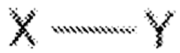
CLAIMS

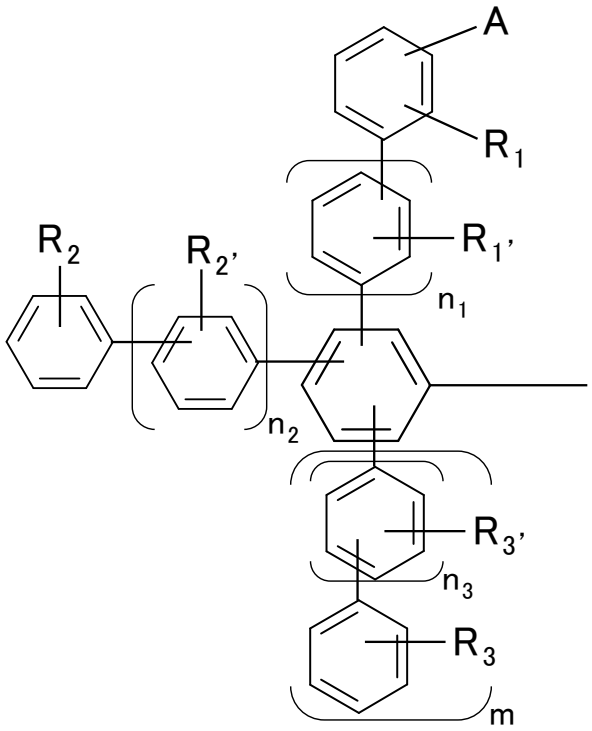
1. A method for manufacturing a semiconductor comprising:

forming an underlayer which comprises applying a layer of an underlayer forming composition to a substrate; and curing the layer to form a coating which is the underlayer and wherein the composition comprises a solvent and a semiconductor material wherein said semiconductor material comprises a compound represented by formula (1):


(formula 1)

wherein

X is a group represented by formula (2):



(formula 2),

wherein

A is -OH, -NH_2, or-SH,

R_1 is hydrogen, -OH, -NH_2, -SH, linear C_{1-10} alkyl, branched C_{3-10} alkyl, or a direct bond to a phenyl ring,

$R_{1'}$ is hydrogen, -OH, -NH_2, -SH, linear C_{1-10} alkyl, branched C_{3-10} alkyl, or a direct bond to a phenyl ring,

R_2 is hydrogen, -OH, -NH_2, -SH, linear C_{1-10} alkyl, branched C_{3-10} alkyl, or a direct bond to a phenyl ring,

$R_{2'}$ is hydrogen, -OH, -NH_2, -SH, linear C_{1-10} alkyl, branched C_{3-10} alkyl, or a direct bond to a phenyl ring,

R_3 is hydrogen, -OH, -NH_2, -SH, linear C_{1-10} alkyl, branched C_{3-10} alkyl, or a direct bond to a phenyl ring,

$R_{3'}$ is hydrogen, -OH, -NH_2, -SH, linear C_{1-10} alkyl, branched C_{3-10} alkyl, or a direct bond to a phenyl ring,

n_1 is 0, 1, or 2,

n_2 is 0, 1, or 2,

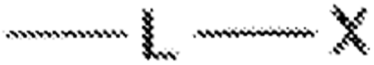
n_3 is 0, 1, or 2,

m is 0, 1, 2, or 3, and;

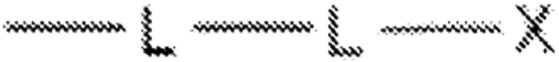
Y is represented by formula (3), (4), (5), or (6):



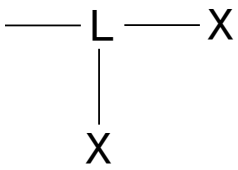
(formula 3)



(formula 4)



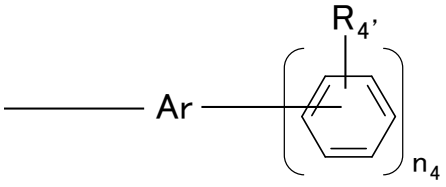
(formula 5)



(formula 6),

wherein

L is a group represented by formula (7):



