

What is claimed is:

1. A method for making coated contact lenses, comprising the steps of:
 - (1) obtaining a contact lens precursor which has a concave surface and an opposite convex surface and comprises a lens bulk material and first reactive functional groups on and/or near the anterior and posterior surfaces, wherein the first reactive functional groups are selected from the group consisting of carboxyl groups, amino groups, azetidinium groups, epoxide groups, aziridine groups, vinylsulfone groups, thiol groups, and combinations thereof;
 - (2) immersing the contact lens precursor in an aqueous solution in a container, wherein the aqueous solution has a room temperature and comprises (a) at least one hydrophilic polymeric material and (b) a pH-buffering system for maintaining pH of the aqueous solution, wherein the pH-buffering system comprises at least two buffering agents, wherein the total concentration of all buffering agents present in the aqueous solution is from about 10 mM to 100 mM, wherein the aqueous solution has a room temperature and a pH of from about 6.8 to about 7.5, wherein the totally concentration of all ions present in the aqueous solution is less than 241 mM, provided that the total concentration of all ions each having two or more charges in the aqueous solution is less than 80 mM, wherein said at least one hydrophilic polymeric material comprises second reactive functional groups each of which is capable of reacting with one first reactive functional group at a temperature above the room temperature to form a covalent linkage, wherein the second reactive functional groups are selected from the group consisting of carboxyl groups, amino groups, azetidinium groups, epoxide groups, aziridine groups, thiol groups, and combinations thereof; and
 - (3) heating the aqueous solution with the contact lens precursor therein to a crosslinking-temperature of from about 50°C to about 140°C and then maintaining the crosslinking temperature for at least about 20 minutes to form a coated contact lens having a hydrogel coating thereon.
2. The method of claim 1, wherein the contact lens precursor inherently comprises comprise first reactive functional groups on and/or near the anterior and posterior surfaces, or wherein the contact lens precursor is obtained by subjecting a preformed contact lens to a surface treatment to have the first reactive functional groups.
3. The method of claim 1 or 2, wherein if the first reactive functional groups are carboxyl groups and/or amino groups, then the second reactive functional groups are azetidinium groups, epoxy groups, aziridine groups, or combinations thereof; wherein if the first reactive functional groups are thiol groups, then the second reactive functional groups are azetidinium groups, epoxy groups, aziridine groups, vinylsulfone

groups, or combinations thereof; wherein if the first reactive functional groups are azetidinium groups, epoxy groups, aziridine groups, or combinations thereof, then the second reactive functional groups are carboxyl groups, amino groups, thiol groups, or combinations thereof; wherein if the first reactive functional groups are vinylsulfone groups, then the second reactive functional groups are thiol groups.

4. The method of any one of claims 1 to 3, wherein the total concentration of all buffering agents present in the aqueous solution is from about 10 mM to 90 mM, and/or wherein the aqueous solution has a pH of from about 6.8 to about 7.4.
5. The method of any one of claims 1 to 4, wherein the total concentration of all ions present in the aqueous solution is less than 221 mM.
6. The method of any one of claims 1 to 5, wherein the total concentration of all ions each having two or more charges in the aqueous solution is less than 70 mM.
7. The method of any one of claims 1 to 6, wherein the aqueous solution additionally includes one or more non-ionic non-ionic tonicity-adjusting agents and are used to adjust the osmolality of the aqueous solution to a value from about 200 to about 450 mOsm/Kg, wherein said one or more nonionic tonicity-adjusting agents are glycerol, propylene glycol, polyols, mannitol, sorbitol, xylitol, or mixtures thereof.
8. The method of any one of claims 1 to 7, wherein said at least one hydrophilic polymeric material is a highly-branched hydrophilic polymeric material comprising the second reactive functional groups.
9. The method of claim 8, wherein the highly-branched hydrophilic polymeric material comprises vinylsulfone groups and is a partial reaction product of at least one vinylsulfone-containing polymer having vinylsulfone groups with at least one thiol-containing hydrophilic polymer having thiol groups, wherein the highly-branched hydrophilic polymeric material comprises epoxy groups and is a partial reaction product of at least one epoxy-containing hydrophilic polymer having epoxy groups with at least one amino-containing hydrophilic polymer having amino groups, at least one carboxyl-containing hydrophilic polymer having carboxyl groups, or at least one thiol-containing hydrophilic polymer having thiol groups, wherein the highly-branched hydrophilic polymeric material comprises aziridine groups and is a partial reaction product of at least one aziridine-containing hydrophilic polymer having aziridine groups with at least one amino-containing hydrophilic polymer having amino groups, at least one carboxyl-containing hydrophilic polymer having carboxyl groups, or at least one thiol-containing hydrophilic polymer having thiol groups, or wherein the highly-branched hydrophilic polymeric material comprises azetidinium groups and is a partial reaction product of at least one azetidinium-containing polymer with at least one hydrophilicity-enhancing polymer having at least one carboxyl, primary amine, secondary amine, or thiol group.

