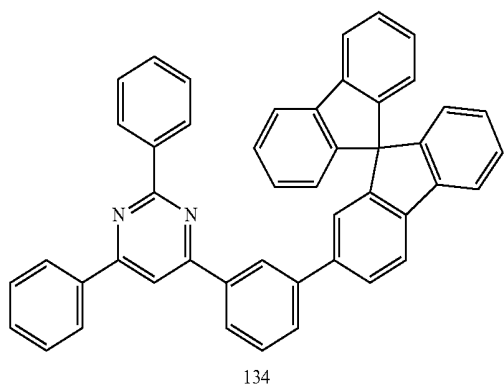
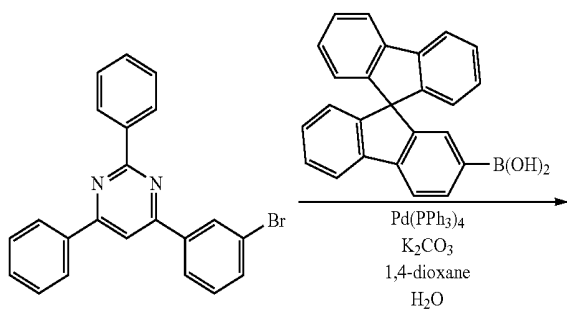


[0087] The same procedure was conducted as in Synthesis Example 5, with the exception of using (9,9-diphenyl-9H-fluorene-2-yl)-boronic acid (11.9 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluorene-2-yl-boronic acid, to afford Compound 74.

[0088] HRMS [M]<sup>+</sup>: 624.77

Synthesis Example 7: Synthesis of Compound 134  
(4-[3-(9,9-Spiro[9H-fluorene]-2-yl)-phenyl]-2,6-diphenyl-pyrimidine)

[0089]

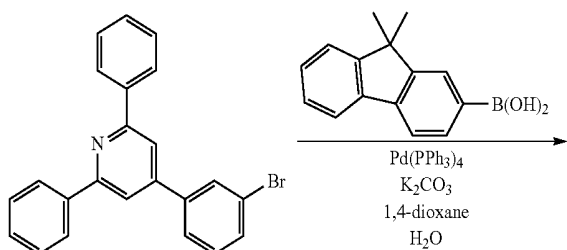


[0090] The same procedure was conducted as in Synthesis Example 5, with the exception of using 9,9'-spiro[9H-fluorene]-2-yl-boronic acid (12.77 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluorene-2-yl-boronic acid, to afford Compound 134.

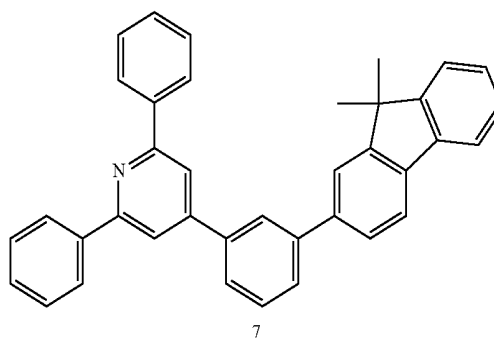
[0091] HRMS [M]<sup>+</sup>: 622.75

Synthesis Example 8: Synthesis of Compound 7  
(4-[3-(9,9-Dimethyl-9H-fluorene-2-yl)-phenyl]-2,6-diphenyl-pyridine)

[0092]



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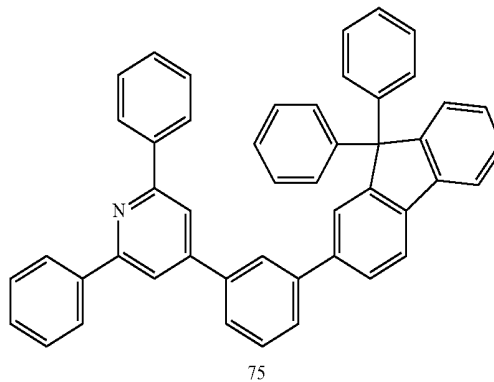
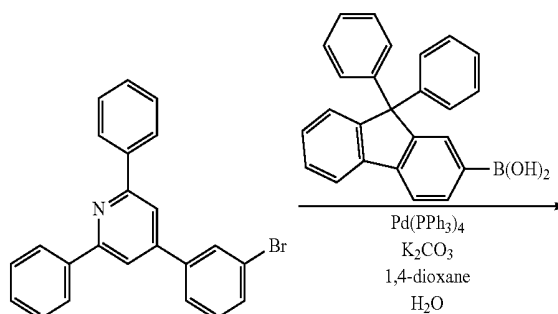


[0093] The same procedure was conducted as in Synthesis Example 1, with the exception of using 4-(3-bromophenyl)-2,6-diphenyl-pyridine (10.0 g, 0.026 mol) instead of 2-(3-bromophenyl)-4,6-diphenyl-[1,3,5]triazine, to afford Compound 7.

[0094] HRMS [M]<sup>+</sup>: 499.64

Synthesis Example 9: Synthesis of Compound 75  
(4-[3-(9,9-Diphenyl-9H-fluorene-2-yl)-phenyl]-2,6-diphenyl-pyridine)

[0095]

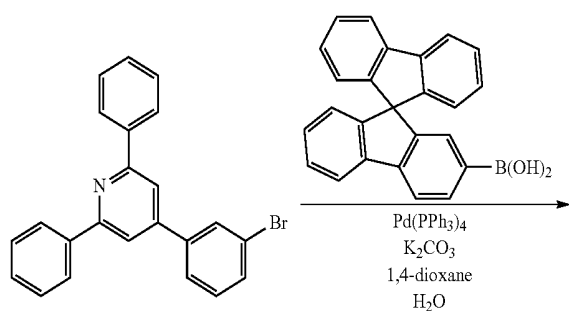


[0096] The same procedure was conducted as in Synthesis Example 8, with the exception of using (9,9-diphenyl-9H-fluorene-2-yl)-boronic acid (11.9 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluorene-2-yl-boronic acid, to afford Compound 75.

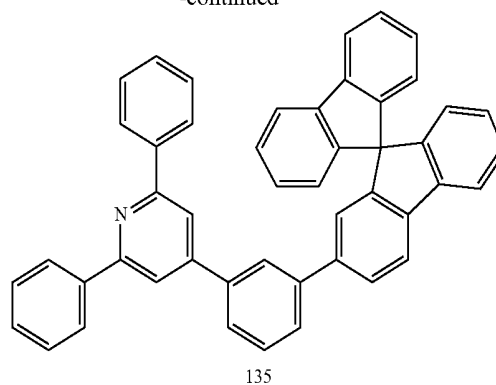
[0097] HRMS [M]<sup>+</sup>: 623.78

Synthesis Example 10: Synthesis of Compound 135  
(4-[3-(9,9-Spiro[9H-fluorene]-2-yl)-phenyl]-2,6-diphenyl-pyridine

[0098]



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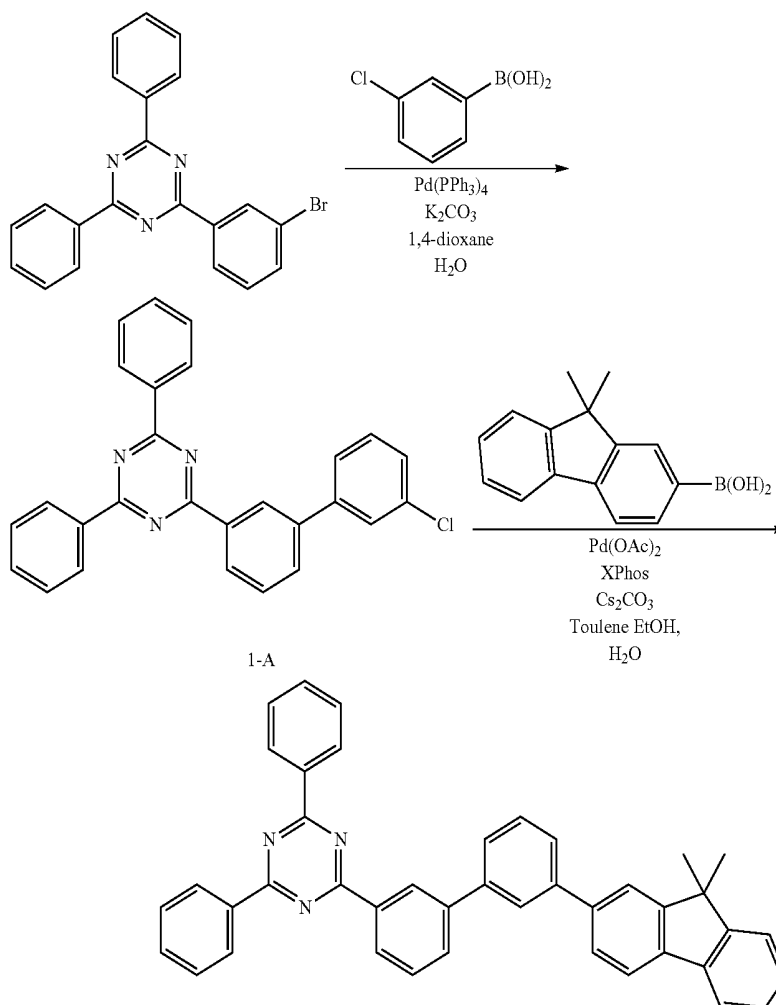


[0099] The same procedure was conducted as in Synthesis Example 8, with the exception of using 9,9'-spiro[9H-fluorene]-2-yl-boronic acid (12.77 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluoren-2-yl-boronic acid, to afford Compound 135.

[0100] HRMS [M]<sup>+</sup>: 622.71

Synthesis Example 11: Synthesis of Compound 21  
(2-(3'-(9,9-dimethyl-9H-fluoren-2-yl)biphenyl-3-yl)-4,6-diphenyl-1,3,5-triazine)

[0101]



<Step 1> Synthesis of Intermediate 1-A (2-(3'-chloro-biphenyl-3-yl)-4,6-diphenyl-1,3,5-triazine)

[0102] Under a nitrogen stream, 2-(3-bromophenyl)-4,6-diphenyl-[1,3,5]triazine (12.0 g, 0.031 mol), 3-chlorophenylboronic acid (6.3 g, 0.040 mol), Pd(PPh<sub>3</sub>)<sub>4</sub> (1.15 g, 0.001 mol), and potassium carbonate (12.85 g, 0.093 mol) were mixed and then stirred under reflux with 1,4-dioxane (100 ml) and H<sub>2</sub>O (25 ml).

[0103] After completion of the reaction, an organic layer was separated with methylene chloride and dried over MgSO<sub>4</sub>. The solvent was removed from the dehydrated organic layer, followed by purification through column chromatography [hexane:MC=5:1 (v/v)] to afford Intermediate 1-A (11.0 g, yield 83%).

[0104] <Step 2> Synthesis of Compound 21 (2-(3'-(9,9-dimethyl-9H-fluoren-2-yl)biphenyl-3-yl)-4,6-diphenyl-1,3,5-triazine)

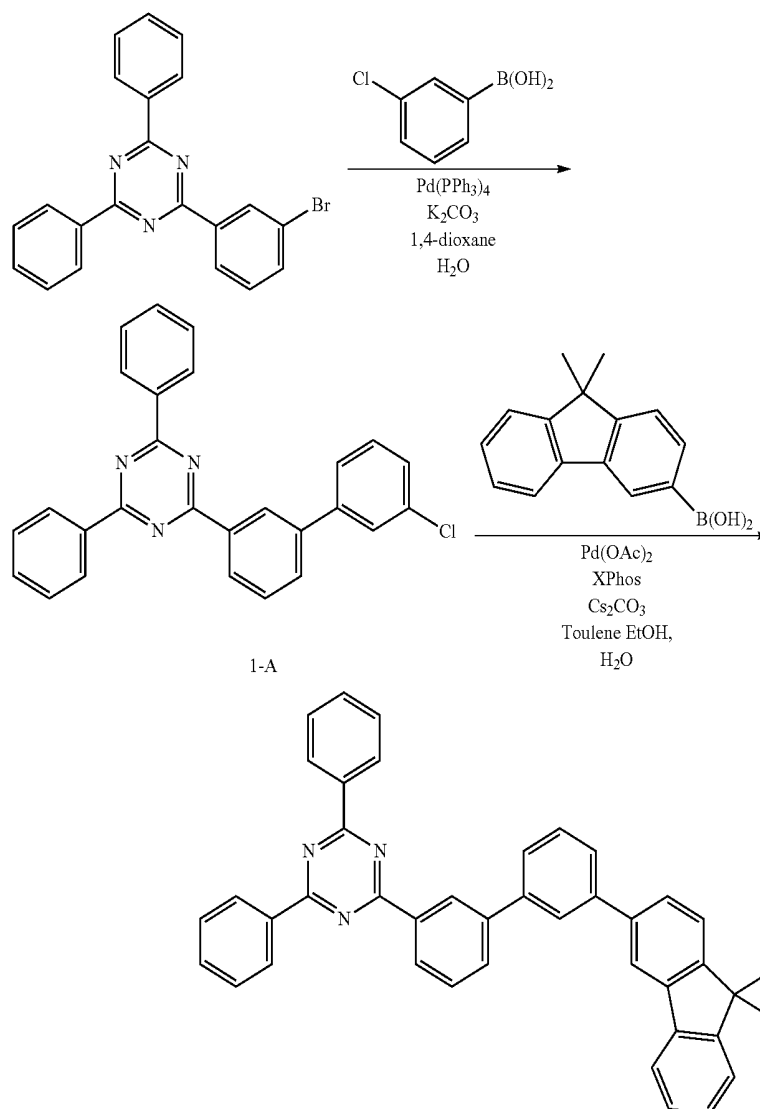
[0105] Under a nitrogen stream, Intermediate 1-A (11.0 g, 0.026 mol) obtained in Step 1, 9,9-dimethyl-9H-fluoren-2-ylboronic acid (7.9 g, 0.033 mol), Pd(OAc)<sub>2</sub> (0.29 g, 0.001 mol), cesium carbonate (25.4 g, 0.078 mol), and XPhos (1.23 g, 0.003 mol) were mixed and then stirred under reflux with toluene (100 ml)/ethanol (20 ml)/H<sub>2</sub>O (20 ml).

[0106] After completion of the reaction, an organic layer was separated with methylene chloride and dried over MgSO<sub>4</sub>. The solvent was removed from the dehydrated organic layer, followed by purification through column chromatography [hexane:MC=5:1 (v/v)] to afford Compound 21 (8.2 g, yield 63%).

[0107] HRMS [M]<sup>+</sup>: 577.72

Synthesis Example 12: Synthesis of Compound 23 (2-[3'-(9,9-Dimethyl-9H-fluoren-3-yl)-biphenyl-3-yl]-4,6-diphenyl-[1,3,5]triazine)

[0108]

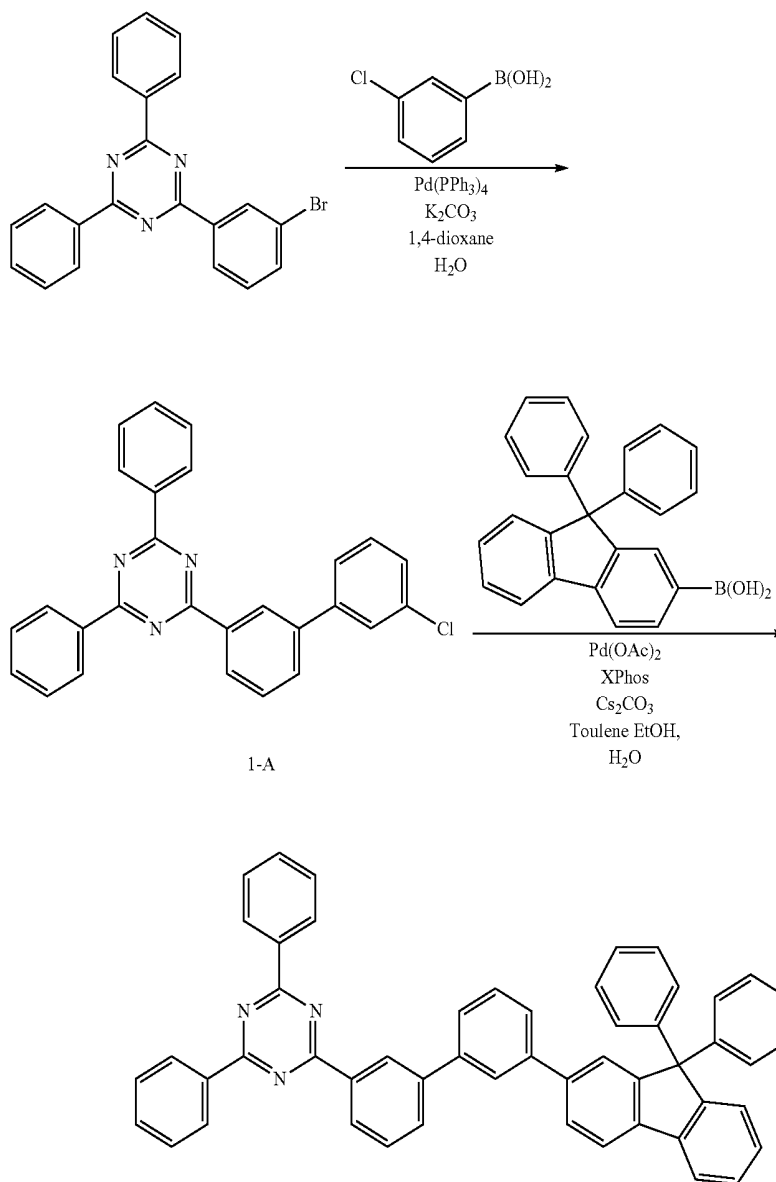


[0109] The same procedure was conducted as in Synthesis Example 11, with the exception of using 9,9-dimethyl-9H-fluoren-3-yl-boronic acid (7.9 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluoren-2-yl-boronic acid used in Step 2 of Synthesis Example 11, to afford Compound 23.

[0110] HRMS [M]<sup>+</sup>: 577.72

Synthesis Example 13: Synthesis of Compound 89  
(2-[3'-(9,9-Diphenyl-9H-fluoren-2-yl)-biphenyl-3-yl]-4,6-diphenyl-[1,3,5]triazine

[0111]



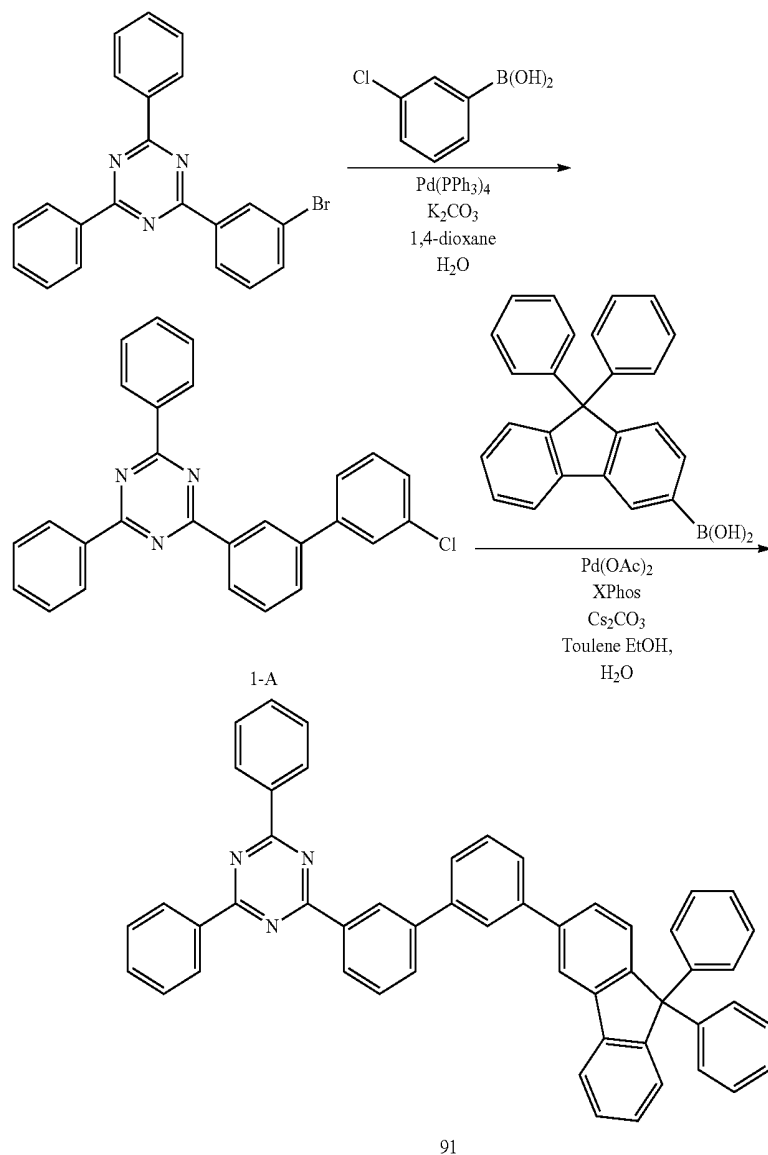
89

[0112] The same procedure was conducted as in Synthesis Example 11, with the exception of using (9,9-diphenyl-9H-fluoren-2-yl)-boronic acid (7.9 g, 0.033 mol) instead of 9,9-Dimethyl-9H-fluoren-2-yl-boronic acid used in Step 2 of Synthesis Example 11.

[0113] HRMS [M]<sup>+</sup>: 701.85

Synthesis Example 14: Synthesis of Compound 91  
 (2-(3'-(9,9-diphenyl-9H-fluoren-3-yl)-[1,1'-biphenyl]-3-yl)-4,6-diphenyl-1,3,5-triazine

[0114]



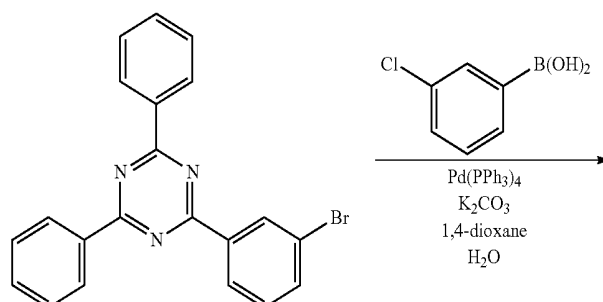
[0115] The same procedure was conducted as in Synthesis Example 11, with the exception of using (9,9-diphenyl-9H-fluoren-3-yl)boronic acid (7.9 g, 0.033 mol) instead of (9,9-dimethyl-9H-fluoren-2-yl)boronic acid used in Step 2 of Synthesis Example 11, to afford Compound 91.

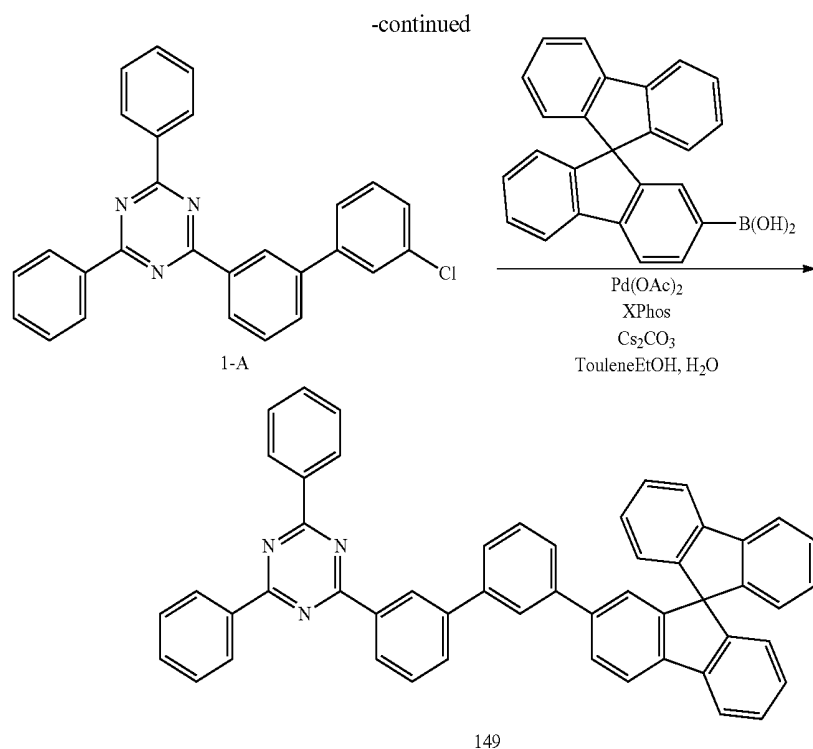
[0116] HRMS [M]<sup>+</sup>: 701.85

Synthesis Example 15: Synthesis of Compound 149

(2-[3'-(9,9-Spirobi[9H-fluorene]-2-yl)-biphenyl-3-yl]-4,6-diphenyl-[1,3,5]triazine

[0117]



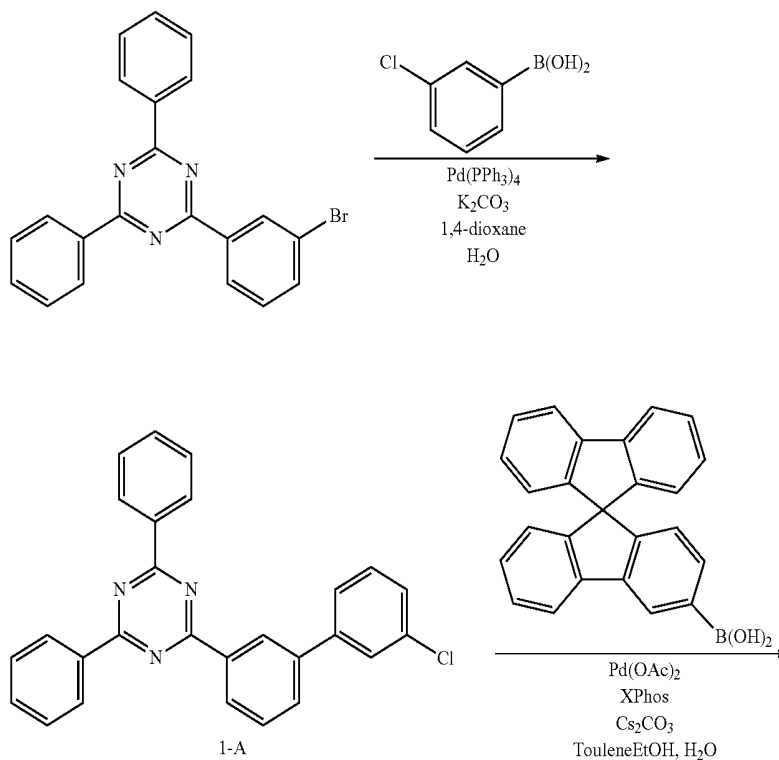


**[0118]** The same procedure was conducted as in Synthesis Example 11, with the exception of using 9,9'-Spirobi[9H-fluorene]-2-yl-boronic acid (12.77 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluorene-2-yl-boronic acid used in Step 2 of Synthesis Example 11, to afford Compound 149.

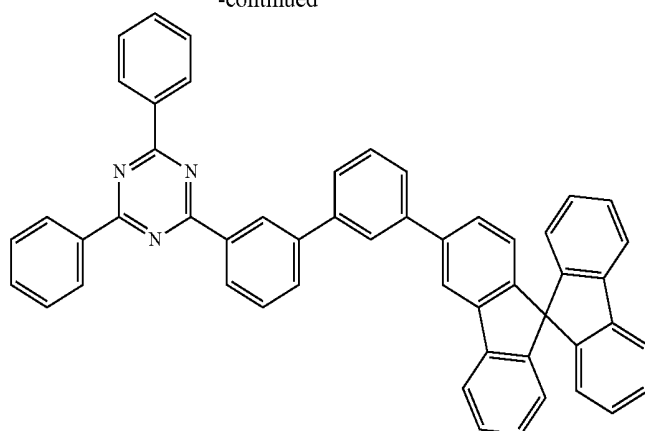
**[0119]** HRMS [M]<sup>+</sup>: 699.84

Synthesis Example 16: Synthesis of Compound 151  
(2-(3'-(9,9'-spirobi[fluoren]-3-yl)-[1,1'-biphenyl]-3-yl)-4,6-diphenyl-1,3,5-triazine

**[0120]**



-continued



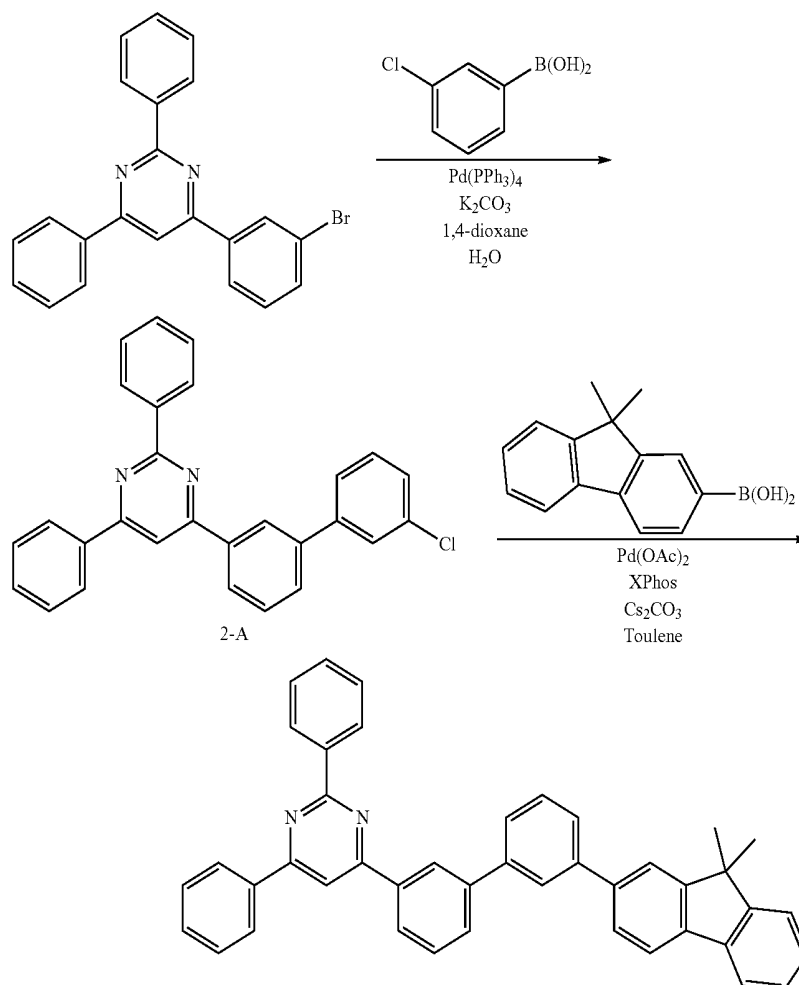
151

[0121] The same procedure was conducted as in Synthesis Example 11, with the exception of using 9,9'-spirobifluorene-3-yl-boronic acid (12.77 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluorene-2-yl-boronic acid used in Step 2 of Synthesis Example 11, to afford Compound 151.

[0122] HRMS [M]<sup>+</sup>: 699.84

Synthesis Example 17: Synthesis of Compound 31  
(4-[3'-(9,9-Dimethyl-9H-fluorene-2-yl)-biphenyl-3-yl]-2,6-diphenyl-pyrimidine)

[0123]



31

<Step 1> Synthesis of Intermediate 2-A (4-(3'-Chloro-biphenyl-3-yl)-2,6-diphenyl-pyrimidine

[0124] The same procedure was conducted as in Step 1 of Synthesis Example 11, with the exception of using 4-(3-bromophenyl)-2,6-diphenyl-pyrimidine (12.0 g, 0.031 mol) instead of 2-(3-bromophenyl)-4,6-diphenyl-[1,3,5]triazine used in Step 1 of Synthesis Example 11, to afford Intermediate 2-A.

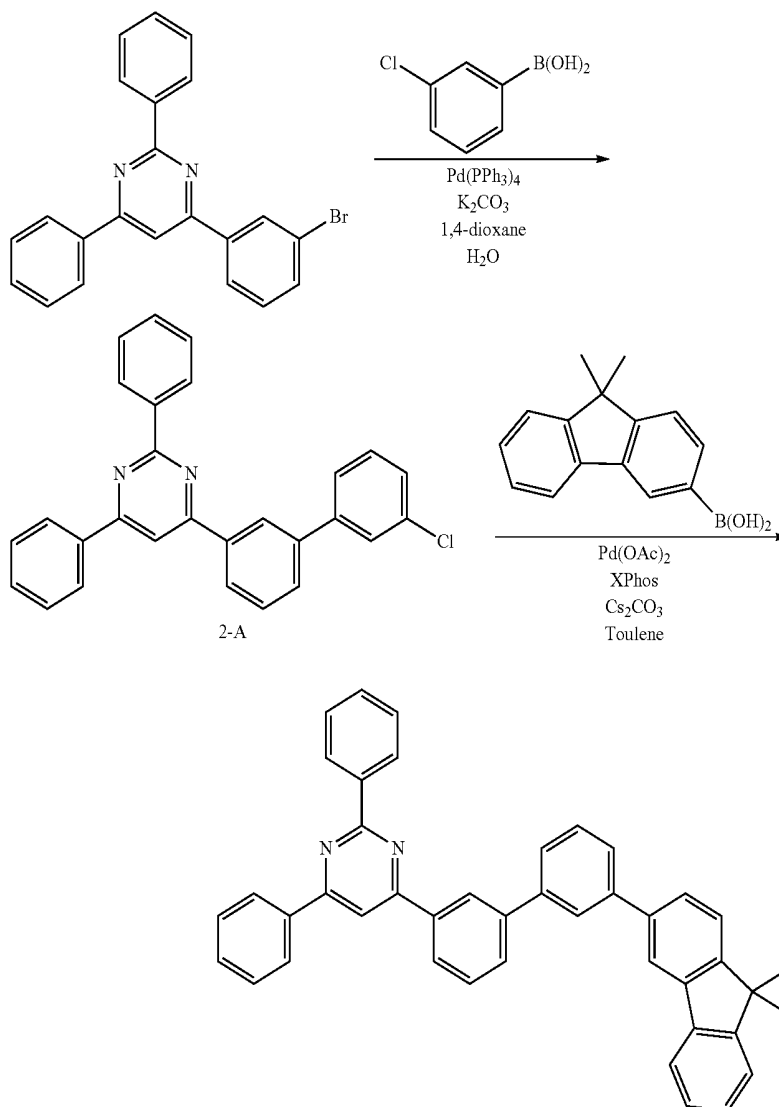
<Step 2> Synthesis of Compound 31 4-[3'-(9,9-Dimethyl-9H-fluoren-2-yl)-biphenyl-3-yl]-2,6-diphenyl-pyrimidine

[0125] The same procedure was conducted as in Step 2 of Synthesis Example 11, with the exception of using Intermediate 2-A (11.0 g, 0.026 mol) synthesized in Step 1 instead of Intermediate 1-A used in Step 2 of Synthesis Example 11, to afford Compound 31.

[0126] HRMS [M]<sup>+</sup>: 576.73

Synthesis Example 18: Synthesis of Compound 35 (4-[3'-(9,9-Dimethyl-9H-fluoren-3-yl)-biphenyl-3-yl]-2,6-diphenyl-pyrimidine

[0127]



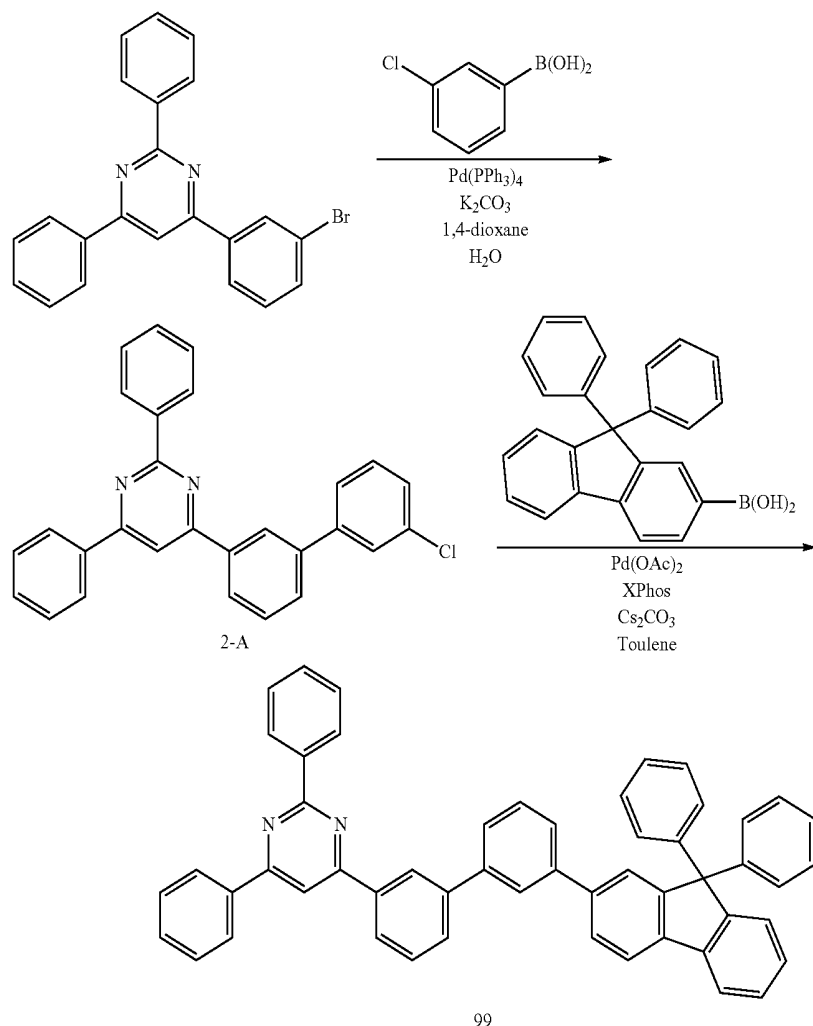
35

[0128] The same procedure was conducted as in Synthesis Example 17, with the exception of using 9,9-dimethyl-9H-fluoren-3-yl-boronic acid (7.9 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluoren-2-yl-boronic acid used in Step 2 of Synthesis Example 17, to afford Compound 35.

[0129] HRMS [M]<sup>+</sup>: 576.73

Synthesis Example 19: Synthesis of Compound 99  
 (4-[3'-(9,9-Diphenyl-9H-fluoren-2-yl)-biphenyl-3-yl]-2,6-diphenyl-pyrimidine

[0130]

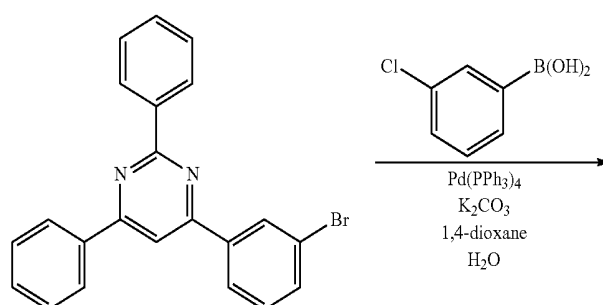


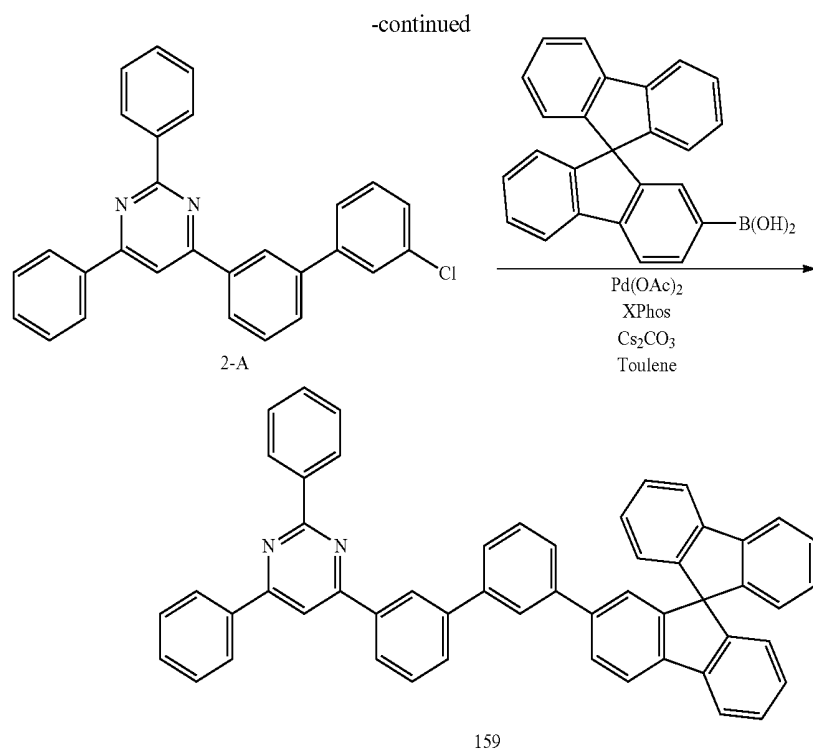
[0131] The same procedure was conducted as in Synthesis Example 17, with the exception of using (9,9-diphenyl-9H-fluoren-2-yl)-boronic acid (11.9 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluoren-2-yl-boronic acid used in Step 2 of Synthesis Example 17, to afford Compound 99.

[0132] HRMS [M]<sup>+</sup>: 687.85

Synthesis Example 20: Synthesis of Compound 159  
 (4-[3'-(9,9-Spirobi[9H-fluorene]-2-yl)-biphenyl-3-yl]-2,6-diphenyl-pyrimidine

[0133]



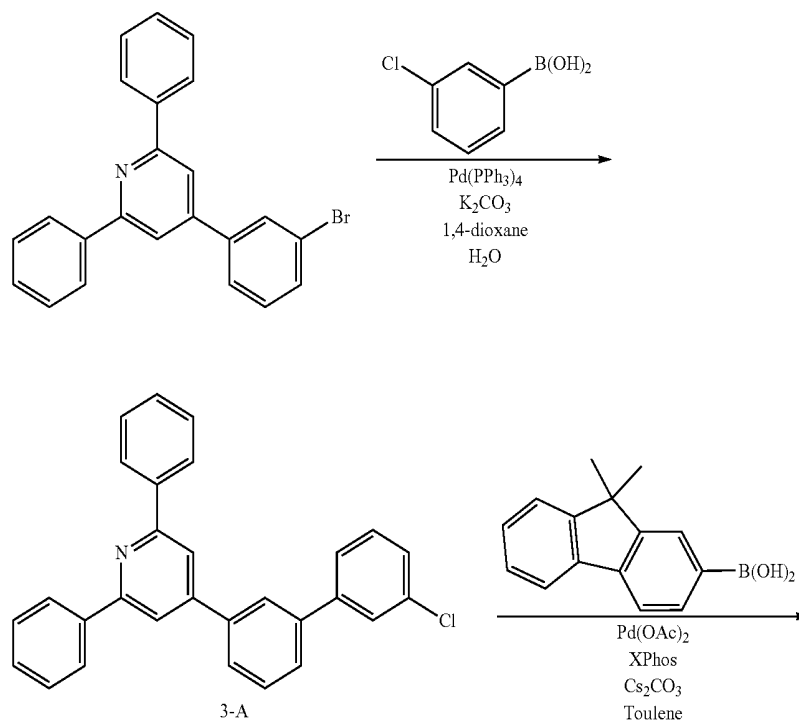


**[0134]** The same procedure was conducted as in Synthesis Example 17, with the exception of using 9,9'-spiro[9H-fluorene]-2-yl-boronic acid (11.88 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluorene-2-yl-boronic acid used in Step 2 of Synthesis Example 17, to afford Compound 159.

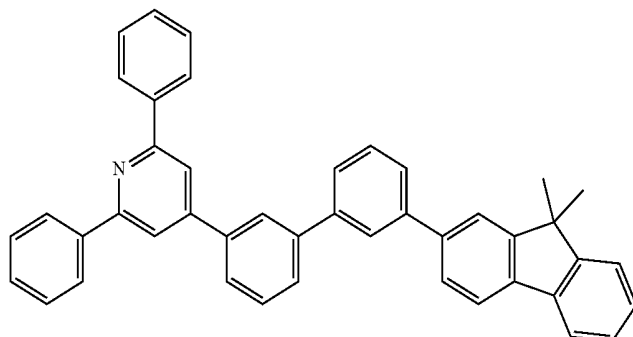
**[0135]** HRMS [M]<sup>+</sup>: 698.85

Synthesis Example 21: Synthesis of Compound 45  
(4-[3'-(9,9-Dimethyl-9H-fluorene-2-yl)-biphenyl-3-yl]-2,6-diphenyl-pyridine)

**[0136]**



-continued



45

<Step 1> Synthesis of Intermediate 3-A (4-(3'-Chloro-biphenyl-3-yl)-2,6-diphenyl-pyridine

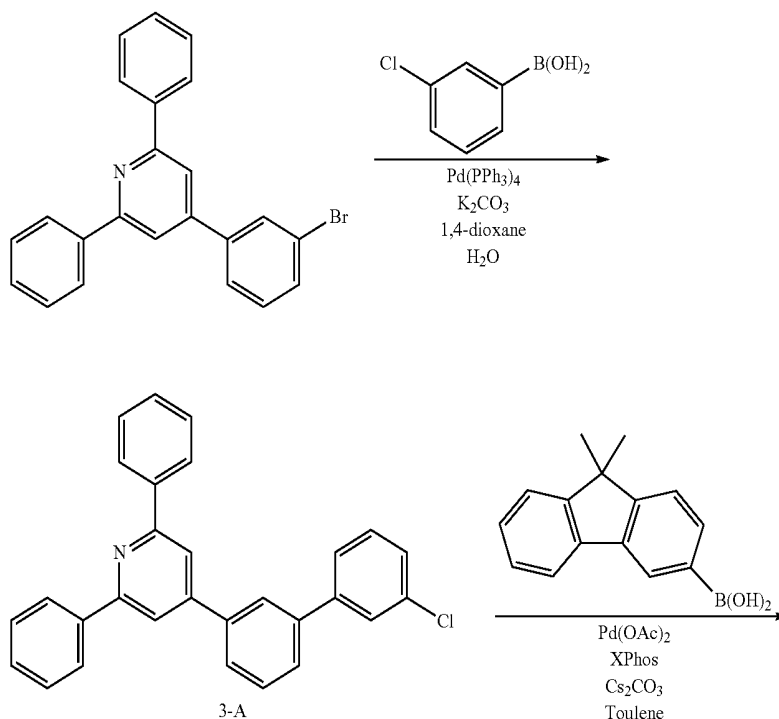
[0137] The same procedure was conducted as in Step 1 of Synthesis Example 11, with the exception of using 4-(3-bromophenyl)-2,6-diphenyl-pyridine (12.0 g, 0.031 mol) instead of 2-(3-bromophenyl)-4,6-diphenyl-[1,3,5]triazine used in Step 1 of Synthesis Example 11, to afford Intermediate 3-A.

<Step 2> Synthesis of Compound 45 (4-[3'-(9,9-Dimethyl-9H-fluoren-2-yl)-biphenyl-3-yl]-2,6-diphenyl-pyridine

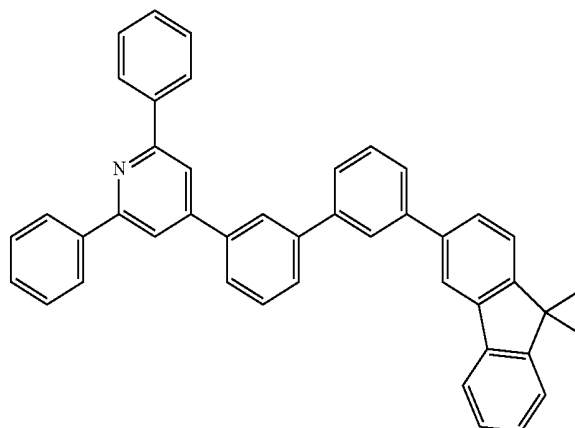
[0138] The same procedure was conducted as in Step 2 of Synthesis Example 11, with the exception of using Intermediate 3-A (11.0 g, 0.026 mol) synthesized in Step 1 instead of Intermediate 1-A used in Step 2 of Synthesis Example 11, to afford Compound 45.

Synthesis Example 22: Synthesis of Compound 53 (4-[3'-(9,9-Dimethyl-9H-fluoren-3-yl)-biphenyl-3-yl]-2,6-diphenyl-pyridine

[0139]



-continued



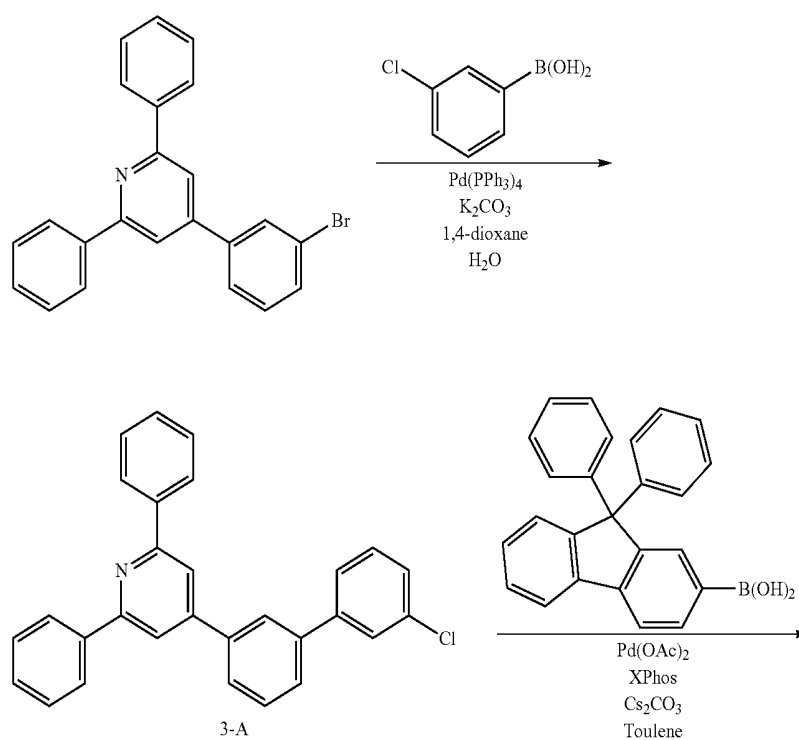
53

[0140] The same procedure was conducted as in Synthesis Example 21, with the exception of using 9,9-dimethyl-9H-fluoren-3-yl-acid (7.9 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluoren-2-yl-boronic acid used in Step 2 of Synthesis Example 21, to afford Compound 53.

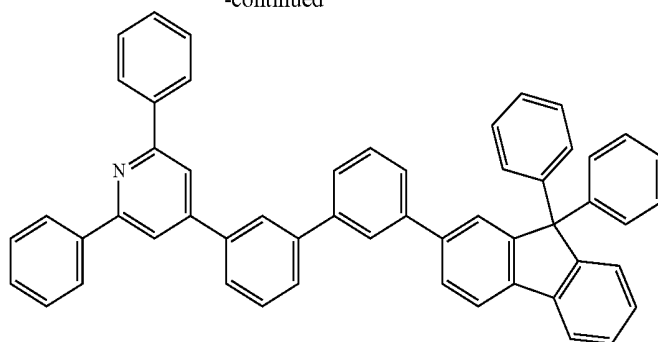
[0141] HRMS [M]<sup>+</sup>: 501.62

Synthesis Example 23: Synthesis of Compound 113  
(4-[3'-(9,9-Diphenyl-9H-fluoren-2-yl)-biphenyl-3-yl]-2,6-diphenyl-pyridine)

[0142]



-continued



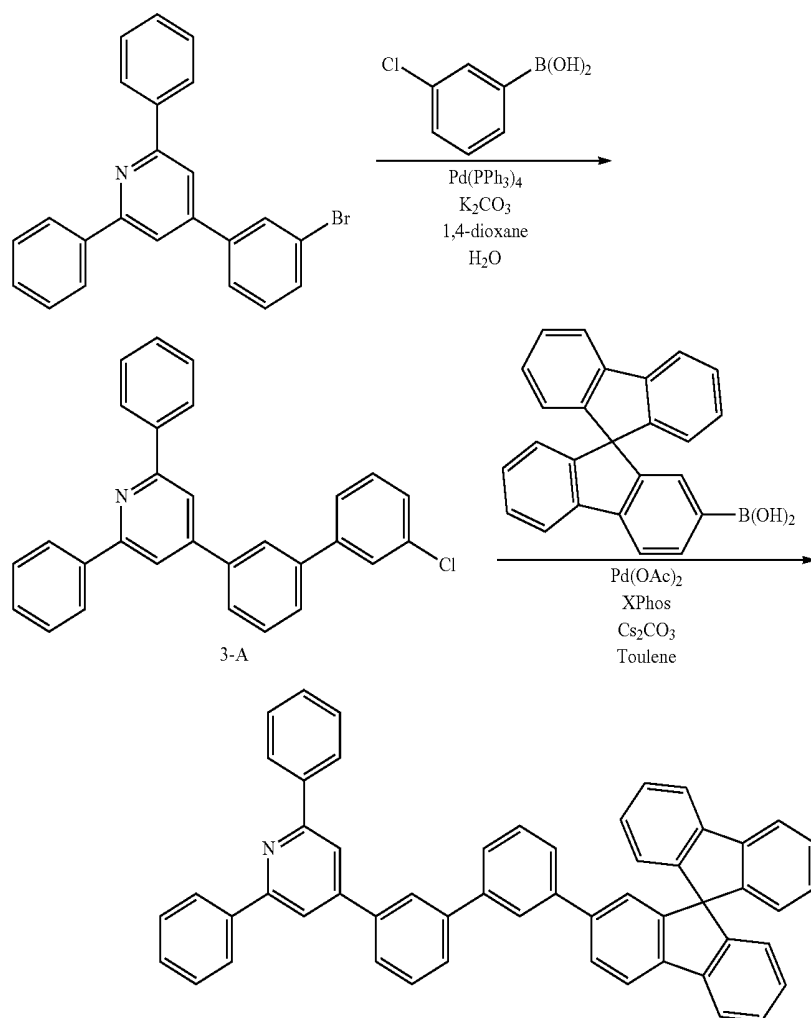
113

[0143] The same procedure was conducted as in Synthesis Example 21, with the exception of using (9,9-diphenyl-9H-fluorene-2-yl)-boronic acid (11.9 g, 0.033 mol) instead of 9,9-Dimethyl-9H-fluorene-2-yl-boronic acid used in Step 2 of Synthesis Example 21, to afford Compound 113.

