temperature inside the typical operating room, the polymeric lens material becomes flexible and foldable, which assists in implanting the lens as described below. In this regard, the polymer lens material can have a glass transition temperature (Tg) that is at or below room temperature (~25°C).

[0017] In order to provide optimal vision correction, the lens can exhibit excellent transparency and minimal glistening. "Glistening" is an imperfection in the lens that results from the formation of fluid-filled microvacuoles. These microvacuoles form as water accumulates inside the lens upon condensation and becomes trapped in the hydrophobic material, unable to disperse into the lens or otherwise exit the lens material. The wearer experiences glare and a "dazzling" effect as the microvacuoles refract light. The lens described herein can have an appropriate water absorption rate in order to control glistening.

[0018] The lens can also undergo minimal hydrolysis when exposed to an aqueous environment, and thus will not elute substantial hydrolyzates (chemical irritants) into the eye over time.

Intraocular Lens Structure

[0019] As shown in FIG. 1, the intraocular lens 11 includes a central optic 12, which is typically convex and mimics the focusing properties of the natural lens, and a pair of haptics 13, which extend from the optic and function as optic positioning elements. The optic 12 and haptics 13 can be made of the same or different material. The haptics 13 can be bonded to the optic 12 to form a 3-piece lens, or can be integrally formed with the optic 12 to provide a 1-piece (monolithic) lens (as shown in FIG. 1).

Lens Manufacturing Method

[0020] The polymeric lens material of the disclosed embodiments can be shaped into an intraocular lens using shaping methods that are commonly employed by those skilled in the art. For example, the lens can be shaped using a cutting and grinding method or a molding method. In the cutting and grinding method, the polymerizable composition is polymerized in a mold or vessel designed to facilitate shaping of an intraocular lens, to obtain a rod-shaped, block-shaped, or plate-shaped polymeric starting material. The starting material is then processed into the desired shape by mechanical processing such as cutting, grinding, or polishing. In the molding method, a mold corresponding to the shape of the desired intraocular lens is first prepared, and then the polymerizable composition is polymerized in this mold to obtain a polymeric molded product, which may further be subjected to mechanical finishing treatment, if necessary. The above-mentioned mold or vessel may be made of glass or a plastic such as polyethylene or polypropylene.

and the methacrylate having a methacryloyl group are each referred to as "(meth) acrylate." For convenience of explanation, the constituent moieties contained in the polymer are specified by the name of the monomer, and the monomers exemplified in the explanation of the structure of the polymer are those having a structure in which the polymerizable group is bonded to other constituent moieties. For example, in the explanation of the structure of a polymer, what is exemplified as "(meth) acrylate" exists as a "(meth) acrylate structure" in the polymer, which means that the double bonds of the (meth) acrylate groups are bonded (polymerized) to the polymer backbone.

[0031] In the lens material, the aromatic ring-containing acrylate structure is a structure based on an aromatic ring-containing acrylate as a base monomer. The aromatic ring-containing acrylate affects the refractive index of the lens material. The aromatic ring-containing acrylate structure may have a phenoxy group, an alkylene group having 2 or less carbon atoms, and an acrylate bonding site. The polymerizable composition can include a single aromatic-ring containing acrylate, where "single" means that the polymer has only one aromatic-ring containing acrylate, optionally including at most negligible amounts of other aromatic-ring containing acrylates (i.e., less than 3.0 parts per 100 parts of the base material).

[0032] Examples of the aromatic ring-containing acrylate include phenoxyethyl acrylate, phenylethyl acrylate, benzyl acrylate, phenyl acrylate, pentabromophenyl acrylate, and the like. Among them, one or more of phenoxyethyl acrylate, phenylethyl acrylate, and benzyl acrylate is preferable from the viewpoint of increasing the refractive index, and phenoxyethyl acrylate is particularly preferable from the viewpoint of also improving flexibility. Even more preferably, phenoxyethyl acrylate is the only aromatic-ring containing acrylate in the entire polymerizable composition (i.e., the polymerizable composition and lens material do not contain any other aromatic-ring containing acrylates).

[0033] Since it is desirable that the lens exhibits a high refractive index even in the water absorbing (hydrated) state, the content of the aromatic acrylate can be 30 parts by mass or more and 80 parts by mass or less, 40 parts by mass or more and 70 parts by mass or less, or 55 parts by mass or more and 65 parts by mass or less per 100 parts by mass of the base material. For example, the content of the aromatic acrylate may be 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, or 65 parts by mass with respect to 100 parts by mass of the base material.

[0034] The molar amount of the aromatic ring-containing acrylate in the polymerizable composition can be 19 mol% to 46 mol%, 34 mol% to 43 mol%, or 35 mol% to 39 mol%.

[0035] The methacrylate structure in the lens polymer (from the alkoxyalkyl methacrylate) has a relatively hard (rigid) structure due to the presence of a methyl group as compared with acrylate. However, the methacrylate structure is less susceptible to water attack and is therefore resistant to hydrolysis.

[0036] The number of carbons in the alkoxyalkyl group (4 or less carbon atoms) also affects the degree of glistening, tackiness, and flexibility. The number of carbon groups in the alkoxyalkyl group is controlled so that the methacrylate structure is not too hard, and thus provides sufficient flexibility.

