CLAIMS

What is claimed is:

1. A method for producing silicone hydrogel contact lenses, comprising the steps of:

(1) obtaining a polymerizable composition which is clear at room temperature, wherein the polymerizable composition comprises

(a) at least one siloxane-containing vinylic monomer,

(b) at least one polysiloxane vinylic crosslinker,

(c) at least one hydrophilic N-vinyl amide monomer,

(d) from about 5% to about 15% by weight of at least one hydrophobic acrylic monomer relative to the total weight of the polymerizable composition, wherein the hydrophobic acrylic monomer is capable of forming a homopolymer having a glass-transition temperature T_g of at least about 60°C, wherein the hydrophobic acrylic monomer is capable of dissolving components (a) to (c) to form a solution with a concentration of at least about 5% by weight,

(e) from about 4% to about 16% by weight of at least one organic solvent having 2 to 8 carbon atoms relative to the total weight of the polymerizable composition,

(f) at least one non-silicone vinylic crosslinker, and (g) at least one free radical initiator, wherein the sum of the amounts of components (a) to (c) is at least about 60% by weight relative to the total weight of the polymerizable composition, wherein weight ratio of component (d) over the sum of components (d) and (e) is at least 0.24 ~~(preferably at least 0.35, more preferably at least 0.45, even more preferably at least 0.55)~~ per 100 grams of the polymerizable composition;

(2) introducing the polymerizable composition into a lens mold, wherein the lens mold comprises a male mold half having a first molding surface and a female mold half having a second molding surface, wherein the male and female mold halves are configured to receive each other such that a mold cavity is formed between the first and second molding surfaces when the mold is closed;

(3) curing thermally or actinically the polymerizable composition in the lens mold to form a ~~unprocessed~~ silicone hydrogel lens precursor within the lens mold;

(4) separating the mold into the male and female mold halves, with the ~~unprocessed~~ silicone hydrogel lens precursor adhered on a lens-adhered mold half which is one of the male and female mold halves;

(5) removing the ~~unprocessed~~ silicone hydrogel lens precursor from the lens-adhered mold half before the ~~unprocessed~~ silicone hydrogel lens precursor is contacted with water ~~or any liquid~~ or an organic solvent, wherein the step of removing is performed by (a) bringing a ultrasonic horn in direct contact with at

least one area of a non-optical surface of the lens-adhered mold half having the ~~unprocessed~~ silicone hydrogel lens precursor attached thereon and (b) applying a ultrasonic vibrational energy of from about 0.2 to about 18 J to the at least one area of the non-optical surface of the lens-adhered mold half having the ~~unprocessed~~ silicone hydrogel lens precursor attached thereon so as to remove the ~~unprocessed~~ silicone hydrogel lens precursor from the lens-adhered mold half; ~~and~~

(6) subjecting the ~~unprocessed~~ silicone hydrogel lens precursor to one or more post-molding processes selected from the group consisting of extraction, hydration, ~~packaging, sterilization,~~ and combinations thereof to obtain a silicone hydrogel contact lens; and

(7) packaging and sterilizing the silicone hydrogel contact lens obtained in step (8).

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2. The method of claim ~~2~~1, wherein the hydrophobic acrylic monomer is methyl methacrylate, ethyl methacrylate, isopropyl methacrylate, sec-butyl methacrylate, tert-butyl methacrylate, cyclohexyl methacrylate, isobornyl acrylate, isobornyl methacrylate, phenyl methacrylate, 4-tert-butylstyrene, 2-methylstyrene, styrene, 4-ethoxystyrene, 2,4-dimethystyrene, 2,5-dimethylstyrene, 3,5-dimethylstyrene, or a combination thereof.

3. The method of claim ~~1 or~~ 2, wherein the organic solvent is 1-propanol, isopropanol, 1-butanol, sec-butanol, isobutanol, tert-butyl alcohol, 1-pentanol, 2-pentanol, 3-pentanol, 3-methyl-2-butanol, 2-methyl-1-butanol, 2,2-dimethyl-1-propanol, tert-amyl alcohol, 1-methoxy-2-propanol, 3-ethoxy-1-propanol, 1-ethoxy-2-propanol, or a combination thereof.

4. The method of ~~any one of claims 1 to~~claim 3, wherein the polymerizable composition comprises about 1.5% or less by weight of at least one non-silicone vinylic crosslinker relative to the total weight of all polymerizable components in the polymerizable composition.

5. The method of claim 4, wherein said at least non-silicone vinylic crosslinker is ethyleneglycol di-(meth)acrylate, diethyleneglycol di-(meth)acrylate, triethyleneglycol di-(meth)acrylate, tetraethyleneglycol di-(meth)acrylate, glycerol di-(meth)acrylate, 1,3-propanediol di-(meth)acrylate, 1,3-butanediol di-(meth)acrylate, 1,4-butanediol di-(meth)acrylate, glycerol 1,3-diglycerolate di-(meth)acrylate, ethylenebis[oxy(2-hydroxypropane-1,3-diyl)] di-(meth)acrylate, bis[2-(meth)acryloxyethyl] phosphate, trimethylolpropane di-(meth)acrylate, and 3,4-bis[(meth)acryloyl]tetrahydrofuan, diacrylamide ~~(i.e., N-(1-oxo-2-propenyl)-2-~~

propenamide), dimethacrylamide (i.e., N-(1-oxo-2-methyl-2-propenyl)-2-methyl-2-propenamide), N,N-di(meth)acryloyl-N-methylamine, N,N-di(meth)acryloyl-N-ethylamine, N,N'-methylene bis(meth)acrylamide, N,N'-ethylene bis(meth)acrylamide, N,N'-dihydroxyethylene bis(meth)acrylamide, N,N'-propylene bis(meth)acrylamide, N,N'-2-hydroxypropylene bis(meth)acrylamide, N,N'-2,3-dihydroxybutylene bis(meth)acrylamide, 1,3-bis(meth)acrylamide-propane-2-yl dihydrogen phosphate (i.e., N,N'-2-phophonyloxypropylene bis(meth)acrylamide), piperazine diacrylamide (or 1,4-bis(meth)acryloyl piperazine), tetraethyleneglycol divinyl ether, triethyleneglycol divinyl ether, diethyleneglycol divinyl ether, ethyleneglycol divinyl ether, triallyl isocyanurate, triallyl cyanurate, trimethylopropane trimethacrylate, pentaerythritol tetramethacrylate, bisphenol A dimethacrylate, or combinations thereof.

6. The method of any one of claims 1 to 5claim 4, wherein the step of curing is carried out thermally.

7. The method of claim 4any one of claims 1 to 5, wherein the step of curing is carried out actnicallyactinically.

8. The method of claim 4any one of claims 1 to 7, wherein the polymerizable composition further comprises about 10% or less by weight of at least one hydrophilic acrylic monomer, relative to the total weight of the polymerizable composition.

9. The method of claim 8, wherein hydrophilic acrylic monomer is N,N-dimethyl (meth)acrylamide, (meth)acrylamide, N-hydroxylethyl (meth)acrylamide, N-hydroxypropyl (meth)acrylamide, hydroxyethyl methacrylate, glycerol methacrylate (GMA), polyethylene glycol (meth)acrylate having a number average molecular weight of up to 1500, polyethylene glycol C_1-C_4-alkyl ether (meth)acrylate having a number average molecular weight of up to 1500, *N*-[tris(hydroxymethyl)methyl]-acrylamide, (meth)acrylic acid, ethylacrylic acid, or a combination thereof.