[0144] HRMS [M]<sup>+</sup>: 699.88

Synthesis Example 24: Synthesis of Compound 173  
(4-[3'-(9,9-Spirobi[9H-fluorene]-2-yl)-biphenyl-3-yl]-2,6-diphenyl-pyridine)

[0145]



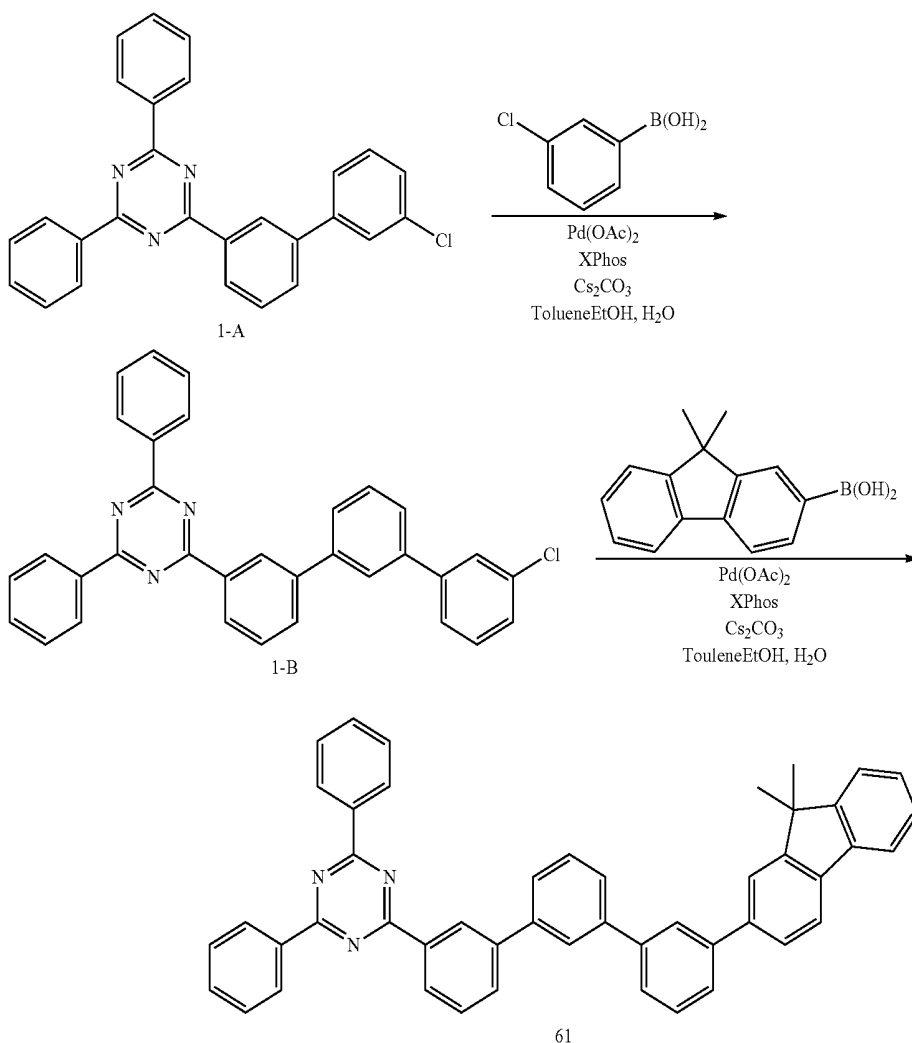
173

[0146] The same procedure was conducted as in Synthesis Example 21, with the exception of using 9,9'-spirobi[9H-fluorene]-2-acid (11.88 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluorene-2-yl-boronic acid used in Step 2 of Synthesis Example 21, to afford Compound 173.

[0147] HRMS [M]<sup>+</sup>: 697.86

Synthesis Example 25: Synthesis of Compound 61  
(2-(3''-(9,9-dimethyl-9H-fluorene-2-yl)-[1,1':3',1''-terphenyl]-3-yl)-4,6-diphenyl-1,3,5-triazine)

[0148]



<Step 1> Synthesis of Intermediate 1-B (2-(3''-chloro-[1,1':3',1''-terphenyl]-3-yl)-4,6-diphenyl-1,3,5-triazine)

[0149] Under a nitrogen stream, Intermediate 1-A (11.0 g, 0.026 mol), 3-Chlorophenylboronic acid (4.8 g, 0.031 mol), Pd(OAc)<sub>2</sub> (0.29 g, 0.001 mol), Cesium carbonate (25.4 g, 0.078 mol), and Xphos (0.3 g, 0.003 mol) were mixed and then stirred under reflux with toluene (100 ml)/ethanol (20 ml)/H<sub>2</sub>O (20 ml).

[0150] After completion of the reaction, an organic layer was separated with methylene chloride and dried over

MgSO<sub>4</sub>. The solvent was removed from the dehydrated organic layer, followed by purification through column chromatography [hexane:MC=5:1 (v/v)] to afford Intermediate 1-B (7.5 g, yield 58%).

<Step 2> Synthesis of Compound 61 (2-(3''-(9,9-dimethyl-9H-fluorene-2-yl)-[1,1':3',1''-terphenyl]-3-yl)-4,6-diphenyl-1,3,5-triazine)

[0151] Under a nitrogen stream, Intermediate 1-B (7.5 g, 0.015 mol) obtained in Step 1, 9,9-dimethyl-9H-fluorene-2-yl-boronic acid (4.3 g, 0.018 mol), Pd(OAc)<sub>2</sub> (0.17 g, 0.75

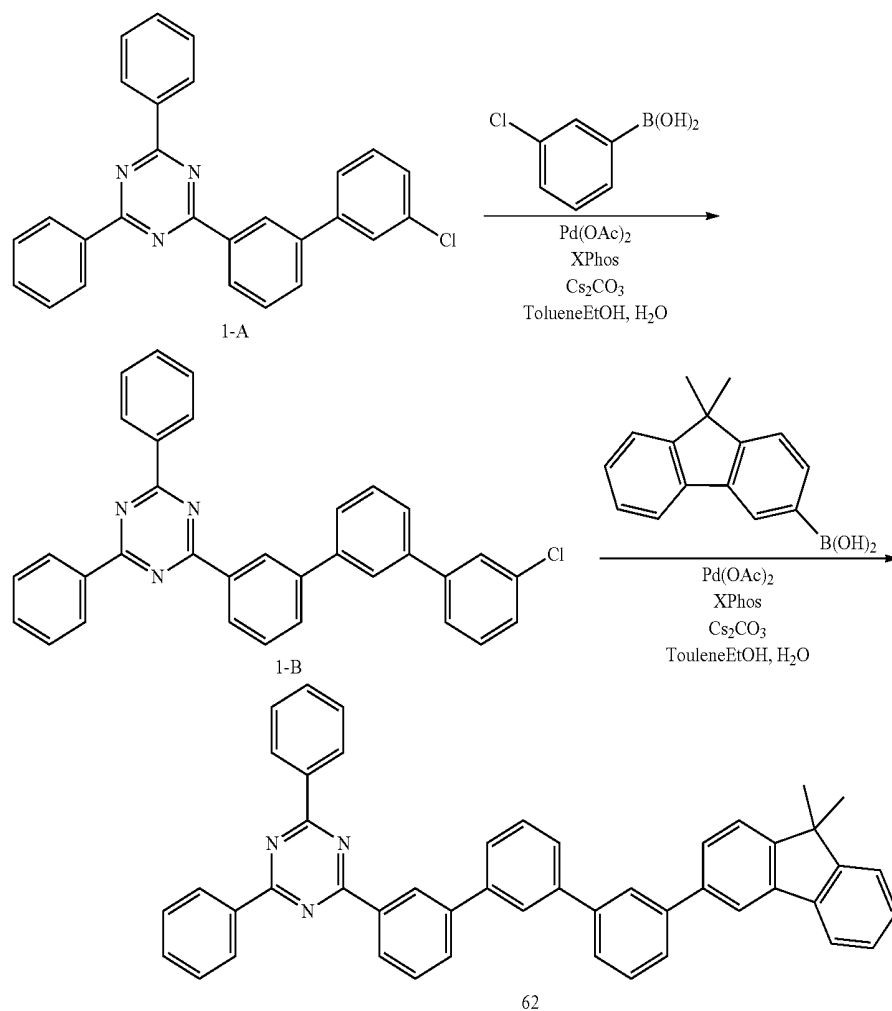
mmol), cesium carbonate (14.6 g, 0.045 mol), and Xphos (0.7 g, 1.5 mmol) were mixed and stirred under reflux with toluene (60 ml)/ethanol (15 ml)/H<sub>2</sub>O (15 ml).

[0152] After completion of the reaction, an organic layer was separated with methylene chloride and dried over MgSO<sub>4</sub>. The solvent was removed from the dehydrated organic layer, followed by purification through column chromatography [hexane:MC=4:1 (v/v)] to afford Compound 61 (8.1 g, yield 83%).

[0153] HRMS [M]<sup>+</sup>: 653.83

Synthesis Example 26: Synthesis of Compound 62  
 (2-(3''-(9,9-dimethyl-9H-fluoren-3-yl)-[1,1':3',1''-terphenyl]-3-yl)-4,6-diphenyl-1,3,5-triazine

[0154]

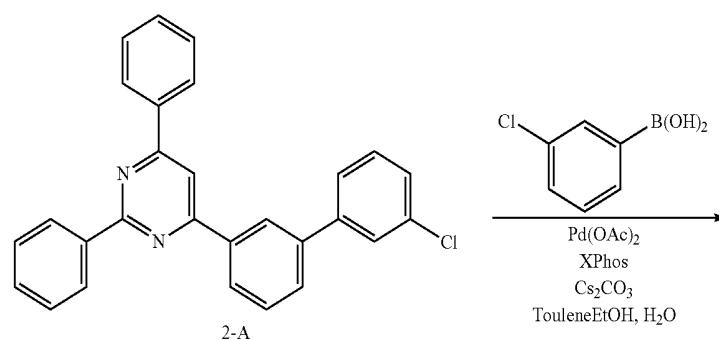


[0155] The same procedure was conducted as in Synthesis Example 25, with the exception of using (9,9-dimethyl-9H-fluoren-3-yl)boronic acid (4.3 g, 0.018 mol) instead of 9,9-dimethyl-9H-fluoren-2-yl-boronic acid used in Step 2 of Synthesis Example 25, to afford Compound 62.

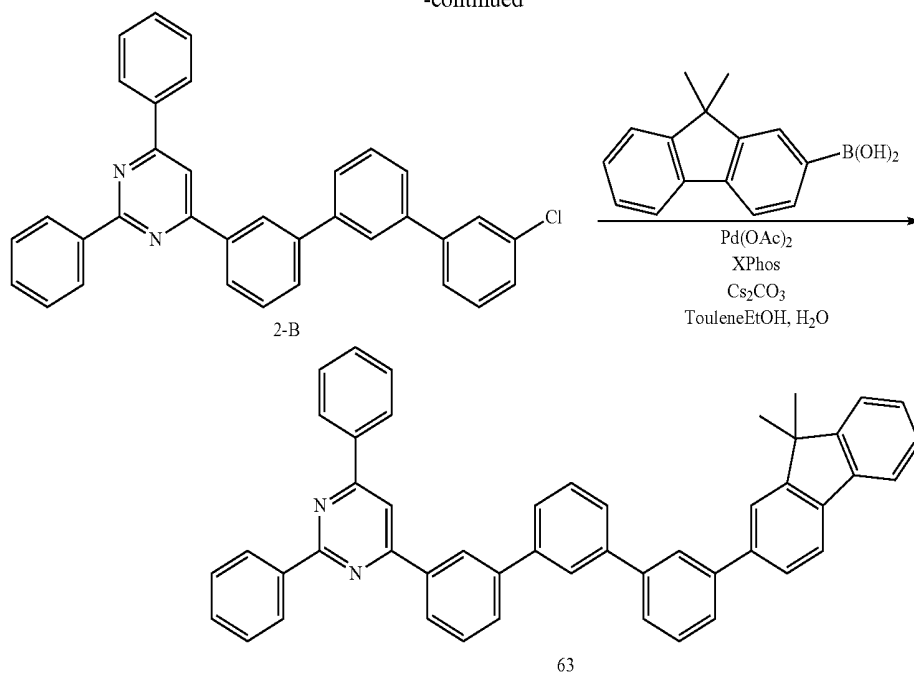
[0156] HRMS [M]<sup>+</sup>: 653.83

Synthesis Example 27: Synthesis of Compound 63  
 (4-(3''-(9,9-dimethyl-9H-fluoren-2-yl)-[1,1':3',1''-terphenyl]-3-yl)-2,6-diphenylpyrimidine

[0157]



-continued



<Step 1> Synthesis of Intermediate 2-B (4-(3''-chloro-[1,1':3',1''-terphenyl]-3-yl)-2,6-diphenylpyrimidine

**[0158]** Under a nitrogen stream, Intermediate 2-A (11.0 g, 0.026 mol), 3-chlorophenylboronic acid (4.8 g, 0.031 mol), Pd(OAc)<sub>2</sub> (0.29 g, 0.001 mol), Cesium carbonate (25.4 g, 0.078 mol), and Xphos (0.3 g, 0.003 mol) were mixed and then stirred under reflux with toluene (100 ml)/ethanol (20 ml)/H<sub>2</sub>O (20 ml).

**[0159]** After completion of the reaction, an organic layer was separated with methylene chloride and then dried over MgSO<sub>4</sub>. The solvent was removed from the dehydrated organic layer, followed by purification through column chromatography [hexane:MC=5:1 (v/v)] to afford Intermediate 2-B (7.5 g, yield 58%).

<Step 2> Synthesis of Compound 63 (4-(3''-(9,9-dimethyl-9H-fluoren-2-yl)-[1,1':3',1''-terphenyl]-3-yl)-2,6-diphenylpyrimidine

**[0160]** Under a nitrogen stream, Intermediate 2-B (7.5 g, 0.015 mol), 9,9-dimethyl-9H-fluoren-2-yl-boronic acid (4.3

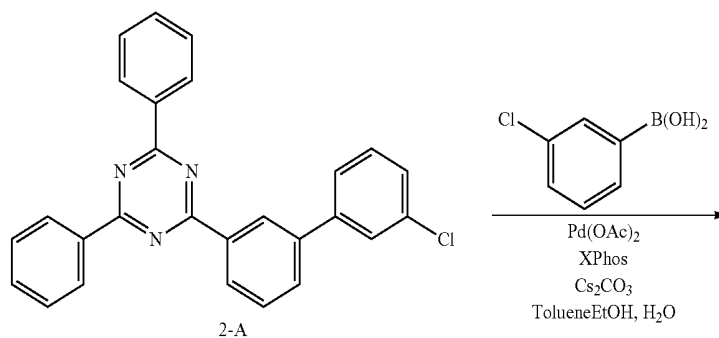
g, 0.018 mol) obtained in Step 1, Pd(OAc)<sub>2</sub> (0.17 g, 0.75 mmol), cesium carbonate (14.6 g, 0.045 mol), and Xphos (0.7 g, 1.5 mmol) were mixed and then mixed and then stirred under reflux with toluene (60 ml)/Ethanol (15 ml)/H<sub>2</sub>O (15 ml).

**[0161]** After completion of the reaction, an organic layer was separated with methylene chloride and then dried over MgSO<sub>4</sub>. The solvent was removed from the dehydrated organic layer, followed by purification through column chromatography [hexane:MC=4:1 (v/v)] to afford Compound 63 (8.1 g, yield 83%).

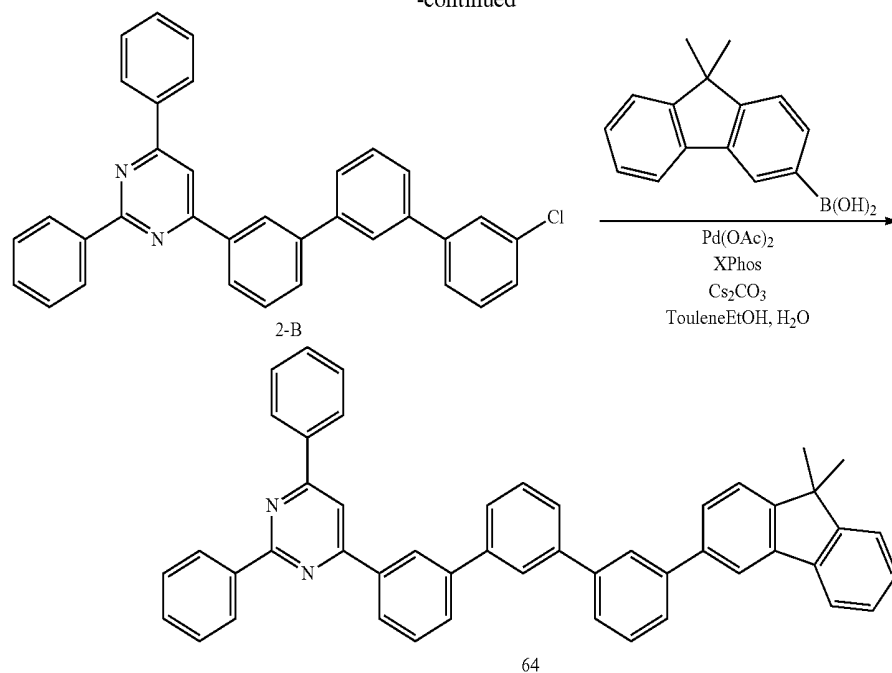
**[0162]** HRMS [M]<sup>+</sup>: 652.84

Synthesis Example 28: Synthesis of Compound 64 (4-(3''-(9,9-dimethyl-9H-fluoren-3-yl)-[1,1':3',1''-terphenyl]-3-yl)-2,6-diphenylpyrimidine

**[0163]**



-continued

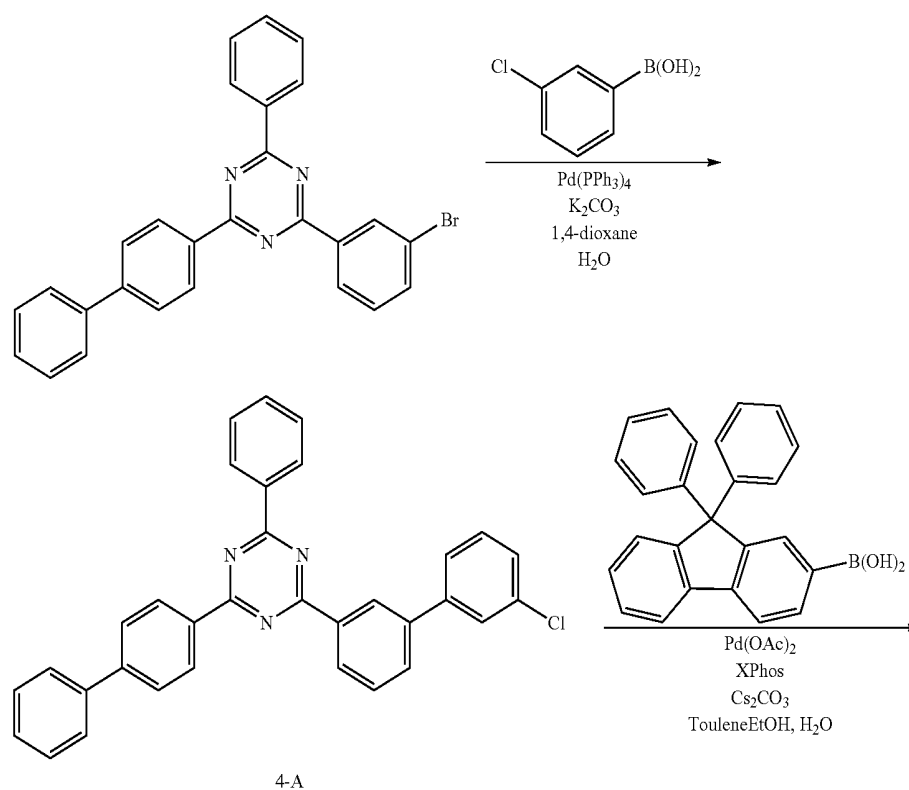


**[0164]** The same procedure was conducted as in Synthesis Example 27, with the exception of using (9,9-dimethyl-9H-fluoren-3-yl)boronic acid (4.3 g, 0.018 mol) instead of 9,9-dimethyl-9H-fluoren-2-yl-boronic acid used in Step 2 of Synthesis Example 27, to afford Compound 64.

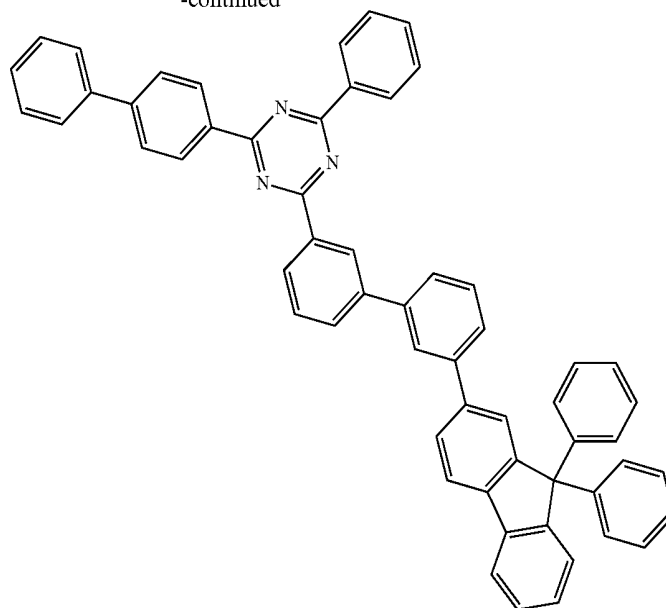
**[0165]** HRMS  $[M]^+$ : 652.84

Synthesis Example 29: Synthesis of Compound 200  
 (2,2-([1,1'-biphenyl]-4-yl)-4-(3'-(9,9-diphenyl-9H-fluoren-2-yl)-[1,1'-biphenyl]-3-yl)-6-phenyl-1,3,5-triazine)

**[0166]**



-continued



200

## &lt;Step 1&gt; Synthesis of Intermediate 4-A

**[0167]** The same procedure was conducted as in Step 1 of Synthesis Example 11, with the exception of using 2-([1,1'-biphenyl]-4-yl)-4-(3-bromophenyl)-6-phenyl-1,3,5-triazine (14.4 g, 0.031 mol) instead of 2-(3-bromophenyl)-4,6-diphenyl-1,3,5-triazine used in Step 1 of Synthesis Example 11, to afford Intermediate 4-A.

## &lt;Step 2&gt; Synthesis of Compound 200 (2 2-([1,1'-biphenyl]-4-yl)-4-(3'-(9,9-diphenyl-9H-fluoren-2-yl)-[1,1'-biphenyl]-3-yl)-6-phenyl-1,3,5-triazine

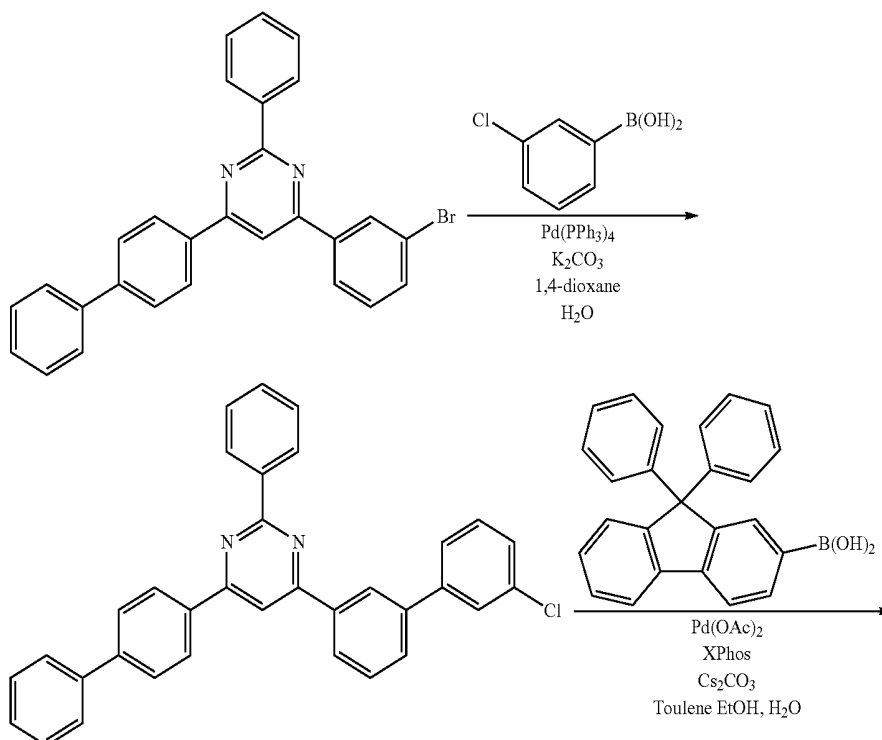
**[0168]** The same procedure was conducted as in Step 2 of Synthesis Example 11, with the exception of using (9,9-

diphenyl-9H-fluoren-2-yl)-boronic acid (11.9 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluoren-2-yl-boronic acid used in Step 2 of Synthesis Example 11, to afford Compound 200.

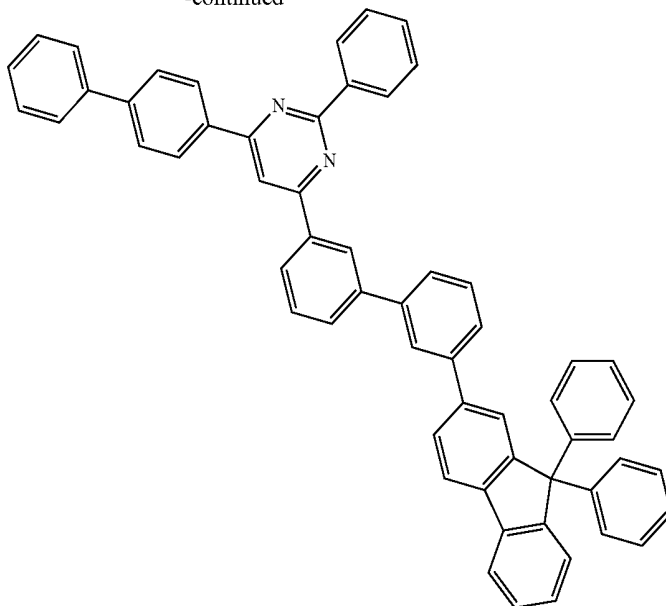
**[0169]** HRMS [M]<sup>+</sup>: 777.97

## Synthesis Example 30: Synthesis of Compound 206 (4-([1,1'-biphenyl]-4-yl)-6-(3'-(9,9-diphenyl-9H-fluoren-2-yl)-[1,1'-biphenyl]-3-yl)-2-phenylpyrimidine

**[0170]**



-continued



206

## &lt;Step 1&gt; Synthesis of Intermediate 5-A

**[0171]** The same procedure was conducted as in Step 1 of Synthesis Example 11, with the exception of using 4-([1,1'-biphenyl]-4-yl)-6-(3-bromophenyl)-2-phenylpyrimidine (14.3 g, 0.031 mol) instead of 2-(3-bromophenyl)-4,6-diphenyl-1,3,5-triazine used in Step 1 of Synthesis Example 11, to afford Intermediate 5-A.

## &lt;Step 2&gt; Synthesis of Compound 206 (4-([1,1'-biphenyl]-4-yl)-6-(3'-(9,9-diphenyl-9H-fluoren-2-yl)-[1,1'-biphenyl]-3-yl)-2-phenylpyrimidine

**[0172]** The same procedure was conducted as in Step 2 of Synthesis Example 11, with the exception of using (9,9-

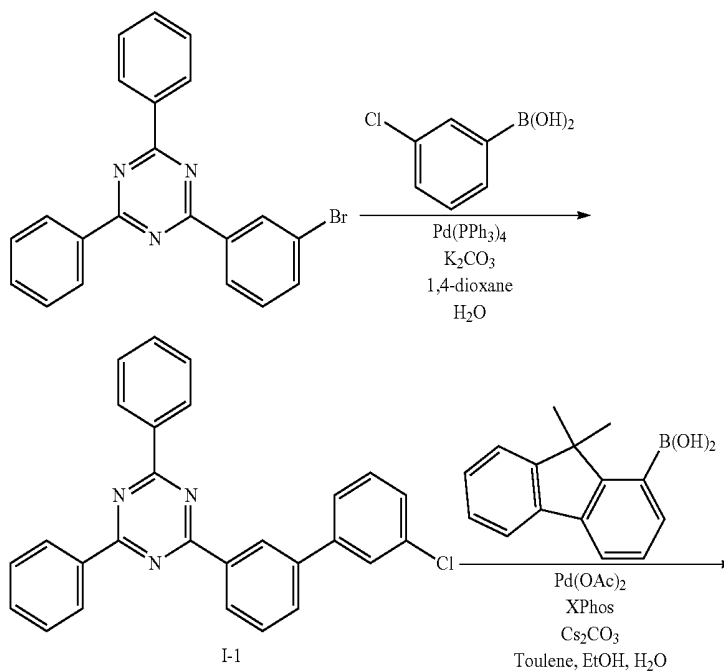
diphenyl-9H-fluoren-2-yl)-boronic acid (11.9 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluoren-2-yl-boronic acid used in Step 2 of Synthesis Example 11, to afford Compound 206.

**[0173]** HRMS [M]<sup>+</sup>: 776.98

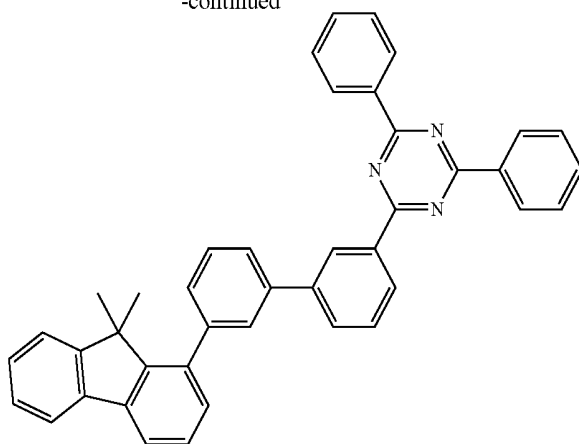
## Synthesis Example 31: Synthesis of Compound 217

(2-(3'-(9,9-dimethyl-9H-fluoren-1-yl)-[1,1'-biphenyl]-3-yl)-4,6-diphenyl-1,3,5-triazine

**[0174]**



-continued



217

<Step 1> Intermediate I-1 (2-(3'-chloro-biphenyl-3-yl)-4,6-diphenyl-1,3,5-triazine

**[0175]** Under a nitrogen stream, 2-(3-Bromo-phenyl)-4,6-diphenyl-[1,3,5]triazine (12.0 g, 0.031 mol), 3-Chlorophenylboronic acid (6.3 g, 0.040 mol), Pd(PPh<sub>3</sub>)<sub>4</sub> (1.15 g, 0.001 mol) and potassium carbonate (12.85 g, 0.093 mol) were mixed and then stirred under reflux with, 1,4-dioxane (100 ml) and H<sub>2</sub>O (25 ml).

**[0176]** After completion of the reaction, an organic layer was separated with methylene chloride and then dried over MgSO<sub>4</sub>. The solvent was removed from the dehydrated organic layer, followed by purification through column chromatography [hexane:MC=5:1 (v/v)] to afford Intermediate I-1 (11.0 g, yield 83%).

<Step 2> Synthesis of Compound 217 (2-(3'(9,9-dimethyl-9H-fluoren-1-yl)-[1,1'-biphenyl]-3-yl)-4,6-diphenyl-1,3,5-triazine

**[0177]** Under a nitrogen stream, Intermediate I-1 (11.0 g, 0.026 mol) obtained in Step 1, (9,9-dimethyl-9H-fluoren-1-

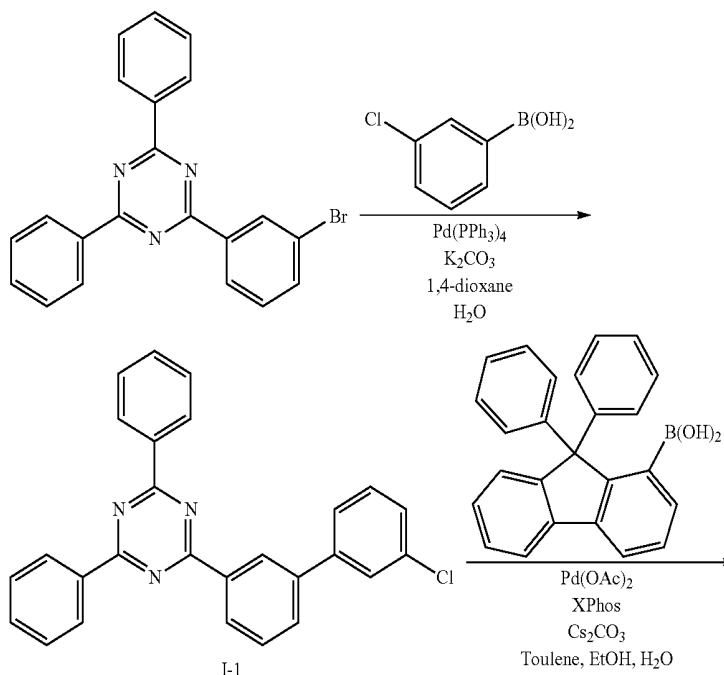
yl)boronic acid (7.9 g, 0.033 mol), Pd(OAc)<sub>2</sub> (0.29 g, 0.001 mol), Cesium carbonate (25.4 g, 0.078 mol), and Xphos (1.23 g, 0.003 mol) were mixed and then stirred under reflux with toluene (100 ml), ethanol (20 ml) and H<sub>2</sub>O (20 ml).

**[0178]** After completion of the reaction, an organic layer was separated with methylene chloride and then dried over MgSO<sub>4</sub>. The solvent was removed from the dehydrated organic layer, followed by purification through column chromatography [hexane:MC=5:1 (v/v)] to afford Compound 217 (8.2 g, yield 63%).

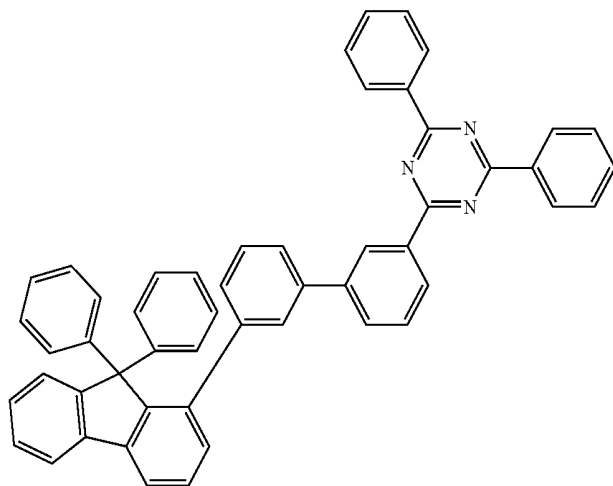
**[0179]** HRMS [M]<sup>+</sup>: 577.25

Synthesis Example 32: Synthesis of Compound 218 (2-(3'(9,9-diphenyl-9H-fluoren-1-yl)-[1,1'-biphenyl]-3-yl)-4,6-diphenyl-1,3,5-triazine

**[0180]**



-continued



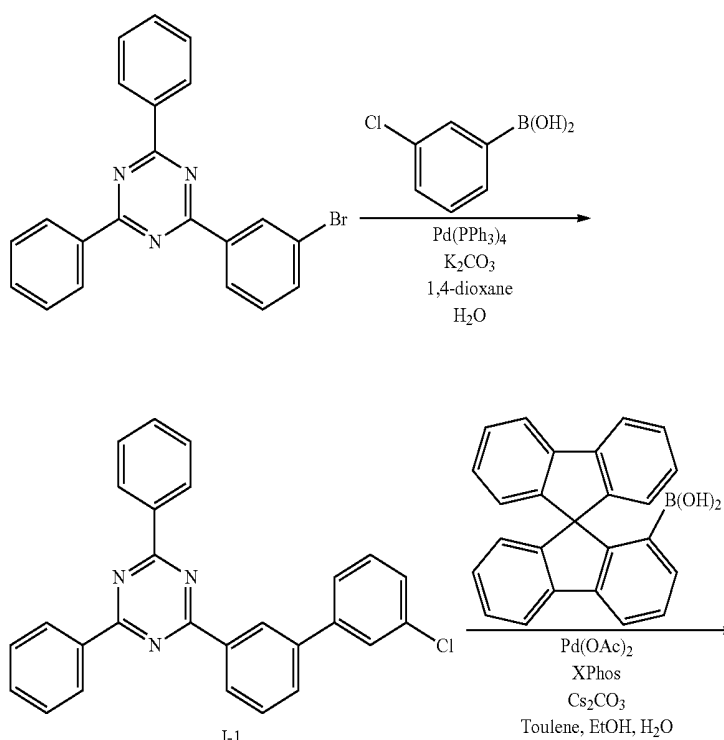
218

[0181] The same procedure was conducted as in Synthesis Example 31, with the exception of using (9,9-diphenyl-9H-fluoren-1-yl)boronic acid (12.0 g, 0.033 mol) instead of (9,9-dimethyl-9H-fluoren-1-yl)boronic acid used in Step 2 of Synthesis Example 31, to afford Compound 218.

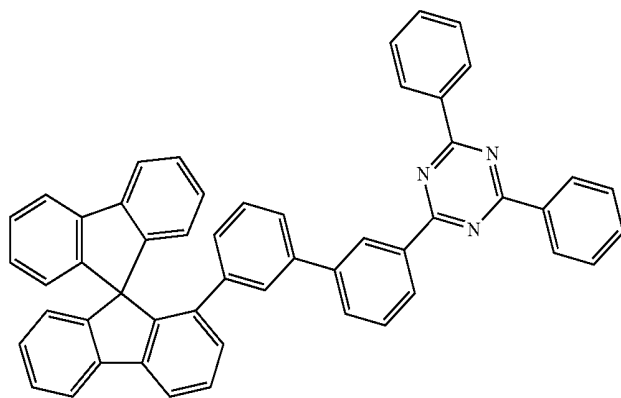
[0182] HRMS [M]<sup>+</sup>: 701.28

Synthesis Example 33: Synthesis of Compound 220  
 (2-(3'-(9,9'-spirobi[fluoren]-1-yl)-[1,1'-biphenyl]-3-yl)-4,6-diphenyl-1,3,5-triazine

[0183]



-continued



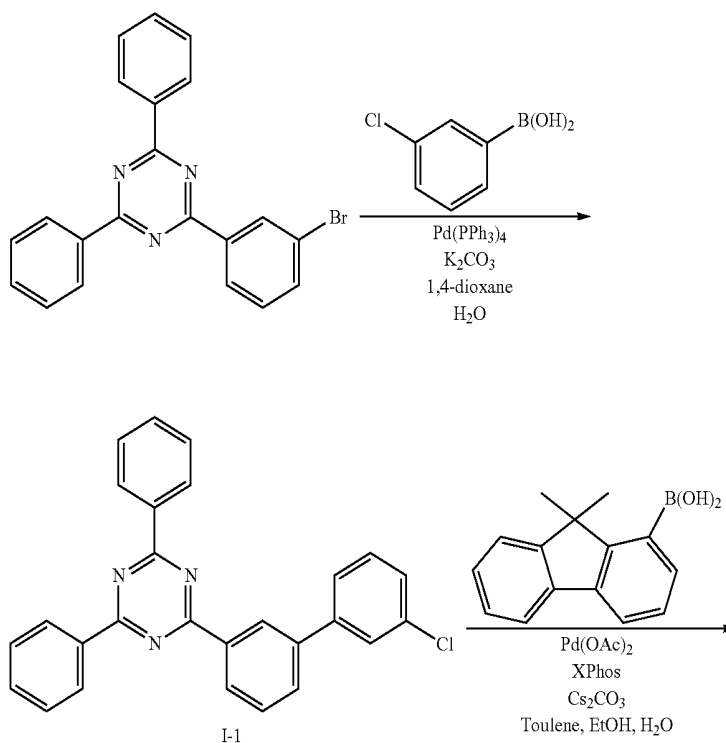
220

[0184] The same procedure was conducted as in Synthesis Example 31, with the exception of using (9,9'-spirobifluorene-1-yl)boronic acid (11.9 g, 0.033 mol) instead of (9,9-dimethyl-9H-fluorene-1-yl)boronic acid used in Step 2 of Synthesis Example 31, to afford Compound 220.

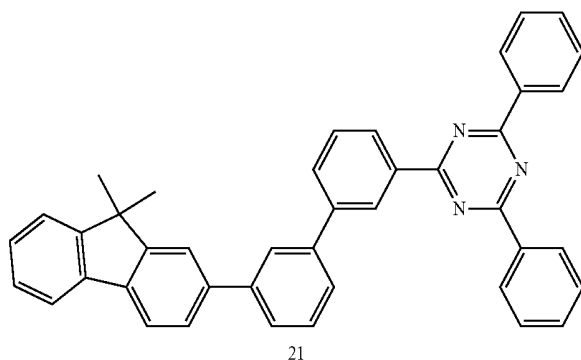
[0185] HRMS [M]<sup>+</sup>: 699.27

Synthesis Example 34: Synthesis of Compound 21  
(2-(3'-(9,9-dimethyl-9H-fluorene-2-yl)-[1,1'-biphenyl]-3-yl)-4,6-diphenyl-1,3,5-triazine)

[0186]



-continued



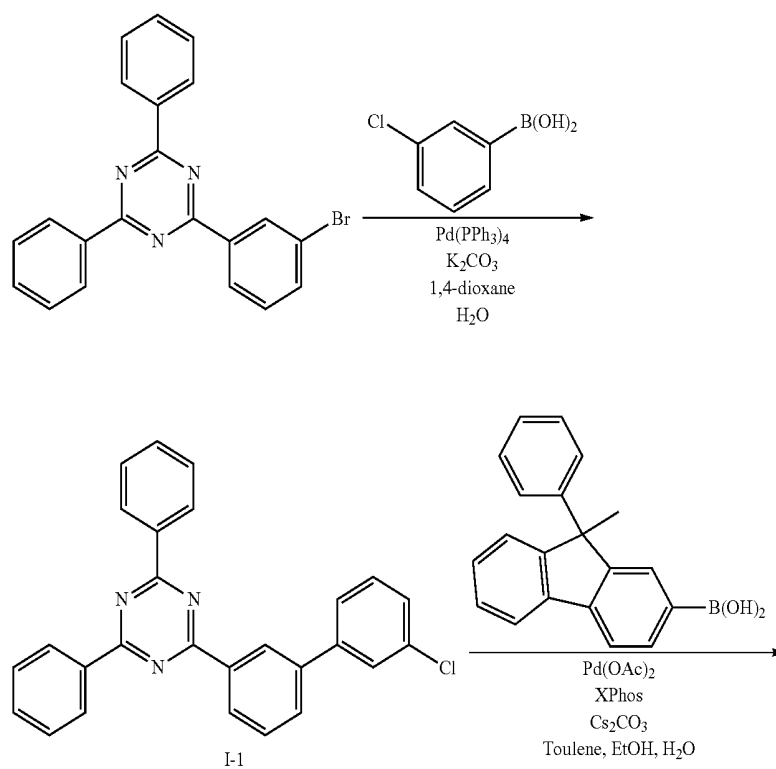
**[0187]** The same procedure was conducted as in Synthesis Example 31, with the exception of using (9,9-dimethyl-9H-fluoren-2-yl)boronic acid (7.9, 0.033 mol) instead of (9,9-dimethyl-9H-fluoren-1-yl)boronic acid used in Step 2 of Synthesis Example 31, to afford Compound 21.

**[0188]** HRMS [M]<sup>+</sup>: 577.25

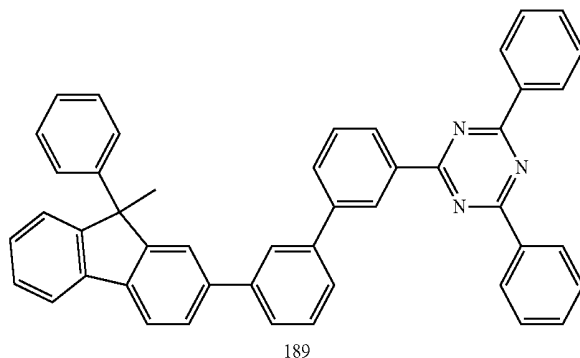
Synthesis Example 35: Synthesis of Compound 189

(2-(3'-(9-methyl-9-phenyl-9H-fluoren-2-yl)-[1,1'-biphenyl]-3-yl)-4,6-diphenyl-1,3,5-triazine

**[0189]**



-continued

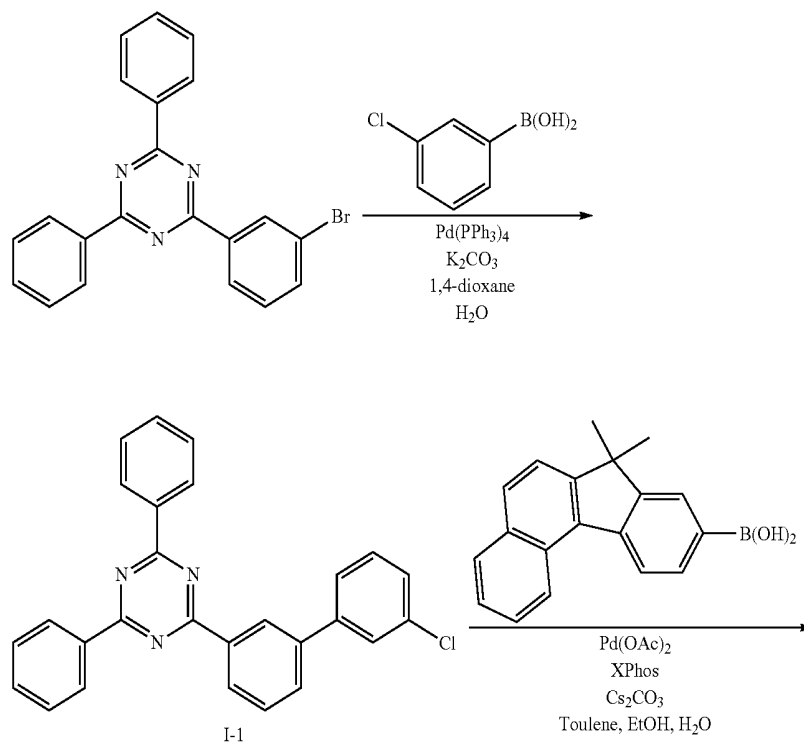


**[0190]** The same procedure was conducted as in Synthesis Example 31, with the exception of using (9-methyl-9-phenyl-9H-fluoren-2-yl)boronic acid (9.9, 0.033 mol) instead of (9,9-dimethyl-9H-fluoren-1-yl)boronic acid used in Step 2 of Synthesis Example 31, to afford Compound 189.

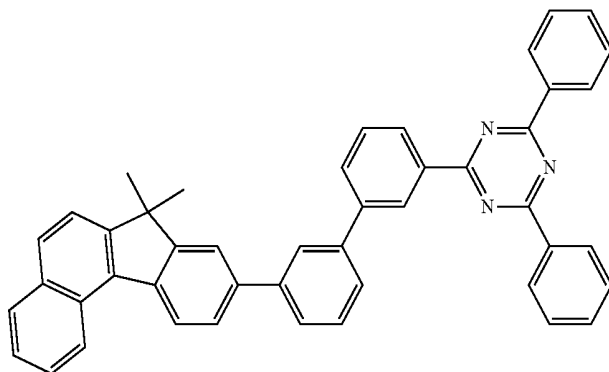
**[0191]** HRMS [M]<sup>+</sup>: 639.27

Synthesis Example 36: Synthesis of Compound 193  
(2-(3'-(7,7-dimethyl-7H-benzo[c]fluoren-9-yl)-[1,1'-biphenyl]-3-yl)-4,6-diphenyl-1,3,5-triazine

**[0192]**



-continued



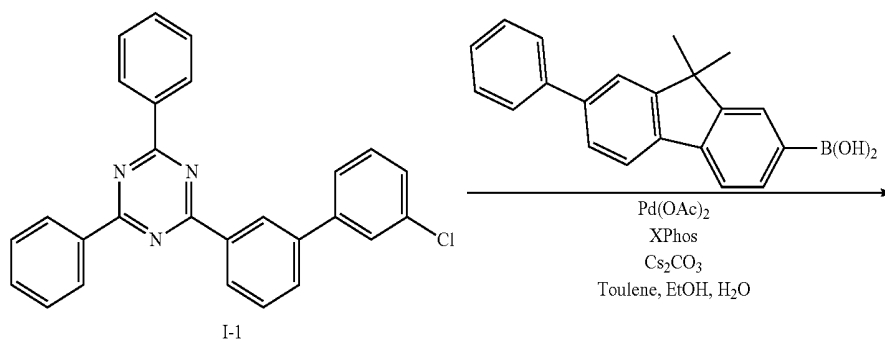
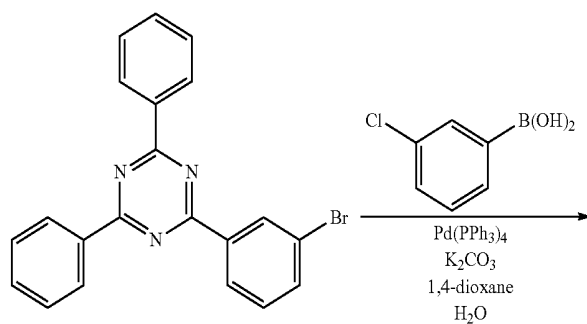
193

**[0193]** The same procedure was conducted as in Synthesis Example 31, with the exception of using (7,7-dimethyl-7H-benzo[c]fluoren-9-yl)boronic acid (9.5, 0.033 mol) instead of (9,9-dimethyl-9H-fluoren-1-yl)boronic acid used in Step 2 of Synthesis Example 31, to afford Compound 193.

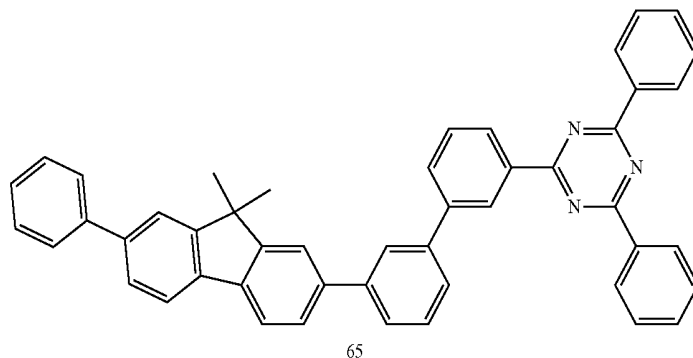
**[0194]** HRMS [M]<sup>+</sup>: 627.27

Synthesis Example 37: Synthesis of Compound 65  
(2-(3'-(9,9-dimethyl-7-phenyl-9H-fluoren-2-yl)-[1,1'-biphenyl]-3-yl)-4,6-diphenyl-1,3,5-triazine

**[0195]**



-continued

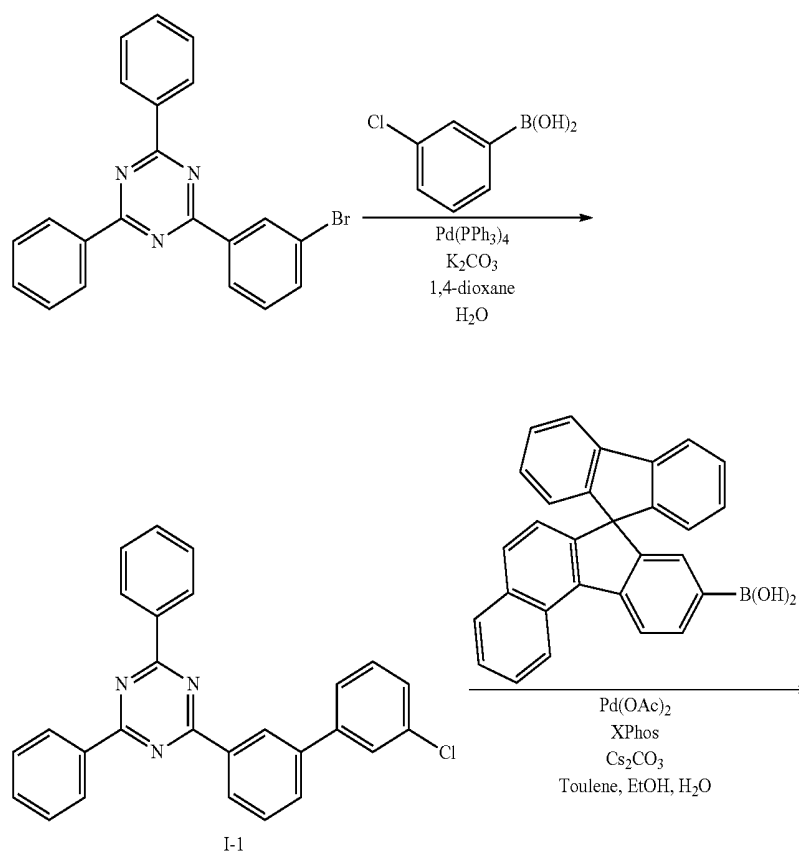


**[0196]** The same procedure was conducted as in Synthesis Example 31, with the exception of using (9,9-dimethyl-7-phenyl-9H-fluorene-2-yl)boronic acid (10.4 g, 0.033 mol) instead of (9,9-dimethyl-9H-fluorene-1-yl)boronic acid used in Step 2 of Synthesis Example 31, to afford Compound 65.

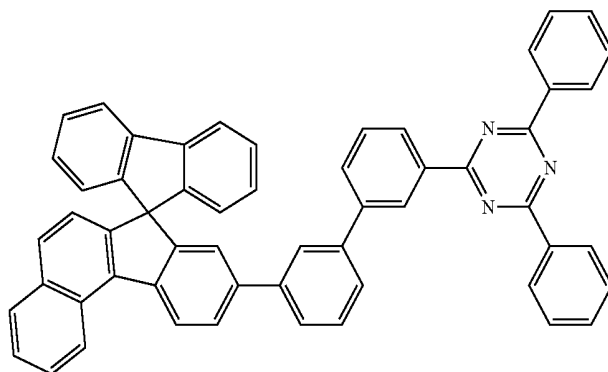
**[0197]** HRMS [M]<sup>+</sup>: 653.28

**Synthesis Example 38: Synthesis of Compound 231**  
(2,4-diphenyl-6-(3'-(spiro[benzo[c]fluorene-7,9'-fluorene]-9-yl)-[1,1'-biphenyl]-3-yl)-1,3,5-triazine

**[0198]**



-continued



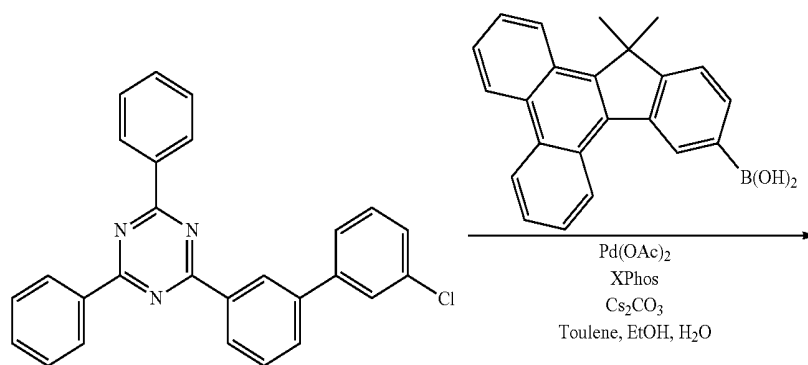
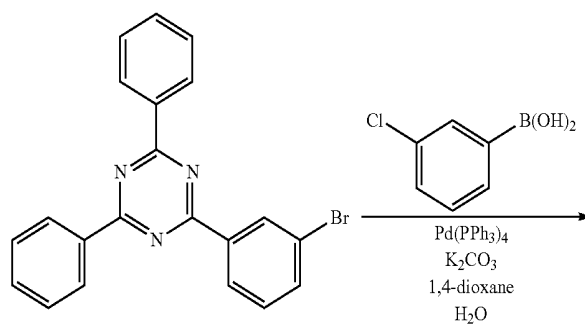
231

[0199] The same procedure was conducted as in Synthesis Example 31, with the exception of using (spiro[benzo[c]fluorene-7,9'-fluorene]-9-yl)boronic acid (13.5 g, 0.033 mol) instead of (9,9-dimethyl-9H-fluorene-1-yl)boronic acid used in Step 2 of Synthesis Example 31, to afford Compound 231.

