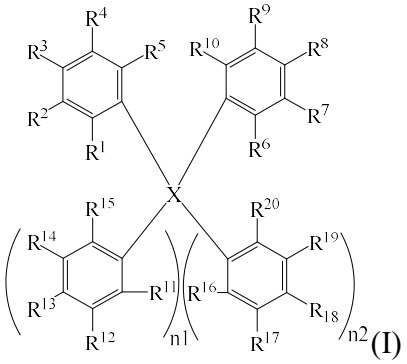
CLAIMS

What is claimed is:

1. A compound of structure (I):



(I)

wherein n1 and n2 are each independently 1 or 0,

X is $C_pH_{2p-n1-n2}$ or $C_{6+4(q-1)}H_{4+2(q-1)-n1-n2}$,

p is 1 to 6,

q is 1 to 3,

wherein one or more H of X may be each independently substituted with C_{1-5} straight-chain alkyl or C_{3-5} branched alkyl,

R^1 to R^{20} are each independently H, a halogen selected from F, Cl, Br, and I, C_{1-15} straight-chain alkyl, C_{3-15} branched alkyl, C_{3-15} alkyl containing a cyclic structure, C_{1-15} straight-chain alkoxy, C_{3-15} branched alkoxy, C_{3-15} alkoxy containing a cyclic structure, $-CH_2OH$, $-CH_2OR^{22}$, -COOH, -OH, or Y represented by formula (II), where R^{22} is C_{1-15} straight-chain alkyl, C_{3-15} branched alkyl, or C_{3-15} alkyl containing a cyclic structure,

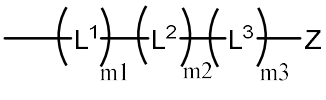
R^{11} and R^{16} may together form a single bond,

when R^1 to R^{20} are each independently alkyl, one or more non-adjacent methylene ($-CH_2-$) of the alkyl may be each independently substituted with -O-, -S-, -CO-, -CO-O-, -O-CO-, -O-CO-O-, -CH=CH-, or -C≡C-,

when R^1 to R^{20} are each independently alkyl, one or more H of the alkyl may be each independently substituted with F, Cl, Br, I, COOH, OH or OR^{22},

where in structure (II), L^1 is each independently C_{1-5} straight-chain alkylene or C_{3-5} branched alkylene, L^2 is each independently -O-, -S-, -CO-, -CO-O-, -O-CO-, -O-CO-O-, -CH=CH-, or -C≡C-, L^3 is each independently C_{1-15} straight-chain alkylene or C_{3-15} branched alkylene, where Z is an oxirane or an oxetane moiety, and said oxirane moiety or oxetane moiety may further comprise as a

substituent a C_{1-8} linear chain alkyl, C_{3-8} branched alkyl, or -CH_2OH, and further where m1, m2, and m3 are each independently 0 or 1, and when m2 is 0, m1 is 0,



(II),

wherein said crosslinking compound of structure (I) is selected from the group consisting of crosslinkings compound of structures (I-2), (I-5) and (I-7),

where in structire (I-2):

R^1 and R^6 are the same and are selected from the group consisting of H, a C_{1-8} alkyl, I, Cl, and Br,

R^2 and R^7 are the same moiety having structure (III),

R^3 and R^8 are the same and have structure (II-1), where L^4 is a C_{1-2} linear-chain alkylene, $L^{4'}$ is either a direct valence bond or a C_1 straight chain alkylene, and L^5 is a C_{1-5} linear chain alkylene or a C_{3-5} branched alkylene, and R^{21} is, H, a C_{1-8} linear-chain alkyl, a C_{3-8} branched alkyl, or a -CH_2OH,

R^4 and R^9 are individually selected from the group consisting of H, a C_{1-8} alkyl, I, Cl, and Br,

R^5 and R^{10} are individually selected from the group consisting of H, a C_{1-8} alkyl, I, Cl, and Br,