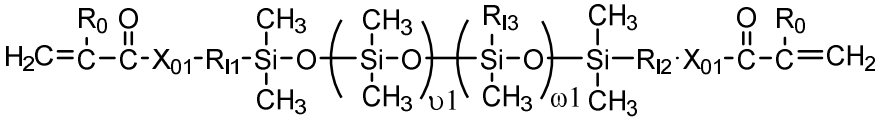
10. The method of claim 4any one of claims 1 to 9, wherein said at least one siloxane-containing vinylic monomer is tris(trimethylsilyloxy)silylpropyl (meth)acrylate, [3-(meth)acryloxy-2-hydroxypropyloxy]propylbis(trimethylsiloxy) methylsilane, [3-(meth)acryloxy-2-hydroxypropyloxy]propylbis(trimethylsiloxy)butylsilane, 3-(meth)acryloxy-2-(2-hydroxyethoxy)-propyloxy)propylbis(trimethylsiloxy)methylsilane, 3-(meth)acryloxy-2-hydroxypropyloxy)propyltris(trimethylsiloxy)silane, N-[tris(trimethylsiloxy)silylpropyl]-(meth)acrylamide, N-(2-hydroxy-3-(3-(bis(trimethylsilyloxy)methylsilyl)propyloxy)-propyl)-2-methyl (meth)acrylamide, N-(2-hydroxy-3-(3-

(bis(trimethylsilyloxy)methylsilyl)-propyloxy)propyl) (meth)acrylamide, N-(2-hydroxy-3-(3-(tris(trimethylsilyloxy)silyl)-propyloxy)propyl)-2-methyl acrylamide, N-(2-hydroxy-3-(3-(tris(trimethylsilyloxy)silyl)-propyloxy)propyl) (meth)acrylamide, N-[tris(dimethylpropylsiloxy)silylpropyl]-(meth)acrylamide, N-[tris(dimethylphenylsiloxy) silylpropyl] (meth)acrylamide, N-[tris(dimethylethylsiloxy)silylpropyl] (meth)acrylamide, N,N-bis[2-hydroxy-3-(3-(bis(trimethylsilyloxy)methylsilyl)propyloxy)propyl]-2-methyl (meth)acrylamide, N,N-bis[2-hydroxy-3-(3-(bis(trimethylsilyloxy)methylsilyl)propyloxy)-propyl] (meth)acrylamide, N,N-bis[2-hydroxy-3-(3-(tris(trimethylsilyloxy)silyl)propyloxy)-propyl]-2-methyl (meth)acrylamide, N,N-bis[2-hydroxy-3-(3-(tris(trimethylsilyloxy)-silyl)propyloxy)propyl] (meth)acrylamide, N-[2-hydroxy-3-(3-(t-butyldimethylsilyl)-propyloxy)propyl]-2-methyl (meth)acrylamide, N-[2-hydroxy-3-(3-(t-butyldimethylsilyl)propyloxy)propyl] (meth)acrylamide, N,N-bis[2-hydroxy-3-(3-(t-butyldimethylsilyl)propyloxy)propyl]-2-methyl (meth)acrylamide, N-2-(meth)acryloxyethyl-O-(methyl-bis-trimethylsiloxy-3-propyl)silyl carbamate, 3-(trimethylsilyl)propylvinyl carbonate, 3-(vinyloxycarbonylthio)-propyl-tris(trimethyl-siloxy)silane, 3-[tris(trimethylsiloxy)silyl]propylvinyl carbamate, 3-[tris(trimethylsiloxy)silyl] propyl allyl carbamate, 3-[tris(trimethylsiloxy)silyl]propyl vinyl carbonate, or a combination thereof.

11. The method of claim 4~~any one of claims 1 to 9~~, wherein said at least one siloxane-containing vinylic monomer is α-(meth)acryloxypropyl terminated ω-C_1-C_4-alkyl terminated polydimethylsiloxane, α-(meth)acryloxy-2-hydroxypropyloxypropyl terminated ω-C_1-C_4-alkyl terminated polydimethylsiloxane, α-(2-hydroxyl-methacryloxypropyloxypropyl)-ω-C_1-C_4-alkyl-decamethylpentasiloxane, α-[3-(meth)acryloxyethoxy-2-hydroxypropyloxypropyl]-terminated ω-C_1-C_4-alkyl terminated polydimethylsiloxane, α-[3-(meth)acryloxy-propyloxy-2-hydroxypropyloxypropyl]-terminated ω-C_1-C_4-alkyl terminated polydimethylsiloxane, α-[3-(meth)acryloxyisopropyloxy-2-hydroxypropyloxypropyl]-terminated ω-C_1-C_4-alkyl terminated polydimethylsiloxane, α-[3-(meth)acryloxybutyloxy-2-hydroxypropyloxypropyl]-terminated ω-C_1-C_4-alkyl terminated polydimethylsiloxane, α-[3-(meth)acryloxyethylamino-2-hydroxypropyloxypropyl]-terminated ω-C_1-C_4-alkyl terminated polydimethylsiloxane, α-[3-(meth)acryloxypropylamino-2-hydroxypropyloxypropyl]-terminated ω-C_1-C_4-alkyl terminated polydimethylsiloxane, α-[3-(meth)acryloxy-butylamino-2-hydroxypropyloxypropyl]-terminated ω-C_1-C_4-alkyl terminated polydimethylsiloxane, α-(meth)acryloxy(polyethylenoxy)-2-

hydroxypropyloxypropyl]-terminated ω-C_1-C_4-alkyl terminated polydimethylsiloxane, α-[(meth)acryloxy-2-hydroxypropyloxy-ethoxypropyl]-terminated ω-C_1-C_4-alkyl terminated polydimethylsiloxane, α-[(meth)acryloxy-2-hydroxypropyl-N-ethylaminopropyl]-terminated ω-C_1-C_4-alkyl terminated polydimethylsiloxane, α-[(meth)acryloxy-2-hydroxypropyl-aminopropyl]-terminated ω-C_1-C_4-alkyl terminated polydimethylsiloxane, α-[(meth)acryloxy-2-hydroxypropyloxy-(polyethylenoxy)propyl]-terminated ω-C_1-C_4-alkyl terminated polydimethylsiloxane, α-(meth)acryloylamidopropyloxypropyl terminated ω-C_1-C_4-alkyl terminated polydimethylsiloxane, α-N-methyl-(meth)acryloylamidopropyloxypropyl terminated ω-C_1-C_4-alkyl terminated polydimethylsiloxane, α-[3-(meth)acrylamidoethoxy-2-hydroxypropyloxy-propyl]-terminated ω-C_1-C_4-alkyl polydimethylsiloxane, α-[3-(meth)acrylamidopropyloxy-2-hydroxypropyloxypropyl]-terminated ω-C_1-C_4-alkyl terminated polydimethylsiloxane, α-[3-(meth)acrylamidoisopropyloxy-2-hydroxypropyloxypropyl]-terminated ω-C_1-C_4-alkyl terminated polydimethylsiloxane, α-[3-(meth)acrylamidobutyloxy-2-hydroxypropyloxypropyl]-terminated ω-C_1-C_4-alkyl terminated polydimethylsiloxane, α-[3-(meth)acryloylamido-2-hydroxypropyloxypropyl] terminated ω-C_1-C_4-alkyl polydimethylsiloxane, α-[3-[N-methyl-(meth)acryloylamido]-2-hydroxypropyloxypropyl] terminated ω-C_1-C_4-alkyl terminated polydimethylsiloxane, N-methyl-N'-(propyltetra(dimethylsiloxy)dimethylbutylsilane) (meth)acrylamide, N-(2,3-dihydroxypropane)-N'-(propyltetra(dimethylsiloxy)dimethylbutylsilane) (meth)acrylamide,
(meth)acryloylamidopropyltetra(dimethylsiloxy)dimethylbutylsilane, α-vinyl carbonate-terminated ω-C_1-C_4-alkyl-terminated polydimethylsiloxanes, α-vinyl carbamate-terminated ω-C_1-C_4-alkyl-terminated polydimethylsiloxane, or a mixture thereof.