[0200] HRMS [M]<sup>+</sup>: 749.28

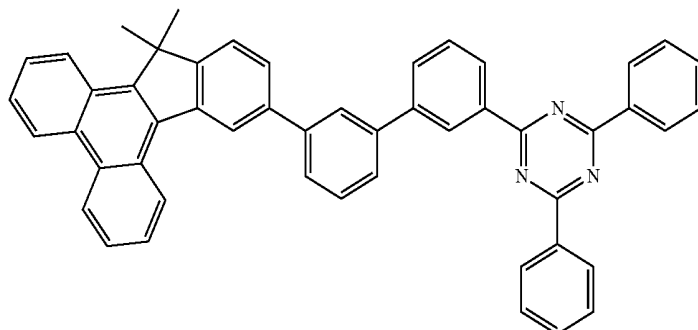
Synthesis Example 39: Synthesis of Compound 234  
(2-(3'-(13,13-dimethyl-13H-indeno[1,2-1]phenanthren-10-yl)-[1,1'-biphenyl]-3-yl)-4,6-diphenyl-1,3,5-triazine

[0201]



I-1

-continued



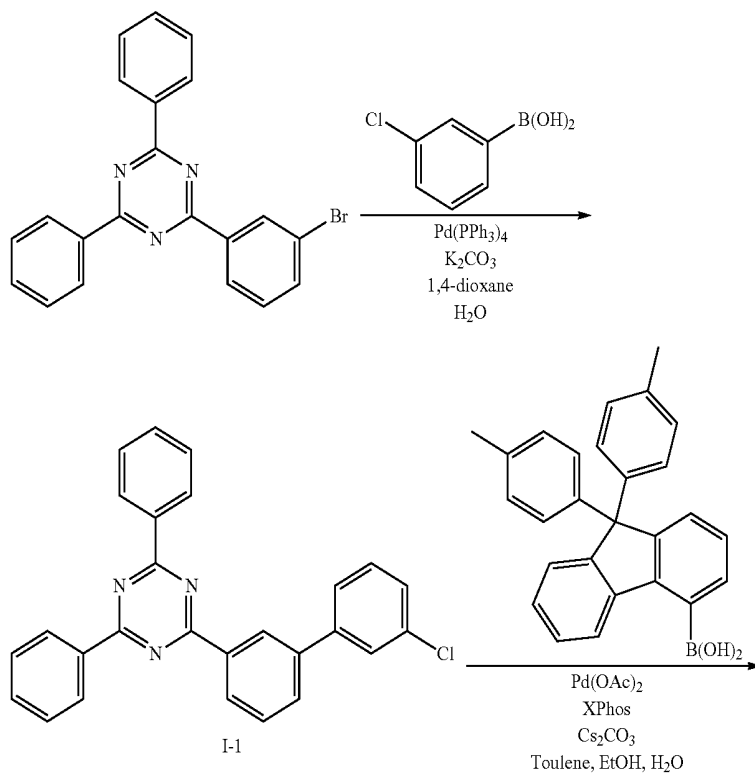
234

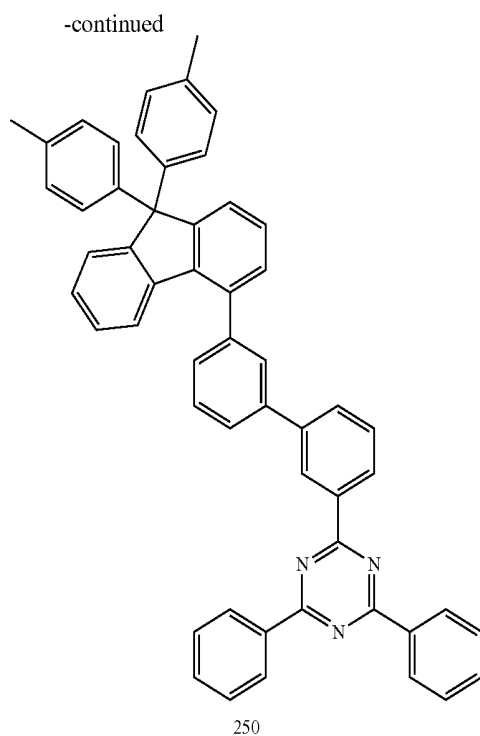
**[0202]** The same procedure was conducted as in Synthesis Example 31, with the exception of using (13,13-dimethyl-13H-indeno[1,2-b]phenanthren-11-yl)boronic acid (11.2 g, 0.033 mol) instead of (9,9-dimethyl-9H-fluoren-1-yl)boronic acid used in Step 2 of Synthesis Example 31, to afford Compound 234.

**[0203]** HRMS [M]<sup>+</sup>: 677.28

Synthesis Example 40: Synthesis of Compound 250  
(2-(3'-(9,9-di-p-tolyl-9H-fluoren-4-yl)-[1,1'-biphenyl]-3-yl)-4,6-diphenyl-1,3,5-triazine

**[0204]**

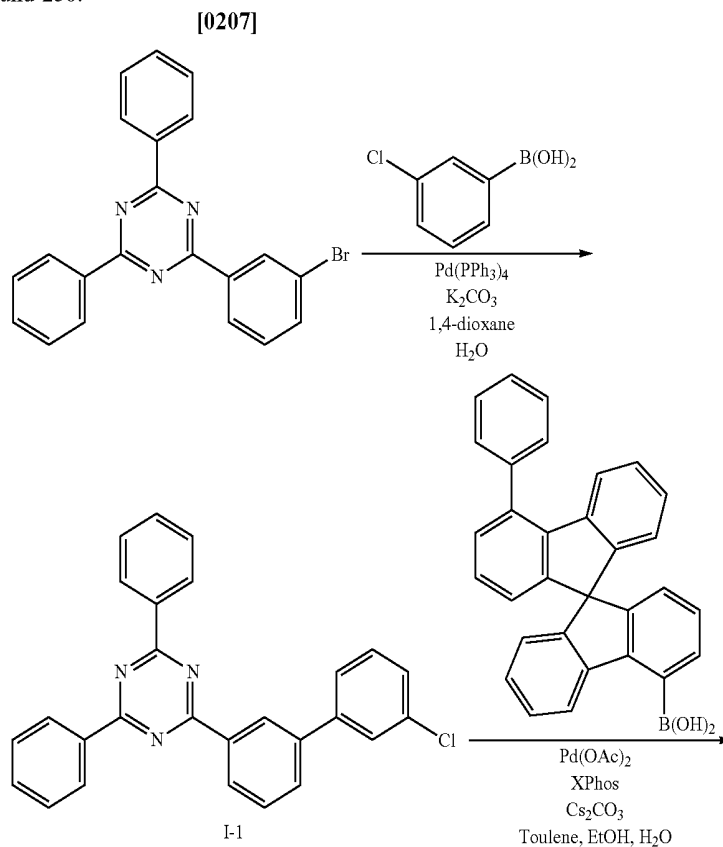


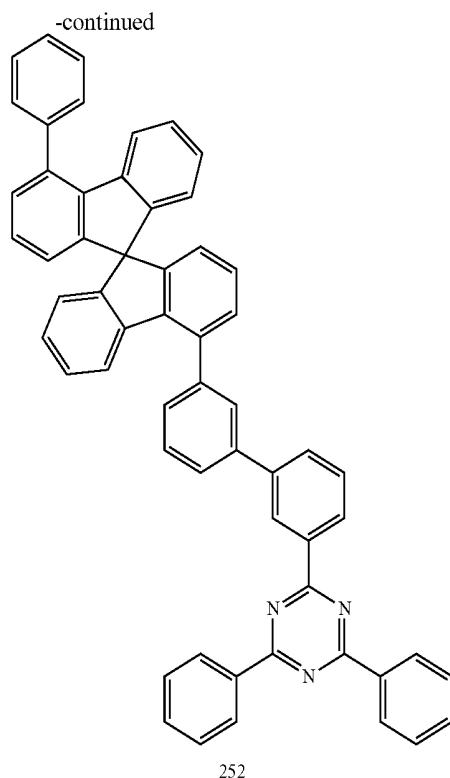


[0205] The same procedure was conducted as in Synthesis Example 31, with the exception of using (9,9-di-*p*-tolyl-9H-fluoren-4-yl)boronic acid (12.9 g, 0.033 mol) instead of (9,9-dimethyl-9H-fluoren-1-yl)boronic acid used in Step 2 of Synthesis Example 31, to afford Compound 250.

[0206] HRMS [M]<sup>+</sup>: 729.31

Synthesis Example 41: Synthesis of Compound 252  
(2,4-diphenyl-6-(3'-(4'-phenyl-9,9'-spirobi[fluorene]-4-yl)-[1,1'-biphenyl]-3-yl)-1,3,5-triazine



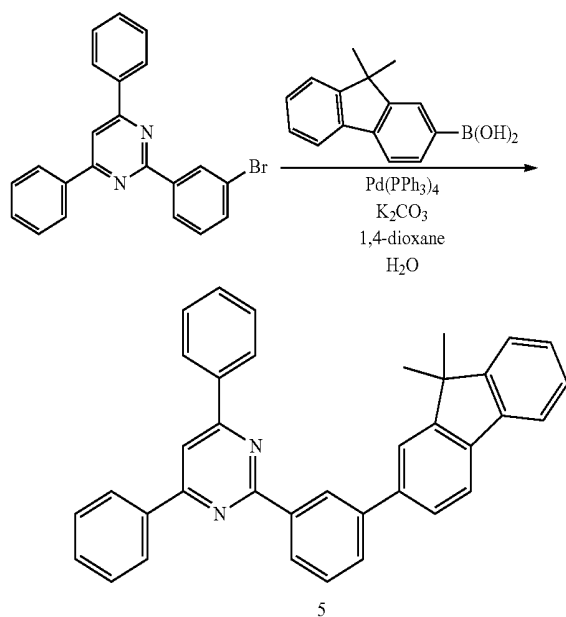


**[0208]** The same procedure was conducted as in Synthesis Example 31, with the exception of using (4'-phenyl-9,9'-spirobi[fluoren]-4-yl)boronic acid (14.4 g, 0.033 mol) instead of (9,9-dimethyl-9H-fluoren-1-yl)boronic acid used in Step 2 of Synthesis Example 31, to afford Compound 252.

**[0209]** HRMS [M]<sup>+</sup>: 775.30

Synthesis Example 42: Synthesis of Compound 5  
(2-(3-(9,9-dimethyl-9H-fluoren-2-yl)phenyl)-4,6-diphenylpyrimidine

**[0210]**

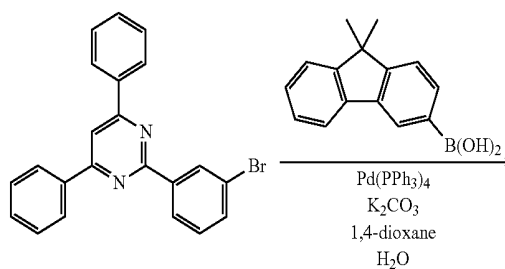


**[0211]** Under a nitrogen stream, 2-(3-bromophenyl)-4,6-diphenylpyrimidine (10.0 g, 0.026 mol), 9,9-dimethyl-9H-fluoren-2-yl-boronic acid (7.9 g, 0.033 mol), Pd(PPh<sub>3</sub>)<sub>4</sub> (0.95 g, 0.001 mol), and potassium carbonate (7.65 g, 0.078 mol) were mixed and then stirred under reflux with 1,4-dioxane (80 ml) and H<sub>2</sub>O (20 ml). After completion of the reaction, an organic layer was separated with methylene chloride and then dried over MgSO<sub>4</sub>. The solvent was removed from the dehydrated organic layer, followed by purification through column chromatography [hexane: MC=5:1 (v/v)] to afford Compound 5 (8.5 g, yield 66%).

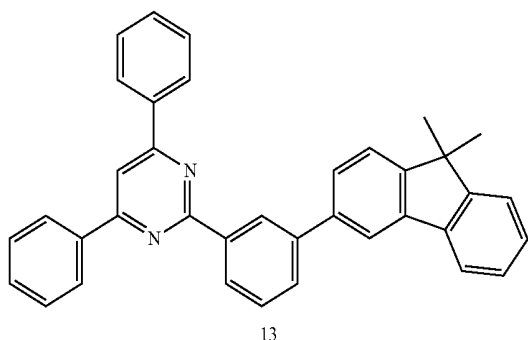
**[0212]** HRMS [M]<sup>+</sup>: 500.23

Synthesis Example 43: Synthesis of Compound 13  
(2-(3-(9,9-dimethyl-9H-fluoren-3-yl)phenyl)-4,6-diphenylpyrimidine

**[0213]**



-continued

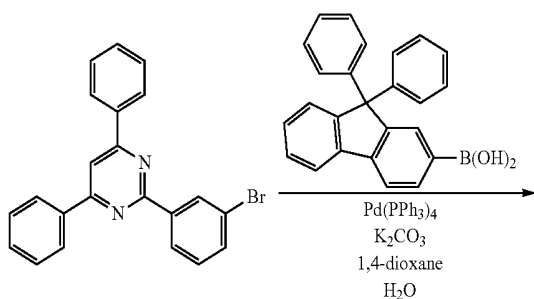


**[0214]** The same procedure was conducted as in Synthesis Example 42, with the exception of using 9,9-dimethyl-9H-fluoren-3-yl-boronic acid (7.9 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluoren-2-yl-boronic acid, to afford Compound 13.

**[0215]** HRMS [M]<sup>+</sup>: 500.23

Synthesis Example 44: Synthesis of Compound 73  
(2-(3-(9,9-diphenyl-9H-fluoren-2-yl)phenyl)-4,6-diphenylpyrimidine

**[0216]**

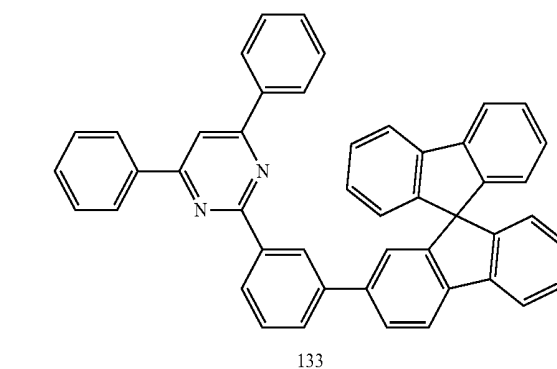
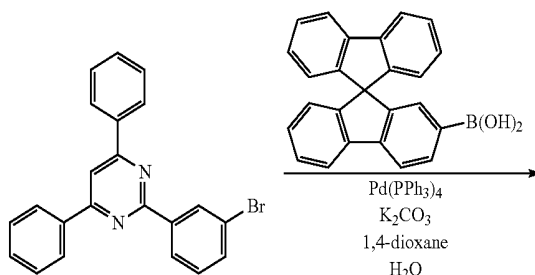


**[0217]** The same procedure was conducted as in Synthesis Example 42, with the exception of using (9,9-diphenyl-9H-fluoren-2-yl)-boronic acid (11.9 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluoren-2-yl-boronic acid to afford Compound 73.

**[0218]** HRMS [M]<sup>+</sup>: 624.26

Synthesis Example 45: Synthesis of Compound 133  
(2-(3-(9,9'-spirobi[fluoren]-2-yl)phenyl)-4,6-diphenylpyrimidine

**[0219]**

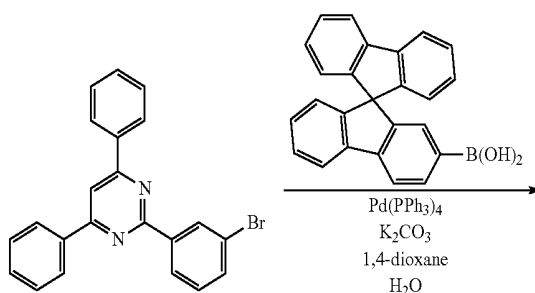


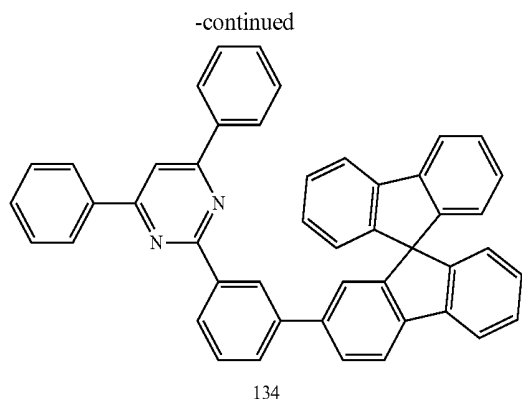
**[0220]** The same procedure was conducted as in Synthesis Example 42, with the exception of using 9,9'-Spirobi[9H-fluorene]-2-yl-boronic acid (11.88 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluoren-2-yl-boronic acid to afford Compound 133.

**[0221]** HRMS [M]<sup>+</sup>: 622.24

Synthesis Example 46: Synthesis of Compound 134  
(4-[3-(9,9-Spirobi[9H-fluorene]-2-yl)-phenyl]-2,6-diphenyl-pyrimidine

**[0222]**



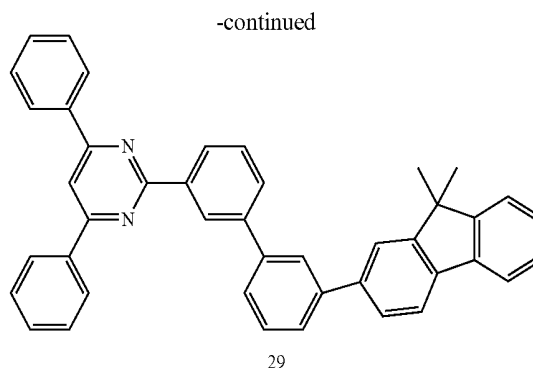
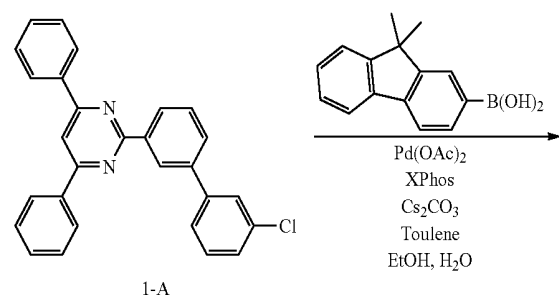
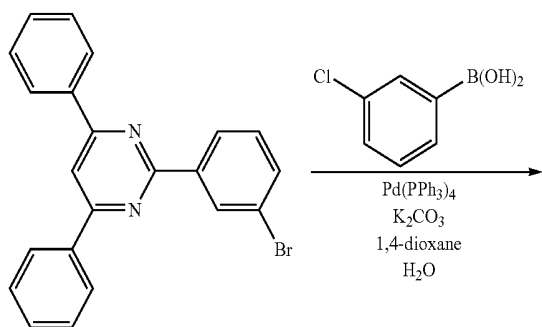


**[0223]** The same procedure was conducted as in Synthesis Example 42, with the exception of using 4-(3-bromophenyl)-2,6-diphenylpyrimidine (10.0 g, 0.026 mol) and 9,9'-Spiro[9H-fluorene]-2-yl-boronic acid (12.77 g, 0.033 mol) instead of 2-(3-bromophenyl)-4,6-diphenylpyrimidine and 9,9-dimethyl-9H-fluorene-2-yl-boronic acid, respectively, to afford Compound 134.

**[0224]** HRMS [M]<sup>+</sup>: 622.24

Synthesis Example 47: Synthesis of Compound 29  
(2-(3'-(9,9-dimethyl-9H-fluorene-2-yl)-[1,1'-biphenyl]-3-yl)-4,6-diphenylpyrimidine

**[0225]**



<Step 1> Synthesis of Intermediate 1-A (2-(3'-chloro-[1,1'-biphenyl]-3-yl)-4,6-diphenylpyrimidine

**[0226]** Under a nitrogen stream, 2-(3-bromophenyl)-4,6-diphenylpyrimidine (12.0 g, 0.031 mol), 3-chlorophenylboronic acid (6.3 g, 0.040 mol), Pd(PPh<sub>3</sub>)<sub>4</sub> (1.15 g, 0.001 mol), and potassium carbonate (12.85 g, 0.093 mol) were mixed and then stirred under reflux with 1,4-dioxane (100 ml) and H<sub>2</sub>O (25 ml).

**[0227]** After completion of the reaction, an organic layer was separated with methylene chloride and then dried over MgSO<sub>4</sub>. The solvent was removed from the dehydrated organic layer, followed by purification through column chromatography [hexane:MC=5:1 (v/v)] to afford Intermediate 1-A (11.0 g, yield 83%).

<Step 2> Synthesis of Compound 29 (2-(3'-(9,9-dimethyl-9H-fluorene-2-yl)-[1,1'-biphenyl]-3-yl)-4,6-diphenylpyrimidine

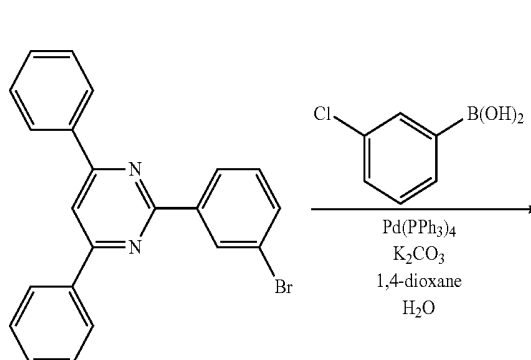
**[0228]** Under a nitrogen stream, Intermediate 1-A (11.0 g, 0.026 mol) obtained in Step 1, 9,9-dimethyl-9H-fluorene-2-yl-boronic acid (7.9 g, 0.033 mol), Pd(OAc)<sub>2</sub> (0.29 g, 0.001 mol), Cesium carbonate (25.4 g, 0.078 mol), and Xphos (1.23 g, 0.003 mol) were mixed and then stirred under reflux with toluene (100 ml), ethanol (20 ml), and H<sub>2</sub>O (20 ml).

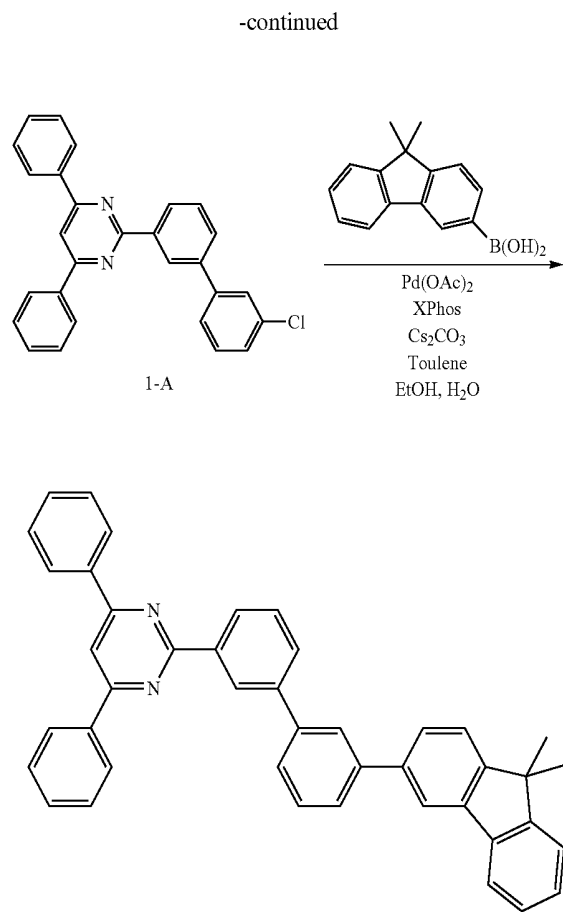
**[0229]** After completion of the reaction, an organic layer was separated with methylene chloride and then dried over MgSO<sub>4</sub>. The solvent was removed from the dehydrated organic layer, followed by purification through column chromatography [hexane:MC=5:1 (v/v)] to afford Compound 29 (11.2 g, yield 74%).

**[0230]** HRMS [M]<sup>+</sup>: 576.26

Synthesis Example 48: Synthesis of Compound 33  
(2-(3'-(9,9-dimethyl-9H-fluorene-3-yl)-[1,1'-biphenyl]-3-yl)-4,6-diphenylpyrimidine

**[0231]**



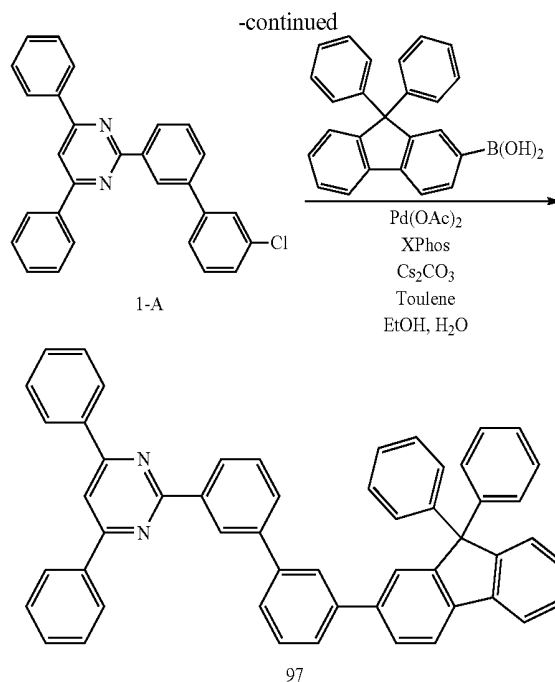
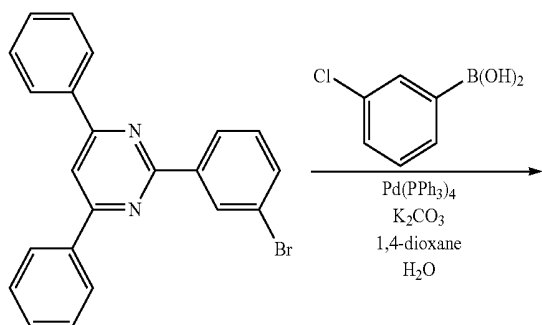


[0232] The same procedure was conducted as in Synthesis Example 47, with the exception of using 9,9-dimethyl-9H-fluoren-3-yl-boronic acid (7.9 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluoren-2-yl-boronic acid used in Step 2 of Synthesis Example 47 to afford Compound 33.

[0233] HRMS [M]<sup>+</sup>: 576.26

Synthesis Example 49: Synthesis of Compound 97  
(2-(3'-(9,9-diphenyl-9H-fluoren-2-yl)-[1,1'-biphenyl]-3-yl)-4,6-diphenylpyrimidine

[0234]

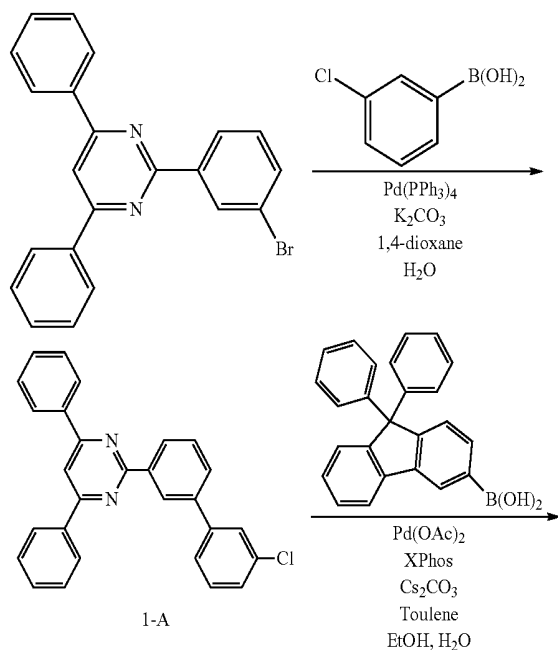


[0235] The same procedure was conducted as in Synthesis Example 47, with the exception of using (9,9-diphenyl-9H-fluoren-2-yl)-boronic acid (12.0 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluoren-2-yl-boronic acid used in Step 2 of Synthesis Example 47 to afford Compound 97.

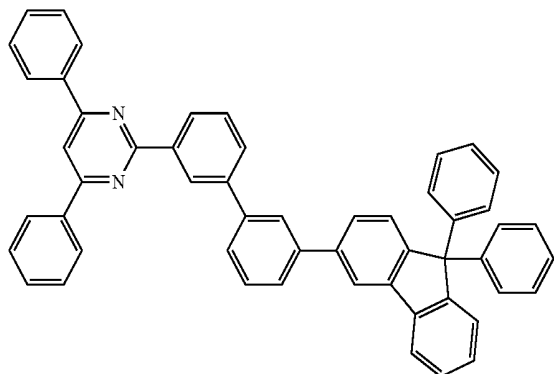
[0236] HRMS [M]<sup>+</sup>: 700.29

Synthesis Example 50: Synthesis of Compound 101  
(2-(3'-(9,9-diphenyl-9H-fluoren-3-yl)-[1,1'-biphenyl]-3-yl)-4,6-diphenylpyrimidine

[0237]



-continued



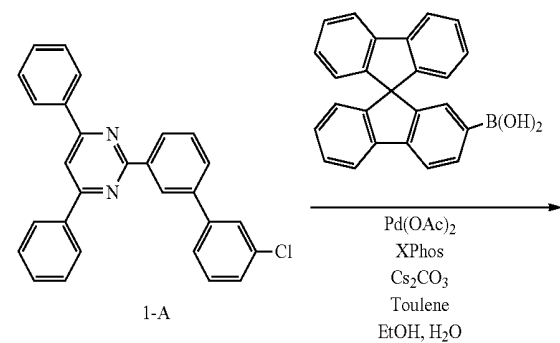
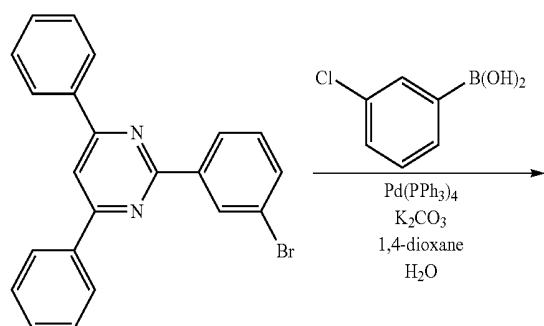
101

[0238] The same procedure was conducted as in Synthesis Example 47, with the exception of using (9,9-diphenyl-9H-fluoren-3-yl)boronic acid (12.0 g, 0.033 mol) instead of (9,9-dimethyl-9H-fluoren-2-yl)boronic acid used in Step 2 of Synthesis Example 47 to afford Compound 101.

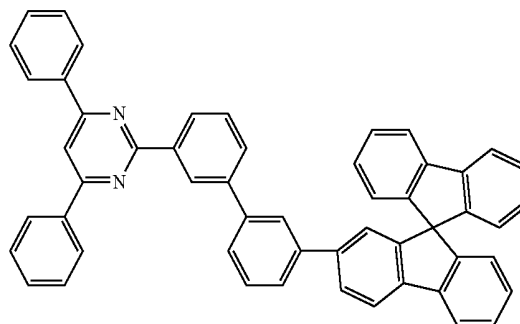
[0239] HRMS [M]<sup>+</sup>: 700.29

Synthesis Example 51: Synthesis of Compound 157  
(2-(3'-(9,9'-spirobi[fluoren]-2-yl)-[1,1'-biphenyl]-3-yl)-4,6-diphenylpyrimidine

[0240]



-continued



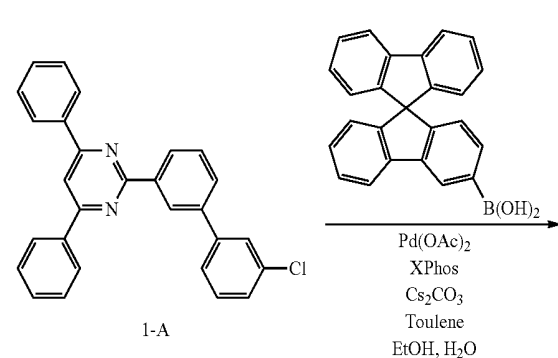
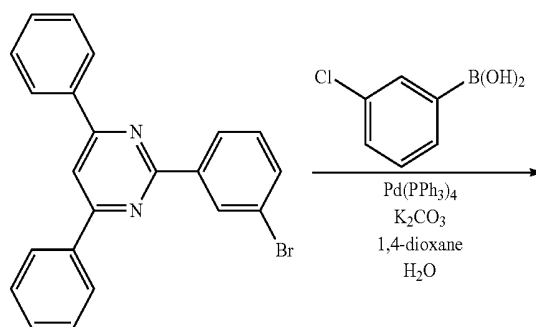
157

[0241] The same procedure was conducted as in Synthesis Example 47, with the exception of using 9,9'-Spirobi[9H-fluorene]-2-yl-boronic acid (11.9 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluoren-2-yl-boronic acid used in Step 2 of Synthesis Example 47 to afford Compound 157.

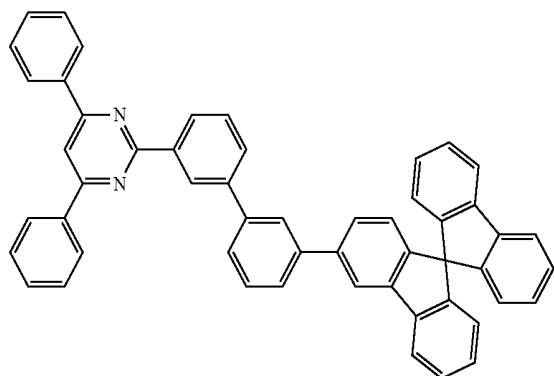
[0242] HRMS [M]<sup>+</sup>: 698.27

Synthesis Example 52: Synthesis of Compound 161  
(2-(3'-(9,9'-spirobi[fluoren]-3-yl)-[1,1'-biphenyl]-3-yl)-4,6-diphenylpyrimidine

[0243]



-continued



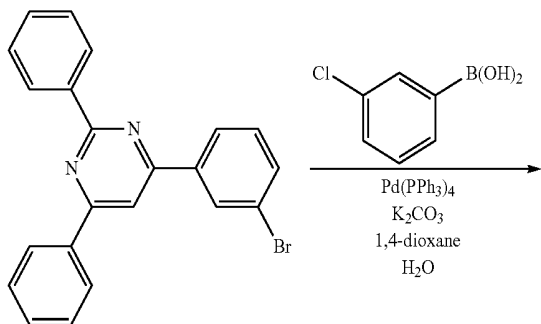
161

**[0244]** The same procedure was conducted as in Synthesis Example 47, with the exception of using 9,9'-spirobifluoren-3-yl-boronic acid (11.9 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluoren-2-yl-boronic acid used in Step 2 of Synthesis Example 47 to afford Compound 161.

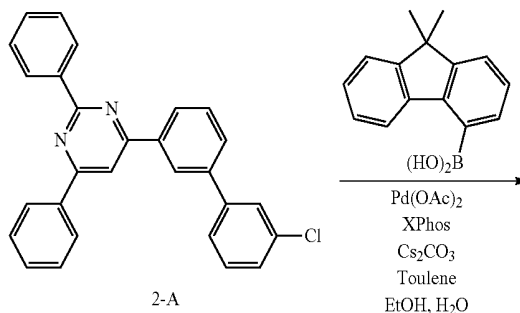
**[0245]** HRMS [M]<sup>+</sup>: 698.27

Synthesis Example 53: Synthesis of Compound 282  
4-(3'-(9,9-dimethyl-9H-fluoren-4-yl)-[1,1'-biphenyl]-3-yl)-2,6-diphenylpyrimidine

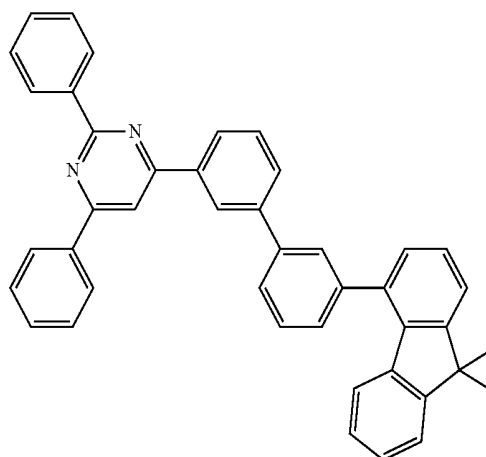
**[0246]**



-continued



2-A



282

<Step 1> Synthesis of Intermediate 2-A (4-(3'-chloro-[1,1'-biphenyl]-3-yl)-2,6-diphenylpyrimidine

**[0247]** The same procedure was conducted as in Step 1 of Synthesis Example 47, with the exception of using 4-(3-bromophenyl)-2,6-diphenylpyrimidine (12.0 g, 0.031 mol) instead of 2-(3-bromophenyl)-4,6-diphenylpyrimidine used in Step 1 of Synthesis Example 47 to afford Intermediate 2-A.

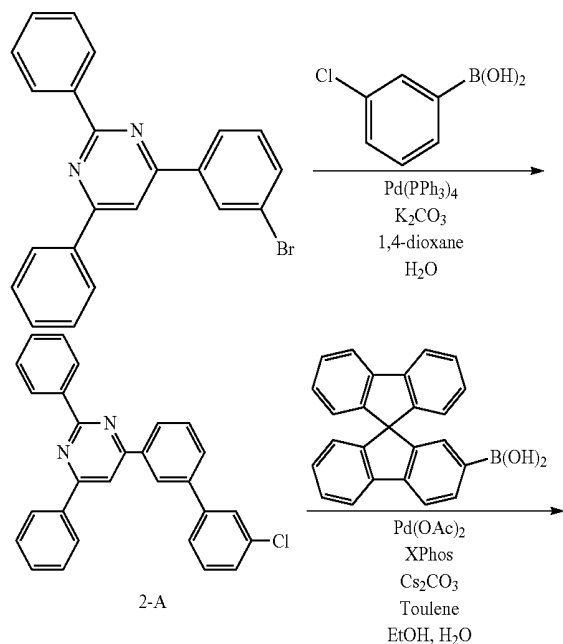
<Step 2> Synthesis of Compound 282 (4-(3'-(9,9-dimethyl-9H-fluoren-4-yl)-[1,1'-biphenyl]-3-yl)-2,6-diphenylpyrimidine

**[0248]** The same procedure was conducted as in Step 2 of Synthesis Example 47, with the exception of using Intermediate 2-A (11.0 g, 0.026 mol) synthesized in Step 1 and (9,9-dimethyl-9H-fluoren-4-yl)boronic acid (7.9 g, 0.033 mol) instead of Intermediate 1-A used in Step 2 of Synthesis Example 47 and 9,9-dimethyl-9H-fluoren-2-yl-boronic acid, respectively, to afford Compound 282.

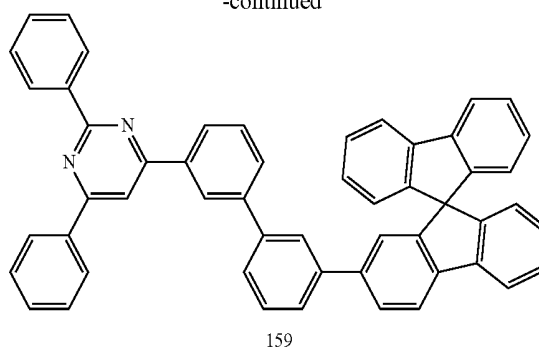
**[0249]** HRMS [M]<sup>+</sup>: 576.26

Synthesis Example 54: Synthesis of Compound 159  
 (4-(3'-(9,9'-spirobi[fluoren]-2-yl)-[1,1'-biphenyl]-3-yl)-2,6-diphenylpyrimidine

[0250]



-continued

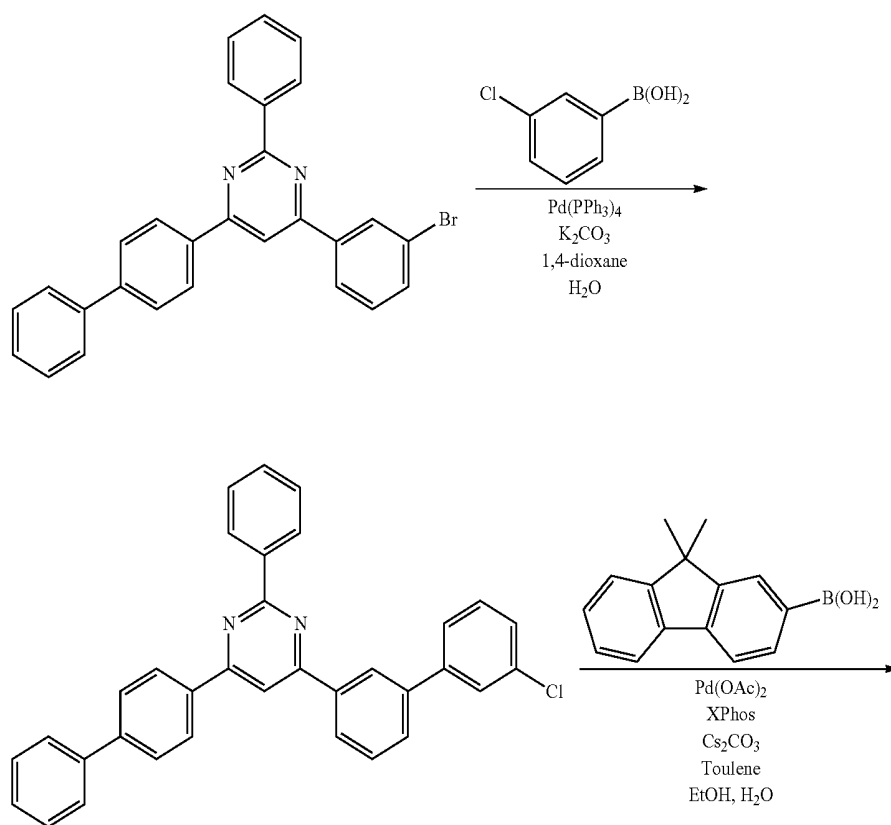


[0251] The same procedure was conducted as in Synthesis Example 53, with the exception of using 9,9'-spirobi[9H-fluorene]-2-yl-boronic acid (11.9 g, 0.033 mol) instead of (9,9-dimethyl-9H-fluoren-4-yl)boronic acid used in Step 2 of Synthesis Example 53 to afford Compound 159.

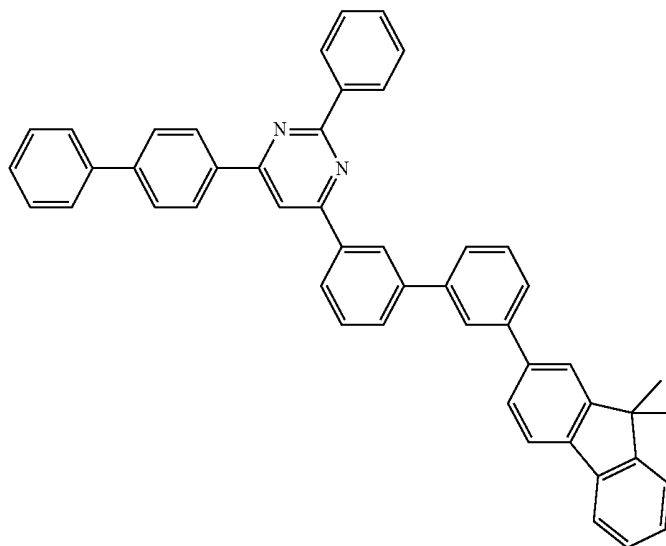
[0252] HRMS [M]<sup>+</sup>: 698.27

Synthesis Example 55: Synthesis of Compound 205  
 (4-([1,1'-biphenyl]-4-yl)-6-(3'-(9,9-dimethyl-9H-fluoren-2-yl)-[1,1'-biphenyl]-3-yl)-2-phenylpyrimidine

[0253]



-continued



205

<Step 1> Synthesis of Intermediate 3-A (4-([1,1'-biphenyl]-4-yl)-6-(3'-chloro-[1,1'-biphenyl]-3-yl)-2-phenylpyrimidine

**[0254]** The same procedure was conducted as in Step 1 of Synthesis Example 53, with the exception of using 4-([1,1'-biphenyl]-4-yl)-6-(3-bromophenyl)-2-phenylpyrimidine (14.4 g, 0.031 mol) instead of 4-(3-bromo-phenyl)-2,6-diphenyl-pyrimidine used in Step 1 of Synthesis Example 53 to afford Intermediate 3-A.

<Step 2> Synthesis of Compound 205 (4-([1,1'-biphenyl]-4-yl)-6-(3'-(9,9-dimethyl-9H-fluoren-2-yl)-[1,1'-biphenyl]-3-yl)-2-phenylpyrimidine

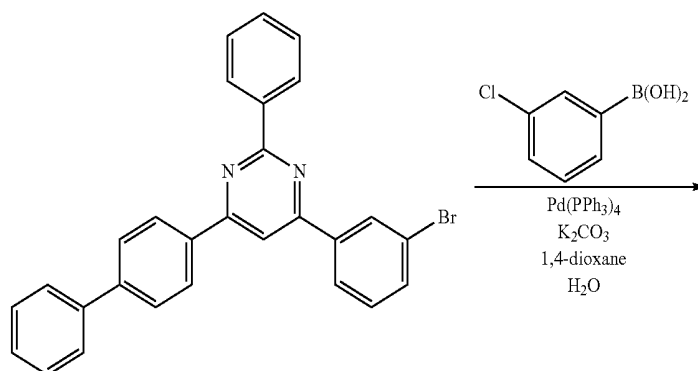
**[0255]** The same procedure was conducted as in Step 2 of Synthesis Example 53, with the exception of using Inter-

mediate 3-A (12.9 g, 0.026 mol) synthesized in Step 1 and (9,9-dimethyl-9H-fluoren-2-yl)boronic acid instead of Intermediate 2-A used in Step 2 of Synthesis Example 53 and (9,9-dimethyl-9H-fluoren-4-yl)boronic acid, respectively, to afford Compound 205.

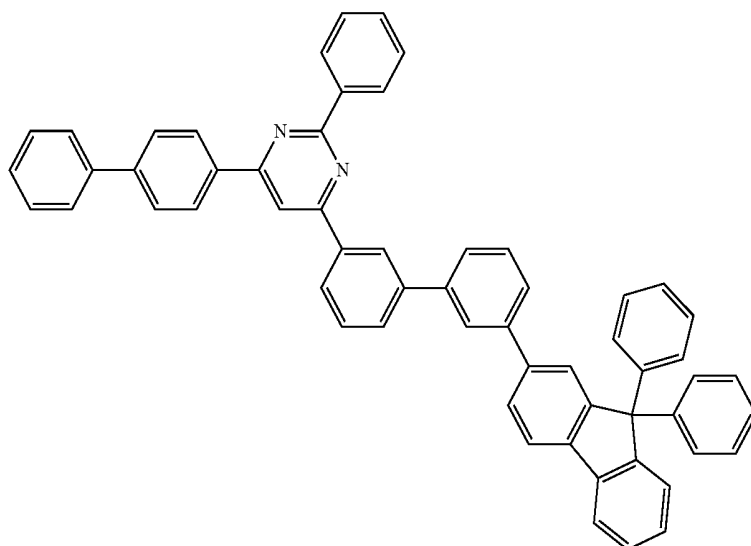
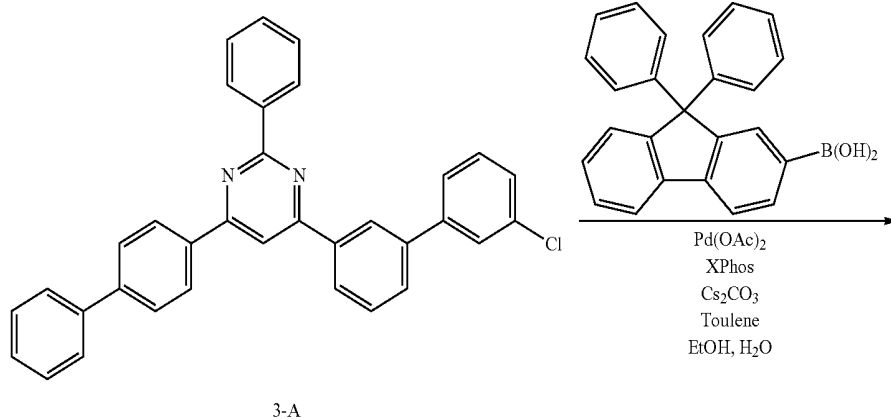
**[0256]** HRMS [M]<sup>+</sup>: 652.29

Synthesis Example 56: Synthesis of Compound 206 (4-([1,1'-biphenyl]-4-yl)-6-(3'-(9,9-diphenyl-9H-fluoren-2-yl)-[1,1'-biphenyl]-3-yl)-2-phenylpyrimidine

**[0257]**



-continued



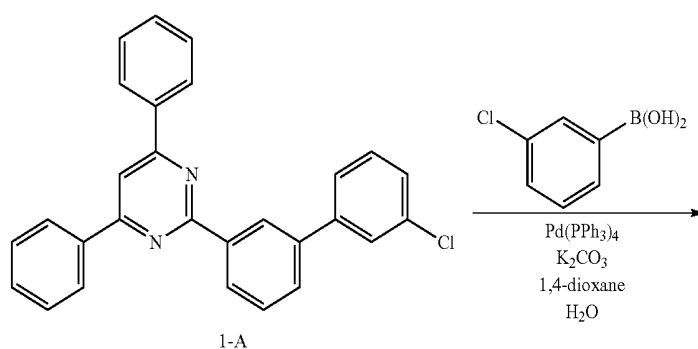
[0258] The same procedure was conducted as in Synthesis Example 55, with the exception of using (9,9-diphenyl-9H-fluoren-2-yl)-boronic acid (11.9 g, 0.033 mol) instead of 9,9-dimethyl-9H-fluoren-2-yl-boronic acid used in Step 2 of Synthesis Example 55, to afford Compound 206.

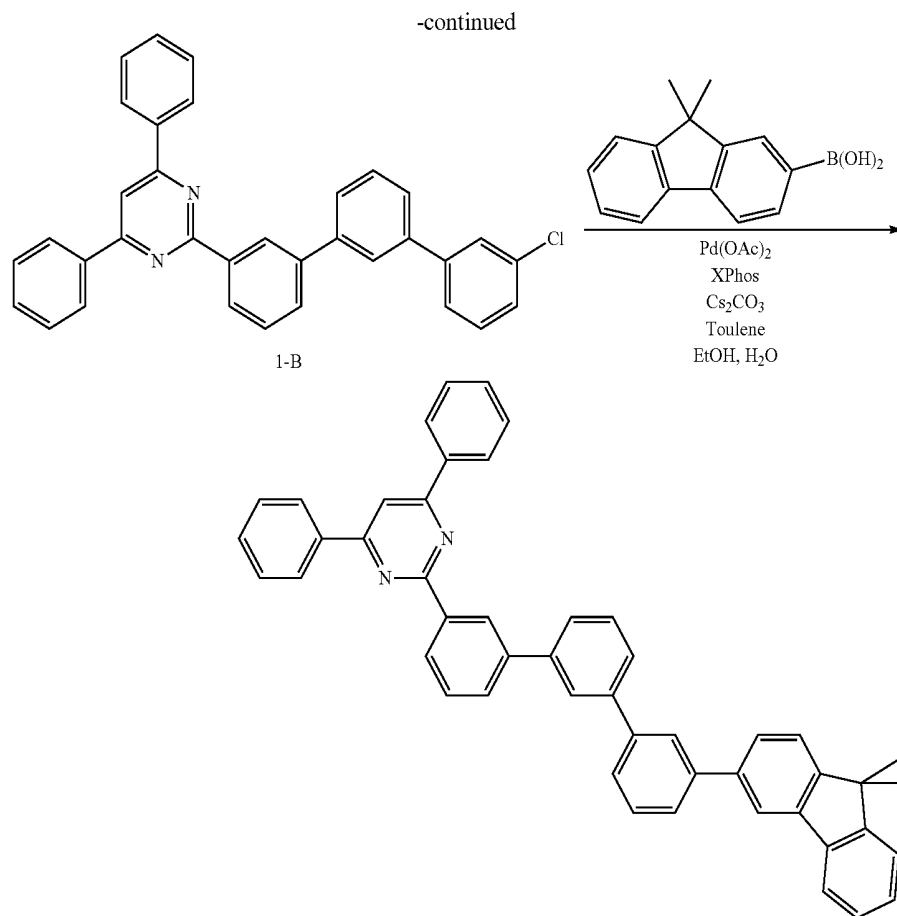
[0259] HRMS [M]<sup>+</sup>: 776.32

Synthesis Example 57: Synthesis of Compound 336

(2-(3''-(9,9-dimethyl-9H-fluoren-3-yl)-[1,1':3',1''-terphenyl]-3-yl)-4,6-diphenylpyrimidine

[0260]





<Step 1> Intermediate 1-B (2-(3''-chloro-[1,1':3',1''-terphenyl]-3-yl)-4,6-diphenylpyrimidine

**[0261]** Under a nitrogen stream, Intermediate 1-A (11.0 g, 0.026 mol), 3-chlorophenylboronic acid (4.8 g, 0.031 mol), Pd(OAc)<sub>2</sub> (0.29 g, 0.001 mol), Cesium carbonate (25.4 g, 0.078 mol), and Xphos (0.3 g, 0.003 mol) were mixed and then stirred under reflux with toluene (100 ml), ethanol (20 ml) and H<sub>2</sub>O (20 ml).

**[0262]** After completion of the reaction, an organic layer was separated with methylene chloride and then dried over MgSO<sub>4</sub>. The solvent was removed from the dehydrated organic layer, followed by purification through column chromatography [hexane:MC=5:1 (v/v)] to afford Intermediate 1-B (7.5 g, yield 58%).