(formula 7),

wherein

Ar is unsubstituted or substituted phenyl,

$R_{4'}$ is hydrogen, -OH, $-NH_2$, -SH, linear C_{1-10} alkyl, or branched C_{3-10} alkyl, or a direct bond to a phenyl ring,

n_4 is 0, 1, 2, 3, or 4,

forming a layer of a photoresist composition above the underlayer;

curing the photoresist composition to form a photoresist layer;

exposing the substrate coated with the photoresist layer;

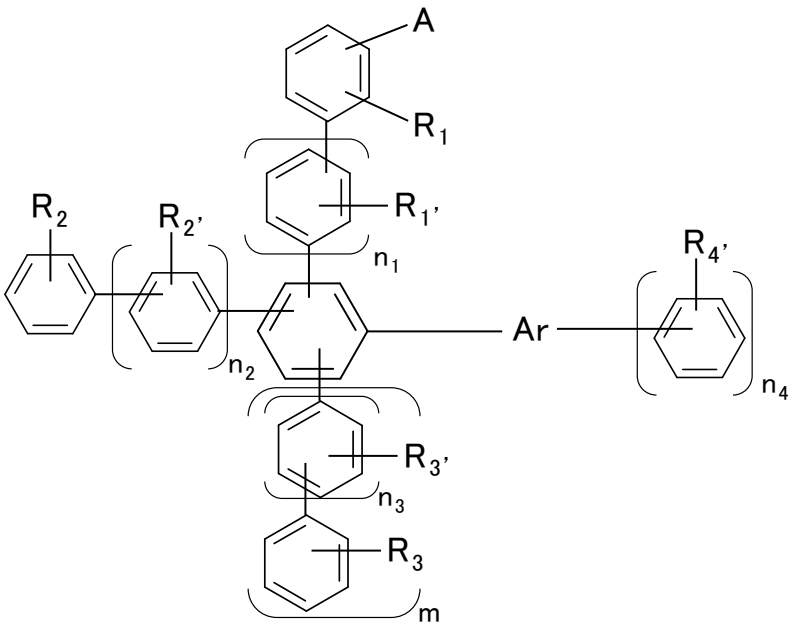
developing the exposed substrate to form a resist pattern;

etching with the resist pattern as a mask; and

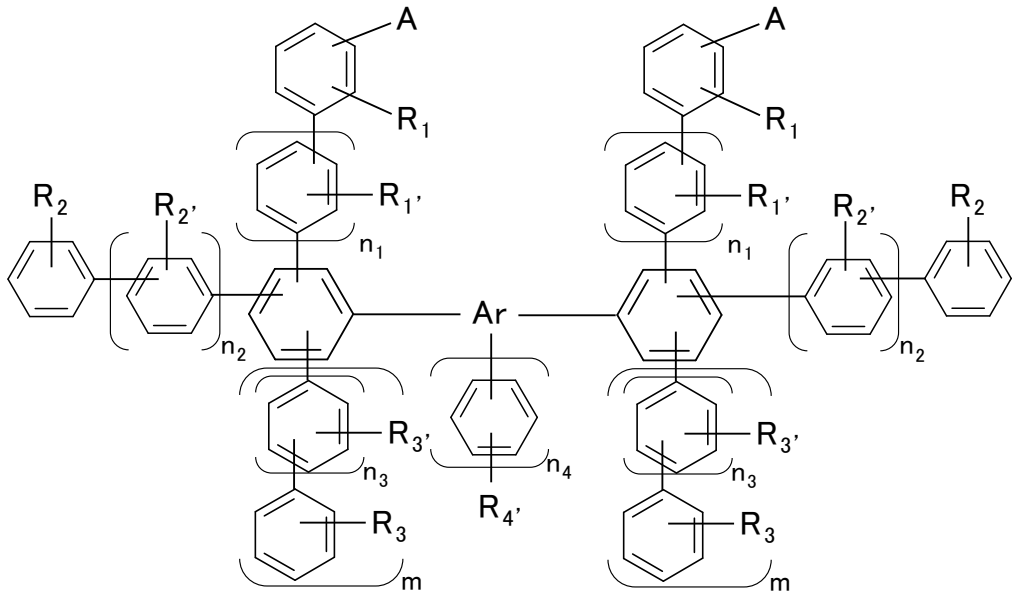
processing the substrate.

