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(54) **COMPOUNDS FOR ELECTRONIC DEVICES**

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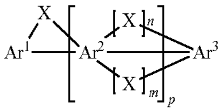
(57) **ABSTRACT**

The present invention relates to compounds of the formula (1), to the use thereof in electronic devices, and to electronic devices, particularly organic electroluminescence devices, comprising said compounds according to the invention, particularly as blue emitting material in an emitting layer.

formula (1)



COMPOUNDS FOR ELECTRONIC DEVICES

[0001] The present invention describes novel organic compounds and the use thereof in electronic devices.

[0002] The general structure of organic electroluminescent devices is described, for example, in U.S. Pat. No. 4,539,507, U.S. Pat. No. 5,151,629, EP 0676461 and WO 98/27136. However, these devices still exhibit problems for which there is a need for improvement:

[0003] 1. There is still a need for improvement in the efficiency, especially in the case of fluorescent OLEDs. This applies in particular to dark-blue-emitting OLEDs.

[0004] 2. A further improvement in the operating lifetime is still desirable, in particular in the case of blue emission.

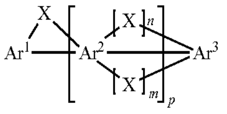
[0005] 3. The operating voltage is quite high, especially in the case of fluorescent OLEDs. There is therefore still a need for improvement here in order to improve the power efficiency. This is of major importance, in particular, for mobile applications.

[0006] 4. Many blue-emitting materials in accordance with the prior art are incompatible with frequently used electron-injection and -transport materials, such as, for example, hydroxyquinolinate/metal complexes (for example Alq, Beq), benzimidazole derivatives, phenanthroline derivatives (for example BCP) or anthracene derivatives, which are mixed with donors, such as alkali or alkaline-earth metals (for example Li, Na, K, Rb or Cs), with inorganic salts thereof (for example LiF or Cs_2CO_3) or with organic salts thereof (for example lithium, sodium, potassium, rubidium or caesium quinolinate) and thus produce an excess of electrons in the device. This incompatibility only results in inadequate device lifetimes. The problems frequently occur, in particular, if the blue-emitting material used is a diarylamino derivative of a condensed aromatic compound. However, emitters of this type are the most frequent and hitherto the best blue emitters. Further improvements are therefore desirable here.

[0007] The closest prior art for blue-fluorescent emitters are dibenzoindenofluorene derivatives in accordance with WO 07/140847 and monobenzoindenofluorene derivatives in accordance with WO 08/006449. In order to obtain efficient blue emitters from these basic structures, the introduction of one or two diarylamino groups is necessary. Good blue-emitting OLEDs have already been achieved with these compounds. However, further improvements are also desirable here with respect to the efficiency. Whereas these diarylamino-substituted compounds also exhibit very good lifetimes in combination with an undoped electron-transport layer, the lifetime is still inadequate if these compounds are used in combination with a doped electron-transport layer, as described above. Further improvements are therefore also necessary with respect to the lifetime, in particular in combination with doped electron-transport layers which result in an excess of electrons in the device.

[0008] Surprisingly, it has been found that compounds in which three aryl or heteroaryl groups are bridged by two indeno bridges or corresponding heterobridges exhibit particularly good properties as blue emitters if, in particular, the sum of the π electrons of the three aromatic or heteroaromatic groups is a least 28. It is not necessary to introduce diarylamino substituents into these compounds since the unsubstituted compounds already exhibit highly efficient dark-blue emission. Furthermore, the compounds result in very good lifetimes in organic electroluminescent devices. The present invention therefore relates to these compounds and to the use thereof in organic electroluminescent devices.

[0009] The invention therefore relates to compounds of the formula (1)



formula (1)

where the following applies to the symbols and indices used:

[0010] Ar^1, Ar^2, Ar^3 are on each occurrence, identically or differently, an aryl or heteroaryl group having 5 to 30 aromatic ring atoms, which may be substituted by one or more radicals R^1, with the proviso that Ar^2 does not stand for anthracene, naphthacene or pentacene;

[0011] X is on each occurrence, identically or differently, a group selected from BR^2, $C(R^2)_2$, $Si(R^2)_2$, $C{=}O$, $C{=}NR^2$, $C{=}C(R^2)_2$, O, S, $S{=}O$, SO_2, NR^2, PR^2, $P({=}O)R^2$ and $P({=}S)R^2$;

[0012] R^1, R^2 are on each occurrence, identically or differently, H, D, F, Cl, Br, I, $N(Ar^4)_2$, $C({=}O)Ar^4$, $P({=}O)(Ar^4)_2$, $S({=}O)Ar^4$, $S({=}O)_2Ar^4$, $CR^2{=}CR^2Ar^4$, CHO, $CR^3{=}C(R^3)_2$, CN, NO_2, $Si(R^3)_3$, $B(OR^3)_2$, $B(R^3)_2$, $B(N(R^3)_2)_2$, OSO_2R^3, a straight-chain alkyl, alkoxy or thioalkoxy group having 1 to 40 C atoms or a straight-chain alkenyl or alkynyl group having 2 to 40 C atoms or a branched or cyclic alkyl, alkenyl, alkynyl, alkoxy or thioalkoxy group having 3 to 40 C atoms, each of which may be substituted by one or more radicals R^3, where in each case one or more non-adjacent CH_2 groups may be replaced by $R^3C{=}CR^3$, $C{\equiv}O$, $Si(R^3)_2$, $Ge(R^3)_2$, $Sn(R^3)_2$, $C{=}O$, $C{=}S$, $C{=}Se$, $C{=}NR^3$, $P({=}O)R^3$, SO, SO_2, NR^3, O, S or $CONR^3$ and where one or more H atoms may be replaced by F, Cl, Br, I, CN or NO_2, or an aromatic or heteroaromatic ring system having 5 to 60 aromatic ring atoms, which may in each case be substituted by one or more radicals R^3, or a combination of these systems; two or more substituents R^1 or R^2 here may also form a mono- or polycyclic, aliphatic or aromatic ring system with one another;

[0013] R^3 is on each occurrence, identically or differently, H, D or an aliphatic or aromatic hydrocarbon radical having 1 to 20 C atoms;

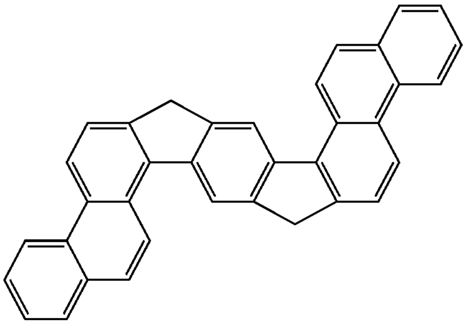
[0014] Ar^4 is on each occurrence, identically or differently, an aromatic or heteroaromatic ring system having 5-30 aromatic ring atoms, which may be substituted by one or more non-aromatic radicals R^1; two radicals Ar on the same nitrogen or phosphorus atom may also be linked to one another here by a single bond or a bridge X;

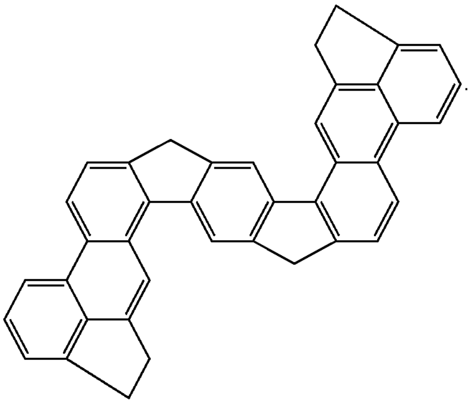
[0015] m, n are 0 or 1, with the proviso that $m+n=1$;

[0016] p is 1, 2, 3, 4, 5 or 6;

Ar^1, Ar^2 and X here together form a five-membered ring or a six-membered ring, and Ar^2, Ar^3 and X together form a five-membered ring or a six-membered ring, with the proviso that either all symbols X in the compound of the formula (1) are bound in a five-membered ring or all symbols X in the compound of the formula (1) are bound in a six-membered ring; characterised in that the sum of all π electrons in groups Ar^1, Ar^2 and Ar^3 is at least 28 if $p=1$ and is at least 34 if $p=2$ and is at least 40 if $p=3$ and is at least 46 if $p=4$ and is at least 52 if $p=5$ and is at least 58 if $p=6$;

the following compounds are excluded from the invention:

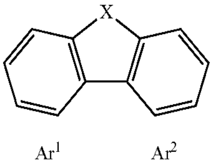




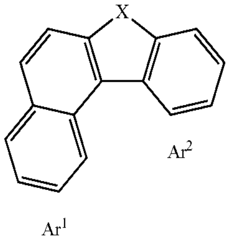
n=0 or m=0 here means that the corresponding group X is not present and that instead hydrogen or a substituent R^1 is bonded to the corresponding positions of Ar^2 and Ar^3.

[0017] The determination of the sum of all π electrons in groups Ar^1, Ar^2 and Ar^3 is obvious to the person skilled in the art. Thus, each double bond in an aryl group (where the double bonds are delocalised) stands for two π electrons, meaning that, for example, benzene has 6 π electrons, naphthalene has 10 π electrons, anthracene and phenanthrene have 14 π electrons, pyrene has 16 π electrons, naphthacene, benzanthracene and chrysene have 18 π electrons, and perylene has 20 π electrons. In an aryl group, the number of π electrons corresponds to the number of C atoms in the aromatic ring system. In heteroaromatic compounds, each double bond (the double bonds here are again delocalised) also contributes two it electrons, where these delocalised double bonds can be formed either between two carbon atoms, between carbon and nitrogen or between two nitrogen atoms. Furthermore, in five-membered heteroaryl groups, the heteroatom, which is formally not bonded in a double bond (i.e. for example, the nitrogen in pyrrole, the oxygen in furan or the sulfur in thiophene) likewise contributes two π electrons to the overall π-electron system via the free electron pair. Pyridine, pyrazine, pyrimidine and pyridazine therefore each have 6 π electrons, quinoline and isoquinoline have 10 π electrons, phenanthroline has 14 π electrons, pyrrole, imidazole, pyrazole, thiophene, thiazole and furan each have 6 π electrons, indole, benzimidazole, benzothiophene and benzofuran each have 10 π electrons, and carbazole, dibenzothiophene and dibenzofuran each have 14 π electrons.

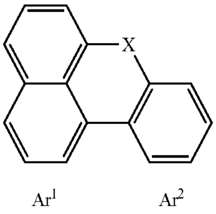
[0018] It is shown below with reference to the example of phenyl and naphthalene as groups Ar^1 and Ar^2 what is meant by the formation of a five-membered ring or six-membered ring from the groups Ar^1, Ar^2 and X:



formation of a five-membered ring



formation of a five-membered ring



formation of a six-membered ring

[0019] With a simple, uncondensed aryl or heteroaryl group, for example with phenyl, it is always only possible to form a five-membered ring. With a condensed aryl or heteroaryl group, for example with naphthalene, the formation of a five-membered ring or six-membered ring is possible, depending on the linking. The same linking principle can be applied correspondingly to other condensed aryl groups or to condensed or uncondensed heteroaryl groups. In a five-membered ring, one edge of the aryl or heteroaryl group Ar^1 or Ar^2 or Ar^3 thus in each case forms a five-membered ring with X. In a six-membered ring, two edges of a condensed aryl or heteroaryl group Ar^1 or Ar^2 or Ar^3 form a six-membered ring together with one edge of a further aryl or heteroaryl group Ar^1 or Ar^2 or Ar^3 and together with X.

[0020] In a preferred embodiment of the invention, Ar^1, Ar^2 and X form a five-membered ring and Ar^2, Ar^3 and X form a five-membered ring. If the index p=2 or 3, two groups Ar^2 preferably also form a five-membered ring together with X.

[0021] For the purposes of this invention, an aryl group or heteroaryl group is taken to mean an aromatic group or heteroaromatic group respectively having a common aromatic electron system, where an aryl group contains 6 to 30 C atoms and a heteroaryl group contains 2 to 30 C atoms and a total of at least 5 aromatic ring atoms. The heteroatoms are preferably selected from N, O and/or S. For the purposes of this invention, this can be a single homo- or heterocyclic ring, for example benzene, pyridine, thiophene, etc., or it can be a condensed aryl or heteroaryl group in which at least two aromatic or heteroaromatic rings, for example benzene rings, are fused to one another, i.e. are condensed onto one another by anellation, i.e. have at least one common edge and thus also a common aromatic system. This aryl or heteroaryl group may be substituted or unsubstituted; any substituents present may likewise form further ring systems. Thus, for example, systems such as naphthalene, anthracene, phenanthrene, pyrene, etc., are to be regarded as aryl groups for the purposes of this invention and quinoline, acridine, benzothiophene, carbazole, etc., are to be regarded as heteroaryl groups for the purposes of this invention, while, for example, biphenyl, fluorene, spirobifluorene, etc., are not aryl groups since separate aromatic electron systems are present here.

[0022] For the purposes of this invention, an aromatic ring system contains 6 to 60 C atoms in the ring system. For the purposes of this invention, a heteroaromatic ring system contains 2 to 60 C atoms and at least one heteroatom in the ring system, with the proviso that the total number of C atoms and heteroatoms is at least 5. The heteroatoms are preferably selected from N, O and/or S. For the purposes of this invention, an aromatic or heteroaromatic ring system is intended to be taken to mean a system which does not necessarily contain only aryl or heteroaryl groups, but in which, in addition, a plurality of aryl or heteroaryl groups may be interrupted by a short, non-aromatic unit (less than 10% of the atoms other than H, preferably less than 5% of the atoms other than H), such as, for example, a C, N or O atom. Thus, for example, systems such as 9,9'-spirobifluorene, 9,9-diarylfluorene, triarylamine, diaryl ether, etc., are also to be regarded as aromatic ring systems for the purposes of this invention.

[0023] For the purposes of the present invention, a C_1- to C_{40}-alkyl group, in which individual H atoms or CH_2 groups may also be substituted by the above-mentioned groups, is particularly preferably taken to mean the radicals methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, s-butyl, t-butyl, 2-methylbutyl, n-pentyl, s-pentyl, tert-pentyl, 2-pentyl, cyclopentyl, n-hexyl, s-hexyl, tert-hexyl, 2-hexyl, 3-hexyl, cyclohexyl, 2-methylpentyl, n-heptyl, 2-heptyl, 3-heptyl, 4-heptyl, cycloheptyl, 1-methylcyclohexyl, n-octyl, 2-ethylhexyl, cyclooctyl, 1-bicyclo[2.2.2]octyl, 2-bicyclo[2.2.2]octyl, 2-(2,6-dimethyl)octyl, 3-(3,7-dimethyl)octyl, trifluoromethyl, pentafluoroethyl, 2,2,2-trifluoroethyl, ethenyl, propenyl, butenyl, pentenyl, cyclopentenyl, hexenyl, heptynyl, cyclohexenyl, heptenyl, cycloheptenyl, octenyl, cyclooctenyl, ethynyl, propynyl, butynyl, pentynyl, hexynyl or octynyl. A C_1- to C_{40}-alkoxy group is particularly preferably taken to mean methoxy, ethoxy, n-propoxy, i-propoxy, n-butoxy, i-butoxy, s-butoxy, t-butoxy or 2-methylbutoxy. A C_2-C_{24}-aryl or -heteroaryl group, which can be monovalent or divalent depending on the use, may in each case also be substituted by the above-mentioned radicals R^1 and may be linked to the aromatic or heteroaromatic ring system via any desired positions, is taken to mean, in particular, groups derived from benzene, naphthalene, anthracene, phenanthrene, pyrene, dihydropyrene, chrysene, perylene, fluoranthene, benzanthracene, benzophenanthrene, benzofluoranthene, tetracene, pentacene, benzopyrene, furan, benzofuran, isobenzofuran, dibenzofuran, thiophene, benzothiophene, isobenzothiophene, dibenzothiophene, pyrrole, indole, isoindole, carbazole, pyridine, quinoline, isoquinoline, acridine, phenanthridine, benzo-5,6-quinoline, benzo-6,7-quinoline, benzo-7,8-quinoline, phenothiazine, phenoxazine, pyrazole, indazole, imidazole, benzimidazole, naphthimidazole, phenanthrimidazole, pyridimidazole, pyrazinimidazole, quinoxalinimidazole, oxazole, benzoxazole, naphthoxazole, anthroxazole, phenanthroxazole, isoxazole, 1,2-thiazole, 1,3-thiazole, benzothiazole, pyridazine, benzopyridazine, pyrimidine, benzopyrimidine, quinoxaline, pyrazine, phenazine, naphthyridine, azacarbazole, benzocarboline, phenanthroline, 1,2,3-triazole, 1,2,4-triazole, benzotriazole, 1,2,3-oxadiazole, 1,2,4-oxadiazole, 1,2,5-oxadiazole, 1,3,4-oxadiazole, 1,2,3-thiadiazole, 1,2,4-thiadiazole, 1,2,5-thiadiazole, 1,3,4-thiadiazole, 1,3,5-triazine, 1,2,4-triazine, 1,2,3-triazine, tetrazole, 1,2,4,5-tetrazine, 1,2,3,4-tetrazine, 1,2,3,5-tetrazine, purine, pteridine, indolizine, benzothiadiazole. In addition to the above-mentioned aryl and heteroaryl groups, aromatic and heteroaromatic ring systems are, for the purposes of this invention, taken to mean, in particular, biphenylene, terphenylene, fluorene, benzofluorene, dibenzofluorene, spirobifluorene, dihydrophenanthrene, tetrahydropyrene, cis- or trans-indenofluorene, cis- or trans-monobenzoindenofluorene or cis- or trans-dibenzoindenofluorene.

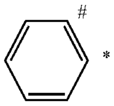
[0024] In a preferred embodiment of the invention, the index p=1, 2 or 3, particularly preferably 1 or 2, very particularly preferably 1.

[0025] In a preferred embodiment of the invention, the sum of all π electrons in groups Ar^1, Ar^2 and Ar^3 is between 28 and 50, particularly preferably between 28 and 46, very particularly preferably between 28 and 42, in particular between 28 and 36, if p=1, and is between 34 and 56, particularly preferably between 34 and 52, very particularly preferably between 34 and 48, in particular between 34 and 40, if p=2, and is between 40 and 62, particularly preferably between 40 and 58, very particularly preferably between 40 and 54, in particular between 40 and 46, if p=3.

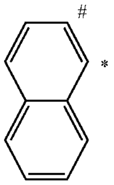
[0026] Preference is furthermore given to compounds of the formula (1) in which the symbols Ar^1, Ar^2 and Ar^3 stand, identically or differently on each occurrence, for an aryl or heteroaryl group having 5 to 22 aromatic ring atoms, in particular having 5 to 18 aromatic ring atoms. The groups Ar^1, Ar^2 and Ar^3 here are particularly preferably selected, independently of one another, from the group consisting of benzene, naphthalene, anthracene, phenanthrene, fluoranthene, naphthacene, benzanthracene, chrysene, pyrene, benzofluoranthene, triphenylene, perylene, dibenzanthracene, benzopyrene, picene, pentacene, pentaphene, benzophenanthrene, pyridine, pyrazine, pyrimidine, pyridazine, quinoline, isoquinoline, phenanthroline, acridine. The symbols Ar^1, Ar^2 and Ar^3 particularly preferably stand on each occurrence, identically or differently, for an aryl group having 6 to 18 aromatic ring atoms, in particular selected from benzene, naphthalene, anthracene, phenanthrene, fluoranthene, naphthacene, benzanthracene, chrysene, pyrene, benzofluoranthene and triphenylene.

[0027] Particularly preferred groups Ar^1 and Ar^3 which form a five-membered ring with Ar^2 are the groups of the formulae (2) to (85) shown below, each of which may be substituted by one or more radicals R^1. The symbol * stands for the position of the link from Ar^1 or Ar^3 to Ar^2, and the symbol # stands for the position of the link from Ar^1 or Ar^3 to X.

formula (2)



formula (3)



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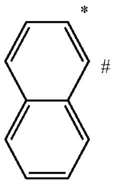
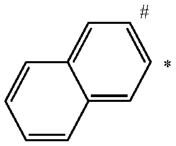
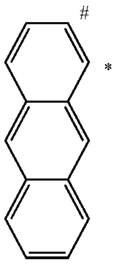
formula (4)



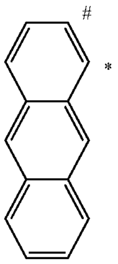
formula (5)



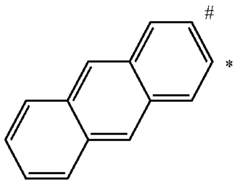
formula (6)



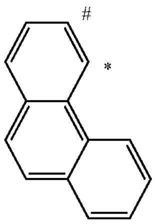
formula (7)



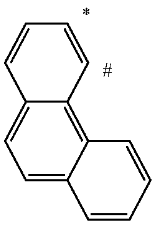
formula (8)



formula (9)



formula (10)



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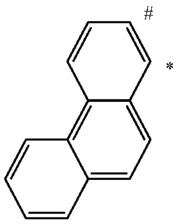
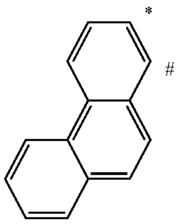
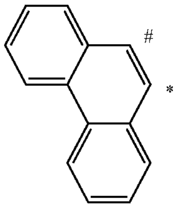
formula (11)



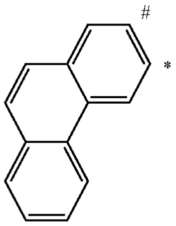
formula (12)



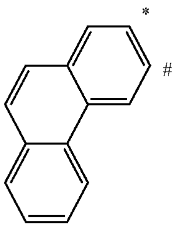
formula (13)



formula (14)



formula (15)



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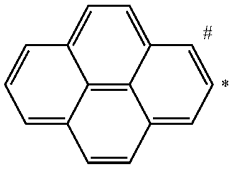
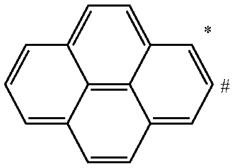


formula (17)



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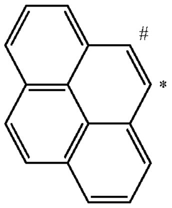
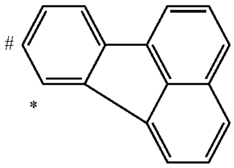
formula (18)



formula (19)



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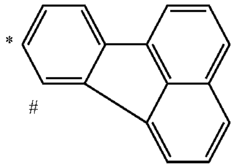

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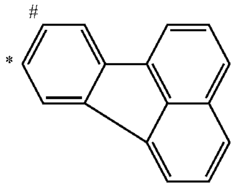

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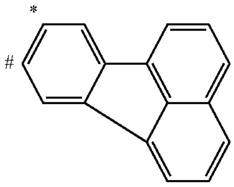

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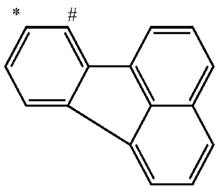

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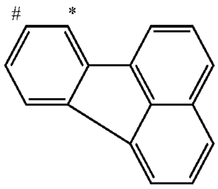

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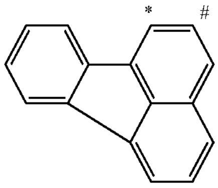

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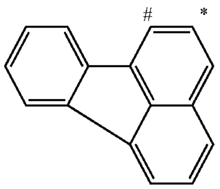

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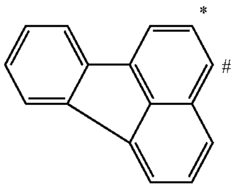

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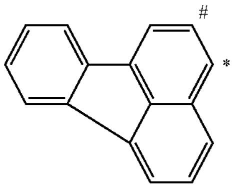

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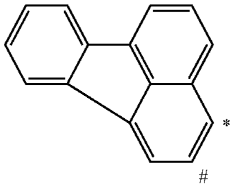

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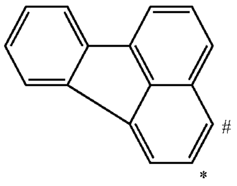

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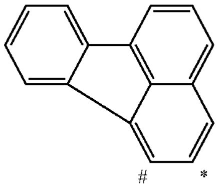

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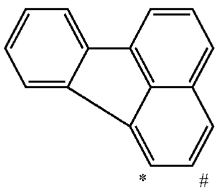

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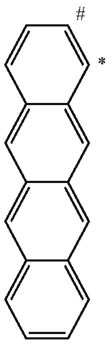

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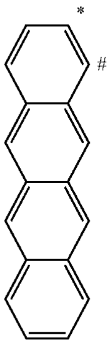

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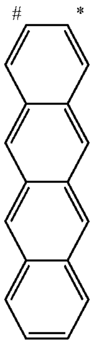

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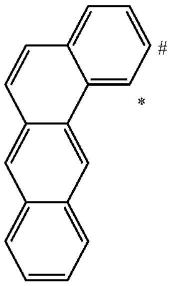

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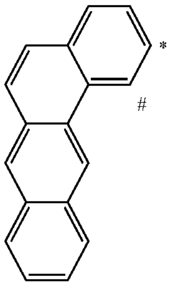

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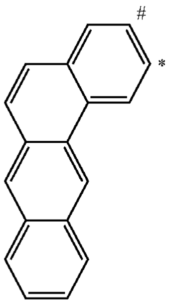

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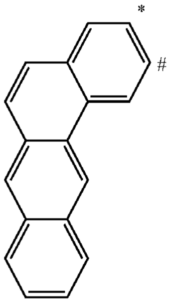

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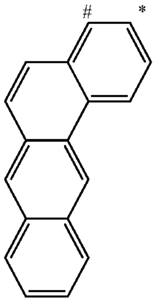

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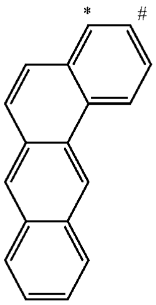

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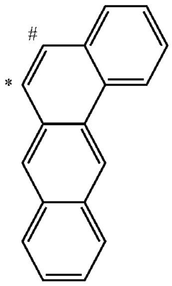

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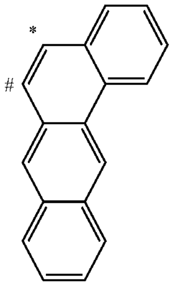

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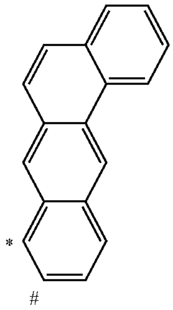

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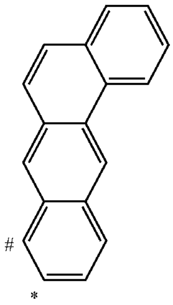

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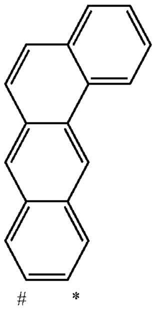

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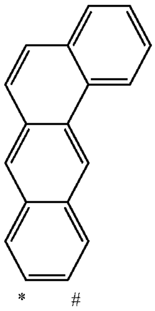

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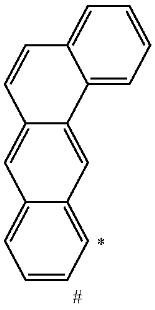

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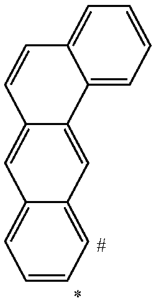

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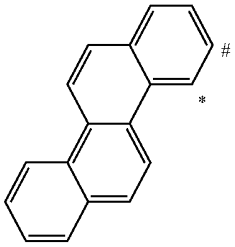
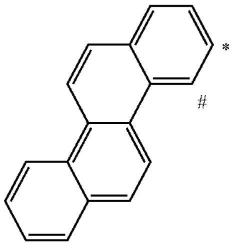


formula (51)



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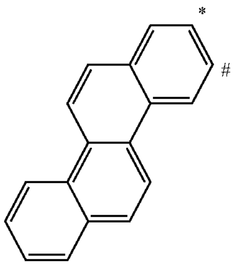

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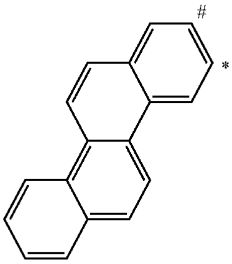
formula (53)



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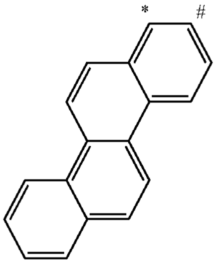

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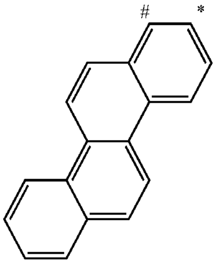
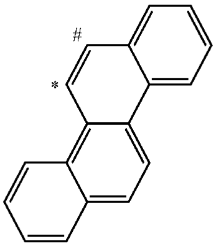


formula (56)



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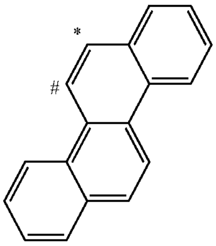

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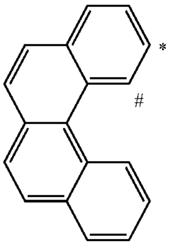

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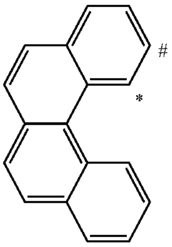
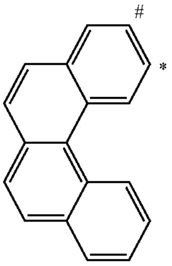
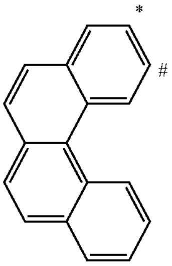
formula (59)



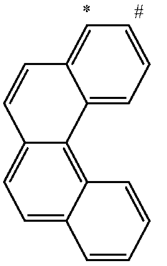
formula (60)



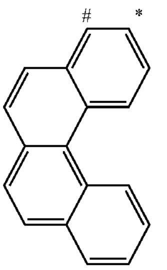
formula (61)



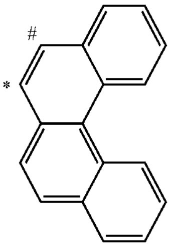
formula (62)



formula (63)



formula (64)



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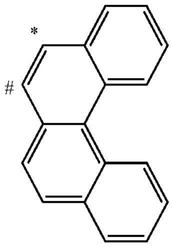
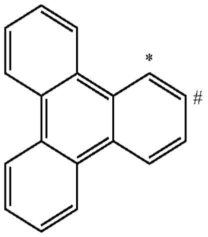
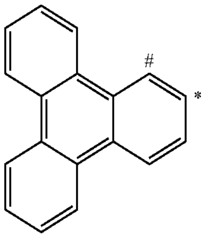
formula (65)



formula (66)



formula (67)



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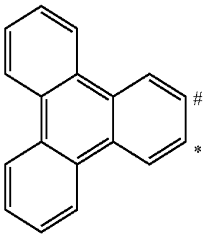

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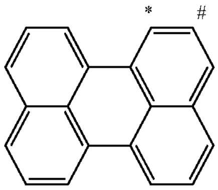
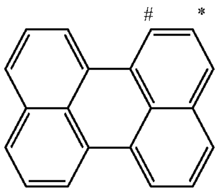


formula (70)



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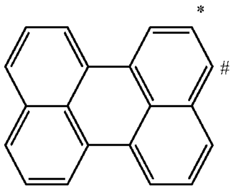

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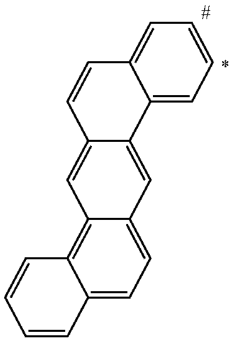
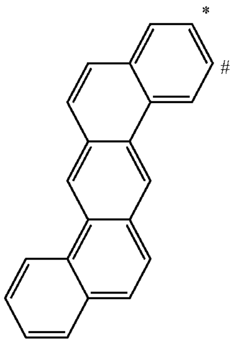
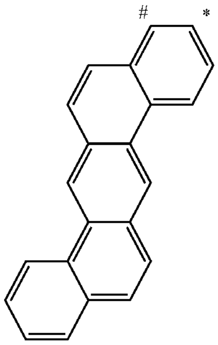
formula (72)



formula (73)



formula (74)



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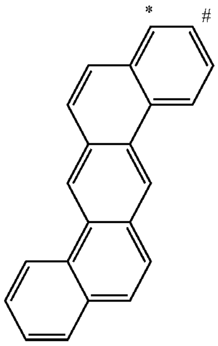

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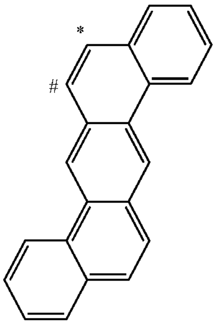

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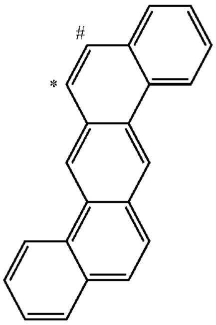

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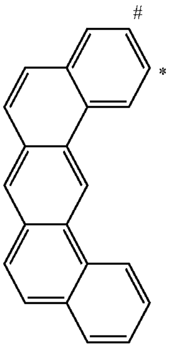

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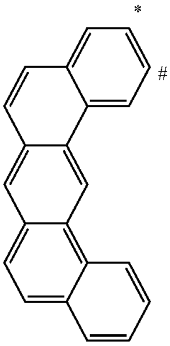

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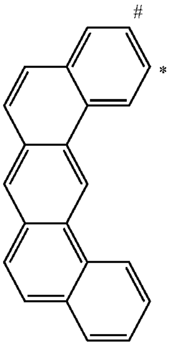
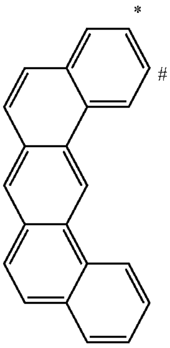
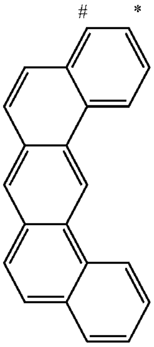
formula (80)



formula (81)



formula (82)



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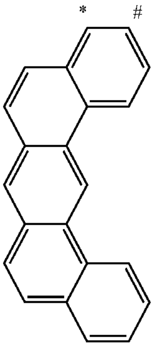

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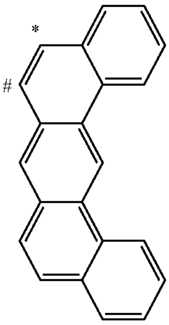
formula (84)



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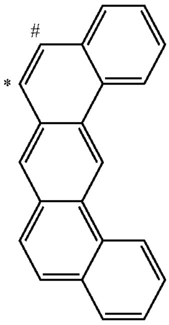
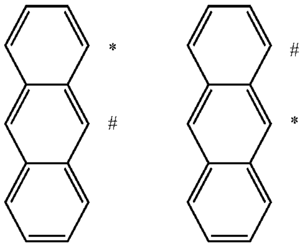
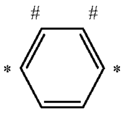


[0028] Preference is likewise given to the groups Ar^1 and Ar^3 mentioned above which form a six-membered ring with Ar^2. The formation of a six-membered ring takes place via two groups in the peri position, as depicted by way of example below with reference to the example of an anthracene group:

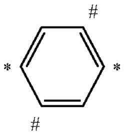


[0029] Particularly preferred groups Ar^2 are the groups of the formulae (86) to (110) shown below, each of which may be substituted by one or more radicals R^1. The symbol * stands for the position of the link from Ar^2 to Ar^1 or Ar^3 and the symbol # stands for the position of the link from Ar^2 to X.

formula (86)



formula (87)



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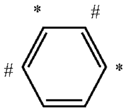
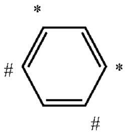
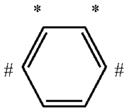
formula (88)



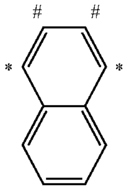
formula (89)



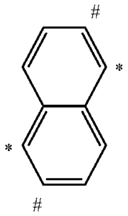
formula (90)



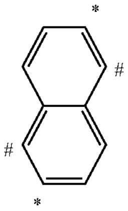
formula (91)



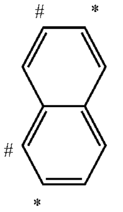
formula (92)



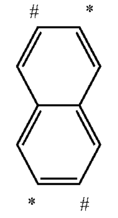
Formula (93)



Formula (94)



formula (95)



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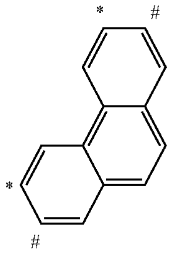
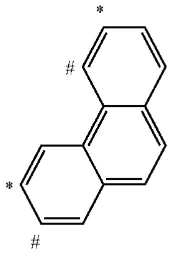
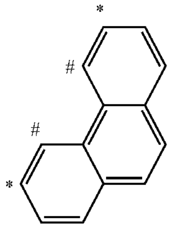
formula (96)



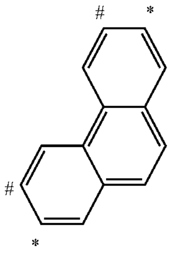
formula (97)



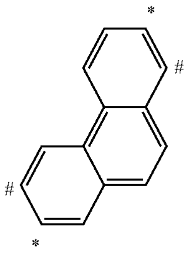
formula (98)



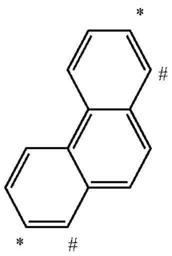
formula (99)



formula (100)



formula (101)



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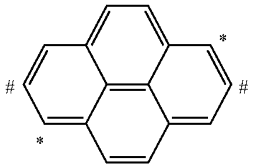
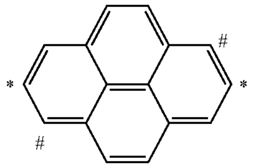
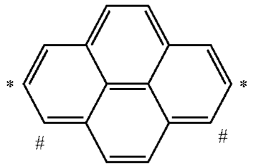
formula (102)



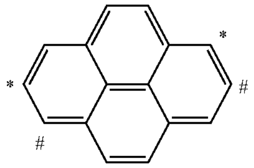
formula (103)



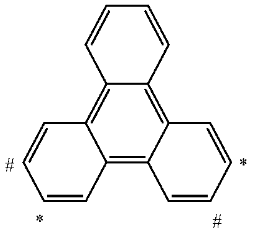
formula (104)



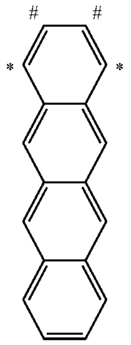
formula (105)



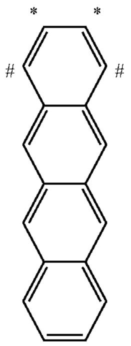
formula (106)



formula (107)



formula (108)



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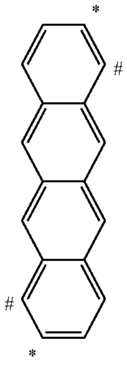
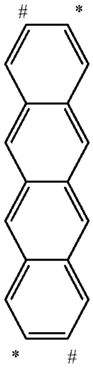
formula (109)



formula (110)



[0030] Entirely analogously, groups Ar^2 which form a six-membered ring with Ar^1 or Ar^3 and X are also possible here.

