An eyeglass lens is made of layers which include an outer, convex hard coating, a layer of hard epoxy, a PVA film, a layer of soft epoxy, a layer of adhesive, a base material, and an inner, concave hard coating. The major steps in producing the lens are:

1. Prepare a clean, soft PVA film.
2. Form the PVA film into the desired curved shape using a convex mold.
3. Add hard epoxy to the outer, convex side of the PVA film.
4. Add soft epoxy to the inner, concave side.
5. Add the base material to the inner, concave side.
6. Harden and package the lens.

FIG. 1
POLARIZED LENS AND METHOD OF MAKING POLARIZED LENS

FIELD OF THE INVENTION

[0001] This invention is generally related to eyewear, and more particularly to polarized lenses for glasses and a method of making polarized lenses.

BACKGROUND OF THE INVENTION

[0002] Polarized lenses have been made using wafers of flat, laminated layers including polarized films, such as polyvinyl alcohol (PVA), laminated with polymers, such as CR-39 or polyurethane, which are subjected to heat and pressure and then bent into the desired lens curvature. Such wafers are not strong, and the heating and bending of the polarized film with its composite sheets in a mold or casting could result in splitting, cracking, or optical deformation. Injection molding at lower temperatures could damage the surface of the polymer, while use of high temperatures could damage the surface of the polarized film. It could be difficult to obtain the desired radius of curvature without damaging the already laminated wafer.

[0003] Such lenses did not take advantage of the polarizing qualities of polyvinyl alcohol (PVA) combined with the use of quantities of epoxy which can include photochromic agents. Such lenses also did not allow for the polymer base material and the polarized film to be separately dipped for coloring. Such lenses were not always suitable for reading glasses, goggles, prescription RX lens, or sunglasses with polarized photochromic, colored, or gradient lenses.

[0004] It is therefore an object of the invention to provide a method of making polarized lenses, which avoids the problems associated with current method of preparing lenses, and to provide a lens made by said method.
SUMMARY OF THE INVENTION

[0005] An eyeglass lens is made of layers which include an outer, convex hard coating, a layer of hard epoxy, a PVA film, a layer of soft epoxy, a layer of adhesive, a base material, and an inner, concave hard coating. The major steps in producing the lens are to 1: prepare a clean, soft PVA film; 2: form the PVA film into the desired curved shape using a convex mold; 3: add hard epoxy to the outer, convex side of the PVA film; 4: add soft epoxy to the inner, concave side; 5: add the base material to the inner, concave side; and 6: harden and package the lens.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The invention is generally shown by way of reference to the accompanying drawings in which:

FIG. 1 depicts one embodiment of a lens having layers;
FIG. 2 depicts one embodiment of an assembly line to prepare a clean, soft PVA film;
FIGS. 3A and 3B depict one embodiment of a holding frame;
FIGS. 4A and 4B depict one embodiment of the PVA film being formed into the desired curved shape using one side of a convex mold;
FIGS. 5A and 5B depict one embodiment of a thin, outer layer of epoxy being added to the PVA film;
FIG. 6 depicts an embodiment of a compressor with UV hardening equipment;
FIG. 7 depicts one embodiment of soft epoxy being added to form a buffer gel layer on the inner, concave surface; and
FIG. 8 depicts the base material of the lens being glued to the inner, concave surface.
DETAILED DESCRIPTION OF THE INVENTION

Some embodiments are described in detail with reference to the related drawings. Additional embodiments, features and/or advantages will become apparent from the ensuing description or may be learned by practicing the invention. In the figures, which are not drawn to scale, like numerals refer to like features throughout the description. The following description is not to be taken in a limiting sense, but is made merely for the purpose of describing the general principles of the invention. The steps described herein for performing methods form one embodiment of the invention, and, unless otherwise indicated, not all of the steps must necessarily be performed to practice the invention, nor must the steps necessarily be performed in the order listed.