2. The method according to claim 1, wherein the compound of formula (1) has 42-120 carbon atoms.

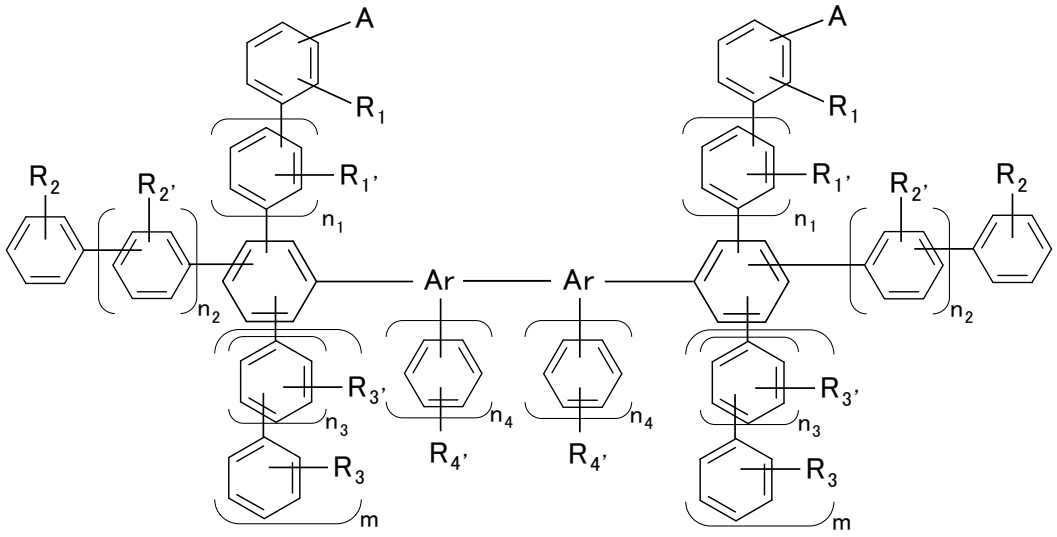
3. The method according to claim 1, wherein the compound of formula (1) is represented by formula (8), (9), (10), or (11):



(formula 8)

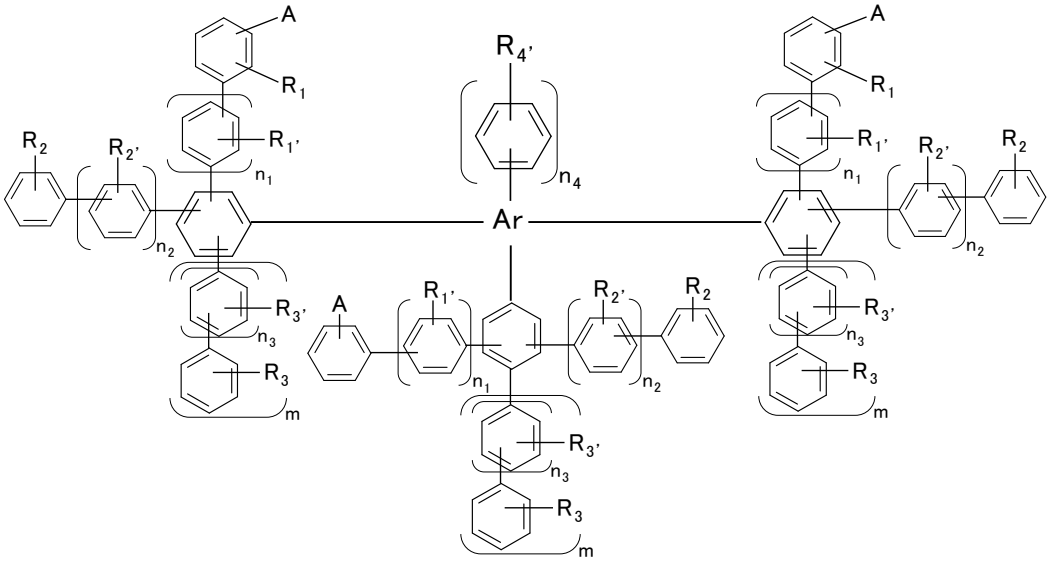


(formula 9)



(formula 10)

(formula 11),



wherein

A, R_1, $R_{1'}$, R_2, $R_{2'}$, R_3, $R_{3'}$, n_1, n_2, n_3, m, Ar, $R_{4'}$, and n_4 are each independently as defined in claim 1.