[0031] Preference is furthermore given to compounds in which at least one of the groups Ar^1, Ar^2 and Ar^3 has at least three condensed rings, i.e. at least 14 π electrons. Particularly preferably, at least one of the groups Ar^1, Ar^2 and Ar^3 has at least 4 condensed rings, i.e. at least 16 π electrons. Very particularly preferably, at least one of the groups Ar^1, Ar^2 and Ar^3 has at least 4 condensed rings, i.e. at least 16 π electrons, and at least one of the other two groups Ar^1, Ar^2 or Ar^3 has at least 2 condensed rings, i.e. at least 10 π electrons.

[0032] Preferred combinations of Ar^1, Ar^2 and Ar^3 are the combinations shown in Table 1 and Table 2. Ar^1, Ar^2 and Ar^3 here may also be substituted by one or more radicals R^1.

TABLE 1

Ar1	Ar2	Ar3
Benzene	Benzene	Pyrene
Benzene	Benzene	Naphthacene
Benzene	Benzene	Benzathracene
Benzene	Benzene	Chrysene
Benzene	Benzene	Benzophenanthrene
Benzene	Benzene	Fluoranthene
Benzene	Benzene	Triphenylene
Benzene	Naphthalene	Anthracene
Benzene	Naphthalene	Phenanthrene
Benzene	Naphthalene	Pyrene
Benzene	Naphthalene	Naphthacene
Benzene	Naphthalene	Benzathracene
Benzene	Naphthalene	Chrysene
Benzene	Naphthalene	Benzophenanthrene
Benzene	Naphthalene	Fluoranthene
Benzene	Naphthalene	Triphenylene
Naphthalene	Benzene	Anthracene
Naphthalene	Benzene	Phenanthrene
Naphthalene	Benzene	Pyrene
Naphthalene	Benzene	Naphthacene
Naphthalene	Benzene	Benzathracene
Naphthalene	Benzene	Chrysene
Naphthalene	Benzene	Benzophenanthrene
Naphthalene	Benzene	Fluoranthene
Naphthalene	Benzene	Triphenylene
Naphthalene	Naphthalene	Naphthalene
Naphthalene	Naphthalene	Anthracene
Naphthalene	Naphthalene	Phenanthrene
Naphthalene	Naphthalene	Pyrene
Naphthalene	Naphthalene	Naphthacene
Naphthalene	Naphthalene	Benzathracene
Naphthalene	Naphthalene	Chrysene
Naphthalene	Naphthalene	Benzophenanthrene
Naphthalene	Naphthalene	Fluoranthene
Naphthalene	Naphthalene	Triphenylene
Anthracene	Benzene	Anthracene
Anthracene	Benzene	Phenanthrene
Anthracene	Benzene	Pyrene
Anthracene	Benzene	Naphthacene
Anthracene	Benzene	Benzathracene
Anthracene	Benzene	Chrysene
Anthracene	Benzene	Benzophenanthrene
Anthracene	Benzene	Fluoranthene
Anthracene	Benzene	Triphenylene
Anthracene	Naphthalene	Anthracene
Anthracene	Naphthalene	Phenanthrene
Anthracene	Naphthalene	Pyrene
Anthracene	Naphthalene	Naphthacene
Anthracene	Naphthalene	Benzathracene
Anthracene	Naphthalene	Chrysene
Anthracene	Naphthalene	Benzophenanthrene
Anthracene	Naphthalene	Fluoranthene
Anthracene	Naphthalene	Triphenylene
Phenanthrene	Benzene	Phenanthrene
Phenanthrene	Benzene	Pyrene
Phenanthrene	Benzene	Naphthacene
Phenanthrene	Benzene	Benzathracene
Phenanthrene	Benzene	Chrysene
Phenanthrene	Benzene	Benzophenanthrene
Phenanthrene	Benzene	Fluoranthene
Phenanthrene	Benzene	Triphenylene
Phenanthrene	Naphthalene	Phenanthrene
Phenanthrene	Naphthalene	Pyrene
Phenanthrene	Naphthalene	Naphthacene
Phenanthrene	Naphthalene	Benzathracene
Phenanthrene	Naphthalene	Chrysene
Phenanthrene	Naphthalene	Benzophenanthrene
Phenanthrene	Naphthalene	Fluoranthene
Phenanthrene	Naphthalene	Triphenylene
Pyrene	Benzene	Pyrene
Pyrene	Benzene	Naphthacene
Pyrene	Benzene	Benzathracene
Pyrene	Benzene	Chrysene
Pyrene	Benzene	Benzophenanthrene
Pyrene	Benzene	Fluoranthene
Pyrene	Benzene	Triphenylene
Pyrene	Naphthalene	Pyrene
Pyrene	Naphthalene	Naphthacene
Pyrene	Naphthalene	Benzathracene
Pyrene	Naphthalene	Chrysene
Pyrene	Naphthalene	Benzophenanthrene
Pyrene	Naphthalene	Fluoranthene
Pyrene	Naphthalene	Triphenylene
Naphthacene	Benzene	Naphthacene
Naphthacene	Benzene	Benzathracene
Naphthacene	Benzene	Chrysene
Naphthacene	Benzene	Benzophenanthrene
Naphthacene	Benzene	Fluoranthene
Naphthacene	Benzene	Triphenylene
Naphthacene	Naphthalene	Naphthacene
Naphthacene	Naphthalene	Benzathracene
Naphthacene	Naphthalene	Chrysene
Naphthacene	Naphthalene	Benzophenanthrene
Naphthacene	Naphthalene	Fluoranthene
Naphthacene	Naphthalene	Triphenylene

TABLE 1-continued

Ar1	Ar2	Ar3
Benzathracene	Benzene	Benzathracene
Benzathracene	Benzene	Chrysene
Benzathracene	Benzene	Benzophenanthrene
Benzathracene	Benzene	Fluoranthene
Benzathracene	Benzene	Triphenylene
Benzathracene	Naphthalene	Benzathracene
Benzathracene	Naphthalene	Chrysene
Benzathracene	Naphthalene	Benzophenanthrene
Benzathracene	Naphthalene	Fluoranthene
Benzathracene	Naphthalene	Triphenylene
Chrysene	Benzene	Chrysene
Chrysene	Benzene	Benzophenanthrene
Chrysene	Benzene	Fluoranthene
Chrysene	Benzene	Triphenylene
Chrysene	Naphthalene	Chrysene
Chrysene	Naphthalene	Benzophenanthrene
Chrysene	Naphthalene	Fluoranthene
Chrysene	Naphthalene	Triphenylene
Benzophenanthrene	Benzene	Benzophenanthrene
Benzophenanthrene	Benzene	Fluoranthene
Benzophenanthrene	Benzene	Triphenylene
Benzophenanthrene	Naphthalene	Benzophenanthrene
Benzophenanthrene	Naphthalene	Fluoranthene
Benzophenanthrene	Naphthalene	Triphenylene
Fluoranthene	Benzene	Fluoranthene
Fluoranthene	Benzene	Triphenylene
Fluoranthene	Naphthalene	Fluoranthene
Fluoranthene	Naphthalene	Triphenylene
Triphenylene	Benzene	Triphenylene
Triphenylene	Naphthalene	Triphenylene

[0033] The above-mentioned units are preferably selected from the units of the formulae (2) to (110). Thus, for Ar^1 or Ar^3 in Table 1, the benzene is selected from the formula (2), the naphthalene is selected from structures of the formulae (3) to (5), the pyrene is selected from structures of the formulae (16) to (18), the naphthacene is selected from structures of the formulae (33) to (35), the benzanthracene is selected from structures of the formulae (36) to (49), the chrysene is selected from structures of the formulae (50) to (57), the benzophenanthrene is selected from structures of the formulae (58) to (65), the fluoranthene is selected from structures of the formulae (19) to (32) and the triphenylene is selected from structures of the formulae (66) to (68). For the group Ar^2, the benzene is selected from structures of the formulae (96) to (100) and the naphthalene is selected from structures of the formulae (101) to (105). These structures may each be substituted by one or more radicals R^1.

TABLE 2

Ar1	Ar2	Ar3
Benzene	Phenanthrene	Naphthalene
Benzene	Phenanthrene	Anthracene
Benzene	Phenanthrene	Phenanthrene
Benzene	Phenanthrene	Pyrene
Benzene	Phenanthrene	Naphthacene
Benzene	Phenanthrene	Benzanthracene
Benzene	Phenanthrene	Chrysene
Benzene	Phenanthrene	Benzophenanthrene
Benzene	Phenanthrene	Fluoranthene
Benzene	Phenanthrene	Triphenylene
Benzene	Pyrene	Benzene
Benzene	Pyrene	Naphthalene
Benzene	Pyrene	Anthracene
Benzene	Pyrene	Phenanthrene
Benzene	Pyrene	Pyrene
Benzene	Pyrene	Naphthacene
Benzene	Pyrene	Benzanthracene
Benzene	Pyrene	Chrysene
Benzene	Pyrene	Benzophenanthrene
Benzene	Pyrene	Fluoranthene
Benzene	Pyrene	Triphenylene
Benzene	Benzanthracene	Benzene
Benzene	Benzanthracene	Naphthalene
Benzene	Benzanthracene	Anthracene
Benzene	Benzanthracene	Phenanthrene
Benzene	Benzanthracene	Pyrene
Benzene	Benzanthracene	Naphthacene
Benzene	Benzanthracene	Benzanthracene
Benzene	Benzanthracene	Chrysene
Benzene	Benzanthracene	Benzophenanthrene
Benzene	Benzanthracene	Fluoranthene
Benzene	Benzanthracene	Triphenylene
Benzene	Chrysene	Benzene
Benzene	Chrysene	Naphthalene
Benzene	Chrysene	Anthracene
Benzene	Chrysene	Phenanthrene
Benzene	Chrysene	Pyrene
Benzene	Chrysene	Naphthacene
Benzene	Chrysene	Benzanthracene
Benzene	Chrysene	Chrysene
Benzene	Chrysene	Benzophenanthrene
Benzene	Chrysene	Fluoranthene
Benzene	Chrysene	Triphenylene
Benzene	Benzophenanthrene	Benzene
Benzene	Benzophenanthrene	Naphthalene
Benzene	Benzophenanthrene	Anthracene
Benzene	Benzophenanthrene	Phenanthrene
Benzene	Benzophenanthrene	Pyrene
Benzene	Benzophenanthrene	Naphthacene
Benzene	Benzophenanthrene	Benzanthracene
Benzene	Benzophenanthrene	Chrysene
Benzene	Benzophenanthrene	Benzophenanthrene
Benzene	Benzophenanthrene	Fluoranthene
Benzene	Benzophenanthrene	Triphenylene
Benzene	Fluoranthene	Benzene
Benzene	Fluoranthene	Naphthalene
Benzene	Fluoranthene	Anthracene
Benzene	Fluoranthene	Phenanthrene
Benzene	Fluoranthene	Pyrene
Benzene	Fluoranthene	Naphthacene
Benzene	Fluoranthene	Benzanthracene
Benzene	Fluoranthene	Chrysene
Benzene	Fluoranthene	Benzophenanthrene
Benzene	Fluoranthene	Fluoranthene
Benzene	Fluoranthene	Triphenylene
Benzene	Triphenylene	Benzene
Benzene	Triphenylene	Naphthalene
Benzene	Triphenylene	Anthracene
Benzene	Triphenylene	Phenanthrene
Benzene	Triphenylene	Pyrene
Benzene	Triphenylene	Naphthacene
Benzene	Triphenylene	Benzanthracene
Benzene	Triphenylene	Chrysene
Benzene	Triphenylene	Benzophenanthrene
Benzene	Triphenylene	Fluoranthene
Benzene	Triphenylene	Triphenylene
Naphthalene	Phenanthrene	Benzene
Naphthalene	Phenanthrene	Naphthalene
Naphthalene	Phenanthrene	Anthracene
Naphthalene	Phenanthrene	Phenanthrene
Naphthalene	Phenanthrene	Pyrene
Naphthalene	Phenanthrene	Naphthacene
Naphthalene	Phenanthrene	Benzanthracene
Naphthalene	Phenanthrene	Chrysene
Naphthalene	Phenanthrene	Benzophenanthrene
Naphthalene	Phenanthrene	Fluoranthene
Naphthalene	Phenanthrene	Triphenylene
Naphthalene	Pyrene	Benzene
Naphthalene	Pyrene	Naphthalene
Naphthalene	Pyrene	Anthracene
Naphthalene	Pyrene	Phenanthrene
Naphthalene	Pyrene	Pyrene
Naphthalene	Pyrene	Naphthacene

TABLE 2-continued

Ar1	Ar2	Ar3
Naphthalene	Pyrene	Benzanthracene
Naphthalene	Pyrene	Chrysene
Naphthalene	Pyrene	Benzophenanthrene
Naphthalene	Pyrene	Fluoranthene
Naphthalene	Pyrene	Triphenylene
Naphthalene	Benzanthracene	Benzene
Naphthalene	Benzanthracene	Naphthalene
Naphthalene	Benzanthracene	Anthracene
Naphthalene	Benzanthracene	Phenanthrene
Naphthalene	Benzanthracene	Pyrene
Naphthalene	Benzanthracene	Naphthacene
Naphthalene	Benzanthracene	Benzanthracene
Naphthalene	Benzanthracene	Chrysene
Naphthalene	Benzanthracene	Benzophenanthrene
Naphthalene	Benzanthracene	Fluoranthene
Naphthalene	Benzanthracene	Triphenylene
Naphthalene	Chrysene	Benzene
Naphthalene	Chrysene	Naphthalene
Naphthalene	Chrysene	Anthracene
Naphthalene	Chrysene	Phenanthrene
Naphthalene	Chrysene	Pyrene
Naphthalene	Chrysene	Naphthacene
Naphthalene	Chrysene	Benzanthracene
Naphthalene	Chrysene	Chrysene
Naphthalene	Chrysene	Benzophenanthrene
Naphthalene	Chrysene	Fluoranthene
Naphthalene	Chrysene	Triphenylene
Naphthalene	Benzophenanthrene	Benzene
Naphthalene	Benzophenanthrene	Naphthalene
Naphthalene	Benzophenanthrene	Anthracene
Naphthalene	Benzophenanthrene	Phenanthrene
Naphthalene	Benzophenanthrene	Pyrene
Naphthalene	Benzophenanthrene	Naphthacene
Naphthalene	Benzophenanthrene	Benzanthracene
Naphthalene	Benzophenanthrene	Chrysene
Naphthalene	Benzophenanthrene	Benzophenanthrene
Naphthalene	Benzophenanthrene	Fluoranthene
Naphthalene	Benzophenanthrene	Triphenylene
Naphthalene	Fluoranthene	Benzene
Naphthalene	Fluoranthene	Naphthalene
Naphthalene	Fluoranthene	Anthracene
Naphthalene	Fluoranthene	Phenanthrene
Naphthalene	Fluoranthene	Pyrene
Naphthalene	Fluoranthene	Naphthacene
Naphthalene	Fluoranthene	Benzanthracene
Naphthalene	Fluoranthene	Chrysene
Naphthalene	Fluoranthene	Benzophenanthrene
Naphthalene	Fluoranthene	Fluoranthene
Naphthalene	Fluoranthene	Triphenylene
Naphthalene	Triphenylene	Benzene
Naphthalene	Triphenylene	Naphthalene
Naphthalene	Triphenylene	Anthracene
Naphthalene	Triphenylene	Phenanthrene
Naphthalene	Triphenylene	Pyrene
Naphthalene	Triphenylene	Naphthacene
Naphthalene	Triphenylene	Benzanthracene
Naphthalene	Triphenylene	Chrysene
Naphthalene	Triphenylene	Benzophenanthrene
Naphthalene	Triphenylene	Fluoranthene
Naphthalene	Triphenylene	Triphenylene

[0034] For Ar^1 and Ar^3 in Table 2, the benzene is a group of the formula (2), and the naphthalene is selected from structures of the formulae (3) to (5). For the group Ar^2, the pyrene is selected from structures of the formulae (112) to (115), the naphthacene is selected from structures of the formulae (117) to (120), and the triphenylene is selected from structures of the formula (116). These structures may each be substituted by one or more radicals R^1.

[0035] Specific particularly preferred combinations of Ar^1, Ar^2 and Ar^3 are revealed, for example, by Table 3 below. The bridges X for these structures are particularly preferably $C(R^2)_2$ groups. Very particularly preferably, both bridges X stand for $C(CH_3)_2$ or both bridges X stand for C(phenyl)$_2$ or one bridge X stands for $C(CH_3)_2$ and the other bridge X stands for C(phenyl)$_2$. The groups Ar^1, Ar^2 and Ar^3 here may be substituted by one or more radicals R^1, but are preferably unsubstituted.

TABLE 3

No.	Ar1	Ar2	Ar3
1	Formula (2)	Formula (86)	Formula (17)
2	Formula (2)	Formula (86)	Formula (28)
3	Formula (2)	Formula (86)	Formula (41)
4	Formula (2)	Formula (87)	Formula (17)
5	Formula (2)	Formula (87)	Formula (28)
6	Formula (2)	Formula (87)	Formula (41)
7	Formula (2)	Formula (91)	Formula (7)
8	Formula (2)	Formula (91)	Formula (8)
9	Formula (2)	Formula (91)	Formula (13)
10	Formula (2)	Formula (91)	Formula (17)
11	Formula (2)	Formula (91)	Formula (28)
12	Formula (2)	Formula (91)	Formula (41)
13	Formula (2)	Formula (93)	Formula (7)
14	Formula (2)	Formula (93)	Formula (8)
15	Formula (2)	Formula (93)	Formula (13)
16	Formula (2)	Formula (93)	Formula (17)
17	Formula (2)	Formula (93)	Formula (28)
18	Formula (2)	Formula (93)	Formula (41)
19	Formula (2)	Formula (95)	Formula (7)
20	Formula (2)	Formula (95)	Formula (8)
21	Formula (2)	Formula (95)	Formula (13)
22	Formula (2)	Formula (95)	Formula (17)
23	Formula (2)	Formula (95)	Formula (28)
24	Formula (2)	Formula (95)	Formula (41)
25	Formula (2)	Formula (102)	Formula (2)
26	Formula (2)	Formula (102)	Formula (3)
27	Formula (2)	Formula (102)	Formula (4)
28	Formula (2)	Formula (102)	Formula (7)
29	Formula (2)	Formula (102)	Formula (8)
30	Formula (2)	Formula (102)	Formula (13)
31	Formula (2)	Formula (102)	Formula (17)
32	Formula (2)	Formula (102)	Formula (28)
33	Formula (2)	Formula (102)	Formula (41)
34	Formula (3)	Formula (86)	Formula (7)
35	Formula (3)	Formula (86)	Formula (8)
36	Formula (3)	Formula (86)	Formula (13)
37	Formula (3)	Formula (86)	Formula (17)
38	Formula (3)	Formula (86)	Formula (28)
39	Formula (3)	Formula (86)	Formula (41)
40	Formula (3)	Formula (87)	Formula (7)
41	Formula (3)	Formula (87)	Formula (8)
42	Formula (3)	Formula (87)	Formula (13)
43	Formula (3)	Formula (87)	Formula (17)
44	Formula (3)	Formula (87)	Formula (28)
45	Formula (3)	Formula (87)	Formula (41)
46	Formula (3)	Formula (91)	Formula (3)
47	Formula (3)	Formula (91)	Formula (4)
48	Formula (3)	Formula (91)	Formula (7)
49	Formula (3)	Formula (91)	Formula (8)
50	Formula (3)	Formula (91)	Formula (13)
51	Formula (3)	Formula (91)	Formula (17)
52	Formula (3)	Formula (91)	Formula (28)
52	Formula (3)	Formula (91)	Formula (41)
53	Formula (3)	Formula (93)	Formula (3)
54	Formula (3)	Formula (93)	Formula (4)
55	Formula (3)	Formula (93)	Formula (7)
56	Formula (3)	Formula (93)	Formula (8)
57	Formula (3)	Formula (93)	Formula (13)
58	Formula (3)	Formula (93)	Formula (17)
59	Formula (3)	Formula (93)	Formula (28)
60	Formula (3)	Formula (93)	Formula (41)
61	Formula (3)	Formula (95)	Formula (3)
62	Formula (3)	Formula (95)	Formula (4)
63	Formula (3)	Formula (95)	Formula (7)
64	Formula (3)	Formula (95)	Formula (8)
65	Formula (3)	Formula (95)	Formula (13)
66	Formula (3)	Formula (95)	Formula (17)
67	Formula (3)	Formula (95)	Formula (28)

TABLE 3-continued

No.	Ar1	Ar2	Ar3
68	Formula (3)	Formula (95)	Formula (41)
69	Formula (3)	Formula (102)	Formula (2)
70	Formula (3)	Formula (102)	Formula (3)
71	Formula (3)	Formula (102)	Formula (4)
72	Formula (3)	Formula (102)	Formula (7)
73	Formula (3)	Formula (102)	Formula (8)
74	Formula (3)	Formula (102)	Formula (13)
75	Formula (3)	Formula (102)	Formula (17)
76	Formula (3)	Formula (102)	Formula (28)
77	Formula (3)	Formula (102)	Formula (41)
78	Formula (4)	Formula (86)	Formula (7)
79	Formula (4)	Formula (86)	Formula (8)
80	Formula (4)	Formula (86)	Formula (13)
81	Formula (4)	Formula (86)	Formula (17)
82	Formula (4)	Formula (86)	Formula (28)
83	Formula (4)	Formula (86)	Formula (41)
84	Formula (4)	Formula (87)	Formula (7)
85	Formula (4)	Formula (87)	Formula (8)
86	Formula (4)	Formula (87)	Formula (13)
87	Formula (4)	Formula (87)	Formula (17)
88	Formula (4)	Formula (87)	Formula (28)
89	Formula (4)	Formula (87)	Formula (41)
90	Formula (4)	Formula (91)	Formula (3)
91	Formula (4)	Formula (91)	Formula (4)
92	Formula (4)	Formula (91)	Formula (7)
93	Formula (4)	Formula (91)	Formula (8)
94	Formula (4)	Formula (91)	Formula (13)
95	Formula (4)	Formula (91)	Formula (17)
96	Formula (4)	Formula (91)	Formula (28)
97	Formula (4)	Formula (91)	Formula (41)
98	Formula (4)	Formula (93)	Formula (2)
99	Formula (4)	Formula (93)	Formula (3)
100	Formula (4)	Formula (93)	Formula (4)
101	Formula (4)	Formula (93)	Formula (7)
102	Formula (4)	Formula (93)	Formula (8)
103	Formula (4)	Formula (93)	Formula (13)
104	Formula (4)	Formula (93)	Formula (17)
105	Formula (4)	Formula (93)	Formula (28)
106	Formula (4)	Formula (93)	Formula (41)
107	Formula (4)	Formula (95)	Formula (2)
108	Formula (4)	Formula (95)	Formula (3)
109	Formula (4)	Formula (95)	Formula (4)
110	Formula (4)	Formula (95)	Formula (7)
111	Formula (4)	Formula (95)	Formula (8)
112	Formula (4)	Formula (95)	Formula (13)
113	Formula (4)	Formula (95)	Formula (17)
114	Formula (4)	Formula (95)	Formula (28)
115	Formula (4)	Formula (95)	Formula (41)
116	Formula (4)	Formula (102)	Formula (2)
117	Formula (4)	Formula (102)	Formula (3)
118	Formula (4)	Formula (102)	Formula (4)
119	Formula (4)	Formula (102)	Formula (7)
120	Formula (4)	Formula (102)	Formula (8)
121	Formula (4)	Formula (102)	Formula (13)
122	Formula (4)	Formula (102)	Formula (17)
123	Formula (4)	Formula (102)	Formula (28)
124	Formula (4)	Formula (102)	Formula (41)
125	Formula (7)	Formula (86)	Formula (3)
126	Formula (7)	Formula (86)	Formula (4)
127	Formula (7)	Formula (86)	Formula (7)
128	Formula (7)	Formula (86)	Formula (8)
129	Formula (7)	Formula (86)	Formula (13)
130	Formula (7)	Formula (86)	Formula (17)
131	Formula (7)	Formula (86)	Formula (28)
132	Formula (7)	Formula (86)	Formula (41)
133	Formula (7)	Formula (87)	Formula (3)
134	Formula (7)	Formula (87)	Formula (4)
135	Formula (7)	Formula (87)	Formula (7)
136	Formula (7)	Formula (87)	Formula (8)
137	Formula (7)	Formula (87)	Formula (13)
138	Formula (7)	Formula (87)	Formula (17)
139	Formula (7)	Formula (87)	Formula (28)
140	Formula (7)	Formula (87)	Formula (41)
141	Formula (7)	Formula (91)	Formula (2)
142	Formula (7)	Formula (91)	Formula (3)

TABLE 3-continued

No.	Ar1	Ar2	Ar3
143	Formula (7)	Formula (91)	Formula (4)
144	Formula (7)	Formula (91)	Formula (7)
145	Formula (7)	Formula (91)	Formula (8)
146	Formula (7)	Formula (91)	Formula (13)
147	Formula (7)	Formula (91)	Formula (17)
148	Formula (7)	Formula (91)	Formula (28)
149	Formula (7)	Formula (91)	Formula (41)
150	Formula (7)	Formula (93)	Formula (2)
151	Formula (7)	Formula (93)	Formula (3)
152	Formula (7)	Formula (93)	Formula (4)
153	Formula (7)	Formula (93)	Formula (7)
154	Formula (7)	Formula (93)	Formula (8)
155	Formula (7)	Formula (93)	Formula (13)
156	Formula (7)	Formula (93)	Formula (17)
157	Formula (7)	Formula (93)	Formula (28)
158	Formula (7)	Formula (93)	Formula (41)
159	Formula (7)	Formula (95)	Formula (2)
160	Formula (7)	Formula (95)	Formula (3)
161	Formula (7)	Formula (95)	Formula (4)
162	Formula (7)	Formula (95)	Formula (7)
163	Formula (7)	Formula (95)	Formula (8)
164	Formula (7)	Formula (95)	Formula (13)
165	Formula (7)	Formula (95)	Formula (17)
166	Formula (7)	Formula (95)	Formula (28)
167	Formula (7)	Formula (95)	Formula (41)
168	Formula (7)	Formula (102)	Formula (2)
169	Formula (7)	Formula (102)	Formula (3)
170	Formula (7)	Formula (102)	Formula (4)
171	Formula (7)	Formula (102)	Formula (7)
172	Formula (7)	Formula (102)	Formula (8)
173	Formula (7)	Formula (102)	Formula (13)
174	Formula (7)	Formula (102)	Formula (17)
175	Formula (7)	Formula (102)	Formula (28)
176	Formula (7)	Formula (102)	Formula (41)
177	Formula (8)	Formula (86)	Formula (3)
178	Formula (8)	Formula (86)	Formula (4)
179	Formula (8)	Formula (86)	Formula (7)
180	Formula (8)	Formula (86)	Formula (8)
181	Formula (8)	Formula (86)	Formula (13)
182	Formula (8)	Formula (86)	Formula (17)
183	Formula (8)	Formula (86)	Formula (28)
184	Formula (8)	Formula (86)	Formula (41)
185	Formula (8)	Formula (87)	Formula (3)
186	Formula (8)	Formula (87)	Formula (4)
187	Formula (8)	Formula (87)	Formula (7)
188	Formula (8)	Formula (87)	Formula (8)
189	Formula (8)	Formula (87)	Formula (13)
190	Formula (8)	Formula (87)	Formula (17)
191	Formula (8)	Formula (87)	Formula (28)
192	Formula (8)	Formula (87)	Formula (41)
193	Formula (8)	Formula (91)	Formula (2)
194	Formula (8)	Formula (91)	Formula (3)
195	Formula (8)	Formula (91)	Formula (4)
196	Formula (8)	Formula (91)	Formula (7)
197	Formula (8)	Formula (91)	Formula (8)
198	Formula (8)	Formula (91)	Formula (13)
199	Formula (8)	Formula (91)	Formula (17)
200	Formula (8)	Formula (91)	Formula (28)
201	Formula (8)	Formula (91)	Formula (41)
202	Formula (8)	Formula (93)	Formula (2)
203	Formula (8)	Formula (93)	Formula (3)
204	Formula (8)	Formula (93)	Formula (4)
205	Formula (8)	Formula (93)	Formula (7)
206	Formula (8)	Formula (93)	Formula (8)
207	Formula (8)	Formula (93)	Formula (13)
208	Formula (8)	Formula (93)	Formula (17)
209	Formula (8)	Formula (93)	Formula (28)
210	Formula (8)	Formula (93)	Formula (41)
211	Formula (8)	Formula (95)	Formula (2)
212	Formula (8)	Formula (95)	Formula (3)
213	Formula (8)	Formula (95)	Formula (4)
214	Formula (8)	Formula (95)	Formula (7)
215	Formula (8)	Formula (95)	Formula (8)
216	Formula (8)	Formula (95)	Formula (13)
217	Formula (8)	Formula (95)	Formula (17)

TABLE 3-continued

No.	Ar1	Ar2	Ar3
218	Formula (8)	Formula (95)	Formula (28)
219	Formula (8)	Formula (95)	Formula (41)
220	Formula (8)	Formula (102)	Formula (2)
221	Formula (8)	Formula (102)	Formula (3)
222	Formula (8)	Formula (102)	Formula (4)
223	Formula (8)	Formula (102)	Formula (7)
224	Formula (8)	Formula (102)	Formula (8)
225	Formula (8)	Formula (102)	Formula (13)
226	Formula (8)	Formula (102)	Formula (17)
227	Formula (8)	Formula (102)	Formula (28)
228	Formula (8)	Formula (102)	Formula (41)
229	Formula (13)	Formula (86)	Formula (3)
230	Formula (13)	Formula (86)	Formula (4)
231	Formula (13)	Formula (86)	Formula (7)
232	Formula (13)	Formula (86)	Formula (8)
233	Formula (13)	Formula (86)	Formula (13)
234	Formula (13)	Formula (86)	Formula (17)
235	Formula (13)	Formula (86)	Formula (28)
236	Formula (13)	Formula (86)	Formula (41)
237	Formula (13)	Formula (87)	Formula (3)
238	Formula (13)	Formula (87)	Formula (4)
239	Formula (13)	Formula (87)	Formula (7)
240	Formula (13)	Formula (87)	Formula (8)
241	Formula (13)	Formula (87)	Formula (13)
242	Formula (13)	Formula (87)	Formula (17)
243	Formula (13)	Formula (87)	Formula (28)
244	Formula (13)	Formula (87)	Formula (41)
245	Formula (13)	Formula (91)	Formula (2)
246	Formula (13)	Formula (91)	Formula (3)
247	Formula (13)	Formula (91)	Formula (4)
248	Formula (13)	Formula (91)	Formula (7)
249	Formula (13)	Formula (91)	Formula (8)
250	Formula (13)	Formula (91)	Formula (13)
251	Formula (13)	Formula (91)	Formula (17)
252	Formula (13)	Formula (91)	Formula (28)
253	Formula (13)	Formula (91)	Formula (41)
254	Formula (13)	Formula (93)	Formula (2)
255	Formula (13)	Formula (93)	Formula (3)
256	Formula (13)	Formula (93)	Formula (4)
257	Formula (13)	Formula (93)	Formula (7)
258	Formula (13)	Formula (93)	Formula (8)
259	Formula (13)	Formula (93)	Formula (13)
260	Formula (13)	Formula (93)	Formula (17)
261	Formula (13)	Formula (93)	Formula (28)
262	Formula (13)	Formula (93)	Formula (41)
263	Formula (13)	Formula (95)	Formula (2)
264	Formula (13)	Formula (95)	Formula (3)
265	Formula (13)	Formula (95)	Formula (4)
266	Formula (13)	Formula (95)	Formula (7)
267	Formula (13)	Formula (95)	Formula (8)
268	Formula (13)	Formula (95)	Formula (13)
269	Formula (13)	Formula (95)	Formula (17)
270	Formula (13)	Formula (95)	Formula (28)
271	Formula (13)	Formula (95)	Formula (41)
272	Formula (13)	Formula (102)	Formula (2)
273	Formula (13)	Formula (102)	Formula (3)
274	Formula (13)	Formula (102)	Formula (4)
275	Formula (13)	Formula (102)	Formula (7)
276	Formula (13)	Formula (102)	Formula (8)
277	Formula (13)	Formula (102)	Formula (13)
278	Formula (13)	Formula (102)	Formula (17)
279	Formula (13)	Formula (102)	Formula (28)
280	Formula (13)	Formula (102)	Formula (41)
281	Formula (17)	Formula (86)	Formula (2)
282	Formula (17)	Formula (86)	Formula (3)
283	Formula (17)	Formula (86)	Formula (4)
284	Formula (17)	Formula (86)	Formula (7)
285	Formula (17)	Formula (86)	Formula (8)
286	Formula (17)	Formula (86)	Formula (13)
287	Formula (17)	Formula (86)	Formula (17)
288	Formula (17)	Formula (86)	Formula (28)
289	Formula (17)	Formula (86)	Formula (41)
290	Formula (17)	Formula (87)	Formula (2)
291	Formula (17)	Formula (87)	Formula (3)
292	Formula (17)	Formula (87)	Formula (4)
293	Formula (17)	Formula (87)	Formula (7)
294	Formula (17)	Formula (87)	Formula (8)
295	Formula (17)	Formula (87)	Formula (13)
296	Formula (17)	Formula (87)	Formula (17)
297	Formula (17)	Formula (87)	Formula (28)
298	Formula (17)	Formula (87)	Formula (41)
299	Formula (17)	Formula (91)	Formula (2)
300	Formula (17)	Formula (91)	Formula (3)
301	Formula (17)	Formula (91)	Formula (4)
302	Formula (17)	Formula (91)	Formula (7)
303	Formula (17)	Formula (91)	Formula (8)
304	Formula (17)	Formula (91)	Formula (13)
305	Formula (17)	Formula (91)	Formula (17)
306	Formula (17)	Formula (91)	Formula (28)
307	Formula (17)	Formula (91)	Formula (41)
308	Formula (17)	Formula (93)	Formula (2)
309	Formula (17)	Formula (93)	Formula (3)
310	Formula (17)	Formula (93)	Formula (4)
311	Formula (17)	Formula (93)	Formula (7)
312	Formula (17)	Formula (93)	Formula (8)
313	Formula (17)	Formula (93)	Formula (13)
314	Formula (17)	Formula (93)	Formula (17)
315	Formula (17)	Formula (93)	Formula (28)
316	Formula (17)	Formula (93)	Formula (41)
317	Formula (17)	Formula (95)	Formula (2)
318	Formula (17)	Formula (95)	Formula (3)
319	Formula (17)	Formula (95)	Formula (4)
320	Formula (17)	Formula (95)	Formula (7)
321	Formula (17)	Formula (95)	Formula (8)
322	Formula (17)	Formula (95)	Formula (13)
323	Formula (17)	Formula (95)	Formula (17)
324	Formula (17)	Formula (95)	Formula (28)
325	Formula (17)	Formula (95)	Formula (41)
326	Formula (17)	Formula (102)	Formula (2)
327	Formula (17)	Formula (102)	Formula (3)
328	Formula (17)	Formula (102)	Formula (4)
329	Formula (17)	Formula (102)	Formula (7)
330	Formula (17)	Formula (102)	Formula (8)
331	Formula (17)	Formula (102)	Formula (13)
332	Formula (17)	Formula (102)	Formula (17)
333	Formula (17)	Formula (102)	Formula (28)
334	Formula (17)	Formula (102)	Formula (41)
335	Formula (28)	Formula (86)	Formula (2)
336	Formula (28)	Formula (86)	Formula (3)
337	Formula (28)	Formula (86)	Formula (4)
338	Formula (28)	Formula (86)	Formula (7)
339	Formula (28)	Formula (86)	Formula (8)
340	Formula (28)	Formula (86)	Formula (13)
341	Formula (28)	Formula (86)	Formula (17)
342	Formula (28)	Formula (86)	Formula (28)
343	Formula (28)	Formula (86)	Formula (41)
344	Formula (28)	Formula (87)	Formula (2)
345	Formula (28)	Formula (87)	Formula (3)
346	Formula (28)	Formula (87)	Formula (4)
347	Formula (28)	Formula (87)	Formula (7)
348	Formula (28)	Formula (87)	Formula (8)
349	Formula (28)	Formula (87)	Formula (13)
350	Formula (28)	Formula (87)	Formula (17)
351	Formula (28)	Formula (87)	Formula (28)
352	Formula (28)	Formula (87)	Formula (41)
353	Formula (28)	Formula (91)	Formula (2)
354	Formula (28)	Formula (91)	Formula (3)
355	Formula (28)	Formula (91)	Formula (4)
356	Formula (28)	Formula (91)	Formula (7)
357	Formula (28)	Formula (91)	Formula (8)
358	Formula (28)	Formula (91)	Formula (13)
359	Formula (28)	Formula (91)	Formula (17)
360	Formula (28)	Formula (91)	Formula (28)
361	Formula (28)	Formula (91)	Formula (41)
362	Formula (28)	Formula (93)	Formula (2)
363	Formula (28)	Formula (93)	Formula (3)
364	Formula (28)	Formula (93)	Formula (4)
365	Formula (28)	Formula (93)	Formula (7)
366	Formula (28)	Formula (93)	Formula (8)
367	Formula (28)	Formula (93)	Formula (13)