10. The method of any one of claims 1 to 9, where the first reactive functional groups are not vinylsulfone groups, the step of heating is performed by autoclaving the preformed contact lens with the first reactive functional groups thereon immersed in the aqueous solution which is a packaging solution in a sealed lens package at a temperature of from about 115°C to about 125°C for approximately 20-90 minutes.
11. A coated contact lens, comprising:
an anterior surface; an opposite posterior surface; and a layered structural configuration from the anterior surface to the posterior surface,
wherein the layered structural configuration comprises an outer anterior surface hydrogel layer, an inner layer, and an outer posterior surface hydrogel layer, wherein the inner layer is a lens bulk material, wherein the coated contact lens has a superior lens surface softness as measured by an averaged indentation depth at 5 KPa compression pressure of at least about 550 nm with using an indenting probe having a tip radius of about 10 μm and a stiffness of about 0.5 N/m in a nanoindentation test, have a water-break-up time (WBUT) of at least 10 seconds and optionally a polyquaternium-1 uptake ("PU") of about 0.4 micrograms/lens or less.
12. The method of any one of claims 1 to 10 or the coated contact lens of claim 11, wherein the contact lens precursor is a preformed hard contact lens and the lens bulk material is a hard plastic material.
13. The method of any one of claims 1 to 10 or the coated contact lens of claim 11, wherein the contact lens precursor is a preformed rigid gas permeable contact lens and the lens bulk material is a rigid gas permeable lens material.
14. The method or coated contact lens according to claim 12 or 13, wherein the outer anterior and posterior surface hydrogel layers independent of each another have a thickness of from about 0.2 μm to about 20 μm when being fully hydrated.
15. The method of any one of claims 1 to 10 or the coated contact lens of claim 11, wherein the contact lens precursor is a preformed hybride contact lens and the lens bulk material consists essentially of a central optical zone that is essentially made of a gas permeable lens material and a peripheral zone that is essentially made of a non-silicone hydrogel material.
16. The method of any one of claims 1 to 10 or the coated contact lens of claim 11, wherein the contact lens precursor is a preformed embedded contact lens, wherein the lens bulk material consists essentially of a 3-dimensional article and a non-silicone hydrogel material, wherein the 3-dimensional article is made of a non-hydrogel material and has a 3-dimensional size smaller than that of the contact lens so that the 3-dimensional article is completely embedded within the non-silicone hydrogel material.

