

CONTACT LENS

Field of Invention

- 5 This invention is related to contact lenses. In particular, the invention relates to a contact lens capable of altering the appearance of the eye of the wearer when the wearer is wearing the contact lens. More particularly, but not exclusively, the contact lens is capable of making the eye appear bigger and brighter.

10 Background

Contact lenses are widely used for correcting many different types of vision deficiencies. These include defects such as near-sightedness and far-sightedness (myopia and hypermetropia, respectively), astigmatism, and defects in near range vision usually
15 associated with aging (presbyopia).

Contact lenses may also be used for cosmetic reasons. One class of "cosmetic" lenses includes coloured lenses. The use of tinted, or coloured, contact lenses to alter the natural colour of the iris is well known. Certain eye colours are sometimes seen as being
20 especially attractive and motif-expressing contact lenses can be worn to mask one's natural eye colour with another. These lenses are useful for enhancing or changing the apparent colour of the wearer's iris. Generally, these lenses include a coloured iris section, and the coloured contact lenses may include an optical correction, for example, a correction to accommodate far-sightedness or near-sightedness of the wearer of the
25 contact lens. Alternatively, the contact lenses may be provided with the coloured iris section solely for cosmetic purposes.

There are also "cosmetic" lenses available in the market that rely on the coloured iris section of the lens to create the 'big' eye effect. These lenses have one thing in common
30 – the lenses are designed to 'fit' the average iris. The coloured iris section covers most part of the wearer's iris, leaving a small blank portion which is roughly the same size as the wearer's pupil.

The problem encountered with these "cosmetic" lenses is that they affect the peripheral vision of the wearer and give rise to "blurred" peripheral vision. The primary reason for this phenomenon is the printing of a starburst-like pattern on the iris section of the lens close to the optic zone. This starburst-like pattern attempts to give the lenses a more natural look.

Summary of Invention

In accordance with a preferred aspect, there is provided a contact lens comprising:

- 10 (a) a non-opaque pupil region;
- (b) a generally annular-shaped iris region having an area and circumferentially surrounding the pupil region;
- (c) an outer periphery surrounding the iris region;
- 15 (d) a pattern printed on the iris region and extending across a portion of the area of the iris region to impart to the iris region at least a perception of a structure of an iris of an eye, the pattern not extending into the outer periphery of the lens;

wherein,

- 20 (e) in use, the diameter of the iris region is greater than the diameter of a wearer's iris thereby providing a lens capable of making the eye of the wearer appear bigger when the wearer is wearing the contact lens; and
- wherein the printed pattern is configured to provide a darkened image within an outer portion of the iris region; and
- in use, the diameter of pupil region is larger than the diameter of the wearer's pupil..

Preferably, in use, the colour of the printed pattern is the same as the colour of the wearer's iris. More preferably, the colour of the printed pattern is black especially if the wearer is Asian. Advantageously, the net effect is that the lens appears like an extension of the wearer's iris. This extension creates the "big" eye effect.

Advantageously, the printed pattern on the lens does not impede on peripheral vision.

Preferably, the printed pattern consists of a single colour. More preferably, the printed pattern is the result of a first pattern and a second pattern that are overlaid wherein the first and second patterns are of different colours.

- 5 Preferably, the area of the pupil region is between 20 to 30 sq mm. More preferably, the pupil region occupies an area between 10 to 20% of the total contact lens area while the printed iris region occupies an area between 60 to 75% of the total contact lens area. Still more preferably, the printed iris region occupies an area between 65 to 70% of the total contact lens area.

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Preferably, the lens is of the disposable kind.

- The present invention provides for a contact lens that looks natural on the eye, has good cosmetic appeal, makes the eye appear bigger and brighter and yet has no issues relating to blurred peripheral vision. The current invention talks about lenses that do not have a starburst-like pattern and yet look natural on the eye. Elimination of the starburst-like pattern helps to achieve good peripheral vision.

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Brief Description of Figures

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In order that the present invention may be fully understood and readily put into practical effect, there shall now be described by way of non-limitative examples only preferred embodiments of the present invention, the description being with reference to the accompanying illustrative figures.

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In the figures:

Figure 1 shows a schematic drawing of a contact lens according with an embodiment of the present invention;

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Figure 2 shows a cross sectional view of the contact lens according with an embodiment of the present invention;

Figure 3 shows a "basic" pattern printed on a contact lens according with an embodiment of the present invention;

Figure 4 shows a "ring" pattern printed on a contact lens according with an embodiment
5 of the present invention;

Figure 5 shows the composite pattern ("basic" and "ring" pattern) printed on a contact lens according with an embodiment of the present invention; and

10 Figure 6 shows a contact lens according with an embodiment of the present invention as it would appear on a wearer's eye.