TABLE 3-continued

No.	Ar1	Ar2	Ar3
368	Formula (28)	Formula (93)	Formula (17)
369	Formula (28)	Formula (93)	Formula (28)
370	Formula (28)	Formula (93)	Formula (41)
371	Formula (28)	Formula (95)	Formula (2)
372	Formula (28)	Formula (95)	Formula (3)
373	Formula (28)	Formula (95)	Formula (4)
374	Formula (28)	Formula (95)	Formula (7)
375	Formula (28)	Formula (95)	Formula (8)
376	Formula (28)	Formula (95)	Formula (13)
377	Formula (28)	Formula (95)	Formula (17)
378	Formula (28)	Formula (95)	Formula (28)
379	Formula (28)	Formula (95)	Formula (41)
380	Formula (28)	Formula (102)	Formula (2)
381	Formula (28)	Formula (102)	Formula (3)
382	Formula (28)	Formula (102)	Formula (4)
383	Formula (28)	Formula (102)	Formula (7)
384	Formula (28)	Formula (102)	Formula (8)
385	Formula (28)	Formula (102)	Formula (13)
386	Formula (28)	Formula (102)	Formula (17)
387	Formula (28)	Formula (102)	Formula (28)
388	Formula (28)	Formula (102)	Formula (41)
389	Formula (41)	Formula (86)	Formula (2)
390	Formula (41)	Formula (86)	Formula (3)
391	Formula (41)	Formula (86)	Formula (4)
392	Formula (41)	Formula (86)	Formula (7)
393	Formula (41)	Formula (86)	Formula (8)
394	Formula (41)	Formula (86)	Formula (13)
395	Formula (41)	Formula (86)	Formula (17)
396	Formula (41)	Formula (86)	Formula (28)
397	Formula (41)	Formula (86)	Formula (41)
398	Formula (41)	Formula (87)	Formula (2)
399	Formula (41)	Formula (87)	Formula (3)
400	Formula (41)	Formula (87)	Formula (4)
401	Formula (41)	Formula (87)	Formula (7)
402	Formula (41)	Formula (87)	Formula (8)
403	Formula (41)	Formula (87)	Formula (13)
404	Formula (41)	Formula (87)	Formula (17)
405	Formula (41)	Formula (87)	Formula (28)
406	Formula (41)	Formula (87)	Formula (41)
407	Formula (41)	Formula (91)	Formula (2)
408	Formula (41)	Formula (91)	Formula (3)
409	Formula (41)	Formula (91)	Formula (4)
410	Formula (41)	Formula (91)	Formula (7)
411	Formula (41)	Formula (91)	Formula (8)
412	Formula (41)	Formula (91)	Formula (13)
413	Formula (41)	Formula (91)	Formula (17)
414	Formula (41)	Formula (91)	Formula (28)
415	Formula (41)	Formula (91)	Formula (41)
416	Formula (41)	Formula (93)	Formula (2)
417	Formula (41)	Formula (93)	Formula (3)
418	Formula (41)	Formula (93)	Formula (4)
419	Formula (41)	Formula (93)	Formula (7)
420	Formula (41)	Formula (93)	Formula (8)
421	Formula (41)	Formula (93)	Formula (13)
422	Formula (41)	Formula (93)	Formula (17)
423	Formula (41)	Formula (93)	Formula (28)
424	Formula (41)	Formula (93)	Formula (41)
425	Formula (41)	Formula (95)	Formula (2)
426	Formula (41)	Formula (95)	Formula (3)
427	Formula (41)	Formula (95)	Formula (4)
428	Formula (41)	Formula (95)	Formula (7)
429	Formula (41)	Formula (95)	Formula (8)
430	Formula (41)	Formula (95)	Formula (13)
431	Formula (41)	Formula (95)	Formula (17)
432	Formula (41)	Formula (95)	Formula (28)
433	Formula (41)	Formula (95)	Formula (41)
434	Formula (41)	Formula (102)	Formula (2)
435	Formula (41)	Formula (102)	Formula (3)
436	Formula (41)	Formula (102)	Formula (4)
437	Formula (41)	Formula (102)	Formula (7)
438	Formula (41)	Formula (102)	Formula (8)
439	Formula (41)	Formula (102)	Formula (13)
440	Formula (41)	Formula (102)	Formula (17)
441	Formula (41)	Formula (102)	Formula (28)
442	Formula (41)	Formula (102)	Formula (41)

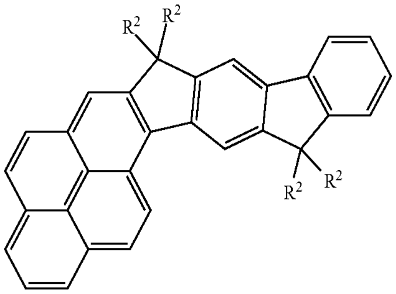
[0036] Preference is furthermore given to compounds of the formula (1) in which the symbol p=1 or p=2. Particular preference is given to compounds where p=1. This preference also applies to the combinations of Ar^1, Ar^2 and Ar^3 shown above in Tables 1, 2 and 3.

[0037] Preference is furthermore given to compounds of the formula (1) in which the symbol X is selected, identically or differently on each occurrence, from the group consisting of $B(R^2)$, $C(R^2)_2$, $Si(R^2)_2$, O, S or $N(R^2)$, particularly preferably $C(R^2)_2$, S or $N(R^2)$. Very particularly preferably, all symbols X stand, identically or differently on each occurrence, for $C(R^2)_2$. R^2 here preferably stands for an alkyl or aryl group.

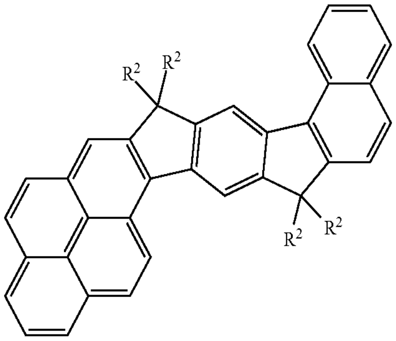
[0038] Ar^1, Ar^2 and Ar^3 are particularly preferably selected as shown in Tables 1 and 2, and X simultaneously stands, identically or differently on each occurrence, for $C(R^2)_2$. R^2 here preferably stands for an alkyl or aryl group.

[0039] Particular preference is given to compounds of the formula (1) selected from the formulae (111) to (141), where the aromatic systems may each also be substituted by one or more radicals R^1:

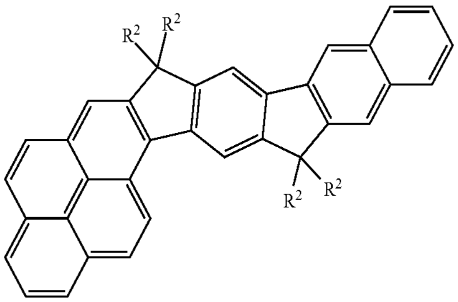
formula (111)



formula (112)



formula (113)



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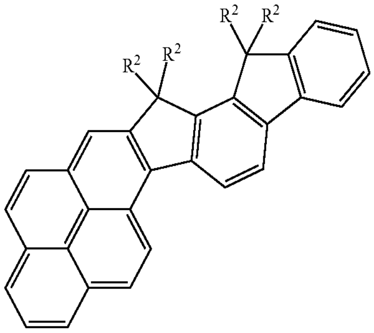
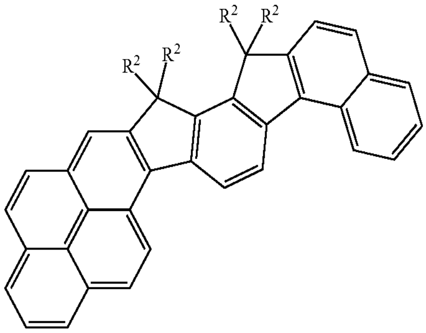
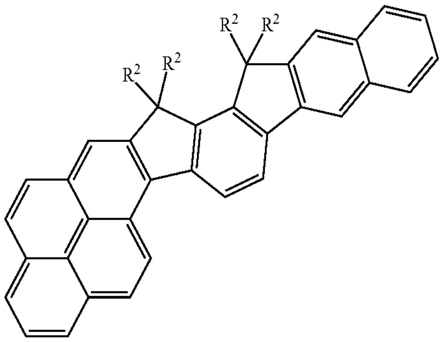
formula (114)



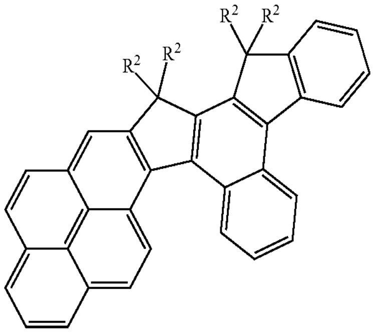
formula (115)



formula (116)



formula (117)



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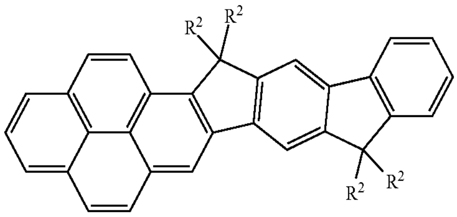

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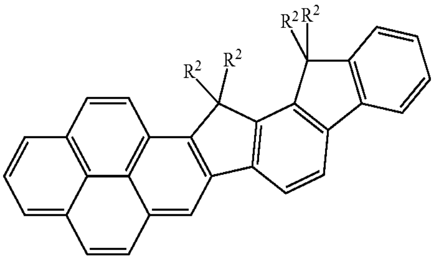
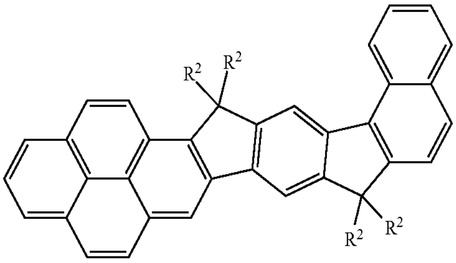
formula (119)



formula (120)



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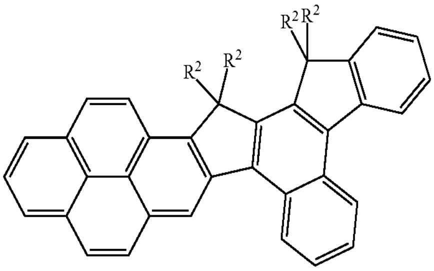

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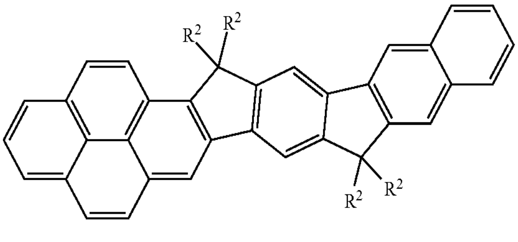
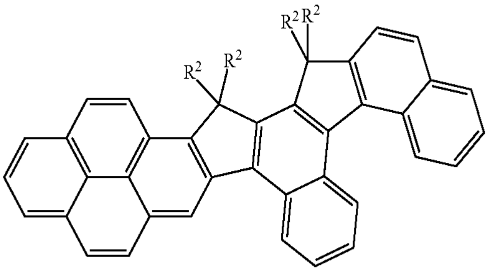


formula (123)



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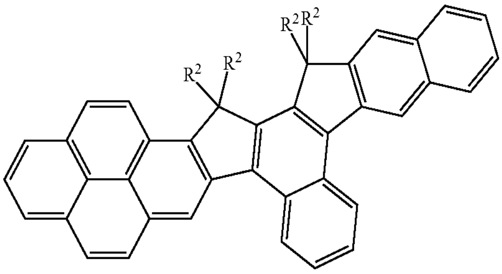
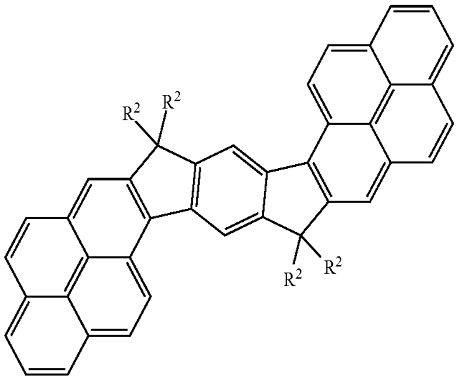


formula (125)



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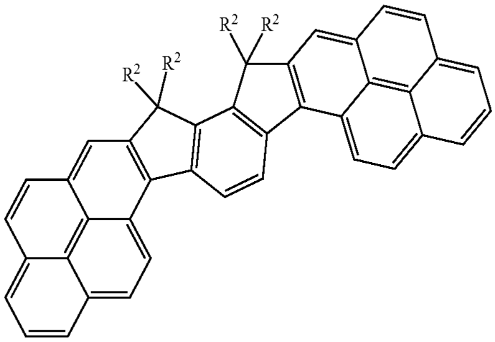
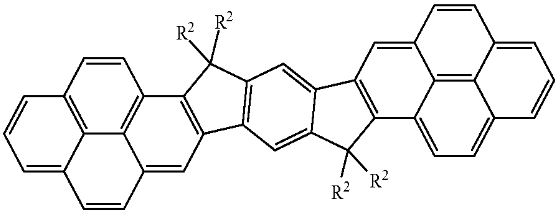
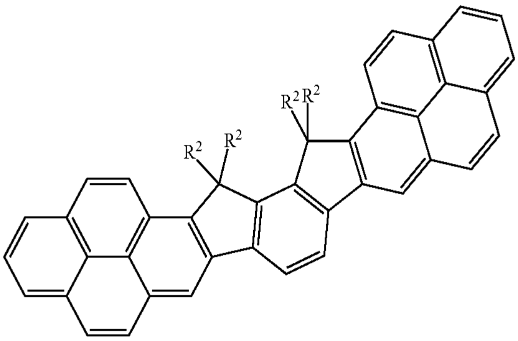


formula (127)



formula (128)



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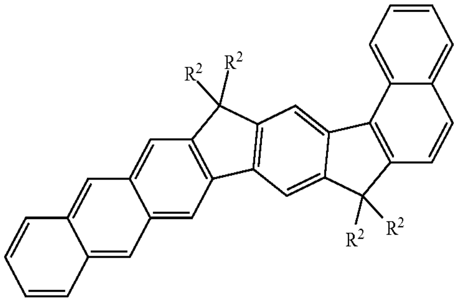

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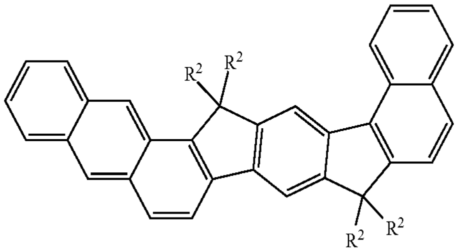

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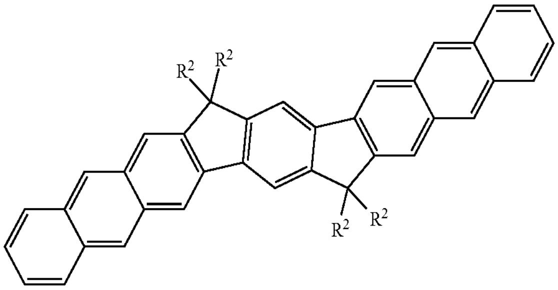

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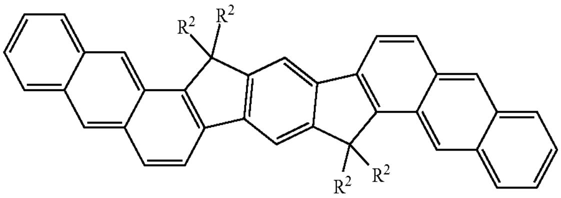

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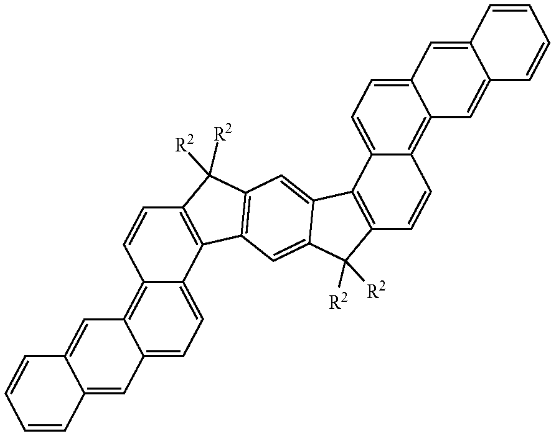

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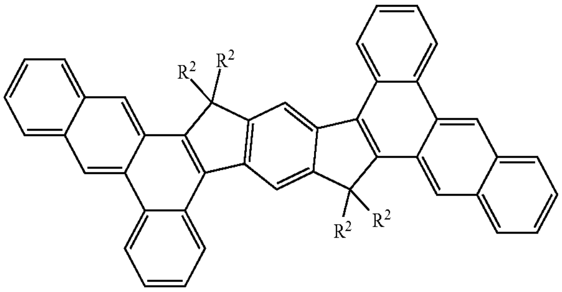

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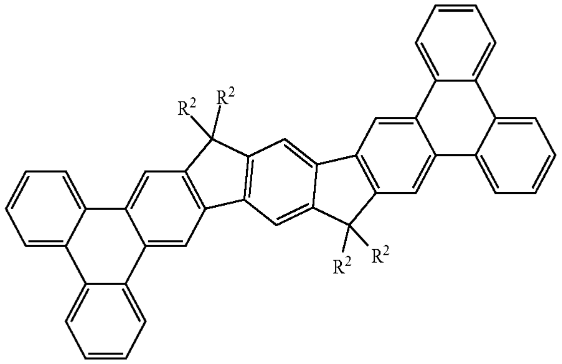

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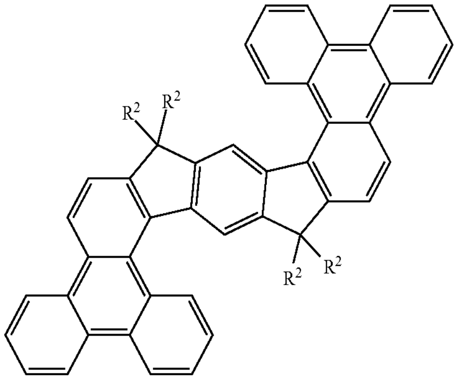

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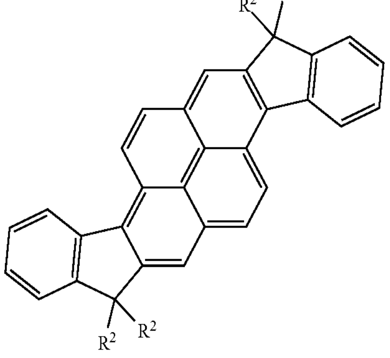

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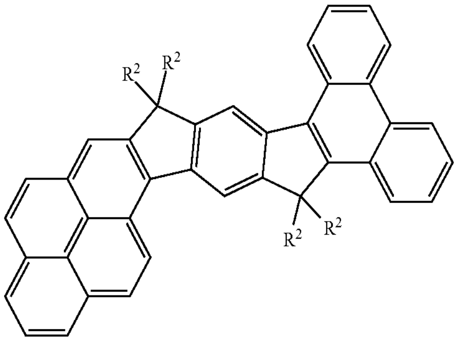

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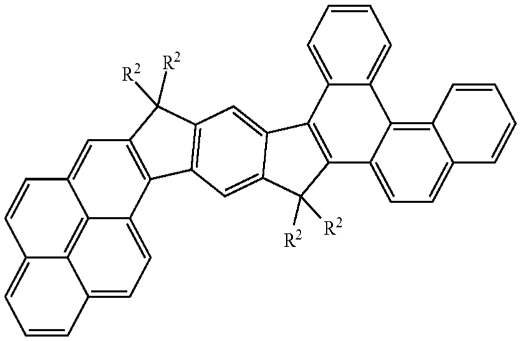

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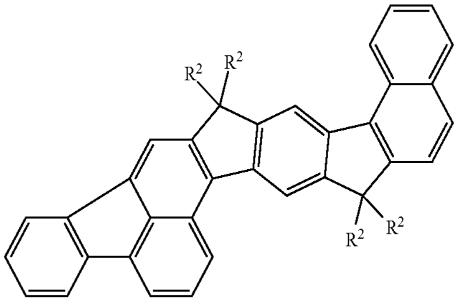

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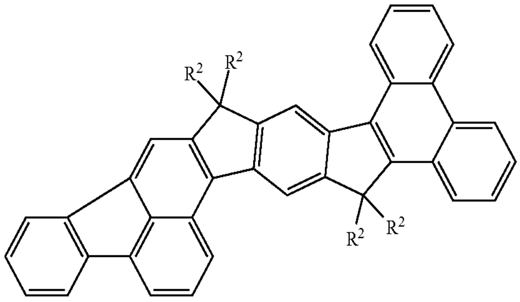
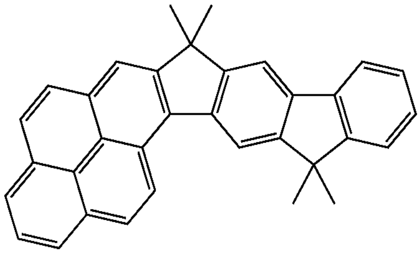


[0040] Preference is furthermore given to compounds of the formula (1) in which the symbol R^1, which may be bonded to Ar^1, Ar^2 or Ar^3 as a substituent, is selected on each occurrence, identically or differently, from the group consisting of H, D, F, $Si(R^3)_3$, straight-chain alkyl or alkoxy groups having 1 to 10 C atoms or branched or cyclic alkyl or alkoxy groups having 3 to 10 C atoms, each of which may be substituted by one or more radicals R^3, where in each case one or more non-adjacent CH_2 groups may be replaced by $R^3C{=}CR^3$ or O and where one or more H atoms may be replaced by F, or aromatic or heteroaromatic ring systems having 5 to 40 aromatic ring atoms, or a combination of these systems; two or more substituents R^1 here may also form a mono- or polycyclic, aliphatic or aromatic ring system with one another. The substituent R^1 is particularly preferably selected from H, D, straight-chain alkyl groups having 1 to 6 C atoms, branched or cyclic alkyl groups having 3 to 6 C atoms or an aromatic or heteroaromatic ring system having 5 to 24 aromatic ring atoms; two or more substituents R^1 here may also form a mono- or polycyclic ring system with one another. The substituent R^1 is very particularly preferably selected from H, D, alkyl groups selected from methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, tert-butyl, cyclopentyl or cyclohexyl, in particular methyl or tert-butyl, and aromatic or heteroaromatic ring systems selected from the group consisting of unsubstituted or R^3-substituted phenyl, naphthyl, benzimidazole, which may also be substituted by phenyl, phenylbenzimidazole, where the benzimidazole may also be substituted by phenyl or other radicals R^3, or triazine, which may also be substituted by phenyl or other radicals R^3.

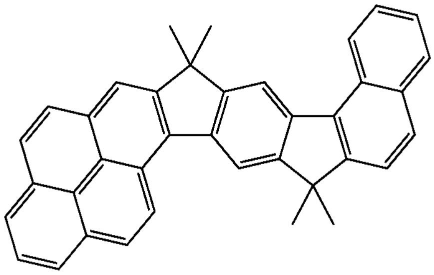
[0041] Preference is furthermore given to compounds of the formula (1) in which the symbol R^2, which is bonded to the group X, is selected on each occurrence, identically or differently, from H, straight-chain alkyl groups having 1 to 10 C atoms or branched or cyclic alkyl groups having 3 to 10 C atoms, where in each case one or more non-adjacent CH_2 groups may be replaced by —$R^2C{=}CR^2$— or —O— and where one or more H atoms may be replaced by F, or a monovalent aryl or heteroaryl group having 5 to 16 aromatic ring atoms, which may be substituted by one or more non-aromatic radicals R^2; two radicals R^2 which are bonded in the same group X may also form a ring system with one another. The radicals R^2 are particularly preferably selected from straight-chain alkyl groups having 1 to 4 C atoms or branched alkyl groups having 3 or 4 C atoms, in particular methyl groups, or phenyl groups; two or more radicals R^2 here may form a ring system with one another. If a plurality of radicals R^2 form a ring system with one another, a spiro structure is thereby formed. This may be preferred, in particular, if the radicals R^2 stand for phenyl groups or if two radicals R^2 stand for alkyl groups which form a ring system with one another.

[0042] Examples of preferred compounds of the formula (1) are structures (1) to (246) depicted below.

(1)



(2)



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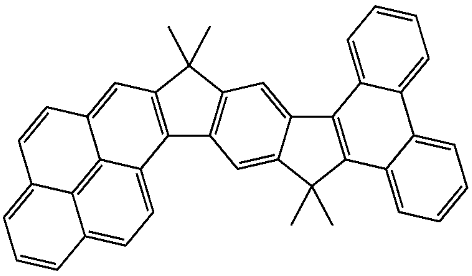
(3)



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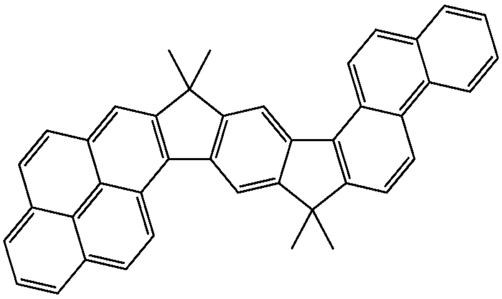

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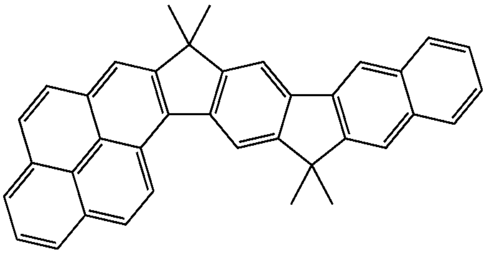

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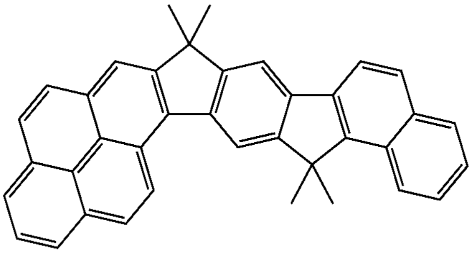

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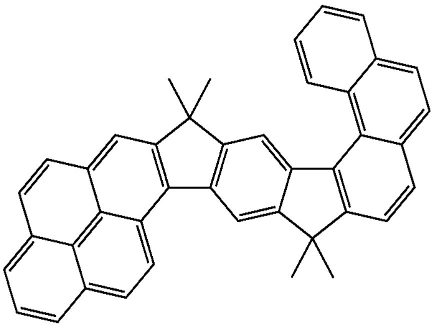

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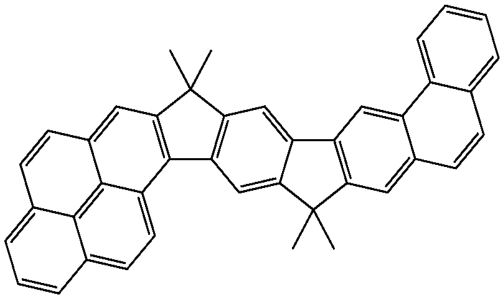

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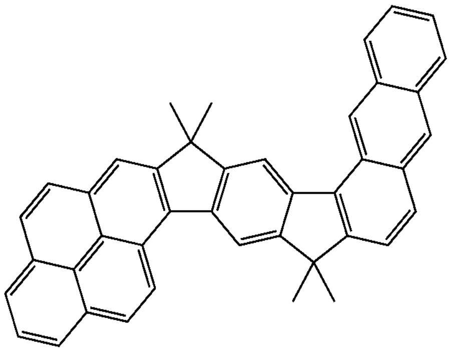

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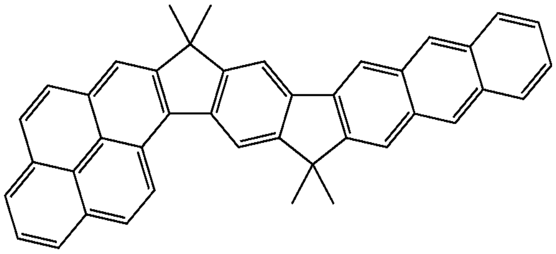

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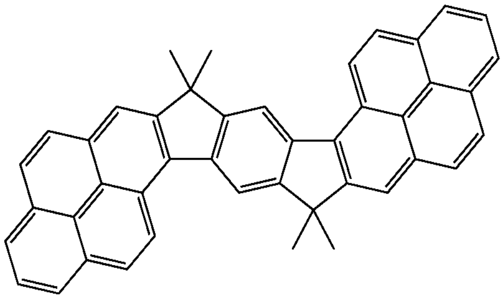

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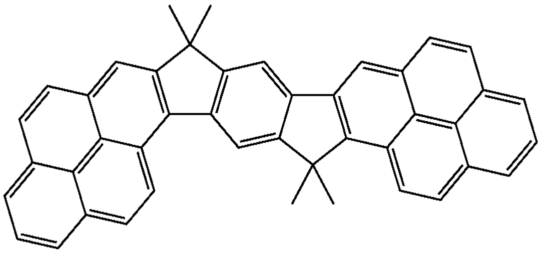

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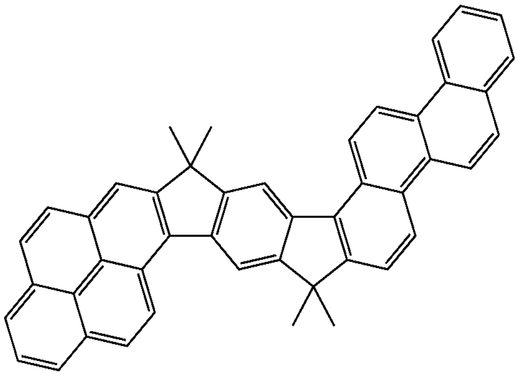

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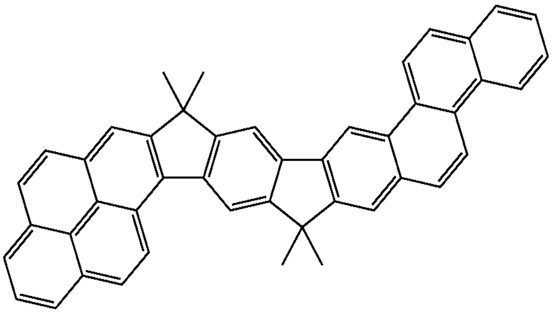

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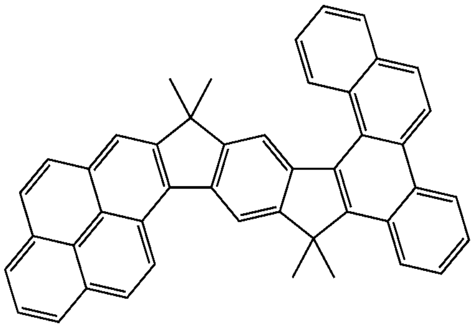

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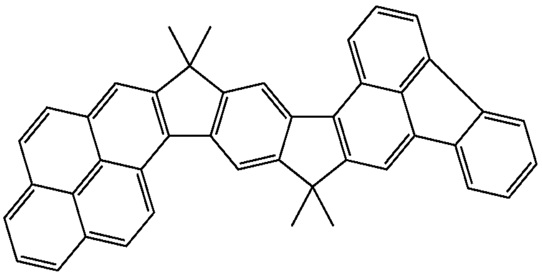

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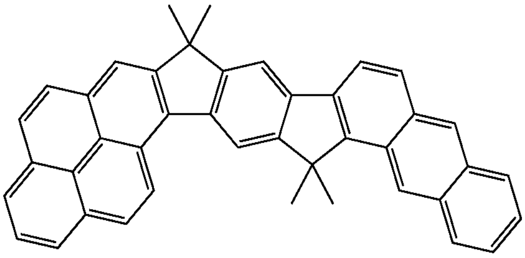

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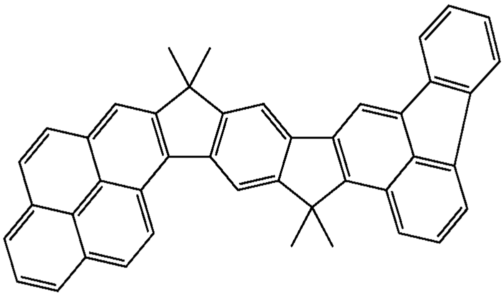

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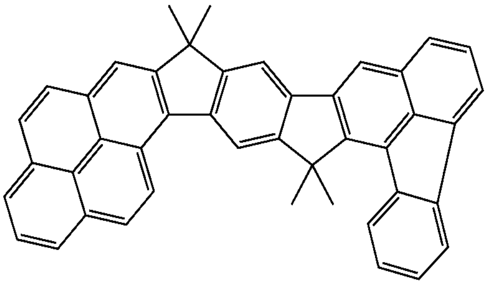

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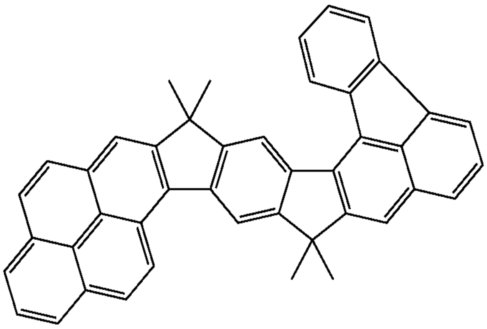

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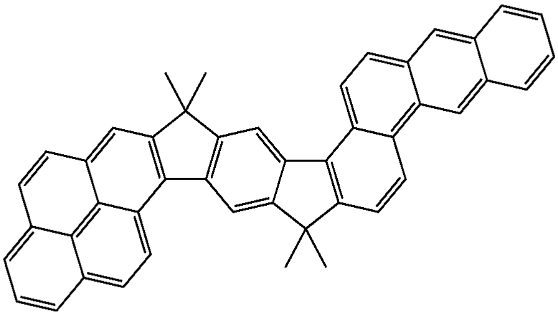

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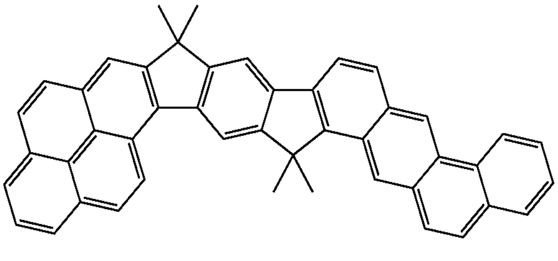

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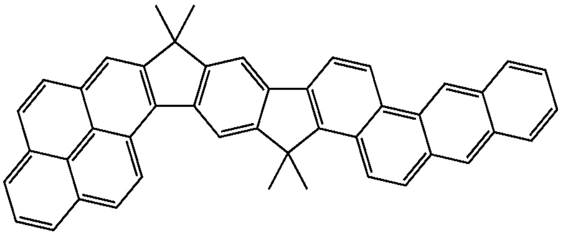

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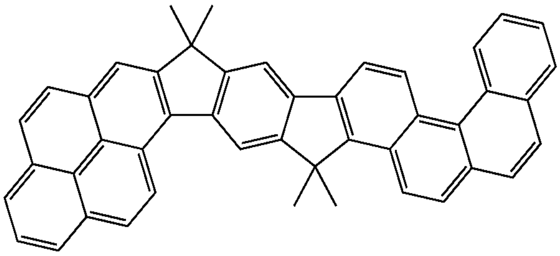