17. The method of any one of claims 1 to 10 or the coated contact lens of claim 11, wherein the contact lens precursor is a preformed non-hydrogel contact lens, wherein the lens bulk material is a preformed non-silicon hydrogel contact lens essentially made of a non-silicone hydrogel material.
18. The method or coated contact lens of any one of claims 15 to 17, wherein the non-silicon hydrogel material comprises at least 50% by mole of repeating units of at least one hydroxyl-containing vinylic monomer.
19. The method or coated contact lens according to any one of claims 15 to 18, wherein the outer anterior and posterior surface hydrogel layers independent of each another have a thickness of from about 0.05 μm to about 20 μm when being fully hydrated.
20. The method of any one of claims 1 to 10 or the coated contact lens according to claim 11, wherein the contact lens precursor is a preformed hybrid contact lens and the lens bulk material consists essentially of a central optical zone that is essentially made of a rigid gas permeable lens material and surrounded by a peripheral zone that is essential made of a silicone hydrogel material.
21. The method of any one of claims 1 to 10 or the coated contact lens according to claim 11, wherein the contact lens precursor is a preformed embedded contact lens, wherein the lens bulk material consists essentially of a 3-dimensional article and a silicone hydrogel material, wherein the 3-dimensional article is made of a non-hydrogel material and has a 3-dimensional size smaller than that of the preformed embedded contact lens so that the 3-dimensionaol article is completely embedded within the silicone hydrogel material.
22. The method of any one of claims 1 to 10 or the coated contact lens according to claim 11, wherein the contact lens precursor is a preformed silicone hydrogel contact lens, wherein the bulk material is a preformed non-silicon hydrogel contact lens essentially made of a silicone hydrogel material.
23. The method or coated contact lens of any one of claims 20 to 22, wherein the silicone hydrogel material has an equilibrium water content of from about 10% to about 80% by weight, and/or an oxygen permeability of from about 50 barrers to about 180 barrers.
24. The method or coated contact lens according to any one of claims 20 to 23, wherein the outer anterior and posterior surface hydrogel layers independent of each another have a thickness of from about 0.05 μm to about 20 μm when being fully hydrated.
25. The method of any one of claims 1-10 and 12-24 or the coated contact lens of any one of claims 11 to 24, wherein the outer anterior and posterior surface hydrogel layers independent of each another are a crosslinked hydrophilic polymeric material comprising polymer chains each of which includes repeating monomeric units of at least one hydrophilic vinylic monomer which comprises: (1) an alkyl (meth)acrylamide

selected from the group consisting of (meth)acrylamide, N,N-dimethyl (meth)acrylamide, N-ethyl (meth)acrylamide, N,N-diethyl (meth)acrylamide, N-propyl (meth)acrylamide, N-isopropyl (meth)acrylamide, N-3-methoxypropyl (meth)acrylamide, and combinations thereof; (2) a hydroxyl-containing acrylic monomer selected from the group consisting of N-2-hydroxyethyl (meth)acrylamide, N,N-bis(hydroxyethyl) (meth)acrylamide, N-3-hydroxypropyl (meth)acrylamide, N-2-hydroxypropyl (meth)acrylamide, N-2,3-dihydroxypropyl (meth)acrylamide, N-tris(hydroxymethyl)methyl (meth)acrylamide, 2-hydroxyethyl (meth)acrylate, 3-hydroxypropyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, glycerol methacrylate (GMA), di(ethylene glycol) (meth)acrylate, tri(ethylene glycol) (meth)acrylate, tetra(ethylene glycol) (meth)acrylate, poly(ethylene glycol) (meth)acrylate having a number average molecular weight of up to 1500, poly(ethylene glycol)ethyl (meth)acrylamide having a number average molecular weight of up to 1500, and combinations thereof; (3) a carboxyl-containing acrylic monomer selected from the group consisting of 2-(meth)acrylamidoglycolic acid, (meth)acrylic acid, ethylacrylic acid, 3-(meth)acrylamidopropionic acid, 5-(meth)acrylamidopentanoic acid, 4-(meth)acrylamidobutanoic acid, 3-(meth)acrylamido-2-methylbutanoic acid, 3-(meth)acrylamido-3-methylbutanoic acid, 2-(meth)acrylamido-2-methyl-3,3-dimethylbutanoic acid, 3-(meth)acrylamidohexanoic acid, 4-(meth)acrylamido-3,3-dimethylhexanoic acid, and combinations thereof; (4) an amino-containing acrylic monomer selected from the group consisting of N-2-aminoethyl (meth)acrylamide, N-2-methylaminoethyl (meth)acrylamide, N-2-ethylaminoethyl (meth)acrylamide, N-2-dimethylaminoethyl (meth)acrylamide, N-3-aminopropyl (meth)acrylamide, N-3-methylaminopropyl (meth)acrylamide, N-3-dimethylaminopropyl (meth)acrylamide, 2-aminoethyl (meth)acrylate, 2-methylaminoethyl (meth)acrylate, 2-ethylaminoethyl (meth)acrylate, 3-aminopropyl (meth)acrylate, 3-methylaminopropyl (meth)acrylate, 3-ethylaminopropyl (meth)acrylate, 3-amino-2-hydroxypropyl (meth)acrylate, trimethylammonium 2-hydroxy propyl (meth)acrylate hydrochloride, dimethylaminoethyl (meth)acrylate, and combinations thereof; (5) an N-vinyl amide monomer selected from the group consisting of N-vinylpyrrolidone (*aka*, N-vinyl-2-pyrrolidone), N-vinyl-3-methyl-2-pyrrolidone, N-vinyl-4-methyl-2-pyrrolidone, N-vinyl-5-methyl-2-pyrrolidone, N-vinyl-6-methyl-2-pyrrolidone, N-vinyl-3-ethyl-2-pyrrolidone, N-vinyl-4,5-dimethyl-2-pyrrolidone, N-vinyl-5,5-dimethyl-2-pyrrolidone, N-vinyl-3,3,5-trimethyl-2-pyrrolidone, N-vinyl piperidone (*aka*, N-vinyl-2-piperidone), N-vinyl-3-methyl-2-piperidone, N-vinyl-4-methyl-2-piperidone, N-vinyl-5-methyl-2-piperidone, N-vinyl-6-methyl-2-piperidone, N-vinyl-6-ethyl-2-piperidone, N-vinyl-3,5-dimethyl-2-piperidone, N-vinyl-4,4-dimethyl-2-piperidone, N-vinyl caprolactam (*aka*, N-vinyl-2-caprolactam), N-