R^{15} and R^{20} are each independently H, a halogen selected from F, Cl, Br, and I, C_{1-15} straight-chain alkyl, C_{3-15} branched alkyl, C_{3-15} alkyl containing a cyclic structure, C_{1-15} straight-chain alkoxy, C_{3-15} branched alkoxy, C_{3-15} alkoxy containing a cyclic structure, -CH_2OH, -CH_2OR^{22}, -COOH, -OH, or Y represented by formula (II), where R^{22} is C_{1-15} straight-chain alkyl, C_{3-15} branched alkyl, or C_{3-15} alkyl containing a cyclic structure,

R^{14} and R^{19} are individually selected from the group consisting of H, I, Cl and Br,

R^{13} and R^{18} are individually selected from the group consisting of H, I, Cl and Br,

R^{11} and R^{16} are individually selected from the group consisting of H, I, Cl, and Br, or where R^{11} and R^{16} may form a single bond,

R^{12} and R^{17} are individually selected from the group consisting of H, I, Cl and Br, structure (II-1), or structure (II-2), where L^4 is a C_{1-2} linear-chain alkylene, $L^{4'}$ is either a direct valence bond or a C_1 straight chain alkylene, and L^5 is a C_{1-5} linear chain alkylene or a C_{3-5} branched alkylene;

where in structure (I-5):

n1 and n2 are each independently 1,

X is $C_pH_{2p-n1-n2}$ or $C_{6+4(q-1)}H_{4+2(q-1)-n1-n2}$,

p is 1 to 6,

q is 1 to 3,

wherein one or more H of X may be each independently substituted with C_{1-5} straight-chain alkyl or C_{3-5} branched alkyl, and further wherein

R^3, R^8, R^{13}, and R^{18} are individually selected from the group consisting of Y,

R^2, R^4, R^7, R^9, R^{12}, R^{14}, R^{19}, R^{17} are selected from the group consisting of H, Cl, Br, and I, and

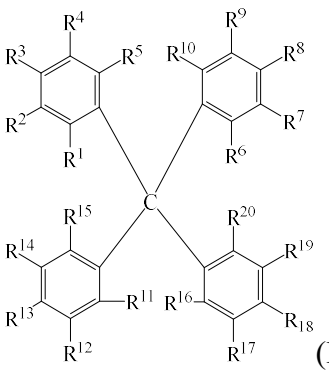
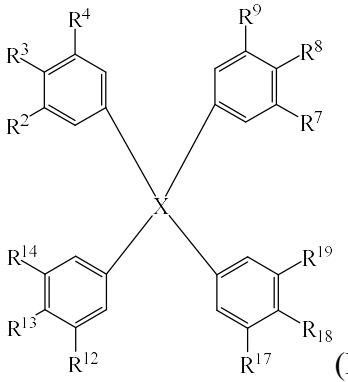
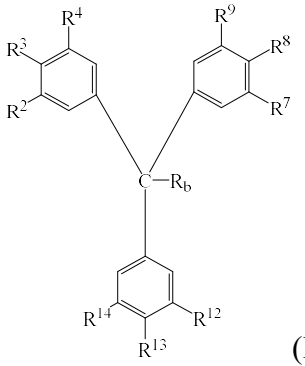
at least one of R^2, R^4, R^7, R^9, R^{12}, R^{14}, R^{19}, R^{17} is a halogen selected from the group consisting of, Cl, Br, and I; and

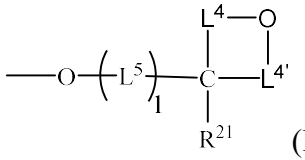
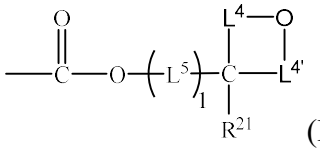
where in structure (I-7):