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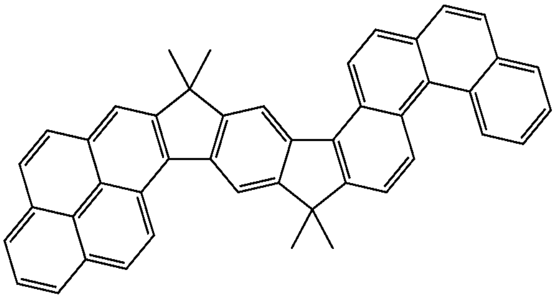

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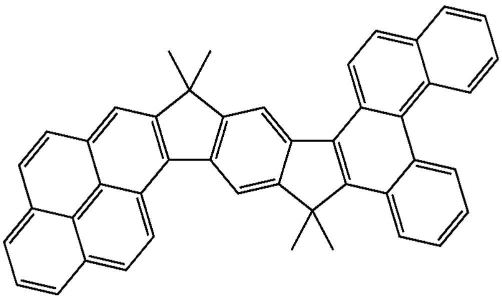

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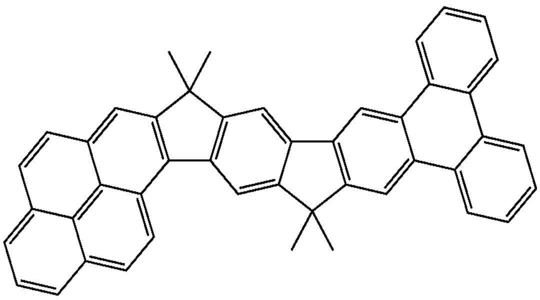

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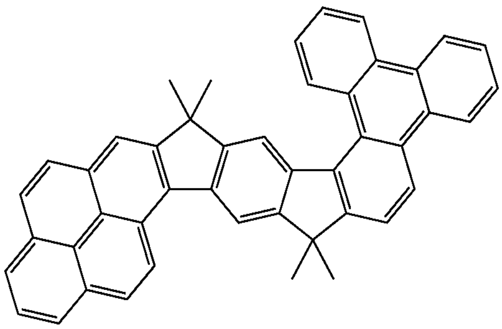

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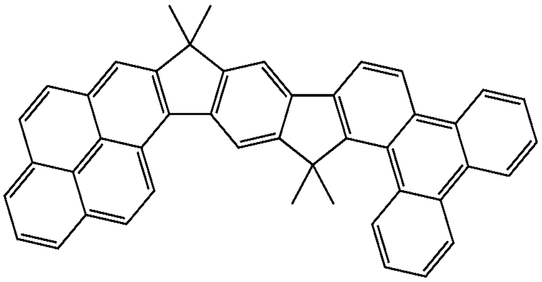

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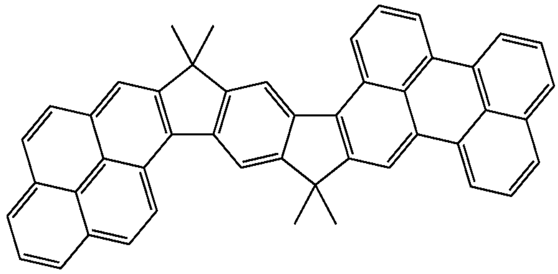

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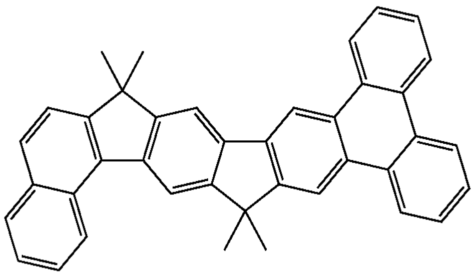

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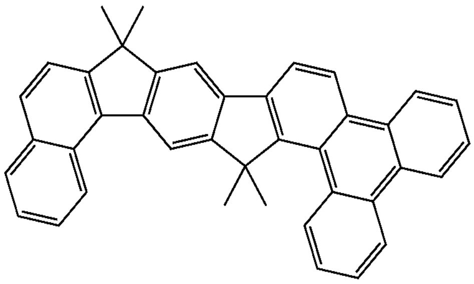

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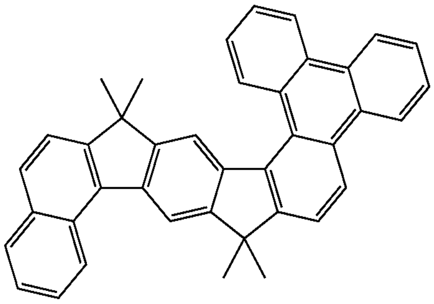

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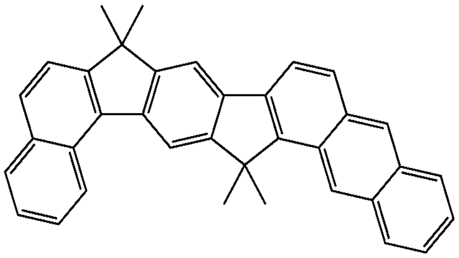

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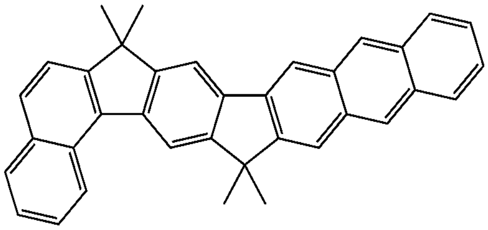

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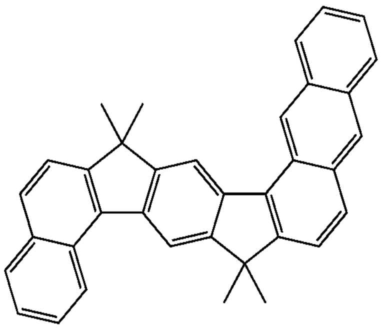

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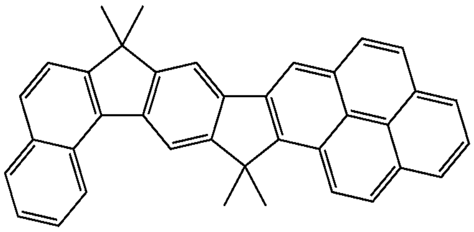

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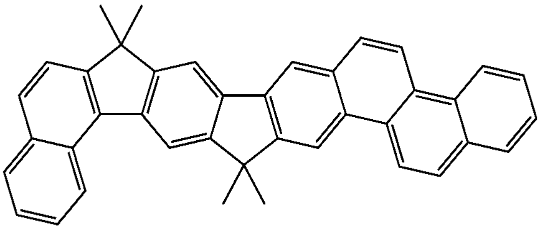

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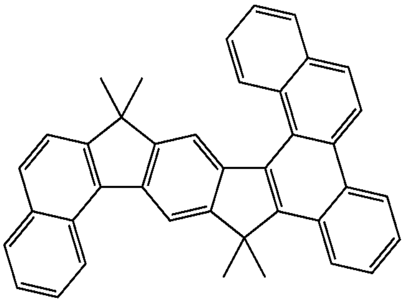

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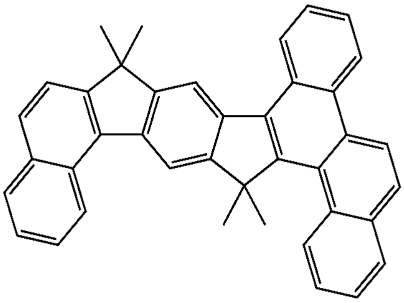

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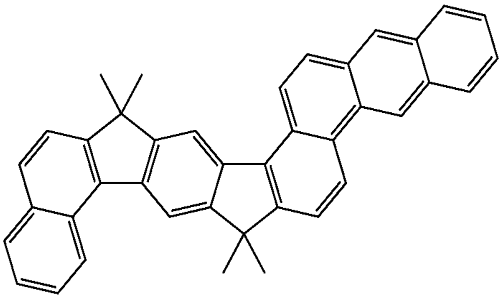

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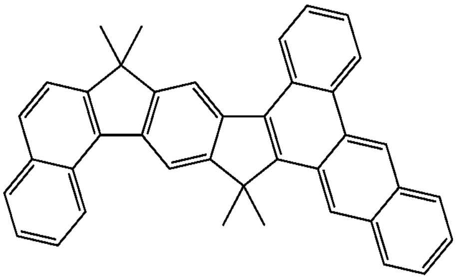

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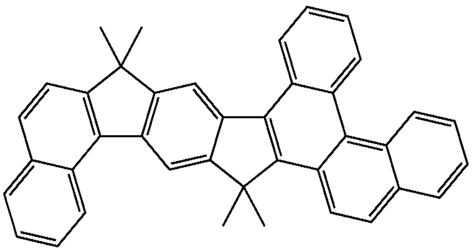

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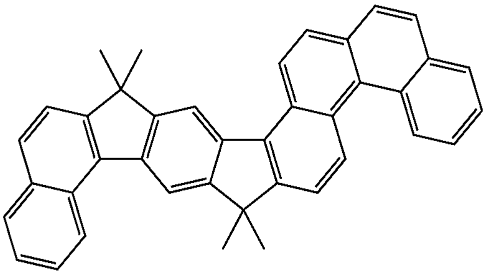

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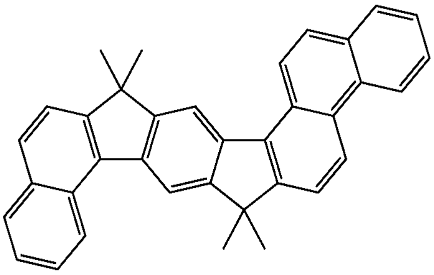

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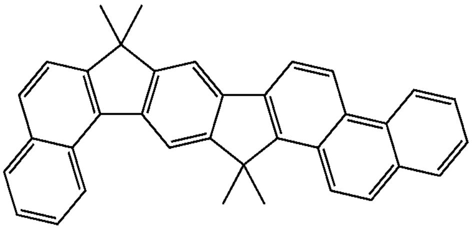

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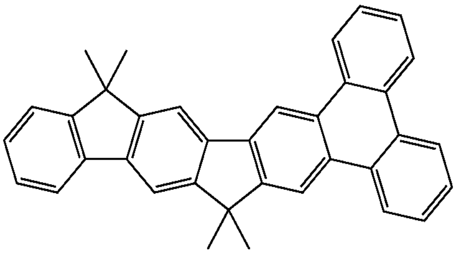

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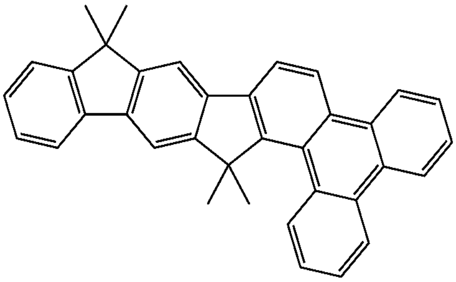

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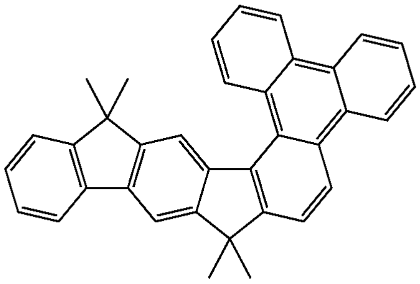

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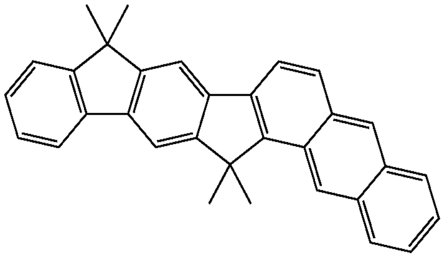

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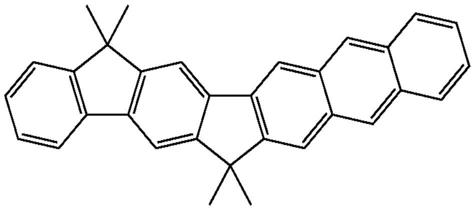

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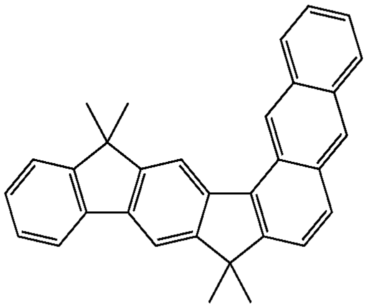

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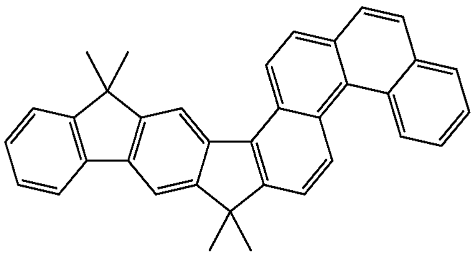

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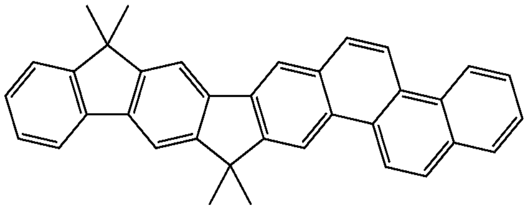

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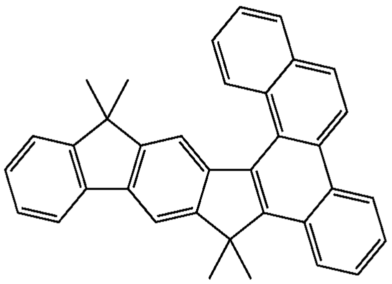

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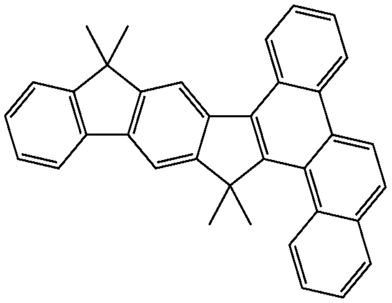

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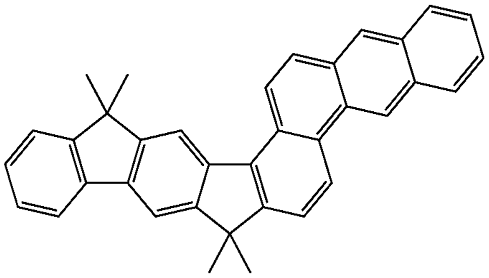

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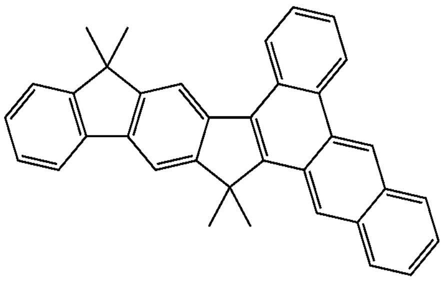

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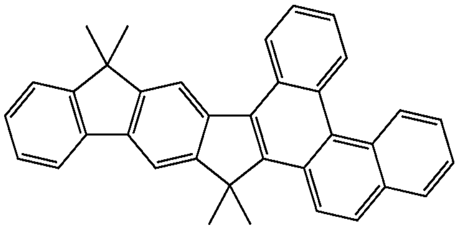

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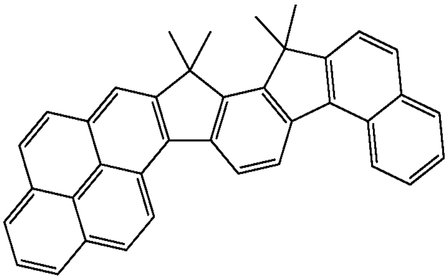

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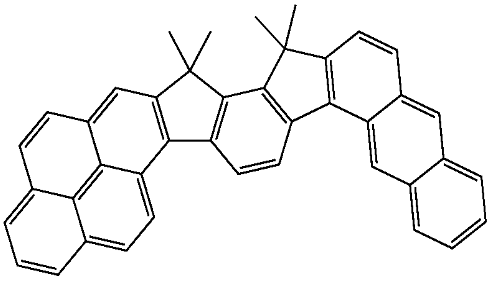

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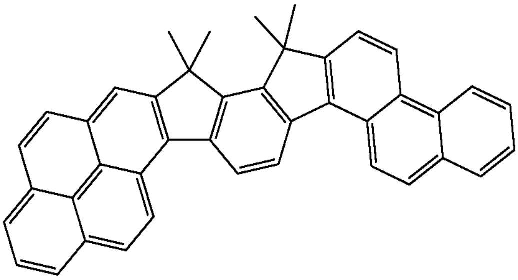

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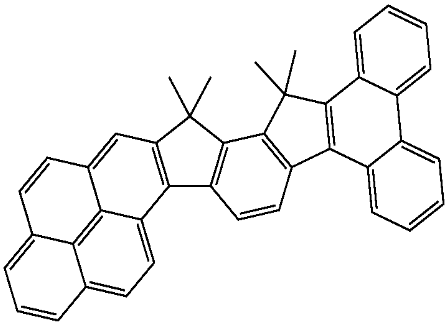

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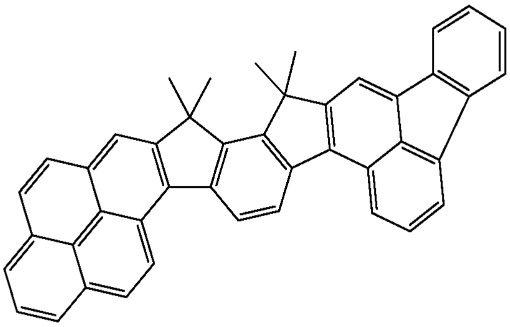

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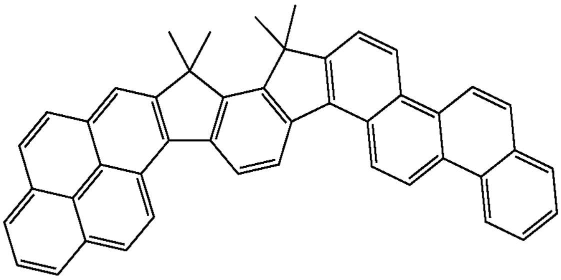

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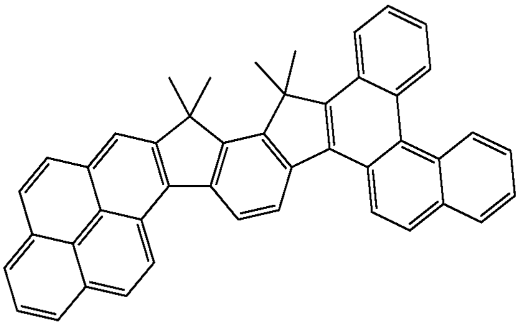

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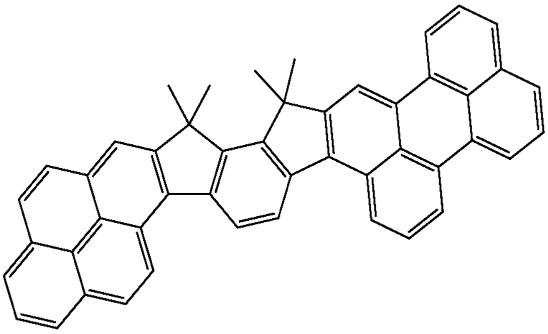

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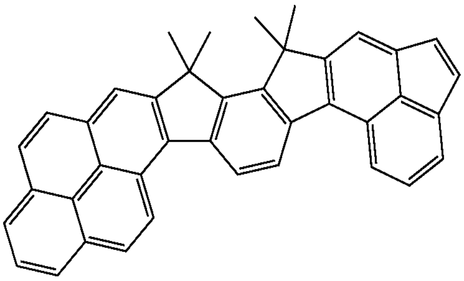

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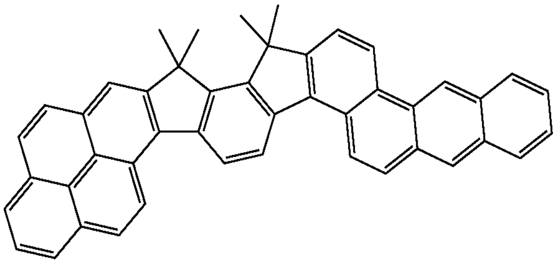

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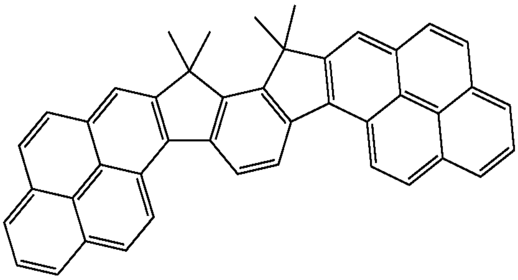

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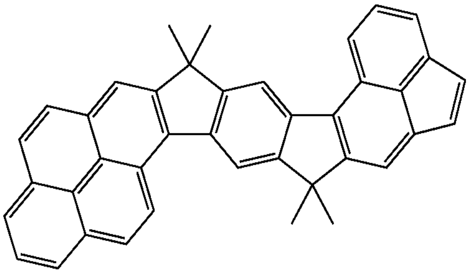

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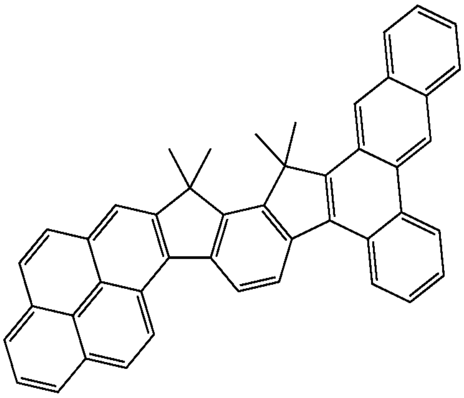

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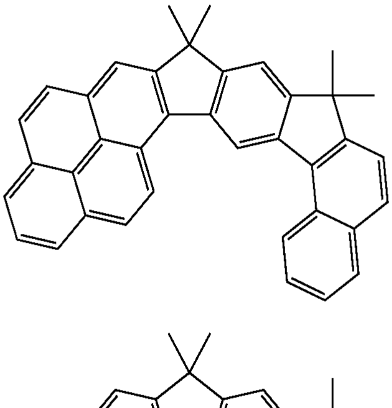

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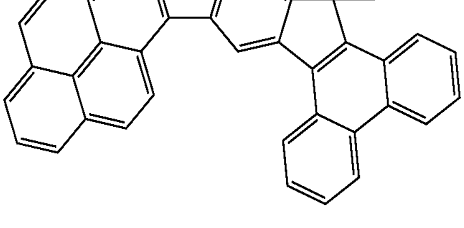

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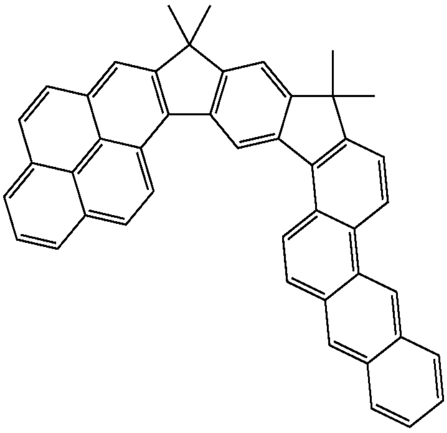

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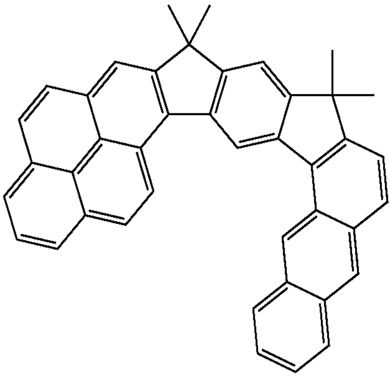

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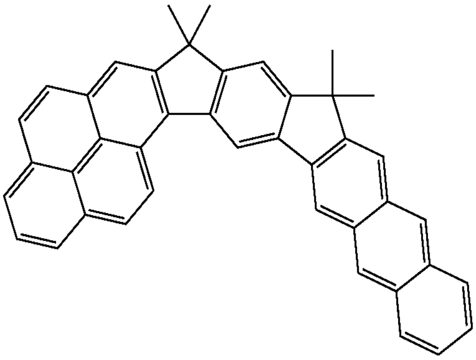

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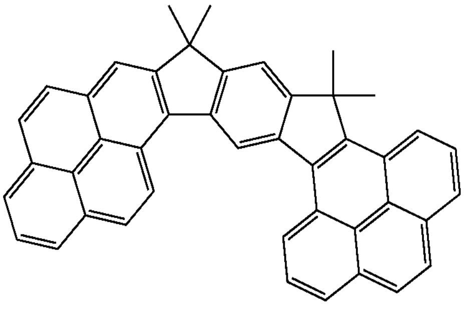

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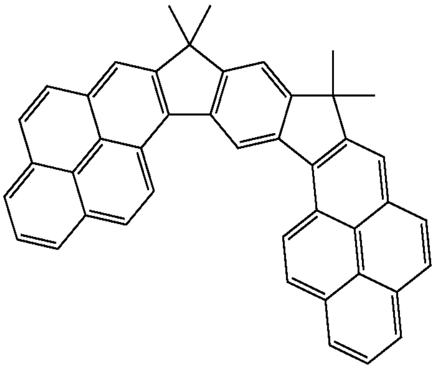

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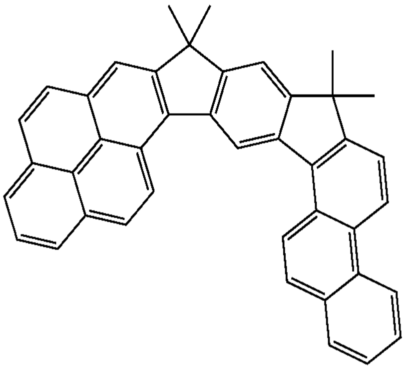

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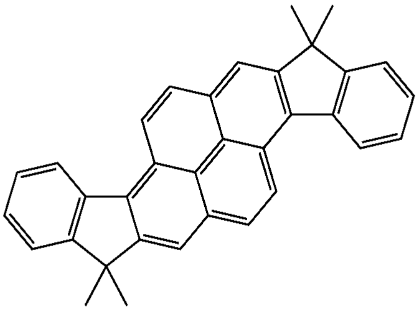

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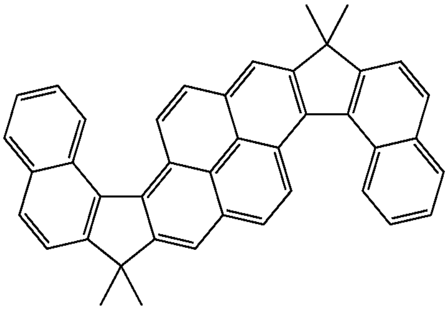

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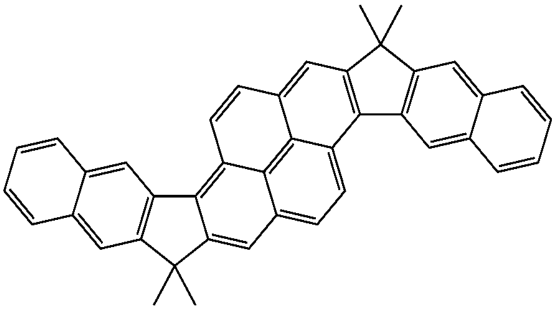

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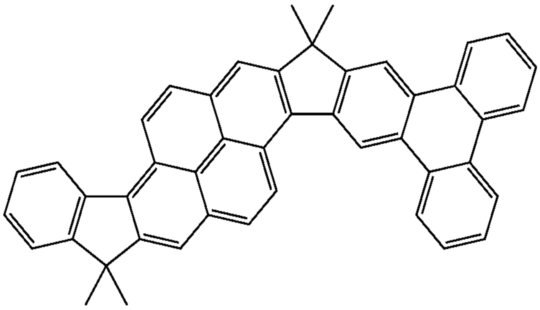

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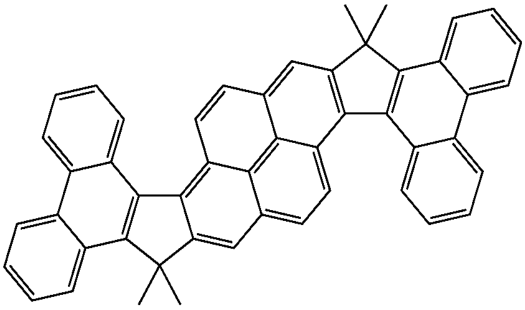

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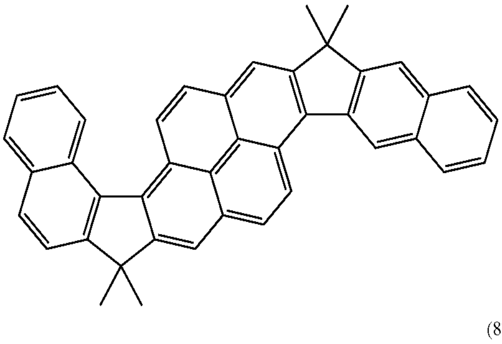

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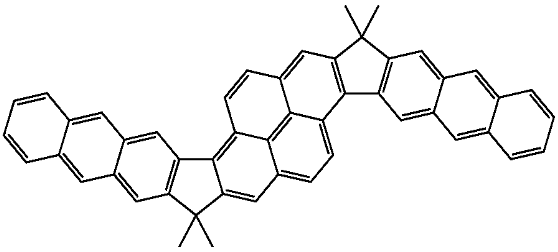

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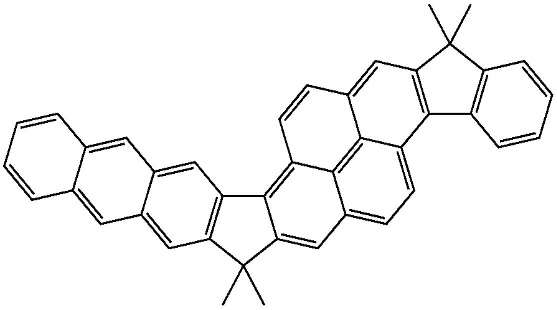

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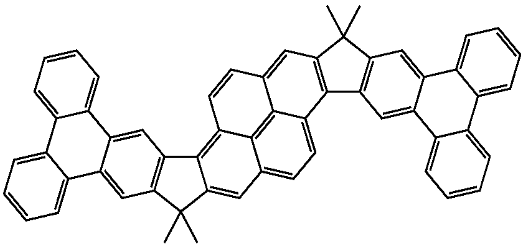

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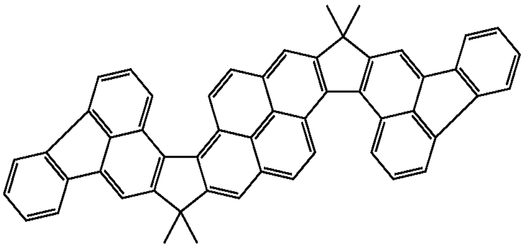

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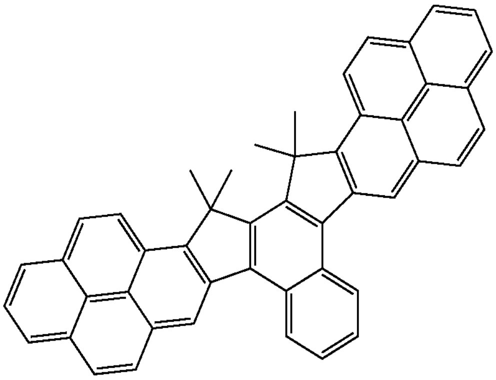

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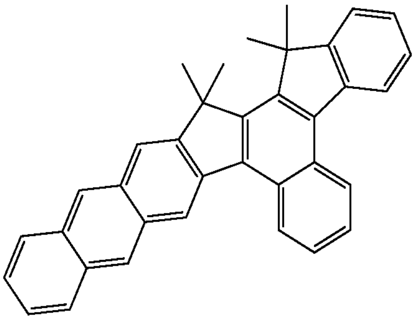

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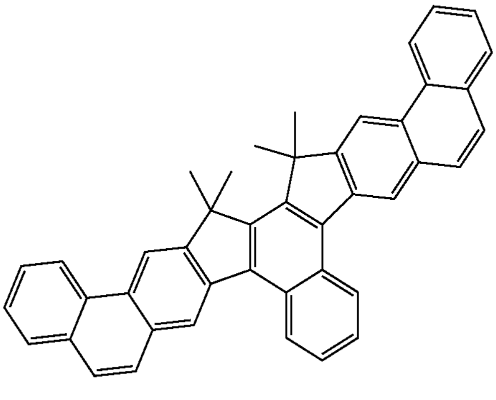

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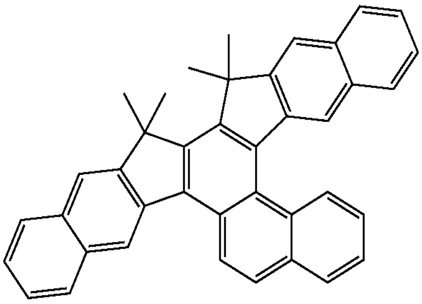

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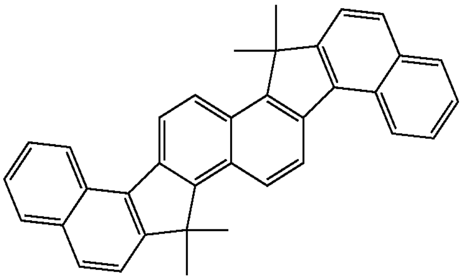

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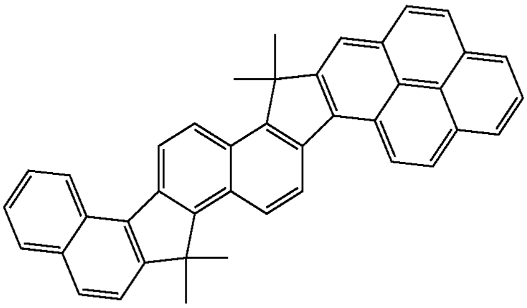

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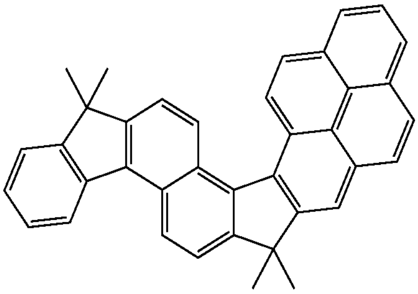

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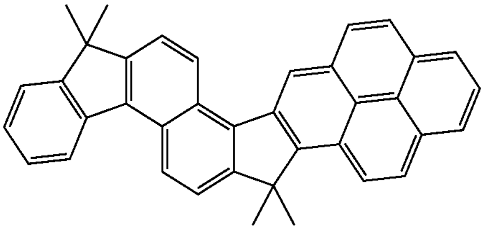

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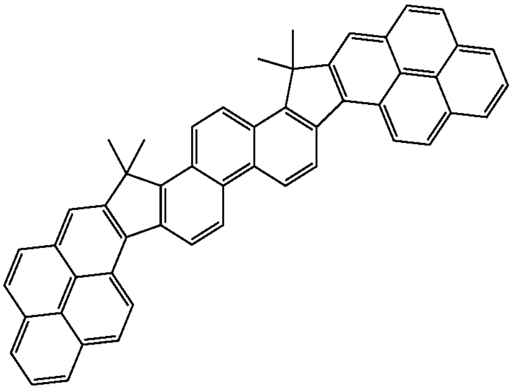

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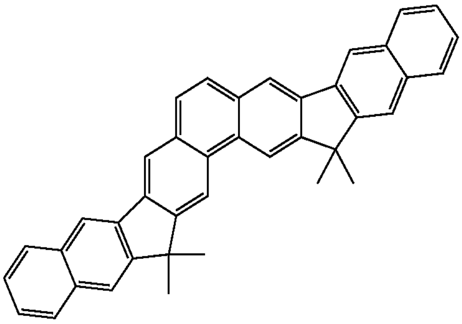

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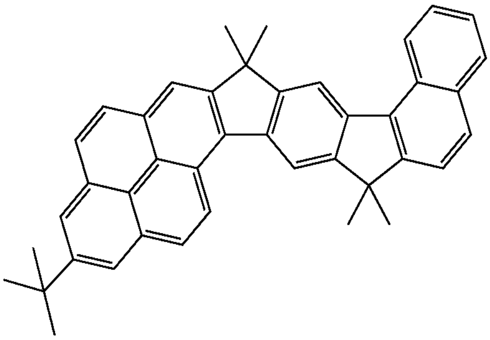

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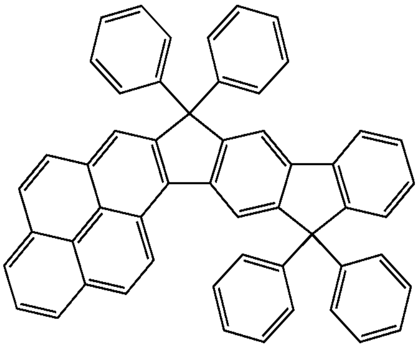

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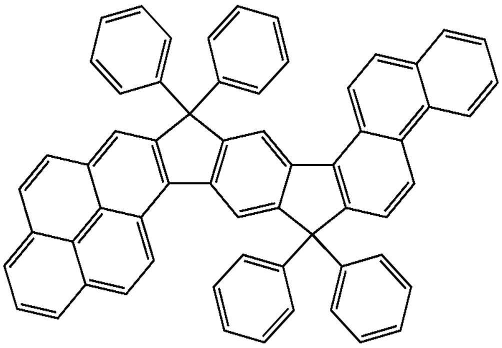