The present invention is a polarized lens and a method of making polarized lenses. As depicted in FIG. 1, one embodiment of lens 10 will have layers as follows: outer, convex hard coating 12; layer of hard epoxy 14; PVA film 16; layer of soft epoxy 18; layer of adhesive 20; base material 22; and inner, concave hard coating 24. A "convex" surface generally bulges out like the outside of a ball, and a "concave" surface generally curves in like the inside of a bowl. The lens user or eyeglass wearer generally peers into the concave side, so the concave side of lens 10 is "inner" and the convex side is "outer." In another embodiment, layer of adhesive 20 and base material 22 are above PVA film 16, rather than below it as depicted in FIG. 1, resulting in a lens 10 where base material 22 is closer to the outer side than the inner side.

PVA 16 is polarized polyvinyl alcohol and may also be tinted or combined with a photochromic agent, which is a chemical that causes a reversible change in color or darkness on exposure to light. Adhesive 20 could be made of a mixture of acrylic resin, polyurethane and oil based solvent. Base material 22 could be polycarbonate, polyurethane, polyethylene, nylon, allyl diglycol carbonate monomer (CR-39), Polymethylmethacrylate (PMMA), glass, or other material, and can be injection molded or otherwise cast with or without pressure to have a desired curvature and optical qualities. Base material 22 could be pre-formed with hard coatings on one or both sides. Outer, convex hard coating 12 and inner, concave hard coating 24 can be resin materials that provide scratch resistance, UV protection, anti-reflective coatings, mirrored coatings,
multi-layer coatings, water-resistance, decorative designs, or a combination of these features. The coatings on the lens or base material can be applied by deposition or vacuum coating, and can include a mirrored coating on the outer, convex side, or an anti-reflective coating on the inner, concave side.

(0010) Hard epoxy 14 is "hard" because it is near the outer surface of the lens where scratch resistance is desirable, and soft epoxy 18 is "soft" because it acts as a buffering gel between PVA 16 and base material 22 to help prevent cracking. Both can be any epoxy or epoxy mixture, and can consist of more than half epoxy resin combined with one or more of polyurethane, acrylic resin, CR-39, or silicon. Both can also be mixed with coloring, tinting, photochromic agents, infrared or ultraviolet blockers, stabilizers, stiffeners, anti-oxidants, anti-fog treatments, or silicon hard coatings. In one embodiment, hard epoxy 14 has a pencil softness rating of 1B to 3B, and soft epoxy 18 has a pencil softness rating of 2B to 4B.

(0011) The major steps in producing the lens are described in the following sections.

1. Prepare a clean, soft PVA film

(0012) FIG. 2 depicts one embodiment of an assembly line to prepare a clean, soft PVA film. Start with an untreated roll of PVA film 102, which is about 0.075 mm thick and generally without sufficient sunlight glare protection or directional molecular arrangement (generally not polarized). Process using assembly line 100 which has rollers to transport PVA film 102 through one or more stages as follows:

- mount untreated roll of PVA film 102 at the beginning of assembly line 100;
- use water to wet, clean, and wash the film until it has approximately 70%-85% water saturation in stage 104;
- soften, expand and stretch the film in stage 106;
- dye dip the film to add tinting, color, or photochromic agents, and further stretch the film in stage 108; and
- clean the film again in stage 110.

(0013) PVA film 102 is stretched to about 4 to 6 times its original length, its width is reduced to about one half, its original width, and its thickness is reduced to about one third of the original thickness, namely, about 0.02 mm to 0.03 mm. The molecules of
PVA film 102 will become more evenly aligned and will become substantially polarized, which reduces glare. Darker lenses, such as those which transmit only 13% to 18% of the light, should filter out approximately 95% to 99% of unpolarized light. Lighter lenses, such as yellow lenses, would filter less than 95%. PVA film 102 is placed in water until it contains about 70%-85% water, which will make it soft and elastic. PVA film 102 can be dipped to produce either a uniform coating or a gradient effect using photochromic agents or coloring chemicals such as dichroic dyes or iodine. This produces a clean, polarized PVA film 112 which is soft due to its high water saturation, which can be fed into a second assembly line for further processing.

