What is claimed is:

1. A composition comprising components a), b), c), d), and e);

a) at least one Diazonaphthoquinonesulfonate Photoactive Compound (DNQ-PAC);

b) at least one heterocyclic thiol having structure (7), (8) and/or (9),

c) at least one photoacid generator;

d) at least one acrylic polymer comprising repeat units selected from ones having structure (1), (2), (3), (4), (5), and (6), wherein

e) at least one Novolak polymer having a dissolution rate in 0.26 N tetramethylammonium hydroxide at 23°C of at least 50 Å/sec, wherein

said repeat units are present in said acrylic polymer in the following mole% ranges, based on the total moles of all different repeat units present, and further where the summation of the individual mole% values for all repeat units present in said polymer must equal 100 mole%, and

(1) ranges from about 0 to about 35 mole%

(2) ranges from about 5 to about 55 mole%

(3) ranges from about 0 to about 30 mole%

(4) ranges from about 15 to about 55 mole%

(5) ranges from about 10 to about 40 mole%,

(6) ranges from about 0 to about 25 mole%, and

R_1, R_2, R_3, R_4, R_5, and R_6 are individually selected from either H, F, a C-1 to C-4 fluoroalkyl, or a C-1 to C-4 alkyl

R_7 is selected from H, a C-1 to C-4 alkyl, a C-1 to C-4 alkyloxy alkyl, and a halogen,

R_8 is a C-3 to C-8 cyclic alkyl, or a C-7 to C-14 alicyclic alkyl,

R_9 is a C-2 to C-8 (hydroxy)alkylene moiety,

R_{10} is an acid cleavable group,

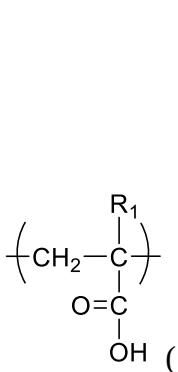
R_{11} is a C-3 to C-12, (alkyloxy)alkylene moiety; and

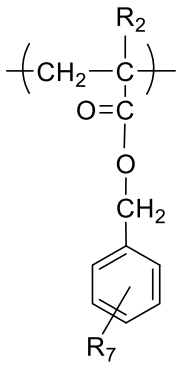
in said structure (7), Xt is selected from the group consisting of $C(Rt_1)(Rt_2)$, O, S, Se, and Te;

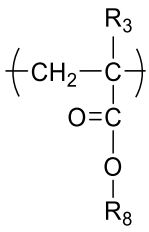
in said structure (8), Y is selected from the group consisting of $C(Rt_3)$ and N;

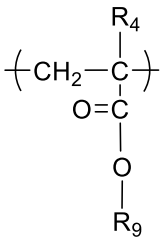
in said structure (9), Z is selected from the group consisting of $C(Rt_3)$ and N; and

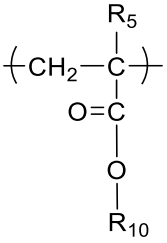
Rt_1, Rt_2, and Rt_3 are independently selected from the group consisting of H, a substituted alkyl group having 1 to 8 carbon atoms, an unsubstituted alkyl group having 1 to 8 carbon atoms, a substituted alkenyl group having 2 to 8 carbon atoms, unsubstituted alkenyl group having 2 to 8 carbon atoms, a substituted alkynyl group having 2 to 8 carbon atoms, unsubstituted alkynyl group having 2 to 8 carbon atoms, a substituted aromatic group having 6 to 20 carbon atoms, a substituted heteroaromatic group having 3 to 20 carbon atoms, unsubstituted aromatic group having 6 to 20 carbon atoms and unsubstituted heteroaromatic group having 3 to 20 carbon atoms;

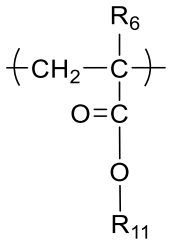

(1)

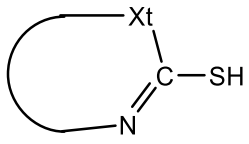

(2)

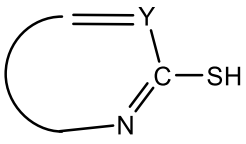

(3)

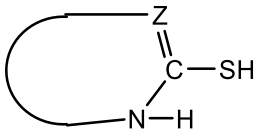

(4)


(5)


(6);

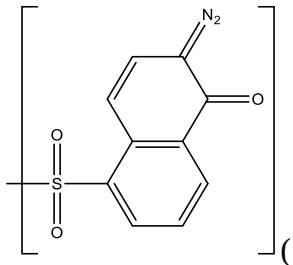


(7)


(8)


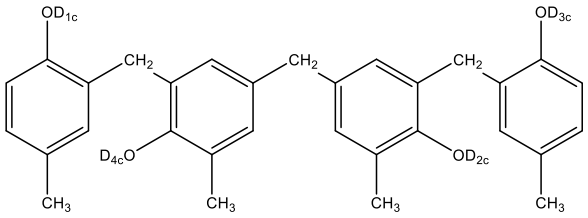
(9).