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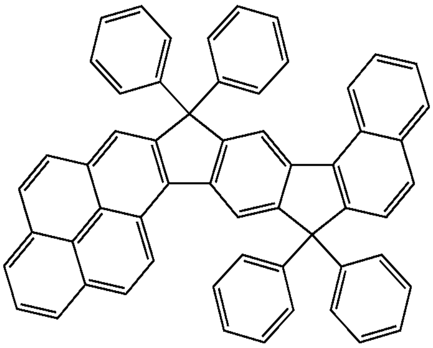

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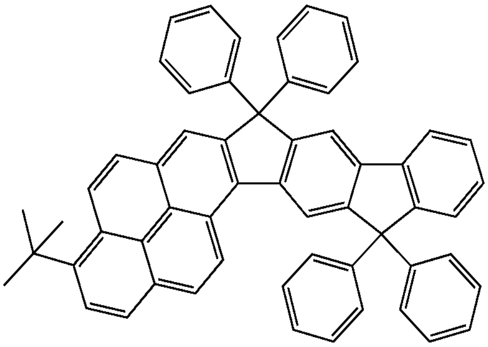

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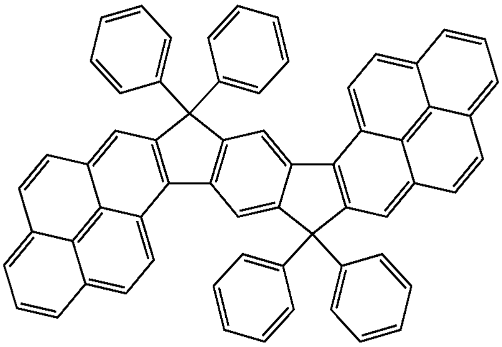

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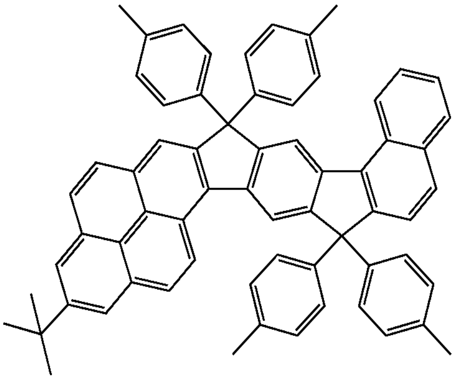

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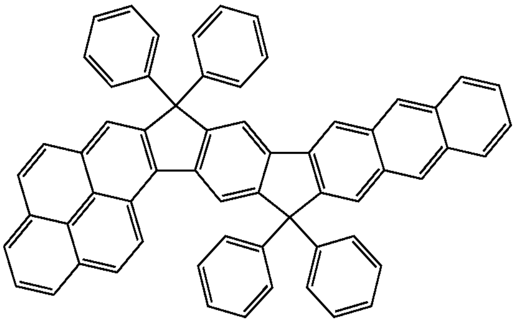

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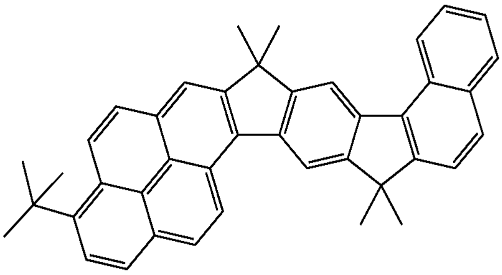

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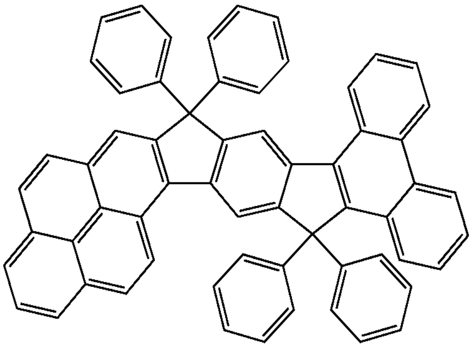

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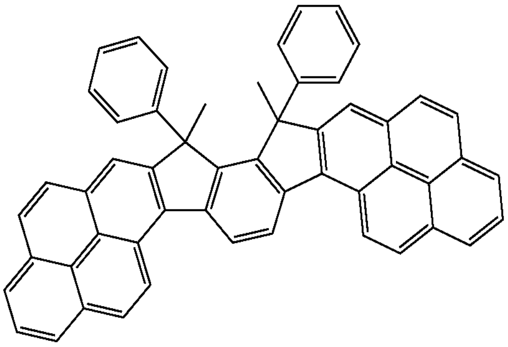

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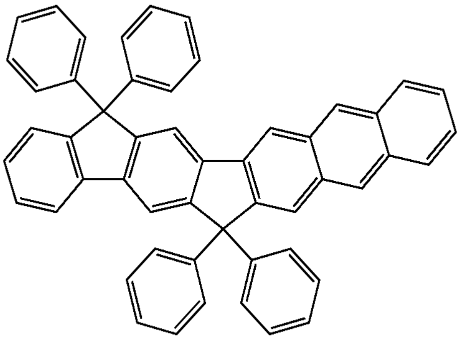

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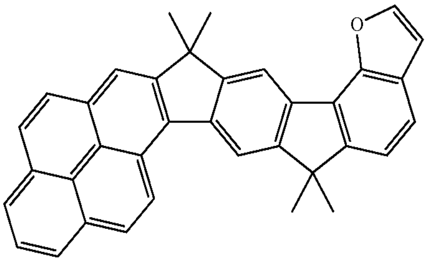

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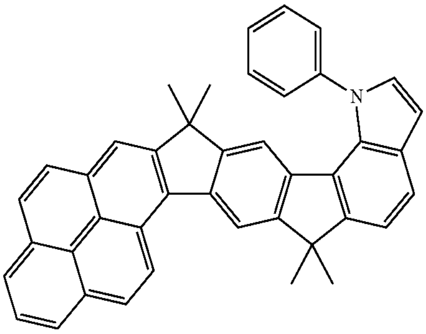

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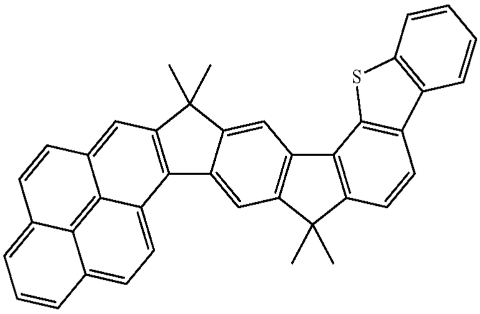

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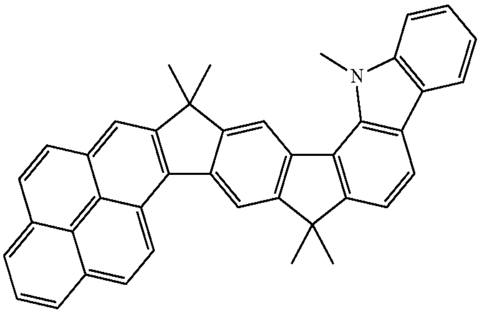

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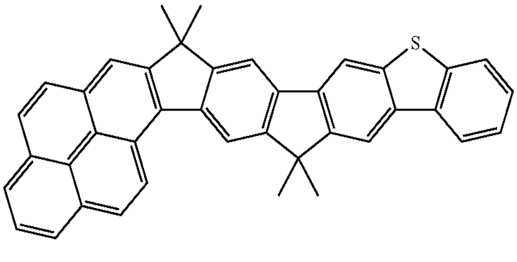

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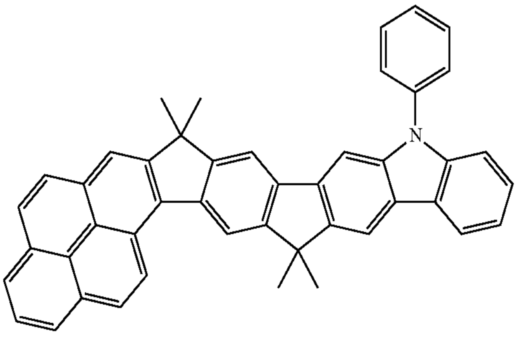

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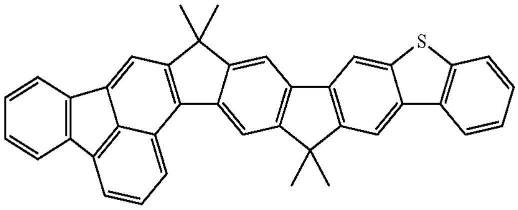

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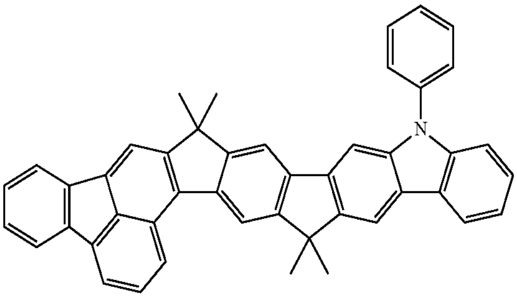

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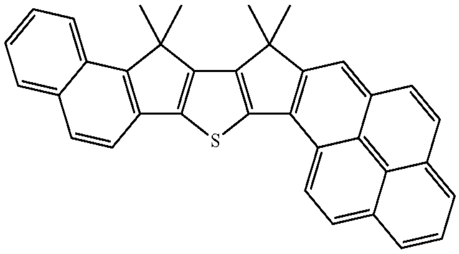

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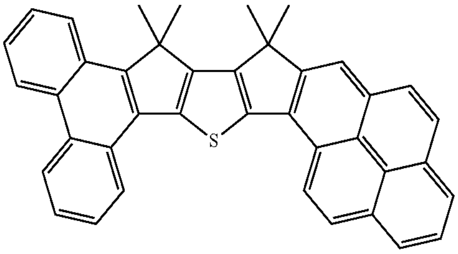

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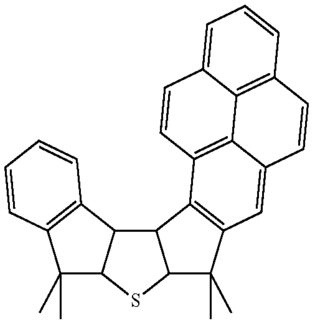

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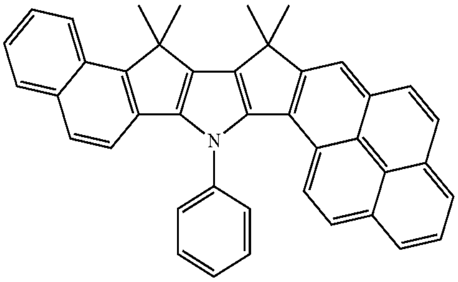

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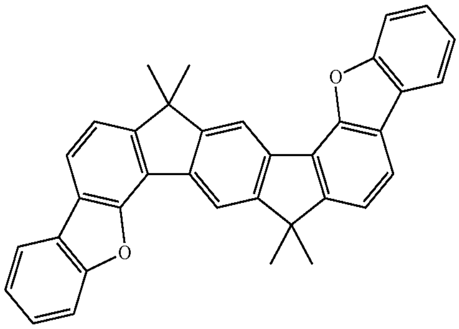

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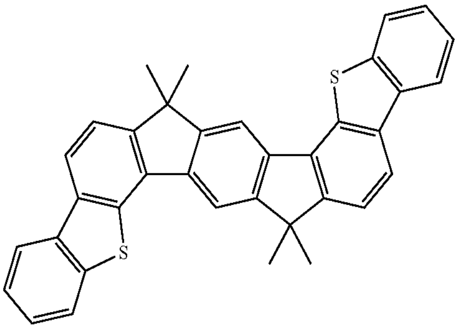

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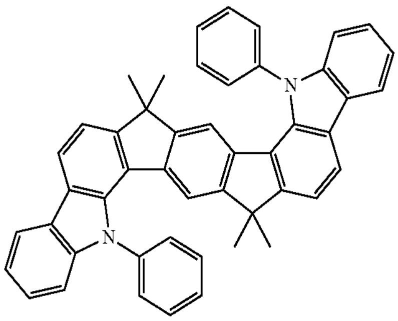

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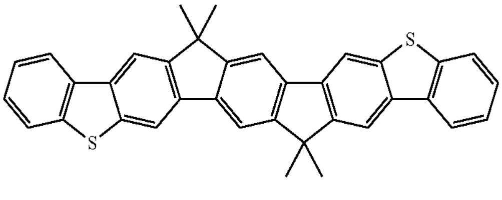

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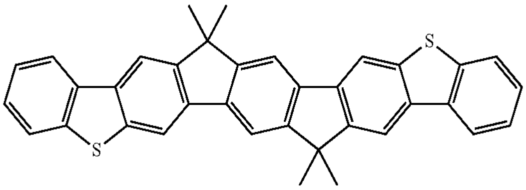

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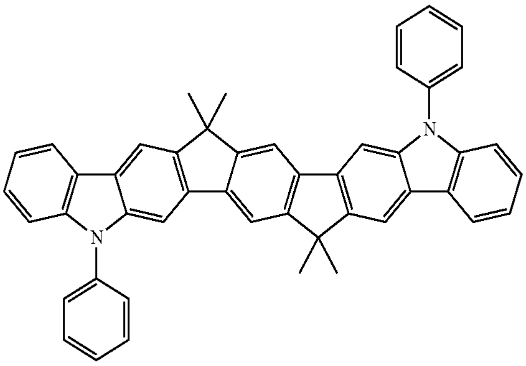

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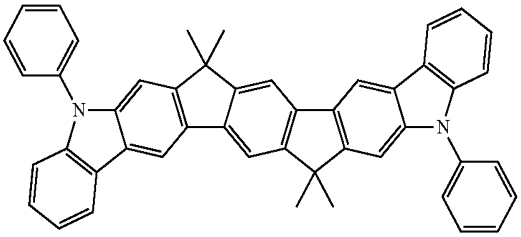

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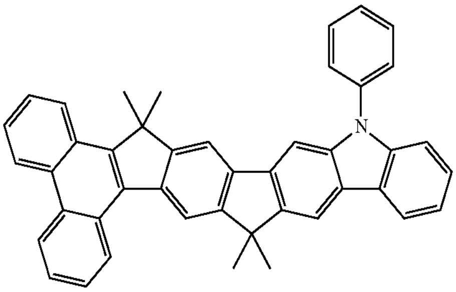

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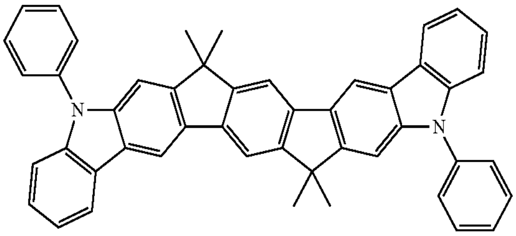

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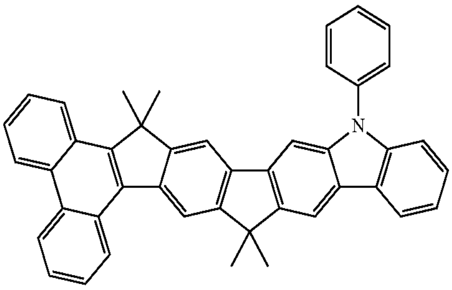

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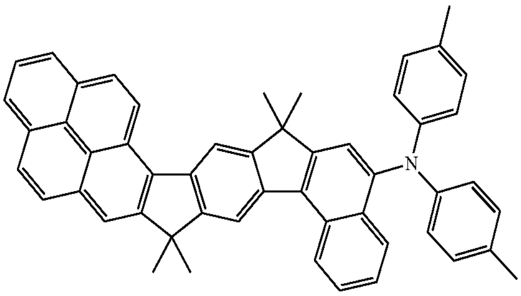

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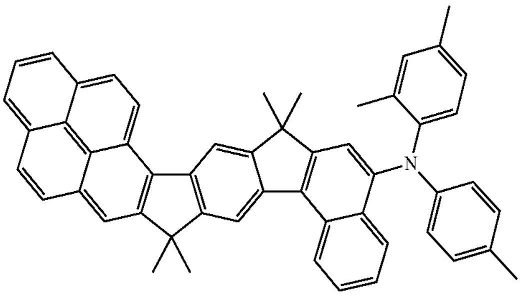

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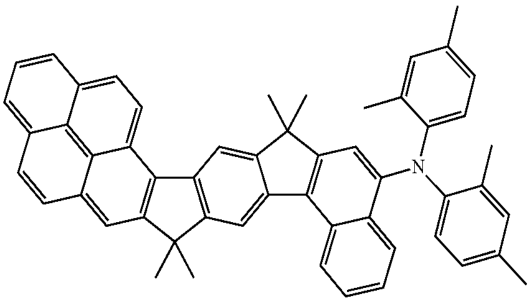

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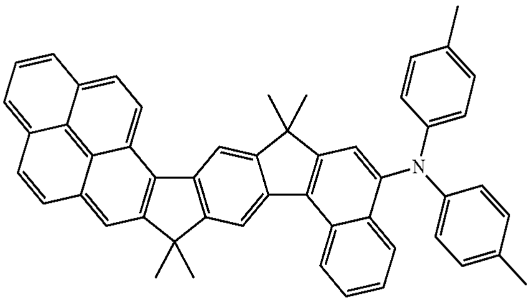

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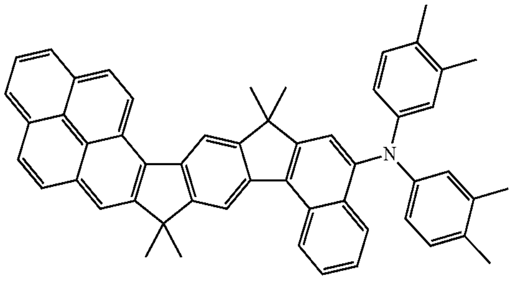

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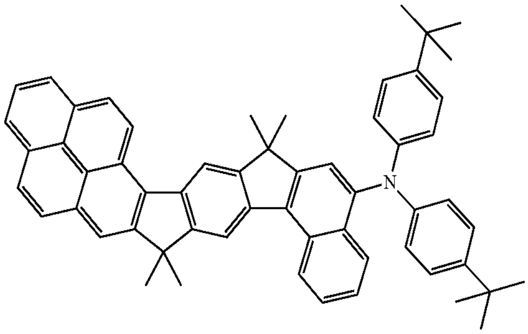

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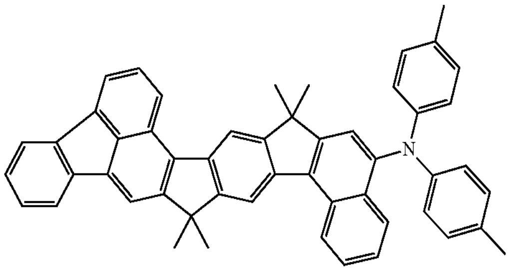

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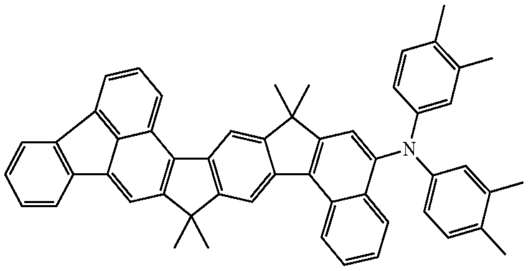

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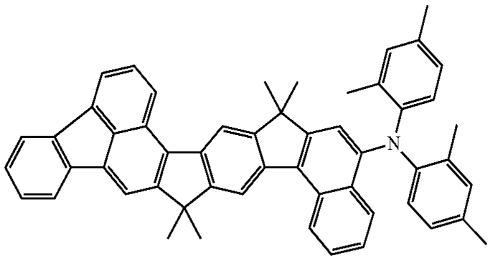

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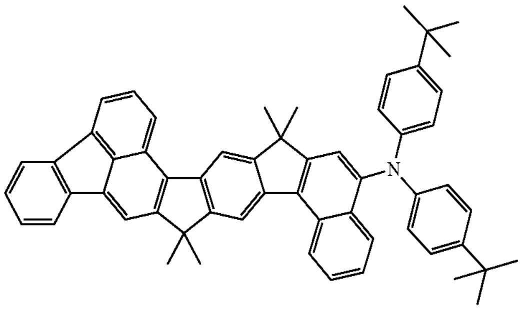

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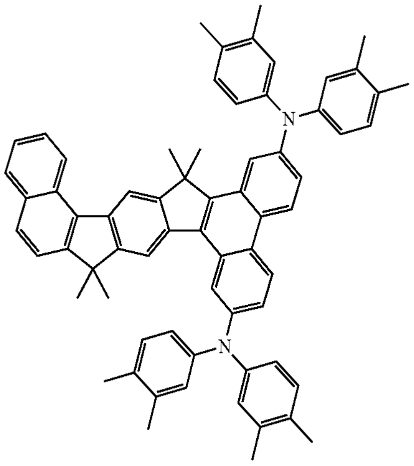

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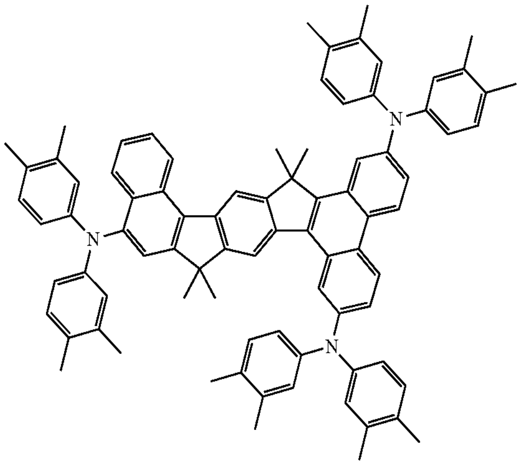

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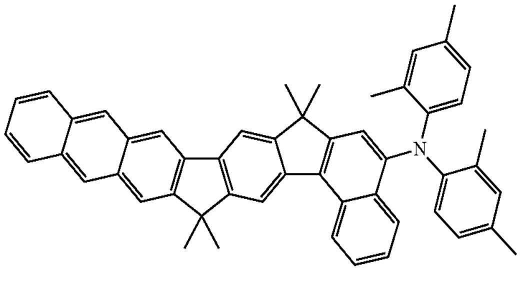

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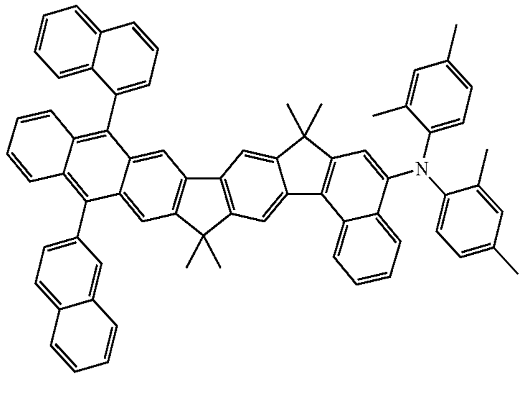

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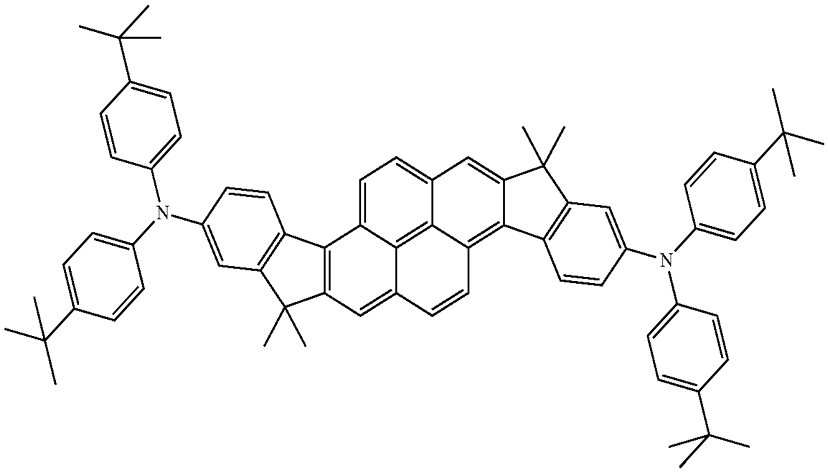

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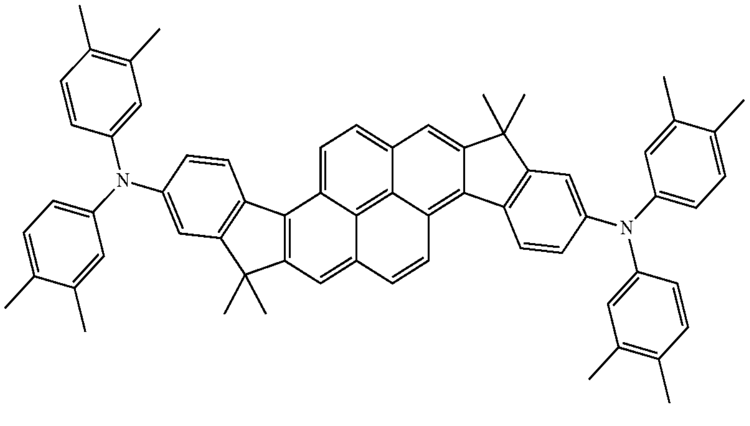

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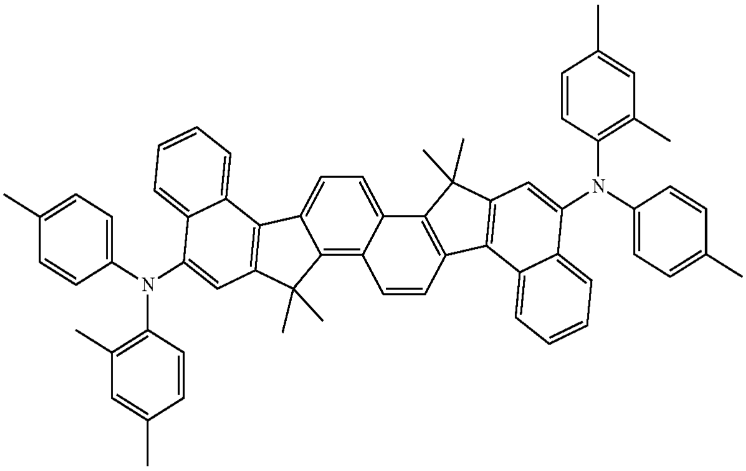

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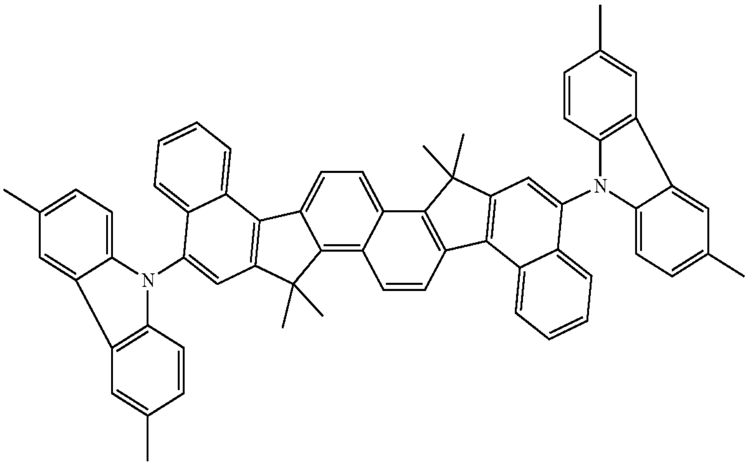

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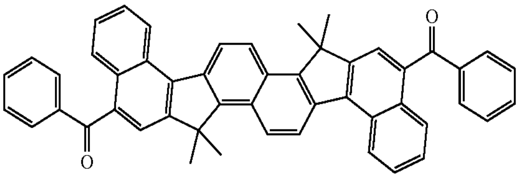

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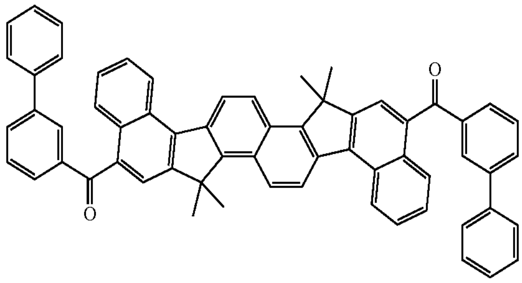

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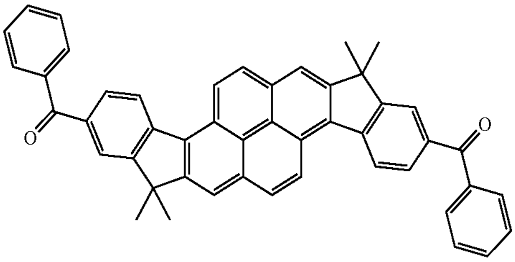

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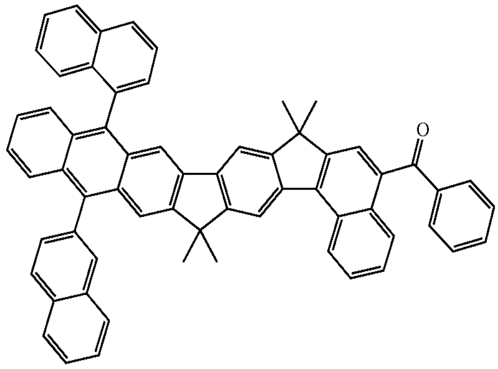

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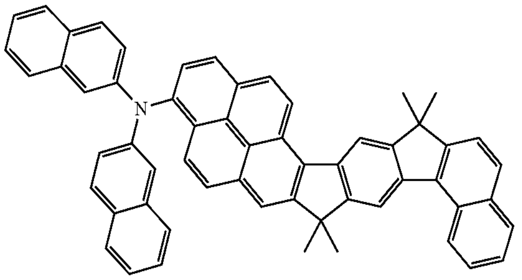

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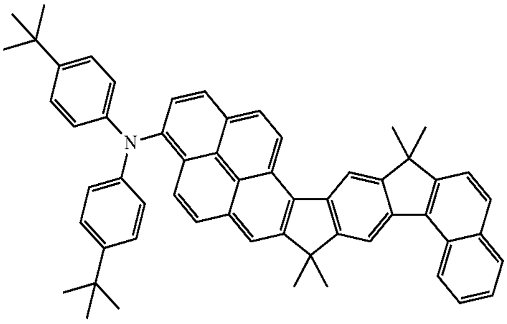

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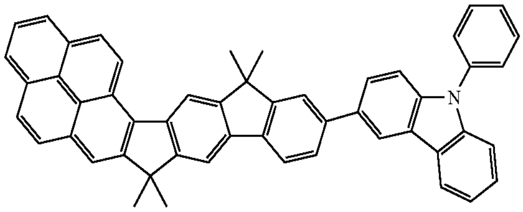

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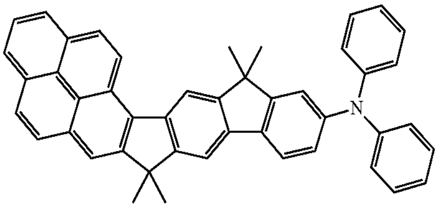

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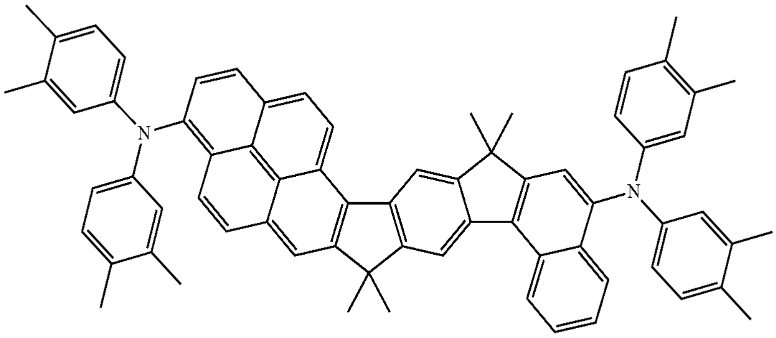

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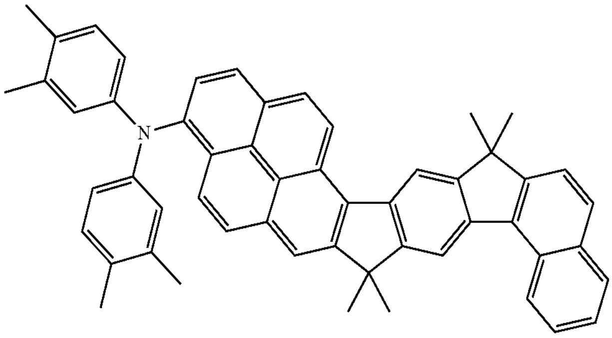

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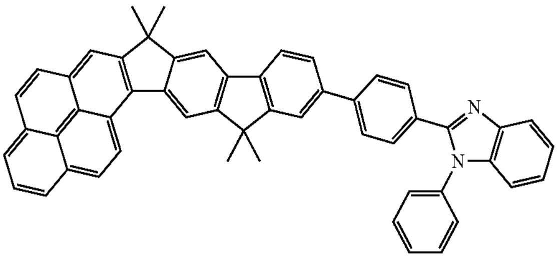

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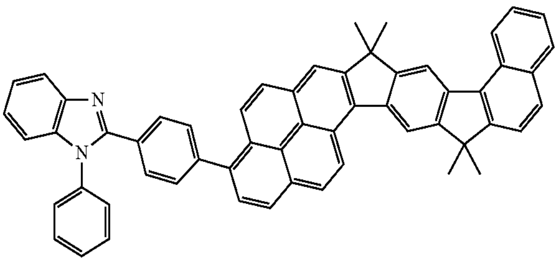

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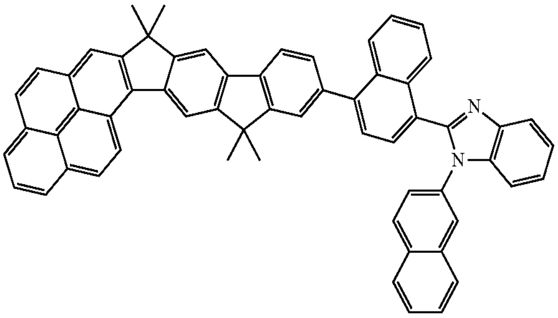

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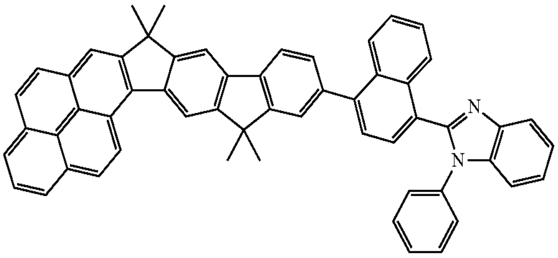

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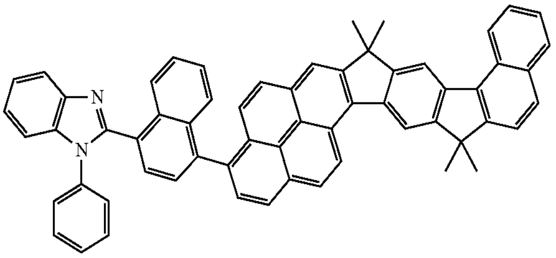

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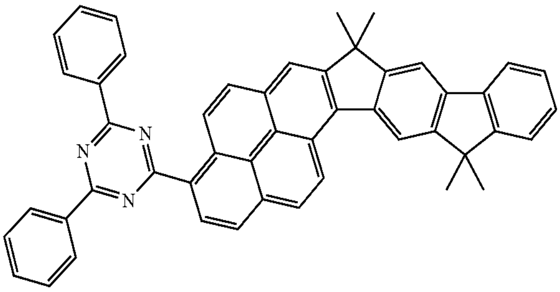

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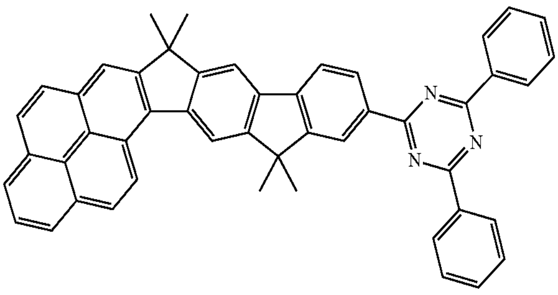

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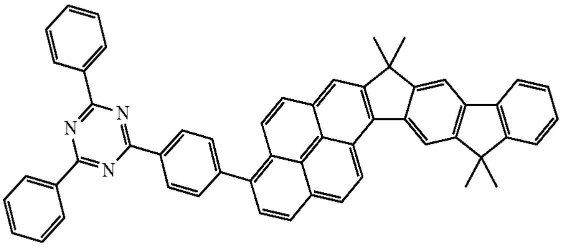

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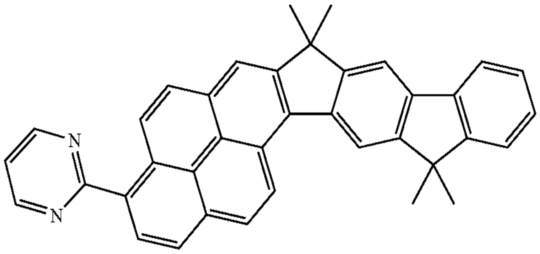

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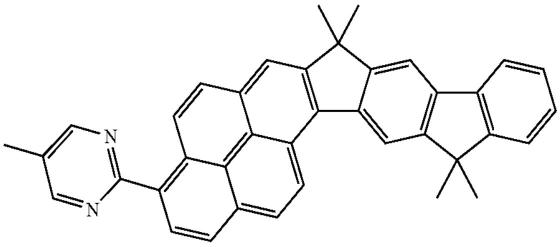