2. Form the PVA film into the desired curved shape using a convex mold.

[0014] FIGs. 3A and 3B depict one embodiment of a holding frame 114. PVA film 122 is stabilized between lower frame plate 116 and upper frame plate 118, which are held together with frame hinge 120 and clip 122. Additional clips can be used to help prevent PVA film 112 from shrinking during shaping.

[0015] FIGs. 4A and 4B depict one embodiment of the PVA film being formed into the desired curved shape using one side of a convex mold as follows:

- stabilize and cut PVA film 112 on holding frame 114;
- press convex mold 124 onto PVA film 112 to force the film into the desired curved shape;
- heat PVA film 112 at 60°c to 80°c until its moisture content is about 50%;
- inspect and mark the polarization direction of PVA film 112; and
- dry the PVA film 112 at approximately 25°c and 40-50% humidity until its moisture content is about 40%.

[0016] PVA film 112 is cut from the end of the clean, soft PVA film output from assembly line 100 into the approximate final lens size or larger. Holding frame 114 is open in the center, which allows convex mold 124 to be pushed through holding frame 114 and against PVA film 112. FIG. 3B shows that holding frame 114 can be held on a conveyor belt which is used in the second assembly line.

[0017] One side of convex mold 124 is used to shape PVA film 112. The convex surface of convex mold 124 is pushed into the flat piece of soft film to bend it into the desired
shape, curve or arc. Since PVA film 112 is soft and wet, it will conform its shape to the mold. In one embodiment, convex mold 124 is made of glass, such as glass in common practice for forming thermoset resin ophthalmic lenses, or another material that is relatively transparent or ultraviolet light, so that the epoxy can be cured by UV light which passes through the mold. In other embodiments, convex mold 124 is made of a material which conducts heat, so that heat can pass through the mold.

PVA film 112 is heated at about 80°C or less to remove the moisture from the wet PVA without melting it. This should take about 10 minutes. PVA film 112 was "wet" because its moisture content made it relatively soft, and it becomes "dry" because the reduction in moisture content will fix or lock in its shape. Temperatures above 80°C may act to melt or liquefy the film.

PVA film 112 is inspected in a quality control stage after the initial drying for air bubbles, dirt, color evenness, polarization levels, tears, etc. The diopter and other optical properties of PVA film 112 can be measured. If all is approved, the lens is marked with a polarization direction marker. After marking, PVA film 112 can then be removed to a clean room at room temperature and low humidity levels for further cooling until PVA film 112 contains about 40% water, which is a good moisture content to adhere with epoxy or other materials. Dryer conditions below 30% can cause cracking. This produces a curved, dry PVA film 112, which eventually becomes PVA film 16 layer in final lens 10.

3. Add Hard Epoxy to the Outer, Convex Side of the PVA film

FIGs. 5A and 5B depict one embodiment of a thin, outer layer of epoxy being added to the PVA film as follows:

- polish and clean the surface of concave mold 130;
- add about 5cc of hard epoxy 132 in liquid form onto concave mold 130; and
- position concave mold 130 and convex mold 124 together so that the outer surface of PVA film 122 is pressed down onto hard epoxy 132;
- compress molds 124 and 130 together;
- determine direction of polarization; and
- UV hardening.
Like convex mold 124, concave mold 130 can be made of transparent glass. About 5cc of hard epoxy 132 is used, which should spread out to form a layer about 0.1 mm - 0.5 mm thick, preferably 0.2 mm - 0.3 mm for good surface tension. This eventually becomes layer of hard epoxy 14 in lens 10. Thermosetting epoxies should be heated to about 80°C to 90°C so that they will be liquid or semi-liquid, to help eliminate bubbles, and so that coloring, photochromic agents, UV and infrared-blocking powders can be added. The liquid epoxy is soft enough to flow, but it is not so viscous that it will flow away without adhering. The liquid epoxy can be dripped onto PVA film 112, smoothly expanding from the center in a circular motion to evenly spread the epoxy and help remove air bubbles. This process can be performed in an environment at approximately room temperature.

