Claims

1. A flexible ophthalmic electro-active lens, comprising:

a flexible refractive optic having a fixed refractive index;

a flexible electro-active element embedded within said flexible refractive optic, wherein said electro-active element has an alterable refractive index; and

a controller electrically connected to said electro-active element wherein when power is applied thereto the refractive index of said electro-active element is altered.

2. The flexible ophthalmic electro-active lens of Claim 1, wherein said flexible electro-active element is less flexible than said flexible refractive optic.

3. The flexible ophthalmic electro-active lens of Claim 1, wherein said electro-active element is as flexible as said flexible refractive optic.

4. The flexible ophthalmic electro-active lens of Claim 1, wherein said flexible refractive optic comprises at least one of a polysulphone material and a polyetherimide material.

5. The flexible ophthalmic electro-active lens of Claim 1, wherein the majority of the optical power is provided by said flexible refractive optic.

6. The flexible ophthalmic electro-active lens of Claim 1, further comprising a photovoltaic cell electrically connected to said electro-active element for providing power thereto.

7. The flexible ophthalmic electro-active lens of Claim 1, further comprising a kinetic energy driver electrically connected to said electro-active element for converting the motion of the eye into electrical power for providing said electro-active element with said electrical power.

8. The flexible ophthalmic electro-active lens of Claim 1, further comprising a piezo-electric firm adapted for connecting the lens to an eye structure, wherein the tension of

said piezo-electric film is changed by the motion of the eye for transducing said change in tension into electrical power.

9. The flexible ophthalmic electro-active lens of Claim 1, wherein said electro-active element is adapted for remote tuning.

10. The flexible ophthalmic electro-active lens of Claim 1, wherein the flexible ophthalmic electro-active lens is one of an intraocular lens, intraocular optic, contact lens, corneal inlay, and corneal onlay.

11. A flexible ophthalmic electro-active lens comprising:

a flexible housing having a fixed optical power and comprising at least one bendable film at least partially defining a flexible electro-active element embedded in said flexible housing,

wherein said flexible electro-active element comprises:

a first conductive material disposed on the at least one bendable film;

a second conductive material disposed on the at least one bendable film; and

a liquid crystal material disposed within a cavity at least partially defined by the at least one bendable film, the flexible electro-active element providing an optical power adapted for changing within an optical power range of from a minimum optical power to a maximum optical power,

wherein said fixed optical power is greater than said maximum optical power.

12. The flexible ophthalmic electro-active lens of Claim 11, further comprising a photovoltaic cell electrically connected to said electro-active element for providing power thereto.

13. The flexible ophthalmic electro-active lens of Claim 11, further comprising a kinetic energy driver electrically connected to said electro-active element for providing power thereto, wherein said kinetic energy driver is adapted for converting the motion of the eye into electrical power.

14. The flexible ophthalmic electro-active lens of Claim 11, further comprising a piezo-electric film electrically connected to said electro-active element for providing power thereto, wherein the tension of said piezo-electric film is changed by the motion of the eye for transducing said change in tension into electrical power.

15. The flexible ophthalmic electro-active lens of Claim 11, further comprising concentric ring shaped electrodes electrically connected to said electro-active element, wherein when electrical power is applied to said electro-active element said element is diffractive.

16. The flexible ophthalmic electro-active lens of Claim 11, wherein said at least one bendable film comprises at least one of a polysulphone material and a polyetherimide material.

17. The flexible ophthalmic electro-active lens of Claim 11, wherein said housing comprises a refractive optic.

18. The flexible ophthalmic electro-active lens of Claim 11, further comprising a rigid housing, wherein the lens is embedded in said rigid housing for use as a spectacle lens.

19. The flexible ophthalmic electro-active lens of Claim 11, wherein said electro-active element is less flexible that said housing.

20. The flexible ophthalmic electro-active lens of Claim 11, wherein said flexible electro-active element is as flexible as said flexible housing.

21. The flexible ophthalmic electro-active lens of Claim 11, further comprising memory metal.

22. The flexible ophthalmic electro-active lens of Claim 11, wherein the flexible ophthalmic electro-active lens is one of an intraocular lens, intraocular optic, contact lens,

corneal inlay, and corneal onlay.