R_b is selected from the group consisting of a C_{1-6} straight-chain alkyl or C_{3-15} branched alkyl, and further wherein R^3, R^8 and R^{13} are individually selected from Y,

where R^2, R^4, R^7, R^9, R^{12}, R^{14}, are selected from the group consisting of, H, Cl, Br, and I, and

at least one of R^2, R^4, R^7, R^9, R^{12}, R^{14} is a halogen selected from the group consisting of, Cl, Br, and I;


(I-2),

(I-5),

(I-7),

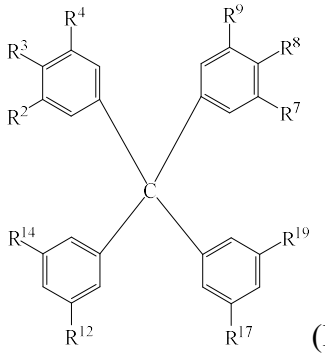
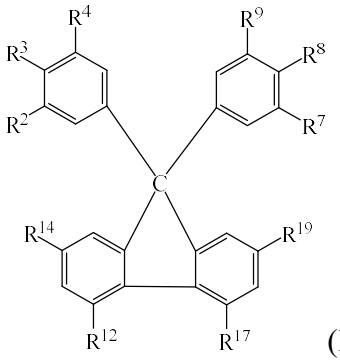

(II-1)

(II-2)

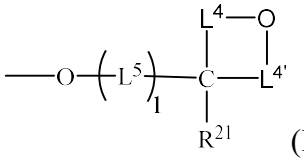
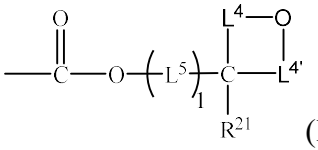
(III).

2. The crosslinking compound of claim 1, which has structure (I-3) or structure (I-4), where R^2 and R^7 are the same moiety having structure (III),

R^3 and R^8 are the same and have structure (II-1), where L^4 is a C_{1-2} linear-chain alkylene, $L^{4'}$ is either a direct valence bond or a C_1 straight chain alkylene, and L^5 is a C_{1-5} linear-chain alkylene or a C_{3-5} branched alkylene, and R^{21} is H, a C_{1-8} linear chain alkyl, a C_{3-8} branched alkyl, or a -CH_2OH,

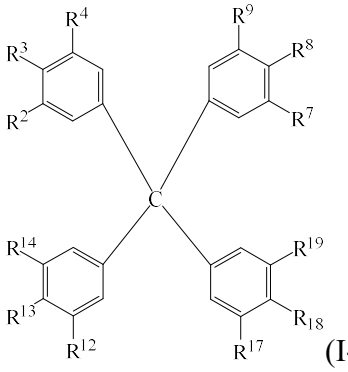
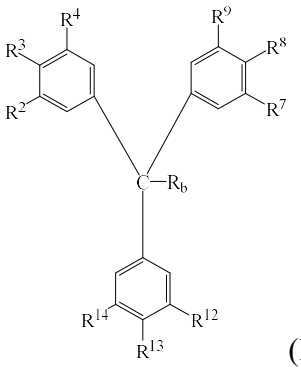
R^4 and R^9 are the same and are selected from the group consisting of H, a C_{1-8} alkyl, I, Cl, and Br,
R^{12} and R^{17} are individually selected from the group consisting of H, structure (II-1), or structure (II-2),
R^{14} and R^{19} are the same and are selected from the group consisting of H, I, Cl, and Br,


(I-3),

(I-4)


(II-1)

(II-2)

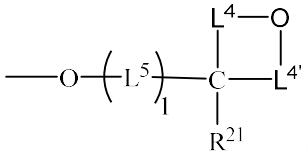
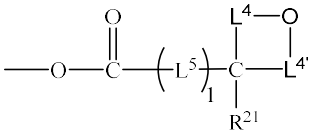
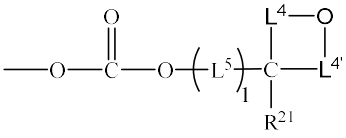
(III).