In one embodiment, holding frame 114 still holds PVA film 112 in contact with convex mold 124, and the convex mold-plus-PVA film combination is inverted and placed on top of concave mold 130 and attached together with a mold-holding tool (not shown). Because the final layer of hard epoxy 132 is less than 0.5 mm, no gasket is needed. During UV hardening, the liquid epoxy is cured and made hard using ultraviolet light, heat, radiation, pressure, passage of time, or other methods for hardening epoxy.

FIG. 6 depicts an embodiment of a compressor 140, which could be an adjustable compressing machine. The PVA-plus-epoxy collection of holding frame 114, convex mold 124, PVA film 112, hard epoxy 132 and concave mold 130 are placed in compressor 140. The convex side of PVA 112 film is pressed down against the epoxy-lined surface of concave mold 130 to help remove air bubbles and evenly spread out the layer of hard epoxy 132. The pressure is applied by compressor 140 to adjust the thickness of hard epoxy 132 to the desired thickness, which is about 0.1 mm to 0.2 mm. The polarization is also be adjusted. In one embodiment, in addition to pressing, compressor 140 also performs preliminary UV hardening using UV light source 142. In other embodiments, compressor 140 includes heating equipment or other equipment for curing epoxy or allowing epoxy to harden.

The PVA-plus-epoxy collection is then sent to an assembly line with UV hardening equipment to be hardened for about three minutes. Fine shaping can also be
performed manually at this stage by cutting away excess PVA. This produces a PVA film 112 with a hard layer of epoxy 132 on its outer, convex surface.

In another embodiment, this produces a polarized wafer coated with epoxy on one side. The uncoated concave side, the epoxy-lined convex side, or both sides could then be combined with a base material, through casting in a gasket mold, injection molding, or other methods for combining lens components.

4. Add Soft Epoxy to the Inner, Concave Side

FIG. 7 depicts one embodiment of soft epoxy being added to form a buffer gel layer on the inner, concave surface as follows:

- remove holding frame 114 and cut away the excess PVA film 122;
- remove convex mold 124;
- inject about 5cc of soft epoxy 150 in liquid form onto the exposed, concave side of PVA film 112;
- place convex mold 124 back on top so that the concave surface presses against soft epoxy 150;
- compress molds 124 and 130 together;
- UV hardening; and
- remove convex mold 124 again.

Excess PVA can be cut away manually, using a lens-cutting machine, or with a computer numerical control (CNC) cutting machine, to form a variety of lens shapes. Compressor 140 is used again, and can also perform preliminary UV or other hardening of soft epoxy 150. This results in a shaped PVA film 112 with epoxy on both sides. Soft epoxy 150 eventually becomes layer of soft epoxy 18 in lens 10. Instead of re-using convex mold 124, a third mold or another properly shaped component could be used to press against soft epoxy 150.

In another embodiment, this produces a polarized wafer coated with epoxy on both sides. One or both sides of the polarized wafer could then be combined with a base material, through casting in a gasket mold, injection molding, or other methods for combining lens components.
5. Add the Base Material to the Inner, Concave Side

(0029) FIG. 8 depicts the base material of the lens being glued to the inner, concave surface as follows:

- add about 2cc of adhesive 152 onto the exposed, concave surface of soft epoxy 150;
- combine with base material 154;
- compress mold 130 against base material 154; and
- inspect.

[0030] Compressor 140 is used again, and can also perform preliminary UV or other hardening of adhesive 152. Base material 154 can have coatings on either side, which can include hard coatings, multi-layer coatings, water resistance, reflector coatings or mirrored coatings, either uniform or in patterns or gradients. Adhesive 152 and base material 154 will eventually become layer of adhesive 20 and base material 22 of lens 10. The combined lens is inspected to check for optical functionality, dirt, adhesion conditions, etc. If it passes inspection, it is sent to the next step; otherwise, the rejected lens is processed accordingly.

6. Harden and Package the Lens

[0031] The outer layers of the lens are hardened as follows:

- sonic cleaning;
- heat dry;
- enter a clean laboratory;
- perform single-sided lens hardening;
- check for defects, remove any remains and excess PVA, clean, and inspect again;
- perform single-sided lens hardening on the other side; and
- package the finished lens.