4. The method according to claim 1, wherein the solvent is selected from a group consisting of water; n-pentane; i-pentane; n-hexane; i-hexane; n-heptane; i-heptane; 2,2,4-trimethylpentane; n-octane; i-octane; cyclohexane; methylcyclohexane; benzene; toluene; xylene; ethylbenzene; trimethylbenzene; methylethylbenzene; n-propylbenzene; i-propylbenzene; diethylbenzene; i-butylbenzene; triethylbenzene; di-i-propylbenzene; n-amylnaphthalene; trimethylbenzene; methanol; ethanol; n-propanol; i-propanol; n-butanol; i-butanol; sec-butanol; t-butanol; n-pentanol; i-pentanol; 2-methylbutanol; sec-pentanol; t-pentanol; 3-methoxybutanol; n-hexanol; 2-methylpentanol; sec-hexanol; 2-ethylbutanol; sec-heptanol; heptanol-3; n-octanol; 2-ethylhexanol; sec-octanol; n-nonyl alcohol; 2,6-dimethylheptanol-4; n-decanol; sec-undecyl alcohol; trimethylnonyl alcohol; sec-tetradecyl alcohol; sec-heptadecyl alcohol; phenol; cyclohexanol; methylcyclohexanol; 3,3,5-trimethylcyclohexanol; benzyl alcohol; phenylmethylcarbinol; diacetone alcohol; cresol; ethylene glycol; propylene glycol; 1,3-butylene glycol; pentanediol-2,4; 2-methylpentanediol-2,4; hexanediol-2,5; heptanediol-2,4; 2-ethylhexanediol-1,3; diethylene glycol; dipropylene glycol; triethylene glycol; tripropylene glycol; glycerin; acetone; methyl ethyl ketone; methyl n-propyl ketone; methyl n-butyl ketone; diethyl ketone; methyl i-butyl ketone; methyl n-pentyl ketone; ethyl n-butyl ketone; methyl n-hexyl ketone; di-i-butyl ketone; trimethylnonanone; cyclohexanone; cyclopentanone; methylcyclohexanone; 2,4-pentanedione; acetonylacetone; diacetone alcohol; acetophenone; fenchone; ethyl ether; i-propyl ether; n-butyl ether; n-hexyl ether; 2-ethylhexyl ether; ethylene

oxide; 1,2-propylene oxide; dioxolane; 4-methyldioxolane; dioxane; dimethyldioxane; ethylene glycol monomethyl ether; ethylene glycol monoethyl ether; ethylene glycol diethyl ether; ethylene glycol mono-n-butyl ether; ethylene glycol mono-n-hexyl ether; ethylene glycol monophenyl ether; ethylene glycol mono-2-ethylbutyl ether; ethylene glycol dibutyl ether; diethylene glycol monomethyl ether; diethylene glycol monoethyl ether; diethylene glycol diethyl ether; diethylene glycol mono-n-butyl ether; diethylene glycol di-n-butyl ether; diethylene glycol mono-n-hexyl ether; ethoxy triglycol; tetraethylene glycol di-n-butyl ether; propylene glycol monomethyl ether; propylene glycol monoethyl ether; propylene glycol monopropyl ether; propylene glycol monobutyl ether; dipropylene glycol monomethyl ether; dipropylene glycol monoethyl ether; dipropylene glycol monopropyl ether; dipropylene glycol monobutyl ether; tripropylene glycol monomethyl ether; tetrahydrofuran; 2-methyltetrahydrofuran; diethyl carbonate; methyl acetate; ethyl acetate; y-butyrolactone; y-valerolactone; n-propyl acetate; i-propyl acetate; n-butyl acetate; i-butyl acetate; sec-butyl acetate; n-pentyl acetate; sec-pentyl acetate; 3-methoxybutyl acetate; methylpentyl acetate; 2-ethylbutyl acetate; 2-ethylhexyl acetate; benzyl acetate; cyclohexyl acetate; methylcyclohexyl acetate; n-nonyl acetate; methyl acetoacetate; ethyl acetoacetate; ethylene glycol monomethyl ether acetate; ethylene glycol monoethyl ether acetate; diethylene glycol monomethyl ether acetate; diethylene glycol monoethyl ether acetate; diethylene glycol mono-n-butyl ether acetate; propylene glycol monomethyl ether acetate; propylene glycol monoethyl ether acetate; propylene glycol monopropyl ether acetate; propylene glycol monobutyl ether acetate; dipropylene glycol monomethyl ether acetate; dipropylene glycol monoethyl ether acetate; glycol diacetate; methoxytriglycol acetate; ethyl propionate; n-butyl propionate; i-amyl propionate; diethyl oxalate; di-n-butyl oxalate; methyl lactate; ethyl lactate; y-butyrolactone; n-butyl lactate; n-amyl lactate; diethyl malonate; dimethyl phthalate; diethyl phthalate; propylene glycol 1-monomethyl ether 2-acetate; propylene glycol monoethyl ether acetate; propylene glycol monopropyl ether acetate; N-methylformamide; N,N-dimethylformamide; N,N-diethylformamide; acetamide; N-methylacetamide; N,N-dimethylacetamide; N-methylpropionamide; N-methylpyrrolidone; dimethyl sulfide; diethyl sulfide; thiophene; tetrahydrothiophene; dimethyl sulfoxide; sulfolane; 1,3-propanesultone; and any mixture of any of these.