Detailed Description of The Preferred Embodiments

15 Referring to the accompanying drawings, Figure 1 shows a contact lens 10 having a pattern 20 printed on the iris region 30, the iris region 30 being an area circumferentially surrounding the non-opaque pupil region 40. To allow the lens to look natural on the eye, the printed pattern 20 is configured to provide a darkened image within an outer portion of the iris region 25. In a preferred embodiment, the printed pattern 20 does not contact
20 the outer periphery 35 of the lens 10. Generally, Asians such as the Chinese, Japanese and Koreans have a dark-coloured iris. Among these groups of people, black is the most common colour for the iris. Therefore, an embodiment of the invention provides for a contact lens with a black pattern. However, other colours such as brown or grey are possible. The colour may be a single colour, or a combination of colours. The colour may
25 be approximately the same as that of the wearer's iris.

By "non-opaque" it is meant to describe a part of the lens that is not printed, non-coloured or coloured with translucent colouring and is preferably transparent.

30 Figure 2 shows a cross sectional view of the contact lens when worn over a wearer's eye. The printed pattern 20 of the lens 10 lies beyond the wearer's iris 50. In other words, the diameter of the iris region 30 is greater than the diameter of the wearer's iris 50. This printed pattern 20 overlaps the wearer's iris 50 at 60. This helps define the

wearer's iris 50 by acting like an extension of the wearer's iris 50 and causes the wearer's eyes to look bigger.

Another feature of the present invention is the area around the optic zone (pupil region 40) that is left unprinted. Referring to Figure 2, the diameter of the pupil region 40 is also larger than the diameter of the wearer's pupil 70. This large unprinted pupil region 40 not only prevents the printed pattern 20 on the lens 10 from impeding peripheral vision of the wearer but, when coupled with the black printed pattern, also cause the wearer's eye to look bigger and brighter.

The area of the non-opaque pupil region 40 ranges between 20 to 30 sq mm. This pupil region 40 occupies an area between 10 to 20% of the total contact lens 10 area. The printed pattern 20 occupies an area between 60 to 75% of the total contact lens 10 area. Preferably, the printed pattern 20 occupies an area between 65 to 70% of the total contact lens 10 area. Assuming that the average diameter of the wearer's iris is between 12 and 13 mm (for convenience, this diameter includes the wearer's pupil), the area of the printed pattern 20 lying outside of the wearer's iris, i.e. the sclera region of the eye (overlapped region 60), is between 3 to 30% of printed pattern 20 area.

Figures 3 and 4 show the constituent patterns ("basic" and "ring" patterns) that are overlaid to obtain the pattern shown in Figure 5. By "pattern" it is meant to describe a mixture of dots and lines, randomly or non-uniformly spaced, to simulate the natural look and appearance of the human iris. These dots and lines can be seen in the Figures 3, 4 and 5. The overlaid pattern also helps to achieve darkened image within an outer portion of the iris region 25.

The ink to obtain the black coloured pattern is based on poly 2-(hydroxyethyl methacrylate), a hydrophilic polymer. The ink contains the typical components namely, the colourant, resin, solvent, additives and a cross-linker. The colourant(s) can either be a pigment or a dye. The resin is typically based on the hydrophilic, 2-hydroxyethyl methacrylate. Though 2-(hydroxyethyl methacrylate) forms the main component of the resin for the ink system, other co-monomers may be used. Examples include methacrylic acid (to increase the water absorbing capability of the ink system that employs the resin), 2-ethoxyethyl methacrylate or methyl methacrylate (to provide

mechanical strength to the resulting ink film). The mechanical strength and the water absorbing capability of the final ink film can both be conveniently controlled by altering the monomer composition. This capability is key to designing coating systems for substrate lenses that have varying water content. It is common knowledge that disposable lenses have a higher water content as compared to the conventional lenses. By altering the monomer composition, a skilled person in the art, would be able to design ink systems suited to substrates with varying water content. Suitable polymerisation initiators such as 2,2'-azobis(isobutyronitrile), benzoyl peroxide or t-butyl peroxide may be used. The molecular weight of the resin, or in other words the binding polymer, can be controlled by using a chain transfer agent, as is well known in the art. Suitable chain transfer agents include 1-dodecyl mercaptan and 2-mercapto ethanol. Any suitable solvent that can bring the material of the resin into solution can be used. Typical solvents would be cyclohexanone, cyclopentanone, ethyl lactate or methylethyl ketone. A combination of solvents may be used. The preferred solvent system is a combination of ethyl lactate and cyclopentanone. Additives to aid dispersion and prevent pigment flocculation may be employed. The ink would also have to include a cross-linking agent that would help obtain a cross-linked network. The cross-linking reaction would ensure that the pigment particles are trapped in the resulting network and also ensure that the ink layer is firmly anchored on to the substrate lens material. A typical cross-linking agent would be based on a bifunctional isocyanate. The two reactive groups per isocyanate molecule would ensure formation of a cross-linked network. Suitable isocyanate compounds would include hexamethylene diisocyanate and 2,4-toluene diisocyanate. Isocyanates are extremely reactive compounds. An end capping reaction might be used to temporarily render the isocyanate inactive. The passive isocyanate may then be activated during the curing/cross linking reaction that follows the printing step, in which the ink gets printed on to the lens substrate.