[0032] The hardening applied to the convex surface will become convex hard coating 12 of lens 10, and the hardening applied to the concave surface will be come concave hard coating 24. This produces a finished lens 10. In one embodiment, a lens-cutting machine or a CNC machine is used to form a variety of lens shapes. In another embodiment, two lenses 10 are mounted in a frame to form polarized eyeglasses or spectacles. In yet other
embodiments, lens 10 is mounted or combined with other lenses to provide wrap-around spectacles or masks, single-lens glasses, rimless eyeglasses, magnifying glasses, telescopes, binoculars, or other polarized optical components.

[0033] Although the present invention has been described by way of example with references to the drawings, it is to be noted herein that various changes and modifications, including performing steps in different orders, will be apparent to those skilled in the art. Therefore, unless such changes and modifications depart from the scope of the present invention, they should be construed as being included therein.
**What is claimed is:**

1. A method of making a polarized lens comprising:
   
   providing a polarized, wet polyvinyl alcohol (PVA) film having first and second surfaces;
   
   pressing a convex mold against the first surface of the PVA film, thereby substantially
   
   conforming the PVA film to the convex mold, the first surface becoming a
   
   concave surface and the second surface becoming a convex surface;
   
   drying the PVA film;
   
   applying a first epoxy to the convex surface of the PVA film;
   
   hardening the first epoxy;
   
   removing the convex mold;
   
   applying a second epoxy to the concave surface of the PVA film; and
   
   hardening the second epoxy.

2. The method of claim 1, wherein the step of providing a polarized, wet PVA film
   
   further comprises:
   
   placing the PVA film in water until it has moisture content between 70% and 85%.

3. The method of claim 1, wherein the step of providing a polarized, wet PVA film
   
   further comprises:
   
   stretching the PVA film until it is substantially polarized.

4. The method of claim 1, wherein the step of providing a polarized, wet PVA film
   
   further comprises:
   
   stretching the PVA film until it is at least 95% polarized.

5. The method of claim 1, wherein the step of providing a polarized, wet PVA film
   
   further comprises:
   
   stretching the PVA film until it is 0.02 - 0.03 mm thick.

6. The method of claim 1, wherein the step of providing a polarized, wet PVA film
   
   further comprises:
   
   combining the PVA film with photochromic tinting.

7. The method of claim 1, wherein the step of providing a polarized, wet PVA film
   
   further comprises:
   
   dipping the PVA film to add gradient tinting.
8. The method of claim 1, wherein the convex mold is glass.

9. The method of claim 1, wherein the convex mold is at least partly transparent to ultraviolet (UV) light.

10. The method of claim 1, wherein the convex mold has a curvature which is predetermined to meet optical requirements of the polarized lens.

11. The method of claim 1, wherein the step of pressing a convex mold against the first surface of the PVA film further comprises:

   mounting the PVA film on a holding frame having an opening; and

   pressing the convex mold through the opening and against the PVA film, thereby substantially conforming the PVA film to the convex mold.

12. The method of claim 11, wherein the convex mold presses up through the holding frame from below.

13. The method of claim 11, wherein the holding frame comprises:

   a lower frame plate;

   an upper frame plate;

   a hinge rotatably coupling the lower frame plate with the upper frame plate; and

   a clip.

14. The method of claim 11, further comprising:

   after applying the second epoxy to the concave surface of the PVA film, removing the frame and trimming away excess PVA film.

15. The method of claim 1, wherein the step of drying the PVA film further comprises:

   reducing the moisture content of a substantial portion of the PVA film to below 50%.

16. The method of claim 1, wherein the step of drying the PVA film further comprises:

   substantially reducing the moisture content of the PVA film so that the PVA film will become stiff enough to generally retain its shape.

17. The method of claim 1, wherein the step of drying the PVA film further comprises:

   heating the PVA film at 60°C to 80°C.

18. The method of claim 1, wherein the step of drying the PVA film further comprises:

   drying the PVA film with heat at 60°C to 80°C until the moisture content of a substantial portion of the PVA film is reduced to below 50%;

   inspecting the PVA film; and
drying the PVA film again after inspection at approximately room temperature to reduce the moisture content of a substantial portion of the PVA film to between 30% and 40%.

