Myopia control contact lenses

Field of the Invention

The present invention concerns a myopia control contact lens. More particularly, but not exclusively, this invention concerns a myopia control contact lens, for slowing progression of myopia in people, having an optical design that is effective in slowing progression of myopia and a material suitable for making such contact lenses.

Background of the Invention

To help combat the increasing prevalence of myopia globally, contact lens manufacturers have developed myopia control contact lenses that have optical designs that are effective in slowing the progression of myopia. It is believed that slowing the progression of myopia is important to reduce the number of people who develop high myopia which can lead to significant ocular pathology. With this goal, there remains a need for new myopia control contact lenses.

Summary of the Invention

The present invention is based on the observation that significant distortions during manufacture result in contact lenses being rejected, since the design is out of specification targets, when the contact lenses are myopia control contact lenses with essential myopia control optical design features made with a contact lens formulation that includes a diluent and small molecular weight silicone monomers, such as TRIS. Surprisingly, it has been found that the same myopia control contact lens can be manufactured successfully when the contact lens is made with a contact lens formulation that contains each of the chemical compounds recited in claim 1 below. The resulting contact lenses have been found not to have the optical distortions and thus are suitable for high volume manufacture.

Thus, the present invention provides according to a first aspect, a myopia control contact lens having the features set out in claim 1 below. Preferred but optional features are set out in the dependent claims.

As described herein, a myopia control contact lens is a contact lens having an optical design that is effective in slowing the progression of myopia of a person. The person is an individual who is younger than 30 years old. However, it will be appreciated that children may particularly benefit from wearing the present contact lenses, and thus it is contemplated that the present myopia control contact lenses advantageously have a design that is effective in slowing progression of myopia in a person from 5 to 18 years of age.

The present myopia control contact lenses include a lens body. The lens body is a polymeric unit that results from polymerisation of a contact lens formulation. The lens body includes an optic zone. The optic zone has a diameter from 7.0 mm to 9.0 mm. The diameter is understood to be a chord diameter. The optic zone corresponds to the portion of the contact lens that overlays the pupil of an eye, and the optic zone refracts light in such a way as to provide the desired visual benefit to the person wearing the contact lens. The optic zone is circumscribed by a peripheral zone. Typically, a border can be seen at the junction of the optic zone and the peripheral zone. This border defines the optic zone perimeter. The lens body also has a lens edge circumscribing the peripheral zone. The lens edge is defined as the junction of the anterior surface and the posterior surface of the lens body.

The optic zone has multiple zones within it that provide the optical properties of the contact lens. The optic zone can be characterized as having a central zone that has a distance corrective refractive power from 0.00 diopters (D) to -20.00 D. The distance corrective refractive power corresponds to the refractive power necessary to correct the person's distance vision. The central zone has a chord diameter from 3.00 mm to 3.50 mm. It has been found that a central zone of this size is beneficial in that a person is able to use the distance corrective refractive power at both near and far viewing distances, unlike in presbyopic people where, due to a lack of accommodation, the person must alternate focus through the distance correction portion of the lens and the near correction portion of the lens.

The optic zone also includes a first myopic defocus zone that circumscribes the central zone. The first myopic defocus zone has a refractive power that is at least 2.00 D more positive than the refractive power of the central zone. The first myopic defocus zone has a radial width of at least 0.6 mm. As an example, if a myopia control contact lens has a central zone with a refractive power of -3.00 D, the refractive power of the first myopic defocus zone may be -1.00 D, or -0.50 D, or even 0.00 D.

In some embodiments, the first myopic defocus zone has a refractive power that is at least 3.00 D more positive than the refractive power of the central zone.

A third zone circumscribes the first myopic defocus zone. The third zone has a refractive power that is equal to the refractive power of the central zone, and the third zone has a radial width of at least 0.8 mm.

It has been found that these dimensions of the zones within the optical zones are important in providing sufficiently clear vision to the person while also providing enough myopic defocus to provide a signal to slow the progression of myopia.