vinyl-3-methyl-2-caprolactam, N-vinyl-4-methyl-2-caprolactam, N-vinyl-7-methyl-2-caprolactam, N-vinyl-7-ethyl-2-caprolactam, N-vinyl-3,5-dimethyl-2-caprolactam, N-vinyl-4,6-dimethyl-2-caprolactam, N-vinyl-3,5,7-trimethyl-2-caprolactam, N-vinyl-N-methyl acetamide, N-vinyl formamide, N-vinyl acetamide, N-vinyl isopropylamide, N-vinyl-N-ethyl acetamide, N-vinyl-N-ethyl formamide, and mixtures thereof; (6) a methylene-containing pyrrolidone monomer selected from the group consisting of 1-methyl-3-methylene-2-pyrrolidone, 1-ethyl-3-methylene-2-pyrrolidone, 1-methyl-5-methylene-2-pyrrolidone, 1-ethyl-5-methylene-2-pyrrolidone, 5-methyl-3-methylene-2-pyrrolidone, 5-ethyl-3-methylene-2-pyrrolidone, 1-n-propyl-3-methylene-2-pyrrolidone, 1-n-propyl-5-methylene-2-pyrrolidone, 1-isopropyl-3-methylene-2-pyrrolidone, 1-isopropyl-5-methylene-2-pyrrolidone, 1-n-butyl-3-methylene-2-pyrrolidone, 1-tert-butyl-3-methylene-2-pyrrolidone, and combinations thereof; (7) an acrylic monomers having a C₁-C₄ alkoxyethoxy group and selected from the group consisting of ethylene glycol methyl ether (meth)acrylate, di(ethylene glycol) methyl ether (meth)acrylate, tri(ethylene glycol) methyl ether (meth)acrylate, tetra(ethylene glycol) methyl ether (meth)acrylate, C₁-C₄-alkoxy poly(ethylene glycol) (meth)acrylate having a number average molecular weight of up to 1500, methoxy-poly(ethylene glycol)ethyl (meth)acrylamide having a number average molecular weight of up to 1500, and combinations thereof; (8) a vinyl ether monomer selected from the group consisting of ethylene glycol monovinyl ether, di(ethylene glycol) monovinyl ether, tri(ethylene glycol) monovinyl ether, tetra(ethylene glycol) monovinyl ether, poly(ethylene glycol) monovinyl ether, ethylene glycol methyl vinyl ether, di(ethylene glycol) methyl vinyl ether, tri(ethylene glycol) methyl vinyl ether, tetra(ethylene glycol) methyl vinyl ether, poly(ethylene glycol) methyl vinyl ether, and combinations thereof; (9) an allyl ether monomer selected from the group consisting of ethylene glycol monoallyl ether, di(ethylene glycol) monoallyl ether, tri(ethylene glycol) monoallyl ether, tetra(ethylene glycol) monoallyl ether, poly(ethylene glycol) monoallyl ether, ethylene glycol methyl allyl ether, di(ethylene glycol) methyl allyl ether, tri(ethylene glycol) methyl allyl ether, tetra(ethylene glycol) methyl allyl ether, poly(ethylene glycol) methyl allyl ether, and combinations thereof; (10) a phosphorylcholine-containing vinylic monomer selected from the group consisting of (meth)acryloyloxyethyl phosphorylcholine, (meth)acryloyloxypropyl phosphorylcholine, 4-((meth)acryloyloxy)butyl-2'-(trimethylammonio)ethylphosphate, 2-[(meth)acryloylamino]ethyl-2'-(trimethylammonio)-ethylphosphate, 3-[(meth)acryloylamino]propyl-2'-(trimethylammonio)ethylphosphate, 4-[(meth)acryloylamino]butyl-2'-(trimethylammonio)ethylphosphate, 5-((meth)acryloyloxy)-pentyl-2'-(trimethylammonio)ethyl phosphate, 6-((meth)acryloyloxy)hexyl-2'-(trimethylammonio)-