12. The method of claim 4~~any one of claims 1 to 11~~, wherein said at least one polysiloxane vinylic crosslinker is a vinylic crosslinker of formula (I)



(I)

in which:

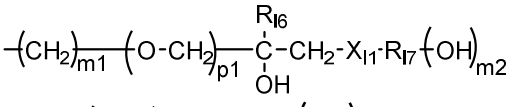
$\upsilon 1$ is an integer of from 30 to 500 and $\omega 1$ is an integer of from 1 to 75, provided that $\omega 1/\upsilon 1$ is from about 0.035 to about 0.15;

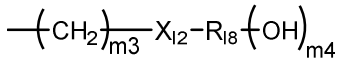
X_{01} is O or NR_N in which R_N is hydrogen or C_1-C_{10}-alkyl;

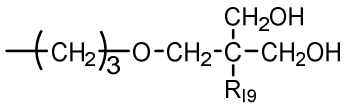
R_o is hydrogen or methyl;

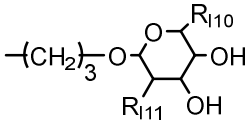
R_{I1} and R_{I2} independently of each other are a substituted or unsubstituted C_1–C_{10} alkylene divalent radical or a divalent radical of $–R_{I4}–O–R_{I5}–$ in which R_{I4} and R_{I5} independently of each other are a substituted or unsubstituted C_1–C_{10} alkylene divalent radical;

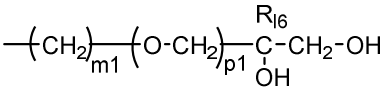
R_{I3} is a monovalent radical of any one of formula (Ia) to (Ie)


(Ia)


(Ib)


(Ic)


(Id)


(Ie)

p1 is zero or 1; m1 is an integer of 2 to 4; m2 is an integer of 1 to 5; m3 is an integer of 3 to 6; m4 is an integer of 2 to 5;

R_{I6} is hydrogen or methyl;

R_{I7} is a C_2-C_6 hydrocarbon radical having (m2+1) valencies;

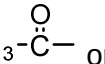
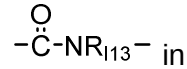
R_{I8} is a C_2-C_6 hydrocarbon radical having (m4+1) valencies;

R_{I9} is ethyl or hydroxymethyl;

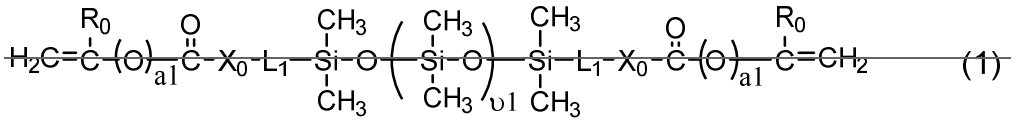
R_{I10} is methyl or hydromethyl;

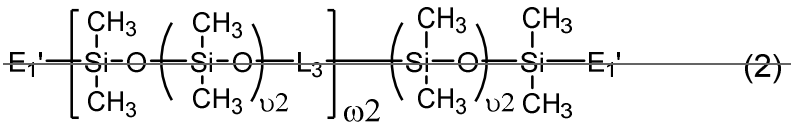
R_{I11} is hydroxyl or methoxy;

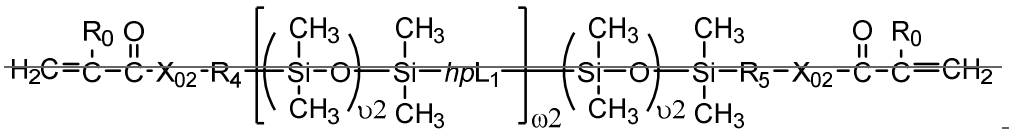
X_{I1} is a sulfur linkage of –S– or a teriary amino linkage of $–NR_{I12}–$ in which R_{I12} is C_1-C_1 alkyl, hydroxyethyl, hydroxypropyl, or 2,3-dihydroxypropyl; and

X_{I2} is an amide linkage of  or  in which R_{I13} is hydrogen or C_1-C_{10} alkyl.

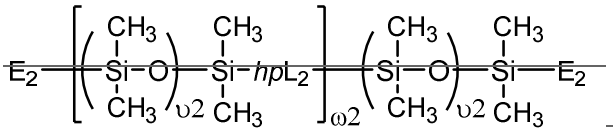
~~13. The method of any one of claims 1 to 11, wherein said at least one polysiloxane vinylic crosslinker is a vinylic crosslinker of any one of formula (1) to (7)~~


~~(1)~~

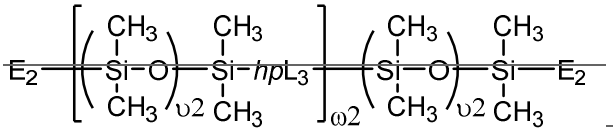

~~(2)~~



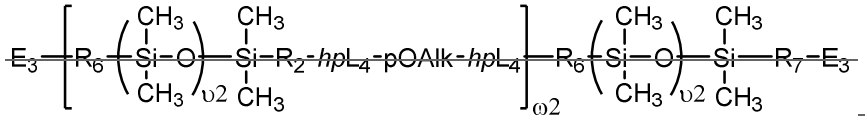
(3)



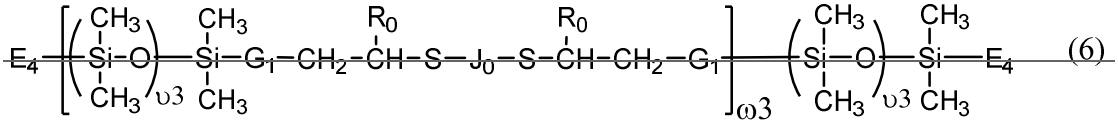
(4)



(5)



(6)



(6)

in which:

υ1 is an integer of from 30 to 500;

υ2 is an integer of from 5 to 50;

υ3 is an integer of from 5 to 100;

ω2 and ω3 independent of each other are an integer of from 1 to 15;

a1 and g1 independent of each other is zero or 1;

h1 is an integer of 1 to 20 and h2 is an integer of 0 to 20;

m1 and m3 indpendent of each other is 0 or 1, m2 is an integer of 1 to 6, m4 is an integer of 1 to 5, m5 is 2 or 3;

q1 is an integer of 1 to 20, q2 is an integer of 0 to 20, q3 is an integer of 0 to 2, q4 is an integer of 2 to 50, q5 and q6 independent of each other are a number of 0 to 35, provided that (q4+q5+q6) is an integer of 2 to 50;

x+y is an integer of from 10 to 30;

e1 is an integer of 5 to 100, p1 and b1 independent of each other are an integer of 0 to 50, provided that (e1+p1+b1)≥10 and $e1/(p1+b1)$ ≥ 2 when (p1+b1)≥1;

R_o is H or methyl;

R_1, R_{1n}, R_{2n}, R_{3n}, and R_{4n} independent of one another are H or a C_1-C_4 alkyl having 0 to 2 hydroxyl group;

R_{n5} is H or a C_1-C_{10} alkyl;

R_2 is a C_4-C_{14} hydrocarbon divalent radical;

R_3 is a C_2-C_6 alkylene divalent radical;

R_4 and R_5 independent of each other are a C_1-C_6 alkylene divalent radical or a C_1-C_6 alkylene-oxy-C_1-C_6 alkylene divalent radical;

R_6 and R_7 independent of each other are a C_1-C_6 alkylene divalent radical or a C_1-C_6 alkoxy-C_1-C_6 alkylene divalent radical;

R_8 and R_9 independent of each other are a substituted or unsubstituted C_1-C_{12} alkylene divalent radical;

X_o, X_1', X_{o1}, X_{02}, and X_{03} independent of one another are O or NR_1;

X_1 is O, NR_1, NHCOO, OCONH, $CONR_1$, or NR_1CO;

X_{o4} is —COO— or —$CONR_{n5}$—;

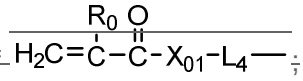
X_{o5} and X_{o7} independent of each other are a direct bond, —COO— or —$CONR_{n5}$—;

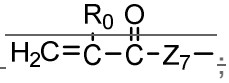
X_{o6} is a direct bond, a C_1-C_6 alkylene divalent radical, a C_1-C_6 alkylenoxy divalent radical, –COO–, or –$CONR_{n5}$–;

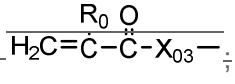
X_{o8} is a direct bond or —COO—;

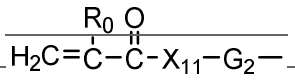
X_{o9} is O or NR_{n5};

X_{10} is a direct bond, a C_1-C_6 alkylene divalent radical, –COO–, or –$CONR_{n5}$–;

E_1' is a monovalent radical of ;

E_2 is a monovalent radical of ;

E_3 is a monovalent radical of ;

E_4 is a monovalent radical of  or ;

L_1 is a C_2-C_8 alkylene divalent radical or a divalent radical of $-L_1'-X_1-L_1''-$,

$-(C_2H_4O)_{q1}-L_1''-$, $-(C_2H_4O)_{q1}CONH-L_1''-$, $-L_1'-NHCOO-(C_2H_4O)_{q1}-L_1''-$,

$-CH_2-CH(OH)-CH_2-X_1'-(C_2H_4O)_{q2}-L_1''-$, $-L_1'-X_1'-CH_2-CH(OH)-CH_2-O-L_1''-$, or

$-(C_2H_4O)_{q1}-CH_2-CH(OH)-CH_2-O-L_1''-$;