2. The composition of claim 1, wherein said DNQ-PAC is a single material or a mixture of materials in which a 2,1,5-Diazonaphthoquinonesulfonate moiety having structure (10) forms at least one sulfonate ester with a phenolic compound,

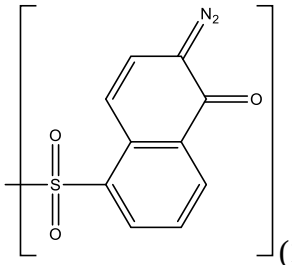


(10).

3. The composition of any one of claims 1 or 2, wherein said DNQ PAC is a single material or a mixture of materials having general formula (11) wherein D_{1c}, D_{2c}, D_{3c} and D_{4c} are individually selected from H or a moiety having structure (10), and further wherein at least one of D_{1c}, D_{2c}, D_{3c} or D_{4c} is a moiety having structure (10),



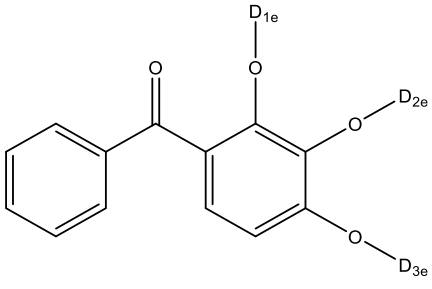
(11)

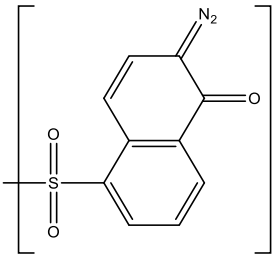


(10).

4. The composition of claims 1 or 2, wherein said DNQ PAC is either a single compound or a mixture of PAC compounds having structure (12a), wherein D_{1e}, D_{2e}, and

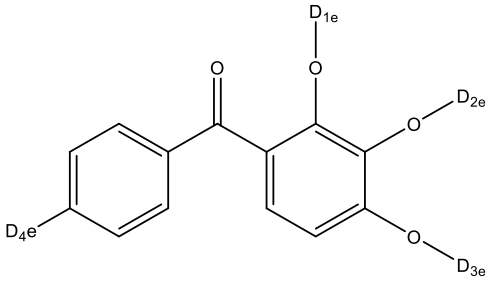
D_{3e} are individually selected from H or a moiety having structure (10), and further wherein at least one of D_{1e}, D_{2e}, or D_{3e} is a moiety having structure (10),

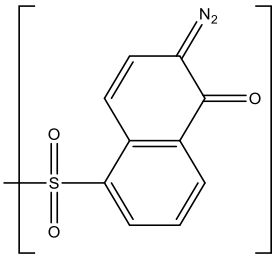


(12a)


(10).

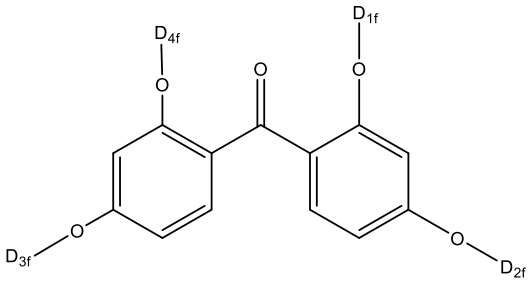
5. The composition of claims 1 or 2, wherein said DNQ PAC is either a single compound or a mixture of PAC compounds having structure (12b), wherein D_{1e}, D_{2e}, D_{3e} and D_{4e} are individually selected from H or a moiety having structure (10), and further wherein at least one of D_{1e}, D_{2e}, D_{3e} or D_{4e} is a moiety having structure (10),

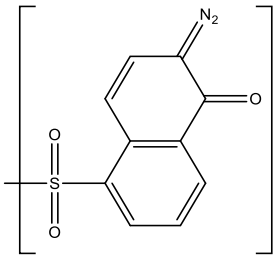


(12b)


(10).

6. The composition of claims 1 or 2, wherein said DNQ PAC is either a single compound or a mixture of compounds having structure (13), wherein D_{1f}, D_{2f}, D_{3f} and D_{4f} are individually selected from H or a moiety having structure (10), and further wherein at least one of D_{1f}, D_{2f}, D_{3f} or D_{4f} is a moiety having structure (10),



(13)


(10).