ethylphosphate, 2-((meth)acryloyloxy)ethyl-2'-(triethylammonio)-ethylphosphate, 2-((meth)acryloyloxy)ethyl-2'-(tripropylammonio)ethylphosphate, 2-((meth)acryloyloxy)ethyl-2'-(tributylammonio)ethyl phosphate, 2-((meth)acryloyloxy)propyl-2'-(trimethylammonio)-ethylphosphate, 2-((meth)acryloyloxy)butyl-2'-(trimethylammonio)-ethylphosphate, 2-((meth)acryloyloxy)pentyl-2'-(trimethylammonio)ethylphosphate, 2-((meth)acryloyloxy)hexyl-2'-(trimethylammonio)ethyl phosphate, 2-(vinylloxy)ethyl-2'-(trimethylammonio)ethylphosphate, 2-(allyloxy)ethyl-2'-(trimethylammonio)ethylphosphate, 2-(vinylloxycarbonyl)ethyl-2'-(trimethylammonio)ethyl phosphate, 2-(allyloxycarbonyl)ethyl-2'-(trimethylammonio)-ethylphosphate, 2-(vinylcarbonylamino)ethyl-2'-(trimethylammonio)-ethylphosphate, 2-(allyloxycarbonylamino)ethyl-2'-(trimethylammonio)ethyl phosphate, 2-(butenoyloxy)ethyl-2'-(trimethylammonio)ethylphosphate, and combinations thereof;

(11) allyl alcohol; (12) N-2-hydroxyethyl vinyl carbamate; (13) N-carboxyvinyl- β -alanine (VINAL); (14) N-carboxyvinyl- α -alanine; (15) or combinations thereof.

26. The method or coated contact lens of claim 25, wherein the monomeric units of said at least one hydrophilic vinylic monomer is present in each polymer chain in an amount of at least about 25% by mole.
27. The method of any one of claims 1-10 and 12-26 or coated contact lens of any one of claims 11 to 26, wherein the outer anterior and posterior surface hydrogel layers independent of each another have an equilibrium water content of at least 80% by weight, and/or wherein the contact lens has a silicon atomic percentage of about 5% or less of total elemental percentage, as measured by XPS analysis of the contact lens in dried state.