5. The method according to claim 1, wherein the amount of the semiconductor material comprising the compound of formula (1) is 2-40 mass% relative to the total amount of the composition.

6. The method according to claim 1, further comprising a surfactant, a crosslinking agent, an acid generator, a radical generator, an agent for enhancing adhesion to substrates, or any combination of any of these.

7. The method according to claim 6, further comprising a surfactant, a crosslinking agent, or an acid generator.

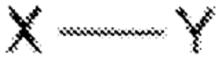
8. The method according to claim 1, wherein

the substrate is a non-flat substrate, the height difference between the top part and the lower part of the substrate surface is 10-10,000 nm.

9. The method according to claim 1, wherein conditions for the curing of the underlayer comprise baking at 150-650°C for 30-180 seconds.

10. The method for manufacturing a semiconductor according to claim 1, further comprising forming wiring in the processed substrate.

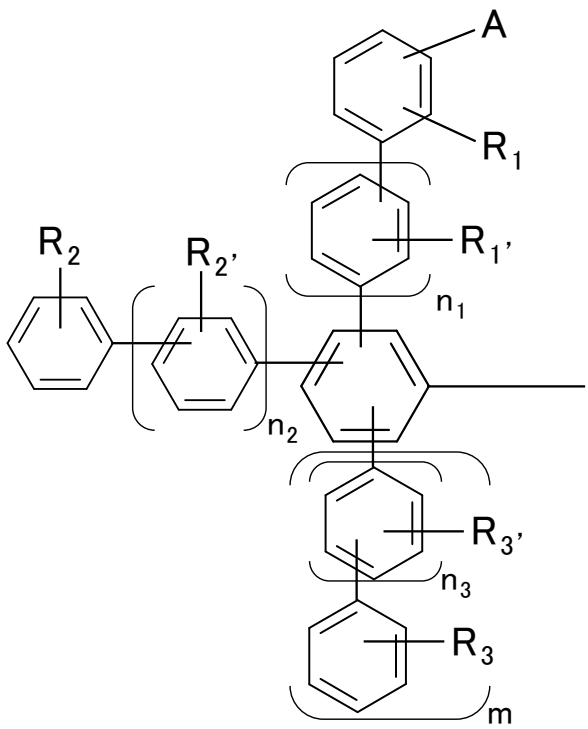
11. A semiconductor material comprises a compound represented by formula (1):



(formula 1)

wherein

X is a group represented by formula (2):



(formula 2),

wherein

A is -OH, $-NH_2$, or -SH,

R_1 is hydrogen, -OH, $-NH_2$, -SH, linear C_{1-10} alkyl, branched C_{3-10} alkyl, or a direct bond to a phenyl ring,

$R_{1'}$ is hydrogen, -OH, $-NH_2$, -SH, linear C_{1-10} alkyl, branched C_{3-10} alkyl, or a direct bond to a phenyl ring,