7. The composition of ~~any one of~~ claims 1 or 2 ~~to 6~~, wherein the heterocyclic thiol is selected from a group consisting of unsubstituted triazole thiol, substituted triazole thiol, unsubstituted imidazole thiol, substituted imidazole thiol, substituted triazine thiol, unsubstituted triazine thiol, a substituted mercapto pyrimidine, unsubstituted mercapto pyrimidine, a substituted thiadiazole-thiol, unsubstituted thiadiazole-thiol, substituted indazole thiol, unsubstituted indazole thiol, tautomers thereof, and combinations thereof.

8. The composition of ~~any one of~~ claims 1 or 2 ~~to 6~~, wherein the heterocyclic thiol is selected from a group consisting of 1,3,5-triazine-2,4,6-trithiol, 2-mercapto-6-methylpyrimidin-4-ol, 3-mercapto-6-methyl-1,2,4-triazin-5-ol, 2-mercaptopyrimidine-4,6-diol, 1H-1,2,4-triazole-3-thiol, 1H-1,2,4-triazole-5-thiol, 1H-imidazole-2-thiol, 1H-imidazole-5-thiol, 1H-imidazole-4-thiol, 2-azabicyclo[3.2.1]oct-2-ene-3-thiol, 2-azabicyclo[2.2.1]hept-2-ene-3-thiol, 1H-benzo[d]imidazole-2-thiol, 2-mercapto-6-methylpyrimidin-4-ol, 2-mercaptopyrimidin-4-ol, 1-methyl-1H-imidazole-2-thiol, 1,3,4-thiadiazole-2,5-dithiol, 1H-indazole-3-thiol, tautomers thereof and combinations thereof.

9. The composition of ~~any one of~~ Claims 1 or 2 ~~to 6~~, wherein at least one photoacid generator is selected from a group consisting of an onium salt, a dicarboximidyl sulfonate ester, an oxime sulfonate ester, a diazo(sulfonyl methyl) compound, a disulfonyl methylene hydrazine compound, a nitrobenzyl sulfonate ester, a biimidazole compound, a diazomethane derivative, a glyoxime derivative, a β-ketosulfone derivative, a disulfone derivative, a sulfonic acid ester derivative, an imidoyl sulfonate derivative, and a halogenated triazine compound, or combinations thereof.

10. The composition of ~~any one of~~ claims 1 or 2 ~~to 9~~, wherein said acrylate polymer is one whose repeat units are selected from the group consisting of repeat units having structure (1), (2), (3), (4), (5), and (6).

11. The composition of ~~any one of~~ claims 1 or 2 ~~to 10~~, wherein said acrylate polymer is one whose repeat units are selected from the group consisting of repeat units having structure (1), (2), (4), (5), and (6).

12. The composition of ~~any one of~~ claims 1 or 2 ~~to 11~~, wherein said acrylate polymer is one wherein

(1) ranges from about 5 to about 20 mole%

(2) ranges from about 5 to about 25 mole%

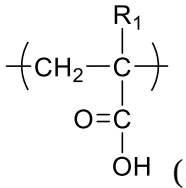
(3) ranges from about 0 to about 30 mole%

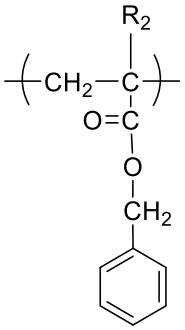
(4) ranges from about 15 to about 55 mole%

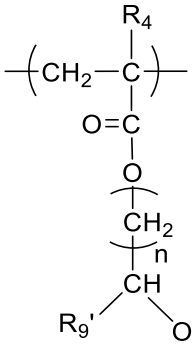
(5) ranges from about 20 to about 40 mole%, and

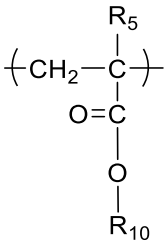
(6) ranges from about 5 to about 25 mole%.

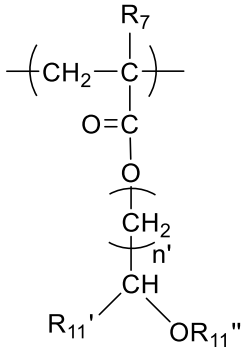
13. The composition of ~~any one of~~ claims 1 or 2 ~~to 12~~, wherein said acrylate polymer is one whose repeat units are the ones having structures (1), (2a), (4a), (5), and (6a) wherein n and n' are the numbers of methylene spacer moieties and range, independently, from 1 to 4, R_1, R_2, R_4, R_5, and R_7, individually, are selected from a C-1 to C-4 alkyl, $R_{9'}$ and $R_{11'}$ are individually selected from H or a C-1 to C-4 alkyl, and $R_{11''}$, is a C-1 to C-4 alkyl,


(1)


(2a)


(4a)


(5)


(6a).