[0037] The alkoxyalkyl group may be represented by, for example, the following Chemical Formula (2):

$$C_nH_{2n+1}OC_mH_{2m}- \quad \text{---Chemical Formula (2)}$$

In the Chemical Formula (2), $(n+m) \leq 4$

[0038] The alkoxyalkyl methacrylate structure having an alkoxyalkyl group having 4 or less carbon atoms has a structure based on alkoxyalkyl methacrylate as a base monomer. The alkoxyalkyl group of the alkoxyalkyl methacrylate may be represented by, for example, the above Chemical Formula (2). Examples of the alkoxy group include a methoxy group, an ethoxy group, and the like. Examples of the alkylene group to which the alkoxy group is bonded include a methylene group, an ethylene group, and the like. The alkoxyalkyl methacrylate is preferably one or more of methoxyethyl methacrylate and ethoxyethyl methacrylate, more preferably ethoxyethyl methacrylate.

[0039] The content of the alkoxyalkyl methacrylate in the polymerizable composition can be in the range of 5 parts by mass or more and 70 parts by mass or less, 6 parts by mass or more and 30 parts by mass or less, or 10 parts by mass or more and 25 parts by mass or less per 100 parts by mass of the base material, from the viewpoint of inhibiting hydrolysis and facilitating folding. For example, the content of the alkoxyalkyl methacrylate may be 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, or 25 parts by mass with respect to 100 parts by mass of the base material.

[0040] The molar amount of the alkoxyalkyl methacrylate in the polymerizable composition can be 5 mol% to 55 mol%, 6 mol% to 30 mol%, or 7 mol% to 20 mol%.

[0041] The alkyl acrylate structure in which the alkyl group has 1 to 20 carbon atoms is a structure based on alkyl acrylate as a base monomer. The alkyl acrylate having 1 to 20 carbon atoms in the alkyl group can affect shape recoverability and flexibility of the

CLAIMS

WHAT IS CLAIMED IS:

1. An intraocular lens comprising a polymeric lens material that is formed from polymerizable composition comprising:

(a) a single aromatic acrylate monomer which is an aromatic-ring containing acrylate;

(b) an alkoxyalkyl methacrylate monomer having an alkoxyalkyl group with 4 or less carbon atoms;

(c) an alkyl acrylate monomer having an alkyl group with 1 to 20 carbon atoms;

(d) a hydrophilic monomer; and

(e) a crosslinkable monomer,

wherein a molar ratio H:C in the polymerizable composition is from 12:1 to 15:1, the molar ratio is molar amount H of the hydrophilic monomer: molar amount C of the crosslinkable monomer.

2. An intraocular lens comprising a polymeric lens material that is formed from polymerizable composition comprising:

(a) a single aromatic acrylate monomer which is an aromatic-ring containing acrylate;

(b) an alkoxyalkyl methacrylate monomer having an alkoxyalkyl group with 4 or less carbon atoms;

(c) an alkyl acrylate monomer having an alkyl group with 1 to 20 carbon atoms;

(d) a hydrophilic monomer; and

(e) a crosslinkable monomer,

wherein:

the single aromatic acrylate monomer, the alkoxyalkyl methacrylate monomer, and the alkyl acrylate monomer constitute a base material of the polymerizable composition, and

the polymerizable composition comprises, per 100 parts of the base material:

from 55 parts to 65 parts by mass of the single aromatic acrylate monomer;

from 10 parts to 25 parts by mass of the alkoxyalkyl methacrylate monomer;

from 15 parts to 30 parts by mass of the alkyl acrylate monomer;

from 15 parts to 30 parts by mass of the hydrophilic monomer; and

from 2 parts to 4 parts by mass of the crosslinkable monomer.

3. The intraocular lens according to claim 2, wherein:

the single aromatic acrylate monomer is phenoxyethyl acrylate, the alkoxyalkyl methacrylate monomer is ethoxyethyl methacrylate,

the alkyl acrylate monomer is ethyl acrylate.

4. The intraocular lens according to claim 3, wherein the hydrophilic monomer is 2- hydroxyethyl methacrylate.

5. An intraocular lens comprising a polymeric lens material that is formed from polymerizable composition comprising:

(a) 35 mol% to 39 mol% of a single aromatic acrylate monomer which is an aromatic-ring containing acrylate;

(b) 7 mol% to 20 mol% of an alkoxyalkyl methacrylate monomer having an alkoxyalkyl group with 4 or less carbon atoms;

(c) 20 mol% to 37 mol% of an alkyl acrylate monomer having an alkyl group with 1 to 20 carbon atoms;

(d) 15 mol% to 24 mol% of a hydrophilic monomer; and

(e) 1.1 mol% to 2.1 mol% of a crosslinkable monomer.

6. The intraocular lens according to claim 5, wherein:

the single aromatic acrylate monomer is phenoxyethyl acrylate, the alkoxyalkyl methacrylate monomer is ethoxyethyl methacrylate, the alkyl acrylate monomer is ethyl acrylate.

7. The intraocular lens according to claim 6, wherein the hydrophilic monomer is 2- hydroxyethyl methacrylate.

8. The intraocular lens according to claim 1, wherein a molar amount of the crosslinkable monomer in the polymerizable composition is less than 2.1 mol%.

9. The intraocular lens according to claim 1, wherein an H×C value of the lens material is more than 3.6×10^{-3} and less than 4.2×10^{-3}, the H×C value being the product of a molar amount H of the hydrophilic monomer and a molar amount C of the crosslinkable monomer in the polymerizable composition.

10. The intraocular lens according to claim 1, wherein a molar ratio MA/A of all methacrylate monomers to all acrylate monomers in the polymerizable composition is in the range of 0.35 to 0.65.

11. The intraocular lens according to claim 1, wherein the polymeric lens material has an elution characteristic of 1.30 mass% or less at 90 days.

12. The intraocular lens according to claim 1, wherein the lens material has a breaking stress of from 5.5 MPa to 11.0 MPa.

13. The intraocular lens according to claim 1, wherein the lens material has a refractive index of 1.50 or more in a state of hydration.

14. The intraocular lens according to claim 1, the lens being formed by molding.