19. The method of claim 1, wherein the PVA film is kept cool enough after the PVA film is dried so that the PVA film does not become soft due to partial melting.

20. The method of claim 1, wherein the first epoxy has a pencil softness rating of from approximately B to 3B.

21. The method of claim 1, further comprising:

combining the first epoxy with at least one of: coloring, tinting, photochromic agents, infrared blockers, ultraviolet blockers, stabilizers, stiffeners, anti-oxidants, anti-fog treatments, or silicon hard coating.

22. The method of claim 1, wherein the first epoxy comprises more than half epoxy resin combined with one or more of polyurethane, acrylic resin, CR-39, or silicon.

23. The method of claim 1, wherein the step of applying a first epoxy to the convex surface of the PVA film further comprises:

applying approximately 5cc of the first epoxy.

24. The method of claim 1, wherein the step of applying a first epoxy to the convex surface of the PVA film further comprises:

applying the first epoxy to a thickness generally from 0.1 to 0.5 mm.

25. The method of claim 1, wherein the step of applying a first epoxy to the convex surface of the PVA film further comprises:

applying the first epoxy to a thickness generally from 0.2 to 0.3 mm.

26. The method of claim 1, further comprising:

heating the first epoxy sufficiently so that it flows in an environment that is substantially room temperature.

27. The method of claim 1, further comprising:

heating the first epoxy to about 80°C to 90°C.

28. The method of claim 1, wherein the step of applying a first epoxy to the convex surface of the PVA film further comprises:

dripping the first epoxy onto the PVA film.

29. The method of claim 1 further comprising:
after applying the first epoxy to the convex surface of the PVA film, pressing the convex mold toward a concave mold so that the first epoxy presses against the concave mold.

30. The method of claim 29, wherein the convex mold is pressed toward the concave mold with even pressure so that the first epoxy spreads out to a thickness generally from 0.1 to 0.5 mm.

31. The method of claim 29, wherein the convex mold is pressed toward the concave mold with even pressure so that the first epoxy spreads out to a thickness generally from 0.2 to 0.3 mm.

32. The method of claim 1 further comprising:
   after applying the first epoxy to the convex surface of the PVA film, pressing the convex mold toward a concave mold using a pressing machine so that the first epoxy presses against the concave mold and the first epoxy spreads out to a generally consistent thickness.

33. The method of claim 32, wherein the first epoxy spreads out to generally from 0.1 to 0.5 mm.

34. The method of claim 32, wherein the first epoxy spreads out to generally from 0.2 to 0.3 mm.

35. The method of claim 32, wherein the pressing machine includes a UV light source and performs at least partial UV curing of the first epoxy.

36. The method of claim 35, wherein at least one of the convex mold and the concave mold are at last partially transparent to UV light.

37. The method of claim 32, wherein the pressing machine includes heating equipment and performs at least partial heat-based hardening of the first epoxy.

38. The method of claim 37, wherein at least one of the convex mold and the concave mold conducts heat.

39. The method of claim 1, wherein the step of hardening the first epoxy further comprises:
curing the first epoxy with UV light.

40. The method of claim 1, wherein the step of hardening the first epoxy further comprises:
curing the first epoxy with heat.

41. The method of claim 1, wherein the second epoxy has a pencil softness rating of from approximately 2B to 4B.

42. The method of claim 1, wherein the second epoxy comprises more than half epoxy resin combined with one or more of polyurethane, acrylic resin, CR-39, or silicon.

43. The method of claim 1, wherein the second epoxy spreads out to generally from 0.1 to 0.5 mm.

44. The method of claim 1, wherein the step of hardening the second epoxy further comprises:

curing the second epoxy with UV light.

45. The method of claim 1, wherein the step of hardening the second epoxy further comprises:

curing the second epoxy with heat.

46. The method of claim 1, further comprising:

after applying the second epoxy to the concave surface of the PVA film, pressing the convex mold toward the concave mold so as to press the convex mold against the second epoxy.