14. The composition of claim 13 wherein,

(1) ranges from about 5 to about 20 mole%

(2a) ranges from about 5 to about 25 mole%

(4a) ranges from about 15 to about 55 mole%

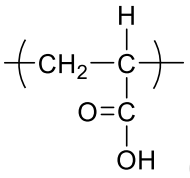
(5) ranges from about 20 to about 40 mole%, and

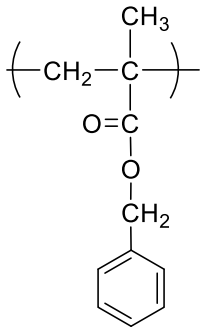
(6a) ranges from about 5 to about 25 mole%.

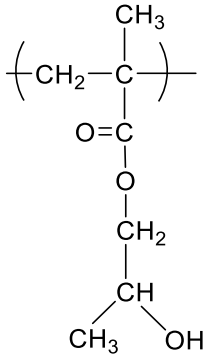
15. The composition of ~~any one of~~ claims 1 or 2 ~~to 14~~, wherein in repeat unit of structure (5), said R_{10} acid cleavable group, is selected from the group consisting of a t-butyl group, a tetrahydropyran-2-yl group, a tetrahydrofuran-2-yl group, a 4-methoxytetrahydropyran-4-yl group, a 1-ethoxyethyl group, a 1-butoxyethyl group, a 1-propoxyethyl group, a 3-oxocyclohexyl group, a 2-methyl-2-adamantyl group, a 2-ethyl-2-adamantyl group, a 8-methyl-8-tricyclo[5.2.1.0 2,6]decyl group, a 1,2,7,7-tetramethyl-

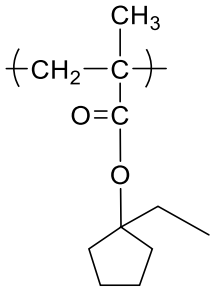
2-norbornyl group, a 2-acetoxymenthyl group, a 2-hydroxymethyl group a 1-methyl-1-cyclohexylethyl group, a 4-methyl-2-oxotetrahydro-2H-pyran-4-yl group, a 2,3-dimethylbutan-2-yl group, a 2,3,3-trimethylbutan-2-yl group, a 1-methyl cyclopentyl group, a 1-ethyl cyclopentyl group, a 1-methyl cyclohexyl group, 1-ethyl cyclohexyl group, a 1,2,3,3-tetramethylbicyclo[2.2.1]heptan-2-yl group, a 2-ethyl-1,3,3-trimethylbicyclo[2.2.1]heptan-2-yl group, a 2,6,6-trimethylbicyclo[3.1.1]heptan-2-yl group, a 2,3-dimethylpentan-3-yl group, or a 3-ethyl-2-methylpentan-3-yl group.

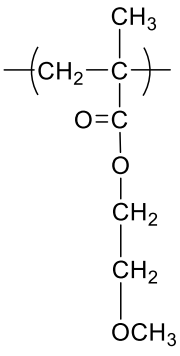
16. The composition of ~~any one of~~ claims 1 or 2 ~~to 15~~, wherein said acrylate polymer is one whose repeat units are the ones having structures (1), (2b), (4b), (5a), and (6b),


(1a)


(2b)


(4b)


(5a)


(6b).

17. The composition of claim 16 wherein,

(1a) ranges from about 5 to about 20 mole%

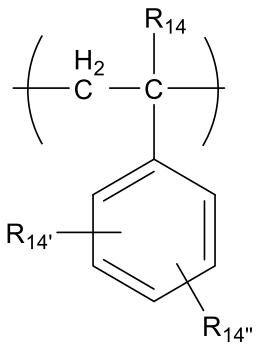
(2b) ranges from about 5 to about 25 mole%

(4b) ranges from about 15 to about 55 mole%

(5a) ranges from about 20 to about 40 mole%, and

(6b) ranges from about 5 to about 25 mole%.