The optic zone of the present myopia control contact lenses may also include a second myopic defocus zone that circumscribes the third zone. The second myopic defocus zone has a refractive power that is 1.00 D to 4.00 D more positive than the refractive power of the central zone, and the second myopic defocus zone has a radial width of at least 0.8 mm. In a further embodiment, the second myopic defocus zone has a radial width from 0.8 to 1.1 mm.

The first myopic defocus zone has a radial width from 0.6 to 0.8 mm, and the third zone has a radial width from 0.8 to 1.2 mm.

In the manufacture of contact lenses, it is desirable to control the dimensions of the lens edge. The shape of the lens edge region can influence the comfort of contact lenses. Thus, in the present contact lenses, the lens edge has an edge thickness that contributes to a comfortable wearing experience for the person. To help ensure desired quality control, the edge thickness is measured at a specified distance from the actual lens edge. Thus, as an example, embodiments of the present contact lenses may have an edge thickness that is less than 0.10 mm when measured at a radial distance 0.10 mm from the lens edge (i.e., from the lens edge towards the geometric center of the contact lens body). In an additional embodiment, the lens edge thickness is less than 0.08 mm at a radial distance 0.10 mm from the lens edge. In a still further embodiment, the lens edge thickness is less than 0.08 mm at a radial distance 0.07 mm from the lens edge. And, still further, an embodiment may have a lens edge thickness less than 0.05 mm at a radial distance 0.07 mm from the lens edge.

The present contact lenses have a center thickness. The center thickness is measured at the geometric center of the contact lens, or at the geometric center of the optic zone. The center thickness can be determined using conventional techniques, such as by visually measuring the distance from the anterior surface to the posterior surface of the lens body at the geometric center of the lens. Alternately, the center thickness can be determined based on design specification targets. In some embodiments, the present contact lenses have a center thickness from 0.06 mm to 0.20 mm, for example when determined visually on a sectioned lens.

In addition, the present contact lenses have a peripheral junction thickness. The peripheral junction corresponds to the junction between the peripheral zone and the ramp surface extending from the lens edge to the peripheral zone. In the present case, the peripheral junction is located about 0.5 mm to 0.9 mm from the lens edge. Embodiments, of the present contact lenses have a peripheral junction thickness from 0.15 mm to 0.25 mm. The peripheral junction thickness and the center thickness can be important features in the design of the optics of the contact lens. For example, one may set the peripheral junction thickness at a set target value, and set the center thickness at a set target value, and then adjust the curvature of the anterior surface of the contact lens to provide the desired refractive power with those two fixed points.

In addition, the present contact lenses may include a transition zone between any two adjacent zones. For example, there may be a transition zone between the central zone and the first myopic defocus zone. The transition zone has a radial width sufficiently small so as not to interfere with the primary optical refraction of the lens. In the present contact lenses, the transition zone between any two zones may have a radial width from 0.03 mm to 0.08 mm.

Furthermore, in the present contact lenses, the rate of power change between any two zones within the optic zone is relatively steep. In some embodiments, the rate of the refractive power change at the junction between two adjacent zones, such as the central zone and the first myopic defocus zone, is at least 6 D/mm when measured at a resolution of less than 0.09 mm. The rate of power change can be determined using optical inspection instruments available from Optocraft or Lambda-X Ophthalmics. Examples include the SHS wavefront sensor and the NIMO wavefront sensor.

In some embodiments, the present contact lenses have a central zone that is free of a defocus zone. In other words, the central zone consists of a single effective

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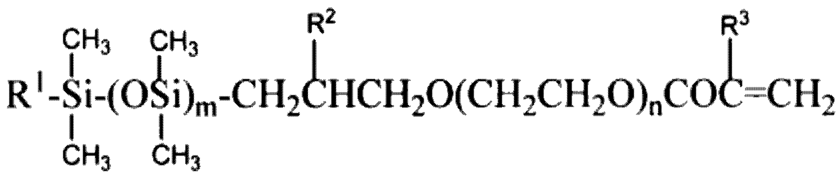
refractive power to correct the distance vision of the person, wherein the refractive power is substantially constant across the entire central zone, including the geometric center of the central zone.

In some embodiments, the present contact lenses are free of lenslets or smaller lenses provided on a surface of the contact lens. Thus, the present annual zones can be considered to be continuous rings providing either myopic defocus or distance correction.