47. The method of claim 1 further comprising:

after applying the second epoxy to the concave surface of the PVA film, pressing the convex mold toward the concave mold using a pressing machine so that the second epoxy presses against the convex mold and the second epoxy spreads out to a generally consistent thickness.

48. The method of claim 1 further comprising:

combining the polarized lens with a base material.

49. The method of claim 48, wherein the base material comprises:

at least one material selected from the group of polycarbonate, polyurethane, polyethylene, nylon, CR-39, and PMMA.

50. The method of claim 48, wherein the base material is pre-formed and curved to meet optical requirements of the polarized lens.

51. The method of claim 50, wherein the base material is pre-formed by casting in a gasket mold or by injection molding.
52. The method of claim 48, wherein the base material is pre-formed with one or two
  hard coatings.
53. The method of claim 48, further comprising:
  depositing a hard coating on the base material by vacuum coating.
54. The method of claim 48, wherein the base material has a mirror coating on at least
  part of one side and an anti-reflective coating on at least part of the other side.
55. The method of claim 48, wherein the step of combining the polarized lens with a base
  material further comprises:
  placing the polarized lens in a gasket mold;
  casting the base material around the polarized lens.
56. The method of claim 48, wherein the step of combining the polarized lens with a base
  material further comprises:
  placing the polarized lens in an injection mold;
  injecting the base material around the polarized lens.
57. The method of claim 48, wherein the step of combining the polarized lens with a base
  material further comprises:
  adhering the base material to the second epoxy with an adhesive.
58. The method of claim 57, wherein the adhesive comprises acrylic resin, polyurethane
  and an oil based solvent.
59. The method of claim 57, wherein the step of adhering a base material to the second
  epoxy with adhesive further comprises:
  applying approximately 2cc of the adhesive.
60. The method of claim 57, wherein the step of adhering a base material to the second
  epoxy with adhesive further comprises:
  applying the adhesive to the concave surface of the second epoxy; and
  pressing the base material against the concave surface of the adhesive.
61. The method of claim 48 further comprising:
  hardening one or both surfaces of the polarized lens.
62. The method of claim 48 further comprising:
  depositing a hard coating on the polarized lens by vacuum coating.
63. The method of claim 48 further comprising:
at least partially coating one surface of the polarized lens with a reflective coating; and
at least partially coating the other surface of the polarized lens with an anti-reflective coating.

64. The method of claim 48 further comprising:
coating one or more surfaces of the polarized lens with resin materials to provide one or more of: scratch resistance, LJV protection, anti-reflective coatings, mirrored coatings, multi-layer coatings, water resistance, or decorative designs.

65. The method of claim 48 further comprising:
providing an eyeglass frame;
cutting the polarized lens to fit the frame; and
mounting the polarized lens the eyeglass frame, thereby providing eyeglasses.

66. A method of making a polarized lens comprising:
placing a PVA film having first and second surfaces in water until it has moisture content between 70% and 85%;
stretching the PVA film until it is substantially polarized;
providing a convex mold having a curvature which is pre-determined to meet optical requirements of the polarized lens;
mounting the PVA film on a holding frame having an opening;
pressing the convex mold through the opening and against the first surface of the PVA film, thereby substantially conforming the PVA film to the convex mold, the first surface becoming a concave surface and the second surface becoming a convex surface;
drying the PVA until the PVA film becomes stiff enough to generally retain its shape;
applying a first epoxy to the convex surface of the PVA film;
pressing the convex mold toward a concave mold using a pressing machine so that the first epoxy presses against the concave mold and the first epoxy spreads out to a generally consistent thickness; and
hardening the first epoxy.

67. The method of claim 66 further comprising:
combining at least one of the PVA film, the first epoxy, or the second epoxy with at least one of coloring, tinting, photochromic agents, infrared or ultraviolet blockers, stabilizers, stiffeners, anti-oxidants, anti-fog treatments, or silicon hard coatings.

68. The method of claim 66 further comprising:
removing the convex mold;
applying a second epoxy to the concave surface of the PVA film; and
hardening the second epoxy.