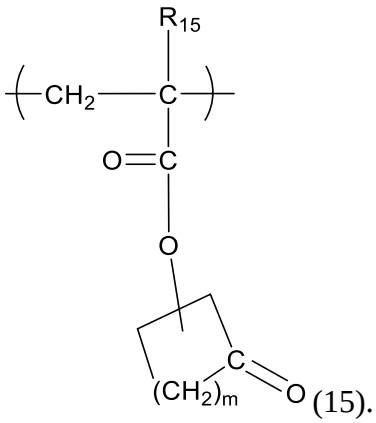
18. The composition of ~~any one of~~ claims 1 or 2 ~~to 9~~, wherein the polymer further comprises at least one styrenic repeat units selected from the ones having the structure (14), where R_{14} is chosen from H, or CH_3 and $R_{14'}$ and $R_{14''}$ can be the same or different, and are chosen from H, OH, $OCOOC(CH_3)_3$, or $OCOCOO(CH_3)_3$.



(14).

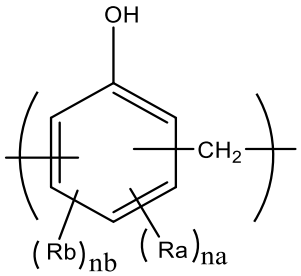
19. The composition of ~~any one of~~ claims 1 or 2 ~~to 9 and 18~~, wherein the polymer further comprises a (meth)acrylate of a lactone moiety which is either a single cyclic lactone or a lactone moiety comprised within an alicyclic alkyl.

20. The composition of ~~any one of~~ claims 1 or 2 ~~to 9, 18 and 19~~, wherein the polymer further comprises at least one repeat unit of structure (15) comprising a lactone moiety wherein R_{15} is chosen from H, or CH_3 and m is 1 or 2,



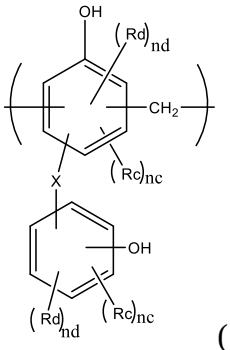
(15).

21. The composition of ~~any one of~~ claims 1 or 2 ~~to 20~~, wherein said Novolak resin comprises a repeat unit of structure (16) wherein, Ra and Rb are independently a C-1 to C-4 alkyl, na is 0 to 3, and nb is 0 or 1.



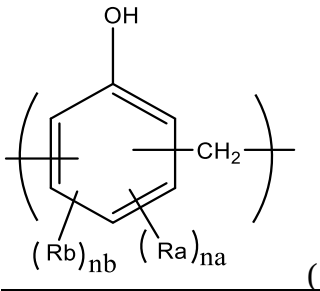
(16).

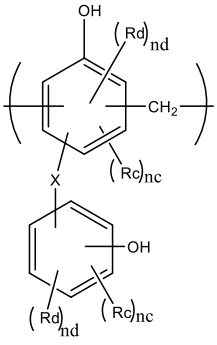
22. The composition of ~~any one of~~ claims 1 or 2 ~~to 21~~, wherein said Novolak resin comprises a repeat unit of structure (17) wherein, Rc is a C-1 to C-4 alkyl, Rd is a C-1 to C-4 alkyl, X is -O-, -$C(CH_3)_2$-, -(C=O)- or -SO_2-, nc is 0 to 3, and nd is 0 or 1.



(17).

23. The composition of ~~any one of~~ claims 1 or 2 ~~to 22~~, wherein said Novolak resin comprises said repeat units (16) and (17) wherein, Ra and Rb are independently a C-1 to C-4 alkyl, na is 0 to 3, and nb is 0 or 1 and Rc is a C-1 to C-4 alkyl, Rd is a C-1 to C-4 alkyl, X is -O-, -$C(CH_3)_2$-, -(C=O)- or -SO_2-, nc is 0 to 3, and nd is 0 or 1



(16)


(17).

24. The composition of ~~any one of~~ claims 1 or 2 ~~to 23~~, wherein said Novolak resin is a m-cresol and formaldehyde Novolak resin.

25. The composition of ~~any one of~~ claims 1 or 2 ~~to 24~~, wherein the Novolak resin comprises from about 10 to about 90 wt% solids.

26. A method of forming a positive relief image comprising:

forming a photosensitive layer by applying the positive working photosensitive composition of ~~any one of~~ claims 1 or 2 ~~to 25~~ to a substrate;

image-wise exposing the photosensitive layer to actinic radiation to form a latent image;

developing the latent image in a developer,

wherein the image-wise exposed photosensitive layer is optionally thermally treated.

27. The method of claim 26 wherein the substrate comprises a chalcophile.

28. The method of claim 26 wherein the substrate is copper.

29. The use of the composition according to ~~any one of~~ claims 1 or 2 ~~to 25~~ for forming a positive relief image on a substrate.