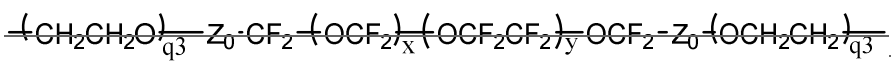
L_1' is a C_2-C_8 alkylene divalent radical which has zero or one hydroxyl group;

L_1" is C_3-C_8 alkylene divalent radical which has zero or one hydroxyl group;

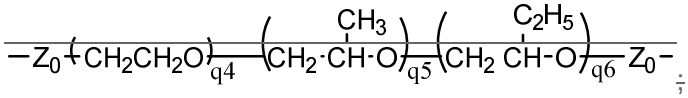
L_3 is a divalent radical of

$-L_3'-O-(C_2H_4O)_{q2}CONH-R_2-(NHCO-PE-CONH-R_2)_{g1}NHCO-(OC_2H_4)_{q2}O-L_3'-$ in which

PE is a divalent radical of

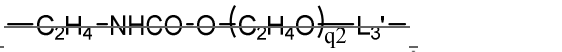


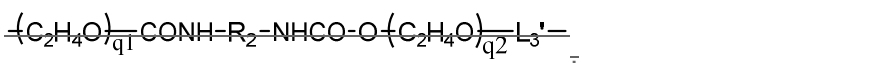
or

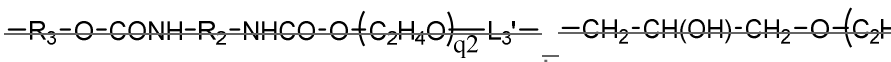


;

L_3' is C_3-C_8 alkylene divalent radical;

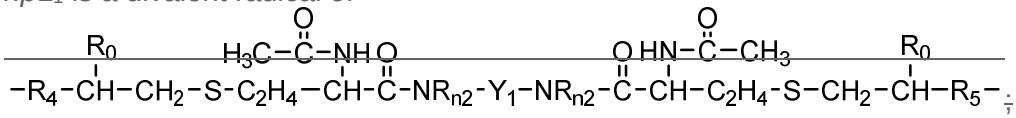
L_4 is a divalent radical of ;

;

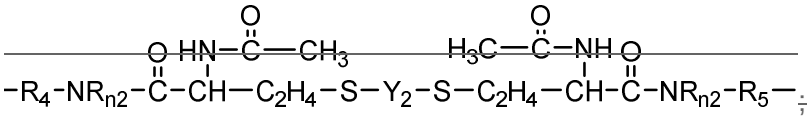
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;

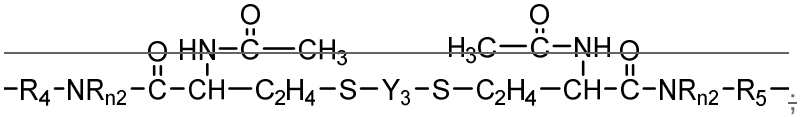
hpL_1 is a divalent radical of

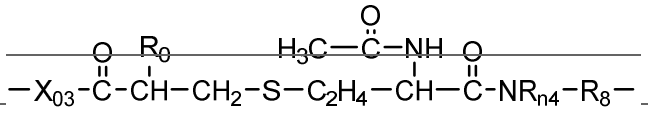
;

hpL_2 is a divalent radical of

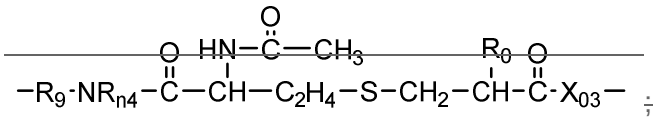
;

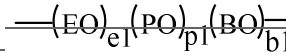
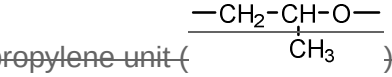
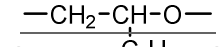
hpL_3 is a divalent radical of

;

hpL_4 is a divalent radical of 

or

;

pOAlk is a divalent radical of  in which EO is an oxyethylene unit ($-CH_2CH_2O-$), PO is an oxypropylene unit (), and BO is an oxybutylene unit ();

M_0 is C_3-C_8 alkylene divalent radical;

M_1 is a C_4-C_{14} hydrocarbon divalent radical;

M_2 and M_3 independent of each other are a C_1-C_6 alkylene divalent radical;

J_0 is a C_1-C_{12} hydrocarbon radical having 0 to 2 hydroxyl or carboxyl groups;

G1 is a direct bond, a C_1-C_4 alkylene divalent radical, or a bivalent radical of

$-X_{04}-(C_2H_4O)_{h1}-CONH-M_1-NHCO-O-(C_2H_4O)_{h2}-M_0-$,

$-X_{05}-M_2-O-CONH-M_1-NHCO-O-(C_2H_4O)_{h2}-M_0-$,

$-X_{06}-CH_2-CH(OH)-CH_2-O-(C_2H_4O)_{h2}-M_0-$, $-X_{07}-(C_2H_4O)_{h2}-M_0-$,

$-X_{08}-M_3-NHCOO-(C_2H_4O)_{h1}-M_0-$, $-X_{10}-CH_2-CH(OH)-CH_2-X_{09}-(C_2H_4O)_{h2}-M_0-$,

$-X_{07}-M_3-X_{09}-CH_2-CH(OH)-CH_2-O-M_0-$, or

$-X_{08}-(C_2H_4O)_{h1}-CH_2-CH(OH)-CH_2-O-M_0-$ in which M_0 is linked to Si atom while X_{04} to X_{10} are linked to the group of $-CH_2-$ in formula (7) and at least one of J_0 and G1 in formula (7) comprises at least one moieties selected from the group consisting of hydroxyl groups, urethane linkage of $-OCONH-$, amino groups of $-NHR^e$, amino linkages of $-NH-$, amide linkages of $-CONH-$, carboxyl groups, and combinations thereof;

G_2 is a C_1-C_4 alkylene divalent radical or a bivalent radical of

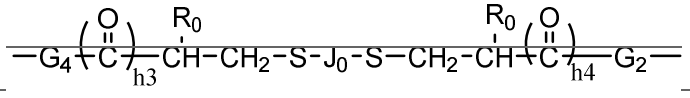
$-(C_2H_4O)_{h1}-CONH-M_1-NHCO-O-(C_2H_4O)_{h2}-M_0-$,

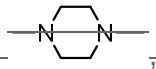
$-M_2-O-CONH-M_1-NHCO-O-(C_2H_4O)_{h2}-M_0-$, $-CH_2-CH(OH)-CH_2-O-(C_2H_4O)_{h2}-M_0-$,

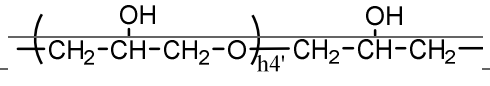
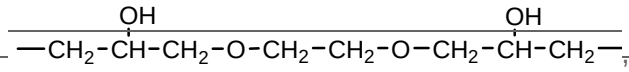
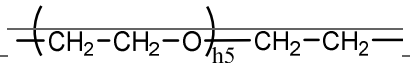
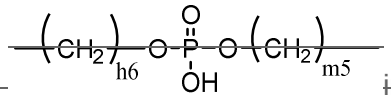
$-(C_2H_4O)_{h2}-M_0-$, $-M_3-NHCOO-(C_2H_4O)_{h1}-M_0-$,

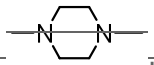
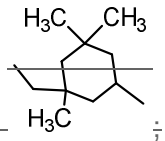
$-CH_2-CH(OH)-CH_2-X_{09}-(C_2H_4O)_{h2}-M_0-$, $-M_3-X_{09}-CH_2-CH(OH)-CH_2-O-M_0-$, or

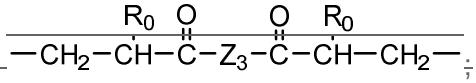
$-(C_2H_4O)_{h1}-CH_2-CH(OH)-CH_2-O-M_0-$;

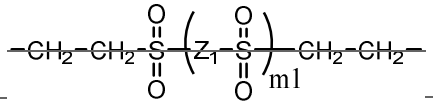
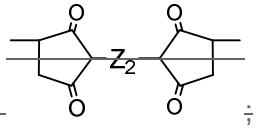
G_3 is a divalent radical of  in which h3 and h4 independent of each other are 1 or 0;

