Claims

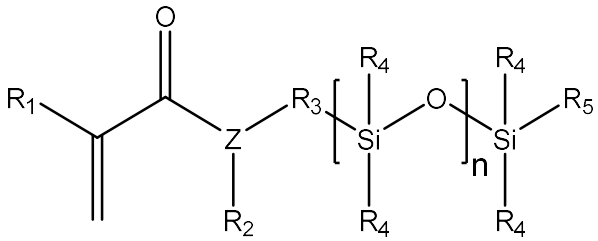
1. A method for making a cosmetic silicone hydrogel contact lens, the method comprising: (i) applying a clear coat to a lens forming surface of a first lens forming mold; (ii) applying to the clear coat an ink composition; (iii) optionally repeating step (i), step (ii), or both step (i) and step (ii); (iv) dispensing a lens material to the first lens forming mold; (v) applying a second lens forming mold; and (vi) curing the lens material to form the cosmetic silicone hydrogel contact lens;

wherein the clear coat does not comprise a colorant; and comprises a nonreactive hydrophilic polymer; and a binder polymer;

wherein the ink composition comprises a colorant; a nonreactive hydrophilic polymer; and a binder polymer;

wherein the binder polymer of the clear coat and ink composition comprises a copolymer formed from a hydrophilic monomer comprising functionality selected from the group consisting of hydroxyalkyl, aminoalkyl, and mixtures thereof; a silicone-containing macromer; and optionally a silicone-containing monomer;

wherein the silicone-containing macromer comprises a chemical structure shown in Formula I:



Formula I

wherein Z is selected from O, N, S or NCH_2CH_2O; when Z = O or S, R_2 is not required; wherein R_1 is a hydrogen atom or methyl; wherein n is a whole number between 1 and 200; wherein R_3 is an alkylene segment $(CH_2)_y$ in which y is a whole number from 1 to 6, and each methylene group may be optionally further and independently substituted with a group selected from the group consisting of ethers, amines, esters, ketones, carbonyls, carboxylates, and carbamates, or when y

is 2 or more a non-terminal methylene group is optionally replaced with a carbamate group; or wherein R_3 is an oxyalkylene segment $O(CH_2)_z$ in which z is a whole number from 1 to 3, or wherein R_3 is a mixture of alkylene and oxyalkylene segments and the sum of y and z is between 1 and 9; wherein R_2 and R_4 are independently a hydrogen atom, a linear, branched, or cyclic alkyl group containing between one and six carbon atoms, a linear, branched, or cyclic alkoxy group containing between one and six carbon atoms, a linear or branched polyethyelenoxyalkyl group, an alkyl-siloxanyl-alkyl group, a phenyl group, a benzyl group, a substituted or un-substituted aryl group, a fluoroalkyl group, a partially fluorinated alkyl group, a perfluoroalkyl group, a fluorine atom, a mono-, di, or tri-hydroxyalkyl group containing between one and six carbon atoms, or combinations thereof; and wherein R_5 is a substituted or un-substituted linear, branched, or cyclic alkyl group having 1 to 8 carbon atoms or an aryl group, any of which may be further substituted with one or more fluorine atoms or trimethylsiloxy groups.

2. The method of claim 1 wherein:

(a) the nonreactive hydrophilic polymer of the clear coat and/or ink composition comprises a polyamide; or

(b) wherein the nonreactive hydrophilic polymer of the clear coat and/or ink composition comprises: dextran, poly(ethylene oxide), polyvinyl alcohol (PVA), poly (N-isopropylacrylamide), poly(oligoethylene oxide), polyethylene glycol (PEG), poly (N,N-dimethylaminoethyl acrylate), poly(imine), poly(acrylic acid), or mixtures of two or more thereof; or

(c) wherein the nonreactive hydrophilic polymer of the clear coat and/or ink composition comprises a cyclic polyamide.

3. The method of any of claims 1 or 2, wherein the clear coat and/or ink composition further comprises a solvent; optionally wherein the solvent comprises: ethanol, 1-propanol, 2-propanol, 1-ethoxy-2-propanol (1E2P), t-butyl alcohol, t-amyl alcohol, and 3,7-dimethyl-1,7-octanediol (D3O), tripropylene glycol methyl ether (TPME), isopropyl lactate (IPL), 1-(2-hydroxy ethyl)-2-pyrrolidone (HEP), glycerol or mixtures of two or more thereof.

4. The method of any one of claims 1 to 3 wherein the colorant comprises: pthalocyanine blue, pthalocyanine green, carbazole violet, vat orange #1, iron oxide black, iron oxide brown, iron oxide yellow, iron oxide red, titanium dioxide, dichlorotriazine, vinyl sulfone-based dyes, and mixtures of two or more thereof.

5. The method of any one of claims 1 to 4, wherein the ink composition comprises: from 0.1 to about 25 weight percent of the colorant; from about 1 to about 50 weight percent of the nonreactive hydrophilic polymer; from about 1 to 60 weight percent of the binder polymer; and from about 50 to about 95 weight percent of a solvent, each based on the total weight of the ink composition.

6. The method of any of any one of claims 1 to 5 wherein the binder polymer of the clear coat and/or ink composition

(a) has a weight average molecular weight in the range of about 10 to about 100 kDa; and/or

(b) is not a block co- or tri-polymer; and/or

(c) is a random copolymer.