The pigment paste required to make the ink can be obtained by grinding the ingredients (except the cross-linker) together. The grinding can be achieved, in any equipment that can bring about particle size reduction – say, a bead mill. The typical process would involve mixing the resin, the colourant(s), the additives(s) and the solvent(s) and then grinding the resulting mixture in the grinding equipment. The mixture would have to be run through a grinding equipment, for example a bead mill, several times to bring about

the required particle size reduction in the pigment(s). The ideal final particle size would be less than 3 microns.

5 The preparation of the ink would involve adding the stoichiometric amount of cross-linker to the pigment paste and then further addition of solvent to obtain the printing viscosity. The cross-linking agent in the current invention is based on a bifunctional isocyanate.

10 The coloured pattern is deposited onto the anterior surface of the lens using offset pad printing. The patterns depicted in Figures 3 and 4 are first etched on stainless steel plates referred as a 'cliché'. The two patterns could be combined and subsequently etched on one single stainless steel plate as well. The circular depressions are typically 12 to 18 microns deep. In a typical printing operation, the depressions would first be filled with an ink, and the excess ink scraped away with a doctor blade. Silicone rubber pads would then help transfer the ink from the depressions onto the lens surface thereby transferring the pattern from the cliché onto the lens surface. Though the invention describes the pad printing methodology, a person well trained in the art would know that any similar printing method could be employed as well. The ink would then be subjected to a curing/cross-linking reaction at a high temperature under reduced pressure. This step could be effectively performed under an inert atmosphere as well. Temperatures of the order of 100 to 135 °C are typical. If a capped isocyanate were to be used as the cross-linking agent, this would be the stage when the compound would be 'decapped', thereby making it available for reaction with the reactive groups on the resin. If the substrate lenses were to be based on a polymer containing 2-hydroxyethyl methacrylate, the isocyanate could react with the hydroxyl groups on the lens surface as well. This in fact would be preferred since it would result in an ink film that would exhibit good adhesion properties. The cured lenses are then subjected to a hydration step. The resulting hydrated lenses are then sterilised as is typical of medical devices.

30 The contact lens may be made of any suitable material and process known in the art, and may be of the disposal kind. For example, the contact lenses may be made using a suitable hydrophilic polymer. The material for the lenses may also be based on the silicone hydrogel material. A skilled person in the art will be able to design the resin to suit different substrates by varying the composition of the monomers in the resin formulation.

Whilst there has been described in the foregoing description preferred embodiments of the present invention, it will be understood by those skilled in the technology concerned that many variations or modifications in details of design or construction may be made
5 without departing from the present invention.

The Claims

1. A contact lens comprising:

(a) a non-opaque pupil region;

(b) a generally annular-shaped iris region having an area and circumferentially surrounding the pupil region;

(c) an outer periphery surrounding the iris region;

(d) a pattern printed on the iris region and extending across a portion of the area of the iris region to impart to the iris region at least a perception of a structure of an iris of an eye, the pattern not extending into the outer periphery of the lens; wherein,

(e) in use, the diameter of the iris region is greater than the diameter of a wearer's iris thereby providing a lens capable of making the eye of the wearer appear bigger when the wearer is wearing the contact lens; and

wherein the printed pattern is configured to provide a darkened image within an outer portion of the iris region; and

in use, the diameter of the pupil region is larger than the diameter of the wearer's pupil, wherein the printed iris region occupies an area between 60 to 75% of the total contact lens area.

2. A contact lens according to any one of the preceding claims, wherein the printed pattern is the result of a first pattern and a second pattern that are overlaid.

3. A contact lens according any one of the preceding claims, wherein the printed pattern consists of a single colour.

4. A contact lens according to claim 3, wherein, in use, the colour of the printed pattern is the same as the colour of the wearer's iris thereby allowing the iris region of the lens to appear like an extension of the wearer's iris.

5. A contact lens according any one of claims 3 or 4, wherein the colour of the printed pattern is black.

6. A contact lens according to any one of the preceding claims, wherein, in use, the area of the iris region lying outside the wearer's iris is between 3 to 30% of the iris region.

5 7. A contact lens according to any one of the preceding claims, wherein the area of the pupil region is between 20 to 30 sq mm.

8. A contact lens according to any one of the preceding claims, wherein the pupil region occupies an area between 10 to 20% of the total contact lens area.

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9. A contact lens according to any one of the preceding claims, wherein the printed iris region occupies an area between 65 to 70% of the total contact lens area.

10. A contact lens according to any one of the preceding claims, wherein the printed pattern is non-uniform.

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11. A contact lens according to any one of the preceding claims, wherein the lens is of the disposable kind.