R_2 is hydrogen, -OH, $-NH_2$, -SH, linear C_{1-10} alkyl, branched C_{3-10} alkyl, or a direct bond to a phenyl ring,

$R_{2'}$ is hydrogen, -OH, $-NH_2$, -SH, linear C_{1-10} alkyl, branched C_{3-10} alkyl, or a direct bond to a phenyl ring,

R_3 is hydrogen, -OH, $-NH_2$, -SH, linear C_{1-10} alkyl, branched C_{3-10} alkyl, or a direct bond to a phenyl ring,

$R_{3'}$ is hydrogen, -OH, $-NH_2$, -SH, linear C_{1-10} alkyl, branched C_{3-10} alkyl, or a direct bond to a phenyl ring,

n_1 is 0, 1, or 2,

n_2 is 0, 1, or 2,

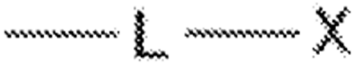
n_3 is 0, 1, or 2,

m is 0, 1, 2, or 3, and;

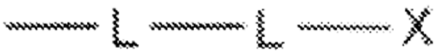
Y is represented by formula (3), (4), (5), or (6):



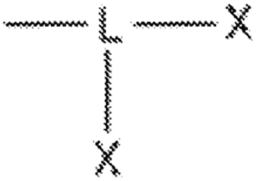
(formula 3)



(formula 4)



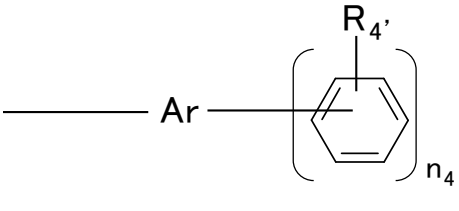
(formula 5)



(formula 6),

wherein

L is a group represented by formula (7):



(formula 7),

wherein

Ar is unsubstituted or substituted phenyl,

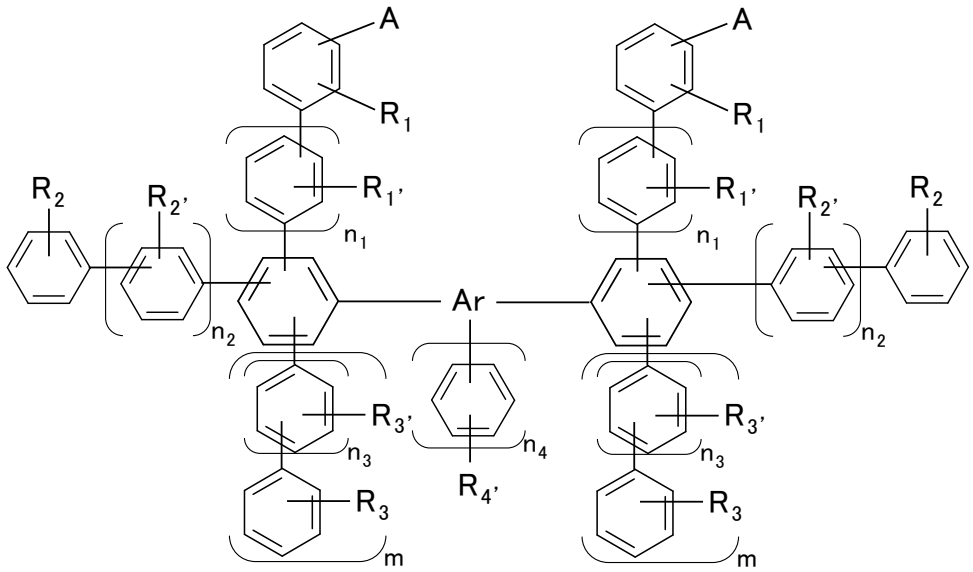
$R_{4'}$ is hydrogen, -OH, $-NH_2$, -SH, linear $C_{1\text{-}10}$ alkyl, or branched $C_{3\text{-}10}$ alkyl, or a direct bond to a phenyl ring,

n_4 is 0, 1, 2, 3, or 4.