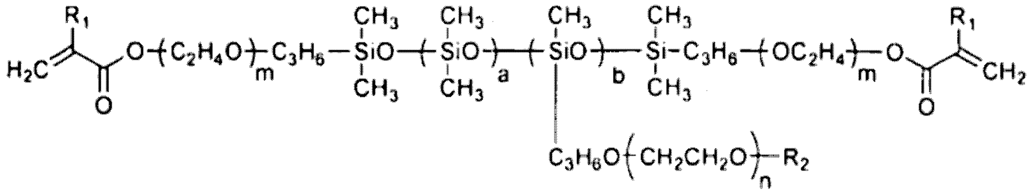
The lens body of the myopia control contact lens is a polymerised reaction product of a diluent-free contact lens formulation. For example, the present contact lens formulations do not include an organic solvent to help reduce phase separation of the different chemical compounds in the formulation or to help with processing of the contact lenses during their manufacture. A diluent is a non-reactive additive that is not incorporated into the contact lens body. Typically, diluents used in the manufacture of contact lenses are extractable from contact lens bodies after polymerisation, e.g. by washing with a 50:50 ethanol:water solution. A diluent-free formulation typically includes less than 3% (wt/wt), especially less than 1% (wt/wt) diluents. The formulation advantageously has less than 3% (wt/wt) organic solvents, especially less than 1% organic solvents.

The contact lens formulation of the myopia control contact lenses includes at least seven different chemical compounds. The formulation includes a compound of Formula 1



where m is an integer from 3 to 10, n is an integer from 0 to 10, R^1 is an alkyl group having 1 to 4 carbon atoms, R^2 is hydrogen or a methyl group, and R^3 is hydrogen or a methyl group. In the present contact lenses, the compound of formula 1 can be a siloxane monomer where R^1 is a butyl group, R^2 is hydrogen, R^3 is a methyl group, m is 4, and n is 1.

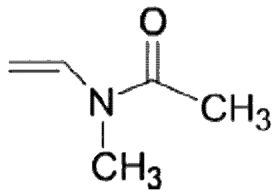
The contact lens formulation also includes a compound of Formula 2



wherein R_1 is selected from either hydrogen or a methyl group; R_2 is selected from either hydrogen or a C1-4 hydrocarbon group; m represents an integer of from 0 to 10; n represents an integer of from 4 up to about 15; a represents an integer from 60 to 100, b represents an integer from 1-10; and the configuration of siloxane units includes a random configuration. One specific example of the compound of formula 2 is a siloxane macromer wherein R_1 and R_2 are methyl groups, m is 0, n represents an integer from about 5 to about 10, a represents an integer of from about 70 to about 90, and b represent an integer of from 1 to about 10, for example from 4 to 8; this siloxane monomer has a molecular weight of about 8,000 to about 16,000 daltons.

The contact lens formulation also includes the following compounds:

a compound of Formula 3



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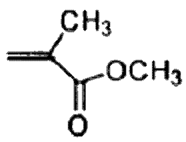
a compound of Formula 4



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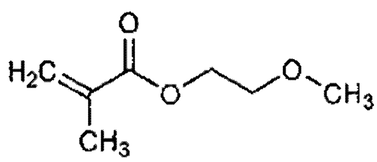
a compound of Formula 5



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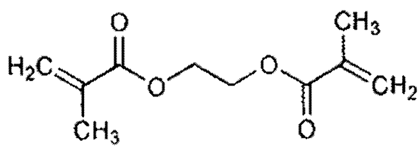
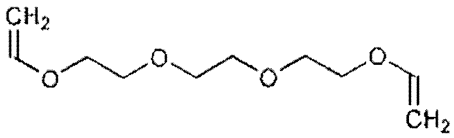
a compound of Formula 6



-; and

a compound of Formula 7



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In some embodiments of the present contact lenses, in the compound of Formula 1, R^1 is a butyl group, R^2 is hydrogen, R^3 is a methyl group, m is 4, and n is 1; and in the compound of Formula 2, R_1 and R_2 are methyl groups, m is 0, n represents an integer from about 5 to about 10, a represents an integer of from about 70 to about 90, and b represent an integer of from 1 to about 10, for example from 4 to 8, and the compound of Formula 2 has a molecular weight of about 8,000 to about 16,000 daltons.