G4 is a divalent radical of any one of (a) $-NR_3'-$ in which R_3' is hydrogen or C_1-C_3 alkyl, (b) , (c) $-NR_0-G_5-NR_0-$ in which G_5 is a C_1-C_6 alkylene divalent radical, 2-hydroxylpropylene divalent radical, 2-(phosphonyloxy)propylene divalent radical, 1,2-dihydroxyethylene divalent radical, 2,3-dihydroxybutylene divalent radical, and (d) $-O-G_6-O-$ in which G_6 is a C_1-C_6 alkylene divalent radical, a

divalent radical of  in which h4' is 1 or 2, a divalent radical of , a divalent radical of  in which h5 is an integer of 1 to 5, a divalent radical of  in which h6 is 2 or 3, or a substituted C_3-C_8 alkylene divalent radical having a hydroxyl group or phosphonyloxy group;

Y_1 is a C_1-C_6 alkylene divalent radical, 2-hydroxylpropylene divalent radical, 2-(phosphonyloxy)propylene divalent radical, 1,2-dihydroxyethylene divalent radical, a divalent radical of , or a divalent radical of ;

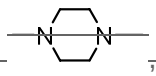
Y_2 is a divalent radical of ;

Y_3 is a divalent radical of  or ;

Z_0 is a direct bond or a C_1-C_{12} alkylene divalent radical;

Z_1 is a C_1-C_6 alkylene divalent radical, a hydroxyl-or methoxy-substituted C_1-C_6 alkylene divalent radical, or a substituted or unsubstituted phenylene divalent radical,

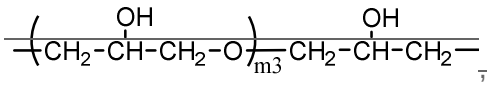
Z_2 is a C_1-C_6 alkylene divalent radical, a hydroxyl-or methoxy-substituted C_1-C_6 alkylene divalent radical, a dihydroxyl- or dimethoxy-substituted C_2-C_6 alkylene divalent radical, a divalent radical of $-C_2H_4-(O-C_2H_4)_{m2}-$, a divalent radical of $-Z_4-S-S-Z_4-$, a hydroxyl- or methoxy-substituted C_1-C_6 alkylene divalent radical, or a substituted or unsubstituted phenylene divalent radical,

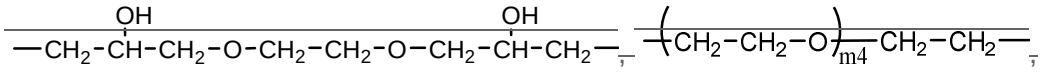
Z_3 is a divalent radical of any one of (a) $-NR_{n3}-$, (b) , (c) $-NR_0-Z_5-NR_0-$, and (d) $-O-Z_6-O-$,

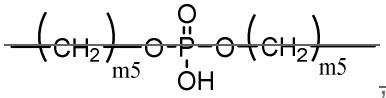
Z_4 is a C_1-C_6 alkylene divalent radical,

Z_5 is a C_1-C_6 alkylene divalent radical, 2-hydroxylpropylene divalent radical, 2-(phosphonyloxy)propylene divalent radical, 1,2-dihydroxyethylene divalent radical, 2,3-dihydroxybutylene divalent radical,

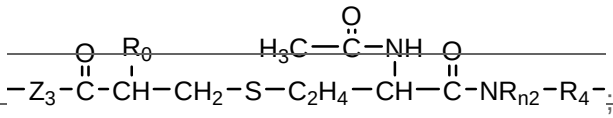
~~Z_6 is (a) a C_1-C_6 alkylene divalent radical, (b) a divalent radical of~~

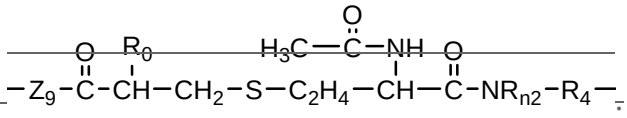






~~, or (c) a substituted C_3-C_8 alkylene divalent radical having a hydroxyl group or phosphonyloxy group,~~

~~Z_7 is a divalent radical of~~ ~~;~~ ~~and~~

~~Z_8 is a divalent radical of~~ ~~.~~

1<u>3</u>~~4~~. The ~~method of~~ <u>method of claim 4</u>~~any one of claims 1 to 11~~, wherein the polymerizable ~~materials comprise~~<u>composition comprises</u> at least one silicone-containing vinylic crosslinker which is α,ω-bis[3-(meth)acrylamidopropyl]-terminated polydimethylsiloxane, α,ω-bis[3-(meth)acryloxypropyl]-terminated polydimethylsiloxane, α,ω-bis[3-(meth)acryloxy-2-hydroxypropyloxypropyl]-terminated polydimethylsiloxane, α,ω-bis[3-(meth)acryloxyethoxy-2-hydroxypropyloxypropyl]-terminated polydimethylsiloxane, α,ω-bis[3-(meth)acryloxypropyloxy-2-hydroxypropyloxypropyl]-terminated polydimethylsiloxane, α,ω-bis[3-(meth)acryloxy-isopropyloxy-2-hydroxypropyloxypropyl]-terminated polydimethylsiloxane, α,ω-bis[3-(meth)acryloxybutyloxy-2-hydroxypropyloxypropyl]-terminated polydimethylsiloxane, α,ω-bis[3-(meth)acrylamidoethoxy-2-hydroxypropyloxypropyl]-terminated polydimethylsiloxane, α,ω-bis[3-(meth)acrylamidopropyloxy-2-hydroxypropyloxypropyl]-terminated polydimethylsiloxane, α,ω-bis[3-(meth)acrylamidoisopropyloxy-2-hydroxypropyloxypropyl]-terminated polydimethylsiloxane, α,ω-bis[3-(meth)acrylamidobutyloxy-2-hydroxypropyloxypropyl]-terminated polydimethylsiloxane, α,ω-bis[3-(meth)acryloxyethylamino-2-hydroxypropyloxypropyl]-terminated polydimethylsiloxane, α,ω-bis[3-(meth)acryloxypropylamino-2-hydroxypropyloxypropyl]-terminated polydimethylsiloxane, α,ω-bis[3-(meth)acryloxybutylamino-2-hydroxypropyloxypropyl]-terminated polydimethylsiloxane, α,ω-bis[(meth)acrylamidoethylamino-2-hydroxypropyloxy-

propyl]-terminated polydimethylsiloxane, α,ω-bis[3-(meth)acrylamidopropylamino-2-hydroxypropyloxypropyl]-terminated polydimethylsiloxane, α,ω-bis[3-(meth)acrylamide-butylamino-2-hydroxypropyloxypropyl]-terminated polydimethylsiloxane, α,ω-bis[(meth)acryloxy-2-hydroxypropyloxy-ethoxypropyl]-terminated polydimethylsiloxane, α,ω-bis[(meth)acryloxy-2-hydroxypropyl-N-ethylaminopropyl]-terminated polydimethylsiloxane, α,ω-bis[(meth)acryloxy-2-hydroxypropyl-aminopropyl]-polydimethylsiloxane, α,ω-bis[(meth)acryloxy-2-hydroxypropyloxy-(polyethylenoxy)propyl]-terminated polydimethylsiloxane, α,ω-bis[(meth)acryloxyethylamino-carbonyloxy-ethoxypropyl]-terminated polydimethylsiloxane, α,ω-bis[(meth)acryloxyethylamino-carbonyloxy-(polyethylenoxy)propyl]-terminated polydimethylsiloxane, or a combination thereof.

145. The method of ~~any one of claims 1 to 14~~claim 4, wherein said at least one hydrophilic N-vinyl amide monomer is N-vinylpyrrolidone, N-vinyl piperidone, N-vinyl caprolactam, N-vinyl-N-methyl acetamide, N-vinyl formamide, N-vinyl acetamide, N-vinyl isopropylamide, N-vinyl-N-methyl acetamide, N-vinyl-N-ethyl acetamide, N-vinyl-N-ethyl formamide, or a mixture thereof.