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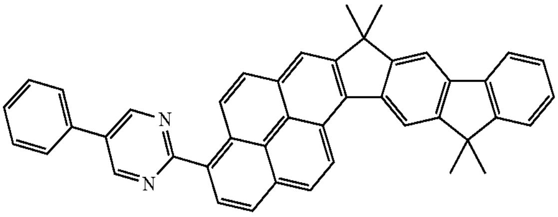

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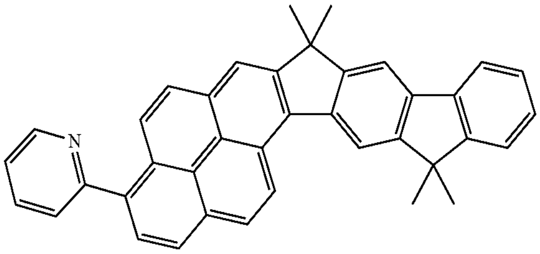

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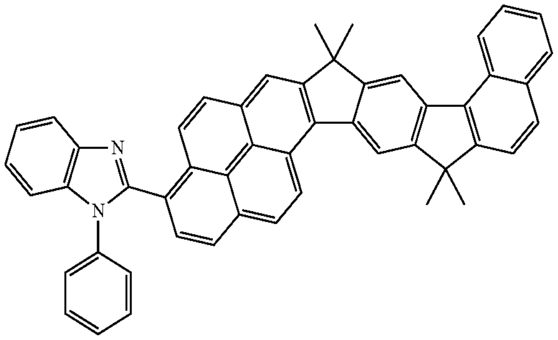

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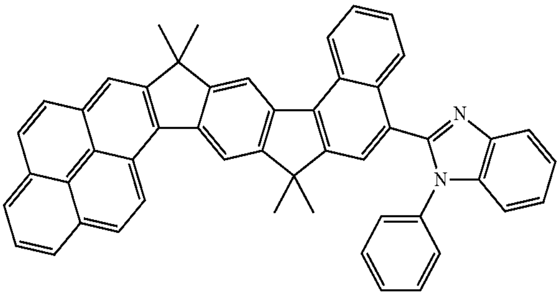

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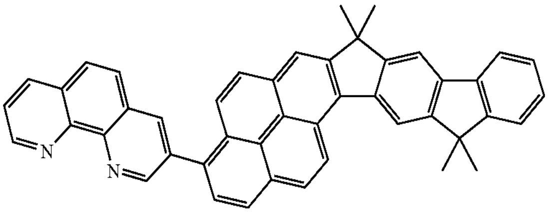

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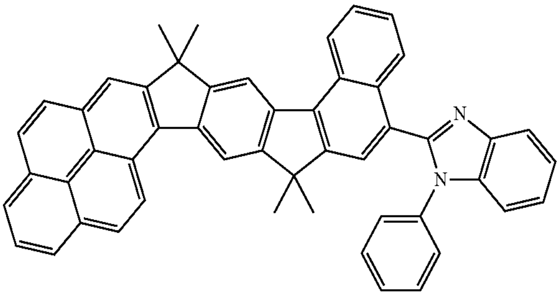

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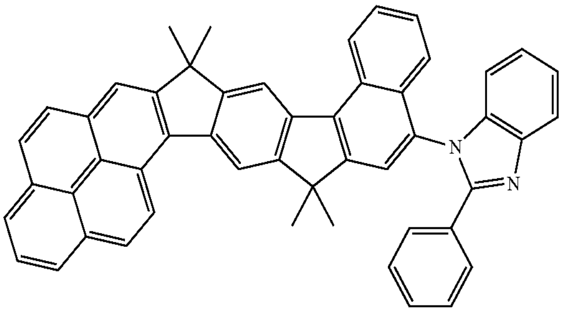

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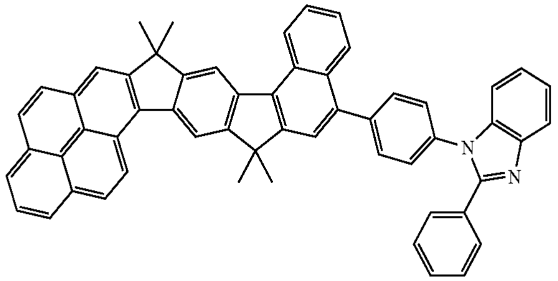

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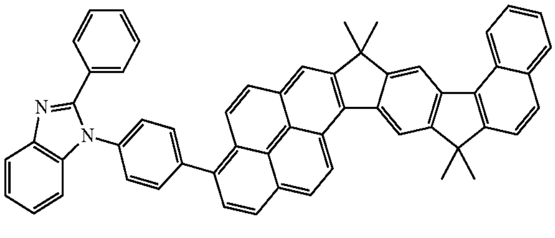

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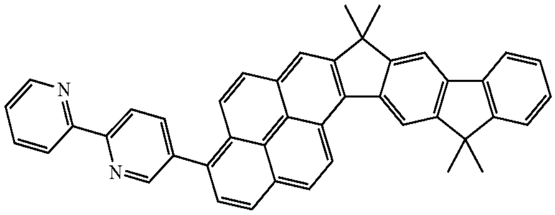

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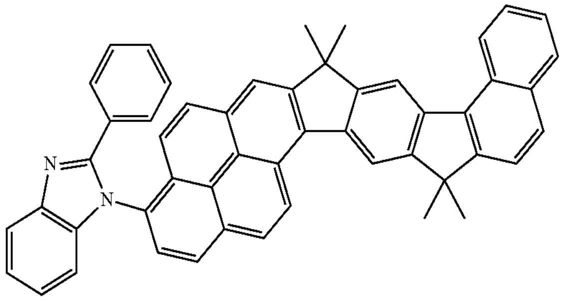

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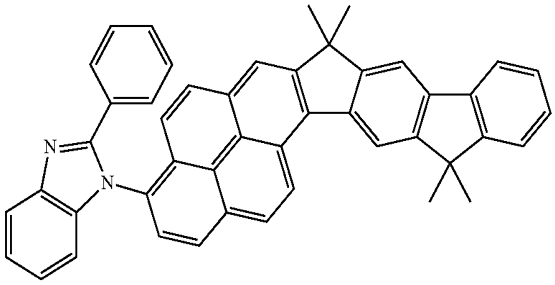

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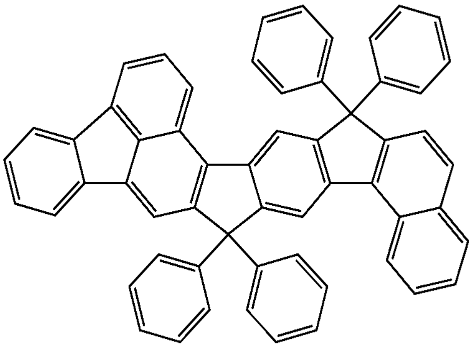

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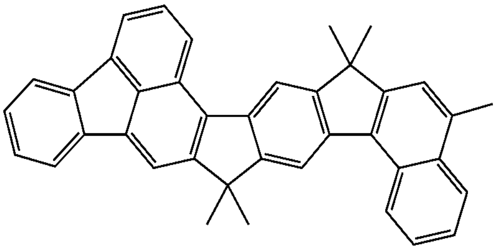

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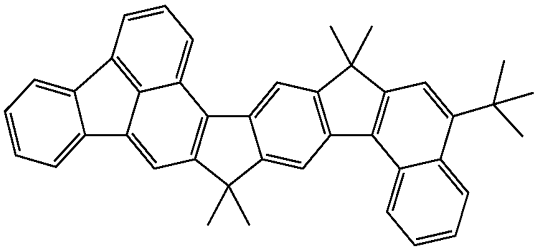

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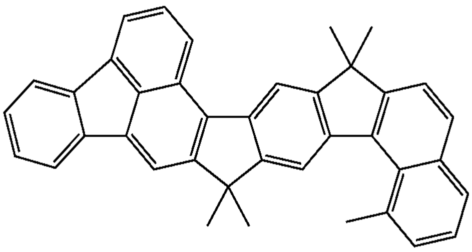

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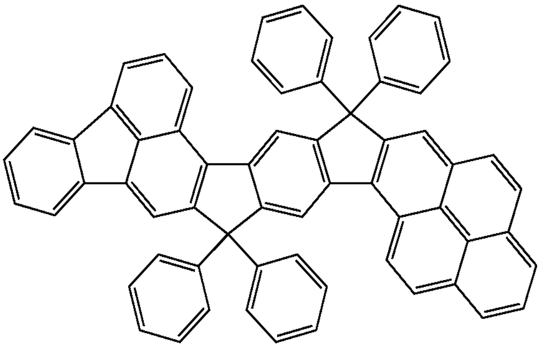

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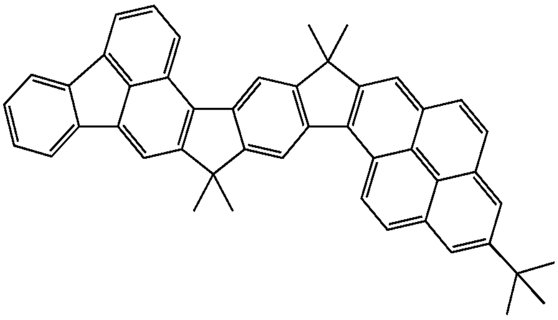

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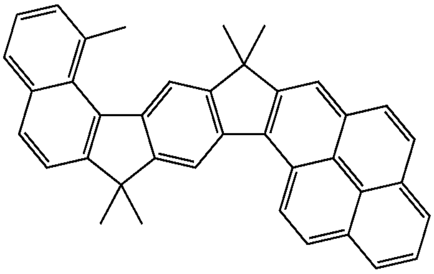

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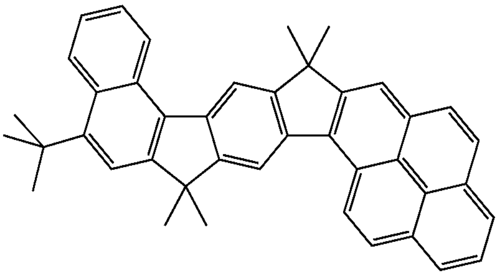

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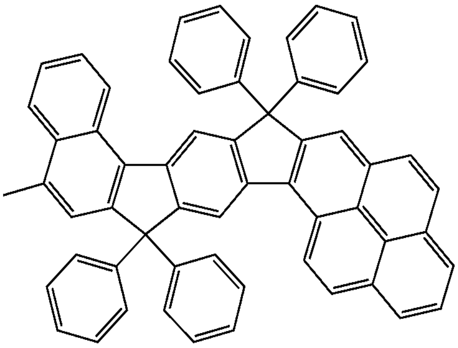

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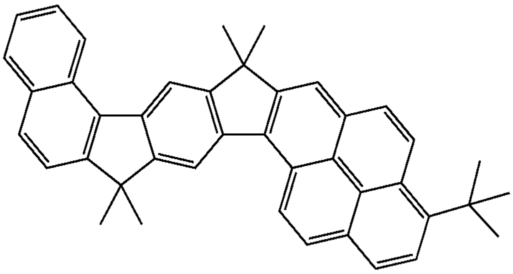

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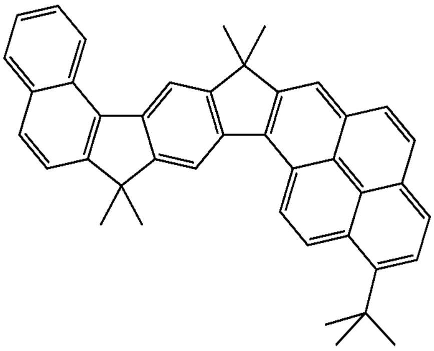

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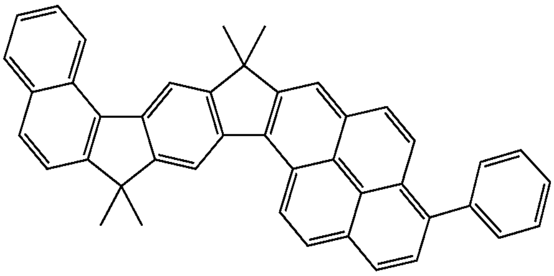

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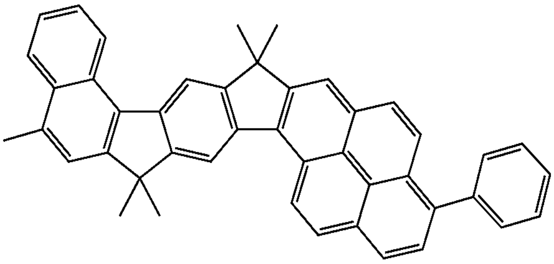

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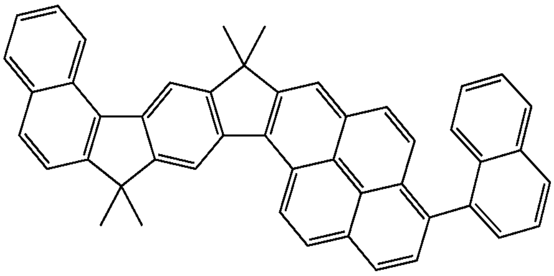

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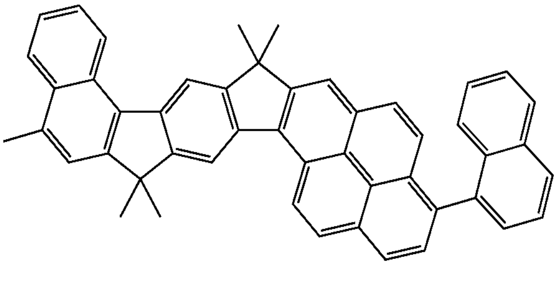

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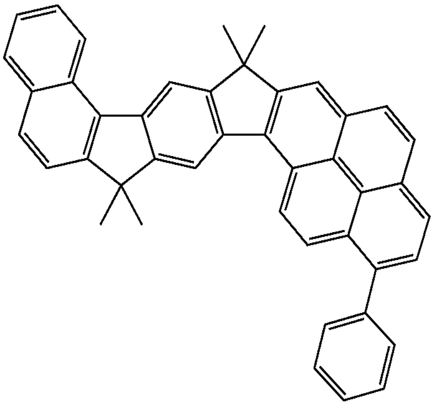

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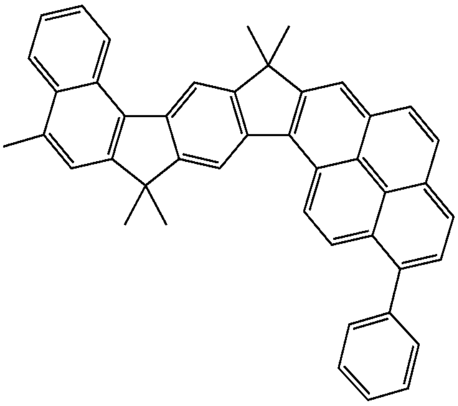

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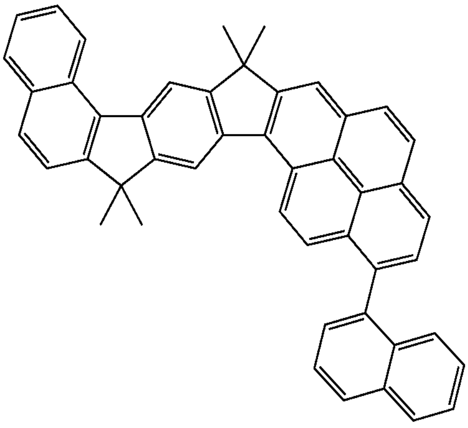

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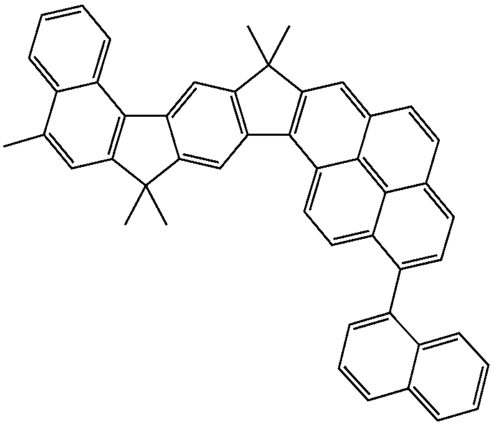

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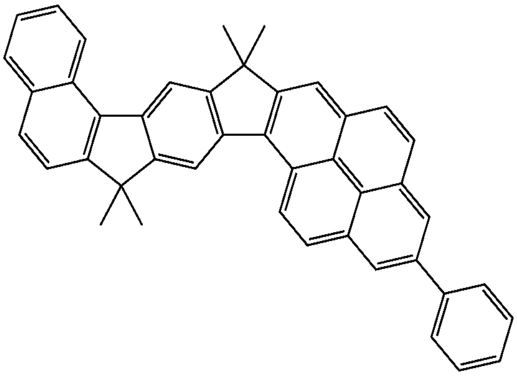

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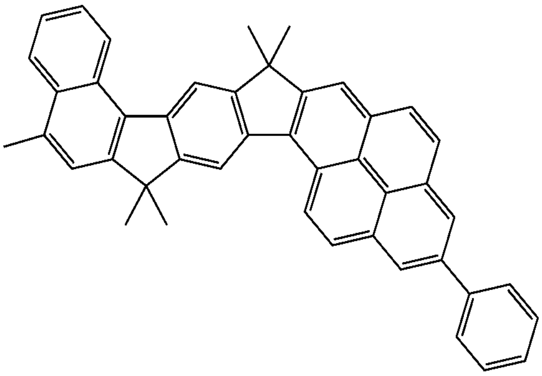

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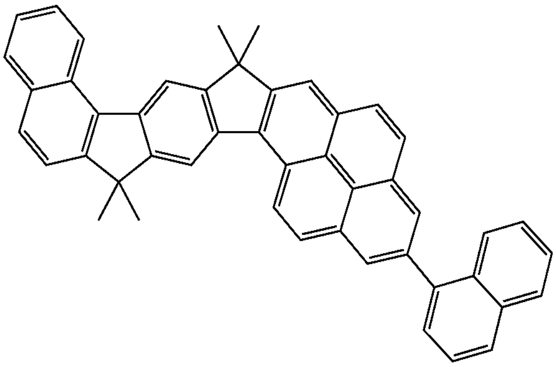

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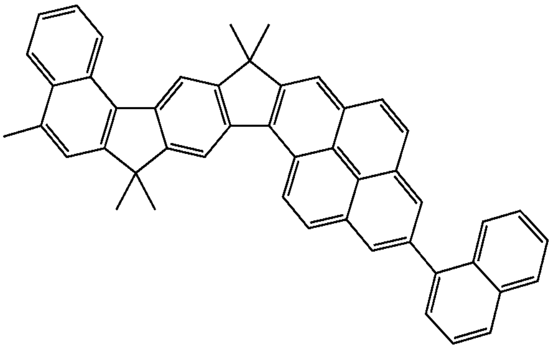

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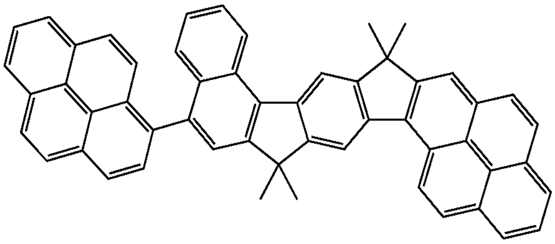

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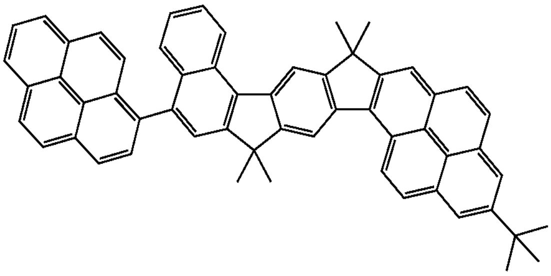

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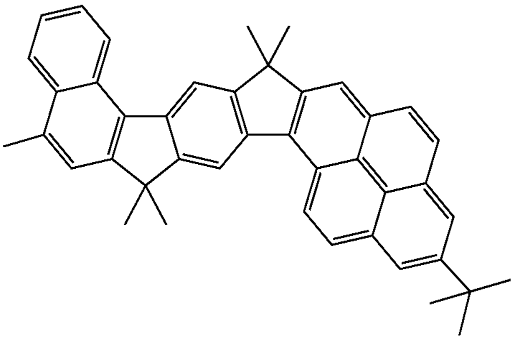

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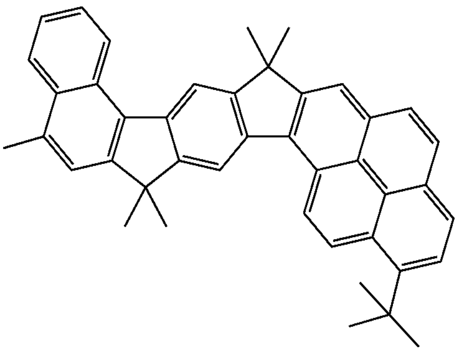

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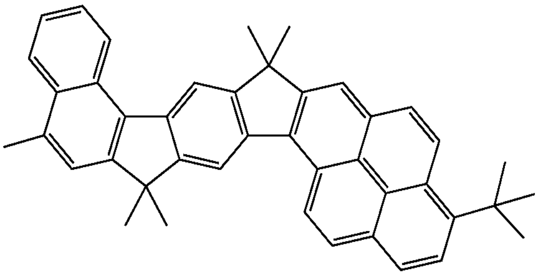

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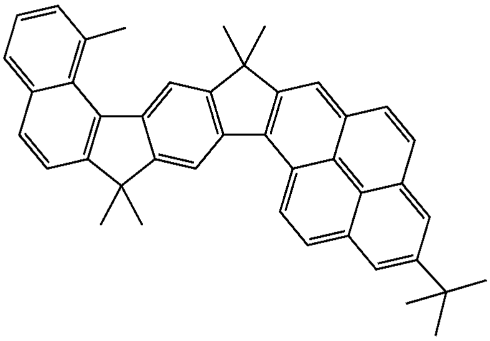

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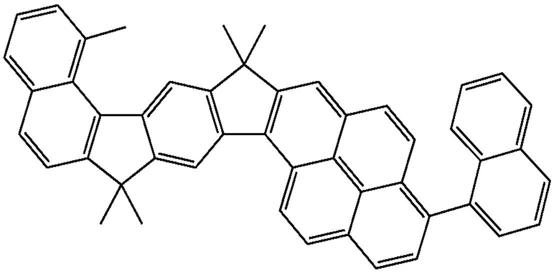

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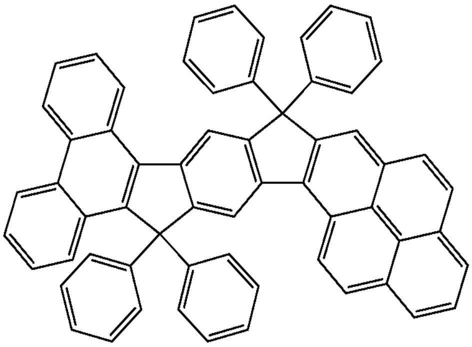

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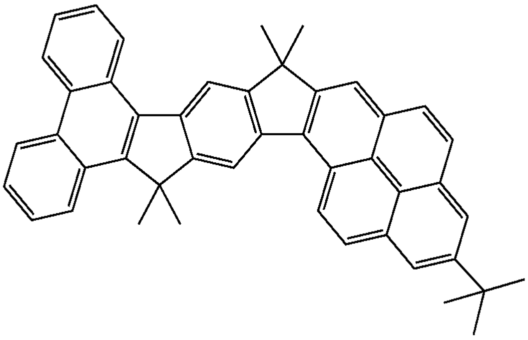

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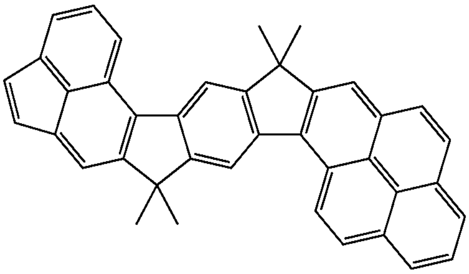

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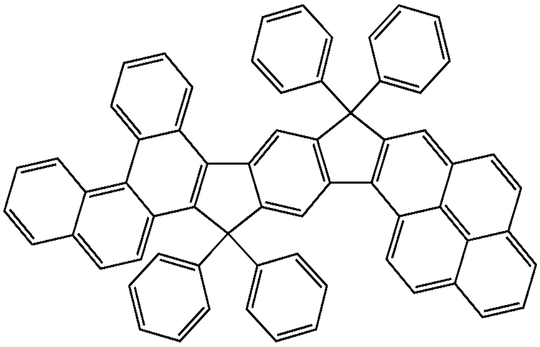

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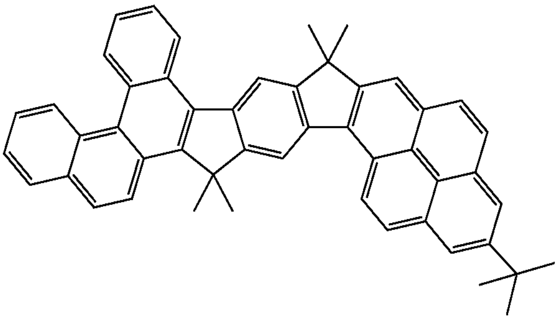

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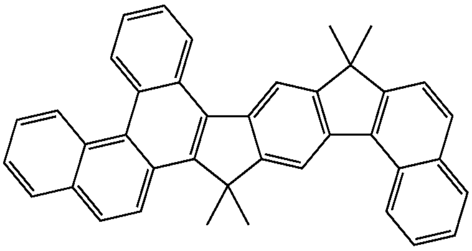

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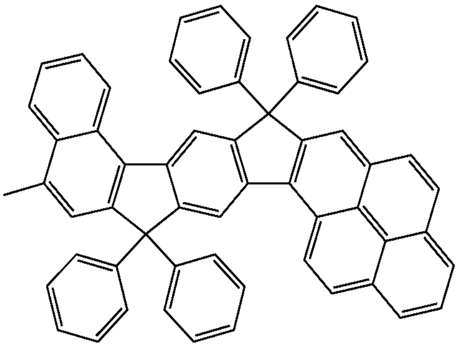

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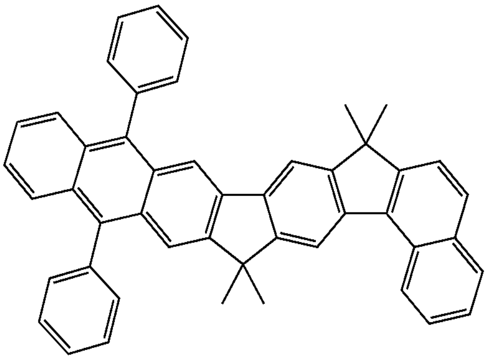

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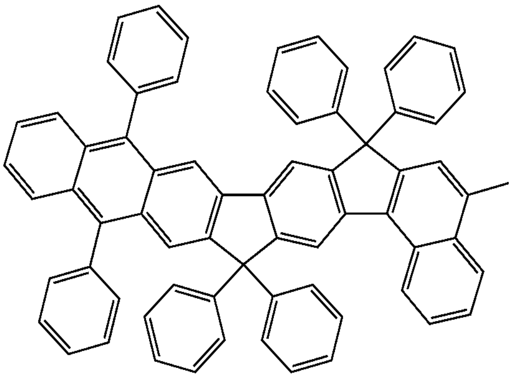

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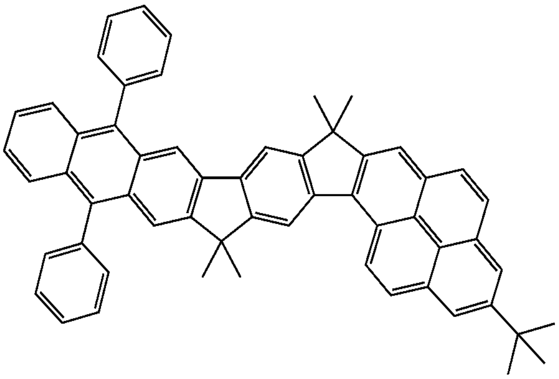

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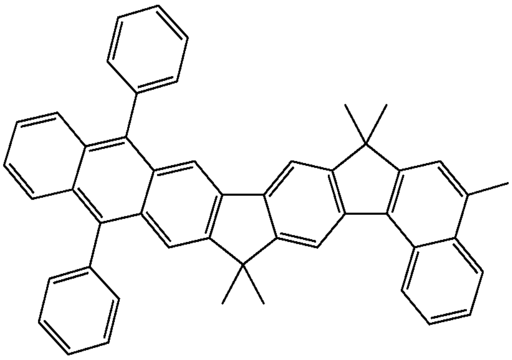

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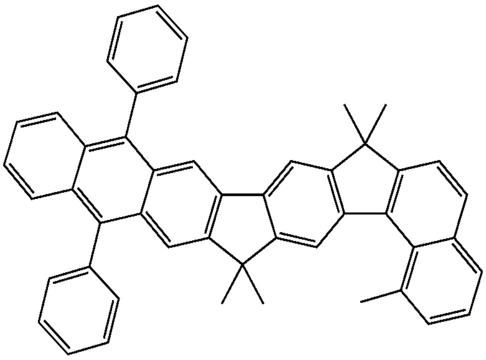

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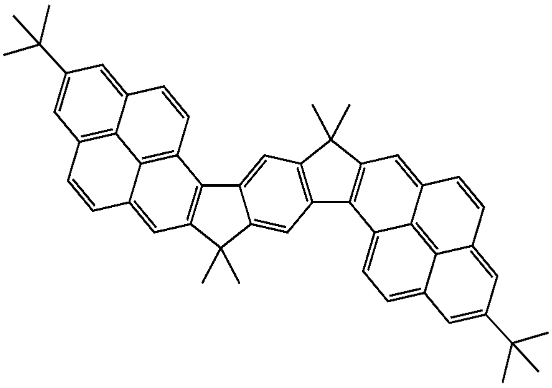

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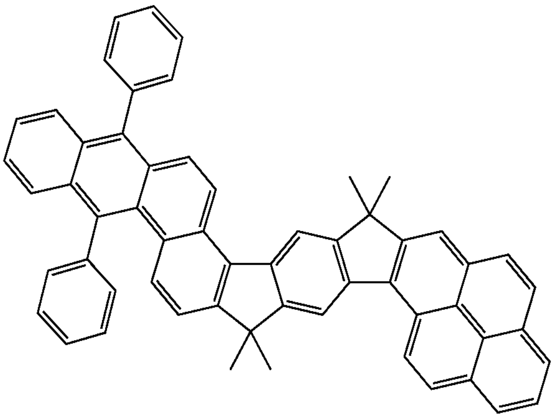

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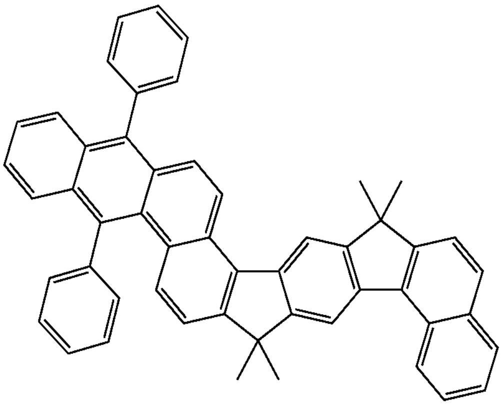

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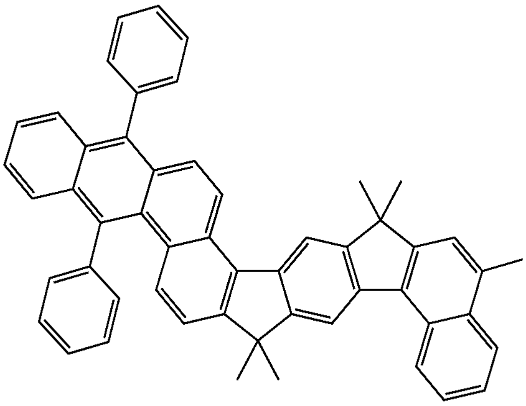

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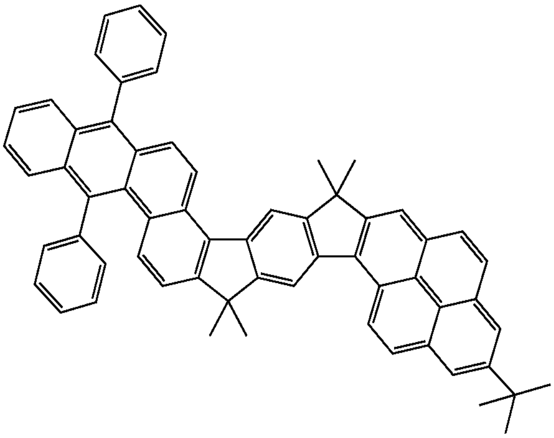

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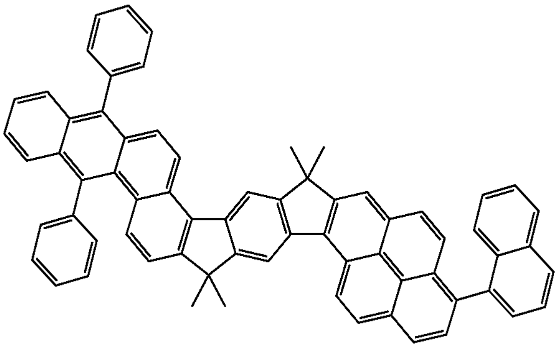

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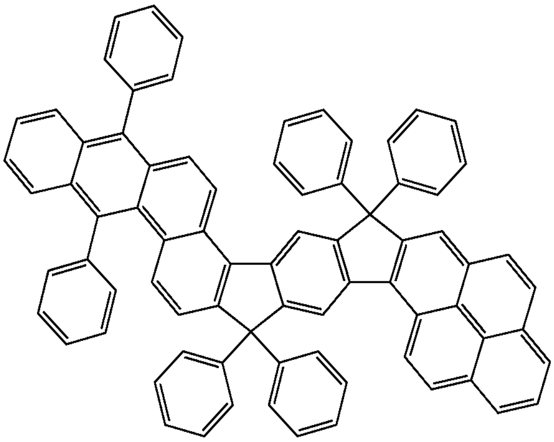

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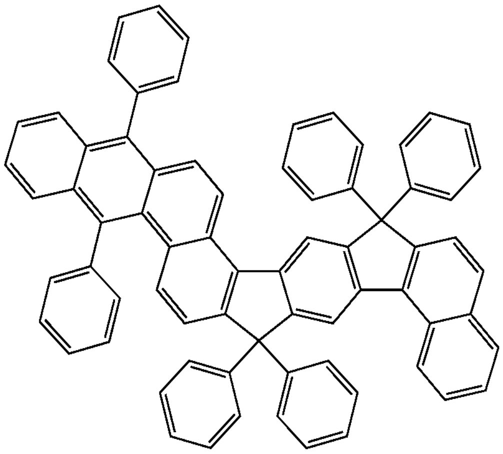

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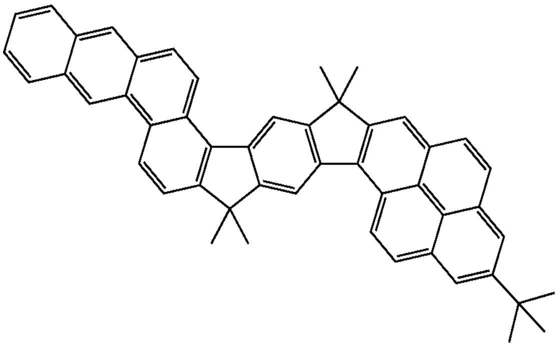

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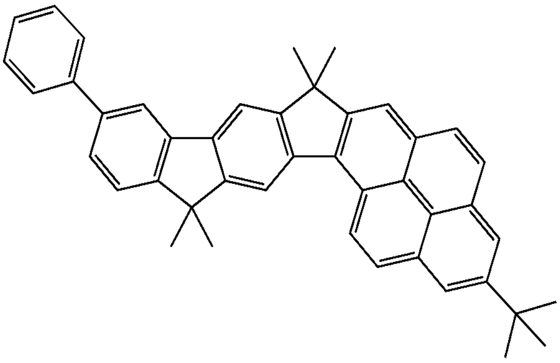

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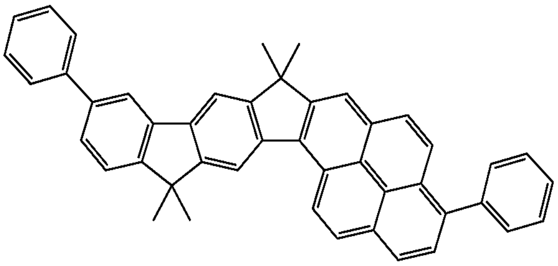

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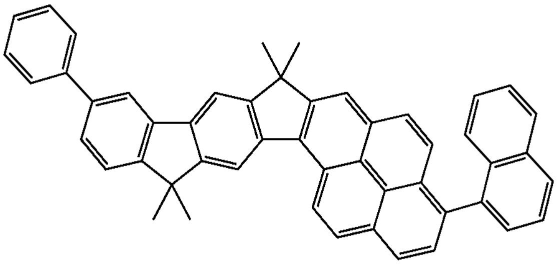

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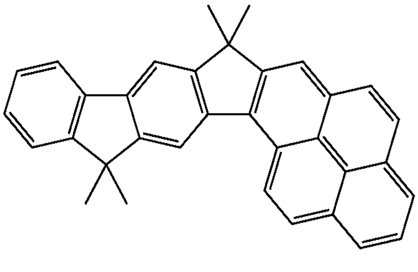

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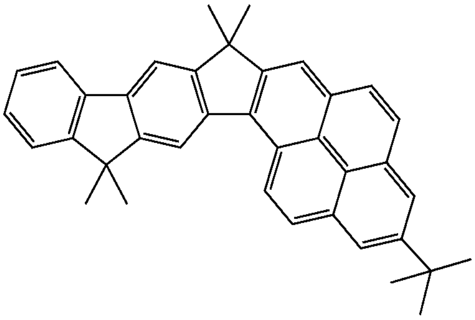

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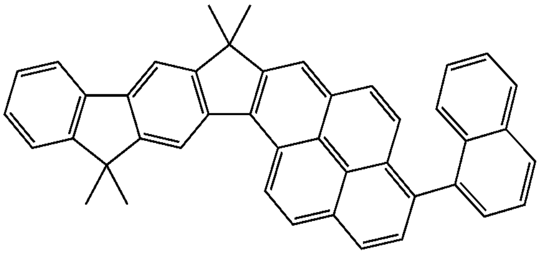

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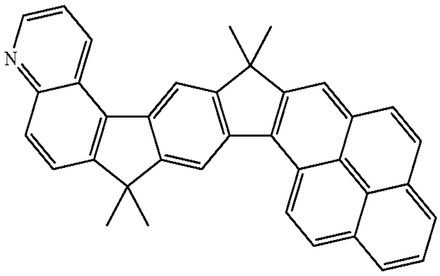

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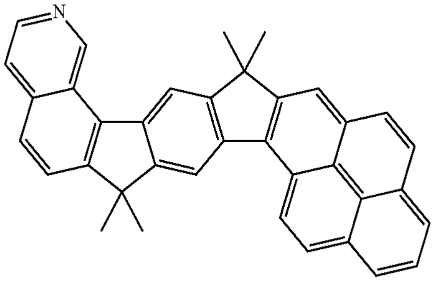

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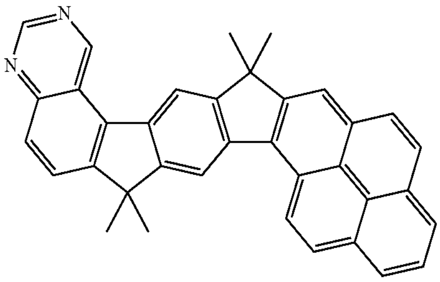

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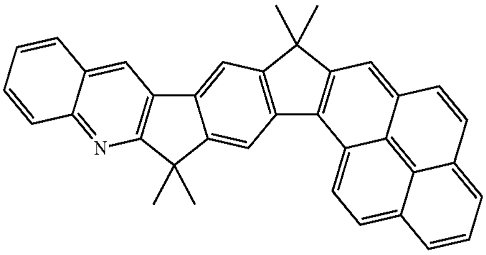

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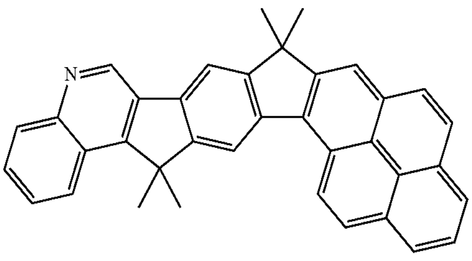
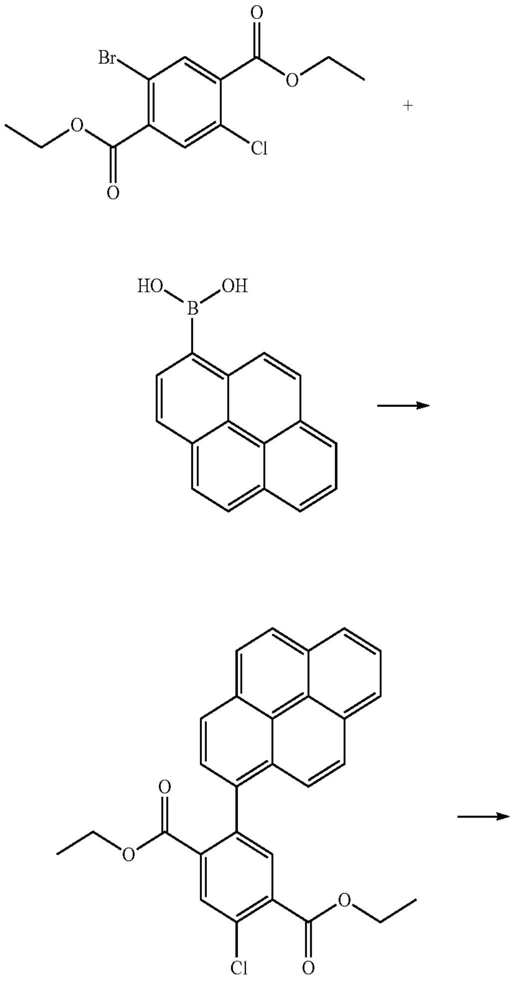


[0043] The compounds according to the invention can be prepared by synthesis steps known to the person skilled in the art, such as, for example, Suzuki coupling and cyclisation reactions, as shown in Scheme 1 for compounds of the formula (112). The synthesis can be carried out entirely analogously with other aryl groups Ar^1, Ar^2 and Ar^3. It is likewise possible firstly to carry out the coupling with the naphthalene and then the coupling with the pyrene.