The present contact lenses may also include an ultraviolet light filter or absorber. In some embodiments, the ultraviolet light filter includes at least one benzotriazole-containing ultraviolet filter. In further embodiments, the ultraviolet light filter is 2-[3-(2H-benzotriazol-yl)-4-hydroxyphenyl] ethyl methacrylate. In other embodiments, the ultraviolet light filter may be a benzophenone-containing compound. In yet further embodiments, the contact lens may include a combination of a benzotriazole-containing ultraviolet filter and a benzophenone-containing ultraviolet filter.

In embodiments of the present contact lenses, the contact lens formulation may also include 2-(allyloxy)ethanol, 1,4-bis[4-(2-methacryloxyethyl) phenylamino]-9,10-anthraquinone, and triphenylphosphine.

In yet further embodiments of the present contact lenses, the contact lens formulation is free of phosphorylcholine monomers.

Methods of making the myopia control contact lenses include steps of: placing the contact lens formulation onto a concave molding surface of a first contact lens mold member, wherein the concave molding surface includes a molding region that corresponds to the optic zone; placing a second contact lens mold member in contact with the first contact lens mold member to form a contact lens mold assembly; polymerising the contact lens formulation in the contact lens mold assembly to form a polymerised contact lens; removing the polymerised contact lens from the contact lens mold assembly to produce a separated contact lens; and packaging the separated contact lens in a contact lens package. The polymerised lens may also optionally be washed using solvents and/or water to remove unreacted chemical compounds. Such a washing step may, for example, be carried out concurrently with the step of removing the polymerised contact lens from the mold assembly. Alternatively or additionally, the washing step may be carried out on the separated lens subsequent to the removing step.

Description of the Drawings

Embodiments of the present invention will now be described by way of example only with reference to the accompanying schematic drawings of which:

Fig. 1 illustrates a plan view of a myopia control contact lens in accordance with the present invention.

Fig. 2 illustrates a section view along line A-A of the contact lens of Fig. 1.

Fig. 3 illustrates a plan view of an optic zone of the contact lens of Fig. 1.

Fig. 4 illustrates a section view similar to Fig. 2.

Detailed Description

Example embodiments of the present invention will be described below in relation to the accompanying figures.

Fig. 1 illustrates a myopia control contact lens 10. The myopia control contact lens has an optical design to provide good distance vision and myopic defocus effective to slow progression of myopia. The contact lens 10 includes a lens body 12. The lens body has an optic zone 14 defined by an optic zone perimeter 16. A peripheral zone 18 circumscribes the optic zone 14 at the optic zone perimeter 16. A lens edge 20 circumscribes the peripheral zone 18, and is formed at the junction of the anterior surface and the posterior surface of the lens body. A peripheral junction 22 is illustrated as defining the outer perimeter of the peripheral zone 18 and spaced radially inward from the lens edge 20.

Fig. 2 illustrates the contact lens 10 of Fig. 1 in section view along line A-A.

Fig. 3 illustrates the subzones of the optic zone 14 of the contact lens 10 of Fig. 1. The optic zone 14 has a central zone 24 with a distance corrective refractive power. A first myopic defocus zone 26 circumscribes the central zone 24. The first myopic defocus zone has a refractive power that is at least 2.00 D more positive than the distance corrective refractive power of the central zone 24. A third zone 28 circumscribes the first myopic defocus zone 26, and has a refractive power substantially the same as the distance corrective refractive power of the central zone. A second myopic defocus zone 30 circumscribes the third zone 28, and the second myopic defocus zone 30 has a refractive power that is 1.00 to 4.00 D more positive than the distance corrective refractive power of the central zone.

Fig. 4 illustrates a section view of the contact lens of Fig. 1, and illustrates the center thickness 32 at the geometric center of the contact lens. It also illustrates the peripheral junction thickness 34 at the peripheral junction 22 (shown in Fig. 2). It also illustrates the edge thickness, which, is measured at point 36, between peripheral junction 22 and lens edge 20, that is a specified radial distance from the lens edge.