<Step 2> Synthesis of Compound 336 (2-(3''-(9,9-dimethyl-9H-fluorene-3-yl)-[1,1':3',1''-terphenyl]-3-yl)-4,6-diphenylpyrimidine

**[0263]** Under a nitrogen stream, Intermediate 1-B (7.5 g, 0.015 mol) synthesized in Step 1, 9,9-dimethyl-9H-fluorene-3-yl-boronic acid (4.3 g, 0.018 mol), Pd(OAc)<sub>2</sub> (0.17 g, 0.75 mmol), Cesium carbonate (14.6 g, 0.045 mol), and Xphos (0.7 g, 1.5 mmol) were mixed and then stirred under reflux with toluene (60 ml), ethanol (15 ml) and H<sub>2</sub>O (15 ml).

**[0264]** After completion of the reaction, an organic layer was separated with methylene chloride and then dried over MgSO<sub>4</sub>. The solvent was removed from the dehydrated

organic layer, followed by purification through column chromatography [hexane:MC=4:1 (v/v)] to afford Compound 336 (8.1 g, yield 83%).

**[0265]** HRMS [M]<sup>+</sup>: 652.29

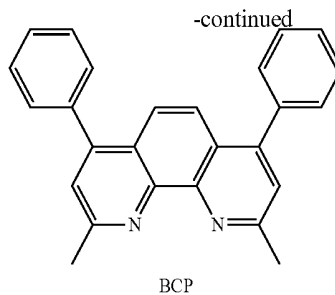
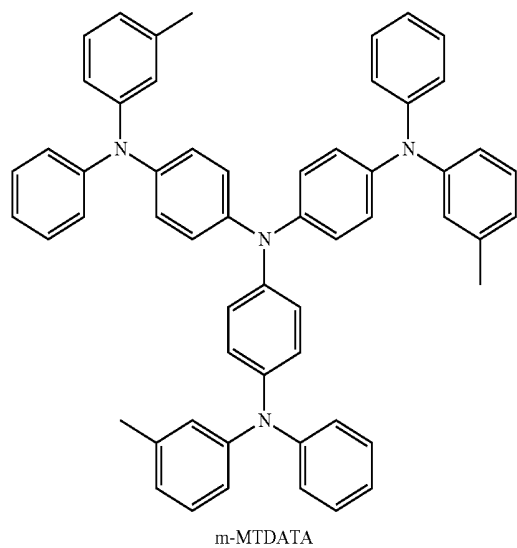
#### Examples 1 to 41: Fabrication of Green Organic Electroluminescent Element

**[0266]** The compounds synthesized in the Synthesis Examples were purified by sublimation to a high degree of purity using a conventional method known in the art before being applied to the fabrication of green organic electroluminescent elements as follows.

**[0267]** First, a glass substrate coated with an ITO (indium tin oxide) thin film 1500 Å thick was cleansed by ultrasonication in distilled water and then in a solvent such as isopropyl alcohol, acetone, methanol, etc. and then dried. The glass substrate was transferred to a UV OZONE cleaner (Power sonic 405, Hwashin Tech) and cleaned for 5 min using UV, and transferred to a vacuum evaporator.

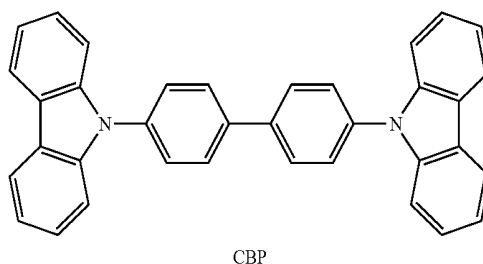
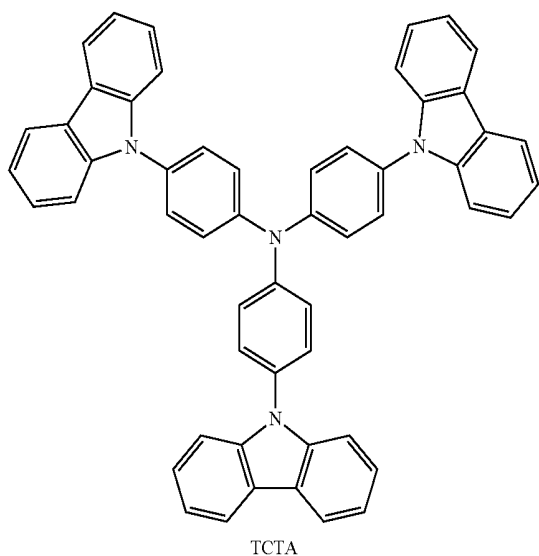
**[0268]** On the transparent ITO substrate (electrode) thus obtained, m-MTDATA (60 nm)/TCTA (80 nm)/90% of each of the compounds synthesized in Synthesis Examples 1 to 41+10% of Ir(ppy)<sub>3</sub> (30 nm)/BCP (10 nm)/Alq<sub>3</sub> (30 nm)/LiF (1 nm)/Al (200 nm) were deposited in that order to fabricate organic electroluminescent elements.

**[0269]** Structures of m-MTDATA, TCTA, Ir(ppy)<sub>3</sub> and BCP are as follows.



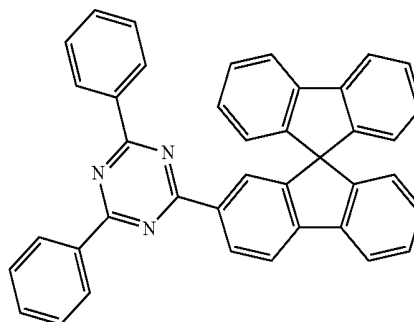
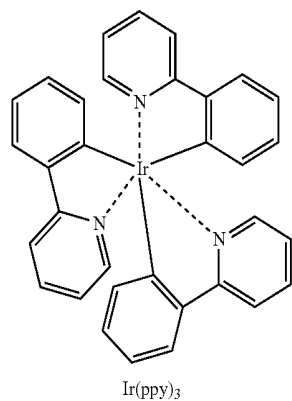
Comparative Example 1: Fabrication of Green Organic Electroluminescent Element

[0270] A green organic electroluminescent element was fabricated in the same manner as in Example 1, with the exception of using the following CBP instead of Compound 1 synthesized in Synthesis Example 1.



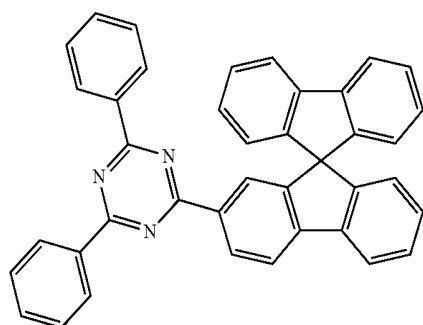
Comparative Example 2: Fabrication of Green Organic Electroluminescent Element

[0271] A green organic electroluminescent element was fabricated in the same manner as in Example 1, with the exception of using the following Compound A instead of Compound 1 synthesized in Synthesis Example 1.



Comparative Example 3: Fabrication of Green Organic Electroluminescent Element

[0272] A green organic electroluminescent element was fabricated in the same manner as in Example 1, with the exception of using the following Compound B instead of Compound 1 synthesized in Synthesis Example 1.



Evaluation Example 1

[0273] The green organic electroluminescent elements fabricated in Examples 1 to 41 and Comparative Examples 1 to 3 were measured for driving voltage at a current density of 10 mA/cm<sup>2</sup>, current efficiency, and emitting peak, and the results are summarized in Table 1, below.

TABLE 1

	Light-Emitting Material	Driving Volt. (V)	Emitting Peak (nm)	Current Efficiency (cd/A)
Example 1	Compound 1	4.50	517	53.5
Example 2	Compound 3	4.61	515	51.5
Example 3	Compound 69	4.45	518	49.8
Example 4	Compound 129	4.57	518	51.7
Example 5	Compound 6	4.60	518	49.6
Example 6	Compound 74	4.59	517	51.7
Example 7	Compound 134	4.56	515	52.7
Example 8	Compound 7	5.10	518	49.8
Example 9	Compound 75	4.65	518	50.5
Example 10	Compound 135	4.35	517	52.5
Example 11	Compound 21	4.10	515	63.4
Example 12	Compound 23	4.05	518	65.4
Example 13	Compound 89	4.15	518	61.5
Example 14	Compound 91	4.05	517	63.3
Example 15	Compound 149	4.15	518	63.5
Example 16	Compound 151	4.11	517	64.2
Example 17	Compound 31	4.28	515	58.3
Example 18	Compound 35	4.15	518	60.5
Example 19	Compound 99	4.40	518	55.5
Example 20	Compound 159	4.33	518	56.6
Example 21	Compound 45	4.30	517	57.5
Example 22	Compound 53	4.20	515	56.5

B

TABLE 1-continued

	Light-Emitting Material	Driving Volt. (V)	Emitting Peak (nm)	Current Efficiency (cd/A)
Example 23	Compound 113	4.33	518	51.5
Example 24	Compound 173	4.30	518	52.7
Example 25	Compound 61	4.15	517	59.3
Example 26	Compound 62	4.10	518	62.7
Example 27	Compound 63	4.20	517	54.5
Example 28	Compound 64	4.23	515	56.5
Example 29	Compound 200	4.65	516	46.9
Example 30	Compound 206	4.23	517	47.2
Example 31	Compound 217	4.15	517	61.8
Example 32	Compound 218	4.26	518	62.5
Example 33	Compound 220	4.32	518	59.8
Example 34	Compound 21	4.10	516	63.4
Example 35	Compound 189	4.15	517	62.3
Example 36	Compound 193	4.35	518	57.8
Example 37	Compound 65	4.52	518	52.3
Example 38	Compound 231	4.41	518	51.3
Example 39	Compound 234	4.50	518	52.6
Example 40	Compound 250	4.35	518	57.6
Example 41	Compound 252	4.48	518	54.6
C. Example 1	CBP	6.93	516	38.2
C. Example 2	Compound A	4.98	517	39.6
C. Example 3	Compound B	5.03	516	37.3

[0274] As understood from Table 1, the organic electroluminescent elements employing the compounds of the present invention in the light-emitting layer thereof (Examples 1 to 41) are far superior in terms of current efficiency and driving voltage compared to that employing the conventional material CBP in the light-emitting layer thereof (Comparative Example 1).

[0275] In addition, when used in the light-emitting layer of an organic electroluminescent element, the compounds having the linker (Examples 1 to 41) decrease the driving voltage and increases current efficiency in the organic electroluminescent element, compared to those lacking the linker (Comparative Examples 2 and 3).

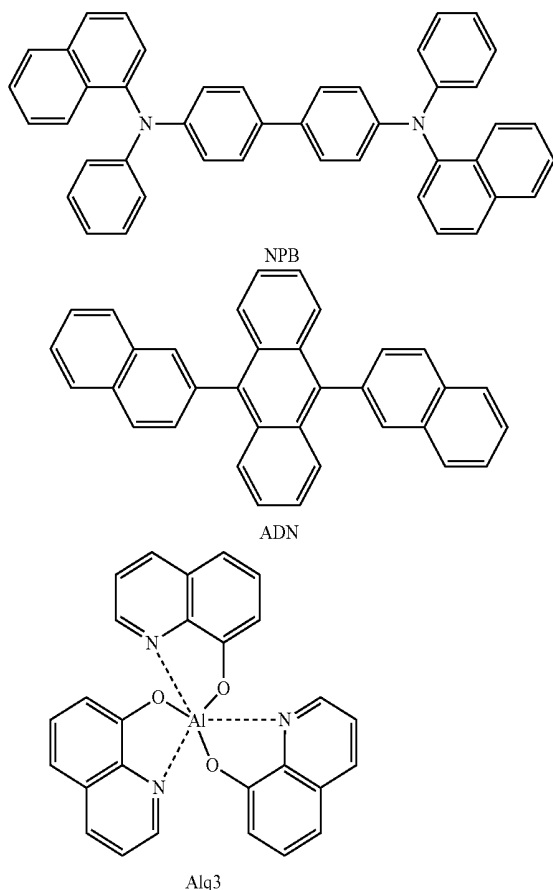
#### Examples 42 to 98: Fabrication of Blue Organic Electroluminescent Element

[0276] The compounds synthesized in the Synthesis Examples were purified by sublimation to a high degree of purity using a conventional method known in the art before being applied to the fabrication of blue organic electroluminescent elements having the structures listed in Table 2, below.

TABLE 2

	Hole Injection Layer	Hole Transport Layer	Light-emitting Layer	Aux. Electron Transport Layer	Electron Transport Layer	Electron Injection Layer	Cathode
Material	DS-205 (Doosan Corporation)	NPB	ADN + 5% DS-405 (Doosan Corporation)	Individual Cpd. Synthesized in Synthesis Examples 1 to 57	Alq <sub>3</sub>	LiF	Al
Thick.	80 nm	15 nm	30 nm	5 nm	25 nm	1 nm	200 nm

[0277] The structures of NPB, ADN, and Alq<sub>3</sub> listed in Table 2 are as follows.

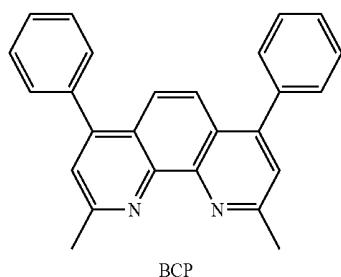


#### Comparative Example 4: Fabrication of Blue Organic Electroluminescent Element

[0278] A blue organic electroluminescent element was fabricated in the same manner as in Example 42, with the exception that an electron transport layer 30 nm thick was deposited without using an auxiliary electron transport layer.

#### Comparative Example 5: Fabrication of Blue Organic Electroluminescent Element

[0279] A blue organic electroluminescent element was fabricated in the same manner as in Example 42, with the exception of using the following BCP instead of Compound 1 synthesized in Synthesis Example 1.



#### Evaluation Example 2

[0280] The blue organic electroluminescent elements fabricated in Examples 42 to 98 and Comparative Examples 4 and 5 were measured for driving voltage at a current density of 10 mA/cm<sup>2</sup>, current efficiency, and emitting peak, and the results are summarized in Table 3, below.

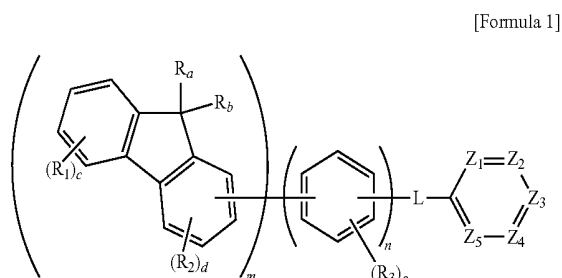
TABLE 3

	Material of Aux. Electron Transport Layer	Driving Volt. (V)	Current Efficiency (cd/A)	Emitting Peak (nm)
Example 42	Compound 1	4.7	6.6	458
Example 43	Compound 3	4.5	6.3	458
Example 44	Compound 69	4.2	6.6	457
Example 45	Compound 129	4.1	6.0	458
Example 46	Compound 6	4.5	6.2	458
Example 47	Compound 74	4.2	6.6	458
Example 48	Compound 134	4.1	6.3	457
Example 49	Compound 7	4.4	6.2	458
Example 50	Compound 75	4.3	6.1	457
Example 51	Compound 135	4.4	6.2	458
Example 52	Compound 21	3.8	8.2	458
Example 53	Compound 23	4.1	7.2	458
Example 54	Compound 89	4.0	8.1	458
Example 55	Compound 91	4.1	8.1	457
Example 56	Compound 149	4.0	8.0	458
Example 57	Compound 151	4.2	7.8	458
Example 58	Compound 31	4.1	8.0	458
Example 59	Compound 35	4.1	7.5	457
Example 60	Compound 99	4.5	8.1	458
Example 61	Compound 159	4.2	7.6	458
Example 62	Compound 45	4.5	6.1	458
Example 63	Compound 53	4.6	6.2	458
Example 64	Compound 113	4.5	6.0	458
Example 65	Compound 173	4.2	6.1	458
Example 66	Compound 61	4.1	6.8	458
Example 67	Compound 62	4.1	6.9	458
Example 68	Compound 63	4.5	7.3	457
Example 69	Compound 64	4.2	7.6	458
Example 70	Compound 200	4.1	7.0	458
Example 71	Compound 206	4.3	7.7	458
Example 72	Compound 217	4.0	8.0	458
Example 73	Compound 218	4.1	8.1	458
Example 74	Compound 220	3.9	8.0	457
Example 75	Compound 21	3.8	8.2	458
Example 76	Compound 189	4.0	8.2	458
Example 77	Compound 193	4.2	7.9	458
Example 78	Compound 65	4.3	7.6	457
Example 79	Compound 231	4.4	7.2	458
Example 80	Compound 234	4.3	7.6	458
Example 81	Compound 250	4.1	7.6	457
Example 82	Compound 252	4.3	7.7	458
Example 83	Compound 5	4.7	6.7	458
Example 84	Compound 13	4.6	6.5	458
Example 85	Compound 73	4.4	6.1	457
Example 86	Compound 133	4.6	6.9	458
Example 87	Compound 134	4.1	6.7	457
Example 88	Compound 29	4.4	7.2	458
Example 89	Compound 33	4.3	7.1	457
Example 90	Compound 97	4.4	7.5	458
Example 91	Compound 101	4.3	7.6	458
Example 92	Compound 157	4.1	7.5	458
Example 93	Compound 161	4.2	7.3	458
Example 94	Compound 282	4.5	7.9	458
Example 95	Compound 159	4.1	8.3	458
Example 96	Compound 205	4.5	8.0	457
Example 97	Compound 206	4.6	7.7	458
Example 98	Compound 336	4.5	7.9	458
C. Example 4	—	4.7	5.6	457
C. Example 5	BCP	5.3	5.9	458

[0281] As shown in Table 3, the compounds according to the present invention, when used in auxiliary electron transport layer of blue organic electroluminescent elements (Ex-

amples 42 to 98), impart excellent current efficiency and driving voltages to the blue organic electroluminescent elements.

1. A compound represented by the following Formula 1:



wherein,

$R_a$  and  $R_b$  are the same or different from each other and are each independently a  $C_1$ - $C_{40}$  alkyl group or a  $C_6$ - $C_{60}$  aryl group or combine with each other to form a fused ring,

$R_1$  to  $R_3$  are the same or different from each other and are each independently selected from the group consisting of a hydrogen, a deuterium, a halogen, a cyano group, a nitro group, an amino group, a  $C_1$ - $C_{40}$  alkyl group, a  $C_2$ - $C_{40}$  alkenyl group, a  $C_2$ - $C_{40}$  alkynyl group, a  $C_3$ - $C_{40}$  cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a  $C_6$ - $C_{60}$  aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a  $C_1$ - $C_{40}$  alkyloxy group, a  $C_6$ - $C_{60}$  aryloxy group, a  $C_1$ - $C_{40}$  alkylsilyl group, a  $C_6$ - $C_{60}$  arylsilyl group, a  $C_1$ - $C_{40}$  alkylboron group, a  $C_6$ - $C_{60}$  arylboron group, a  $C_1$ - $C_{40}$  phosphine group, a  $C_1$ - $C_{40}$  phosphine oxide group, and a  $C_6$ - $C_{60}$  arylamine group, or in this case, adjacent ones of  $R_1$  to  $R_3$  are optionally respectively to each other to form a fused ring,

$L$  is selected from the group consisting of a single bond, a  $C_6$ - $C_{18}$  arylene group and a heteroarylene group having 5 to 18 nuclear atoms,

$Z_1$  to  $Z_5$  are the same or different from each other and are each independently N or  $C(R_4)$ , and provided that  $Z_1$  to  $Z_5$  include at least one N, and when  $C(R_4)$  is present in a plural number, they are optionally the same as or different from each other,

$c$  and  $e$  are each an integer of 0 to 4,

$d$  is an integer of 0 to 3,

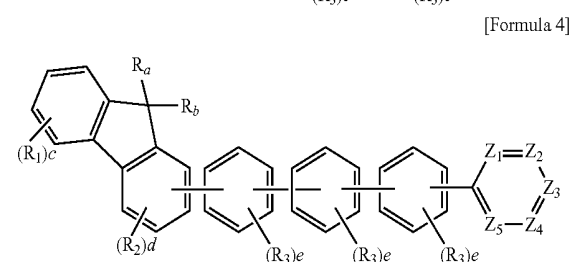
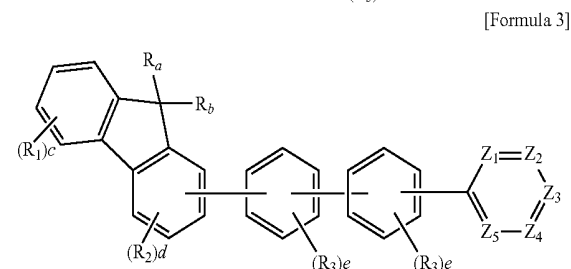
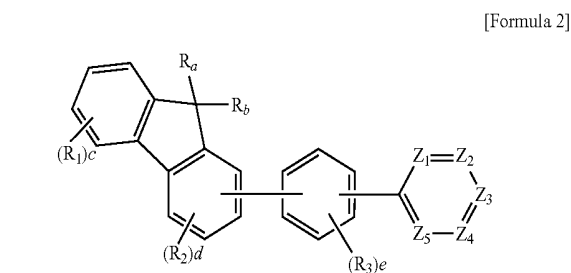
$m$  and  $n$  are each an integer of 1 to 3,

$R_4$  is selected from the group consisting of a hydrogen, a deuterium, a halogen, a cyano group, a nitro group, an amino group, a  $C_1$ - $C_{40}$  alkyl group, a  $C_2$ - $C_{40}$  alkenyl group, a  $C_2$ - $C_{40}$  alkynyl group, a  $C_3$ - $C_{40}$  cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a  $C_6$ - $C_{60}$  aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a  $C_1$ - $C_{40}$  alkyloxy group, a  $C_6$ - $C_{60}$  aryloxy group, a  $C_1$ - $C_{40}$  alkylsilyl group, a  $C_6$ - $C_{60}$  arylsilyl group, a  $C_1$ - $C_{40}$  alkylboron group, a  $C_6$ - $C_{60}$  arylboron group, a  $C_1$ - $C_{40}$  phosphine group, a  $C_1$ - $C_{40}$  phosphine oxide group, and a  $C_6$ - $C_{60}$  arylamine group, or bonded to an adjacent substituent to form a fused ring,

the alkyl and aryl groups of  $R_a$  and  $R_b$ ; the alkyl, alkenyl, alkynyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, alkyloxy, aryloxy, alkylsilyl, arylsilyl, alkylboron, aryl-

boron, phosphine, phosphine oxide, and arylamine groups of  $R_1$  to  $R_4$ ; and the arylene and heteroarylene groups of  $L$  are optionally each independently unsubstituted or substituted with at least one selected from the group consisting of a deuterium, a halogen, a cyano group, a nitro group, an amino group, a  $C_1$ - $C_{40}$  alkyl group, a  $C_2$ - $C_{40}$  alkenyl group, a  $C_2$ - $C_{40}$  alkynyl group, a  $C_3$ - $C_{40}$  cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a  $C_6$ - $C_{60}$  aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a  $C_1$ - $C_{40}$  alkyloxy group, a  $C_6$ - $C_{60}$  aryloxy group, a  $C_1$ - $C_{40}$  alkylsilyl group, a  $C_6$ - $C_{60}$  arylsilyl group, a  $C_1$ - $C_{40}$  alkylboron group, a  $C_6$ - $C_{60}$  arylboron group, a  $C_1$ - $C_{40}$  phosphine group, a  $C_1$ - $C_{40}$  phosphine oxide group, and a  $C_6$ - $C_{60}$  arylamine group, and provided that when the substituent is present in a plural number, they are optionally the same or different from each other.

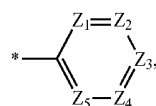
2. The Compound of claim 1, wherein the compound represented by Formula 1 is selected from the group consisting of the compounds represented by the following Formula 2 to 4:



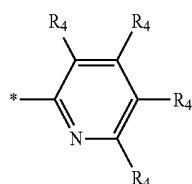
wherein,

$R_a$ ,  $R_b$ ,  $R_1$  to  $R_3$ ,  $Z_1$  to  $Z_5$ ,  $c$ ,  $d$ , and  $e$  are the same as defined in claim 1.

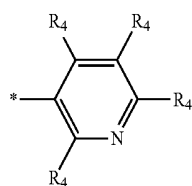
3. The Compound of claim 1, wherein the structure represented by



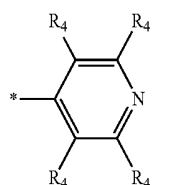
wherein \* is a site where to bond with L, in Formula 1 is selected from the group consisting of the structures represented by the following C-1 to C-15:



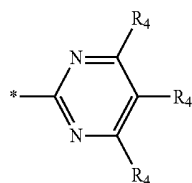
C-1



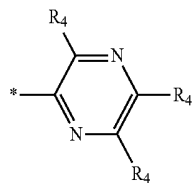
C-2



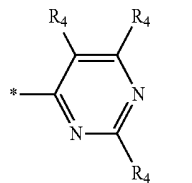
C-3



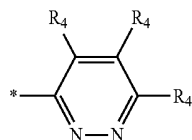
C-4



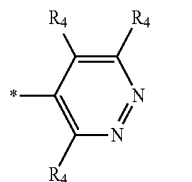
C-5



C-6



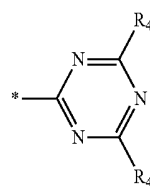
C-7



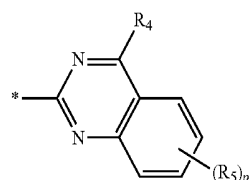
C-8

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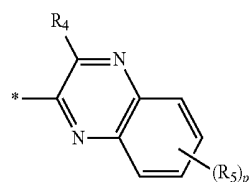
C-9



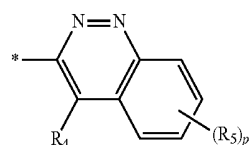
C-10



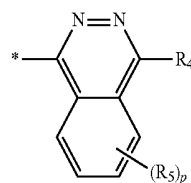
C-11



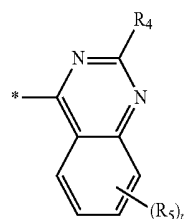
C-12



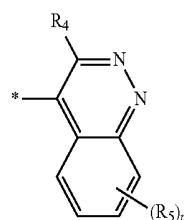
C-13



C-14



C-15



wherein,

R<sub>4</sub> is the same as defined in claim 1,

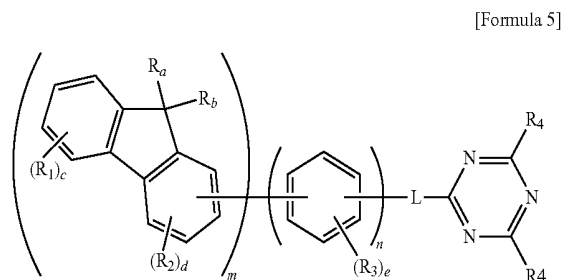
R<sub>5</sub> is selected from the group consisting of a hydrogen, a deuterium, a halogen, a cyano group, a nitro group, a C<sub>1</sub>-C<sub>40</sub> alkyl group, a C<sub>2</sub>-C<sub>40</sub> alkenyl group, a C<sub>2</sub>-C<sub>40</sub> alkynyl group, a C<sub>3</sub>-C<sub>40</sub> cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a C<sub>6</sub>-C<sub>60</sub> aryl group, a heteroaryl group having 5 to 60 nuclear

atoms, a C<sub>6</sub>-C<sub>60</sub> aryloxy group, a C<sub>1</sub>-C<sub>40</sub> alkyloxy group, a C<sub>6</sub>-C<sub>60</sub> arylamine group, a C<sub>1</sub>-C<sub>40</sub> alkylsilyl group, a C<sub>6</sub>-C<sub>60</sub> arylboron group, a C<sub>1</sub>-C<sub>40</sub> alkylboron group, a C<sub>6</sub>-C<sub>60</sub> arylphosphine group, a C<sub>6</sub>-C<sub>60</sub> arylphosphine oxide group, and a C<sub>6</sub>-C<sub>60</sub> arylsilyl group, or combines with an adjacent substituent to form a fused ring,

p is an integer of 1 to 4,

the alkyl, alkenyl, alkynyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, aryloxy, alkyloxy, arylamine, alkylsilyl, alkylboron, arylboron, arylphosphine, arylphosphine oxide and arylsilyl groups of R<sub>5</sub> are optionally each independently unsubstituted or substituted with at least one selected from the group consisting of a deuterium, a halogen, a cyano group, a nitro group, a C<sub>1</sub>-C<sub>40</sub> alkyl group, a C<sub>2</sub>-C<sub>40</sub> alkenyl group, a C<sub>2</sub>-C<sub>40</sub> alkynyl group, a C<sub>6</sub>-C<sub>60</sub> aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a C<sub>6</sub>-C<sub>60</sub> aryloxy group, a C<sub>1</sub>-C<sub>40</sub> alkyloxy group, a C<sub>6</sub>-C<sub>60</sub> arylamine group, a C<sub>3</sub>-C<sub>40</sub> cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a C<sub>1</sub>-C<sub>40</sub> alkylsilyl group, a C<sub>1</sub>-C<sub>40</sub> alkylboron group, a C<sub>6</sub>-C<sub>60</sub> arylboron group, a C<sub>6</sub>-C<sub>60</sub> arylphosphine group, a C<sub>6</sub>-C<sub>60</sub> arylphosphine oxide group and a C<sub>6</sub>-C<sub>60</sub> arylsilyl group, and provided that when the substituent is present in a plural number, they are optionally the same or different from each other.

4. The Compound of claim 3, wherein the compound represented by Formula 1 is represented by the following Formula 5:

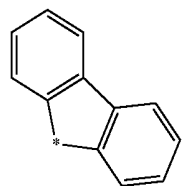


wherein,

R<sub>a</sub>, R<sub>b</sub>, R<sub>1</sub> to R<sub>4</sub>, L, c, d, e, m, and n are the same as defined in claim 1.

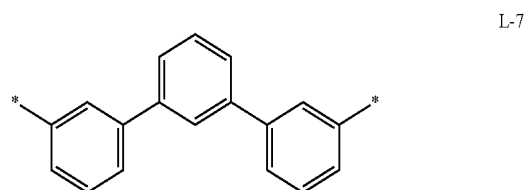
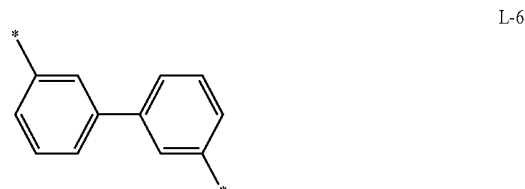
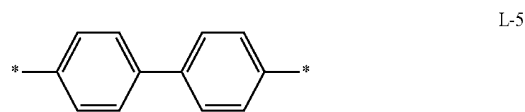
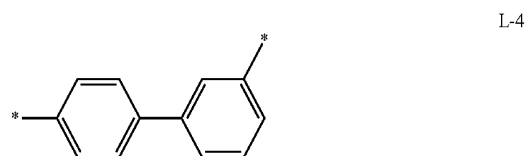
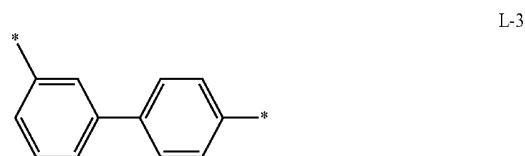
5. The Compound of claim 4, wherein R<sub>4</sub>'s on the compound represented by Formula 5 are identical.

6. The Compound of claim 1, wherein R<sub>a</sub> and R<sub>b</sub> are each independently a methyl or a phenyl or bond each other to form a fused ring represented by



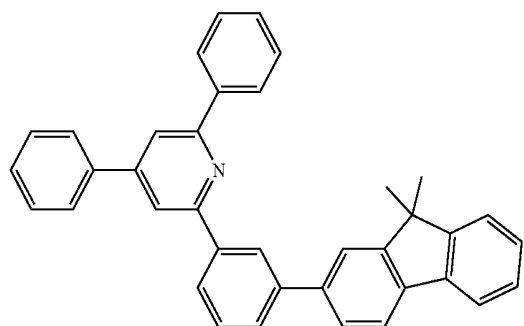
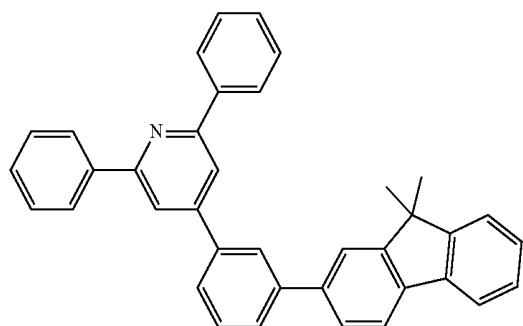
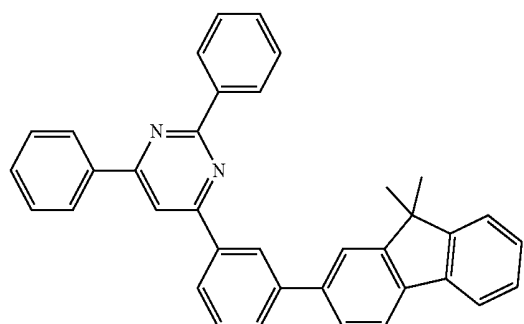
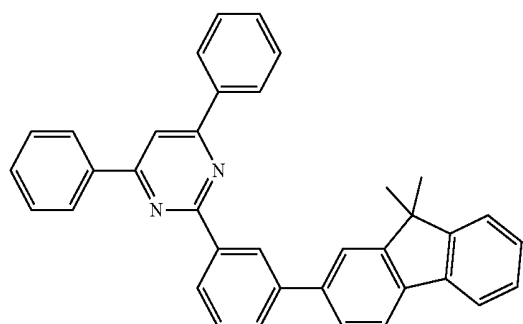
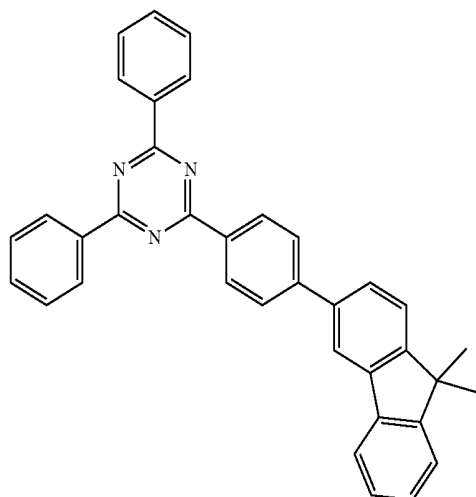
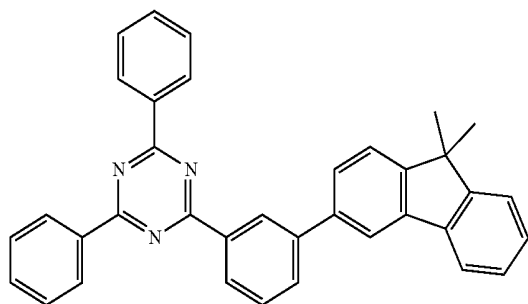
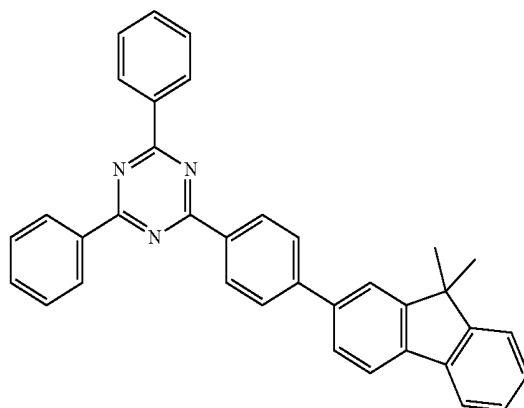
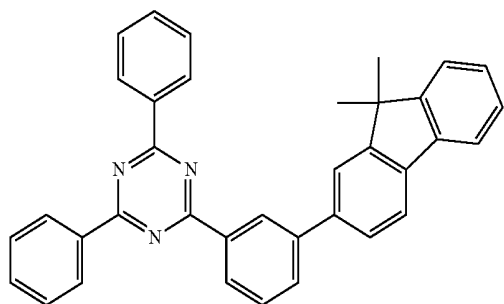
wherein \* is a site where to bond.

7. The compound of claim 1, wherein L is selected from the group consisting of the structures represented by the following L-1 to L-7:



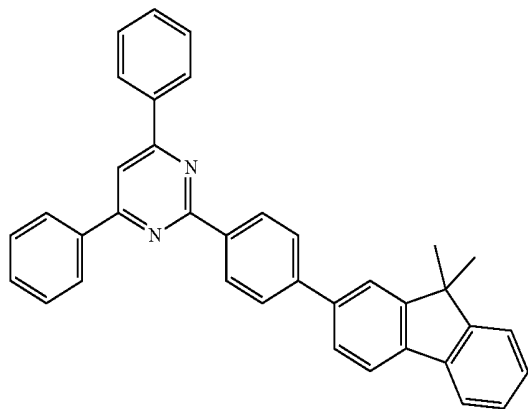
wherein \* is a site where to bond.

8. The Compound of claim 1, wherein the compound represented by Formula 1 is selected from the group consisting of the following Compounds 1 to 366:

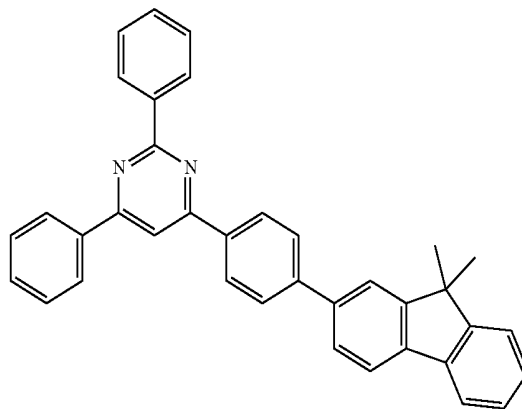


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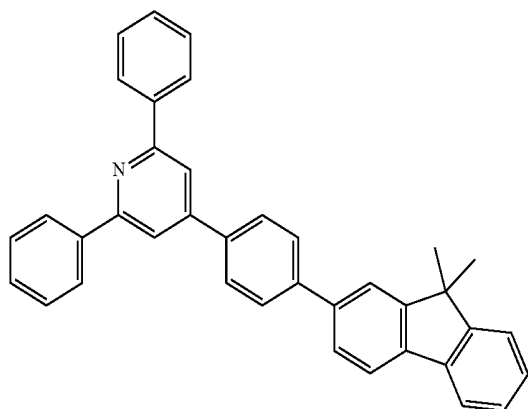
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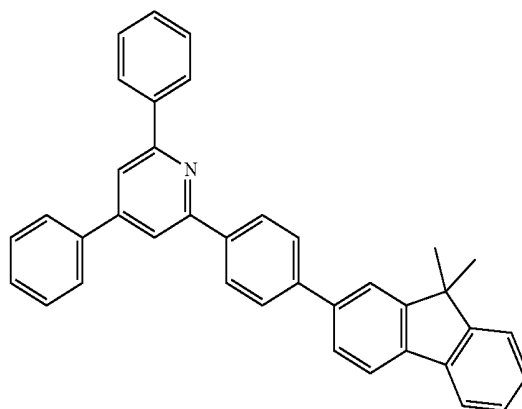
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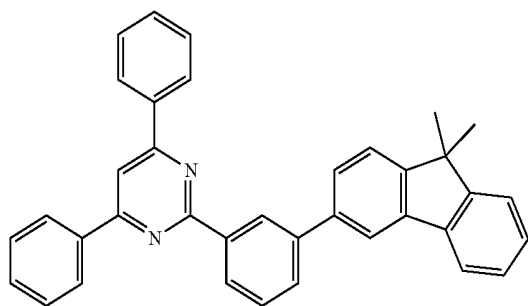
11



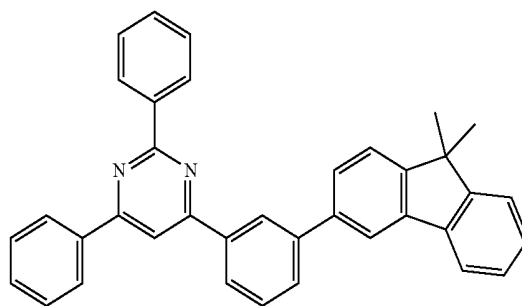
12



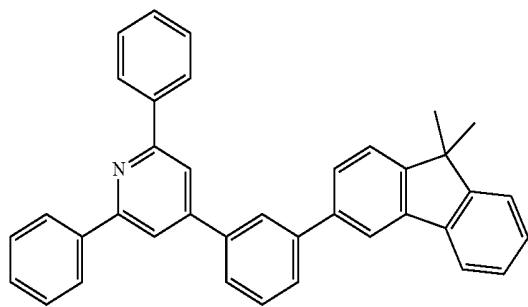
13



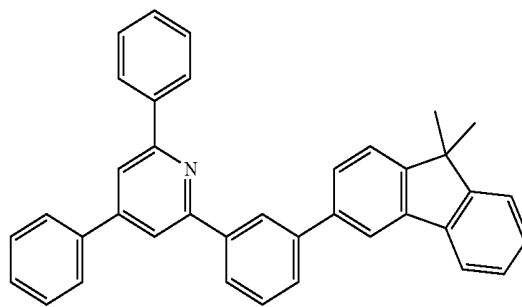
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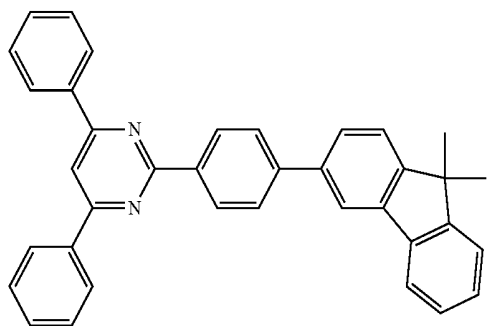
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16

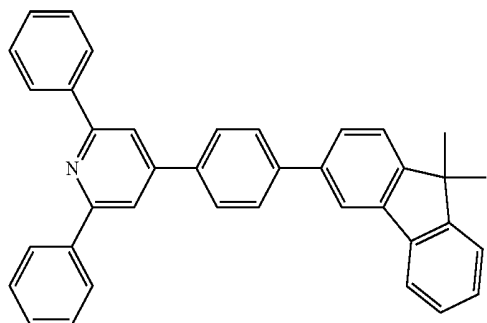
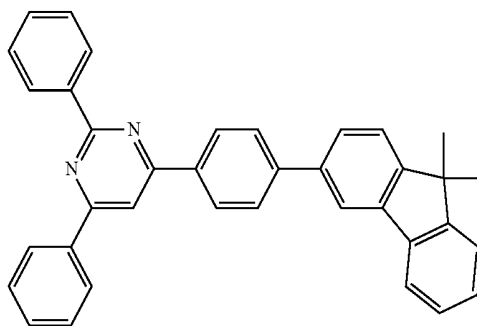


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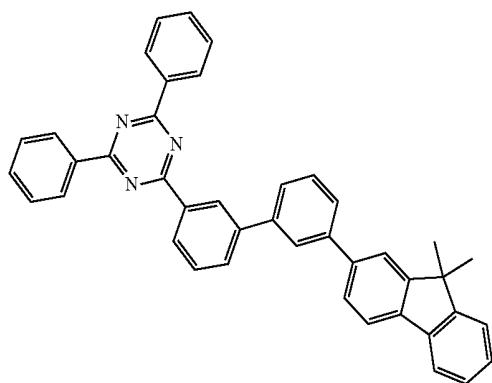
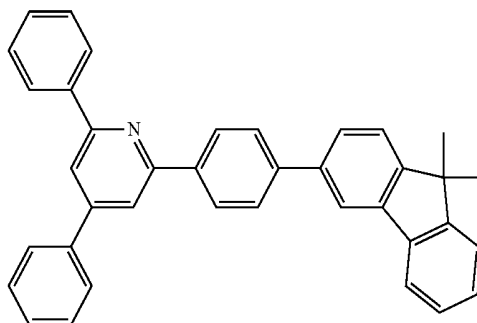
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18



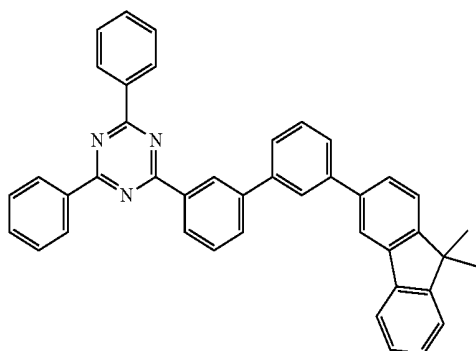
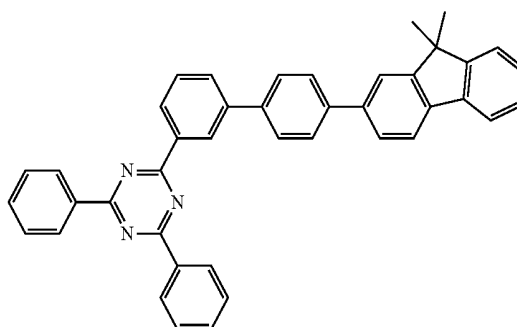
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20



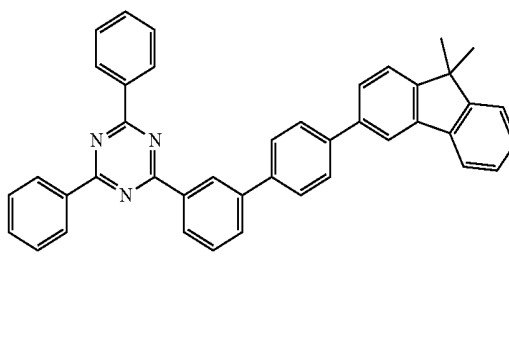
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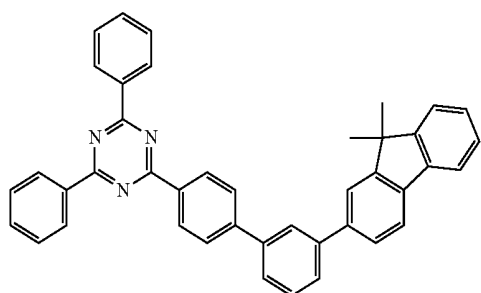


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24

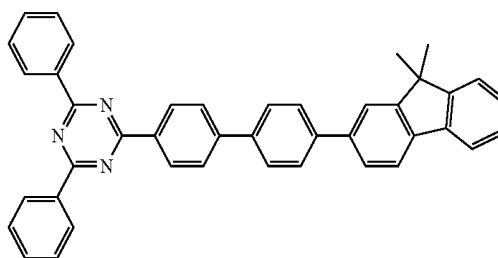


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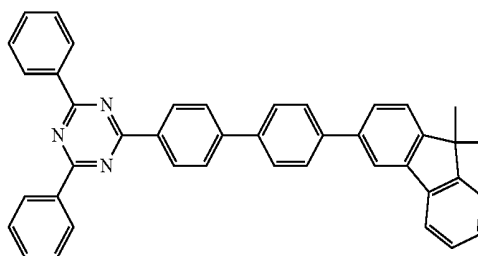
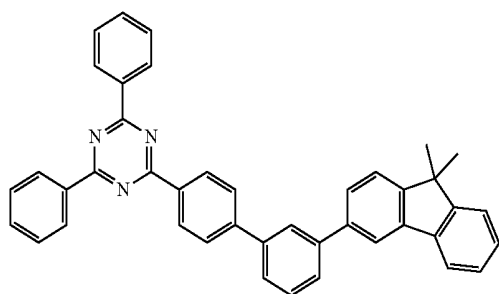
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26



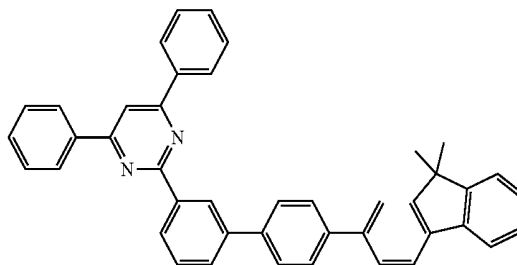
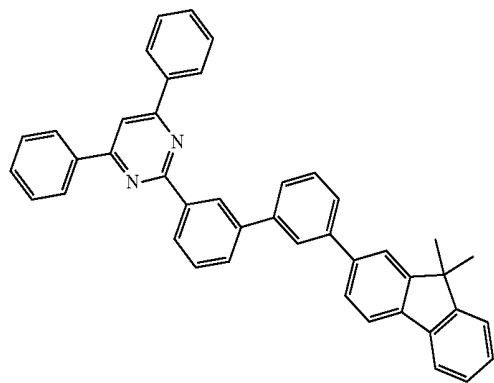
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28



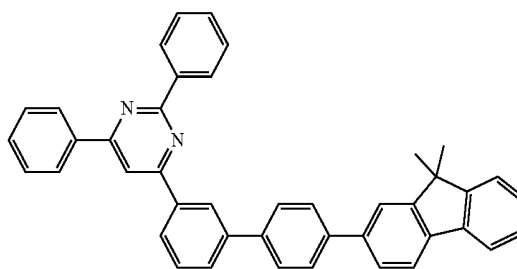
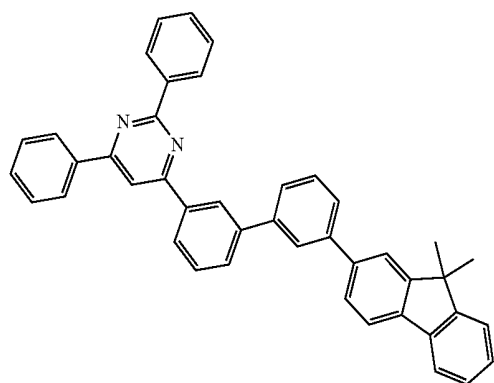
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30

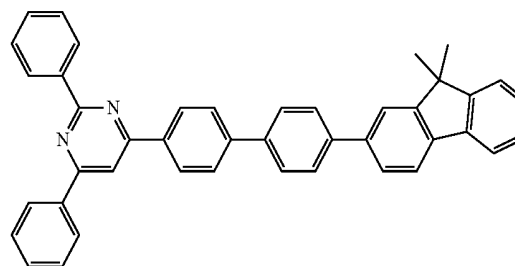
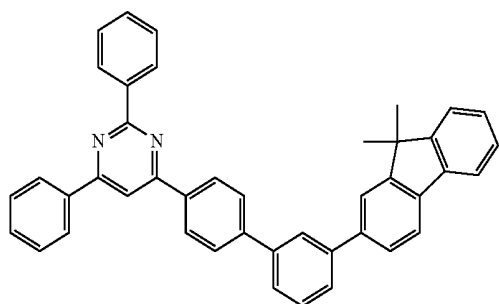
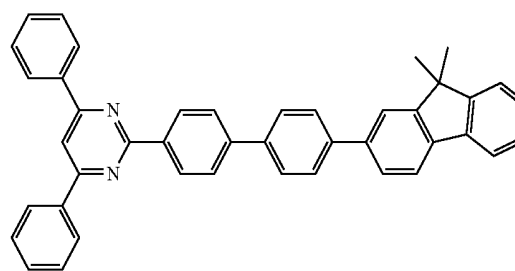
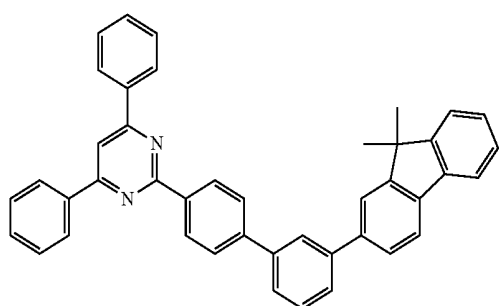
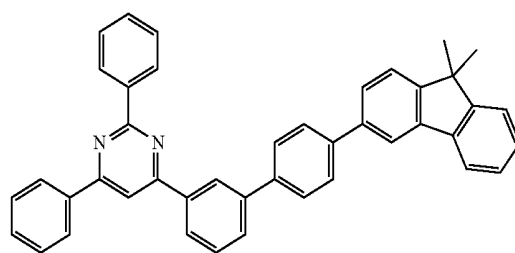
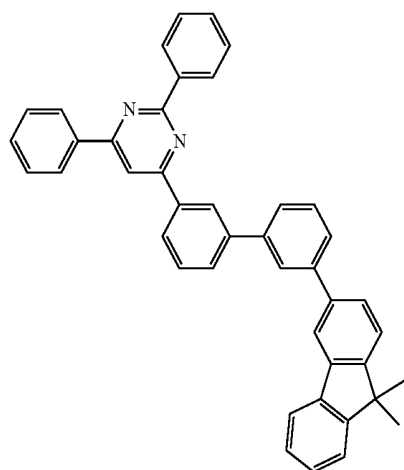
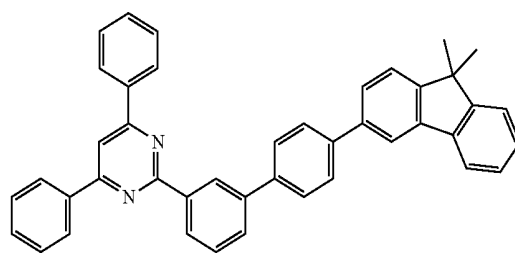
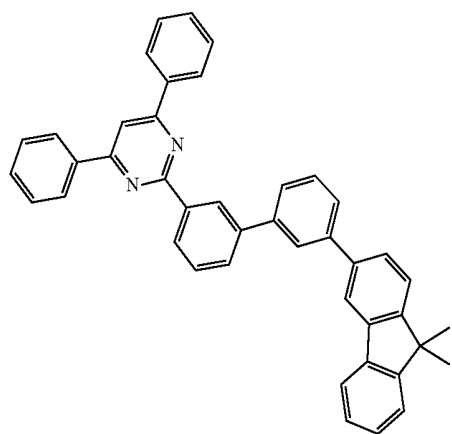