7. The method of any of claims to 1 to 6 wherein the nonreactive hydrophilic polymer of the clear coat and/or ink composition

(a) is poly(vinylpyrrolidone); and/or

(b) has a weight average molecular weight from about 30,000 to about 500,000.

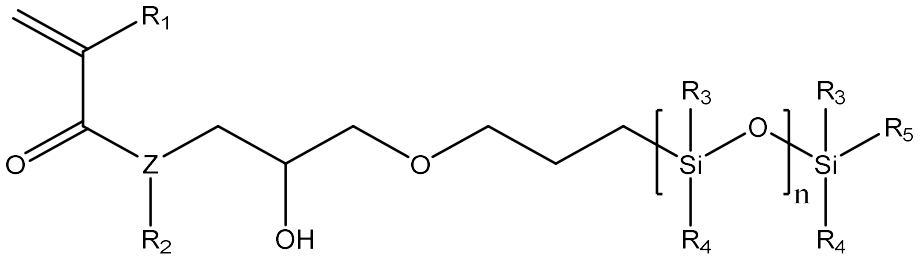
8. The method of any one of claims 1-7, wherein the hydrophilic monomer comprises 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 3-hydroxypropyl (meth)acrylate, 2,3-dihydroxypropyl (meth)acrylate, 2-hydroxybutyl (meth)acrylate, 3-hydroxybutyl (meth)acrylate, 4-hydroxybutyl (meth)acrylate, N-(2-hydroxyethyl) (meth)acrylamide, N,N-bis(2-hydroxyethyl) (meth)acrylamide, N-(2-hydroxypropyl) (meth)acrylamide, N,N-bis(2-hydroxypropyl) (meth)acrylamide, N-(3-hydroxypropyl) (meth)acrylamide, N-(2-hydroxybutyl) (meth)acrylamide, N-(3-hydroxybutyl) (meth)acrylamide, N-(4-hydroxybutyl) (meth)acrylamide, or mixtures thereof;

optionally wherein the hydrophilic monomer is 2-hydroxyethyl (meth)acrylate.

9. The method of any one of claims 1 to 8, wherein the silicone-containing macromer

(a) is selected from the group consisting of monoalkyl terminated, mono(meth)acrylate terminated poly(dialkylsiloxanes), monoalkyl terminated, monoalkyl terminated, mono(meth)acrylate terminated poly(diarylsiloxanes), monoalkyl terminated, mono(meth)acrylate terminated poly(alkylarylsiloxanes), and mixtures thereof; optionally wherein the silicone-containing macromer is mono-n-butyl terminated monomethacryloxypropyl terminated polydimethylsiloxane; and/or

(b) comprises a chemical structure shown in Formula VIII:



Formula VIII

wherein Z is selected from O, N, S or NCH_2CH_2O; wherein R_1 is independently hydrogen atom or methyl group; wherein R_2, R_3, and R_4 are independently a hydrogen atom or a linear, branched, or cyclic alkyl group containing one to eight carbon atoms, any of which may be further substituted with at least one hydroxy group, and which may be optionally substituted with amido, ether, amino, carboxyl, carbonyl groups and combinations thereof; for Z = O and S, R_2 is not required; wherein n is the number of siloxane repeating units and is from 4 to 200; and wherein R_5 is selected from straight or branched C_1 to C_8 alkyl groups; and/or

(c) is mono-n-butyl terminated mono-(2-hydroxy-3-methacryloxypropyl)-propyl ether terminated polydimethylsiloxane; and/or

(d) is selected from the group consisting of mono-n-butyl terminated monomethacryloxypropyl terminated polydimethylsiloxane, mono-n-butyl terminated mono-(2-hydroxy-3-methacryloxypropyl)-propyl ether terminated polydimethylsiloxane, and mixtures thereof.

10. The method of any one of claims 1 to 9, wherein the silicone-containing macromer has a number average molecular weight greater than 500 Daltons or between about 500 Daltons and about 20,000 Daltons.

11. The method of any of claims 1 to 10, wherein the repeating units of the silicone-containing macromer are present in the range of about 30 and about 80 weight percent of the total weight of the binder polymer.

12. The method of any of claims 1 to 11, wherein the silicone-containing monomer is selected from the group consisting of: 3-methacryloxypropyl tris(trimethylsiloxy)silane, 3-acryloxypropyl tris(trimethylsiloxy)silane, 3-methacrylamidopropyl tris(trimethylsiloxy)silane, 3-acrylamidopropyl tris(trimethylsiloxy)silane, tris(trimethylsiloxy)silyl styrene, 2-methyl-2-hydroxy-3-[3-[1,3,3,3-tetramethyl-1-[(trimethylsilyl)oxy]disiloxanyl]propoxy]propyl ester, N-(2,3-dihydroxylpropyl) N-(3-tetra(dimethylsiloxy)dimethylbutylsilane)propyl) acrylamide and mixtures thereof.

13. A cosmetic silicone hydrogel contact lens obtained by the method of any one of claims 1 to 12.

14. The cosmetic contact lens of claim 13 further comprising an internal wetting agent.

15. The cosmetic contact lens of claims 13 or 14

(a) wherein the lens comprises multiple layers of ink composition wherein the multiple layers of ink composition may be the same or different; and/or

(b) further comprising an ink layer that is free of nonreactive hydrophilic polymer.