The contact lens 10 has a lens body 12 that is the polymerised reaction product of a diluent-free contact lens formulation containing compounds of Formulae 1-7 as described above. In particular, in the compound of Formula 1, R^1 is a butyl group, R^2 is hydrogen, R^3 is a methyl group, m is 4, and n is 1; and in the compound of Formula 2, R_1 and R_2 are methyl groups, m is 0, n represents an integer from about 5 to about 10, a represents an integer of from about 70 to about 90, and b represent an integer of from 1 to about 10 and the compound of Formula 2 has a molecular weight of about 8,000 to about 16,000 daltons. The compounds of Formula 1 and Formula 2 are present in the formulation in a combined amount from 25-45 % (wt/wt). The remaining compounds of Formulae 3-7 are present in a combined amount from 55-75% (wt/wt).

The contact lens 10 is made by placing a volume of the contact lens formulation on a concave molding surface of a female mold half, and placing the convex surface of a male mold half in contact with the exposed volume of contact lens formulation to form a contact lens mold assembly. The contact lens mold assembly is then subjected to heat and/or irradiation, e.g. in an oven, and the contact lens formulation is polymerised using heat and/or ultraviolet light. The polymerised lens is then removed from the mold assembly, and washed using solvents and water to remove unreacted chemical compounds. The washed contact lens then is placed in a contact lens package with a packaging solution and is sealed and sterilized using an autoclave.

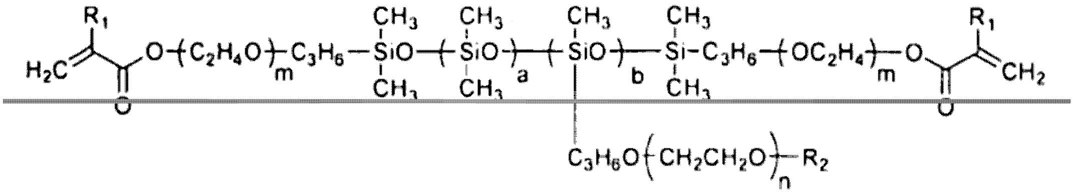
The resulting contact lens advantageously has an equilibrium water content from 50-60%, and thus is understood to be a soft hydrogel contact lens. It advantageously has a Young's modulus from about 0.3 MPa to about 0.6 MPa. The contact lens advantageously has an oxygen permeability (Dk) of at least 80 barrers.

Whilst the present invention has been described and illustrated with reference to particular embodiments, it will be appreciated by those of ordinary skill in the art that the invention lends itself to many different variations not specifically illustrated herein.

Where in the foregoing description, integers or elements are mentioned which have known, obvious or foreseeable equivalents, then such equivalents are herein incorporated as if individually set forth. Reference should be made to the claims for determining the true scope of the present invention, which should be construed so as to encompass any such equivalents. It will also be appreciated by the reader that integers or features of the invention that are described as preferable, advantageous, convenient or the like are optional and do not limit the scope of the independent claims. Moreover, it is to be understood that such optional integers or features, whilst of possible benefit in some embodiments of the invention, may not be desirable, and may therefore be absent, in other embodiments.

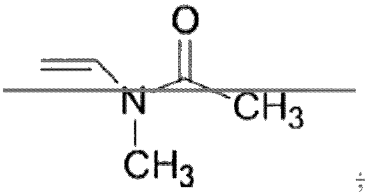
~~where m is an integer from 3 to 10, n is an integer from 0 to 10, R^1 is an alkyl group having 1 to 4 carbon atoms, R^2 is hydrogen or a methyl group, and R^3 is hydrogen or a methyl group;~~

~~a compound of Formula 2~~



~~wherein R_1 is selected from either hydrogen or a methyl group; R_2 is selected from either hydrogen or a C1-4 hydrocarbon group; m represents an integer of from 0 to 10; n represents an integer of from 4 up to about 15; a represents an integer from 60 to 100, b represents an integer from 4-8; and the configuration of siloxane units includes a random configuration;~~