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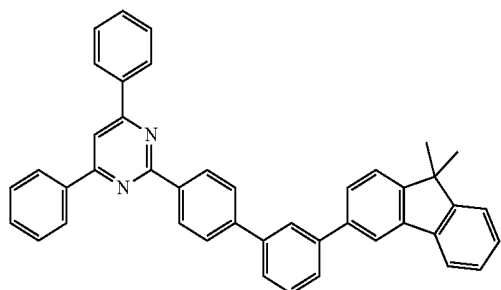
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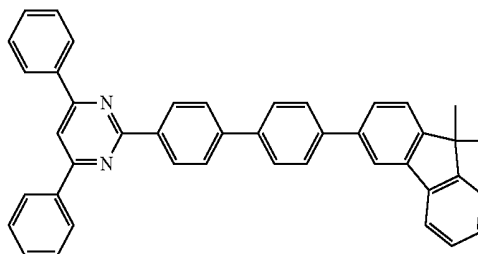
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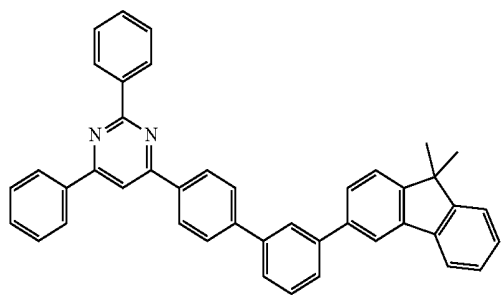
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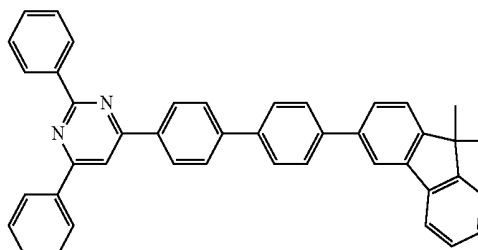
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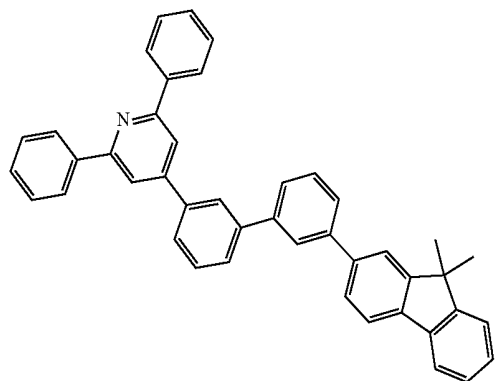
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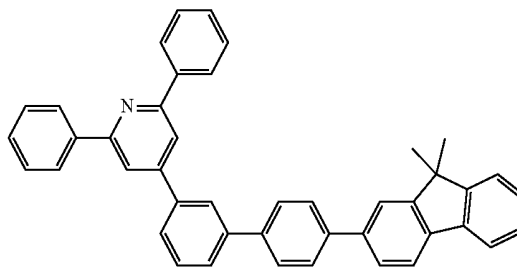
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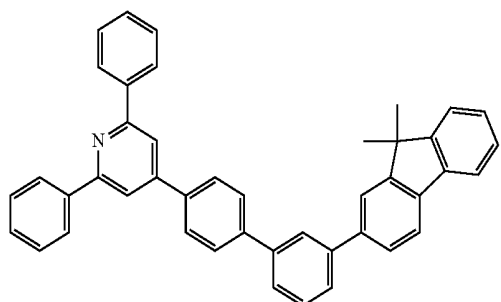
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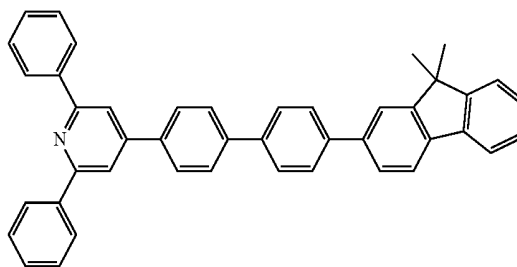
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46



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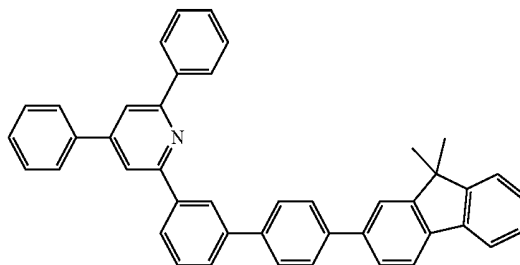
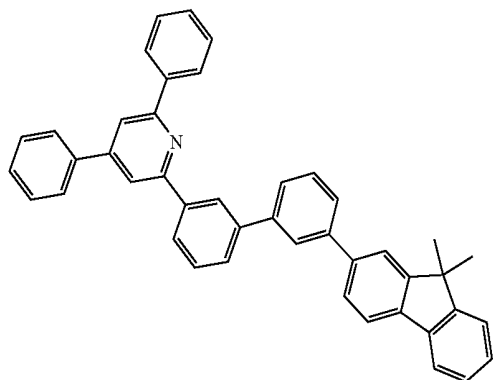


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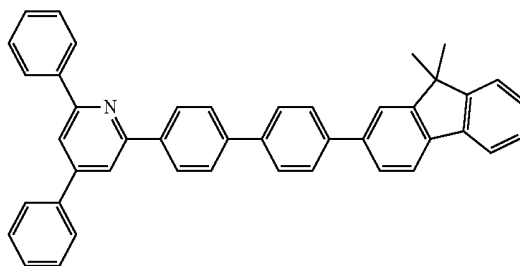
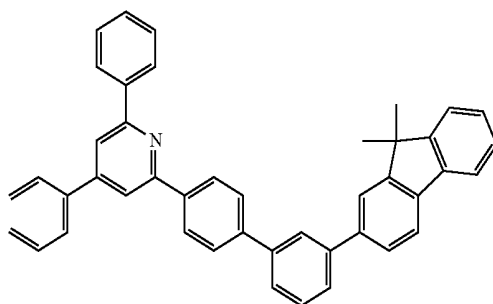
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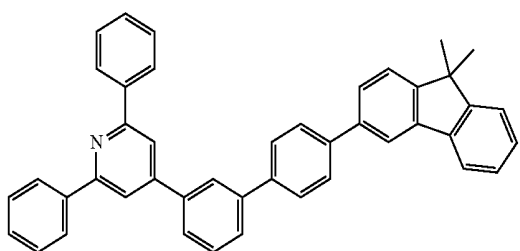
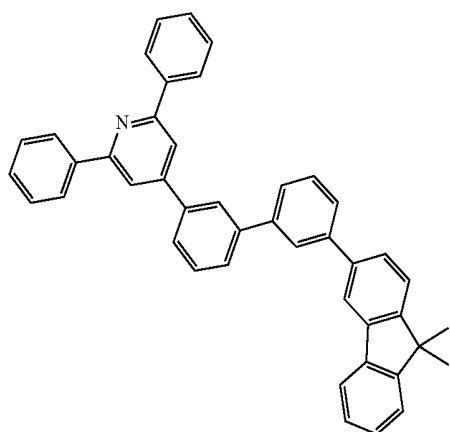
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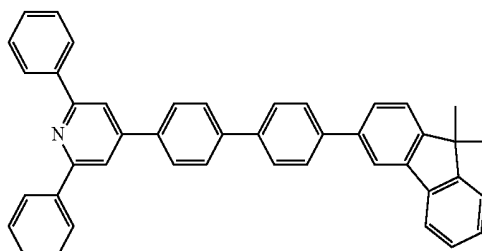
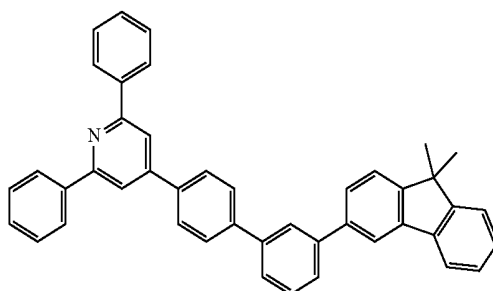
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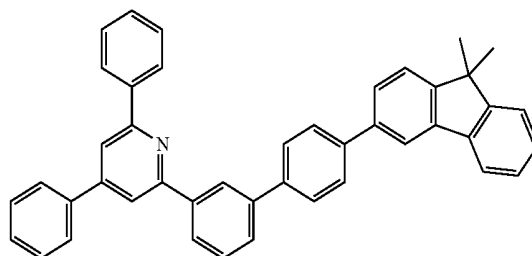
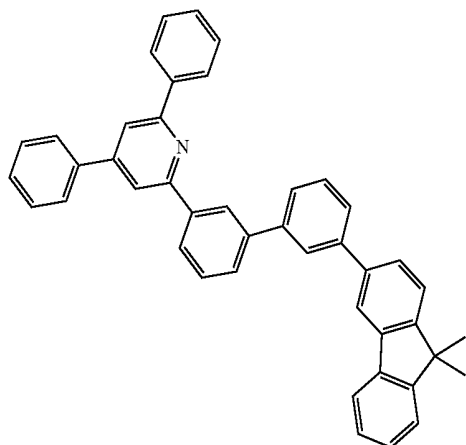
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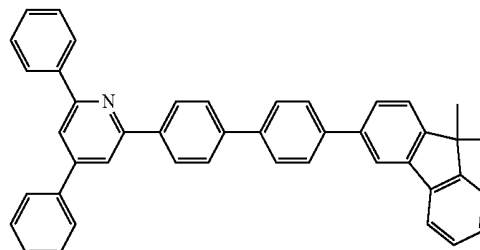
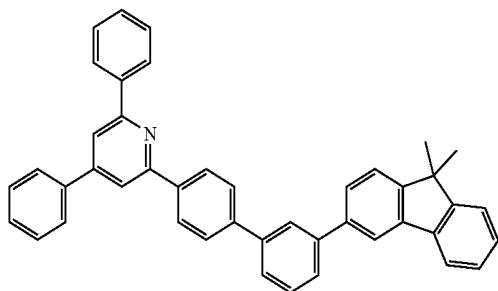
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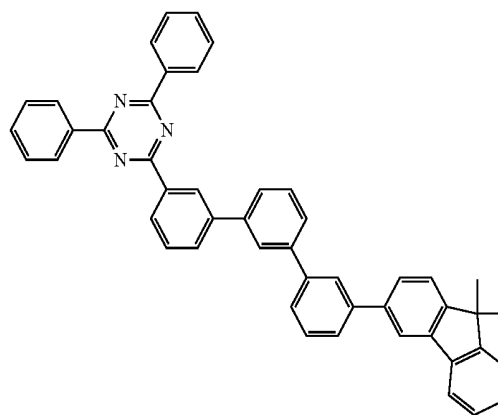
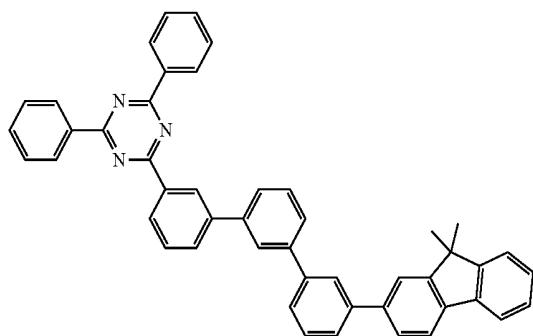
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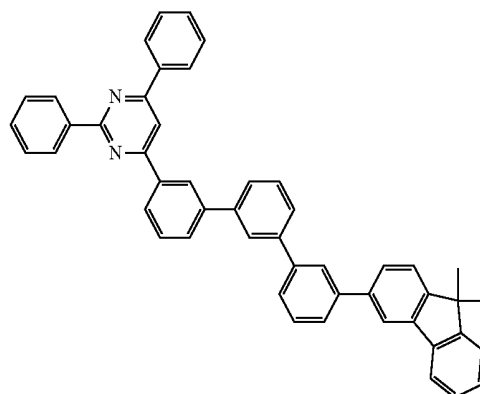
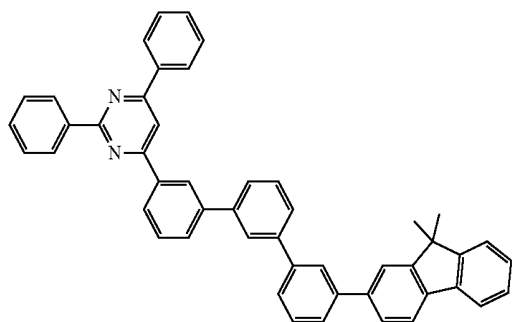
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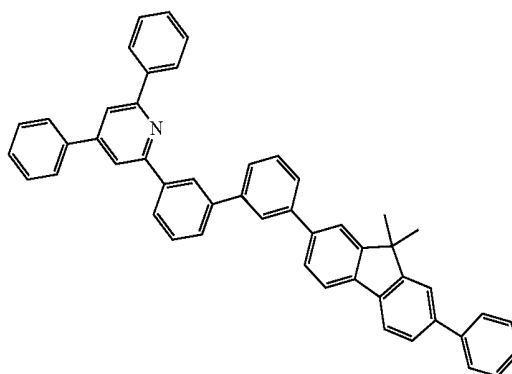
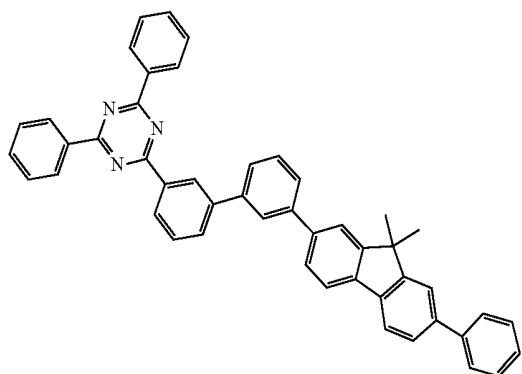
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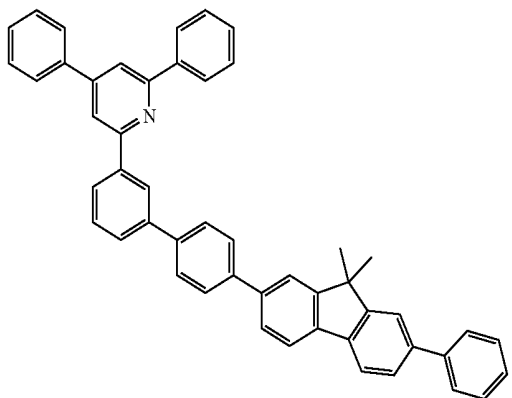
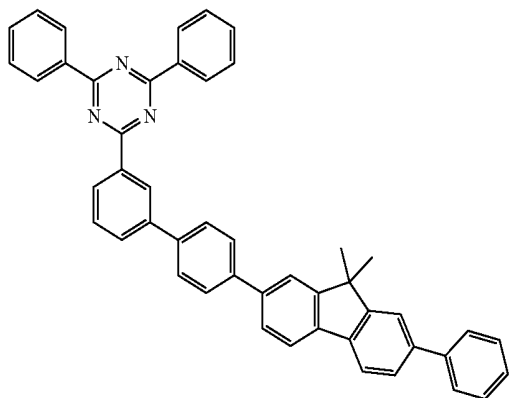
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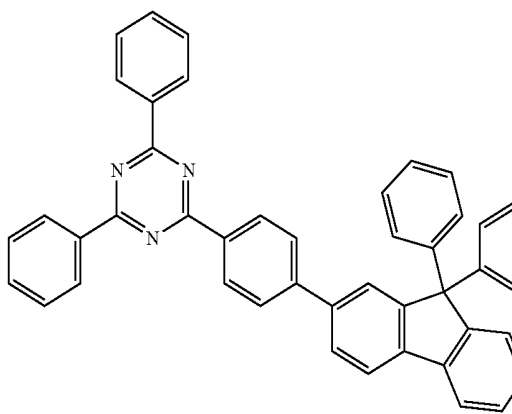
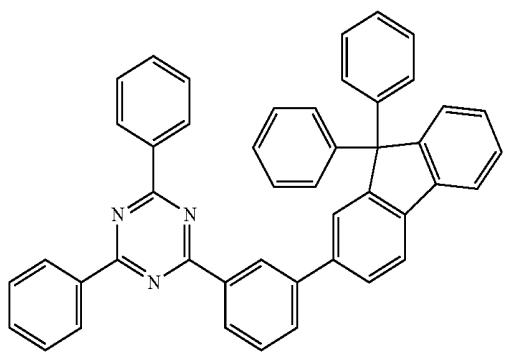
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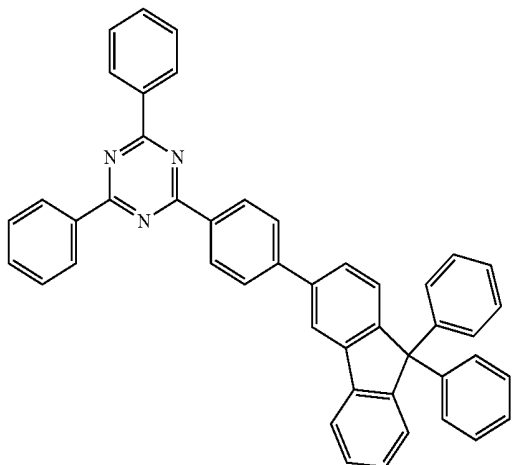
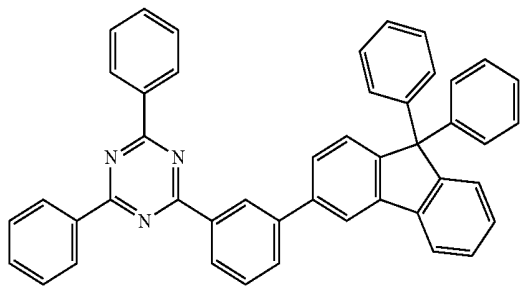
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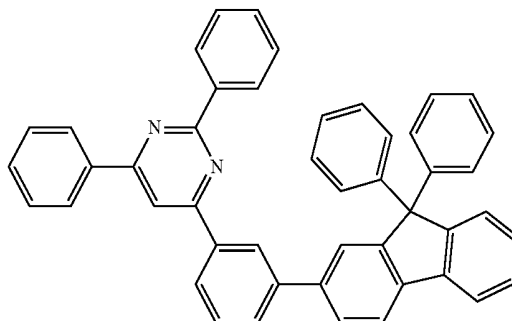
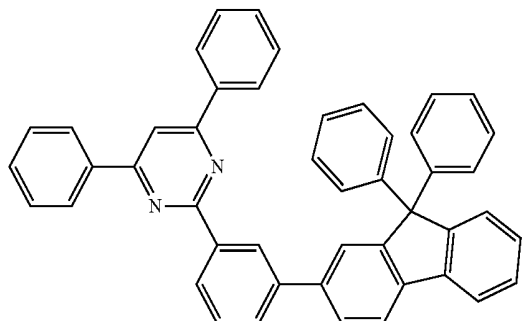
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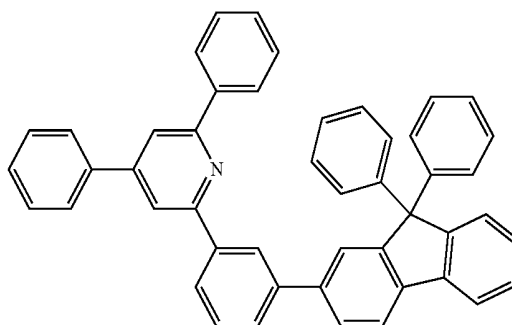
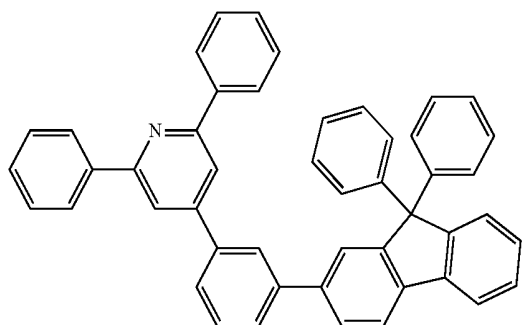
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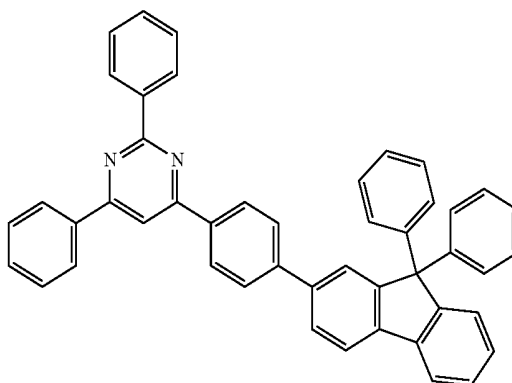
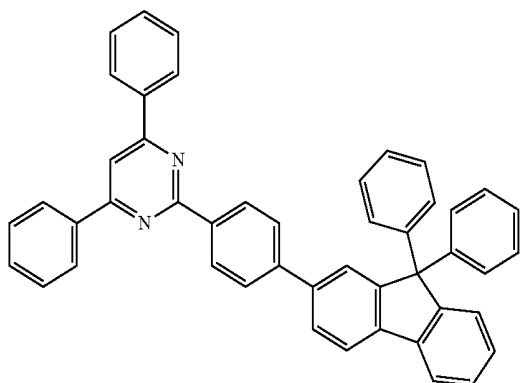
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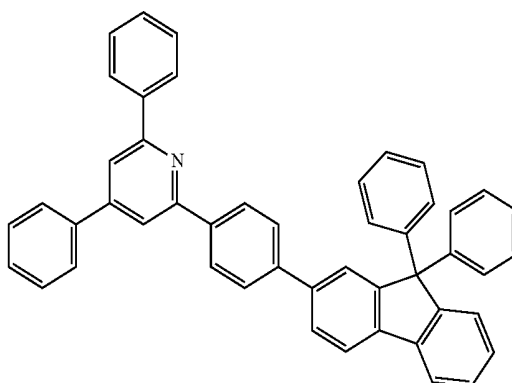
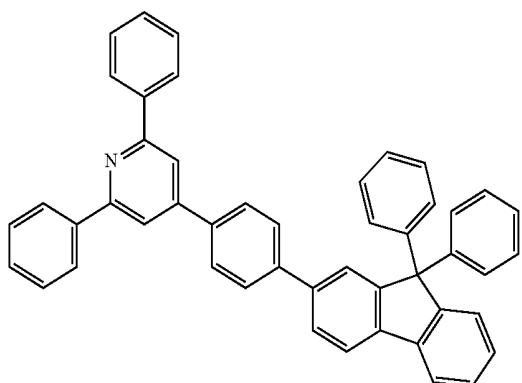
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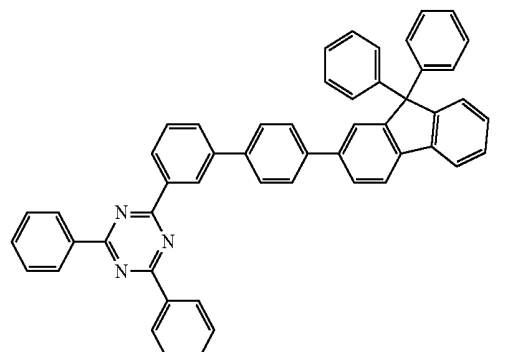
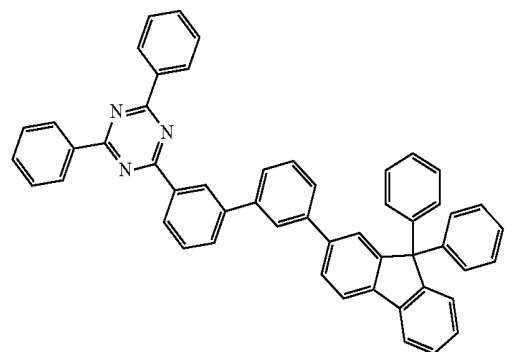
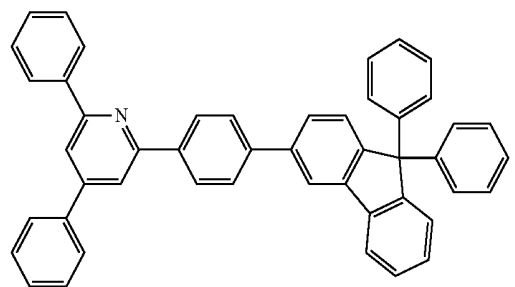
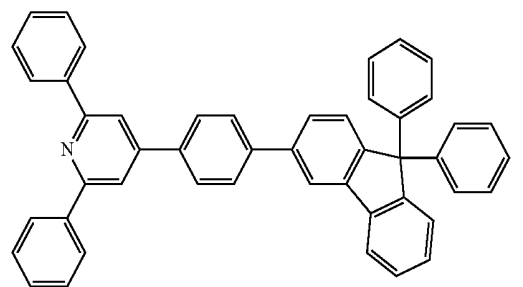
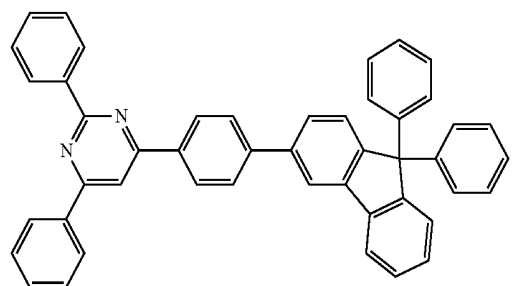
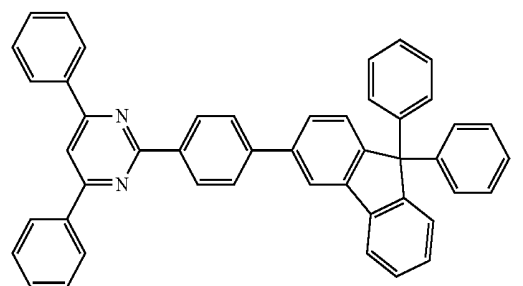
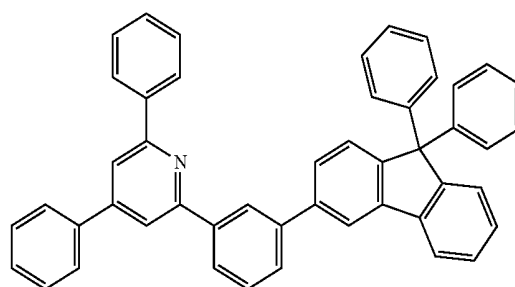
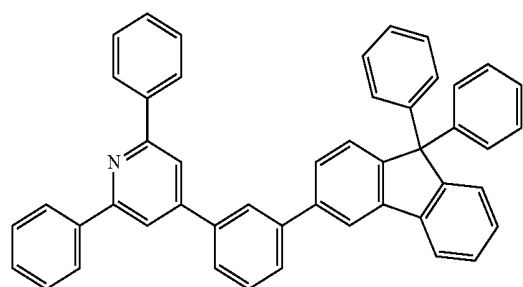
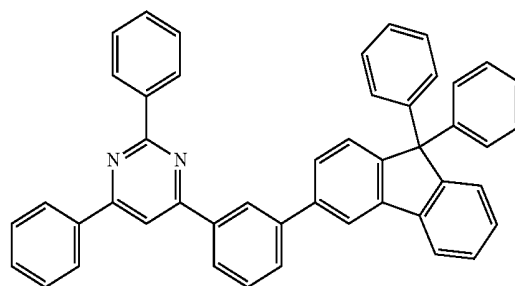
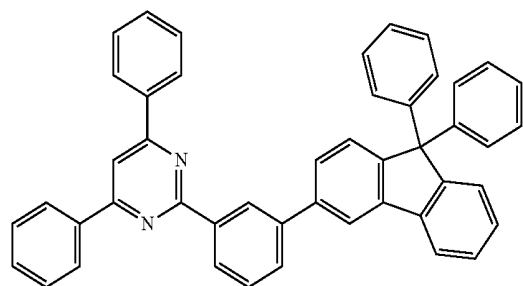


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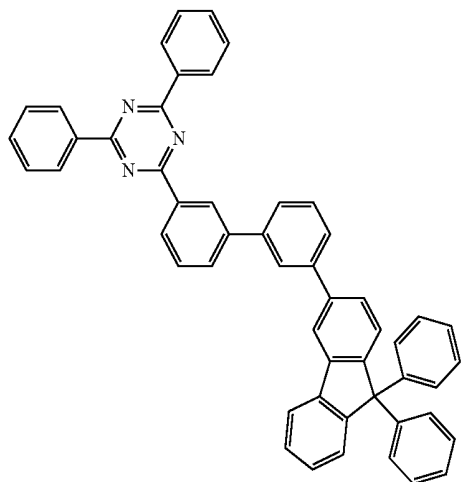


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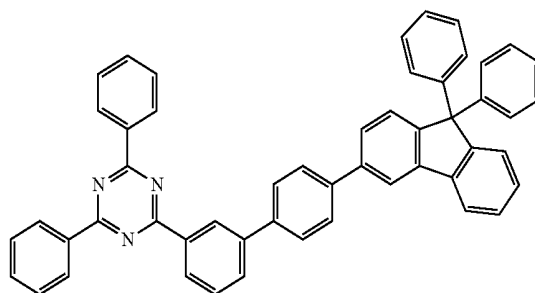


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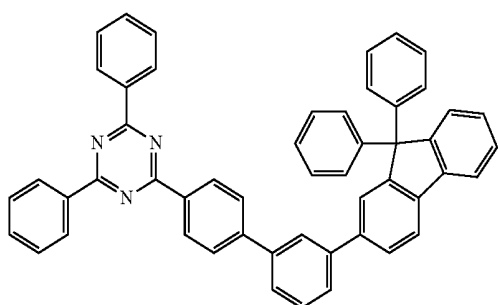
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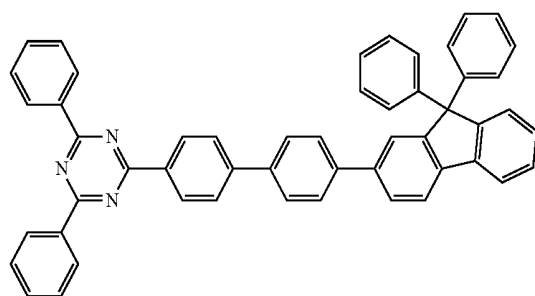
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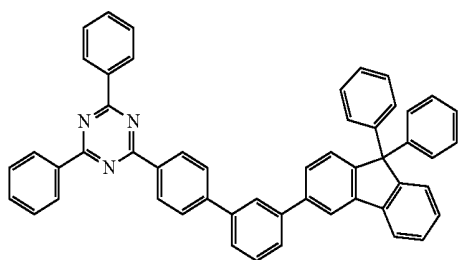
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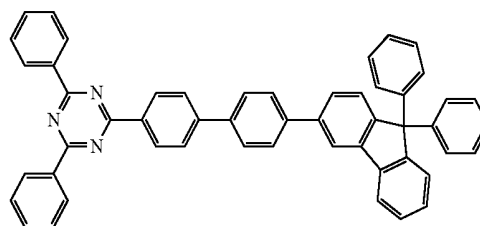
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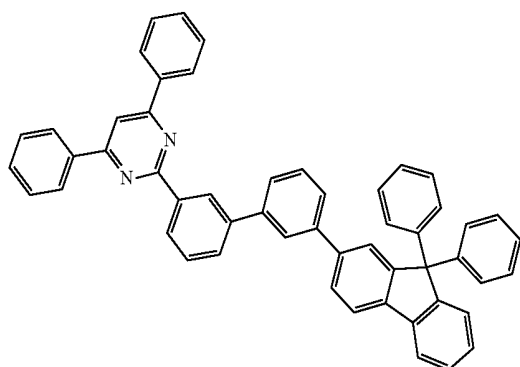
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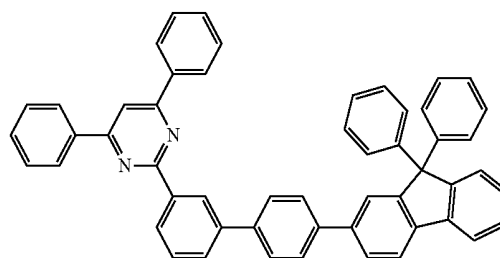
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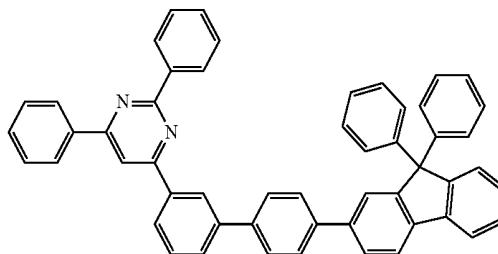
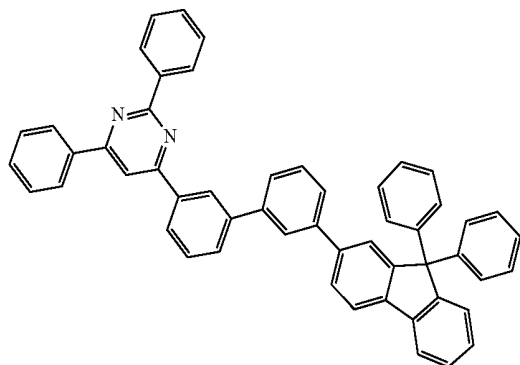
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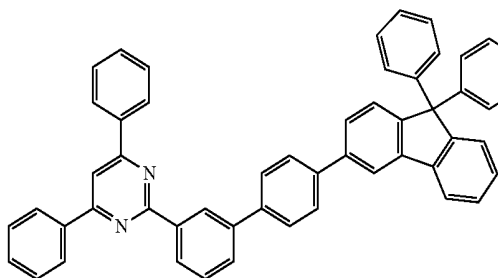
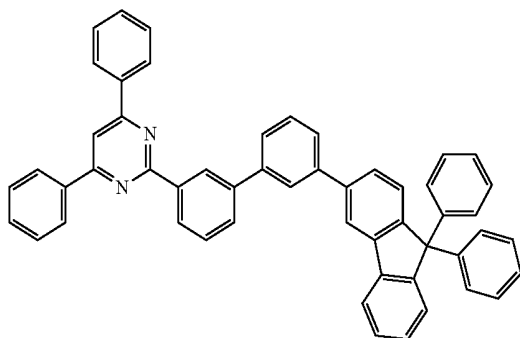
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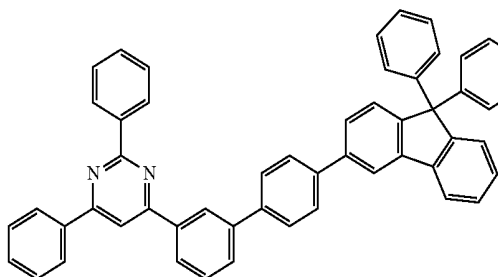
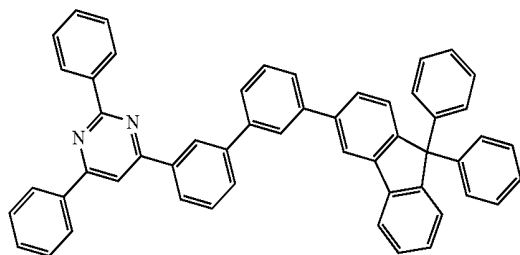
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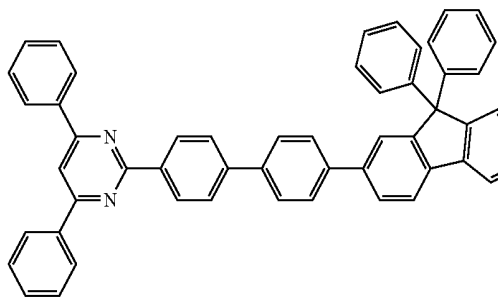
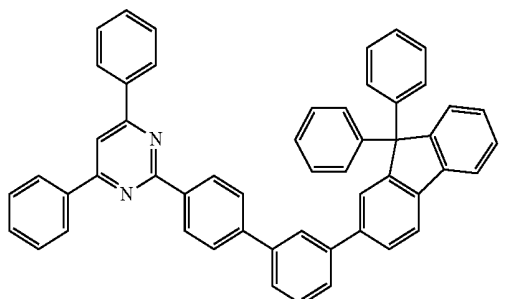
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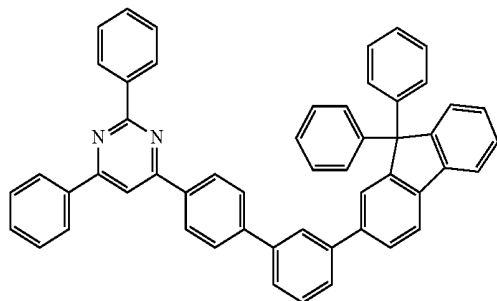
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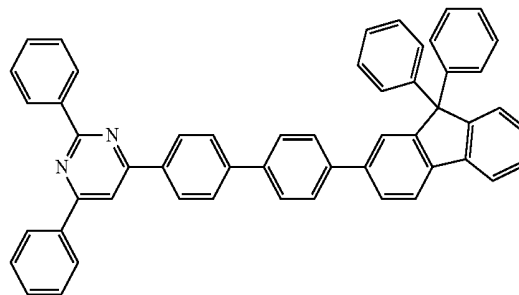


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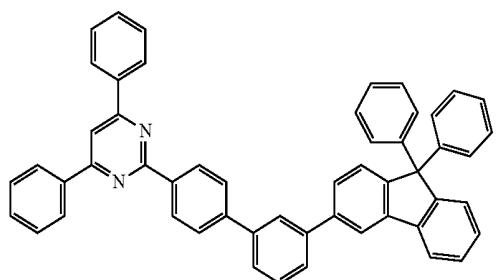
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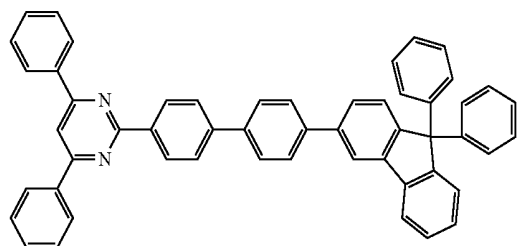
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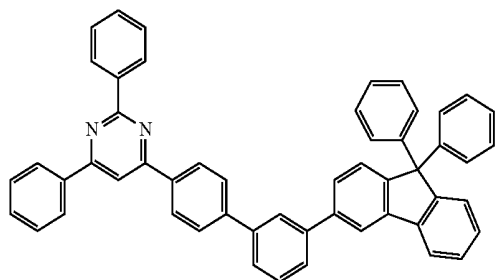
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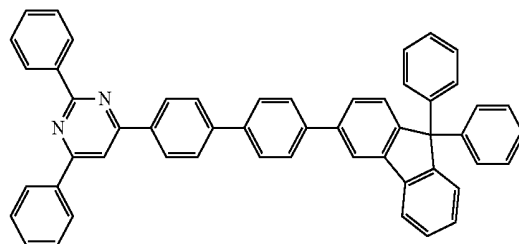
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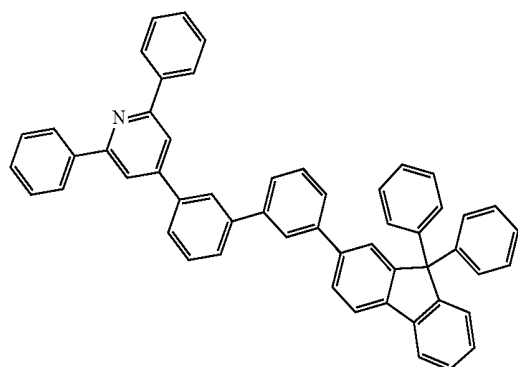
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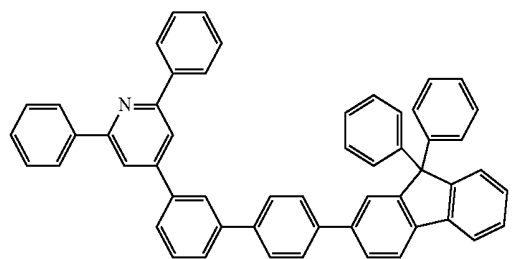
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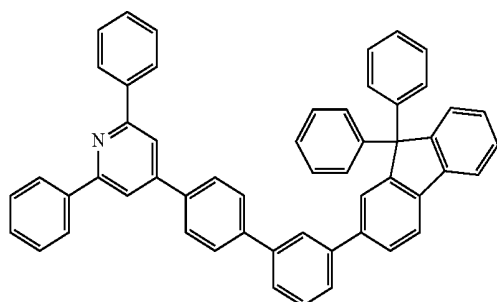
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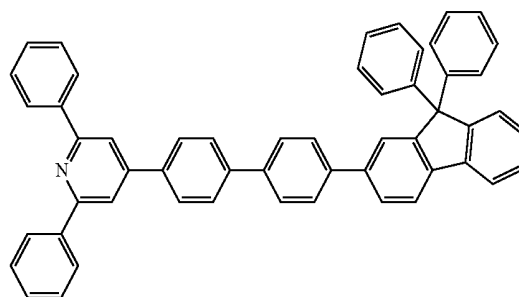
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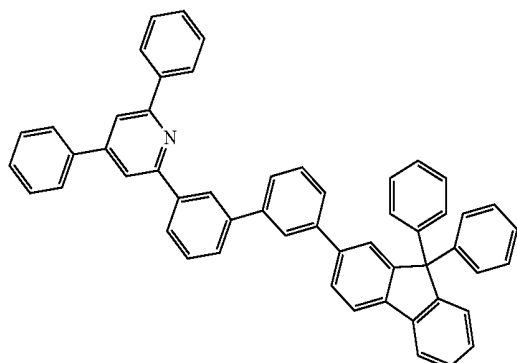


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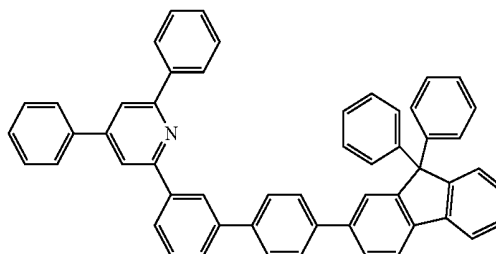


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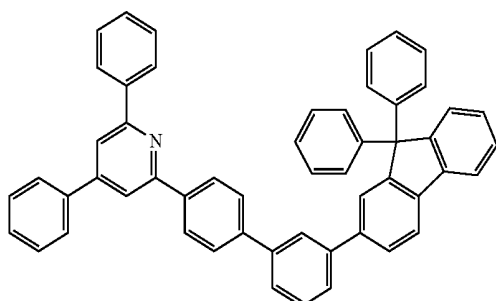


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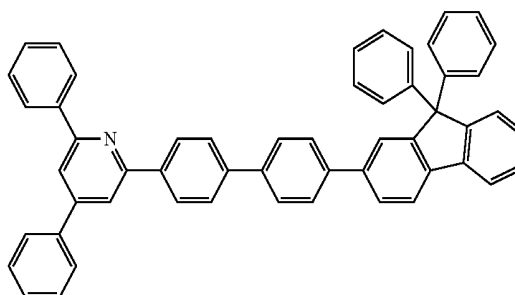
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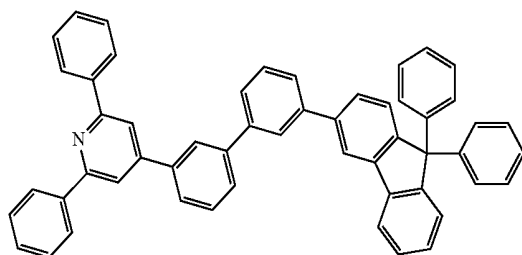
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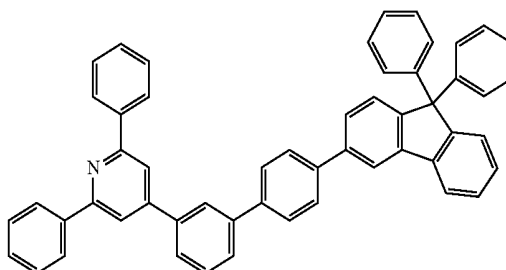
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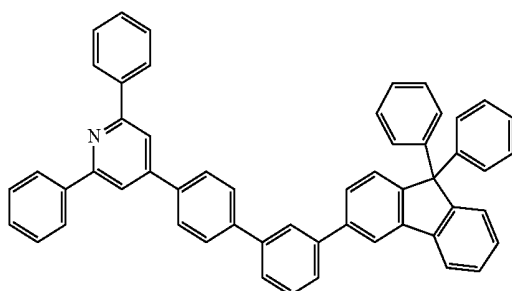
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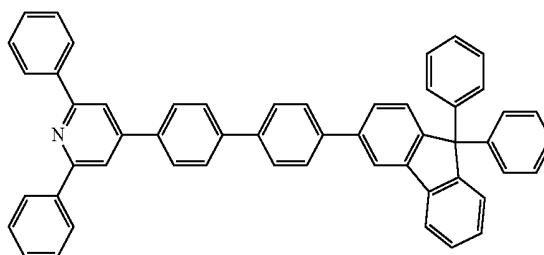
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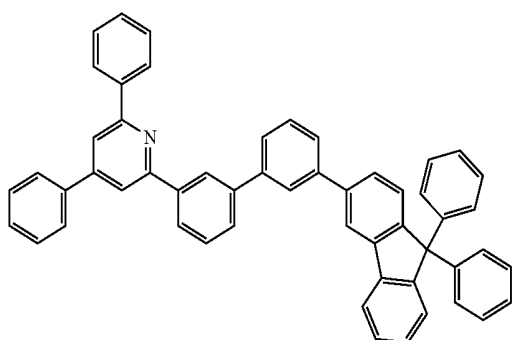
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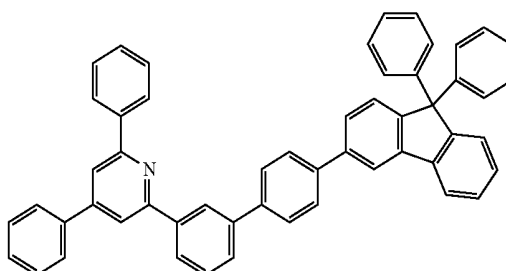
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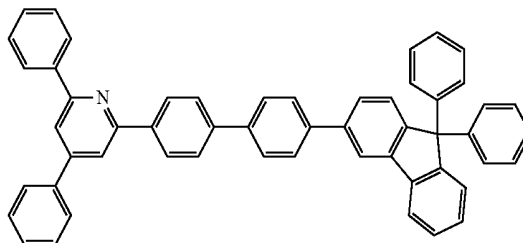
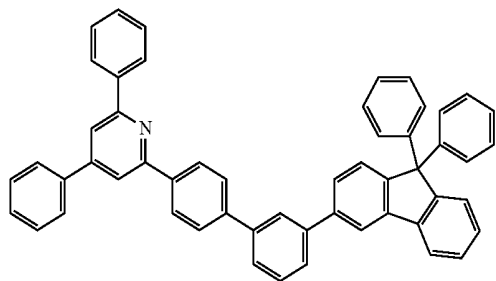
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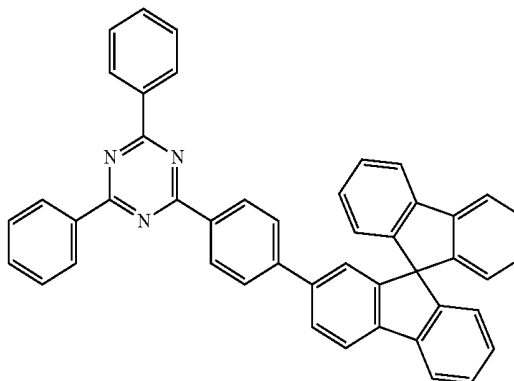
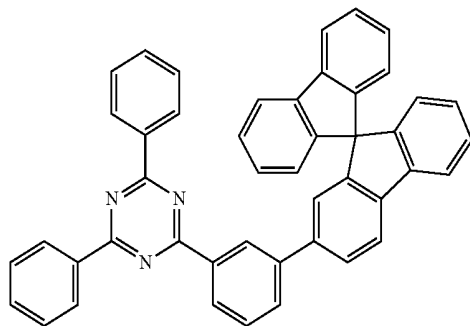
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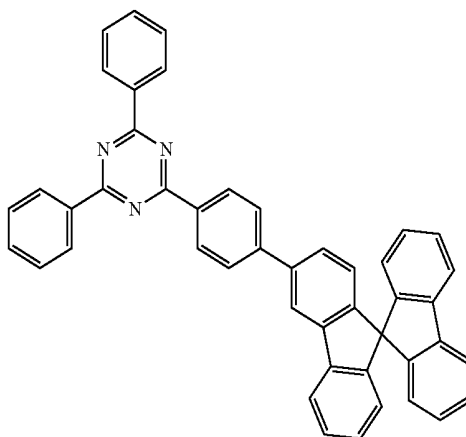
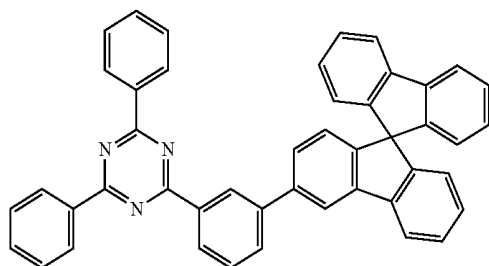
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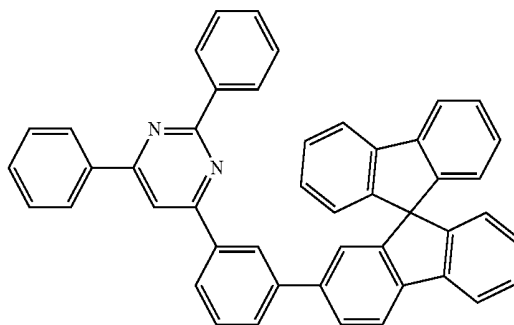
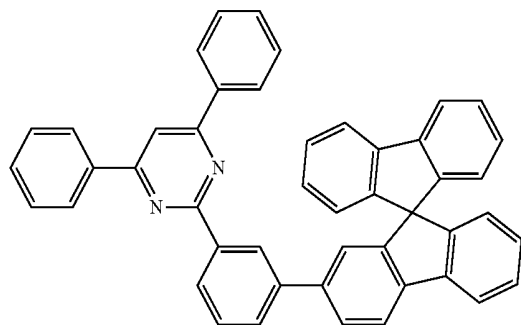
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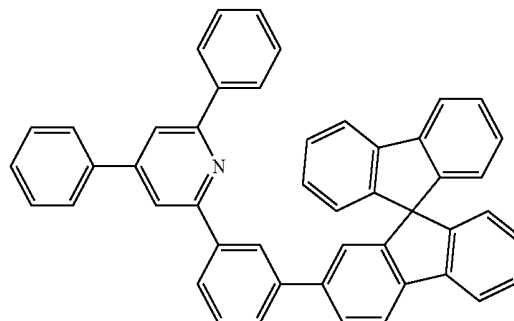
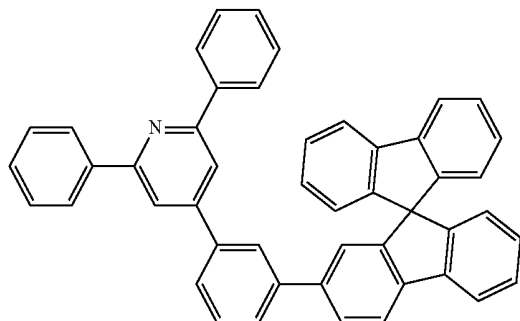
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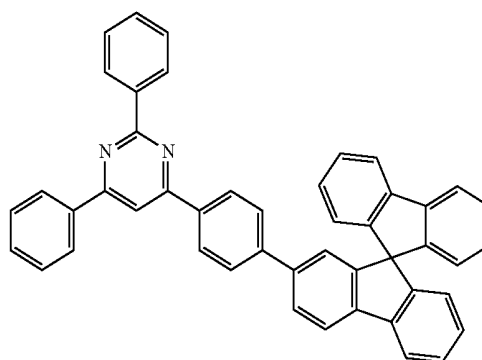
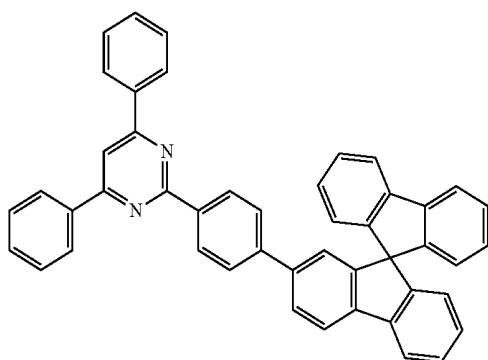
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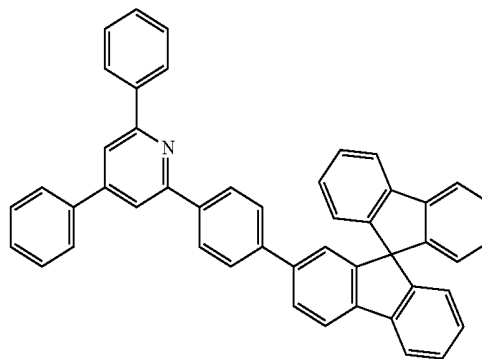
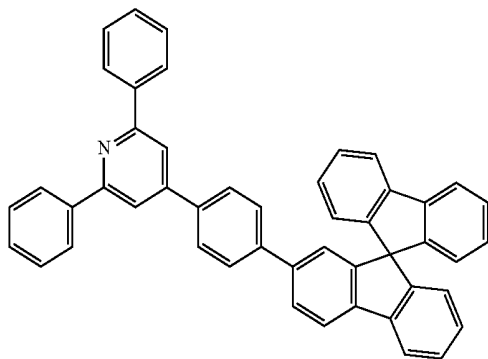
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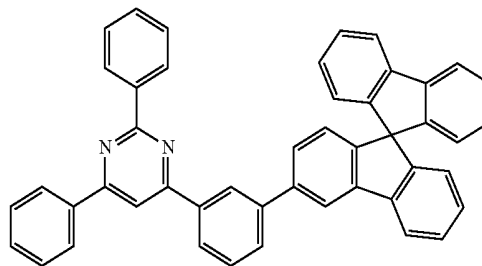
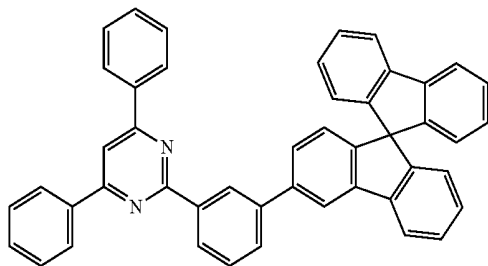
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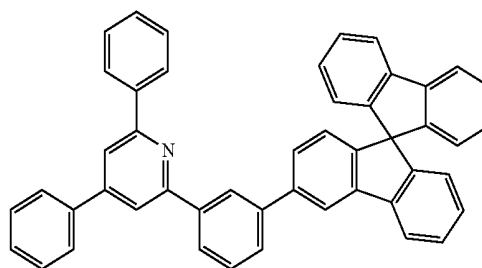
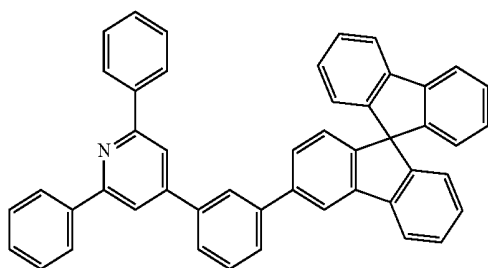
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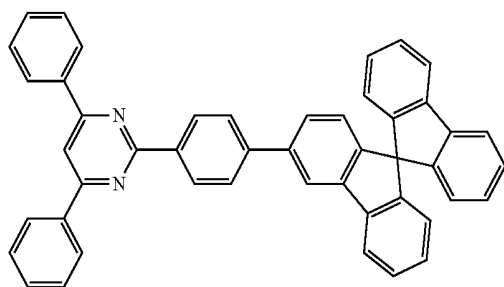