Scheme 1:



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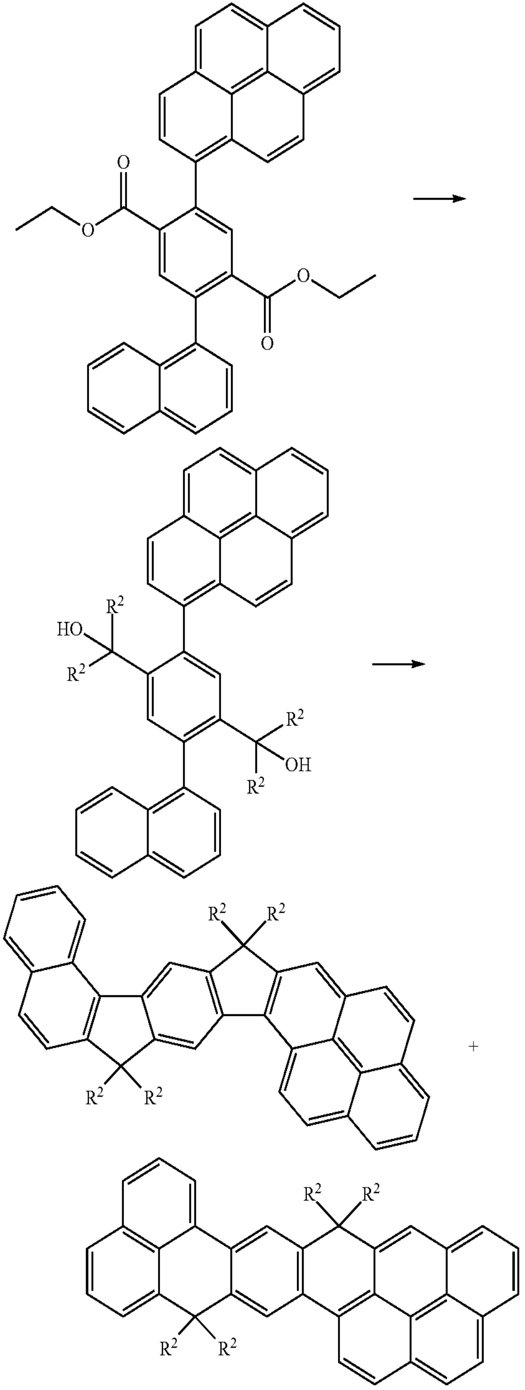


[0044] To this end, a boronic acid derivative of the aromatic group Ar^1, in this case pyreneboronic acid, is coupled to a bromochlorobis(carboxylate) derivative of the aromatic group Ar^2, in this case diethyl 2-bromo-5-chloro-terephthalate, with palladium catalysis, followed by coupling of a boronic acid derivative of the aromatic group Ar^3, in this case 1-naphthylboronic acid. These selective coupling steps succeed due to different reactivity of chlorine and bromine. The carboxylate groups are converted into the corresponding alcohol by the addition reaction of an alkyl- or arylmetal compound, for example an alkyl- or aryllithium compound or an alkyl- or aryl-Grignard compound. This alcohol can be cyclised under acidic conditions, where the precise reaction conditions determine whether a five-membered ring, a six-membered ring or a mixture of five-membered ring and six-membered ring is formed. If a mixture of five-membered ring and six-membered ring is formed, this can be separated, for example by recrystallisation or chromatographic methods. This reaction is possible entirely analogously with other arylboronic acid derivatives and other chlorobromo-dicarboxylic acid derivatives. It is likewise possible to employ aryl groups that are already substituted. Furthermore, the use of a 3-bromo-6-chlorophthalic acid ester enables the corresponding cis-linked derivatives to be synthesised. It is likewise possible to use other C—C linking reactions instead of a Suzuki coupling.

[0045] The present invention therefore furthermore relates to a process for the preparation of the compounds according to the invention, comprising the following reaction steps:

[0046] a) coupling of suitably substituted Ar^1, Ar^2 and Ar^3, where suitable substituents can be, for example, carboxylate groups; and

[0047] b) cyclisation of the substituents for introduction of the bridges X.

[0048] Preference is given to a process for the preparation of the compounds of the formula (1), comprising the following reaction steps:

[0049] a) coupling of a boronic acid or a boronic acid derivative of Ar^1 to a bromochlorobis(carboxylate) derivative of Ar^2;

[0050] b) coupling of the reaction product from a) to a boronic acid or a boronic acid derivative of Ar^3;

[0051] c) conversion of the carboxylate groups into alcohol groups; and

[0052] d) cyclisation under acidic conditions.

[0053] The compounds according to the invention described above, in particular compounds which are substituted by reactive leaving groups, such as bromine, iodine, or boronic acid or boronic acid ester, can also be used as monomers for the production of corresponding conjugated, partially conjugated or non-conjugated polymers or oligomers or as the core of dendrimers. The polymerisation here is preferably carried out via the halogen functionality or the boronic acid functionality.

[0054] The invention furthermore relates to polymers, oligomers or dendrimers comprising one or more compounds according to the invention, where one or more radicals R^1 or R^2 represent bonds from a compound to the polymer or dendrimer. These polymers, oligomers or dendrimers may be conjugated, partially conjugated or non-conjugated.

[0055] The same preferences as described above apply to the polymer recurring units according to the invention.

[0056] These compounds are homopolymerised or copolymerised with further monomers. Suitable and preferred monomers are selected from fluorenes (for example in accordance with EP 842208 or WO 00/22026), spirobifluorenes (for example in accordance with EP 707020, EP 894107 or WO 06/061181), para-phenylenes (for example in accordance with WO 92/18552), carbazoles (for example in accordance with WO 04/070772 or WO 04/113468), thiophenes (for example in accordance with EP 1028136), dihydrophenanthrenes (for example in accordance with WO 05/014689), cis- and trans-indenofluorenes (for example in accordance with WO 04/041901 or WO 04/113412), ketones (for example in accordance with WO 05/040302), phenanthrenes (for example in accordance with WO 05/104264 or the unpublished application DE 102005037734.3) or also a plurality of these units. These polymers usually also contain further units, for example emitting (fluorescent or phosphorescent) units, such as, for example, vinyltriarylamines (for example in accordance with the unpublished application DE 102005060473.0) or phosphorescent metal complexes (for example in accordance with WO 06/003000), and/or charge-transport units, in particular those based on tri-arylamines

[0057] The compounds of the formula (1) according to the invention and the corresponding polymers, oligomers or dendrimers are suitable for use in electronic devices, in particular in organic electroluminescent devices (OLEDs, PLEDs). Depending on the structure, the compounds are employed in different functions and layers. The precise use of the compounds depends, in particular, on the choice of the aryl groups Ar^1, Ar^2 and Ar^3 and on the groups X.

[0058] The invention therefore furthermore relates to the use of the compounds of the formula (1) according to the invention or the corresponding polymers, oligomers or dendrimers in electronic devices, in particular in organic electroluminescent devices (OLEDs), organic field-effect transistors (O-FETs), organic thin-film transistors (O-TFTs), organic light-emitting transistors (O-LETs), organic integrated circuits (O-ICs), organic solar cells (O-SCs), organic field-quench devices (O-FQDs), light-emitting electrochemical cells (LECs), organic photoreceptors or organic laser diodes (O-Laser).

[0059] The invention furthermore relates to electronic devices, in particular the electronic devices mentioned above, comprising at least one compound of the formula (1) or a corresponding oligomer, polymer or dendrimer, in particular organic electroluminescent devices comprising anode, cathode and at least one emitting layer, characterised in that at least one organic layer, which may be an emitting layer or another layer, comprises at least one compound of the formula (1).

[0060] The preferred embodiments mentioned above apply to the use in the electronic device.

[0061] Apart from cathode, anode and emitting layer, the organic electroluminescent device may also comprise further layers. These are selected, for example, from in each case one or more hole-injection layers, hole-transport layers, hole-blocking layers, electron-transport layers, electron-injection layers, electron-blocking layers, exciton-blocking layers, charge-generation layers and/or organic or inorganic p/n junctions. However, it should be pointed out that each of these layers does not necessarily have to be present, and the choice of the layers always depends on the compounds used and in particular also on whether it is a fluorescent or phosphorescent electroluminescent device.

[0062] The organic electroluminescent device may also comprise a plurality of emitting layers, where at least one organic layer comprises at least one compound of the formula (1) or a corresponding oligomer, polymer or dendrimer. These emission layers particularly preferably have in total a plurality of emission maxima between 380 nm and 750 nm; resulting overall in white emission, i.e. various emitting compounds which are able to fluoresce or phosphoresce and emit blue and yellow, orange or red light are used in the emitting layers. Particular preference is given to three-layer systems, i.e. systems having three emitting layers, where at least one of these layers comprises at least one compound of the formula (1) or a corresponding oligomer, polymer or dendrimer and where the three layers exhibit blue, green and orange or red emission (for the basic structure, see, for example, WO 05/011013) and systems which have more than three emitting layers. Emitters which have broad-band emission bands and thus exhibit white emission are likewise suitable for white emission.

[0063] It is particularly preferred for the compounds of the formula (1) to be employed in an emitting layer. In this case, they can be employed either as emitting material (emitting dopant) or as host material for an emitting material. The compounds of the formula (1) are particularly preferably suitable as emitting material.

[0064] If the compound of the formula (1) is employed as emitting material in an emitting layer, it is preferably employed in combination with a host material. A host material is taken to mean the component in a system comprising host and dopant that is present in the higher proportion in the system. In the case of a system comprising one host and a plurality of dopants, the host is taken to mean the component whose proportion in the mixture is the highest.

[0065] The proportion of the compound of the formula (1) in the mixture of the emitting layer is between 0.1 and 50.0% by vol., preferably between 0.5 and 20.0% by vol., particularly preferably between 1.0 and 10.0% by vol. Correspondingly, the proportion of the host material is between 50.0 and 99.9% by vol., preferably between 80.0 and 99.5% by vol., particularly preferably between 90.0 and 99.0% by vol.

[0066] Suitable host materials for this purpose are materials from various classes of substance. Preferred host materials are selected from the classes of the oligoarylenes (for example 2,2',7,7'-tetraphenylspirobifluorene in accordance with EP 676461 or dinaphthylanthracene), in particular the oligoarylenes containing condensed aromatic groups, the oligoarylenevinylenes (for example DPVBi or spiro-DPVBi in accordance with EP 676461), the polypodal metal complexes (for example in accordance with WO 04/081017), the hole-conducting compounds (for example in accordance with WO 04/058911), the electron-conducting compounds, in particular ketones, phosphine oxides, sulfoxides, etc. (for example in accordance with WO 05/084081 and WO 05/084082), the atropisomers (for example in accordance with WO 06/048268), the boronic acid derivatives (for example in accordance with WO 06/117052) or the benzanthracenes (for example in accordance with the unpublished application DE 102007024850.6). Particularly preferred host materials are selected from the classes of the oligoarylenes containing naphthalene, anthracene, benzanthracene and/or pyrene, or atropisomers of these compounds, the ketones, the phosphine oxides and the sulfoxides. Very particularly preferred host materials are selected from the classes of the oligoarylenes containing anthracene, benzanthracene and/or pyrene, or atropisomers of these compounds. For the purposes of this invention, an oligoarylene is intended to be taken to mean a compound in which at least three aryl or arylene groups are bonded to one another.

[0067] Preferred host materials are, in particular, selected from compounds of the formula (138)

$$Ar^4\text{-}(Ar^5)_p\text{-}Ar^6 \qquad \text{formula (138)}$$

where Ar^4, Ar^5, Ar^6 are on each occurrence, identically or differently, an aryl or heteroaryl group having 5 to 30 aromatic ring atoms, which may be substituted by one or more radicals R^1, and R^1 and p have the same meaning as described above; the sum of the π electrons in Ar^4, Ar^5 and Ar^6 is at least 30 if p=1 and is at least 36 if p=2 and is at least 42 if $p=^3$.

[0068] The group Ar^5 in the host materials of the formula (138) particularly preferably stands for anthracene, which may be substituted by one or more radicals R^1, and the groups Ar^4 and Ar^6 are bonded in the 9- and 10-position. Very particularly preferably, at least one of the groups Ar^4 and/or Ar^6 is a condensed aryl group selected from 1- and 2-naphthyl, 2-, 3- and 9-phenanthrenyl and 2-, 3-, 4-, 5-, 6- and 7-benzanthracenyl, each of which may be substituted by one or more radicals R^1.

[0069] It is furthermore preferred for the compound of the formula (1) to be employed as host material, in particular for a fluorescent dopant.

[0070] Suitable fluorescent emitters are selected, example, from the class of the monostyrylamines, distyrylamines, tristyrylamines, tetrastyrylamines, styrylphosphines, styryl ethers and arylamines. A monostyrylamine is taken to mean a compound which contains one styryl group and at least one amine, which is preferably aromatic. A distyrylamine is taken to mean a compound which contains two styryl groups and at least one amine, which is preferably aromatic. A tristyrylamine is taken to mean a compound which contains three styryl groups and at least one amine, which is preferably aromatic. A tetrastyrylamine is taken to mean a compound which contains four styryl groups and at least one amine, which is preferably aromatic. The styryl groups are particularly preferably stilbenes, which may also be further substituted. Corresponding phosphines and ethers are defined analogously to the amines. For the purposes of this invention, an arylamine or an aromatic amine is taken to mean a compound which contains three substituted or unsubstituted aromatic or heteroaromatic ring systems bonded directly to the nitrogen. Preferred examples thereof are aromatic anthracenamines, aromatic pyrenamines, aromatic pyrenediamines, aromatic chrysenamines or aromatic chrysenediamines. An aromatic anthracenamine is taken to mean a compound in which one diarylamino group is bonded directly to an anthracene group, preferably in the 9-position or in the 2-position. Aromatic pyrenamines, pyrenediamines, chrysenamines and chrysenediamines are defined analogously thereto, where the diarylamino groups are preferably bonded to the pyrene in the 1-position or in the 1,6-position. Further preferred dopants are selected from indenofluorenamines or indenofluorenediamines, for example in accordance with WO 06/122630, benzoindenofluorenamines or benzoindenofluorened amines, for example in accordance with WO 08/006449, and dibenzoindenofluorenamines or dibenzoindenofluorenediamines, for example in accordance with WO 07/140847. Examples of dopants from the class of the styrylamines are substituted or unsubstituted tristilbenamines or the dopants described in WO 06/000388, WO 06/058737, WO 06/000389, WO 07/065549 and WO 07/115610.

[0071] Depending on the substitution pattern, the compounds of the formula (1) can also be employed in other layers.

[0072] A possible further use of compounds of the formula (1) is the use as hole-transport or hole-injection material in a hole-transport or hole-injection layer. This use is particularly suitable if one or more bridges X stand for S or NR^2.

[0073] A further possible use of compounds of the formula (1) is the use as electron-transport material in an electron-transport layer. Particularly suitable for this purpose are compounds of the formula (1) which are substituted by at least one electron-deficient heteroaromatic group. Electron-deficient heteroaromatic groups are 6-membered heteroaromatic groups having at least one nitrogen atom and corresponding condensed systems, for example pyridine, pyrazine, pyrimidine, pyridazine, triazine, quinoline, quinoxaline or phenanthroline, or 5-membered heteroaromatic groups having at least one nitrogen atom and a further heteroatom selected from N, O and S, and corresponding condensed systems, for example pyrazole, imidazole, oxazole, oxadiazole or benzimidazole. A suitable electron-transport material is furthermore compounds in which Ar^1, Ar^2 and/or Ar^3 stand for an electron-deficient heterocycle. If the compounds of the formula (1) are used as electron-transport material, the bridge X preferably stands for $C(R^2)_2$. In addition, the compounds are also suitable as electron-transport materials if at least one bridge X, preferably both bridges X, stand for C═O, P(═O)R^2, SO or SO_2.

[0074] Preference is furthermore given to an organic electroluminescent device, characterised in that one or more layers are coated by a sublimation process. In this, the materials are vapour-deposited in vacuum sublimation units at an initial pressure below 10^{-5} mbar, preferably below 10^{-6} mbar. However, it is also possible for the initial pressure to be even lower, for example below 10^{-7} mbar.

[0075] Preference is likewise given to an organic electroluminescent device, characterised in that one or more layers are coated by the OVPD (organic vapour phase deposition) process or with the aid of carrier-gas sublimation. Here, the materials are applied at a pressure between 10^{-5} mbar and 1 bar. A special case of this process is the OVJP (organic vapour jet printing) process, in which the materials are applied directly through a nozzle and are thus structured (for example M. S. Arnold et al., *Appl. Phys. Lett.* 2008, 92, 053301).

[0076] Preference is furthermore given to an organic electroluminescent device, characterised in that one or more layers are produced from solution, such as, for example, by spin coating, or by means of any desired printing process, such as, for example, screen printing, flexographic printing or offset printing, but particularly preferably LITI (light-induced thermal imaging, thermal transfer printing) or ink-jet printing. Soluble compounds of the formula (1) are necessary for this purpose. High solubility can be achieved by suitable substitution of the compounds. A coating method from solution is also particularly suitable for oligomers, polymers or dendrimers.

[0077] For application from solution, solutions of the compounds according to the invention in one or more solvents are necessary. The invention therefore furthermore relates to solutions of the compounds according to the invention or corresponding oligomers, polymers or dendrimers in one or more solvents. The solution here may also comprise further constituents, for example a host material for the compound according to the invention.

[0078] On use in organic electroluminescent devices, the compounds according to the invention have the following surprising advantages over the prior art:

[0079] 1. The compounds according to the invention exhibit dark-blue emission on use as emitting materials in organic electroluminescent devices (CIE y in the range from 0.10 to 0.13) and are thus eminently suitable for the production of dark-blue-emitting electroluminescent devices.

[0080] 2. A suitable choice of the groups Ar^1, Ar^2 and Ar^3 enables the colour location of the emission from the compound to be set simply using the compounds according to the invention. Thus, both deep-blue- and also pale-blue-emitting compounds are accessible, where the colour location can in each case be optimised for the desired use.

[0081] 3. The electroluminescent devices furthermore exhibit very good efficiencies (EQE>6%).

[0082] 4. Furthermore, electroluminescent devices comprising the compounds according to the invention exhibit a significant improvement with respect to the lifetime.

[0083] 5. In particular on use in the electron-injection and -transport layer of doped electron-transport materials which result in an excess of electrons in the device, the compounds according to the invention, if employed as emitters, exhibit significant improvements with respect to efficiency and lifetime compared with emitters in accordance with the prior art which contain diarylamino groups. This is an essential advantage since the very combination of LiQ with benzimidazole derivatives is frequently used as electron-transport material.

[0084] The invention is described in greater detail by the following examples, without wishing to restrict it thereby. The person are skilled in the art will be able, without being inventive, to carry out the invention throughout the range disclosed and thus produce further materials and organic electroluminescent devices according to the invention.

EXAMPLES

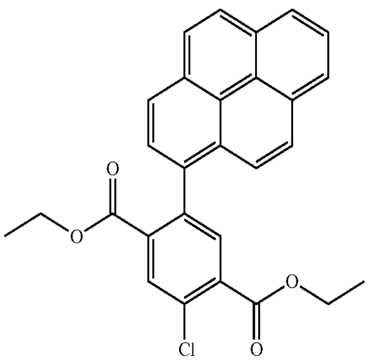
[0085] The following syntheses were carried out under a protective-gas atmosphere, unless indicated otherwise. The starting materials were purchased from ALDRICH or ABCR.

Example 1

Synthesis of 1,1-dimethylbenzindeno-1,1-dimethylindeno-[a]pyrene

a) Diethyl 2-chloro-5-pyren-1-ylterephthalate

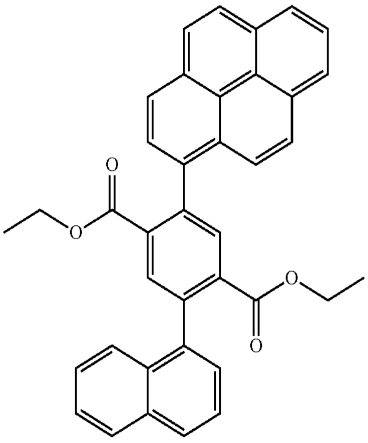
[0086]



[0087] 28.9 g (103 mmol) of bromopyrene are dissolved in 275 ml of dry THF, the solution is cooled to −75° C., and 52 ml (104 mmol) of a 2 M solution of n-butyllithium are added dropwise at this temperature. The yellow suspension is stirred at −75° C. for 1 h, and 17.5 ml (155 mmol) of trimethyl borate are then added dropwise. After the mixture has been warmed to RT, 34.5 g (103 mmol) of diethyl chlorobromoterephthalate, 22 g (206 mmol) of Na_2CO_3, 1.2 g (1.03 mmol) of tetrakis(triphenylphosphine)palladium(0), 140 ml of H_2O, 280 nil of toluene and 140 ml of EtOH are added, and the mixture is heated at the boil for 2 h. After the organic phase has been separated off, washed twice with water and dried over Na_2SO_4, the solvent is removed in vacuo, and the oil which remains is brought to crystallisation in heptane. Recrystallisation twice gives the product in the form of a colourless solid (33 g, 70%) and a purity of >98%, which is employed in this form in the subsequent reaction.

b) Diethyl 2-naphthalen-1-yl-5-pyren-1-ylterephthalate

[0088]



[0089] 43.5 g (90 mmol) of diethyl 2-chloro-5-pyren-1-ylterephthalate, 21.5 g (120 mmol) of 1-naphthylboronic acid and 58.1 g of Cs_2CO_3 are initially introduced in 230 nil of dry dioxane, and the mixture is saturated with N_2 for 30 min. 2.7 ml of a 1.0 M solution of tri-tert-butylphosphine in toluene, followed by 300 mg (1.3 mmol) of $Pd(OAc)_2$, are then added. The mixture is heated at the boil for 4 h and extended with water and EtOH, and the precipitate is filtered off with suction, washed with water and EtOH and dried. The solid is recrystallised three times from dioxane and then has a purity of >99% according to ^1H-NMR. The yield is 44.2 g (90%) of colourless solid.

[0090] The following compounds (Examples 2b to 10b) are prepared analogously to the process described above.

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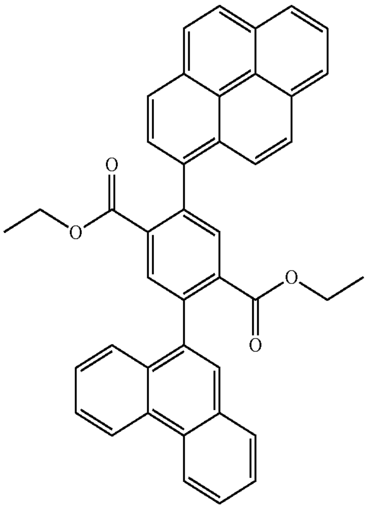
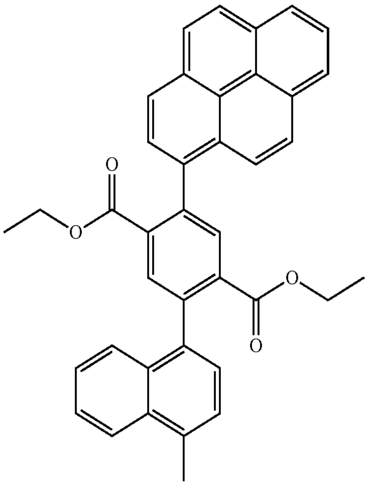
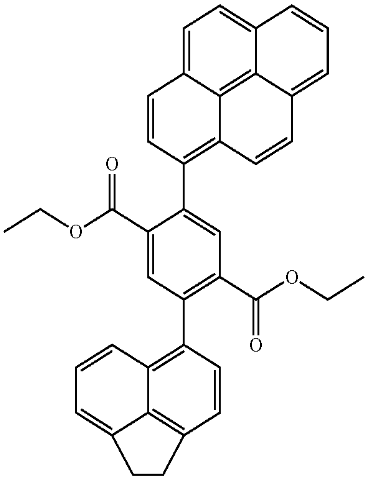
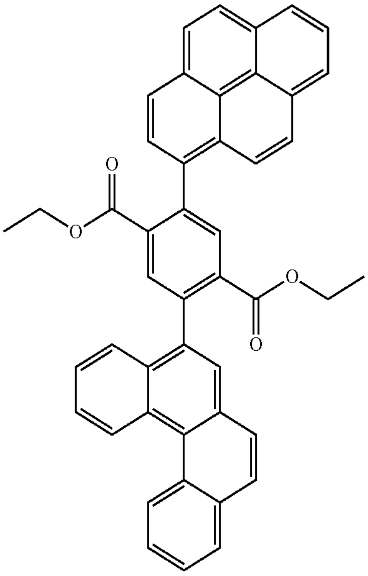
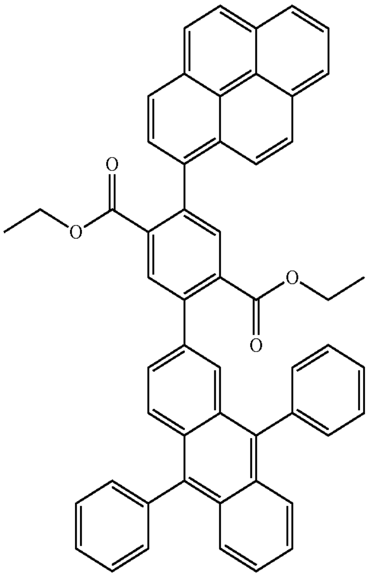
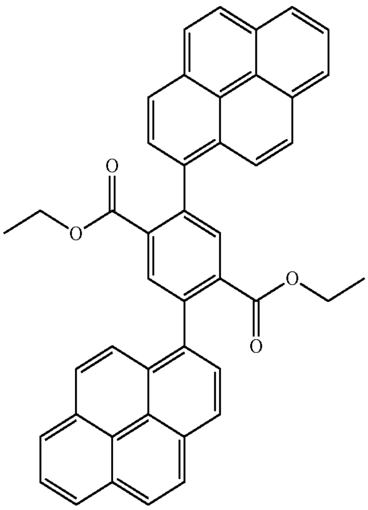
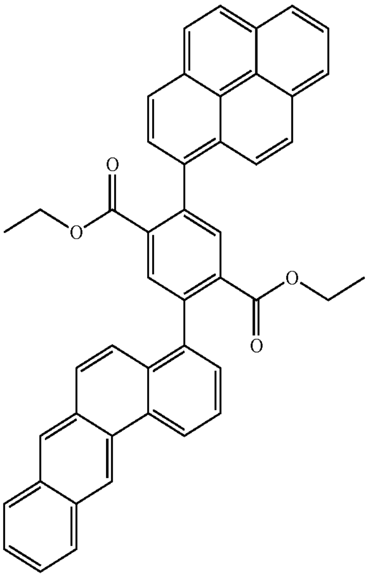
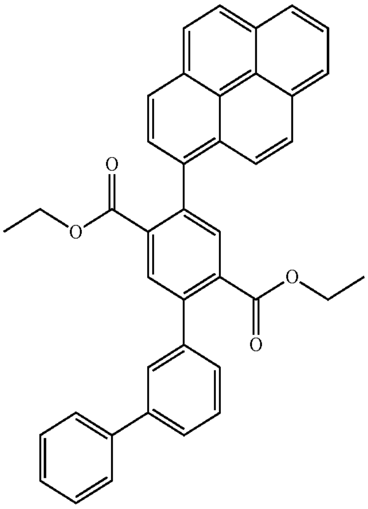
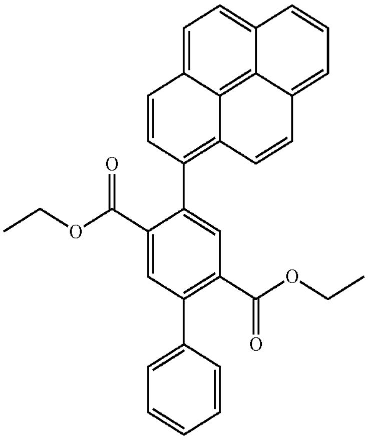
Ex.	Structure	Yield (%)
2b		95
3b		50
4b		53
5b		67

-continued

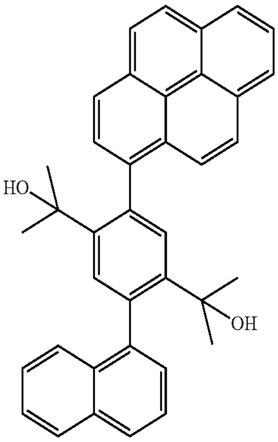
Ex.	Structure	Yield (%)
6b		12
7b		36

-continued

Ex.	Structure	Yield (%)
8b		50
9b		62
10b		75

c) 2-[4-(1-Hydroxy-1-methylethyl)-2-naphthalen-1-yl-5-pyren-1-ylphenyl]propan-2-ol

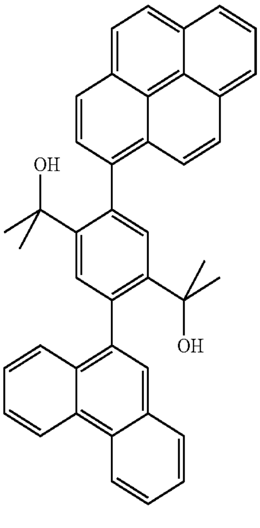
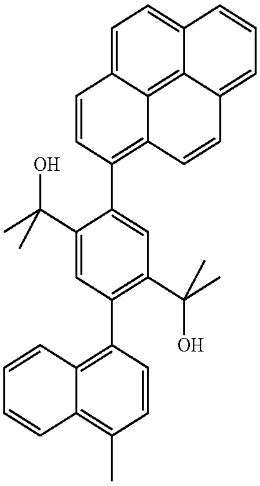
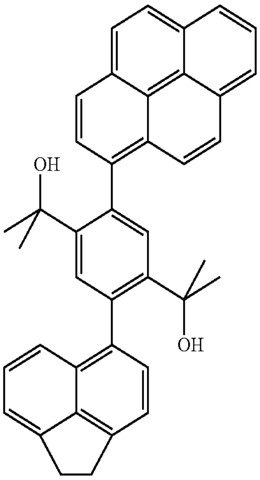
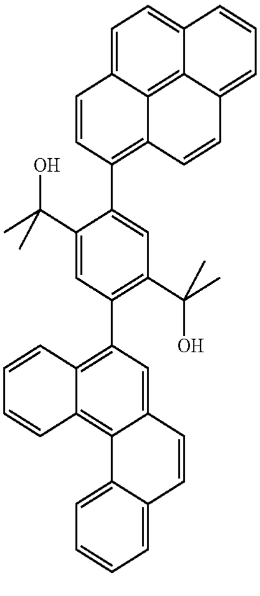
[0091]



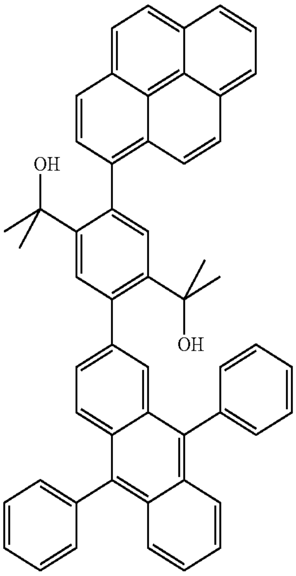
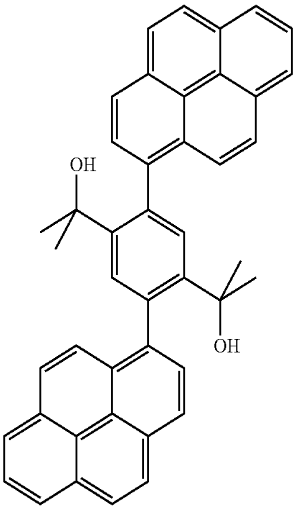
[0092] 30 g (55 mol) of diethyl 2-naphthalen-1-yl-5-pyren-1-ylterephthalate are dissolved in 270 ml of dry THF, 110 ml (330 mmol) of a 3 M methylmagnesium chloride solution in THF are added dropwise at 5° C., and the mixture is stirred at RT for 12 h. After the reaction has been interrupted by addition of 180 ml of 25% acetic acid, the mixture is worked up by extraction with ethyl acetate/water, dried over Na_2SO_4 and evaporated in a rotary evaporator. Recrystallisation from EtOH/toluene leaves 26.3 g (92%) of colourless solid, which has a purity of >98% according to ^{1}H-NMR.