~~a compound of Formula 3~~



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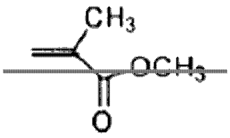
~~a compound of Formula 4~~



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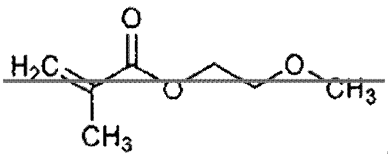
~~a compound of Formula 5~~



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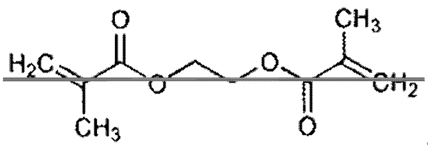
~~a compound of Formula 6~~



~~; and~~

~~a compound of Formula 7~~

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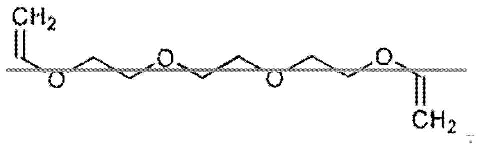


~~2. The myopia control contact lens of clause 1, wherein in the compound of Formula 1, R^1 is a butyl group, R^2 is hydrogen, R^3 is a methyl group, m is 4, and n is 1; and in the compound of Formula 2, R_1 and R_2 are methyl groups, m is 0, n represents an integer from about 5 to about 10, a represents an integer of from about 70 to about 90, and b represent an integer of from 1 to about 10 and the compound of Formula 2 has a molecular weight of about 8,000 to about 16,000 daltons.~~

~~3. The myopia control contact lens of any preceding clause, wherein the contact lens formulation further comprises at least one benzotriazole-containing ultraviolet light filter.~~

~~4. The myopia control contact lens of clause 3, wherein the ultraviolet light filter is 2-[3-(2H-benzotriazol-yl)-4-hydroxyphenyl] ethyl methacrylate.~~

~~5. The myopia control contact lens of any preceding clause, wherein the contact lens formulation further comprises 2-(allyloxy)ethanol, 1,4-bis[4-(2-methacryloxyethyl) phenylamino]-9,10-anthraquinone, and triphenylphosphine.~~

~~6. The myopia control contact lens of any preceding clause, wherein the optic zone further comprises a second myopic defocus zone circumscribing the third zone, the second myopic defocus zone having a refractive power that is at least 1.00 to 4.00 D more positive than the refractive power of the central zone, and having a radial width of at least 0.8 mm.~~

~~7. The myopia control contact lens of clause 6, wherein the second myopic defocus zone has a radial width from 0.8 to 1.1 mm.~~

~~8. The myopia control contact lens of any preceding clause, wherein the first myopic defocus zone has a radial width from 0.6 to 0.8 mm, and the third zone has a radial width from 0.8 to 1.2 mm.~~

~~9. The myopia control contact lens of any preceding clause, wherein the lens edge has an edge thickness less than 0.10 mm measured at a radial distance 0.10 mm from the lens edge.~~

~~10. The myopia control contact lens of clause 9, wherein the lens edge thickness is less than 0.08 mm at a radial distance 0.10 mm from the lens edge.~~

11. The myopia control contact lens of any preceding clause, wherein the lens edge thickness is less than 0.08 mm at a radial distance 0.07 mm from the lens edge.

12. The myopia control contact lens of clause 11, wherein the lens edge thickness is less than 0.05 mm at a radial distance 0.07 mm from the lens edge.

13. The myopia control contact lens of any preceding clause, wherein the first myopic defocus zone has a refractive power that is at least 3.00 D more positive than the refractive power of the central zone.

14. The myopia control contact lens of any preceding clause, wherein contact lens has a center thickness from 0.06 mm to 0.20 mm.

15. The myopia control contact lens of any preceding clause, wherein the contact lens has a peripheral junction about 0.5 mm to 0.9 mm from the lens edge, the peripheral junction having a thickness from 0.15 mm to 0.25 mm.