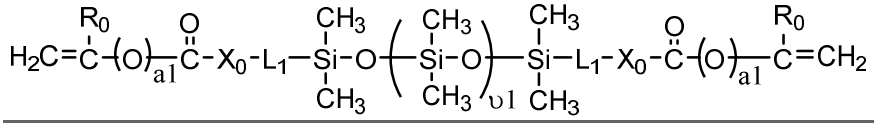
156. The method of ~~any one of~~ claim 4~~claims 1 to 15~~, wherein the polymerizable composition further comprises from about 1% to about 10% by weight of at least one hydrophilic acrylic monomer relative to the total weight of the polymerizable composition, wherein said at least one hydrophilic acrylic monomer is N,N-dimethyl (meth)acrylamide, (meth)acrylamide, N-hydroxylethyl (meth)acrylamide, N-hydroxypropyl (meth)acrylamide, hydroxyethyl methacrylate, glycerol methacrylate (GMA), polyethylene glycol (meth)acrylate having a number average molecular weight of up to 1500, polyethylene glycol C_1-C_4-alkyl ether (meth)acrylate having a number average molecular weight of up to 1500, *N*-[tris(hydroxymethyl)methyl]-acrylamide, (meth)acrylic acid, ethylacrylic acid, or a combination thereof.

167. The method of claim 4~~any one of claims 1 to 16~~, wherein the ultrasonic horn has a convex surface which is in contact with the lens-adhered mold half.

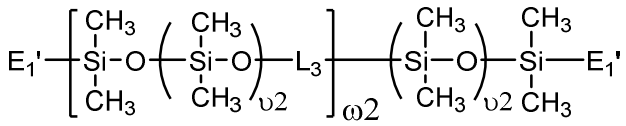
178. The method of claim 4~~any one of claims 1 to 16~~, wherein the ultrasonic horn has a concave surface which is in contact with the lens-adhered mold half.

189. The method of claim 4~~any one of claims 1 to 16~~, wherein the ultrasonic horn has a flat surface which is in contact with the lens-adhered mold half.

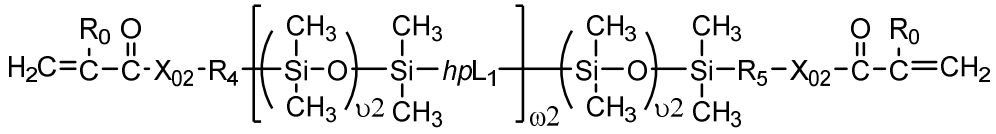
19. The method of claim 4, wherein said at least one polysiloxane vinylic crosslinker is a vinylic crosslinker of formula (1), (2) or (3)



(1)



(2)



(3)

in which:

□1 is an integer of from 30 to 500;

□2 is an integer of from 5 to 50;

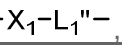
ω2 is an integer of from 1 to 15;

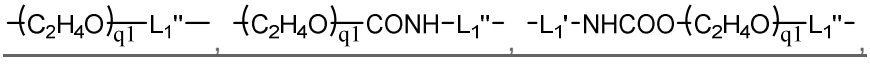
a1 is zero or 1;

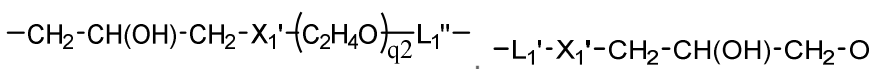
R_0 is H or methyl;

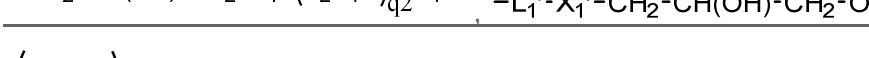
X_0 is O or NR_1;

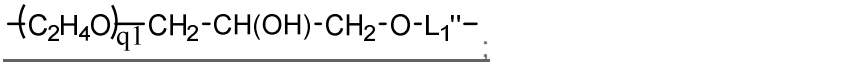
R_1 is H or a C_1-C_4 alkyl having 0 to 2 hydroxyl group;

L_1 is a C_2-C_8 alkylene divalent radical or a divalent radical of ,

,

,

, or

;

X_1 is O, NR_1, NHCOO, OCONH, $CONR_1$, or NR_1CO;

X_1' is O or NR_1;

q1 is an integer of 1 to 20 and q2 is an integer of 0 to 20;

L_1' is a C_2-C_8 alkylene divalent radical which has zero or one hydroxyl group;

L_1" is C_3-C_8 alkylene divalent radical which has zero or one hydroxyl group;

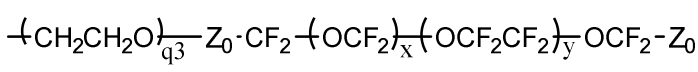
L_3 is a divalent radical of



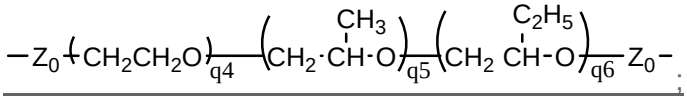
in which

g1 is zero or 1;

PE is a divalent radical of



or

;

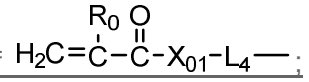
Z_0 is a direct bond or a C_1-C_{12} alkylene divalent radical;

L_3' is C_3-C_8 alkylene divalent radical;

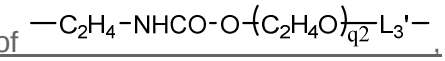
R_2 is a C_4-C_{14} hydrocarbon divalent radical;

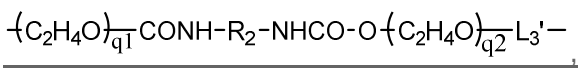
q3 is an integer of 0 to 2, q4 is an integer of 2 to 50, q5 and q6 independent of each other are a number of 0 to 35, provided that (q4+q5+q6) is an integer of 2 to 50;

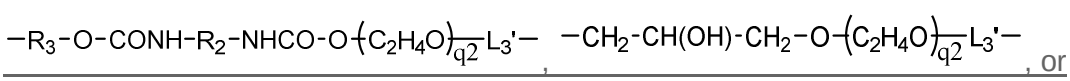
x+y is an integer of from 10 to 30;

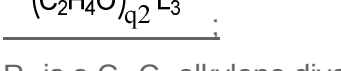
E_1' is a monovalent radical of ;

X_{o1} is O or NR_1;

L_4 is a divalent radical of ,

,

, , or

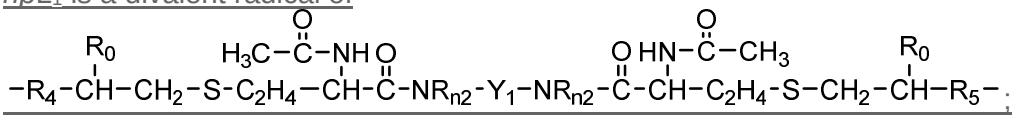
;

R_3 is a C_2-C_6 alkylene divalent radical;

X_{02} is O or NR_1;

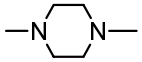
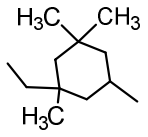
R_4 and R_5 independent of each other are a C_1-C_6 alkylene divalent radical or a C_1-C_6 alkylene-oxy-C_1-C_6 alkylene divalent radical;

hpL_1 is a divalent radical of

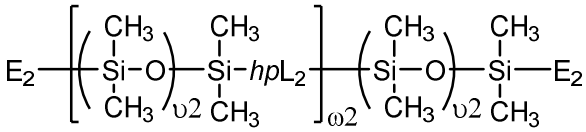
;

R_{n2} is H or a C_1-C_4 alkyl having 0 to 2 hydroxyl group; and

Y_1 is a C_1-C_6 alkylene divalent radical, 2-hydroxylpropylene divalent radical, 2-(phosphonyloxy)propylene divalent radical, 1,2-dihydroxyethylene divalent radical,

a divalent radical of , or a divalent radical of .