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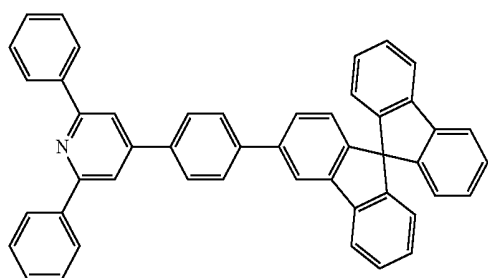
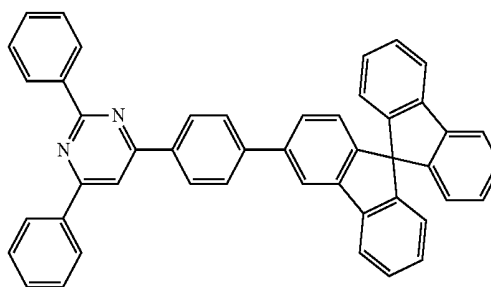


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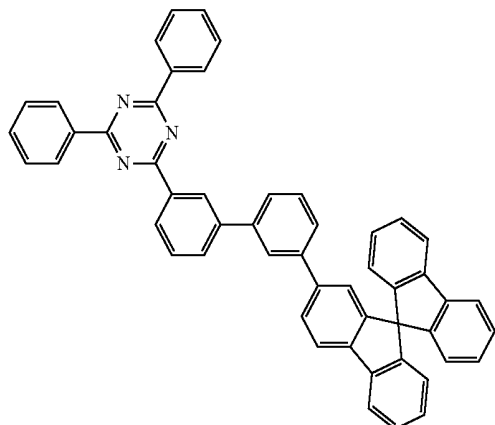
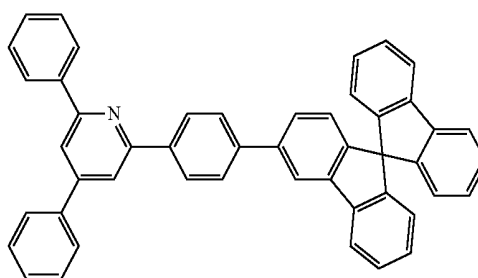
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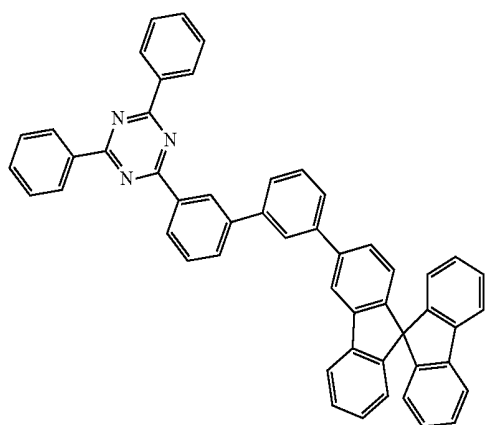
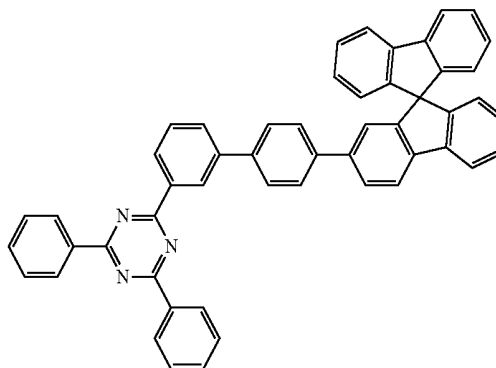
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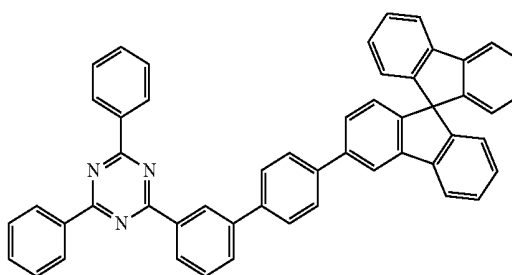
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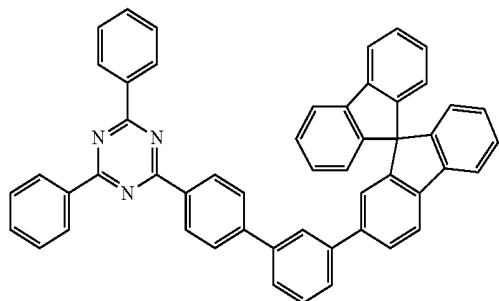
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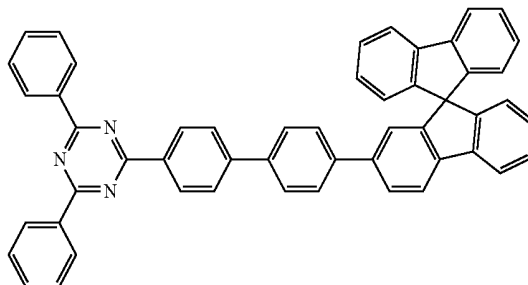


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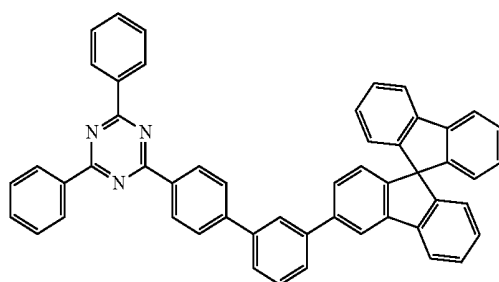
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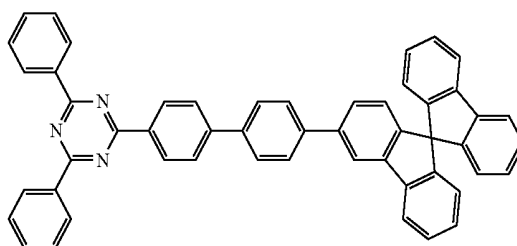
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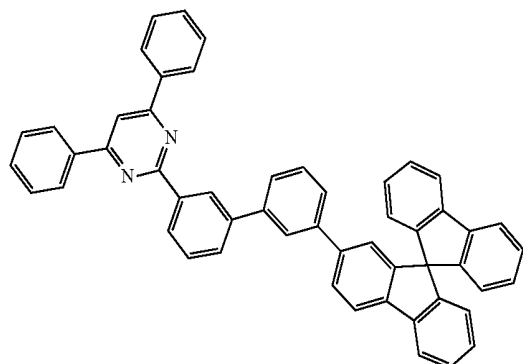
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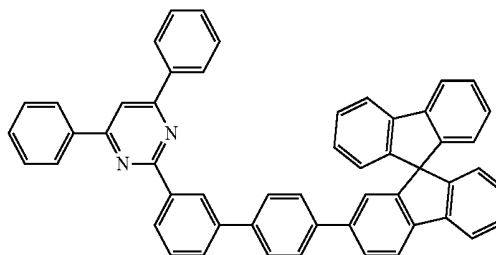
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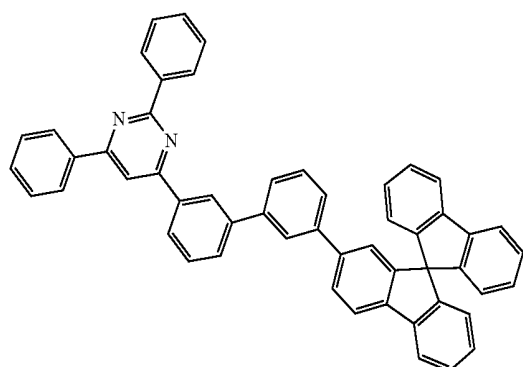
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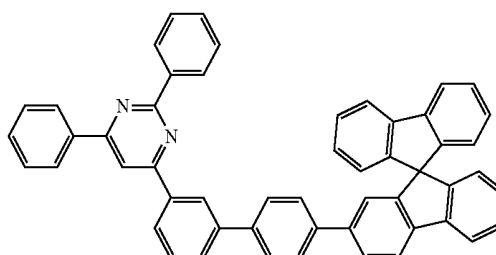
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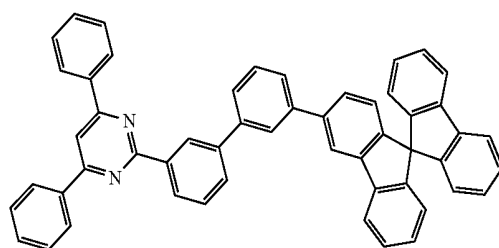
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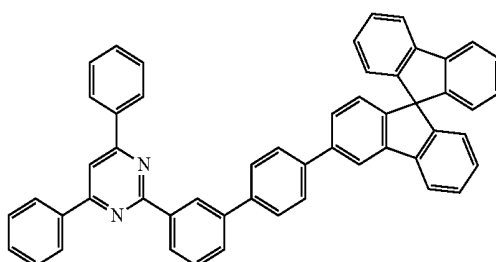
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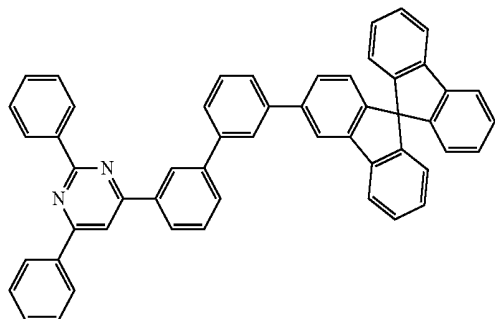


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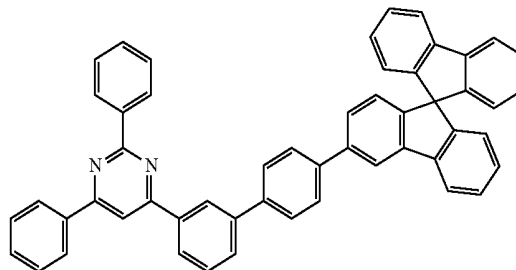


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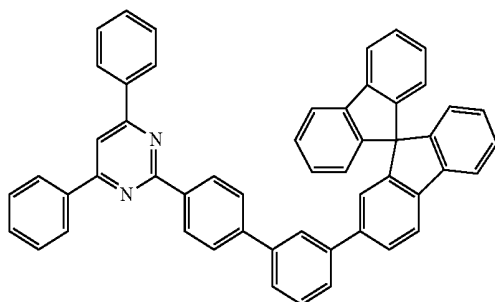
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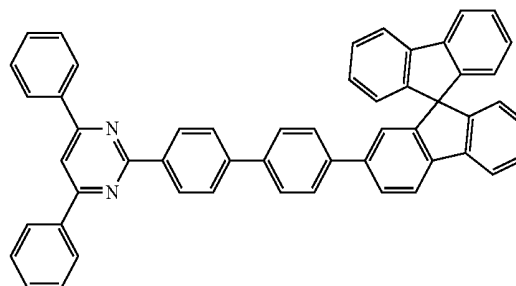
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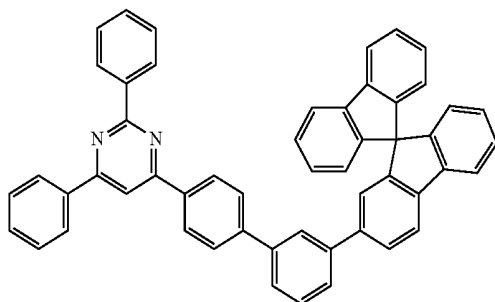
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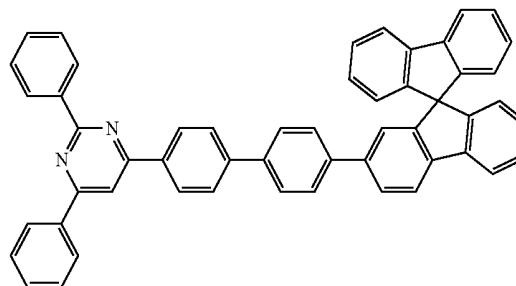
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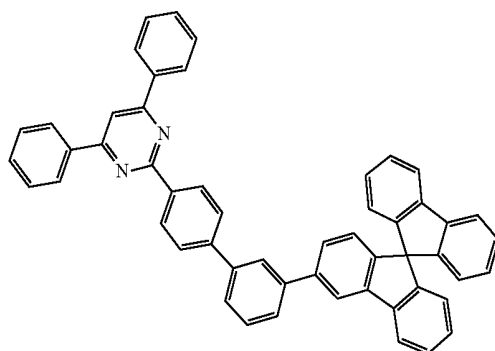
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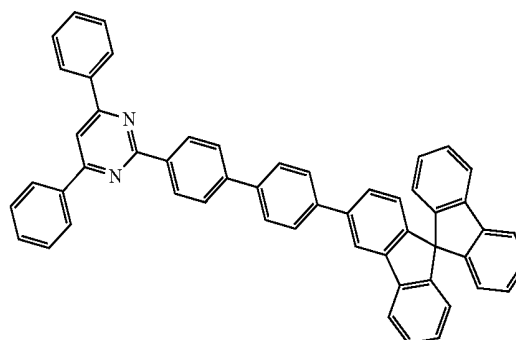
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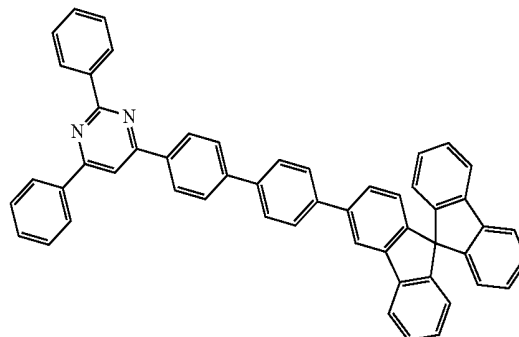
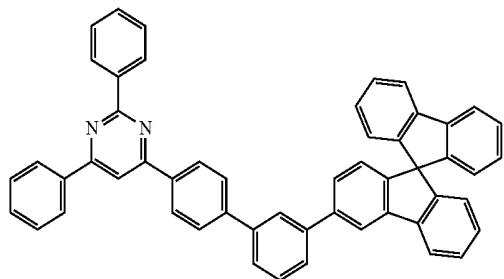
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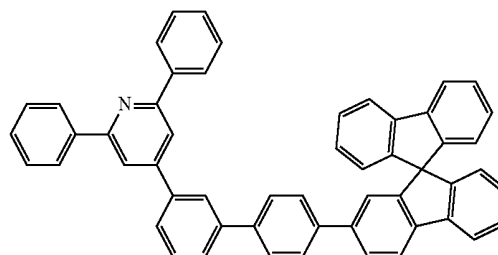
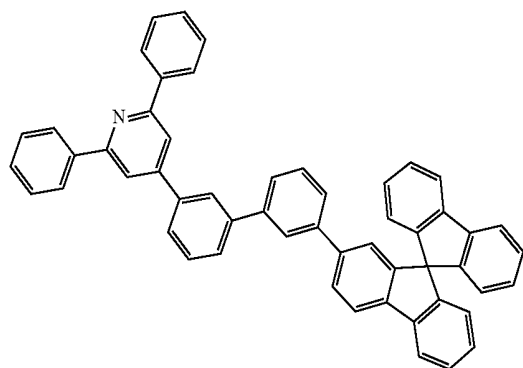
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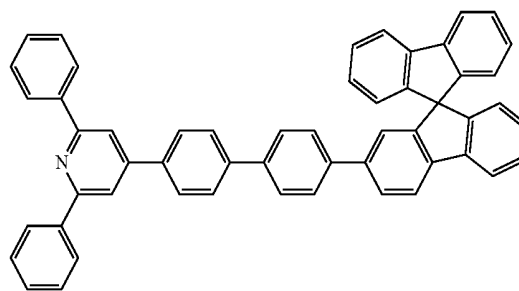
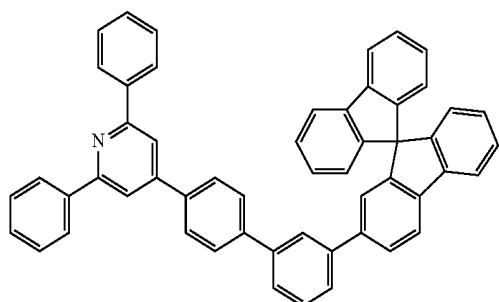
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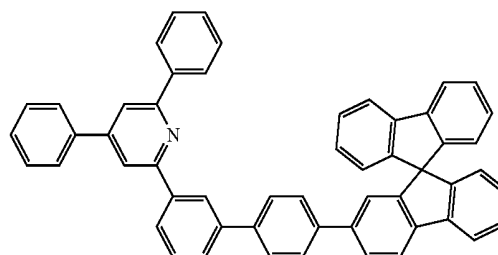
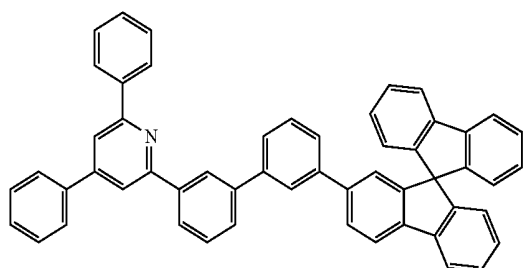
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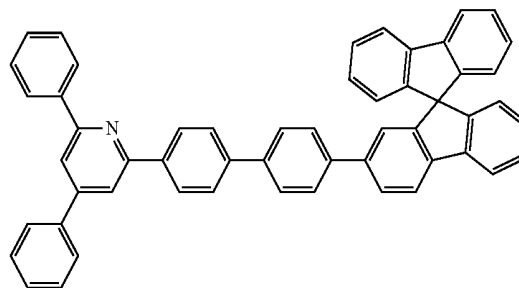
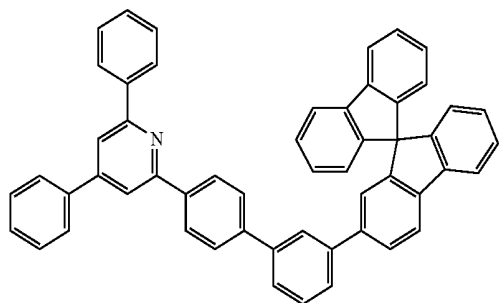
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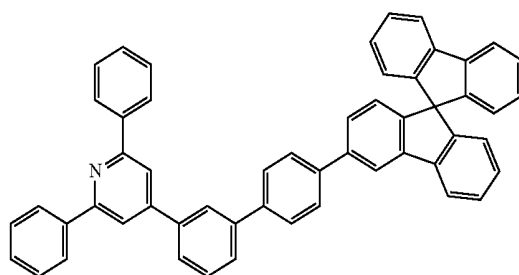
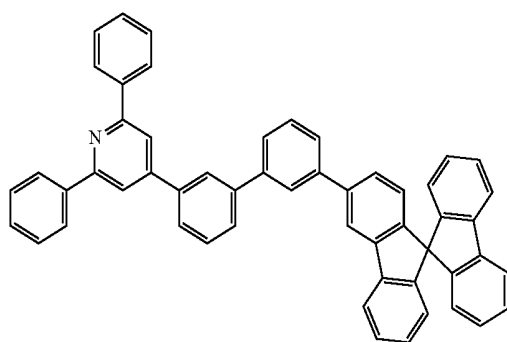
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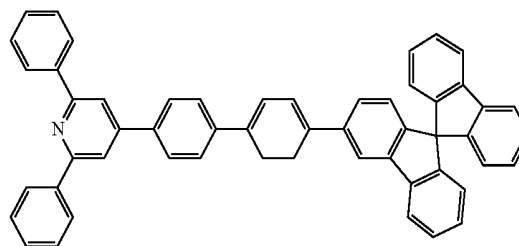
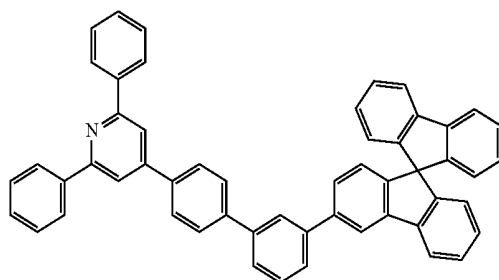
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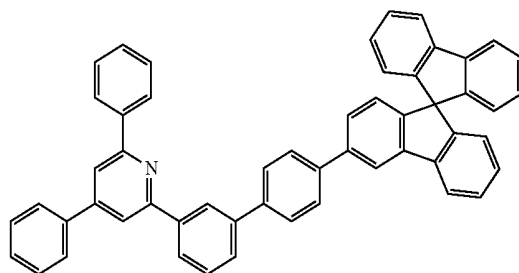
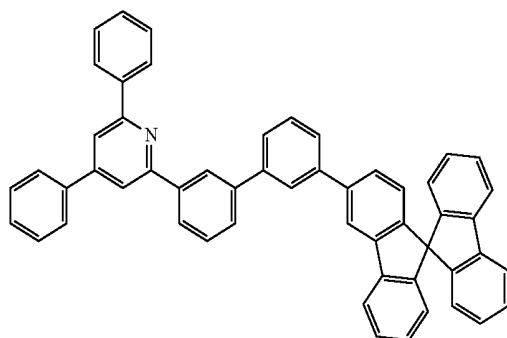
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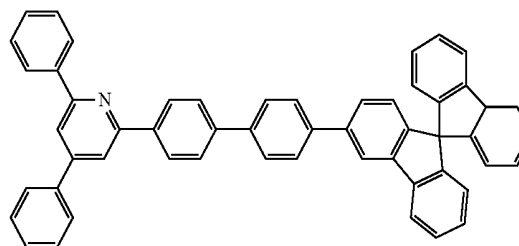
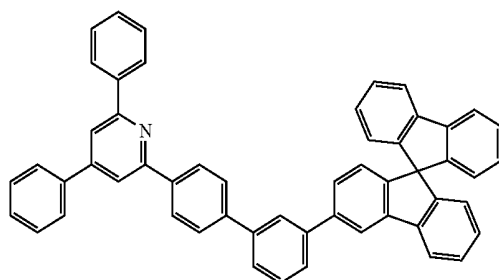
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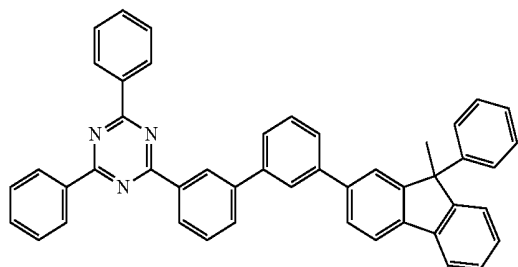
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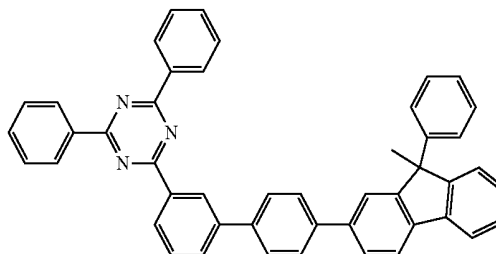


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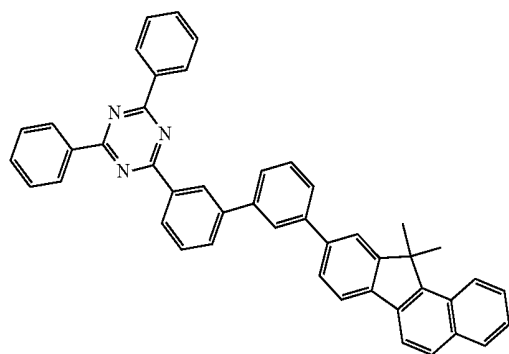
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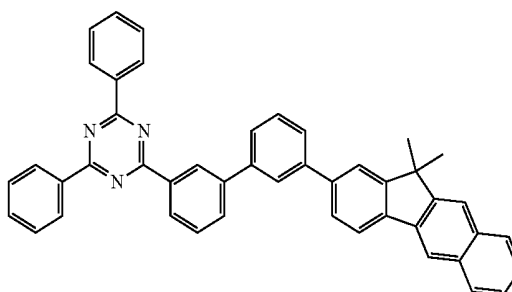
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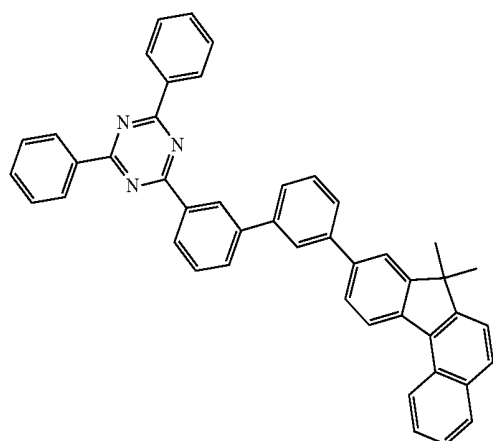
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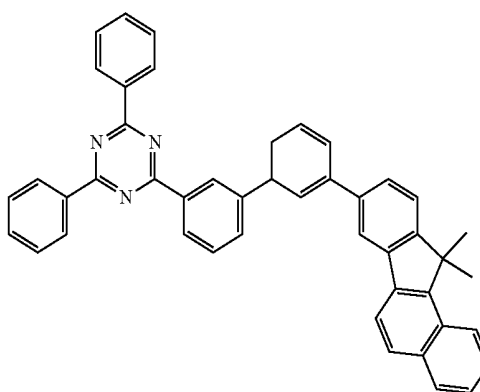
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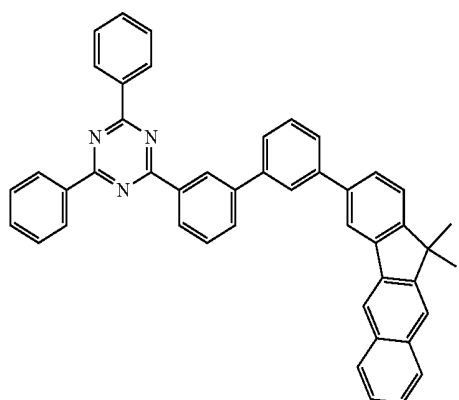
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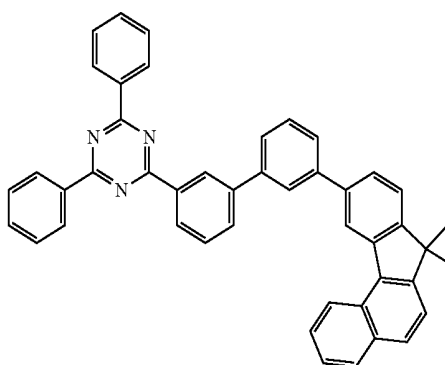
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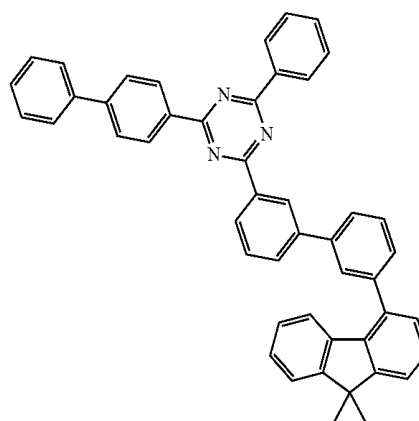
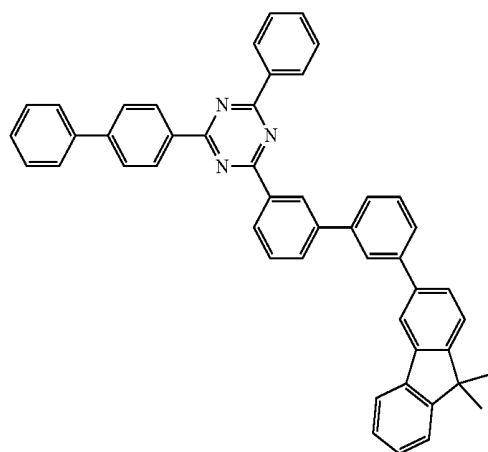
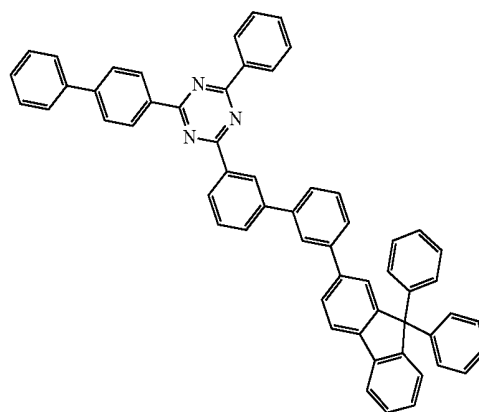
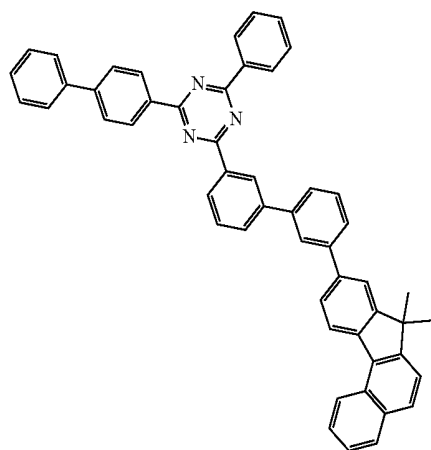
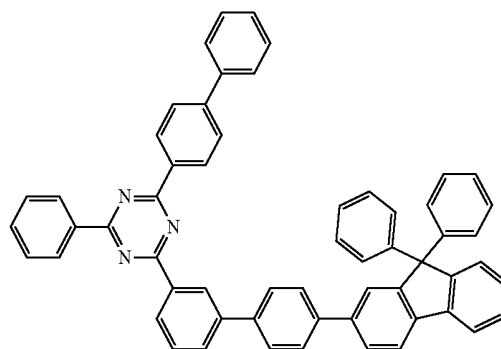
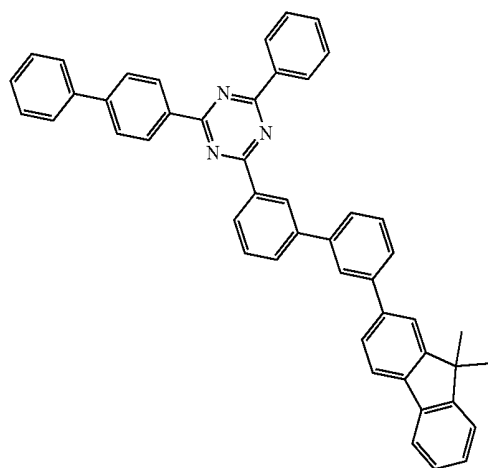
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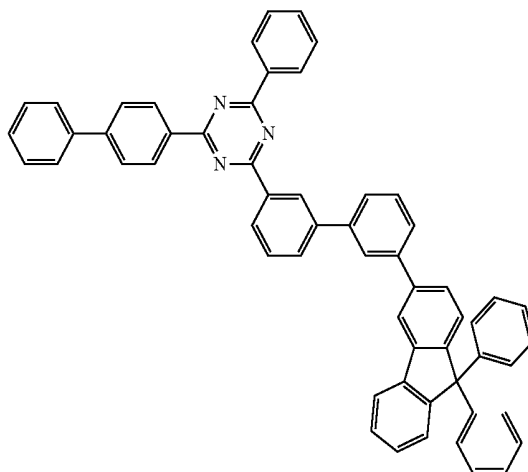
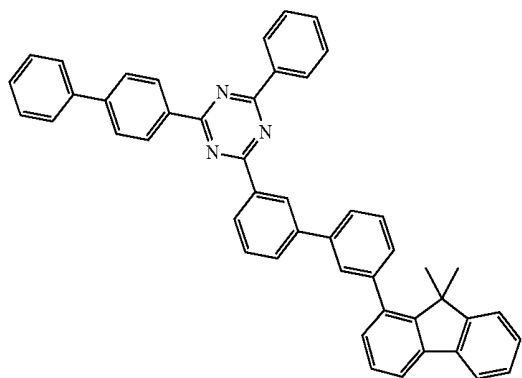
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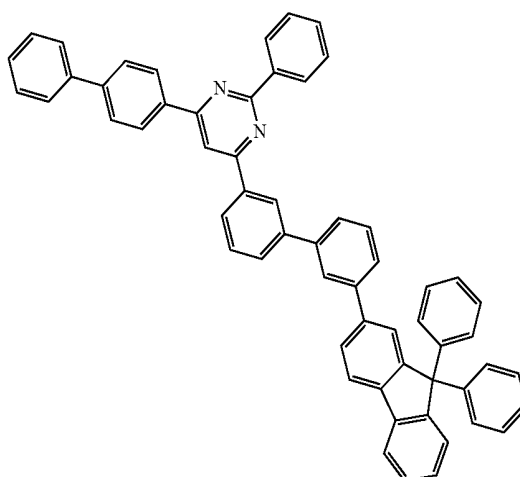
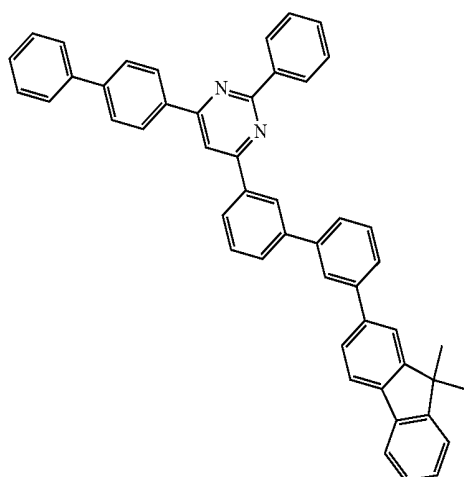
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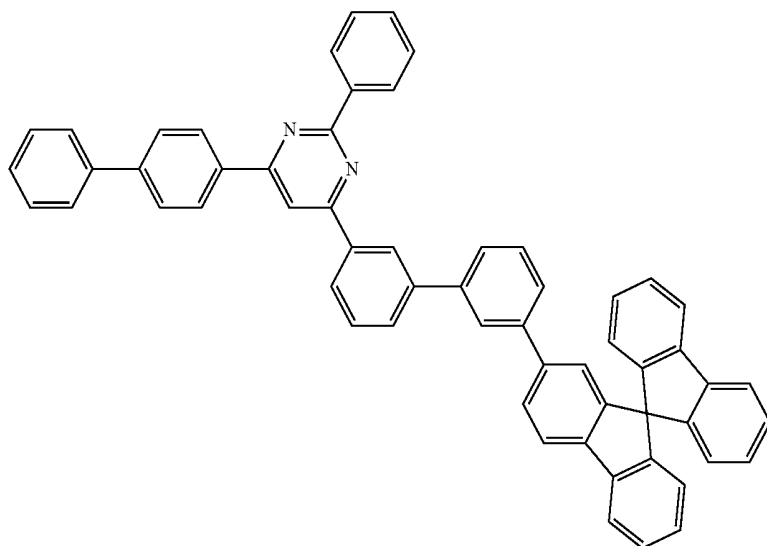


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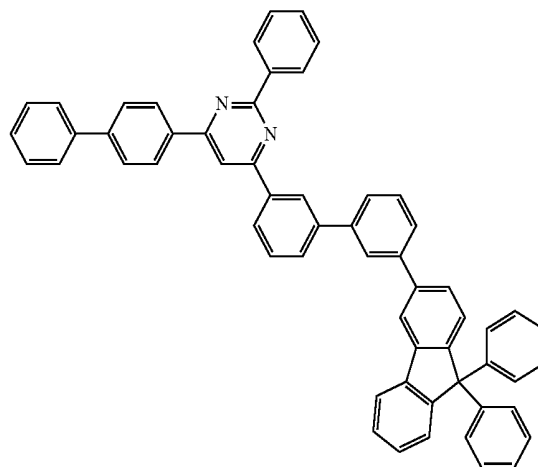
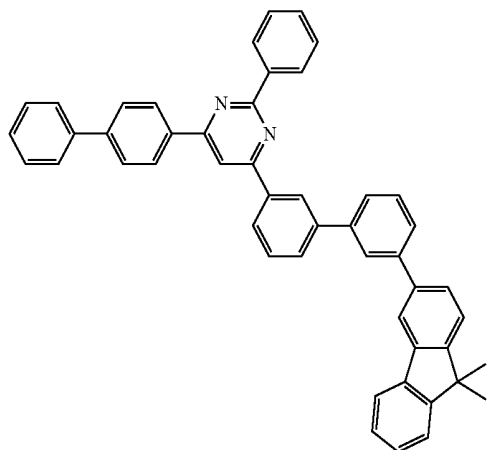
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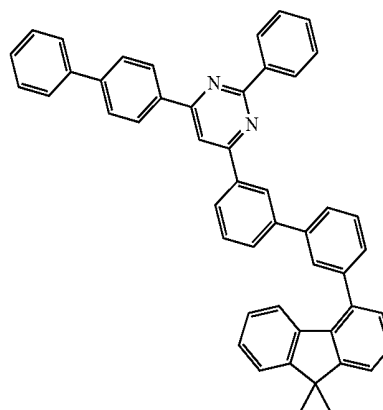
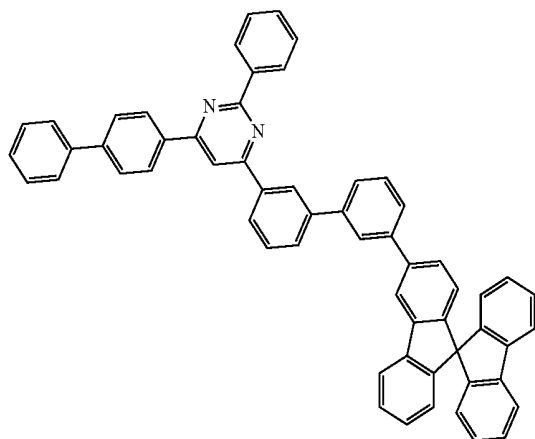
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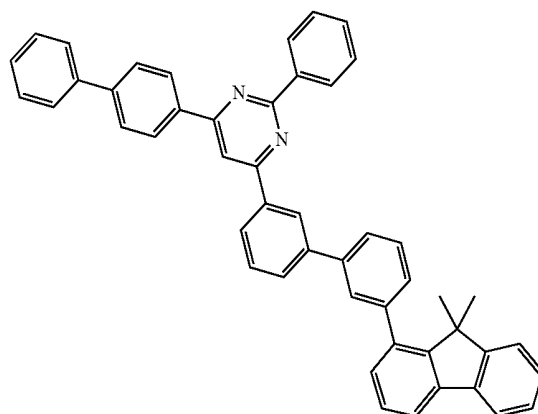
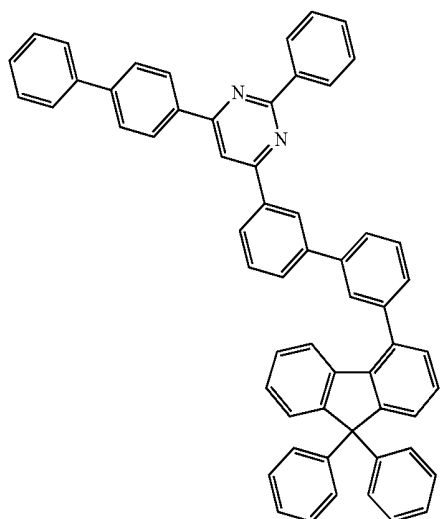
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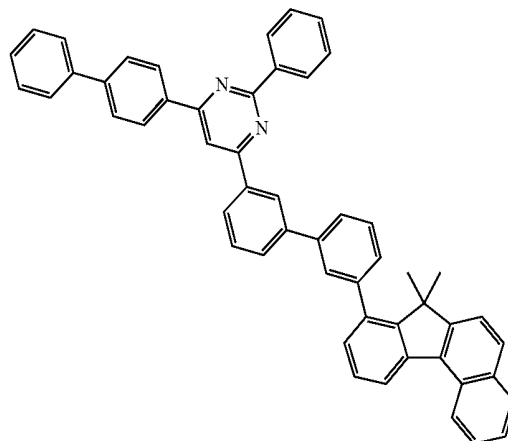
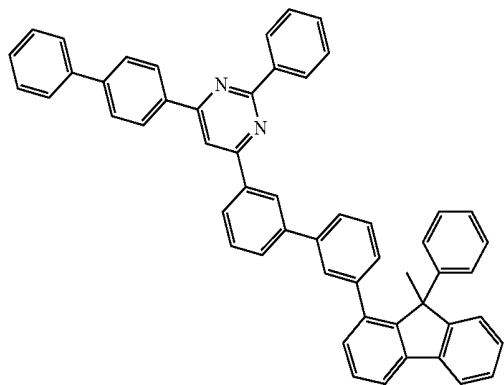
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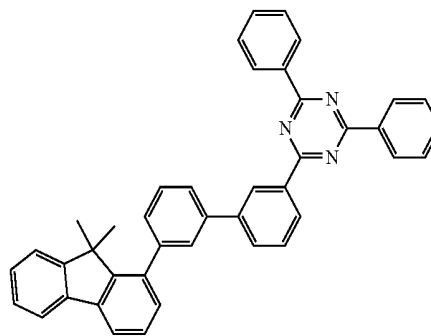
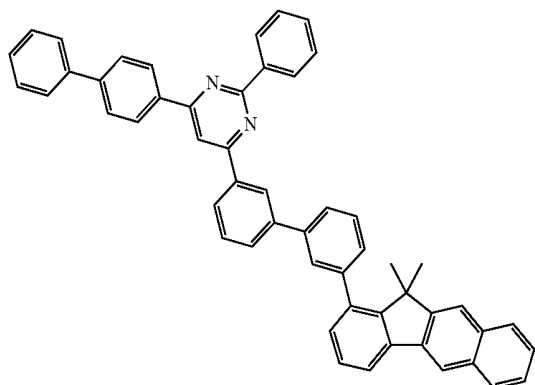
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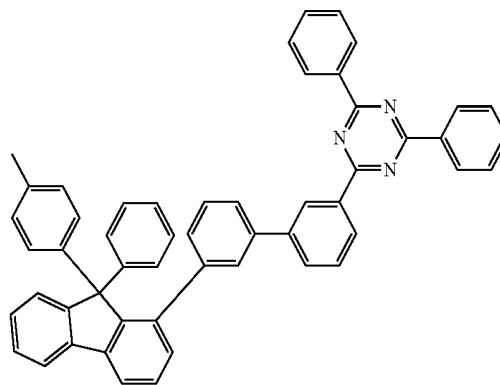
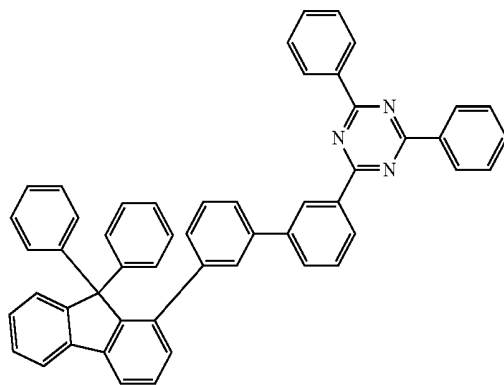
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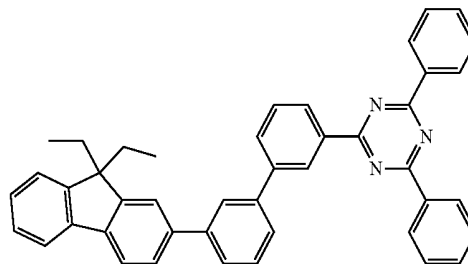
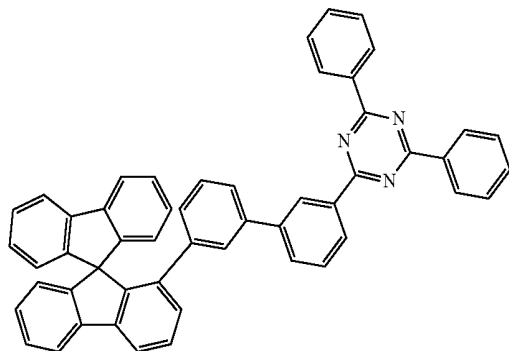
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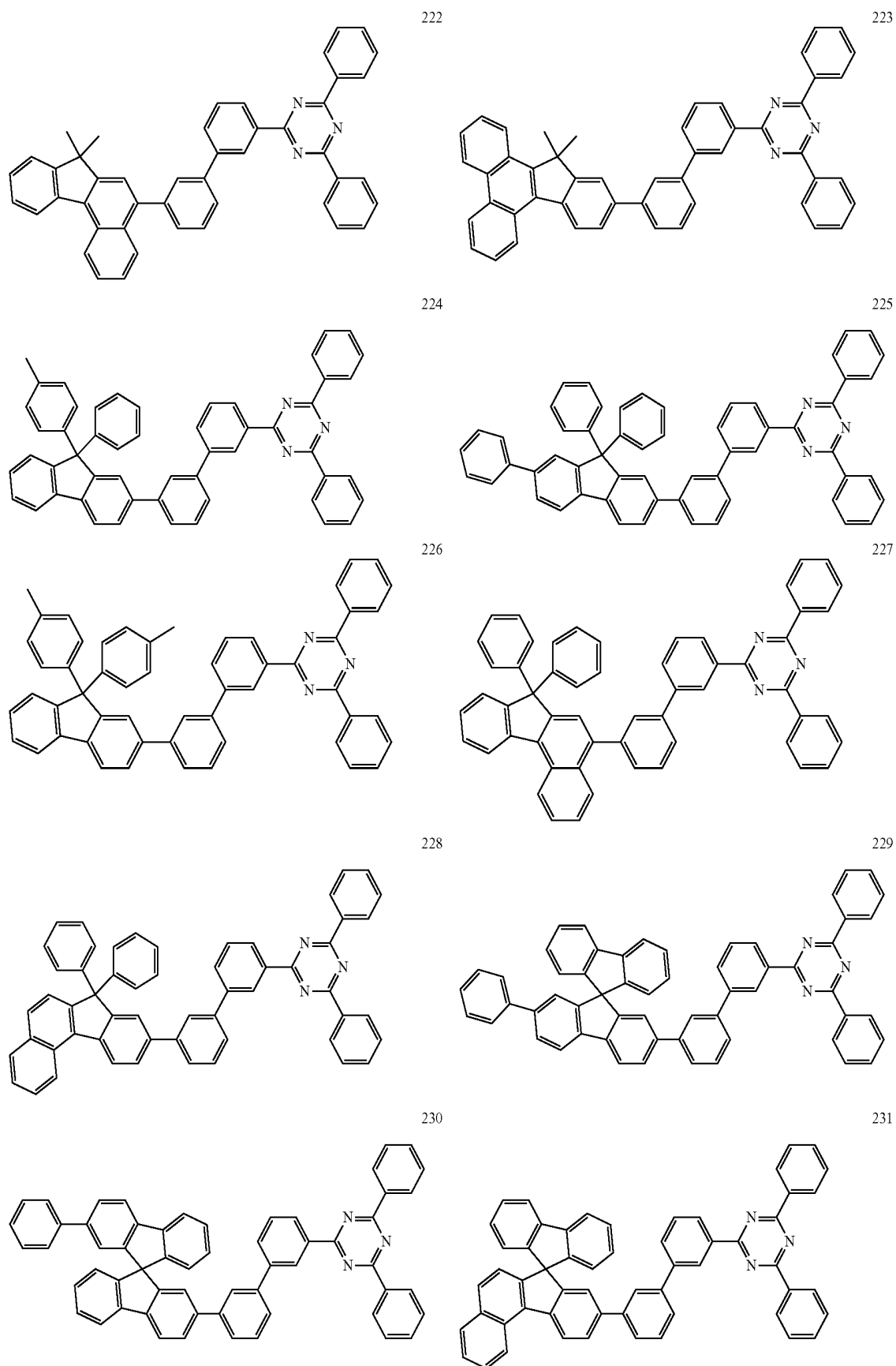


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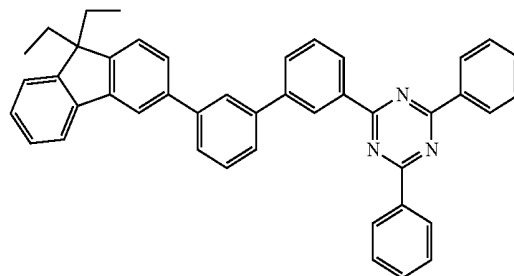
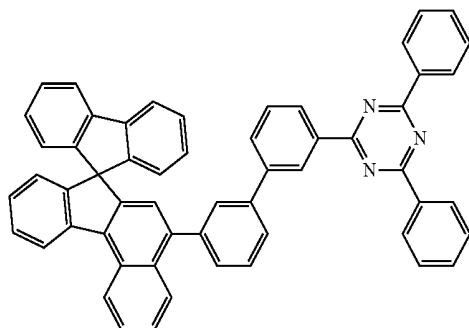
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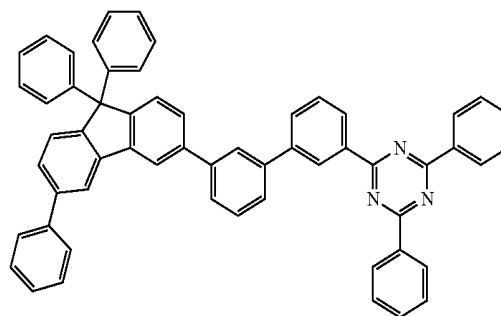
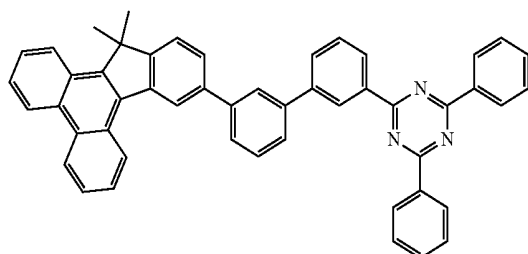
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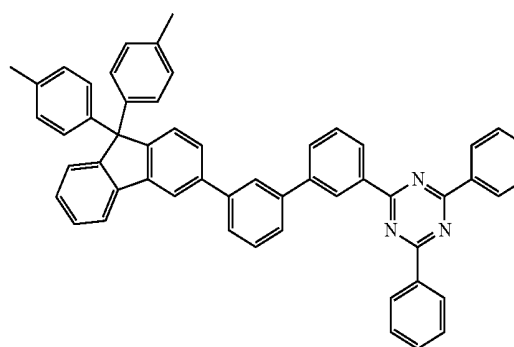
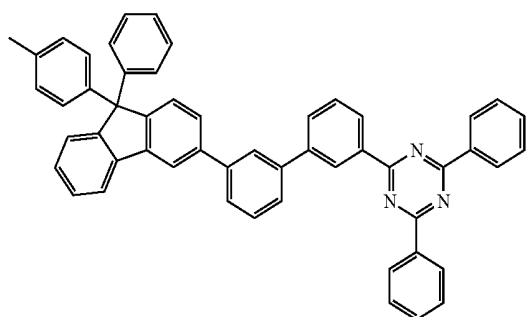
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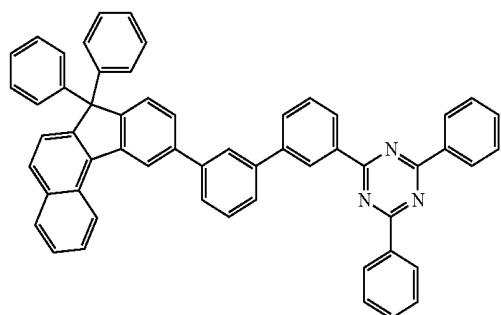
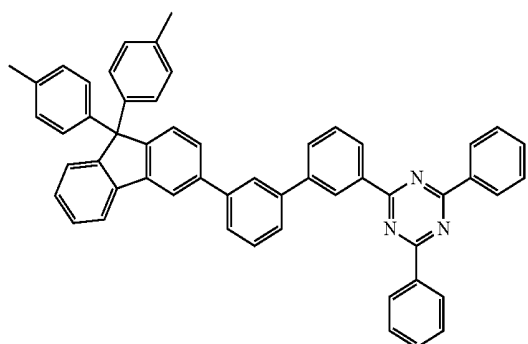
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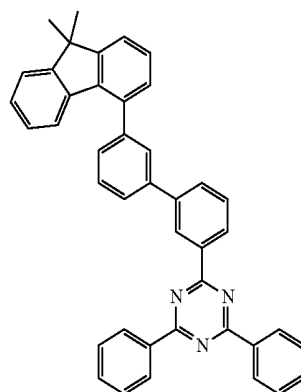
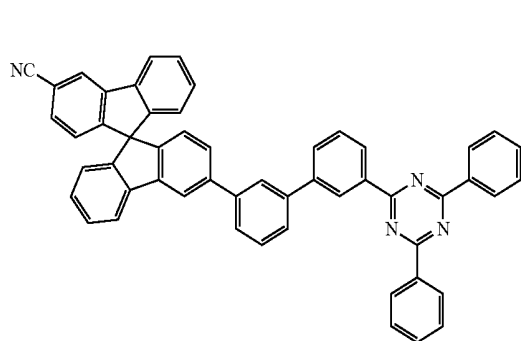
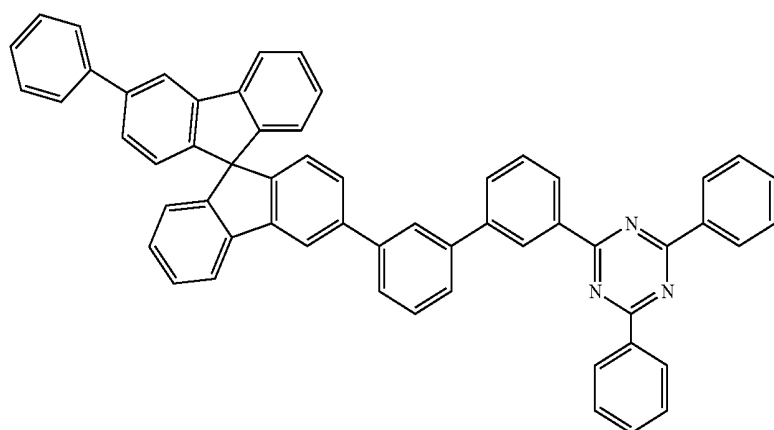
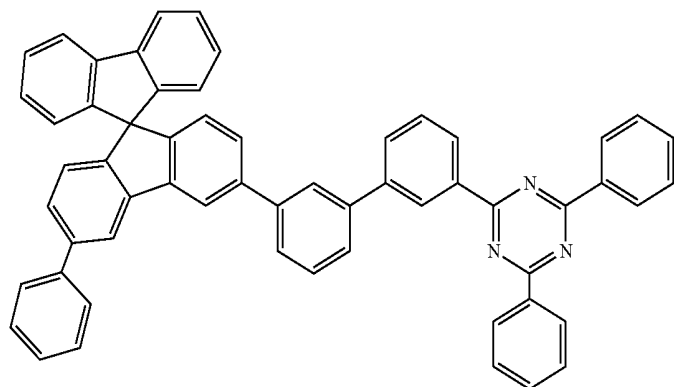