16. The myopia control contact lens of any preceding clause, wherein the rate of refractive power change at the junction between any two adjacent zones in the optic zone is at least 6 D/mm when measured at a resolution of less than 0.09 mm.

17. A method of making the myopia control contact lens of any preceding clause, comprising:

placing the contact lens formulation onto a concave molding surface of a first contact lens mold member, wherein the concave molding surface includes a molding region that corresponds to the optic zone;

placing a second contact lens mold member in contact with the first contact lens mold member to form a contact lens mold assembly;

polymerising the contact lens formulation in the contact lens mold assembly to form a polymerised contact lens;

removing the polymerised contact lens from the contact lens mold assembly to produce a separated contact lens; and

packaging the separated contact lens in a contact lens package.

Whilst the present invention has been described and illustrated with reference to particular embodiments, it will be appreciated by those of ordinary skill in the art that the invention lends itself to many different variations not specifically illustrated herein.

Where in the foregoing description, integers or elements are mentioned which have known, obvious or foreseeable equivalents, then such equivalents are herein incorporated as if individually set forth. Reference should be made to the claims for

~~determining the true scope of the present invention, which should be construed so as to encompass any such equivalents. It will also be appreciated by the reader that integers or features of the invention that are described as preferable, advantageous, convenient or the like are optional and do not limit the scope of the independent claims. Moreover, it is to be understood that such optional integers or features, whilst of possible benefit in some embodiments of the invention, may not be desirable, and may therefore be absent, in other embodiments.~~

Claims

1. A myopia control contact lens for slowing the progression of myopia of a person, comprising:

a lens body comprising an optic zone, a peripheral zone circumscribing the optic zone, and a lens edge circumscribing the peripheral zone, wherein the contact lens has a center thickness from 0.06 mm to 0.20 mm and a peripheral junction about 0.5 mm to 0.9 mm from the lens edge, the peripheral junction having a thickness from 0.15 mm to 0.25 mm, wherein the optic zone has a diameter from 7.0 mm to 9.0 mm, and the optic zone comprises:

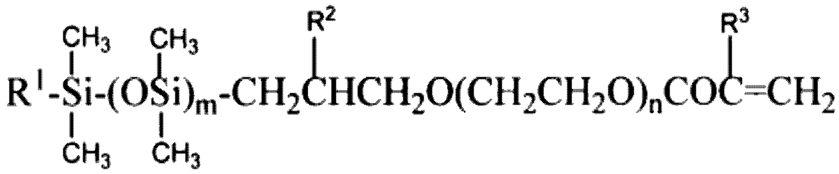
a central zone having a distance corrective refractive power from 0.00 diopters to -20.00 diopters (D) and having a chord diameter from 3.00 mm to 3.50 mm;

a first myopic defocus zone circumscribing the central zone, the first myopic defocus zone having a refractive power that is at least 2.00 D more positive than the refractive power of the central zone, and having a radial width of at least 0.6 mm;

a third zone circumscribing the first myopic defocus zone, the third zone having a refractive power equal to the refractive power of the central zone, and having a radial width of at least 0.8 mm,

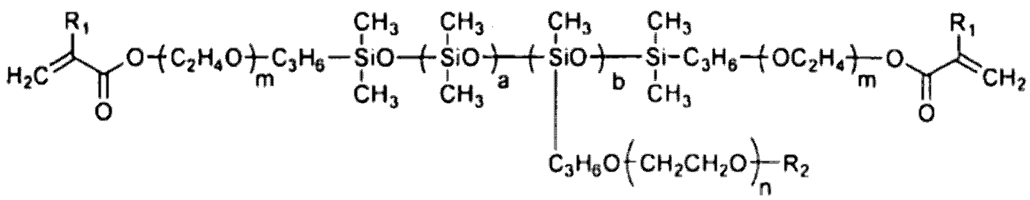
wherein the lens body is a polymerised reaction product of a diluent-free contact lens formulation comprising:

a compound of Formula 1



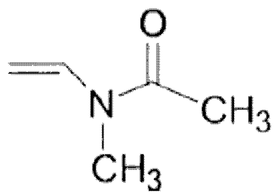
where m is an integer from 3 to 10, n is an integer from 0 to 10, R^1 is an alkyl group having 1 to 4 carbon atoms, R^2 is hydrogen or a methyl group, and R^3 is hydrogen or a methyl group;