20. The method of claim 4, wherein said at least one polysiloxane vinylic crosslinker is a vinylic crosslinker of any one of formula (4)

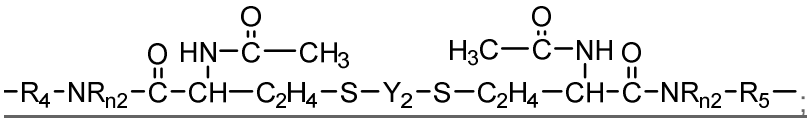
 (4)

in which:

□2 is an integer of from 5 to 50;

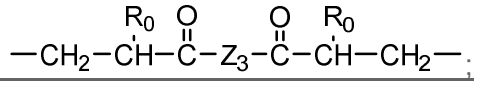
ω2 is an integer of from 1 to 15;

hpL_2 is a divalent radical of

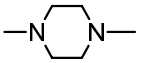


R_4 and R_5 independent of each other are a C_1-C_6 alkylene divalent radical or a C_1-C_6 alkylene-oxy-C_1-C_6 alkylene divalent radical;

R_{n2} is H or a C_1-C_4 alkyl having 0 to 2 hydroxyl group;

Y_2 is a divalent radical of ;

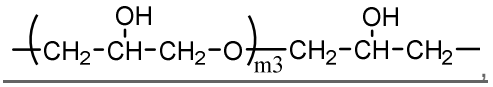
R_o is H or methyl;

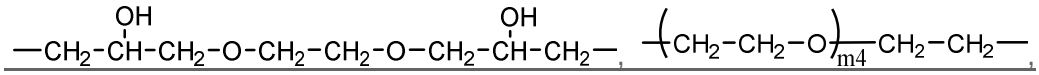
Z_3 is a divalent radical of any one of (a) $–NR_{n3}–$, (b) , (c) $–NR_0–Z_5–NR_0–$, and (d) $–O–Z_6–O–$;

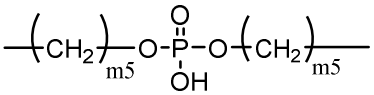
R_{n3} is H or a C_1-C_4 alkyl having 0 to 2 hydroxyl group;

Z_5 is a C_1-C_6 alkylene divalent radical, 2-hydroxylpropylene divalent radical, 2-(phosphonyloxy)propylene divalent radical, 1,2-dihydroxyethylene divalent radical, 2,3-dihydroxybutylene divalent radical,

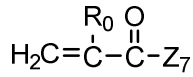
Z_6 is (a) a C_1-C_6 alkylene divalent radical, (b) a divalent radical of

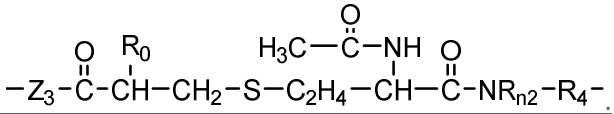
,

,

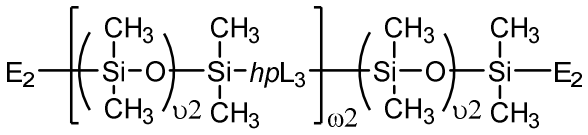
, or (c) a substituted C_3-C_8 alkylene divalent radical having a hydroxyl group or phosphonyloxy group;

m3 is 0 or 1, m4 is an integer of 1 to 5, and m5 is 2 or 3;

E_2 is a monovalent radical of ; and

Z_7 is a divalent radical of .

21. The method of claim 4, wherein said at least one polysiloxane vinylic crosslinker is a vinylic crosslinker of formula (5)



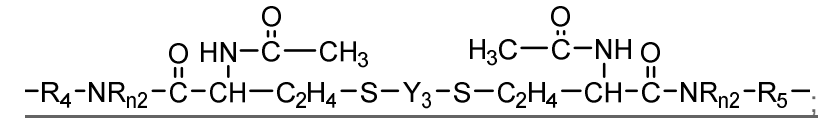
(5)

in which:

□2 is an integer of from 5 to 50;

ω2 is an integer of from 1 to 15;

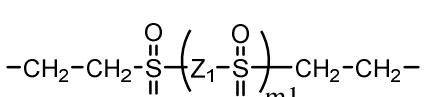
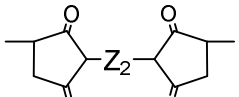
hpL_3 is a divalent radical of



;

R_4 and R_5 independent of each other are a C_1-C_6 alkylene divalent radical or a C_1-C_6 alkylene-oxy-C_1-C_6 alkylene divalent radical;

R_{n2} is H or a C_1-C_4 alkyl having 0 to 2 hydroxyl group;

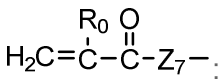
Y_3 is a divalent radical of  or ;

m1 is 0 or 1;

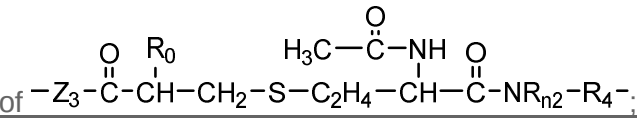
Z_1 is a C_1-C_6 alkylene divalent radical, a hydroxyl-or methoxy-substituted C_1-C_6 alkylene divalent radical, or a substituted or unsubstituted phenylene divalent radical,

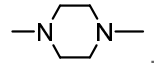
Z_2 is a C_1-C_6 alkylene divalent radical, a hydroxyl-or methoxy-substituted C_1-C_6 alkylene divalent radical, a dihydroxyl- or dimethoxy-substituted C_2-C_6 alkylene divalent radical, a divalent radical of $–C_2H_4–(O–C_2H_4)_{m2}–$ in which m2 is an integer of 1 to 6, a divalent radical of $–Z_4–S–S–Z_4–$, a hydroxyl- or methoxy-substituted C_1-C_6 alkylene divalent radical, or a substituted or unsubstituted phenylene divalent radical,

Z_4 is a C_1-C_6 alkylene divalent radical;

E_2 is a monovalent radical of ;

R_o is H or methyl;

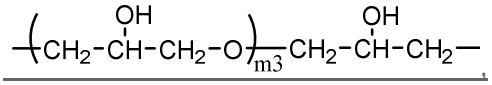
Z_7 is a divalent radical of ;

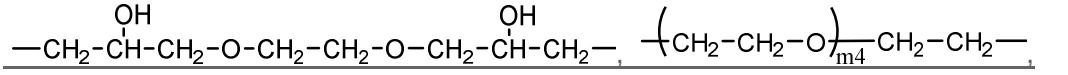
Z_3 is a divalent radical of any one of (a) $–NR_{n3}–$, (b) , (c) $–NR_0–Z_5–NR_0–$, and (d) $–O–Z_6–O–$;

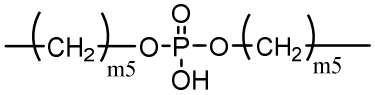
R_{n3} is H or a C_1-C_4 alkyl having 0 to 2 hydroxyl group;

Z_5 is a C_1-C_6 alkylene divalent radical, 2-hydroxylpropylene divalent radical, 2-(phosphonyloxy)propylene divalent radical, 1,2-dihydroxyethylene divalent radical, 2,3-dihydroxybutylene divalent radical;

Z_6 is (a) a C_1-C_6 alkylene divalent radical, (b) a divalent radical of

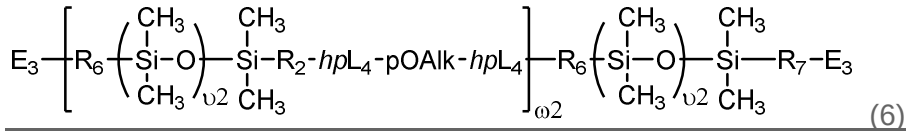





, or (c) a substituted C_3-C_8 alkylene divalent radical having a hydroxyl group or phosphonyloxy group; and

m3 is 0 or 1, m4 is an integer of 1 to 5, and m5 is 2 or 3.

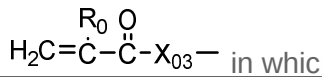
22. The method of claim 4, wherein said at least one polysiloxane vinylic crosslinker is a vinylic crosslinker of formula (6)


(6)

in which:

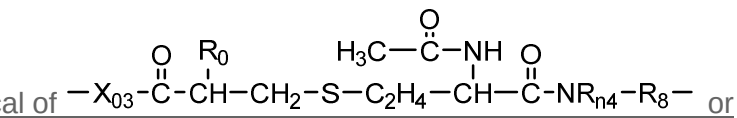
□2 is an integer of from 5 to 50;

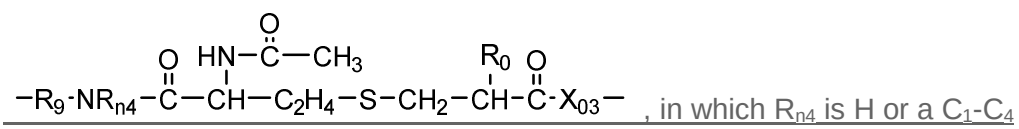
ω2 is an integer of from 1 to 15;

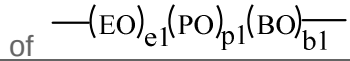
E_3 is a monovalent radical of  in which X_{03} is O or NR_1 and R_o is H or methyl;

R_2 is a C_4-C_{14} hydrocarbon divalent radical;