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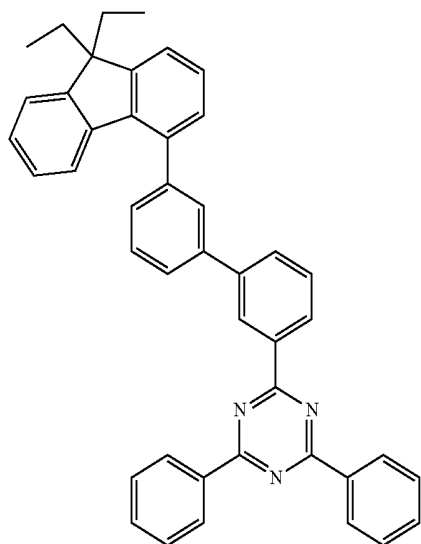
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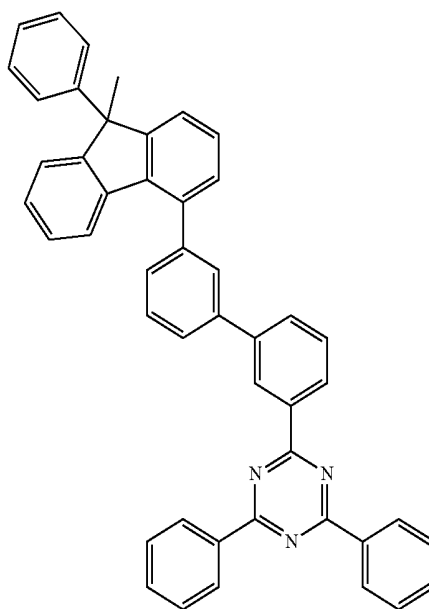


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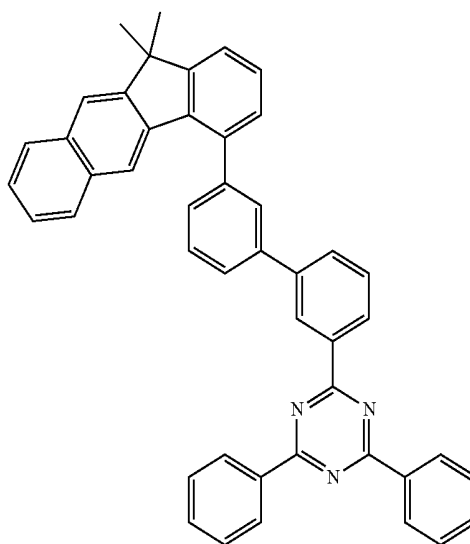
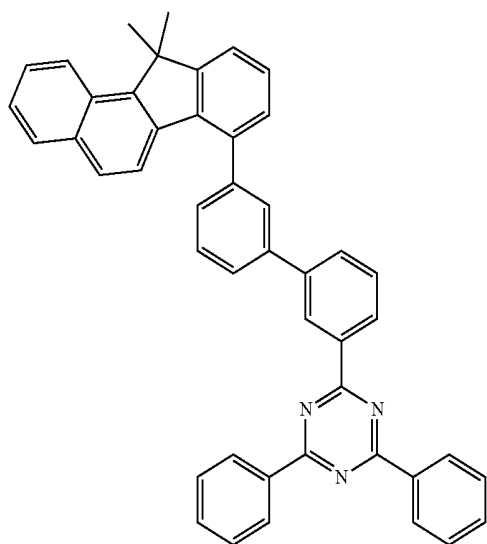
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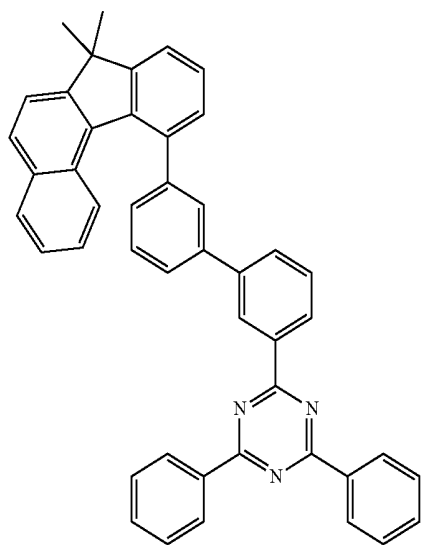


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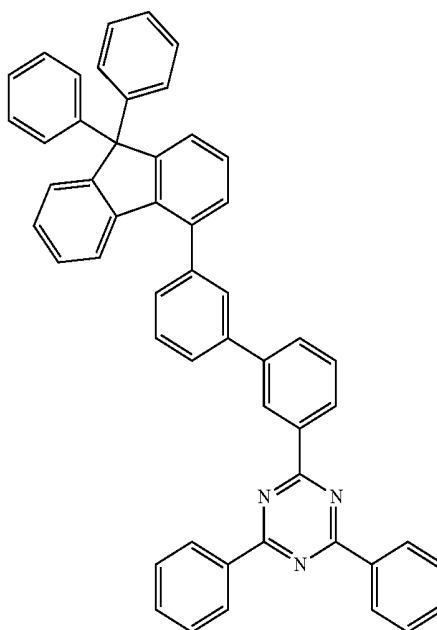


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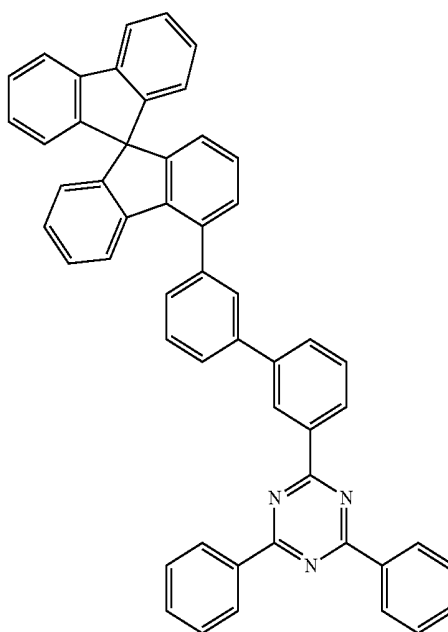
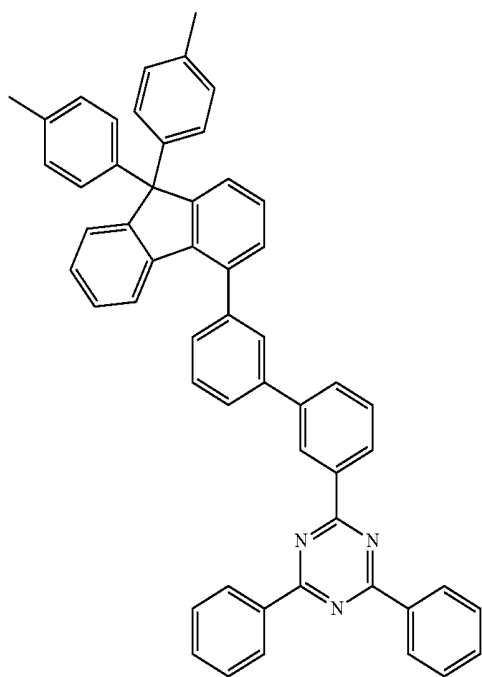
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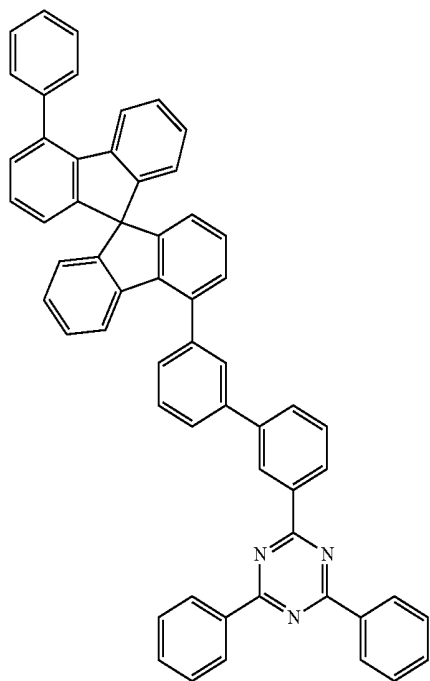


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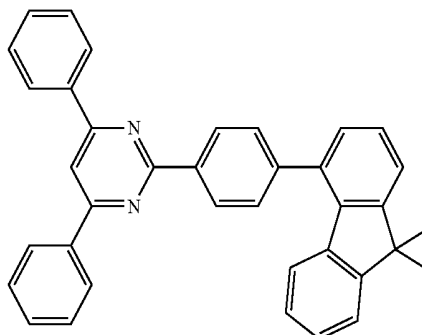


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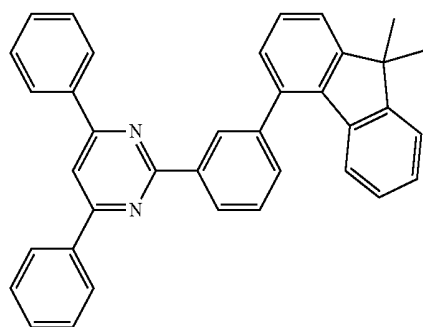
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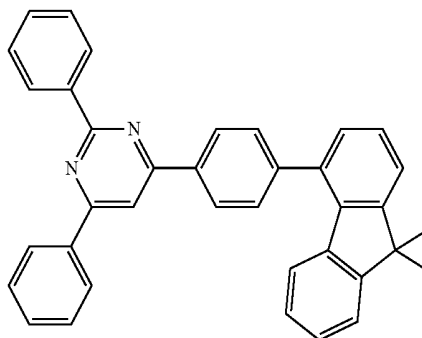
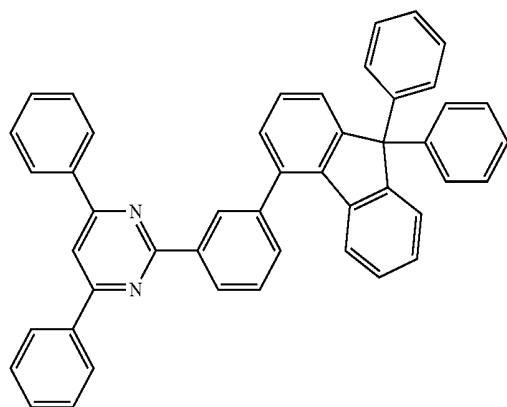
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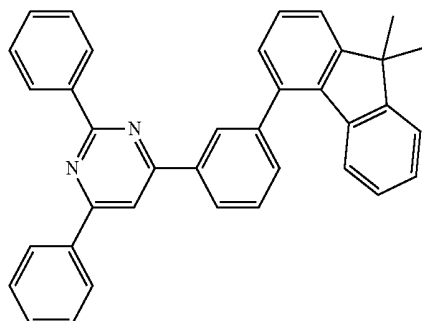
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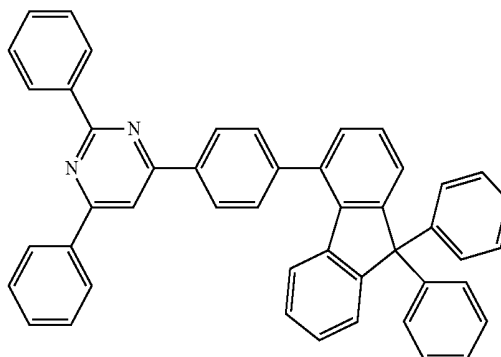


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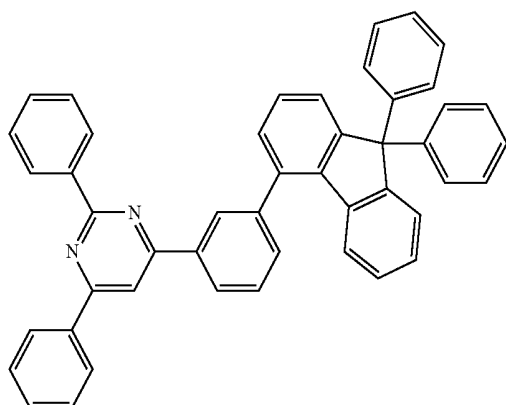
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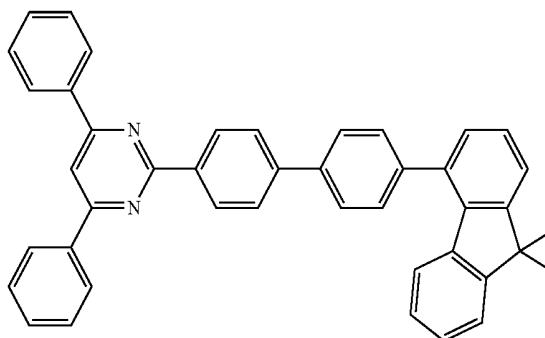
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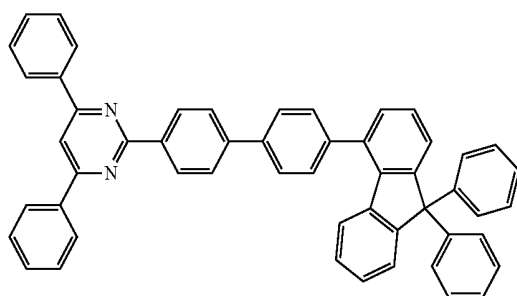
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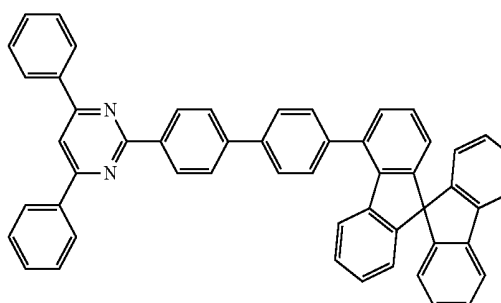
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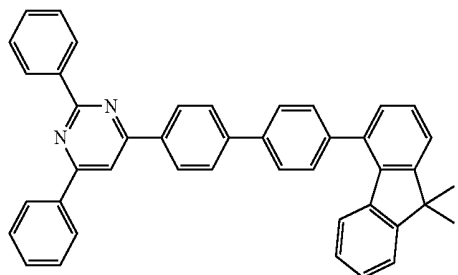
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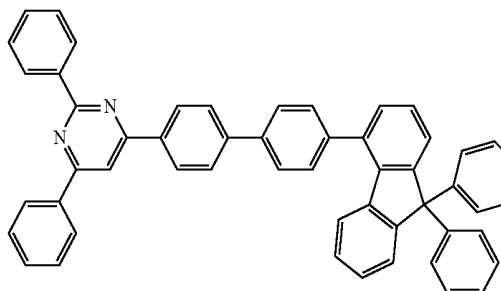
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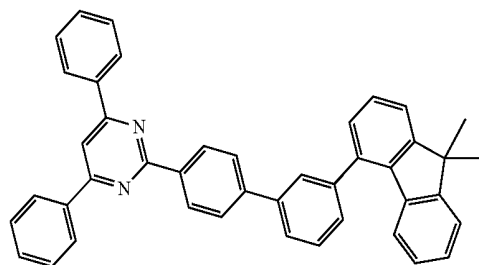
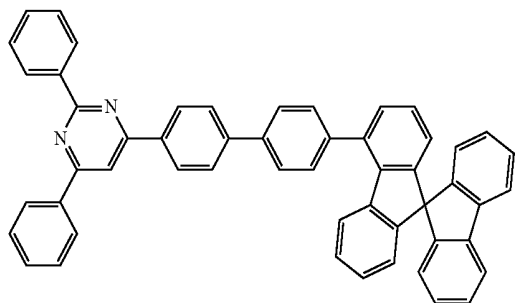
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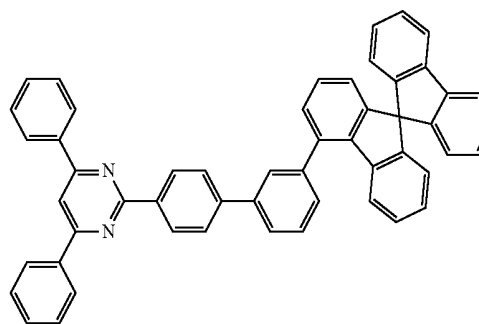
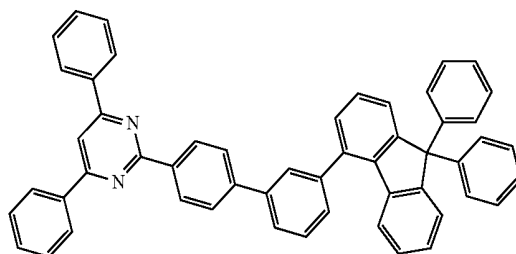
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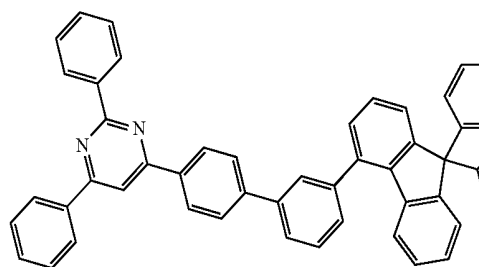
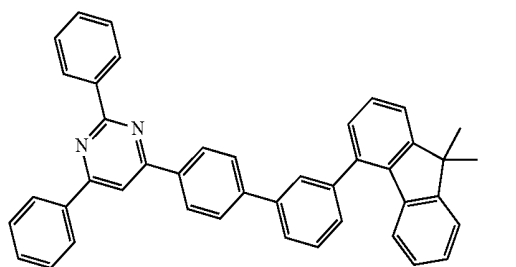
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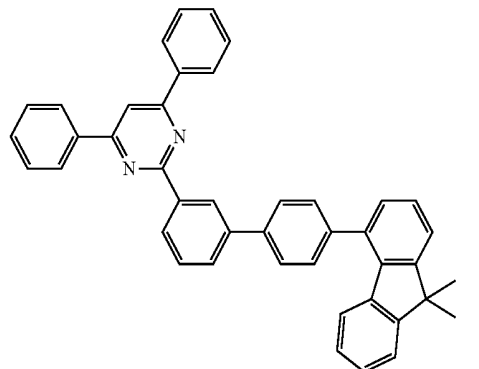
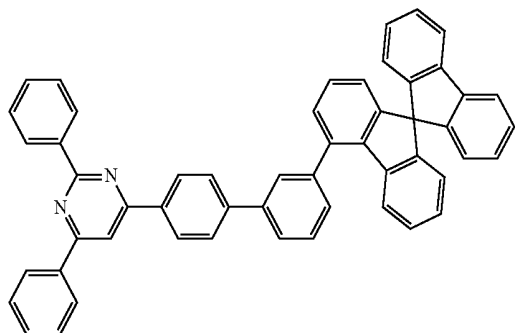
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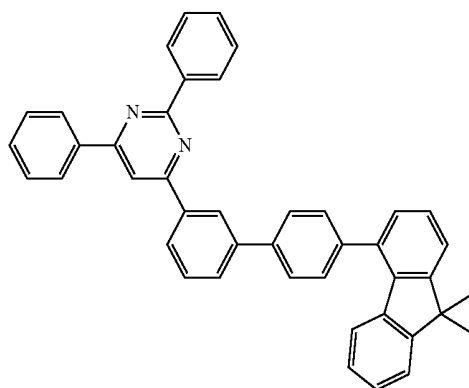
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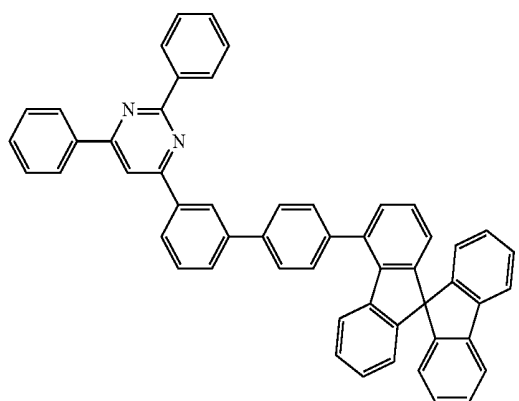


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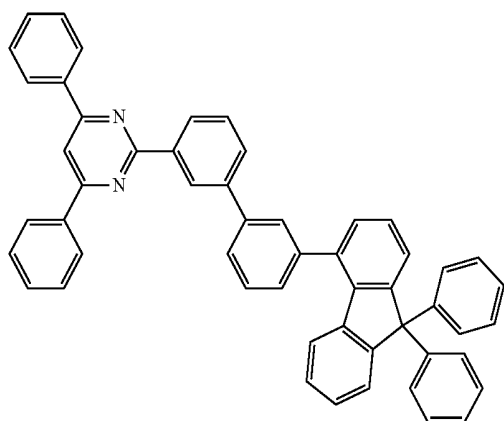
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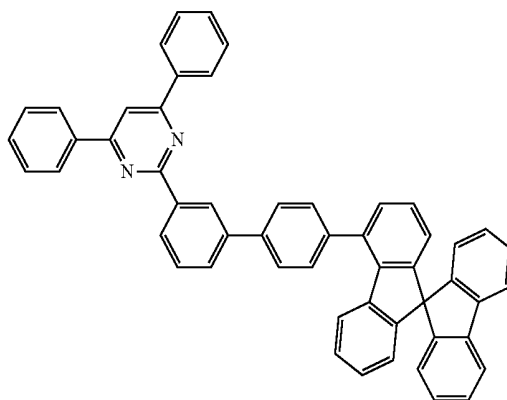
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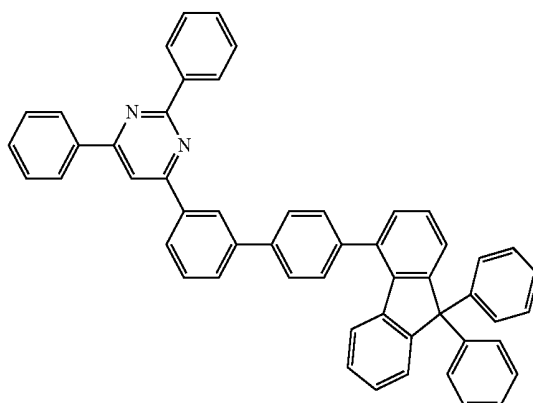
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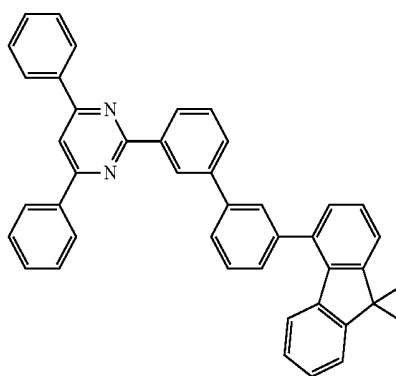
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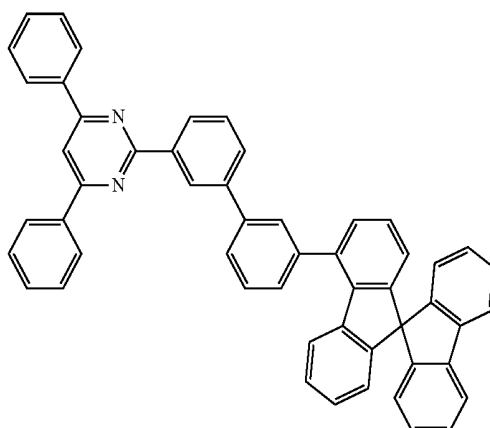
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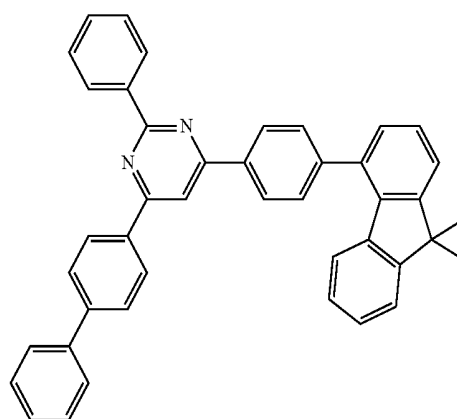
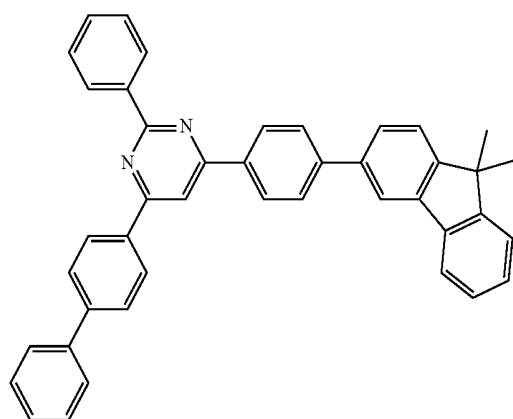
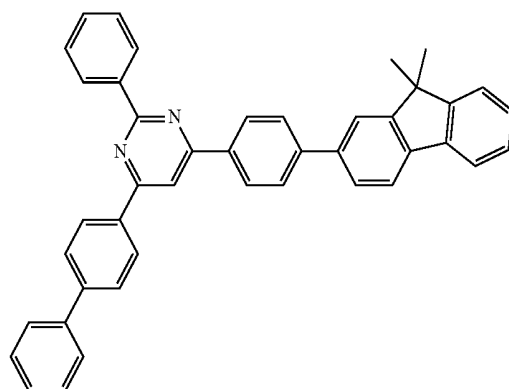
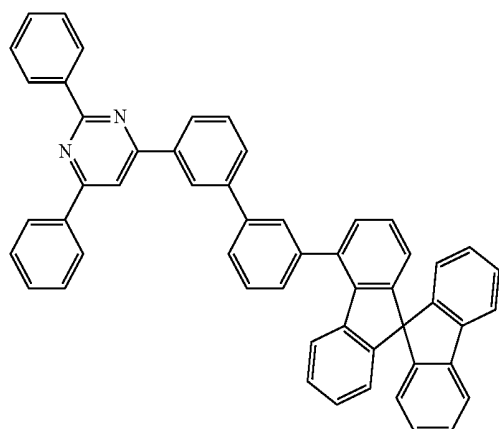
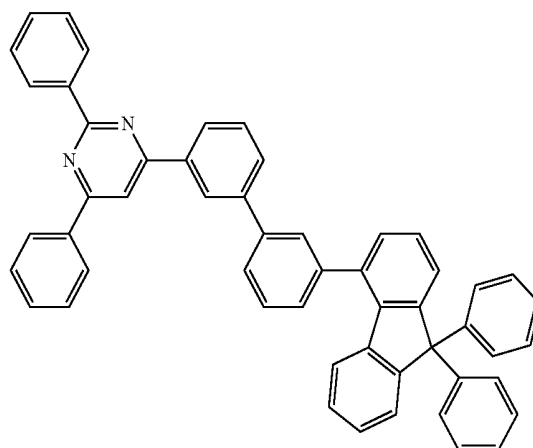
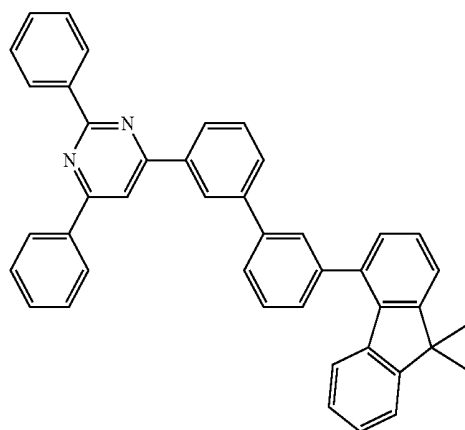
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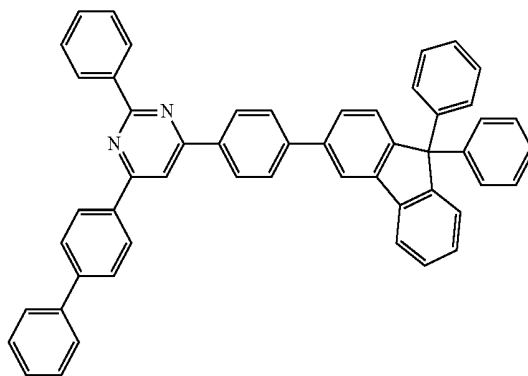
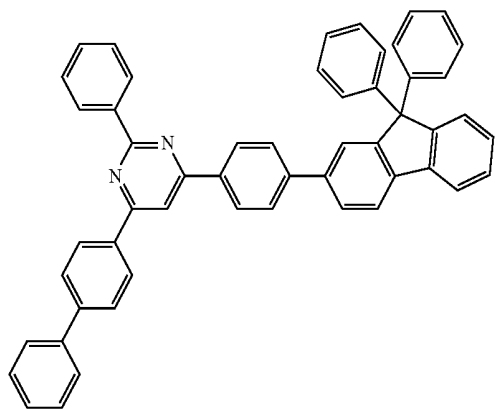
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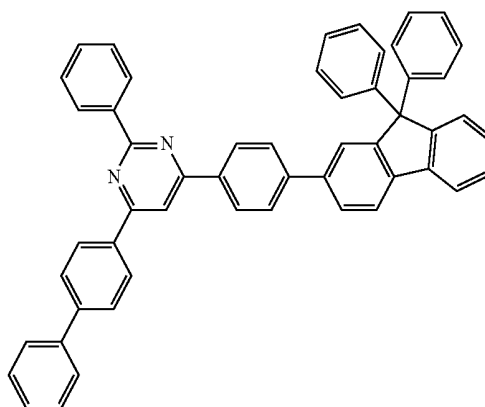
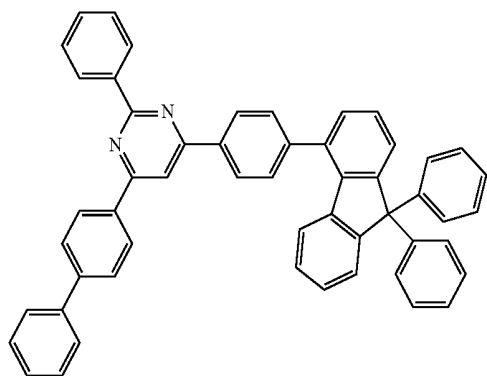
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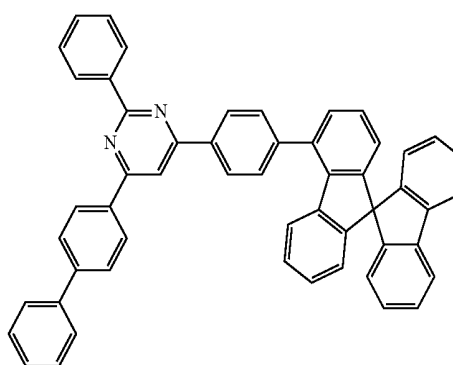
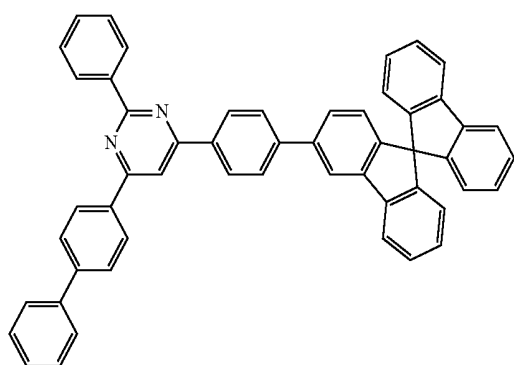
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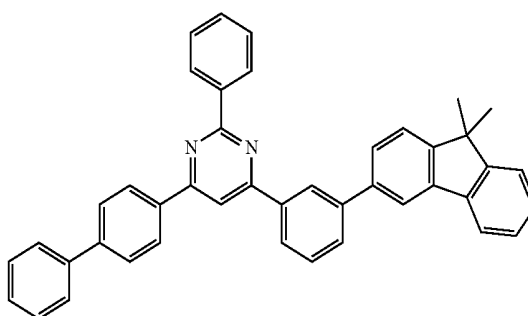
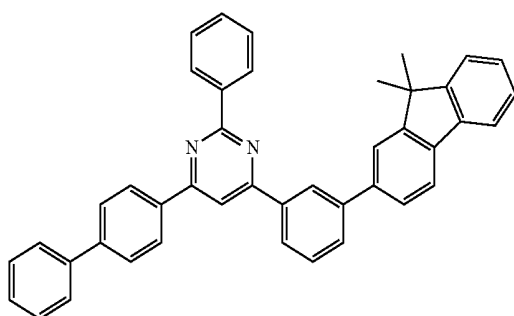
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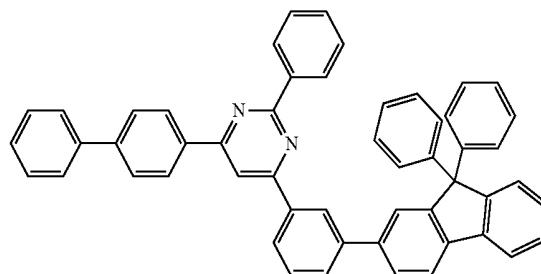
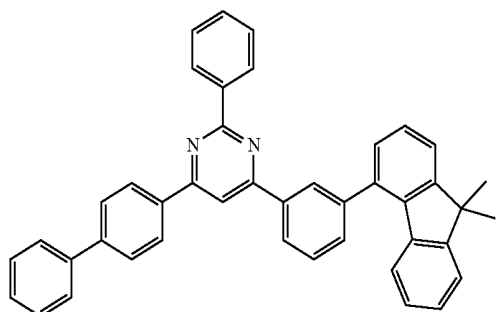
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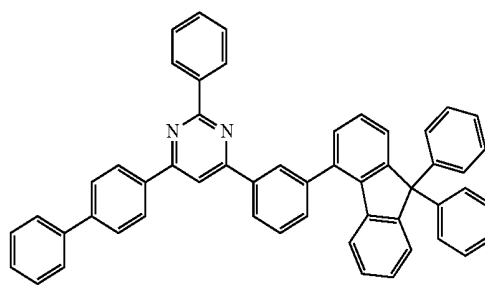
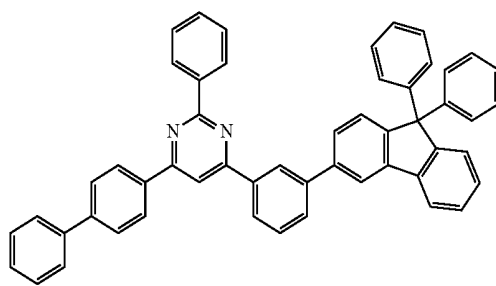
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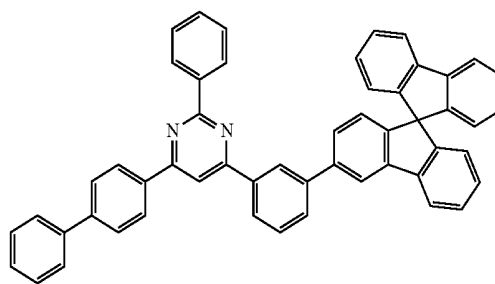
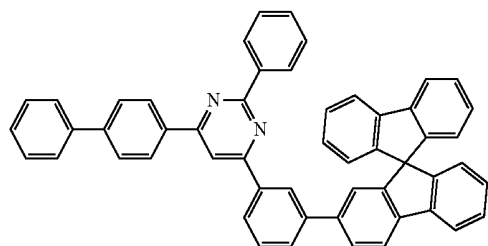
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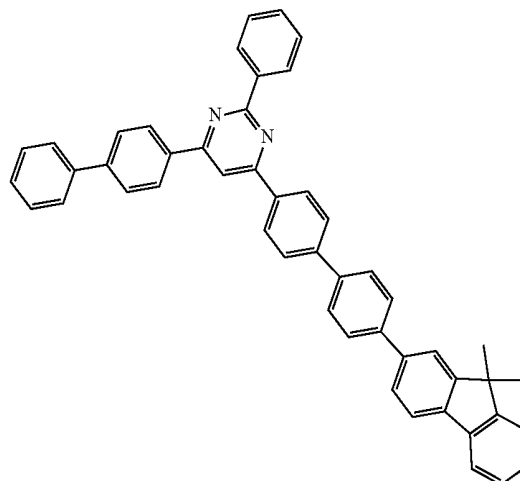
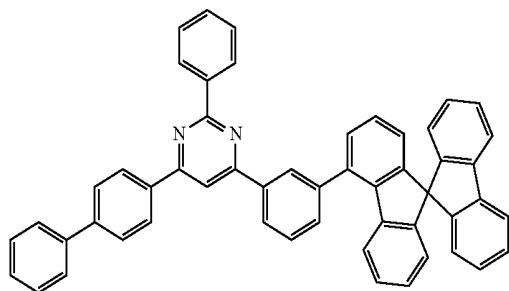
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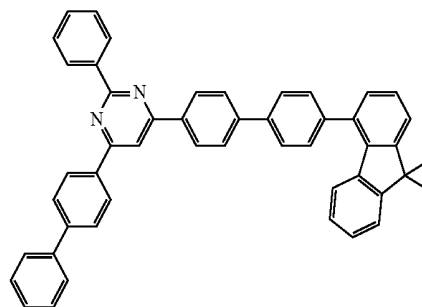
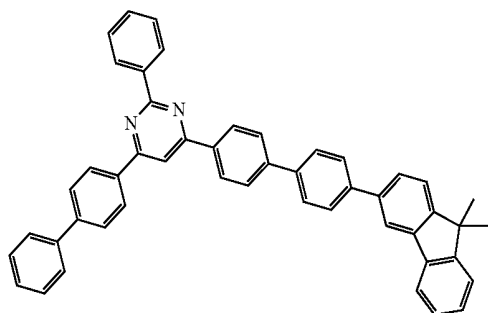
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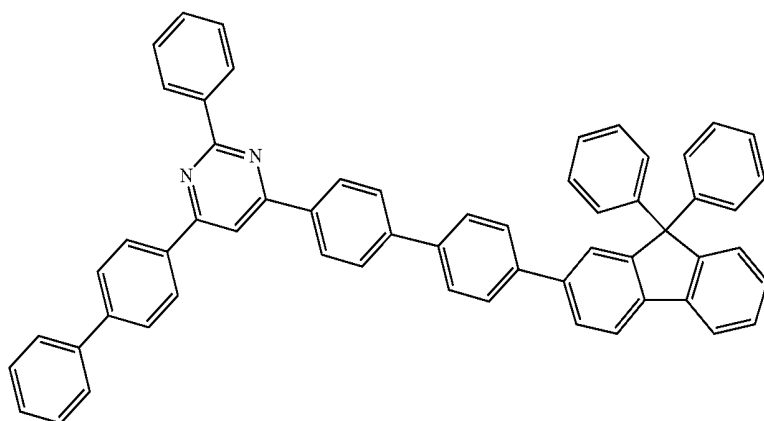
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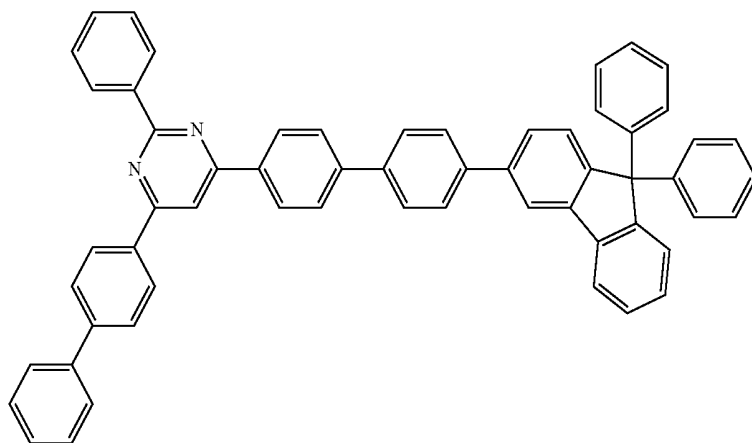
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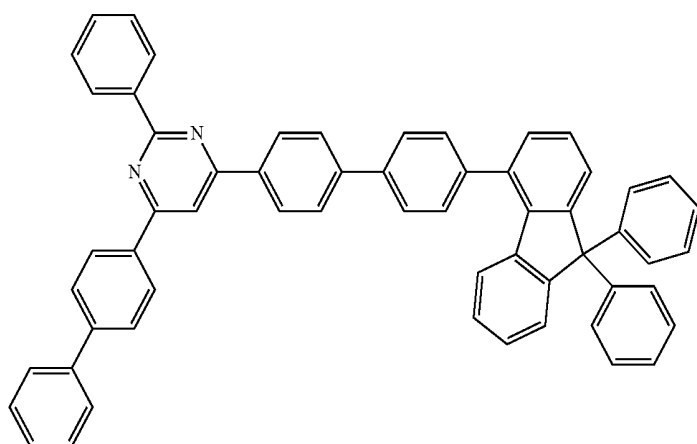
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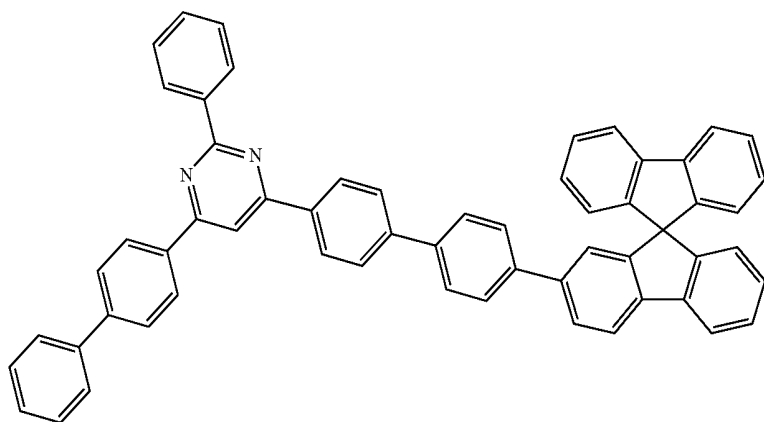


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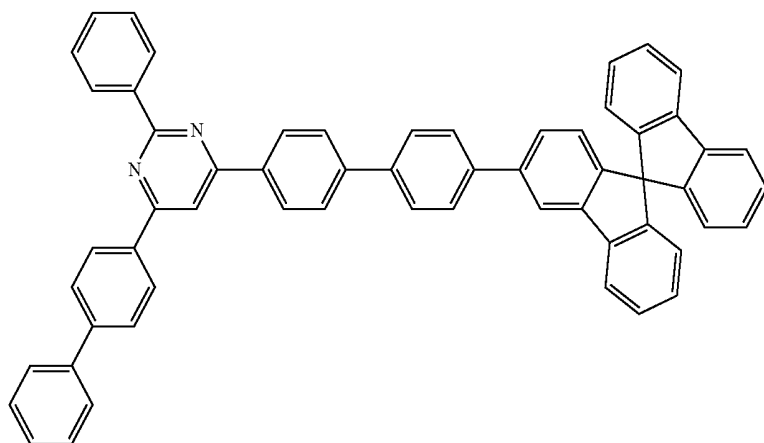


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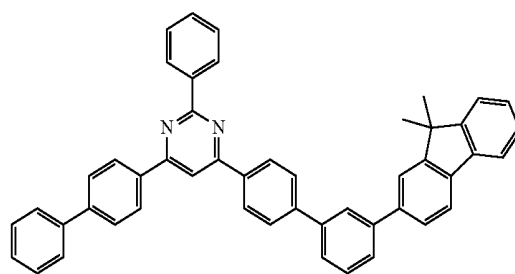
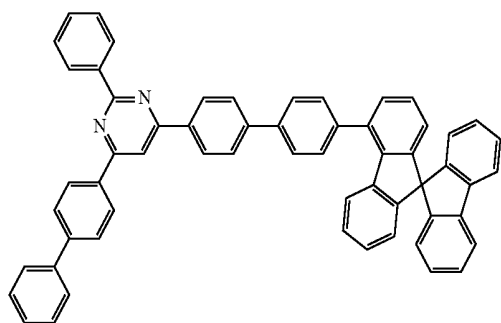


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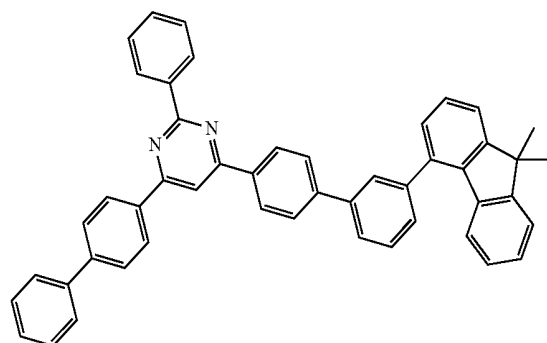
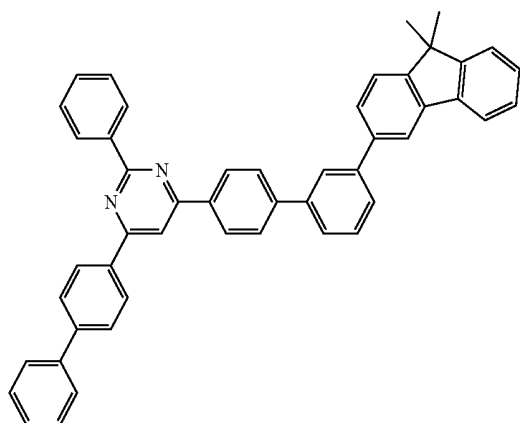
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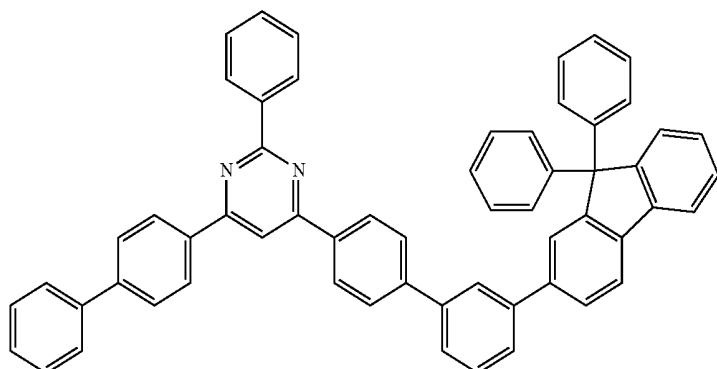
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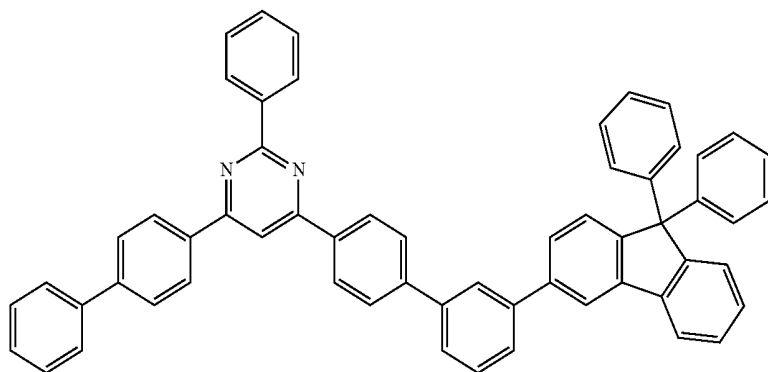


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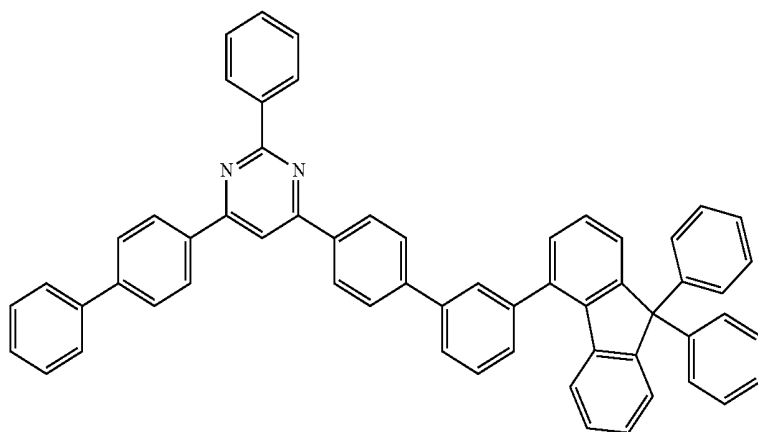
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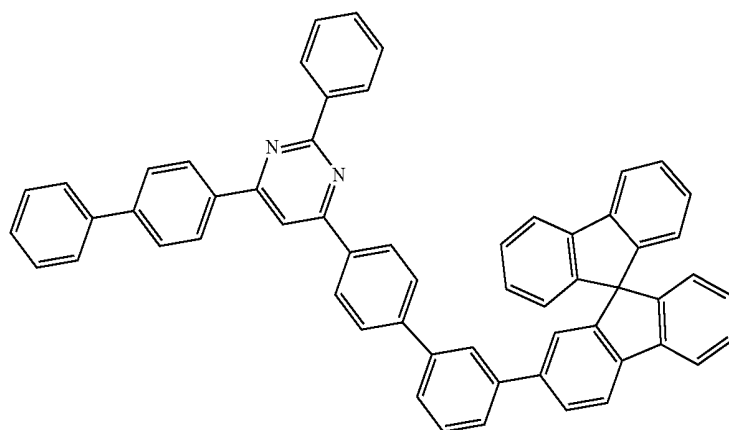
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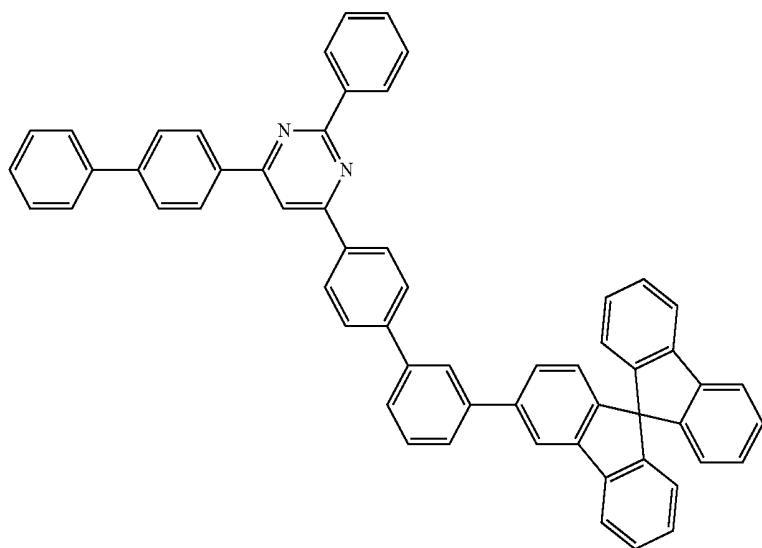


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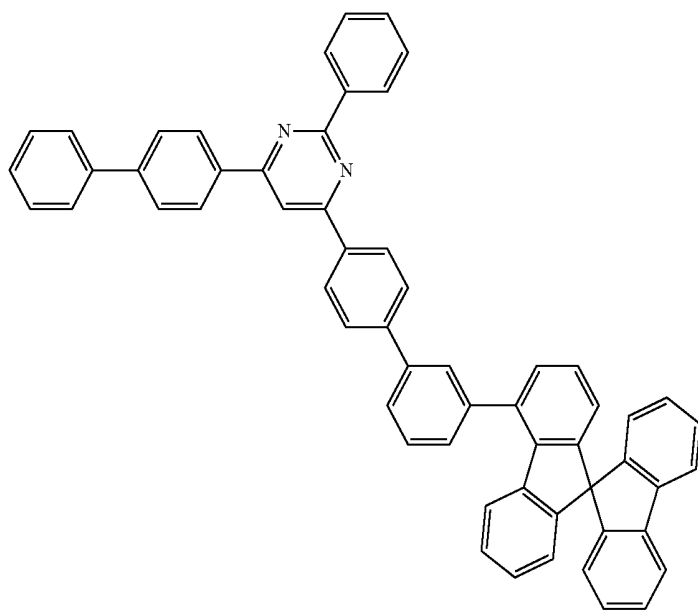


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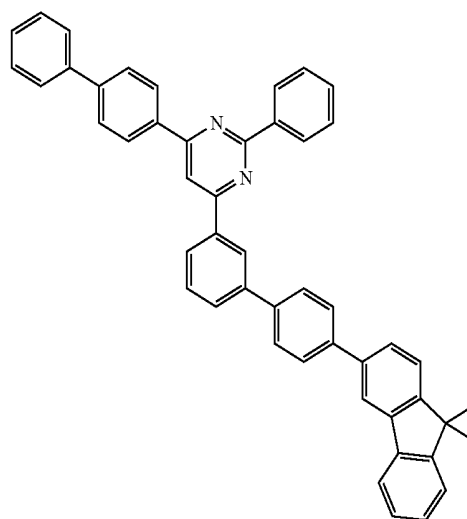
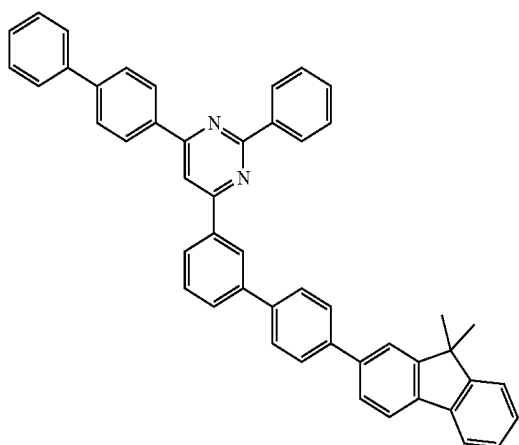


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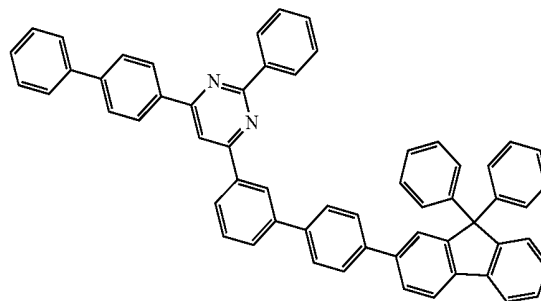
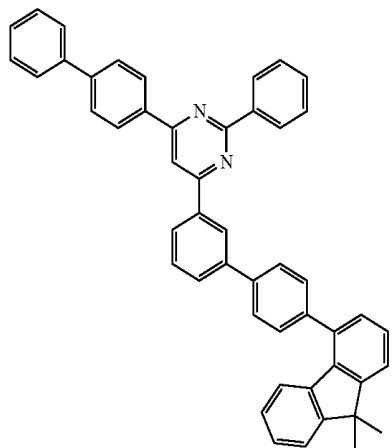
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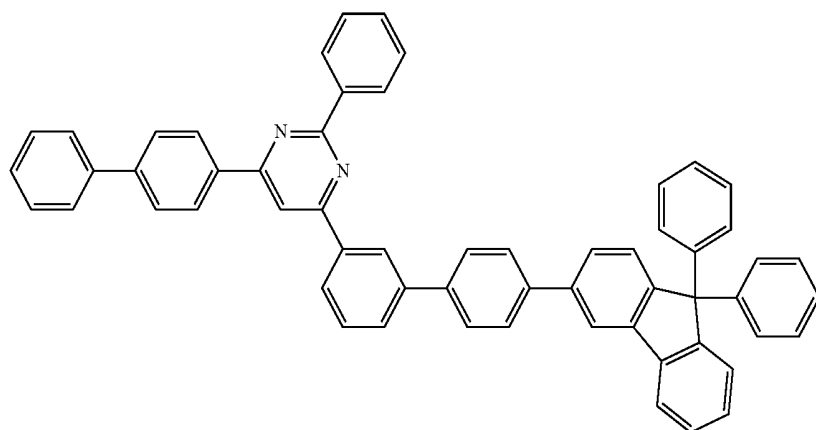
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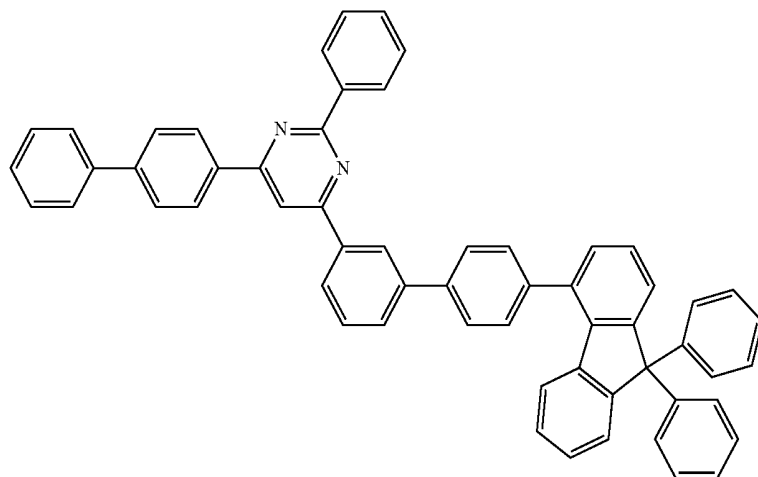
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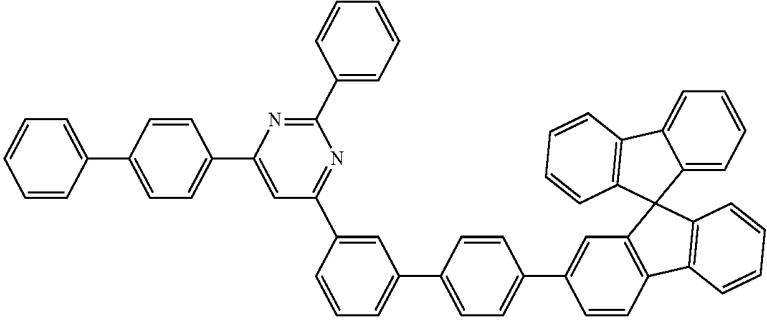