69. The method of claim 68 further comprising:
applying an adhesive to the concave surface of the second epoxy; and
applying a base material to the concave surface of the adhesive.

70. A polarized lens comprising:
a polarized, polyvinyl alcohol (PVA) film;
a layer of first epoxy on one surface of the PVA film; and
a layer of second epoxy on the other surface of the PVA film;
the polarized lens having substantially no splitting, cracking, or optical deformation caused by heating of the combined PVA film and epoxy layers.

71. The polarized lens of claim 70, wherein the thickness of the layers of first and second epoxy are generally 0.1 to 0.5 mm each.

72. The polarized lens of claim 70, wherein at least one of the PVA film, the first epoxy, or the second epoxy has at least one of coloring, tinting, photochromic agents, infrared or ultraviolet blockers, stabilizers, stiffeners, anti-oxidants, anti-fog treatments, or silicon hard coatings.

73. The polarized lens of claim 70 further comprising:
a base material.

74. The polarized lens of claim 73, wherein the base material is injection molded to meet optical requirements of the polarized lens.

75. The polarized lens of claim 73, wherein the base material is cast in a gasket mold to meet optical requirements of the polarized lens.

76. The polarized lens of claim 73, wherein the base material comprises one or two hard coatings.

77. The polarized lens of claim 73 further comprising:
an adhesive which adheres the base material to the layer of second epoxy.

78. The polarized lens of claim 73 further comprising:
    one or two hard coatings to provide one or more of: scratch resistance, UV protection, anti-reflective coatings, mirrored coatings, multi-layer coatings, water resistance, or decorative designs.

79. Eyeglasses comprising:
    a first polarized lens as in claim 73;
    a second polarized lens as in claim 73; and
    an eyeglass frame, the first and second polarized lenses disposed in the eyeglass frame.
A  CLASSIFICATION OF SUBJECT MATTER
IPC(8) - G02C 7/10 (2008.01)
USPC - 351/44
According to International Patent Classification (IPC) or to both national classification and IPC

B  FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
IPC G02C 7/10 (2008.01)
USPC 351/44

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
IPC G02C 7/12, G02B 1/08, G02B 1/04 (2008.01)
USPC 351/49, 351/165, 351/163, 351/177, 351/166

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST (PGP,USPT,EPAB,JPAB), Google Scholar
convex, concave, epoxy, pva, polyvinyl alcohol, press, compress, stretch, mold, form
wet, saturate, moist, water, polarize, lens, optics, coating, layer, film, holding frame, plate, aperture, sheet, shape, shaping

C  DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 2005/0243274 A1 (CHOU) 3 November 2005 (03 11 2005) see especially para [0017], [0033], [0034], [0035], [0039], [0041], [0042], [0046]-[0061], [0071]</td>
<td>70-73, 76-78</td>
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<td></td>
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<td>1-69, 74, 75, 79</td>
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<tr>
<td>Y</td>
<td>US 2007/0241313 A1 (KATO) 18 October 2007 (18 10 2007) see especially para [0018], [0029], [0045], [0048], [0049]</td>
<td>1-69, 74, 75, 79</td>
</tr>
<tr>
<td>Y</td>
<td>US 2,612,079 A (MAHLER) 30 September 1952 (30 09 1952) see especially col 3, in 23-35, col 3, in 60 to col 4, in 59, fig 9</td>
<td>1-69</td>
</tr>
</tbody>
</table>

J  Further documents are listed in the continuation of Box C

- Special categories of cited documents
  - 'A' - document defining the general state of the art which is not considered to be of particular relevance
  - 'E' - earlier application or patent but published on or after the international filing date
  - 'L' - document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
  - 'O' - document referring to an oral disclosure, use, exhibition or other means
  - 'P' - document published prior to the international filing date but later than the priority date claimed
  - 'T' - later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  - 'X' - document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  - 'Y' - document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
  - 'K' - document member of the same patent family

Date of the actual completion of the international search
16 February 2008 (16 02 2008)

Date of mailing of the international search report
19 NIAR 2008

Authorized officer
Lee W Young

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