12. A composition comprising a semiconductor material according to claim 11 and a solvent.

13. An underlayer-forming composition consisting of the composition according to claim 12.

14. A compound represented by formula (9)':



formula (9)',

wherein

A is -OH, $-NH_2$, or-SH,

R_1 is hydrogen, -OH, $-NH_2$, -SH, linear $C_{1\text{-}10}$ alkyl, branched $C_{3\text{-}10}$ alkyl, or a direct bond to a phenyl ring,

$R_{1'}$ is hydrogen, -OH, $-NH_2$, -SH, linear $C_{1\text{-}10}$ alkyl, branched $C_{3\text{-}10}$ alkyl, or a direct bond to a phenyl ring,

R_2 is hydrogen, -OH, $-NH_2$, -SH, linear $C_{1\text{-}10}$ alkyl, branched $C_{3\text{-}10}$ alkyl, or a direct bond to a phenyl ring,

$R_{2'}$ is hydrogen, -OH, $-NH_2$, -SH, linear C_{1-10} alkyl, branched C_{3-10} alkyl, or a direct bond to a phenyl ring,

R_3 is hydrogen, -OH, $-NH_2$, -SH, linear C_{1-10} alkyl, branched C_{3-10} alkyl, or a direct bond to a phenyl ring,

$R_{3'}$ is hydrogen, -OH, $-NH_2$, -SH, linear C_{1-10} alkyl, branched C_{3-10} alkyl, or a direct bond to a phenyl ring,

n_1 is 0, 1, or 2,

n_2 is 0, 1, or 2,

n_3 is 0, 1, or 2,

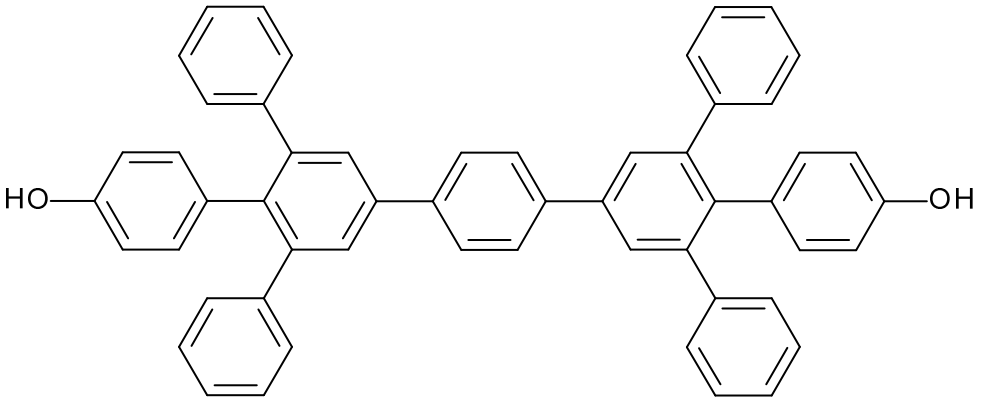
m is 0, 1, 2, or 3, and;

Ar is a C_{6-20} aromatic hydrocarbon ring unsubstituted or substituted by a substituent selected from -OH, $-NH_2$, -SH, linear C_{1-10} alkyl, or branched C_{3-10} alkyl,

$R_{4'}$ is hydrogen, -OH, $-NH_2$, -SH, linear C_{1-10} alkyl, branched C_{3-10} alkyl, or a direct bond to a phenyl ring, and

n_4 is 0, 1, 2, 3, or 4,

provided that the following compounds are excluded:


HO
OH

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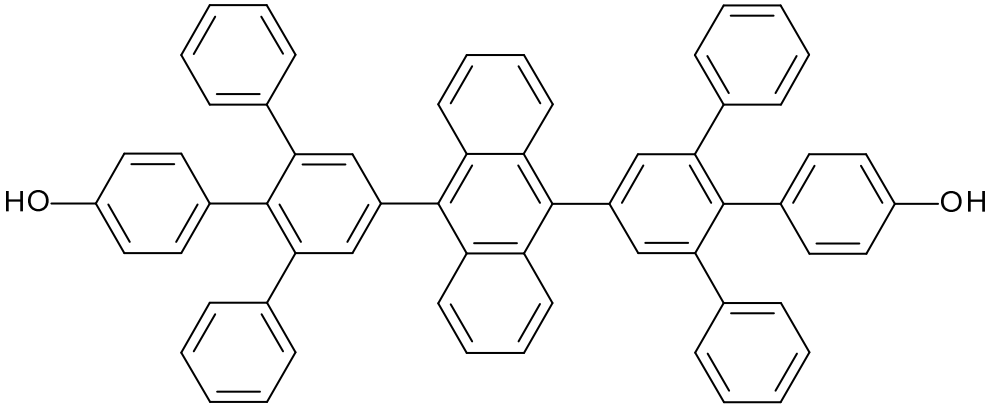
HO
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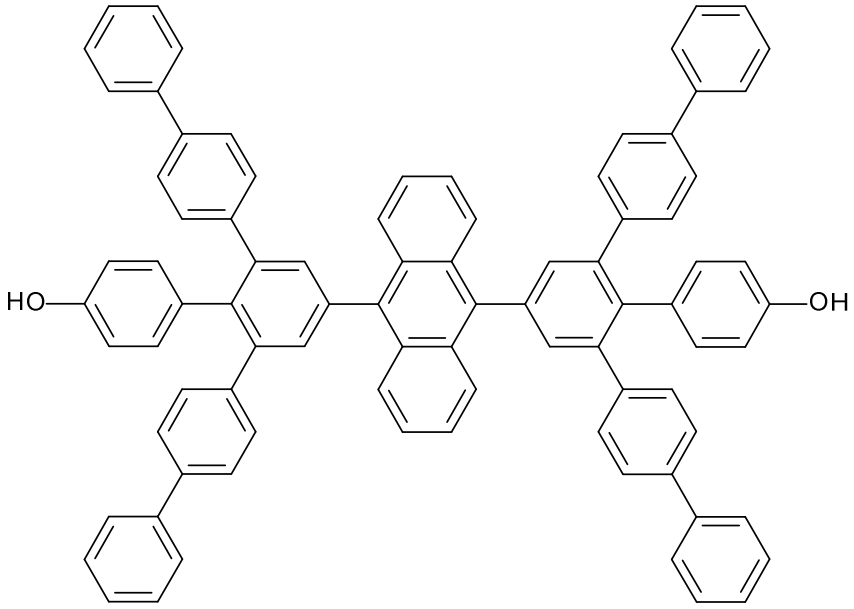

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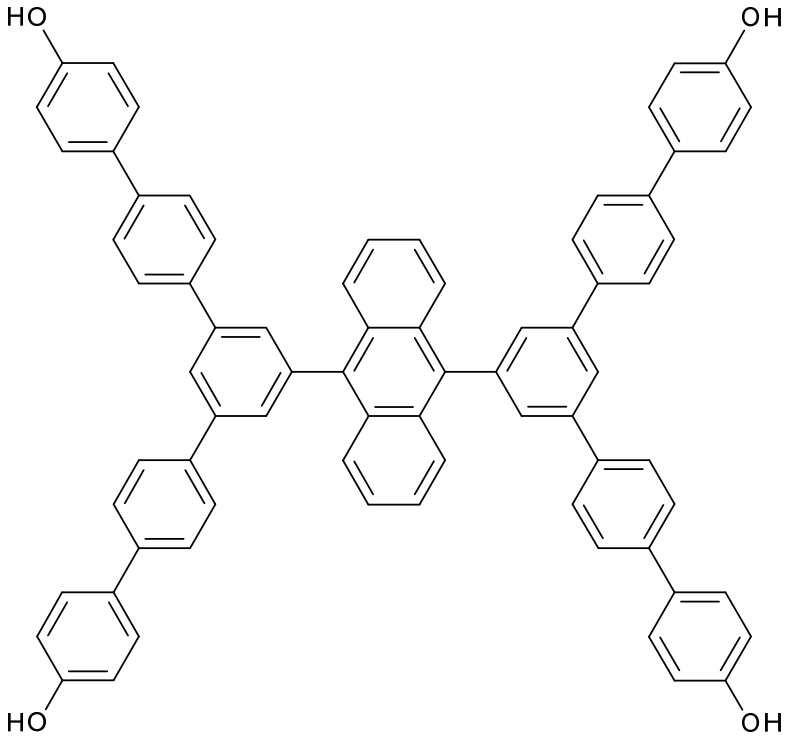

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