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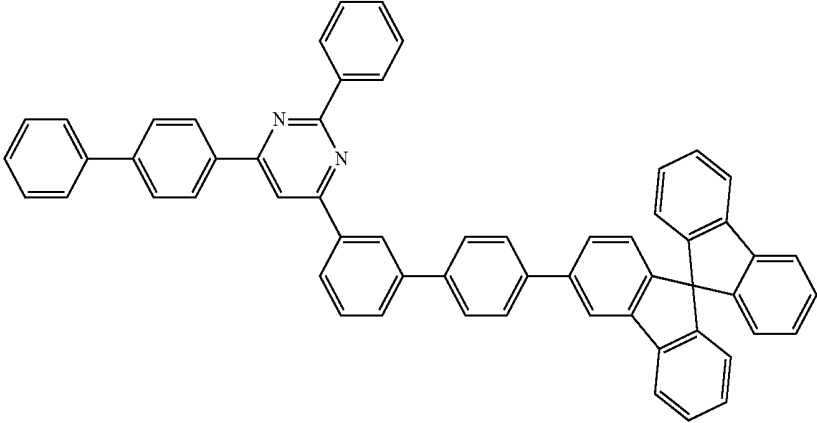


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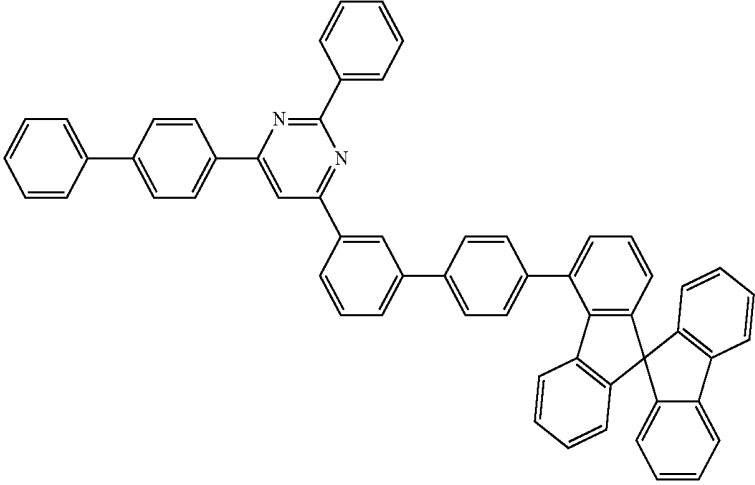
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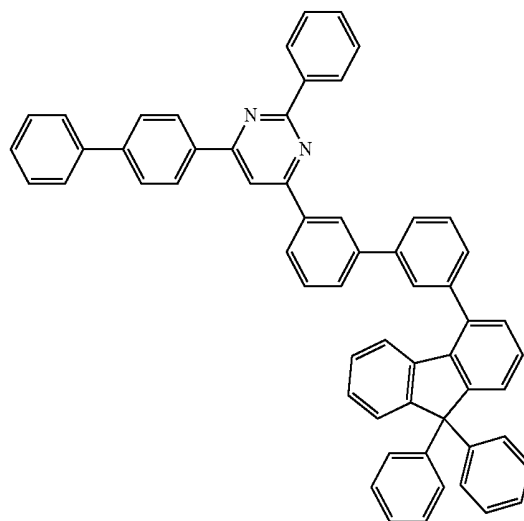
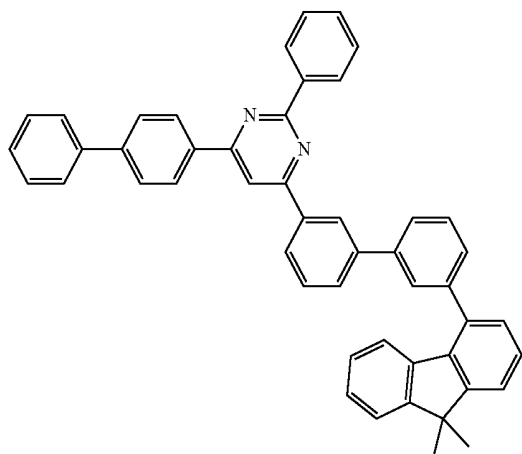
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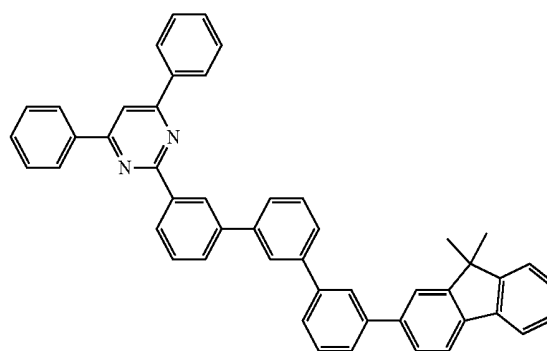
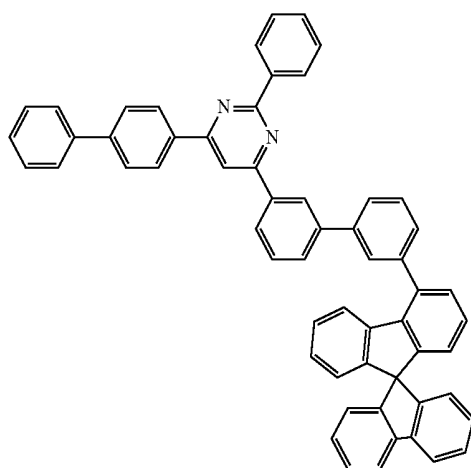
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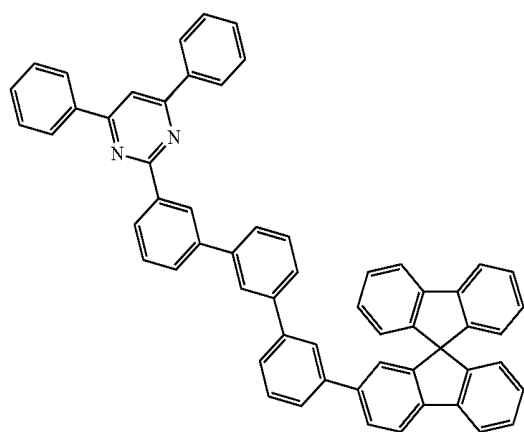
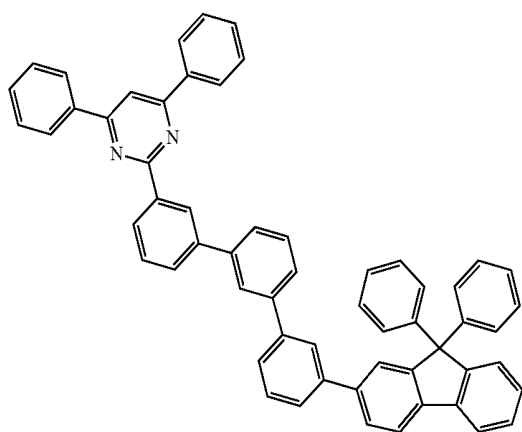
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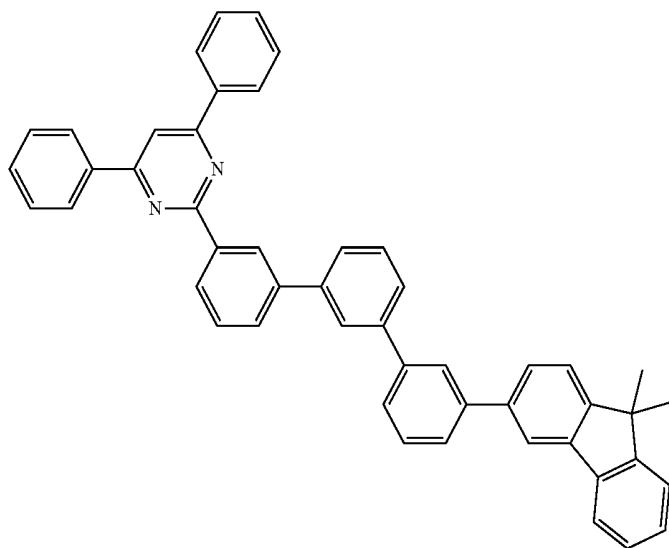
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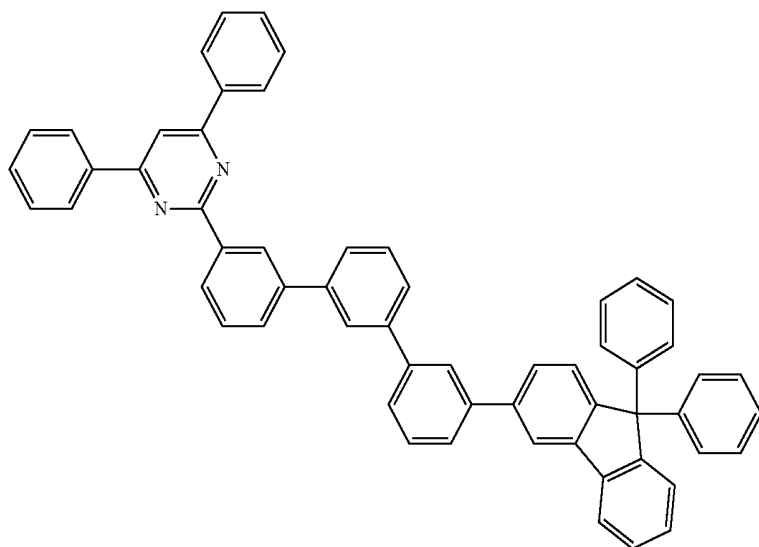


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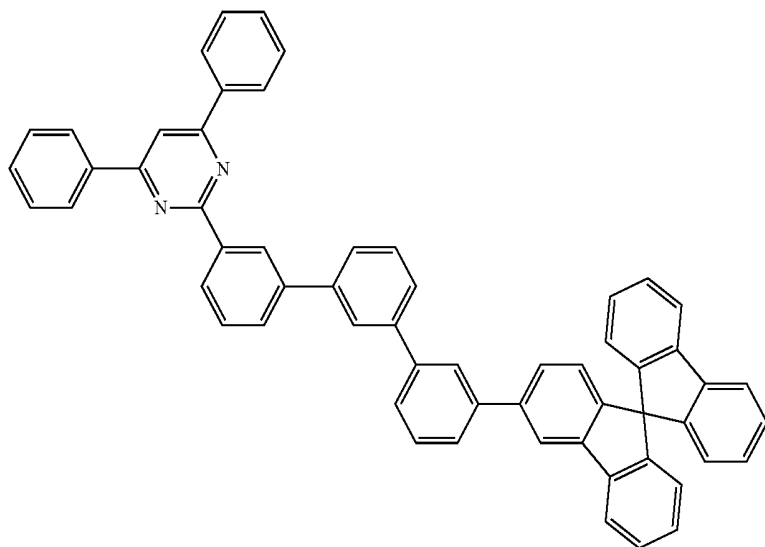
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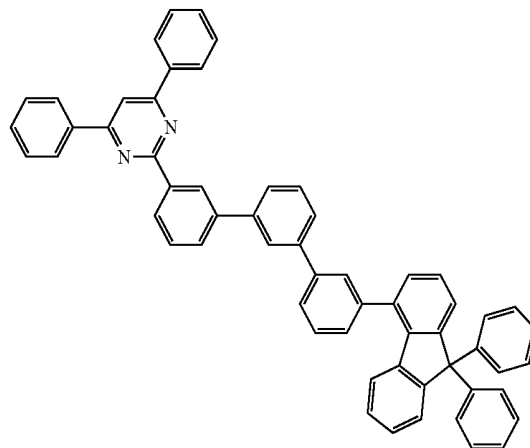
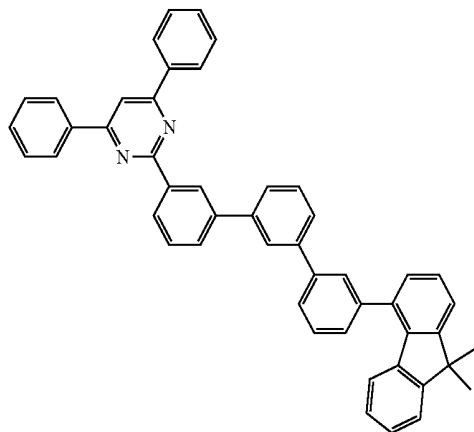
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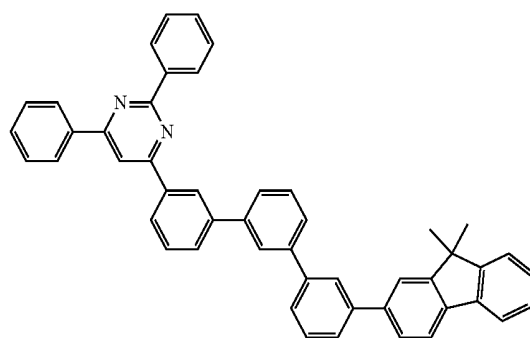
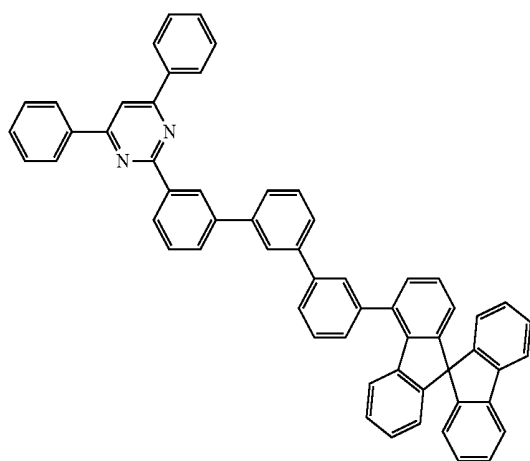
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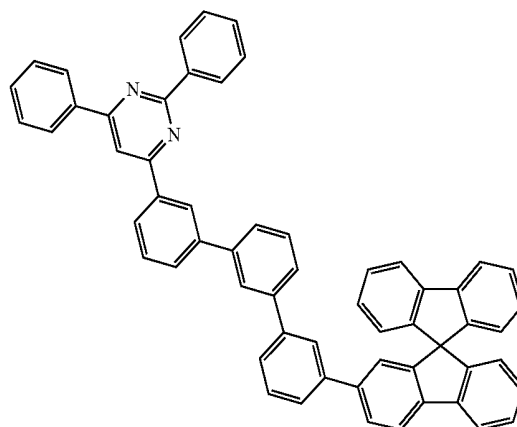
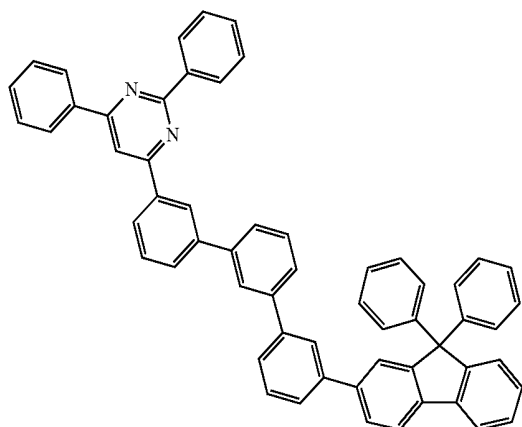
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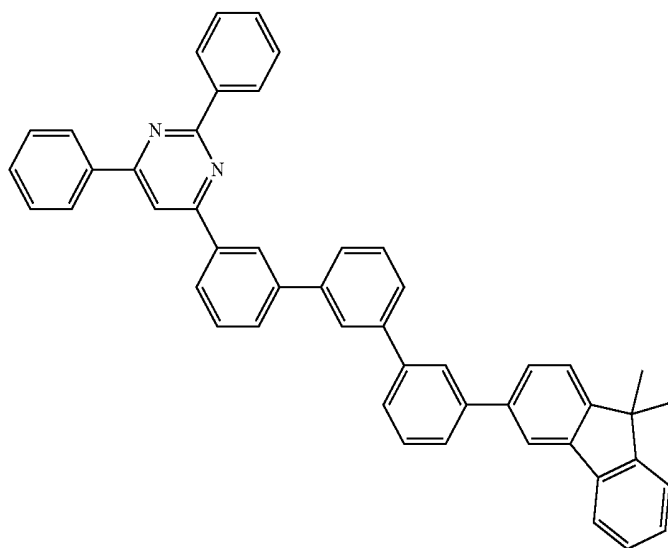
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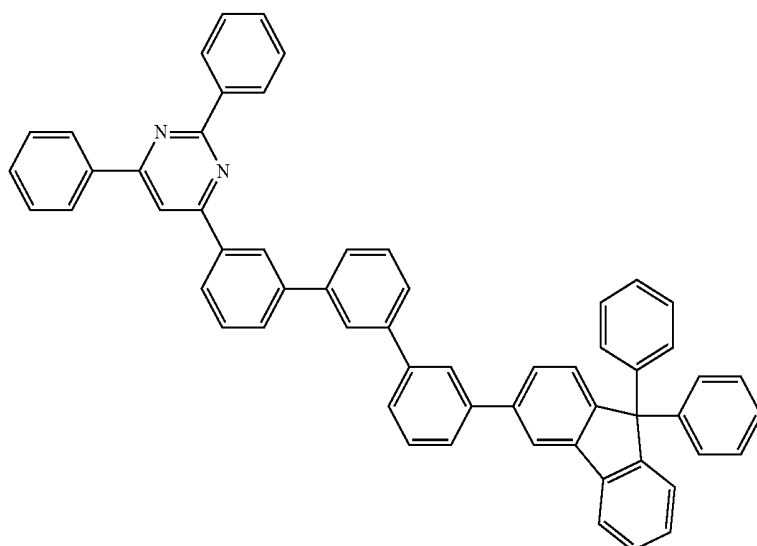


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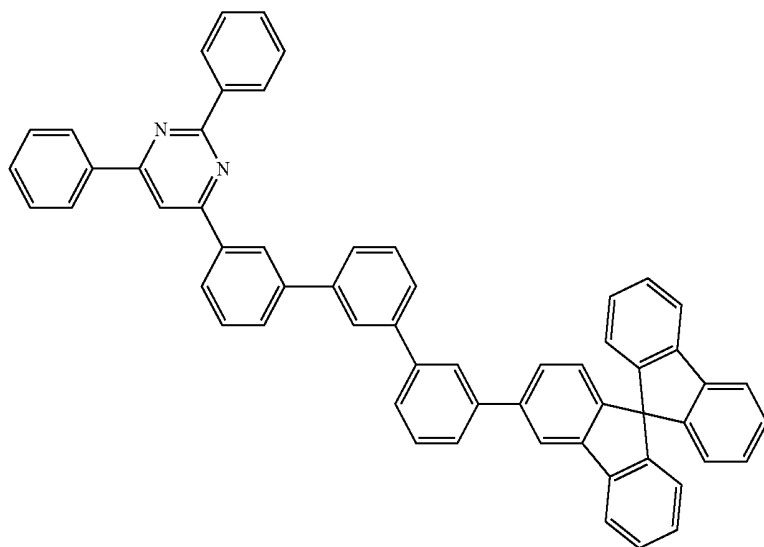
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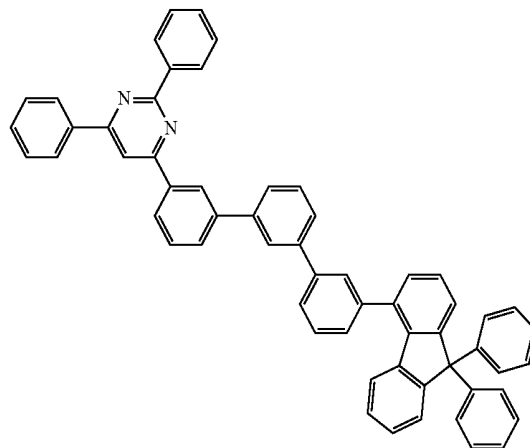
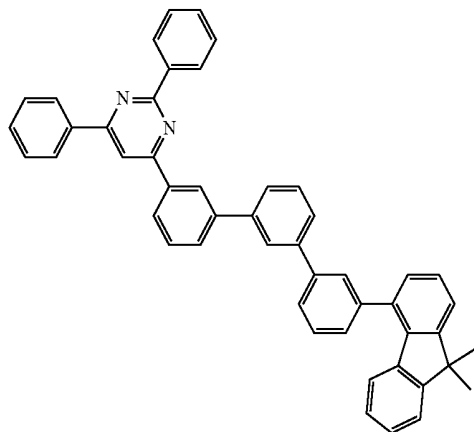
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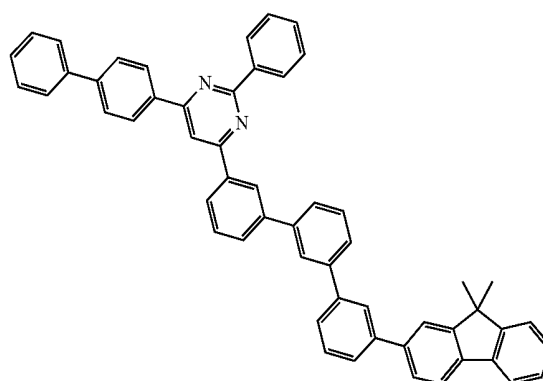
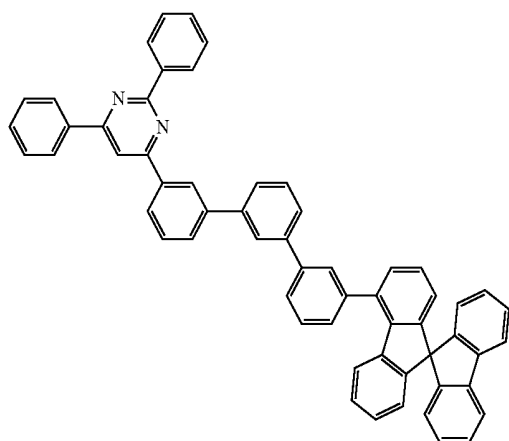
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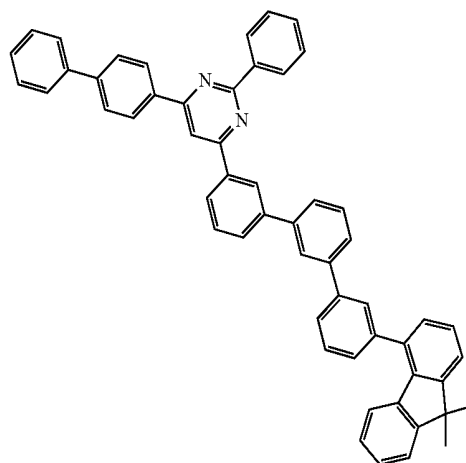
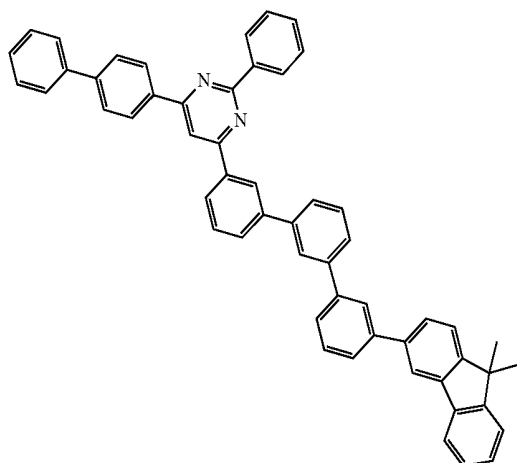
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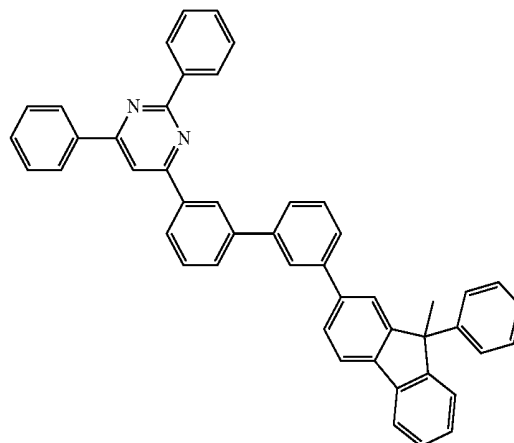
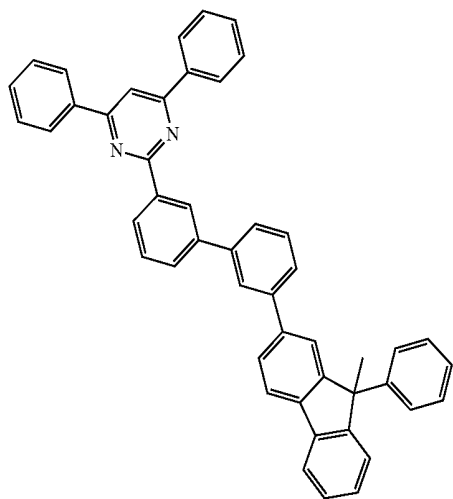
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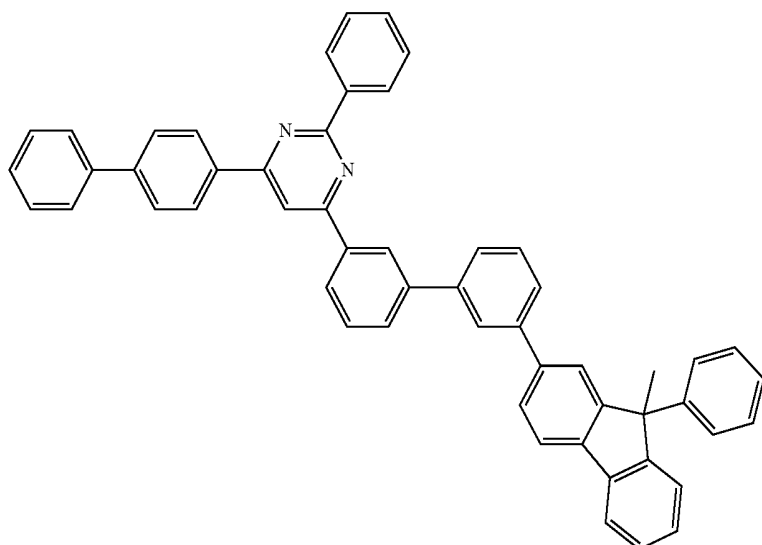
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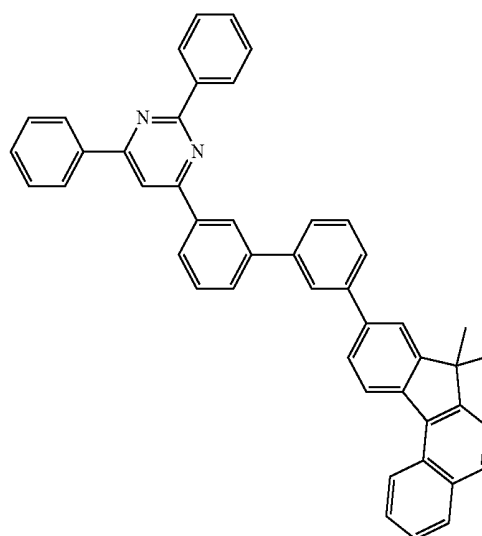
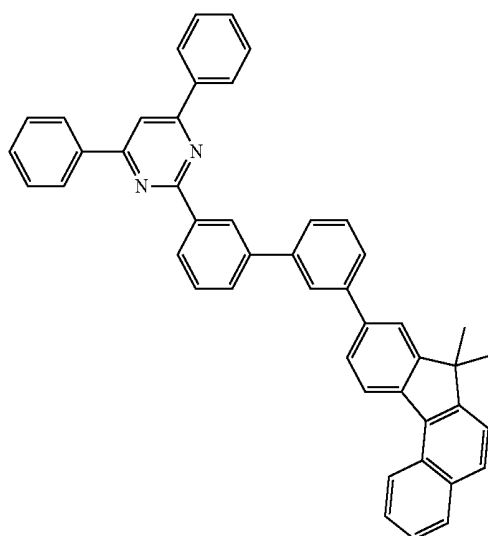


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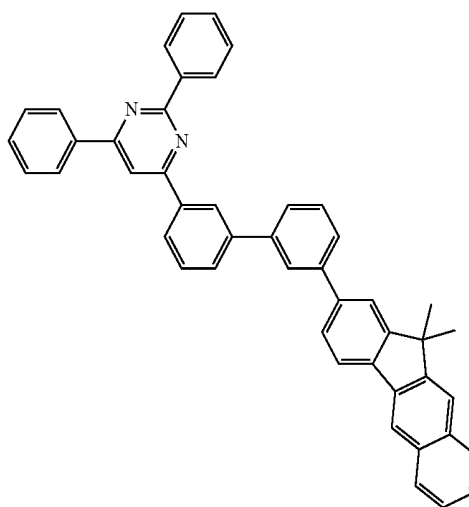
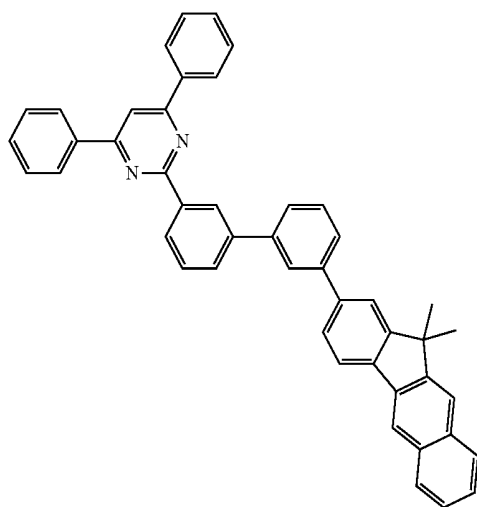
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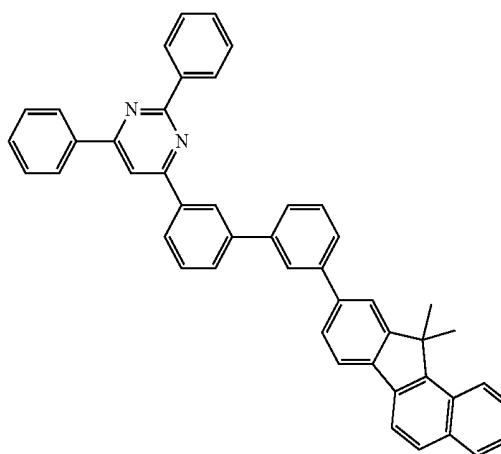
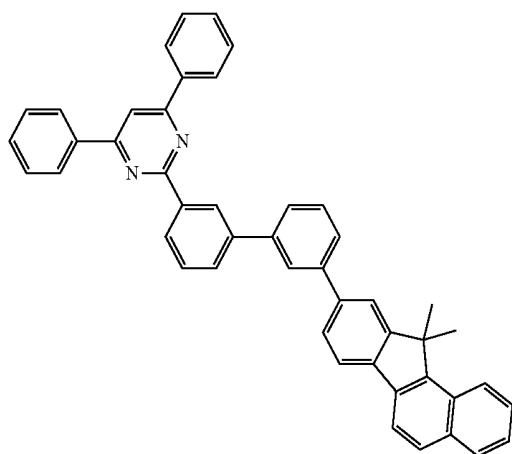
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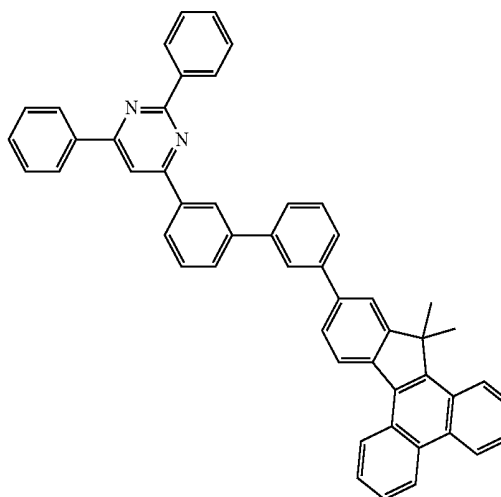
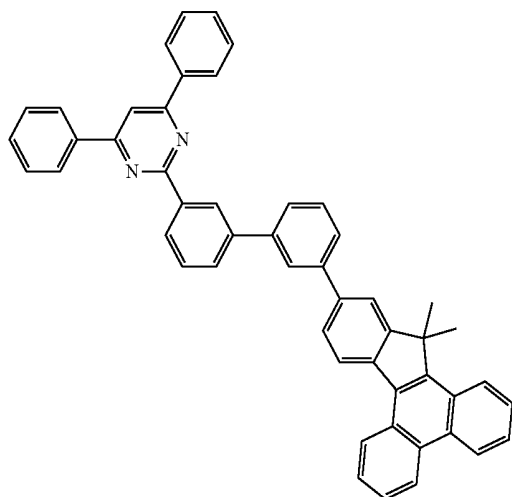
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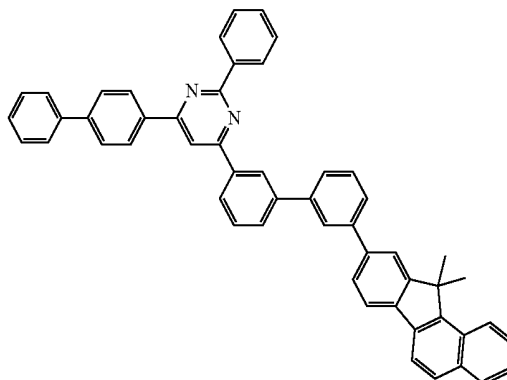
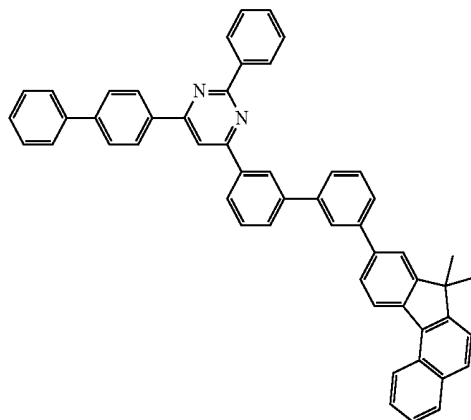
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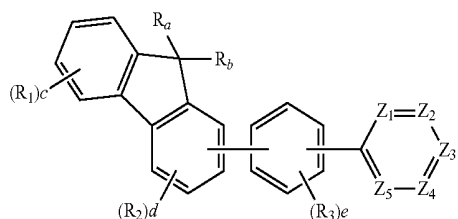


9. An organic electroluminescent element, comprising an anode, a cathode, and at least one organic layer interposed therebetween, wherein at least one of the organic layer comprises the compound of claim 1.

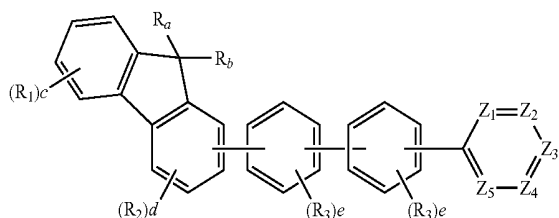
10. The organic electroluminescent element of claim 9, wherein the organic layer comprising the compound is a light-emitting layer or an auxiliary electron transport layer.

11. The organic electroluminescent element of claim 9, wherein the compound is selected from the group consisting of the compounds represented by the following Formula 2 to 4:

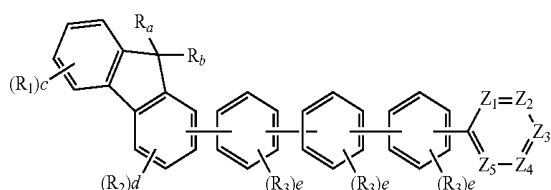
Formula 2



Formula 3



Formula 4



wherein,

$R_a$  and  $R_b$  are the same or different from each other and are each independently a  $C_1$ - $C_{40}$  alkyl group or a  $C_6$ - $C_{60}$  aryl group or combine with each other to form a fused ring,

$R_1$  to  $R_3$  are the same or different from each other and are each independently selected from the group consisting of a hydrogen, a deuterium, a halogen, a cyano group, a nitro group, an amino group, a  $C_1$ - $C_{40}$  alkyl group, a  $C_2$ - $C_{40}$  alkenyl group, a  $C_2$ - $C_{40}$  alkynyl group, a  $C_3$ - $C_{40}$  cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a  $C_6$ - $C_{60}$  aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a  $C_1$ - $C_{40}$  alkoxy group, a  $C_6$ - $C_{60}$  aryloxy group, a  $C_1$ - $C_{40}$  alkylsilyl group, a  $C_6$ - $C_{60}$  arylsilyl group, a  $C_1$ - $C_{40}$  alkylboron group, a  $C_6$ - $C_{60}$  arylboron group, a  $C_1$ - $C_{40}$  phosphine group, a  $C_1$ - $C_{40}$  phosphine oxide group, and a  $C_6$ - $C_{60}$  arylamine group, or in this case, adjacent ones of  $R_1$  to  $R_3$  are optionally respectively to each other to form a fused ring,

$Z_1$  to  $Z_5$  are the same or different from each other and are each independently N or C( $R_4$ ), and provided that  $Z_1$  to  $Z_5$  include at least one N, and when C( $R_4$ ) is present in a plural number, they are optionally the same as or different from each other,

c and e are each an integer of 0 to 4,

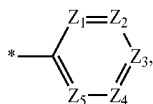
d is an integer of 0 to 3,

$R_4$  is selected from the group consisting of a hydrogen, a deuterium, a halogen, a cyano group, a nitro group, an amino group, a  $C_1$ - $C_{40}$  alkyl group, a  $C_2$ - $C_{40}$  alkenyl group, a  $C_2$ - $C_{40}$  alkynyl group, a  $C_3$ - $C_{40}$  cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a  $C_6$ - $C_{60}$  aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a  $C_1$ - $C_{40}$  alkoxy group, a  $C_6$ - $C_{60}$  aryloxy group, a  $C_1$ - $C_{40}$  alkylsilyl group, a  $C_6$ - $C_{60}$  arylsilyl group, a  $C_1$ - $C_{40}$  alkylboron group, a  $C_6$ - $C_{60}$  arylboron group, a  $C_1$ - $C_{40}$  phosphine group, a  $C_1$ - $C_{40}$  phosphine oxide group, and a  $C_6$ - $C_{60}$  arylamine group, or bonded to an adjacent substituent to form a fused ring,

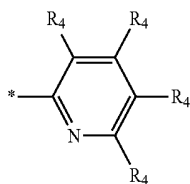
the alkyl and aryl groups of  $R_a$  and  $R_b$ ; the alkyl, alkenyl, alkynyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, alkoxy, aryloxy, alkylsilyl, arylsilyl, alkylboron, arylboron, phosphine, phosphine oxide, and arylamine groups of  $R_1$  to  $R_4$ ; and the arylene and heteroarylene

groups of L are optionally each independently unsubstituted or substituted with at least one selected from the group consisting of a deuterium, a halogen, a cyano group, a nitro group, an amino group, a C<sub>1</sub>-C<sub>40</sub> alkyl group, a C<sub>2</sub>-C<sub>40</sub> alkenyl group, a C<sub>2</sub>-C<sub>40</sub> alkynyl group, a C<sub>3</sub>-C<sub>40</sub> cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a C<sub>6</sub>-C<sub>60</sub> aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a C<sub>1</sub>-C<sub>40</sub> alkyloxy group, a C<sub>6</sub>-C<sub>60</sub> aryloxy group, a C<sub>1</sub>-C<sub>40</sub> alkylsilyl group, a C<sub>6</sub>-C<sub>60</sub> arylsilyl group, a C<sub>1</sub>-C<sub>40</sub> alkylboron group, a C<sub>6</sub>-C<sub>60</sub> arylboron group, a C<sub>1</sub>-C<sub>40</sub> phosphine group, a C<sub>1</sub>-C<sub>40</sub> phosphine oxide group, and a C<sub>6</sub>-C<sub>60</sub> arylamine group, and provided that when the substituent is present in a plural number, they are optionally the same or different from each other.

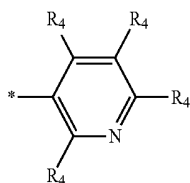
12. The organic electroluminescent element of claim 9, wherein the structure represented by



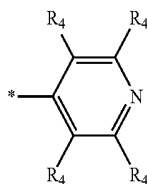
wherein \* is a site where to bond with L, in Formula 1 is selected from the group consisting of the structures represented by the following C-1 to C-15:



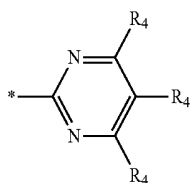
C-1



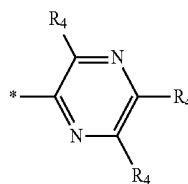
C-2



C-3

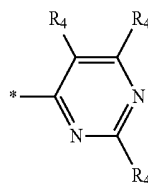


C-4

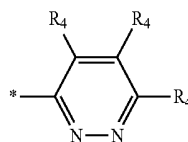


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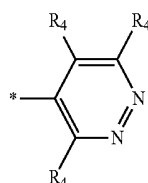
C-5



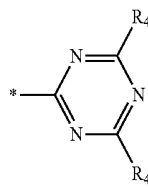
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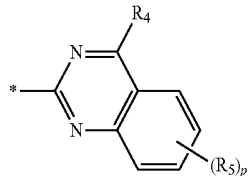
C-7



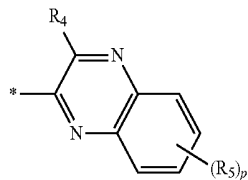
C-8



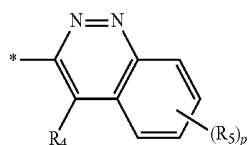
C-9



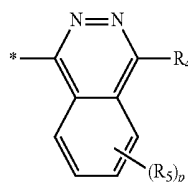
C-10



C-11

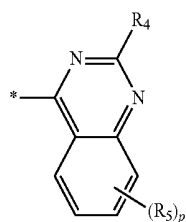


C-12



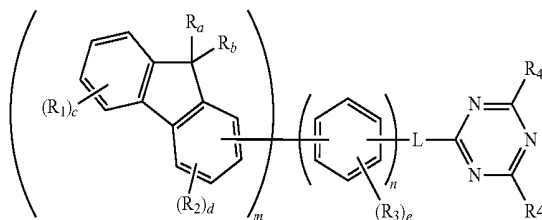
C-13

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C-14

Formula 5



C-15

wherein,

R<sub>4</sub> is the same as defined in claim 1,

R<sub>5</sub> is selected from the group consisting of a hydrogen, a deuterium, a halogen, a cyano group, a nitro group, a C<sub>1</sub>-C<sub>40</sub> alkyl group, a C<sub>2</sub>-C<sub>40</sub> alkenyl group, a C<sub>2</sub>-C<sub>40</sub> alkynyl group, a C<sub>3</sub>-C<sub>40</sub> cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a C<sub>6</sub>-C<sub>60</sub> aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a C<sub>6</sub>-C<sub>60</sub> aryloxy group, a C<sub>1</sub>-C<sub>40</sub> alkyloxy group, a C<sub>6</sub>-C<sub>60</sub> aryloxy group, a C<sub>1</sub>-C<sub>40</sub> alkylsilyl group, a C<sub>6</sub>-C<sub>60</sub> arylamine group, a C<sub>1</sub>-C<sub>40</sub> alkylboron group, a C<sub>1</sub>-C<sub>40</sub> alkylphosphine group, a C<sub>6</sub>-C<sub>60</sub> arylphosphine group, a C<sub>6</sub>-C<sub>60</sub> arylphosphine oxide group, and a C<sub>6</sub>-C<sub>60</sub> arylsilyl group, or combines with an adjacent substituent to form a fused ring,

p is an integer of 1 to 4,

the alkyl, alkenyl, alkynyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, aryloxy, alkyloxy, arylamine, alkylsilyl, alkylboron, arylboron, arylphosphine, arylphosphine oxide and arylsilyl groups of R<sub>5</sub> are optionally each independently unsubstituted or substituted with at least one selected from the group consisting of a deuterium, a halogen, a cyano group, a nitro group, a C<sub>1</sub>-C<sub>40</sub> alkyl group, a C<sub>2</sub>-C<sub>40</sub> alkenyl group, a C<sub>2</sub>-C<sub>40</sub> alkynyl group, a C<sub>6</sub>-C<sub>60</sub> aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a C<sub>6</sub>-C<sub>60</sub> aryloxy group, a C<sub>1</sub>-C<sub>40</sub> alkyloxy group, a C<sub>6</sub>-C<sub>60</sub> arylamine group, a C<sub>3</sub>-C<sub>40</sub> cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a C<sub>1</sub>-C<sub>40</sub> alkylsilyl group, a C<sub>1</sub>-C<sub>40</sub> alkylboron group, a C<sub>6</sub>-C<sub>60</sub> arylboron group, a C<sub>6</sub>-C<sub>60</sub> arylphosphine group, a C<sub>6</sub>-C<sub>60</sub> arylphosphine oxide group and a C<sub>6</sub>-C<sub>60</sub> arylsilyl group, and provided that when the substituent is present in a plural number, they are optionally the same or different from each other.

13. The organic electroluminescent element of claim 12, wherein the compound is represented by the following Formula 5:

wherein,

R<sub>a</sub> and R<sub>b</sub> are the same or different from each other and are each independently a C<sub>1</sub>-C<sub>40</sub> alkyl group or a C<sub>6</sub>-C<sub>60</sub> aryl group or combine with each other to form a fused ring,

R<sub>1</sub> to R<sub>3</sub> are the same or different from each other and are each independently selected from the group consisting of a hydrogen, a deuterium, a halogen, a cyano group, a nitro group, an amino group, a C<sub>1</sub>-C<sub>40</sub> alkyl group, a C<sub>2</sub>-C<sub>40</sub> alkenyl group, a C<sub>2</sub>-C<sub>40</sub> alkynyl group, a C<sub>3</sub>-C<sub>40</sub> cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a C<sub>6</sub>-C<sub>60</sub> aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a C<sub>1</sub>-C<sub>40</sub> alkyloxy group, a C<sub>6</sub>-C<sub>60</sub> aryloxy group, a C<sub>1</sub>-C<sub>40</sub> alkylsilyl group, a C<sub>6</sub>-C<sub>60</sub> arylsilyl group, a C<sub>1</sub>-C<sub>40</sub> alkylboron group, a C<sub>6</sub>-C<sub>60</sub> arylboron group, a C<sub>1</sub>-C<sub>40</sub> phosphine group, a C<sub>1</sub>-C<sub>40</sub> phosphine oxide group, and a C<sub>6</sub>-C<sub>60</sub> arylamine group, or in this case, adjacent ones of R<sub>1</sub> to R<sub>3</sub> are optionally respectively to each other to form a fused ring,

L is selected from the group consisting of a single bond, a C<sub>6</sub>-C<sub>18</sub> arylene group and a heteroarylene group having 5 to 18 nuclear atoms,

R<sub>4</sub> is selected from the group consisting of a hydrogen, a deuterium, a halogen, a cyano group, a nitro group, an amino group, a C<sub>1</sub>-C<sub>40</sub> alkyl group, a C<sub>2</sub>-C<sub>40</sub> alkenyl group, a C<sub>2</sub>-C<sub>40</sub> alkynyl group, a C<sub>3</sub>-C<sub>40</sub> cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a C<sub>6</sub>-C<sub>60</sub> aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a C<sub>1</sub>-C<sub>40</sub> alkyloxy group, a C<sub>6</sub>-C<sub>60</sub> aryloxy group, a C<sub>1</sub>-C<sub>40</sub> alkylsilyl group, a C<sub>6</sub>-C<sub>60</sub> arylsilyl group, a C<sub>1</sub>-C<sub>40</sub> alkylboron group, a C<sub>6</sub>-C<sub>60</sub> arylboron group, a C<sub>1</sub>-C<sub>40</sub> phosphine group, a C<sub>1</sub>-C<sub>40</sub> phosphine oxide group, and a C<sub>6</sub>-C<sub>60</sub> arylamine group, or bonded to an adjacent substituent to form a fused ring,

c and e are each an integer of 0 to 4,

d is an integer of 0 to 3,

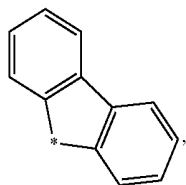
m and n are each an integer of 1 to 3,

the alkyl and aryl groups of R<sub>a</sub> and R<sub>b</sub>; the alkyl, alkenyl, alkynyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, alkyloxy, aryloxy, alkylsilyl, arylsilyl, alkylboron, arylboron, phosphine, phosphine oxide, and arylamine groups of R<sub>1</sub> to R<sub>4</sub>; and the arylene and heteroarylene groups of L are optionally each independently unsubstituted or substituted with at least one selected from the group consisting of a deuterium, a halogen, a cyano group, a nitro group, an amino group, a C<sub>1</sub>-C<sub>40</sub> alkyl group, a C<sub>2</sub>-C<sub>40</sub> alkenyl group, a C<sub>2</sub>-C<sub>40</sub> alkynyl group, a C<sub>3</sub>-C<sub>40</sub> cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a C<sub>6</sub>-C<sub>60</sub> aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a

C<sub>1</sub>-C<sub>40</sub> alkyloxy group, a C<sub>6</sub>-C<sub>60</sub> aryloxy group, a C<sub>1</sub>-C<sub>40</sub> alkylsilyl group, a C<sub>6</sub>-C<sub>60</sub> arylsilyl group, a C<sub>1</sub>-C<sub>40</sub> alkylboron group, a C<sub>6</sub>-C<sub>60</sub> arylboron group, a C<sub>1</sub>-C<sub>40</sub> phosphine group, a C<sub>1</sub>-C<sub>40</sub> phosphine oxide group, and a C<sub>6</sub>-C<sub>60</sub> arylamine group, and provided that when the substituent is present in a plural number, they are optionally the same or different from each other.

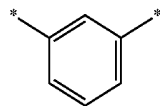
14. The organic electroluminescent element of claim 13, wherein R<sub>4</sub>'s on the compound represented by Formula 5 are identical.

15. The organic electroluminescent element of claim 9, wherein R<sub>a</sub> and R<sub>b</sub> are each independently a methyl or a phenyl or bond each other to form a fused ring represented by



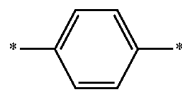
wherein \* is a site where to bond.

16. The organic electroluminescent element of claim 9, wherein L is selected from the group consisting of the structures represented by the following L-1 to L-7:

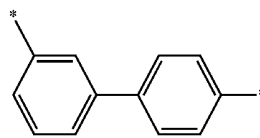


L-1

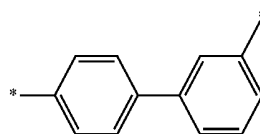
-continued



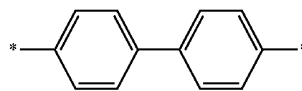
L-2



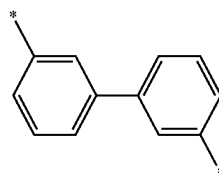
L-3



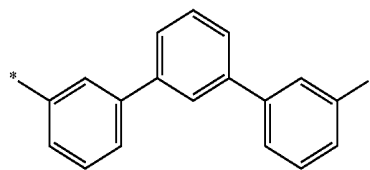
L-4



L-5



L-6



L-7

wherein \* is a site where to bond.

\* \* \* \* \*

专利名称(译)	有机化合物和包含其的有机电致发光元件		
公开(公告)号	<a href="#">US20180053900A1</a>	公开(公告)日	2018-02-22
申请号	US15/539223	申请日	2015-12-24
[标]申请(专利权)人(译)	株式会社斗山		
申请(专利权)人(译)	斗山公司		
当前申请(专利权)人(译)	斗山公司		
[标]发明人	EUM MIN SIK SON HOJUN PARK WOO JAE KIM TAE HYUNG KIM JIYI BEAK YOUNGMI		
发明人	EUM, MIN-SIK SON, HOJUN PARK, WOO JAE KIM, TAE HYUNG KIM, JIYI BEAK, YOUNGMI		
IPC分类号	H01L51/00 C07D251/24 C09K11/02 C07D239/26 C07D213/16 C09K11/06		
CPC分类号	H01L51/0067 C07D251/24 C09K11/025 H01L51/0052 H01L51/0056 C07D239/26 C07D213/16 H01L51/0055 H01L51/0054 H01L51/0059 H01L51/0061 H01L51/0072 H01L51/0085 C09K11/06 C09K2211/185 C09K2211/1029 C09K2211/1007 H01L51/5016 H01L51/508 C07D213/06 C09K2211/1011 C09K2211/1044 C09K2211/1059 H01L51/50 H01L51/5012 H01L51/5072 C07C13/567 C07D239/20 C07D251/12 C09K2211/1003 H01L51/5004 H01L51/5092 H01L51/52 H01L2251/552		
优先权	1020140188953 2014-12-24 KR 1020150171639 2015-12-03 KR 1020150171678 2015-12-03 KR 1020150178926 2015-12-15 KR		
外部链接	<a href="#">Espacenet</a> <a href="#">USPTO</a>		

摘要(译)

本发明涉及一种新型有机化合物和有机电致发光元件，其通过在一个或多个有机材料层中含有新型有机化合物而具有改善的特性，例如发光效率，驱动电压和寿命。

[Formula 1]