a compound of Formula 2



wherein R_1 is selected from either hydrogen or a methyl group; R_2 is selected from either hydrogen or a C1-4 hydrocarbon group; m represents an integer of from 0 to 10; n represents an integer of from 4 up to about 15; a represents an integer from 60 to 100, b represents an integer from 4-8; and the configuration of siloxane units includes a random configuration;

a compound of Formula 3



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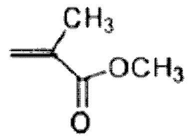
a compound of Formula 4



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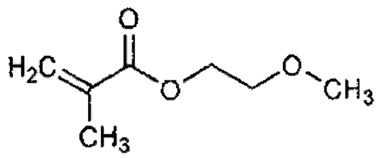
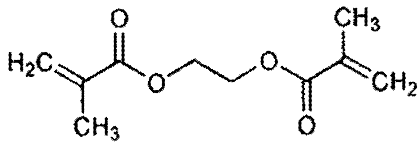
a compound of Formula 5



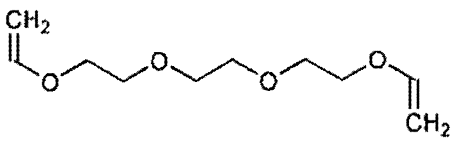
-;

a compound of Formula 6



-; and

a compound of Formula 7



;

wherein the first myopic defocus zone has a radial width from 0.6 to 0.8 mm, and the third zone has a radial width from 0.8 to 1.2 mm.

2. The myopia control contact lens of claim 1, wherein in the compound of Formula 1, R^1 is a butyl group, R^2 is hydrogen, R^3 is a methyl group, m is 4, and n is

1; and in the compound of Formula 2, R_1 and R_2 are methyl groups, m is 0, n represents an integer from about 5 to about 10, a represents an integer of from about 70 to about 90, and b represent an integer of from 1 to about 10 and the compound of Formula 2 has a molecular weight of about 8,000 to about 16,000 daltons.

3. The myopia control contact lens of any preceding claim, wherein the contact lens formulation further comprises at least one benzotriazole-containing ultraviolet light filter.

4. The myopia control contact lens of claim 3, wherein the ultraviolet light filter is 2-[3-(2H-benzotriazol-yl)-4-hydroxyphenyl] ethyl methacrylate.

5. The myopia control contact lens of any preceding claim, wherein the contact lens formulation further comprises 2-(allyloxy)ethanol, 1,4-bis[4-(2-methacryloxyethyl) phenylamino]-9,10-anthraquinone, and triphenylphosphine.

6. The myopia control contact lens of any preceding claim, wherein the optic zone further comprises a second myopic defocus zone circumscribing the third zone, the second myopic defocus zone having a refractive power that is at least 1.00 to 4.00 D more positive than the refractive power of the central zone, and having a radial width of at least 0.8 mm.

7. The myopia control contact lens of claim 6, wherein the second myopic defocus zone has a radial width from 0.8 to 1.1 mm.

8. The myopia control contact lens of any preceding claim, wherein the lens edge has an edge thickness less than 0.10 mm measured at a radial distance 0.10 mm from the lens edge.

9. The myopia control contact lens of claim 8, wherein the lens edge thickness is less than 0.08 mm at a radial distance 0.10 mm from the lens edge.

10. The myopia control contact lens of any preceding claim, wherein the lens edge thickness is less than 0.08 mm at a radial distance 0.07 mm from the lens edge.

11. The myopia control contact lens of claim 10, wherein the lens edge thickness is less than 0.05 mm at a radial distance 0.07 mm from the lens edge.

12. The myopia control contact lens of any preceding claim, wherein the first myopic defocus zone has a refractive power that is at least 3.00 D more positive than the refractive power of the central zone.

13. The myopia control contact lens of any preceding claim, wherein the rate of refractive power change at the junction between any two adjacent zones in the optic zone is at least 6 D/mm when measured at a resolution of less than 0.09 mm.