3. The crosslinking compound of claim 1, which has structure (I-6) or structure (I-7), wherein R_b is selected from the group consisting of a C_{1-6} straight-chain alkyl or C_{3-15} branched alkyl,
R^3, R^8, R^{13}, and R^{18} are individually selected from Y,
R^2, R^4, R^7, R^9, R^{12}, R^{14}, R^{19}, R^{17} are selected from the group consisting of, H, Cl, Br, and I, and at least one of R^2, R^4, R^7, R^9, R^{12}, R^{14}, R^{19}, R^{17} is a halogen selected from the group consisting of, Cl, Br, and I,


(I-6),

(I-7).

4. The crosslinking compound of claim 3, wherein said halogen is I.

5. The crosslinking compound of claim 3, wherein R^3, R^8, R^{13}, and R^{18} are individually selected from structure (II-1), structure (II-3) or structure (II-4), where L^4 is a C_{1-2} linear-chain alkylene, $L^{4'}$ is either a direct valence bond or a C_1 straight chain alkylene, and L^5 is a C_{1-5} linear chain alkylene or a C_{3-5} branched alkylene, and R^{21} is H, C_{1-8} linear-chain alkyl, C_{3-8} branched alkyl, or $-CH_2OH$,


(II-1),

(II-3)

(II-4).

6. The crosslinking compound of claim 3 having structure (I-7), wherein only one, only two, only three, only four, only five, or all of R2, R4, R7, R9, R12, and R14 are selected from the group consisting of Cl, Br, I.

7. The crosslinking compound of any one of claims 3 to 6 having structure (I-7), wherein L4 is -CH2-, L4' is a direct valence bond and R21 is H; or
wherein L4 is -CH2-, L4' is -CH2- and R21 is a C1 to C4 linear-chain alkyl; or
wherein L4 is -CH2-, L4' is -CH2- and R21 is a -CH2-OH.

8. A composition comprising at least one crosslinking compound of any one of claims 1 to 7, and an acid generating agent, preferably a photoacid generator, more preferably wherein at least two acid generators are present.

9. The composition of claim 8 comprising at least two different crosslinking compounds of any one of claims 1 to 7 and an acid generating agent.

10. The composition of claim 8 comprising at least one crosslinking compound of claim 1 or 2 having structure (I-2), (I-3) or (I-4).

11. The composition of claim 8 comprising at least one crosslinking compound of any one of claims 1 or 3 to 7 having structure (I-5), (I-6) or (I-7).

12. The composition of claim 8 comprising at least one crosslinking compound of any one of claims 1 or 2 having structure (I-2), (I-3) or (I-4) and at least one crosslinking compound of any one of claims 1 and 3 to 7 having structure (I-5), (I-6) or (I-7).

13. The composition of any one of claims 8 to 12, wherein it is a negative chemically mplified EUV or e-beam photoresist composition comprising,
Component (A) a crosslinking compound of any one of claims 1 to 7,
Component (B) a photoacid generator
Component (C) an optional additional crosslinking component,
Component (D) an optional acid quencher component,
Component (E) an organic spin coating solvent.

14. A process of forming negative image with a negative photoresist by EUV or e beam exposure, comprising step ia) to va)
i) coating the negative chemically amplified EUV photoresist or beam composition of claim 13 on a substrate, to form a coated film,
ii) baking said coated film to form a baked coated film,
iii) exposing regions of the baked coated film through a mask with EUV or e-beam radiation, forming exposed and unexposed regions,
iv) an optional post exposure baking step,
v) developing away the unexposed regions with an organic solvent developer forming a negative image pattern in said coated photoresist on the substrate,
vi) etching the substrate with a plasma or a chemical etchant using said negative image pattern as a mask, forming a negative image in the substrate.

15. The use of the crosslinking compound of any one of claims 1 to 7 or the composition of any one of claims 8 to 13 for coating a substrate.