R_6 and R_7 independent of each other are a C_1-C_6 alkylene divalent radical or a C_1-C_6 alkoxy-C_1-C_6 alkylene divalent radical;

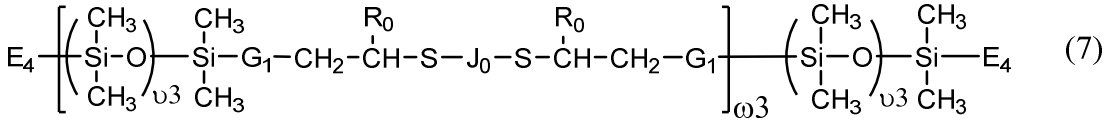
hpL_4 is a divalent radical of  or


, in which R_{n4} is H or a C_1-C_4 alkyl having 0 to 2 hydroxyl group, R_8 and R_9 independent of each other are a substituted or unsubstituted C_1-C_{12} alkylene divalent radical;

pOAlk is a divalent radical of  in which EO is an

oxyethylene unit (–CH_2CH_2O–), PO is an oxypropylene unit ($-CH_2-\underset{CH_3}{CH}-O-$), BO is an oxybutylene unit ($-CH_2-\underset{C_2H_5}{CH}-O-$), e1 is an integer of 5 to 100, p1 and b1 independent of each other are an integer of 0 to 50, provided that (e1+p1+b1)≥10 and $e1/(p1+b1)$ ≥ 2 when (p1+b1)≥1.

23. The method of claim 4, wherein said at least one polysiloxane vinylic crosslinker is a vinylic crosslinker of formula (7)



(7)

in which:

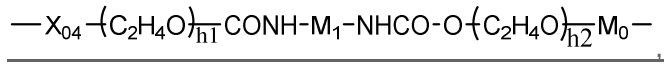
□3 is an integer of from 5 to 100;

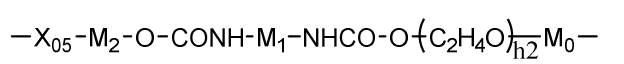
ω3 is an integer of from 1 to 15;

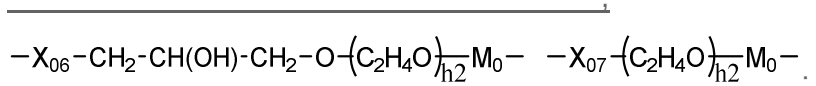
R_o is H or methyl;

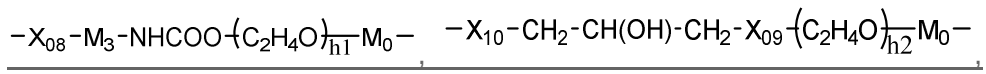
J_0 is a C_1–C_{12} hydrocarbon radical having 0 to 2 hydroxyl or carboxyl groups;

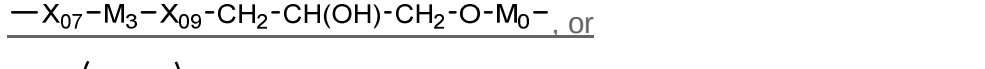
G1 is a direct bond, a C_1-C_4 alkylene divalent radical, or a bivalent radical of

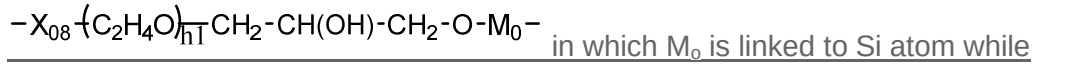












in which M_o is linked to Si atom while X_{04} to X_{10} are linked to the group of –CH_2– in formula (7) and at least one of J_0 and G1 in formula (7) comprises at least one moieties selected from the group consisting of hydroxyl groups, urethane linkage of –OCONH–, amino groups of –NHR^o, amino linkages of –NH–, amide linkages of –CONH–, carboxyl groups, and combinations thereof;

h1 is an integer of 1 to 20 and h2 is an integer of 0 to 20;

X_{o4} is –COO– or –$CONR_{n5}$–;

R_{n5} is H or a C_1-C_{10} alkyl;

X_{o5} and X_{o7} independent of each other are a direct bond, –COO– or –$CONR_{n5}$–;

X_{o6} is a direct bond, a C_1-C_6 alkylene divalent radical, a C_1-C_6 alkylenoxy divalent radical, –COO–, or –$CONR_{n5}$–;

X_{o8} is a direct bond or –COO–;

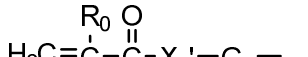
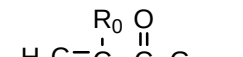
X_{o9} is O or NR_{n5};

X_{10} is a direct bond, a C_1-C_6 alkylene divalent radical, –COO–, or –$CONR_{n5}$–;

M_0 is C_3-C_8 alkylene divalent radical;

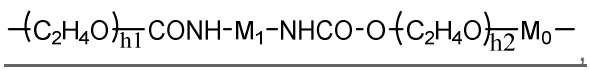
M_1 is a C_4-C_{14} hydrocarbon divalent radical;

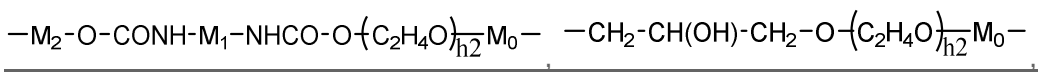
M_2 and M_3 independent of each other are a C_1-C_6 alkylene divalent radical;

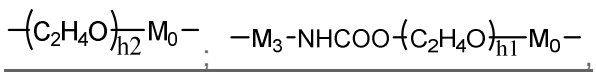
E_4 is a monovalent radical of  or ;

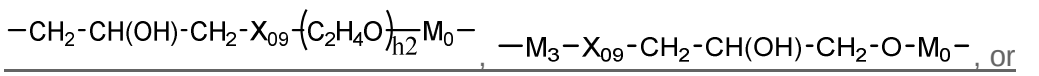
X_1' is O or NR_1 in which R_1 is H or C_1-C_4 alkyl having 0 to 2 hydroxyl group;

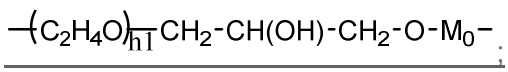
G_2 is a C_1-C_4 alkylene divalent radical or a bivalent radical of

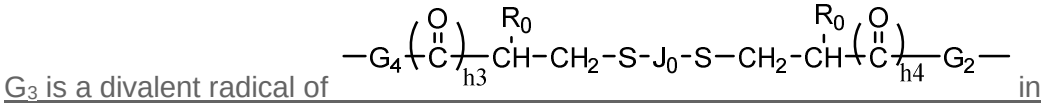
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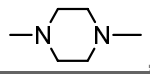
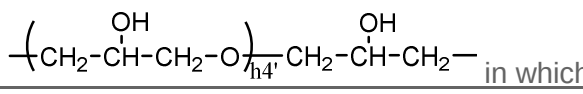
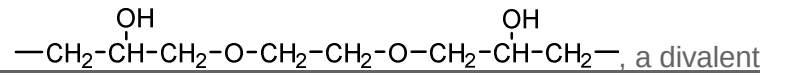
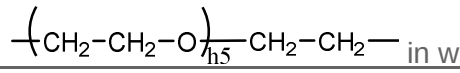
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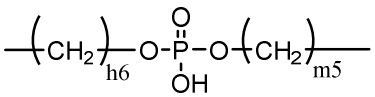
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, or

;

G_3 is a divalent radical of  in which h3 and h4 independent of each other are 1 or 0;

G4 is a divalent radical of any one of (a) –NR_3'– in which R_3' is hydrogen or C_1-C_3 alkyl, (b) , (c) –NR_0–G_5–NR_0– in which G_5 is a C_1-C_6 alkylene divalent radical, 2-hydroxylpropylene divalent radical, 2-(phosphonyloxy)propylene divalent radical, 1,2-dihydroxyethylene divalent radical, 2,3-dihydroxybutylene divalent radical, and (d) –O–G_6–O– in which G_6 is a C_1-C_6 alkylene divalent radical, a divalent radical of  in which h4' is 1 or 2, a divalent radical of , a divalent radical of  in which h5 is an integer of 1 to 5, a

divalent radical of  in which h6 is 2 or 3, or a substituted C_3-C_8 alkylene divalent radical having a hydroxyl group or phosphonyloxy group and m5 is 2 or 3.