[0093] The following compounds (Examples 2c to 9c) are prepared analogously to the process described above. In Example 10c, phenyllithium is employed as reagent instead of methylmagnesium chloride.

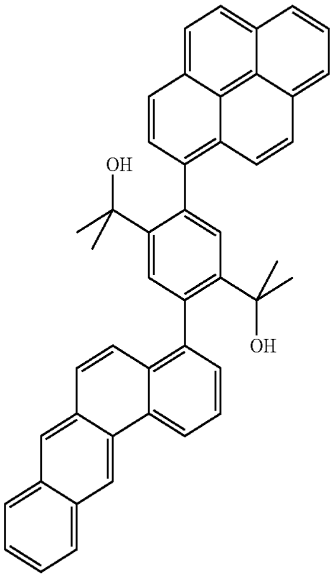
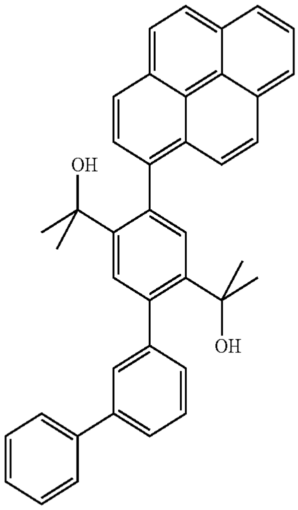
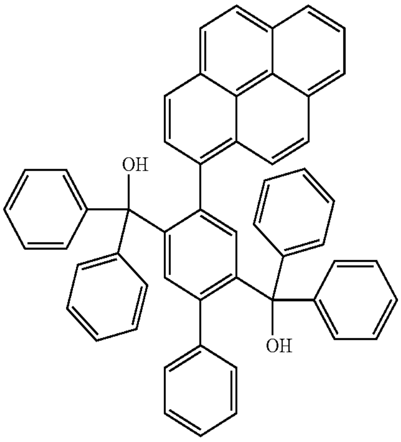
-continued

Ex.	Structure	Yield (%)
2c		92
3c		78
4c		94
5c		80

-continued

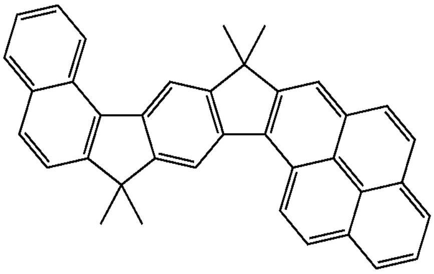
Ex.	Structure	Yield (%)
6c		73
7c		90

-continued

Ex.	Structure	Yield (%)
8c		quant.
9c		quant.
10c		quant.

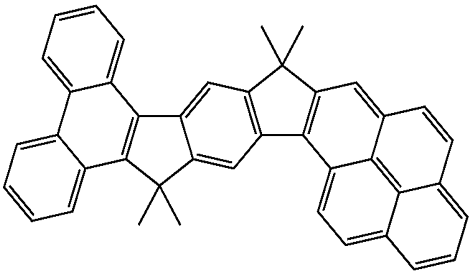
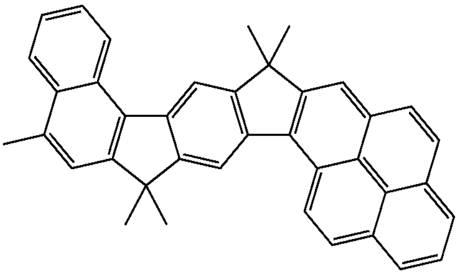
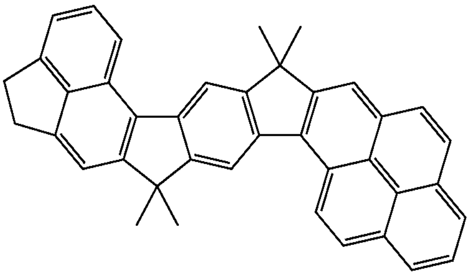
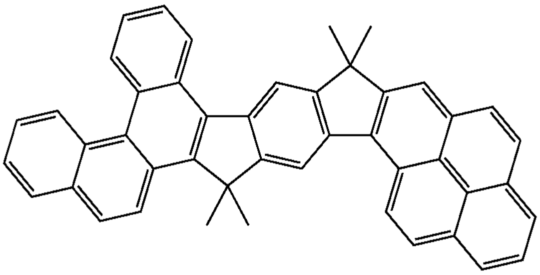
d) 1,1-Dimethylbenzindeno-1,1-dimethylindeno[a]pyrene

[0094]

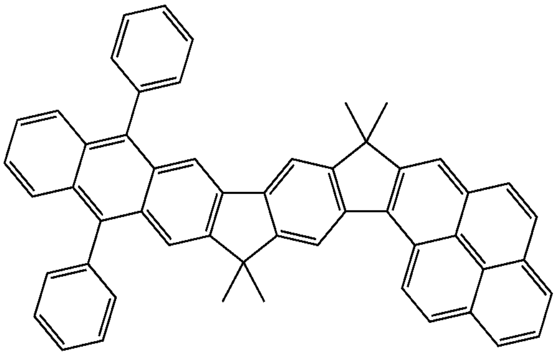
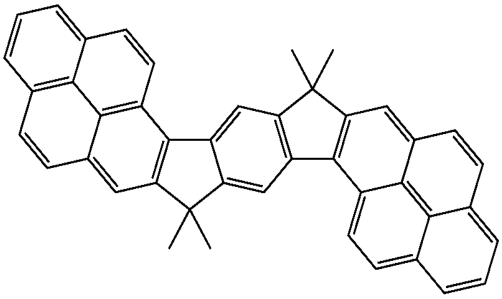
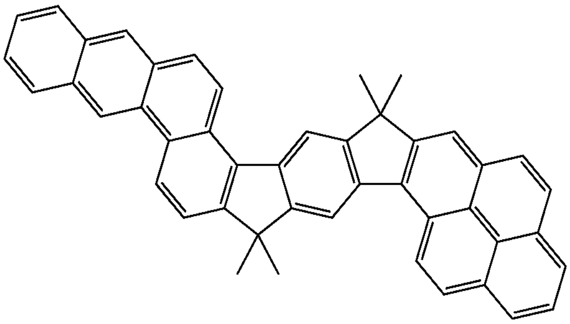
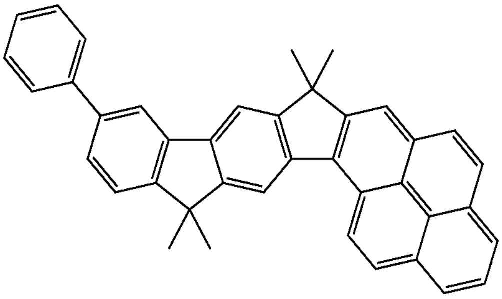


[0095] 26.3 g (50.5 mmol) of 2-[4-(1-hydroxy-1-methylethyl)-2-naphthalen-1-yl-5-pyren-1-ylphenyl]propan-2-ol are dissolved in 750 ml of dichloromethane, 45 ml of methanesulfonic acid in 70 g of polyphosphoric acid are added dropwise at −20° C., and the mixture is stirred at this temperature for 1 h. When the reaction is complete, 400 ml of EtOH are added dropwise, the mixture is heated at the boil for 1 h, and the yellow solid is filtered off. Recrystallisation four times from NMP and sublimation twice in vacuo ($p=1\times10^{-5}$ mbar, T=340° C.) gives a yellow powder having a purity >99.9% (16 g, 65%).

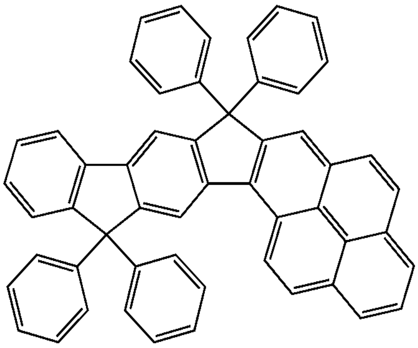
[0096] The following compounds (Examples 2d to 10d) are prepared analogously to the process described above.

Ex.	Structure	Yield (%)
2d		27
3d		41
4d		50
5d		15

-continued

Ex.	Structure	Yield (%)
6d		32
7d		10
8d		53
9d		37

-continued

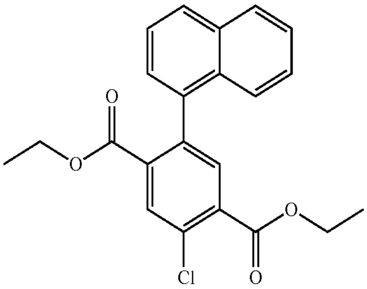
Ex.	Structure	Yield (%)
10d		37

Example 11

Synthesis of 1,1-dimethylbenzindeno-1,1-dimethylindeno[b]fluoranthene

a) Diethyl 2-chloro-5-naphthalen-1-ylterephthalate

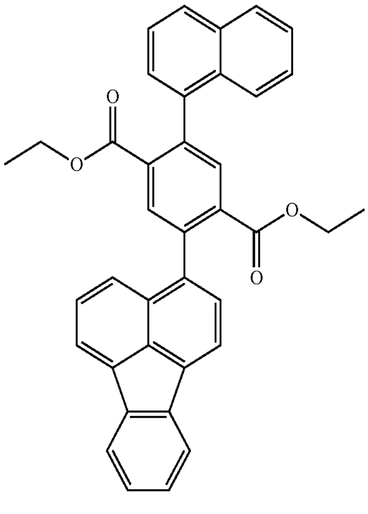
[0097]



[0098] 51 g (298 mmol) of 1-naphthylboronic acid, 100 g (298 mmol) of diethyl chlorobromoterephthalate and 144 g (626 mmol) of potassium phosphate monohydrate are initially introduced in a mixture of 600 ml of dist. water, 400 ml of toluene and 200 ml of dioxane and saturated with N_2 for 30 min. 5.4 g (18 mmol) of tri(o-tolyl)phosphine and 669 mg (3 mmol) of palladium(II) acetate are subsequently added, and the mixture is heated at the boil for 3 h. After dilution with toluene, the organic phase is separated off, washed twice with water, dried over Na_2SO_4 and evaporated in vacuo. The oil which remains is distilled in a thin-film evaporator ($p=5\times10^{-3}$ mbar, T=130° C.) and isolated in the form of a yellow oil (74 g, 65%), which, according to ^{1}H-NMR, has a purity of >95%.

b) Diethyl 2-fluoranthen-3-yl-5-naphthalen-1-ylterephthalate

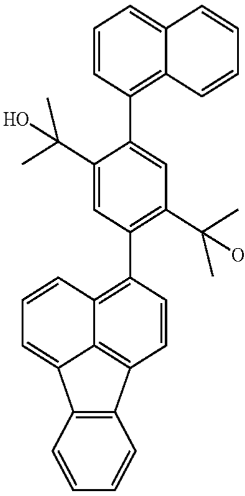
[0099]



[0100] 15.4 g (40 mmol) of diethyl 2-chloro-5-naphthalen-1-ylterephthalate, 14.0 g (56 mmol) of fluoranthene-3-boronic acid and 17.7 g of Cs_2CO_3 are initially introduced in 70 ml of dry dioxane and saturated with N_2 for 30 min. 0.8 ml of a 1.0 M solution of tri-tert-butylphosphine in toluene, followed by 91 mg (0.4 mmol) of $Pd(OAc)_2$ are then added. The mixture is heated at the boil for 4 h, extended with water and EtOH, the precipitate is filtered off with suction, washed with heptane and dried. The solid is recrystallised from toluene and then has, according to ^{1}H-NMR, a purity of >95%. The yield is 8.5 g (38%) of colourless solid.

c) 2-[4-(1-Hydroxy-1-methylethyl)-2-fluoranthen-3-yl-5-naphthalin-1-ylphenyl]propan-2-ol

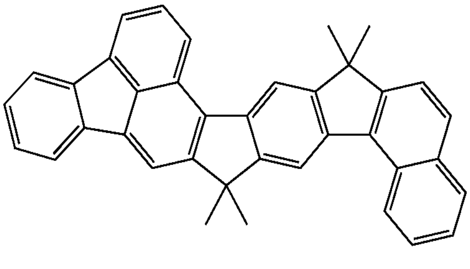
[0101]



[0102] 8.5 g (15 mol) of diethyl 2-fluoranthen-3-yl-5-naphthalin-1-ylterephthalate are dissolved in 75 ml of dry THF, 31 ml (93 mmol) of a 3 M methylmagnesium chloride solution in THF are added at 5° C., and the mixture is stirred at RT for 12 h. After interruption of the reaction by addition of 30 ml of 25% acetic acid, the mixture is worked up by extraction with ethyl acetate/water, dried over Na_2SO_4 and evaporated in a rotary evaporator, giving 8.0 g (99%) of the crude product, which is employed in the next step without further purification.

d) 1,1-Dimethylbenzindeno-1,1-dimethylindeno[b]fluoranthene

[0103]

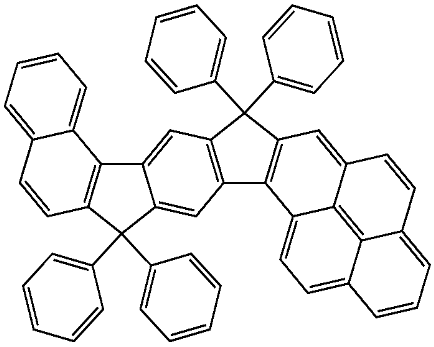


[0104] 8.0 g (15.4 mmol) of 2-[4-(1-hydroxy-1-methylethyl)-2-fluoranthen-3-yl-5-naphthalen-1-ylphenyl]propan-2-ol are dissolved in 250 ml of dichloromethane, 15 ml of methanesulfonic acid in 22 g of polyphosphoric acid are added dropwise at −20° C., and the mixture is stirred at this temperature for 1 h. When the reaction is complete, 130 ml of EtOH are added dropwise, the mixture is heated at the boil for 1 h, and the yellow solid is filtered off. Recrystallisation twice from toluene and sublimation twice in vacuo ($p=4\times10^{-6}$ mbar, T=300° C.) gives a yellow powder having a purity of >99.9% (1.9 g, 25%).

Example 12

Synthesis of 1,1-diphenylbenzindeno-1,1-diphenylindeno[a]pyrene

[0105]



[0106] The synthesis is carried out analogously to Example 1, with phenylmagnesium chloride solution being used instead of methylmagnesium chloride solution in step c).

Example 13

Production of OLEDs

[0107] OLEDs are produced by a process which is described in general in WO 04/058911 and which is adapted in individual cases to the particular circumstances (for example layer-thickness variation in order to achieve optimum efficiency or colour).

[0108] The results for various OLEDs are presented in Examples 14 to 31 below. Glass plates which have been coated with structured ITO (indium tin oxide) form the substrates of the OLEDs. The OLEDs consist of the following layer sequence: substrate/hole-injection layer (HIM)/hole-transport layer (HTM1) 60 nm/hole-transport layer (HTM2) 20 nm/emission layer (EML) 30 nm/electron-transport layer (ETM) 20 nm and finally a cathode. The materials are thermally vapour-deposited in a vacuum chamber. The emission layer here always consists of a matrix material (host) and a dopant, which is admixed with the host by co-evaporation. The cathode is formed by a 1 nm thin LiF layer and a 100 nm Al layer deposited on top. Table 4 shows the chemical structures of the materials used to build up the OLEDs.

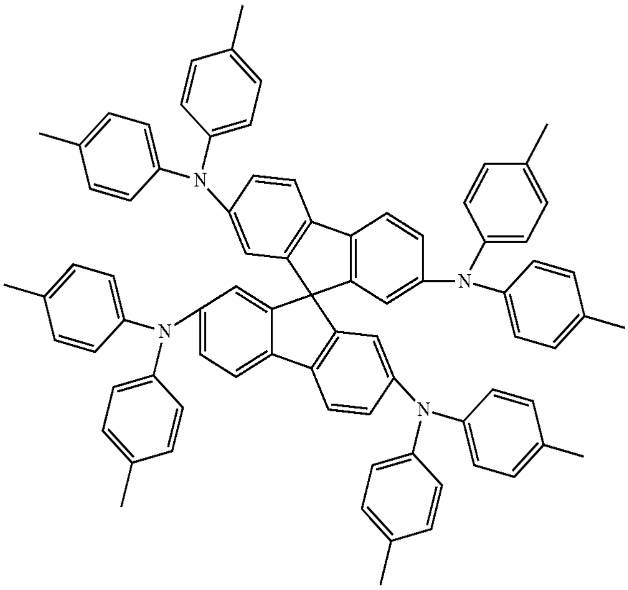
[0109] These OLEDs are characterised by standard methods; for this purpose, the electroluminescence spectra, the efficiency (measured in cd/A), the power efficiency (measured in lm/W) as a function of the luminance, calculated from current-voltage-luminance characteristic lines (IUL characteristic lines), and the lifetime are determined. The lifetime is defined as the time after which the initial luminance of 6000 cd/m^2 (for blue-emitting OLEDs) or 25,000 cd/m^2 (for green-emitting OLEDs) has dropped to half.

[0110] Tables 5 and 6 show the results for some OLEDs (Examples 14 to 31). The host materials and emitter materials according to the invention are the compounds of Examples 1d, 2d, 5d and 12. The comparative examples used are host H1 and emitters D1, D2 or D3 in accordance with the prior art.

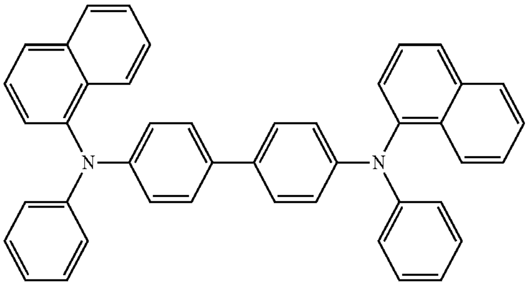
[0111] As is clearly evident from the results in Tables 5 and 6, organic electroluminescent devices comprising the compounds according to the invention have a significantly longer lifetime for use of the compound according to the invention as matrix material and improved colour coordinates and a significantly longer lifetime for use as dopants compared with materials in accordance with the prior art.

TABLE 4

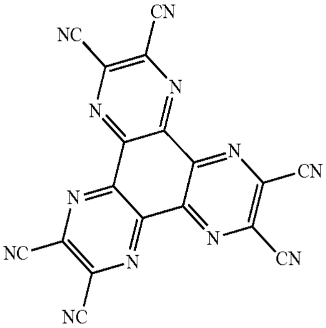
HTM1



HTM 2



HIM



ETM1

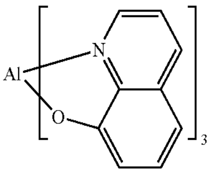
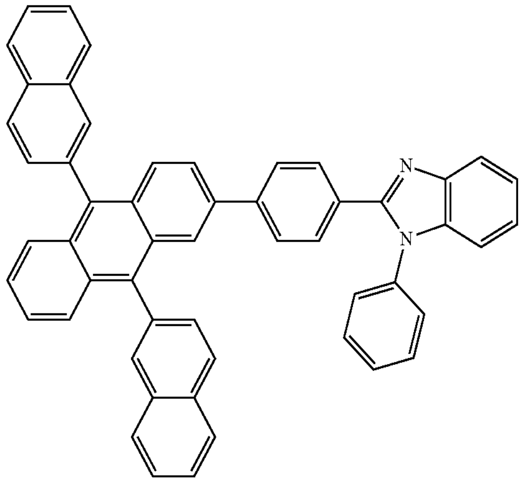
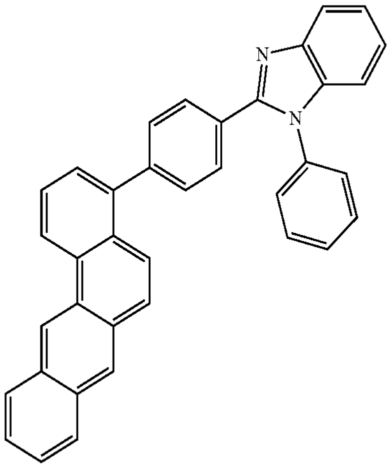


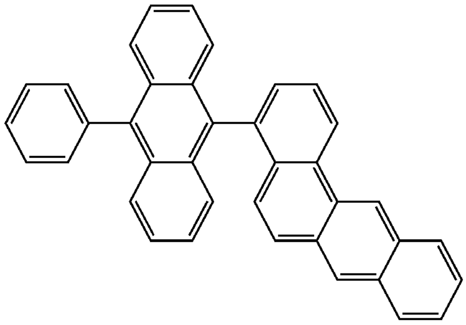
TABLE 4-continued



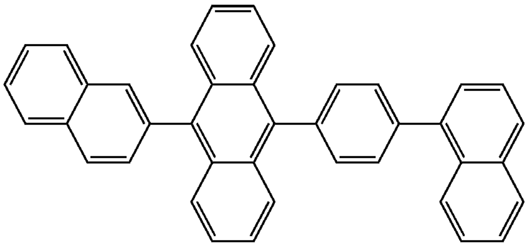
ETM 2



ETM3



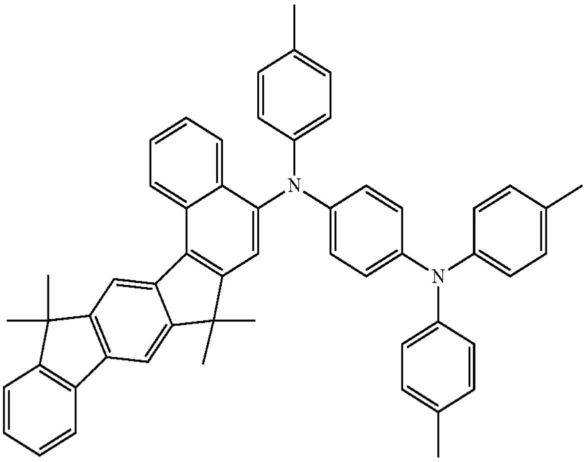
H2



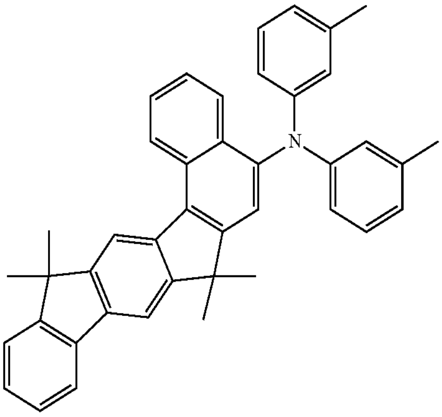
H1

TABLE 4-continued

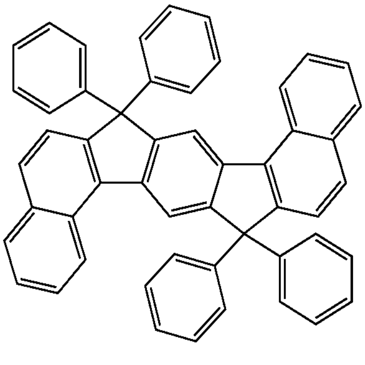
D1



D2



D3



Bsp. 1d

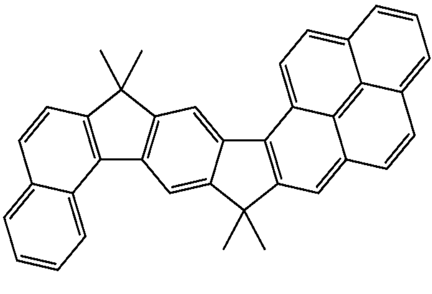
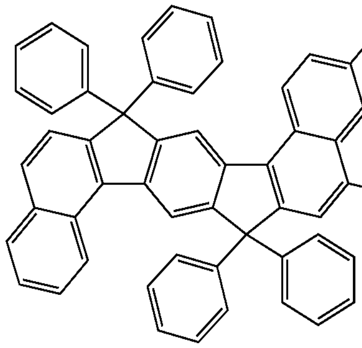
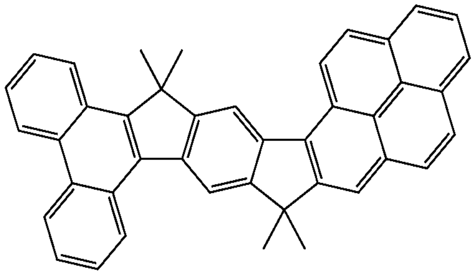


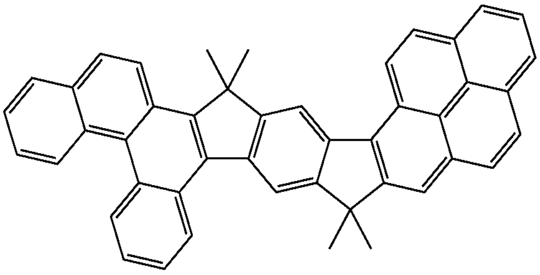
TABLE 4-continued



Ex. 12



Ex. 2d



Ex. 5d

TABLE 5

Ex.	EML	ETM	Colour	Eff. (cd/A) at 1000 cd/m^2	Voltage (V) at 1000 cd/m^2	CIE	Life-time at 25000 cd/m^2 (h)
14 (comp.)	H1 + 9% of D1	ETM2	green	16.3	5.2	x = 0.29/ y = 0.60	300
15	Ex. 12 + 9% of D1	ETM2	green	18.1	4.3	x = 0.29/ y = 0.61	320

TABLE 6

Example	EML	ETM	Colour	Max. efficiency (cd/A)	Voltage (V) at 1000 cd/m^2	CIE	Lifetime at 6000 cd/m^2 (h)
16 (comp.)	H1 + 5% of D2	ETM1	blue	4.1	5.3	x = 0.14/ y = 0.16	160
17 (comp.)	H2 + 5% of D2	ETM1	blue	4.3	5.2	x = 0.14/ y = 0.15	180
18 (comp.)	H2 + 5% of D3	ETM1	blue	1.5	5.1	x = 0.16/ y = 0.10	30
19 (comp.)	H1 + 5% of D2	H2 (50%) + ETM3 (50%)	blue	4.9	5.0	x = 0.14/ y = 0.16	90
20 (comp.)	H2 + 5% of D2	H2 (50%) + ETM3 (50%)	blue	5.3	4.9	x = 0.14/ y = 0.15	120
21 (comp.)	H2 + 5% of D3	H2 (50%) + ETM3 (50%)	blue	1.9	5.0	x = 0.16/ y = 0.09	65
22	H2 + 5% of Ex. 1d	ETM1	blue	3.5	5.9	x = 0.15/ y = 0.14	230

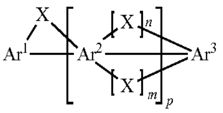
TABLE 6-continued

Example	EML	ETM	Colour	Max. efficiency (cd/A)	Voltage (V) at 1000 cd/m^2	CIE	Lifetime at 6000 cd/m^2 (h)
23	H2 + 3% of Ex. 1d	ETM2	blue	3.0	5.8	x = 0.15/ y = 0.11	210
24	H2 + 5% of Ex. 1d	H2 (50%) + ETM3 (50%)	blue	6.4	4.6	x = 0.15/ y = 0.13	240
25	H2 + 1% of Ex. 1d	H2 (50%) + ETM3 (50%)	blue	5.5	4.4	x = 0.14/ y = 0.11	260
26	H2 + 1% of Ex. 2d	H2 (50%) + ETM3 (50%)	blue	4.7	4.8	x = 0.15/ y = 0.01	260
27	H2 + 5% of Ex. 2d	H2 (50%) + ETM3 (50%)	blue	5.0	4.7	x = 0.15/ y = 0.11	270
28	H2 + 5% of Ex. 2d	ETM2	blue	4.6	5,4	x = 0.15/ y = 0.11	290
29	H2+ 1% of Ex. 5d	H2 (50%) + ETM3 (50%)	blue	7.4	4.7	x = 0.14/ y = 0.15	300
30	H2 + 5% of Ex. 5d	H2 (50%) + ETM3 (50%)	blue	7.8	4.5	x = 0.14/ y = 0.16	310
31	H2 + 5% of Ex. 5d	ETM2	blue	6.8	5.3	x = 0.14/ y = 0.16	330

1-17. (canceled)

18. An electroluminescent element comprising a compound of formula (1)

formula (1)



wherein

Ar^1, Ar^2 and Ar^3

are on each occurrence, identically or differently, an aryl or heteroaryl group having 5 to 30 aromatic ring atoms, optionally substituted by one or more radicals R^1, with the proviso that Ar^2 is not anthracene, naphthacene or pentacene;

X is on each occurrence, identically or differently, a group selected from BR^2, $C(R^2)_2$, $Si(R^2)_2$, C═O, $C═NR^2$, $C═C(R^2)_2$, O, S, S═O, SO_2, PR^2, $P(═O)R^2$ and $P(═S)R^2$;

R^1 and R^2 are on each occurrence, identically or differently, H, D, F, Cl, Br, I, $C(═O)Ar^4$, $P(═O)(Ar^4)_2$, $S(═O)Ar^4$, $S(═O)_2Ar^4$, $CR^2═CR^2Ar^4$, CHO, $CR^3═C(R^3)_2$, CN, NO_2, $Si(R^3)_3$, $B(OR^3)_2$, $B(R^3)_2$, $B(N(R^3)_2)_2$, OSO_2R^3, a straight-chain alkyl, alkoxy or thioalkoxy group having 1 to 40 C atoms or a straight-chain alkenyl or alkynyl group having 2 to 40 C atoms or a branched or cyclic alkyl, alkenyl, alkynyl, alkoxy or thioalkoxy group having 3 to 40 C atoms, each of which are optionally substituted by one or more radicals R^3, where in each case one or more non-adjacent CH_2 groups are optionally replaced by $R^3C═CR^3$, C≡C, $Si(R^3)_2$, $Ge(R^3)_2$, $Sn(R^3)_2$, C═O, C═S, C═Se, $C═NR^3$, $P(═O)R^3$, SO, SO_2, O, S or $CONR^3$ and where one or more H atoms are optionally replaced by F, Cl, Br, I, CN or NO_2, or an aromatic or heteroaromatic ring system having 5 to 60 aromatic ring atoms, which in each case are optionally substituted by one or more radicals R^3, or a combination of these systems; and wherein two or more substituents R^1 or R^2 optionally define a mono- or polycyclic, aliphatic or aromatic ring system with one another;

Ar^4 is on each occurrence, identically or differently, an aromatic or heteroaromatic ring system having 5-30 aromatic ring atoms, which are optionally substituted by one or more non-aromatic radicals R^1; and wherein two radicals Ar on the same nitrogen or phosphorus atom are optionally linked to one another here by a single bond or a bridge X;

R^3 is on each occurrence, identically or differently, H or an aliphatic or aromatic hydrocarbon radical having 1 to 20 C atoms;

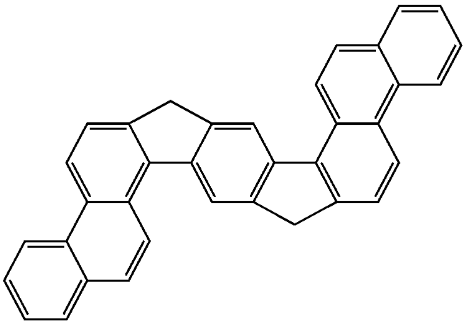
m, n are 0 or 1, with the proviso that m+n=1;

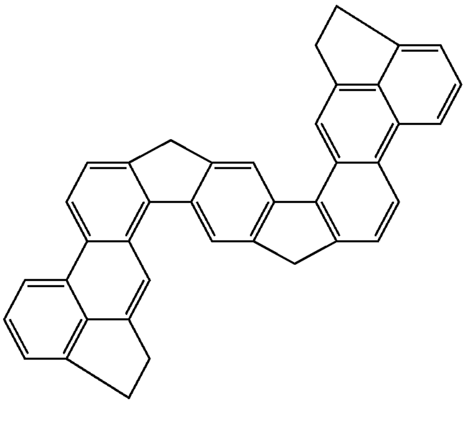
p is 1, 2 or 3;

wherein Ar^1, Ar^2 and X together define a five-membered ring or a six-membered ring, and Ar^2, Ar^3 and X together define a five-membered ring or a six-membered ring, with the proviso that either all groups X in the compound of the formula (1) are bound in a five-membered ring or all groups X in the compound of the formula (1) are bound in a six-membered ring;

wherein the sum of all π electrons in groups Ar^1, Ar^2 and Ar^3 is at least 28 if p=1 and is at least 34 if p=2 and is at least 40 if p=3;

with the proviso that the following compounds are excluded from formula (1):





as a blue emitting compound in the emitting layer,

where the compound of formula (1) is present in the emitting layer in combination with a host material selected from the group consisting of oligoarylenes, oligoarylenes containing condensed aromatic groups, anthracenes, oligoarylenevinylenes, polypodal metal complexes, hole-conducting compounds, electron-conducting compounds, ketones, phosphine oxides, sulfoxides, boronic acid derivatives, benzanthracenes, and where the compound of formula (1) is present in the emitting layer in a proportion of 0.5 to 20% by vol.

19. The electroluminescent element according to claim **18**, wherein p=1 or 2.

20. The electroluminescent element according to claim **18**, wherein p=1.

21. The electroluminescent element according to claim **18**, wherein Ar^1, Ar^2 and Ar^3 stand, identically or differently on each occurrence, for an aryl or heteroaryl group having 5 to 22 aromatic ring atoms, selected from benzene, naphthalene, anthracene, phenanthrene, fluoranthene, naphthacene, benzanthracene, chrysene, pyrene, benzofluoranthene, triphenylene, perylene, dibenzanthracene, benzopyrene, picene, pentacene, pentaphene, pyridine, pyrazine, pyrimidine, pyridazine, quinoline, isoquinoline, phenanthroline, acridine.

22. The electroluminescent element according to claim **18**, wherein at least one of the groups Ar^1, Ar^2 and Ar^3 has at least 4 condensed rings, i.e., at least 16 π electrons.

23. The electroluminescent element according to claim **18**, wherein X is selected, identically or differently on each occurrence, from the group consisting of BR^2, $C(R^2)_2$, $Si(R^2)_2$, O or S.

24. The electroluminescent element according to claim **18** wherein R^1 is selected on each occurrence, identically or differently, from H, D, F, $Si(R^3)_3$, straight-chain alkyl or alkoxy groups having 1 to 10 C atoms or branched or cyclic alkyl or alkoxy groups having 3 to 10 C atoms, each of which are optionally substituted by one or more radicals R^3, where in each case one or more non-adjacent CH_2 groups may be replaced by $R^3C{=}CR^3$ or O and where one or more H atoms are optionally replaced by F, or aromatic or heteroaromatic ring systems having 5 to 40 aromatic ring atoms, or a combination of these systems; and wherein two or more substituents R^1 optionally define a mono- or polycyclic, aliphatic or aromatic ring system with one another.

25. The electroluminescent element according to claim **18**, wherein R^2 is selected on each occurrence, identically or differently, from H, straight-chain alkyl groups having 1 to 10 C atoms or branched or cyclic alkyl groups having 3 to 10 C atoms, where in each case one or more non-adjacent CH_2 groups are optionally replaced by $—R^2C{=}CR^2—$ or —O— and where one or more H atoms are optionally replaced by F, or a monovalent aryl or heteroaryl group having 5 to 16 aromatic ring atoms, which may be substituted by one or more non-aromatic radicals R^2; and wherein two radicals R^2 which are bonded in the same group X optionally form a ring system with one another.

26. The electroluminescent element according to claim **18**, wherein the host material is selected from anthracenes.

* * * * *

专利名称(译)	电子设备用化合物		
公开(公告)号	US20150228905A1	公开(公告)日	2015-08-13
申请号	US14/691708	申请日	2015-04-21
申请(专利权)人(译)	MERCK PATENT GMBH		
当前申请(专利权)人(译)	MERCK PATENT GMBH		
[标]发明人	BUESING ARNE HELL HOLGER STOESSEL PHILIPP		
发明人	BUESING, ARNE HELL, HOLGER STOESSEL, PHILIPP		
IPC分类号	H01L51/00 C09K11/02 C09K11/06		
CPC分类号	H01L51/0056 C09K2211/1018 H01L51/0072 H01L51/0074 H01L51/006 H01L51/0058 H01L51/0067 C09K11/06 C09K11/025 H01L2251/308 H01L51/5088 H01L51/5064 H01L51/5012 H01L51/5072 H01L51/5221 H01L51/5206 H01L2251/301 C09K2211/1011 H01L51/0073 C07C13/62 C07C2603/16 C09K2211/1007 H01L51/5048 Y02E10/549 Y02P70/521		
优先权	102008035413 2008-07-29 DE PCT/EP2009/003602 2009-05-20 WO		
其他公开文献	US10074807		
外部链接	Espacenet USPTO		

摘要(译)

本发明涉及式（1）化合物，其在电子器件中的用途，以及包含根据本发明的所述化合物的电子器件，特别是有机电致发光器件，特别是作为发光层中的蓝色发光材料。