Claims:

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, azetidnium groups, and combinations thereof, wherein the lens bulk material is a layer that has a 3-dimensional shape of a contact lens and includes a central curved plane which divides the contact lens into two parts, one containing the anterior surface and the other containing the posterior surface) and has a variable thickness;

(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 which are phosphates, wherein the total concentration of all buffering agents present in the aqueous solution is from 10 mM to 70 mM, wherein the aqueous solution has a room temperature and a pH of from 6.9 to 7.3, wherein the totally concentration of all ions present in the aqueous solution is less than 201 mM, provided that the total concentration of all ions each having two or more charges in the aqueous solution is less than 50 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, azetidnium groups, and combinations thereof; and

(3) heating the aqueous solution with the contact lens precursor therein to a crosslinking-temperature of from 50°C to 140°C and then maintaining the crosslinking temperature for at least 20 minutes to form a coated contact lens having a hydrogel coating thereon, 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 550 nm with using an indenting probe having a tip radius of 10 μm and a stiffness of 0.5 N/m in a nanoindentation test.

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; 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, then the second reactive functional groups are carboxyl groups, amino groups, or combinations thereof.
4. The method of any one of claims 1 to 3, 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 200 to 450 mOsm/Kg, wherein said one or more nonionic tonicity-adjusting agents are glycerol, propylene glycol, polyols, mannitol, sorbitol, xylitol, or mixtures thereof.
5. The method of any one of claims 1 to 4, wherein said at least one hydrophilic polymeric material is a highly-branched hydrophilic polymeric material comprising the second reactive functional groups.
6. The method of claim 5, wherein the highly-branched hydrophilic polymric 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.
7. The method of any one of claims 1 to 6, wherein 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 115°C to 125°C for 20-90 minutes.
8. 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 lens bulk material is a layer that has a 3-dimensional shape of a contact lens and includes a central curved plane which divides the contact lens into two parts, one containing the anterior surface and the other containing the posterior surface) and has a variable thickness, 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 550 nm with using an indenting probe having a tip radius of 10 μm and a stiffness of 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 0.4 micrograms/lens or less.

9. The method of any one of claims 1 to 7 or the coated contact lens of claim 8, wherein the contact lens precursor is a preformed hard contact lens and the lens bulk material is a hard plastic material.
10. The method of any one of claims 1 to 7 or the coated contact lens of claim 8, 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.
11. The method or coated contact lens according to claim 9 or 10, wherein the outer anterior and posterior surface hydrogel layers independent of each another have a thickness of from 0.2 µm to 20 µm when being fully hydrated.
12. The method of any one of claims 1 to 7 or the coated contact lens of claim 8, 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 gas permeable lens material and a peripheral zone that is essentially made of a non-silicone hydrogel material.
13. The method of any one of claims 1 to 7 or the coated contact lens of claim 8, 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.

14. The method of any one of claims 1 to 7 or the coated contact lens of claim 8, 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.
15. The method or coated contact lens of any one of claims 12 to 14, wherein the non-silicon hydrogel material comprises at least 50% by mole of repeating units of at least one hydroxyl-containing vinylic monomer.
16. The method or coated contact lens according to any one of claims 12 to 15, wherein the outer anterior and posterior surface hydrogel layers independent of each another have a thickness of from 0.05 µm to 20 µm when being fully hydrated.
17. The method of any one of claims 1 to 7 or the coated contact lens according to claim 8, 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 essentially made of a silicone hydrogel material.
18. The method of any one of claims 1 to 7 or the coated contact lens according to claim 8,

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-dimensioal article is completely embedded within the silicone hydrogel material.

19. The method of any one of claims 1 to 7 or the coated contact lens according to claim 8, 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.

20. The method or coated contact lens of any one of claims 17 to 19, wherein the silicone hydrogel material has an equilibrium water content of from 10% to 80% by weight, and/or an oxygen permeability of from 50 barrers to 180 barrers.

21. The method or coated contact lens according to any one of claims 17 to 19, wherein the outer anterior and posterior surface hydrogel layers independent of each another have a thickness of from 0.05 μm to 20 μm when being fully hydrated.

22. The method of any one of claims 1-7 and 9-21 or the coated contact lens of any one of claims 8 to 21, 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-hydroxylethyl (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, 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-2methyl—3,3-dimethyl butanoic 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, 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, 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, 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 C_1-C_4 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, C_1-C_4-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-(vinyloxy)ethyl-2'-(trimethylammonio)ethylphosphate, 2-(allyloxy)ethyl-2'-(trimethylammonio)ethylphosphate, 2-(vinyloxycarbonyl)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; (14) N-carboxyvinyl-α-alanine; (15) or combinations thereof.

23. The method or coated contact lens of claim 22, wherein the monomeric units of said at least one hydrophilic vinylic monomer is present in each polymer chain in an amount of at least 25% by mole.

24. The method of any one of claims 1-7 and 9-23 or coated contact lens of any one of claims 8 to 23, 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 5% or less of total elemental percentage, as measured by XPS analysis of the contact lens in dried state.