23. A flexible ophthalmic electro-active lens, comprising:

a flexible housing;

a rigid electro-active element embedded within said flexible housing, wherein said rigid electro-active element has an alterable refractive index,

wherein said rigid electro-active element comprises an electro-active material having an alterable refractive index approximately equal to the fixed refractive index in an unaltered state so as to provide failsafe operation of the flexible electro-active lens, and

wherein the flexible ophthalmic electro-active lens is one of an intraocular lens, intraocular optic, contact lens, corneal inlay, and corneal onlay.

24. The flexible ophthalmic electro-active lens of Claim 23, further comprising a kinetic energy driver electrically connected to said rigid electro-active element for converting the motion of the eye into electrical power for providing said rigid electro-active element with said electrical power.

25. The flexible ophthalmic electro-active lens of Claim 23, further comprising a photovoltaic cell electrically connected to said rigid electro-active element for providing power thereto.

26. The flexible ophthalmic electro-active lens of Claim 23, further comprising a piezo-electric film adapted for connecting the lens to an eye structure, wherein the tension of said piezo-electric film is changed by the motion of the eye for transducing said change in tension into electrical power.

27. The flexible ophthalmic electro-active lens of Claim 23, wherein said flexible housing comprises at least one of a polysulphone material and a polyetherimide material.

28. The flexible ophthalmic electro-active lens of Claim 23, wherein said electro-active element is adapted for remote tuning.

29. A flexible ophthalmic electro-active lens, comprising:

a first flexible film having a surface relief diffractive pattern;

a second flexible film;

a liquid crystal layer disposed between said first and second films, wherein said liquid crystal layer has an alterable refractive index; and

electrodes electrically connected to said liquid crystal layer, wherein when power is applied thereto the refractive index of said liquid crystal layer is altered.

30. The flexible ophthalmic electro-active lens of Claim 29, wherein each of said first and second flexible films are adapted for moving between a folded and an unfolded state and the lens further comprises a memory metal material for biasing the lens toward said unfolded state.

31. The flexible ophthalmic electro-active lens of Claim 29, wherein said first and second films comprise at least one of a polysulphone material and a polyetherimide material.

32. The flexible ophthalmic electro-active lens of Claim 29, further comprising a kinetic energy driver electrically connected to said liquid crystal layer for converting the motion of the eye into electrical power for providing said liquid crystal layer with electrical power.

33. The flexible ophthalmic electro-active lens of Claim 29, further comprising a photovoltaic cell electrically connected to said liquid crystal layer for providing power thereto.

34. The flexible ophthalmic electro-active lens of Claim 29, further comprising a piezo-electric film adapted for connecting the lens to an eye structure, wherein the tension of said piezo-electric film is changed by the motion of the eye for transducing said change in tension into electrical power.

35. The flexible ophthalmic electro-active lens of Claim 29, wherein the flexible ophthalmic electro-active lens is one of an intraocular lens, intraocular optic, contact lens, corneal inlay, and corneal onlay.

36. The flexible ophthalmic electro-active lens of Claim 29, wherein the flexible ophthalmic electro-active lens is an inter-ocular lens.

37. The flexible ophthalmic electro-active lens of Claim 29, further comprising a rigid housing, wherein said flexible ophthalmic electro-active lens is embedded in said rigid housing for use as a spectacle lens.

38. The flexible ophthalmic electro-active lens of Claim 29, wherein said refractive index of said liquid crystal layer is adapted for remote tuning.

39. The flexible ophthalmic electro-active lens of Claim 29, wherein said liquid crystal layer comprises bi-stable liquid crystals.

40. The flexible ophthalmic electro-active lens of Claim 29, wherein at least one of said electrodes comprises a patterned electrode.

41. The flexible ophthalmic electro-active lens of Claim 29, wherein said electrodes comprise transparent conductive oxides.

42. The flexible ophthalmic electro-active lens of Claim 29, wherein said electrodes are flexible.

CLAIMS:

1. A flexible electro-active lens, comprising:

a flexible refractive optic having a fixed refractive index;

a flexible electro-active element embedded within said flexible refractive optic, wherein said flexible electro-active element has an alterable refractive index; and

a controller electrically connected to said flexible electro-active element wherein when power is applied thereto the refractive index of said flexible electro-active element is altered.

2. The flexible electro-active lens of claim 1, wherein said electro-active element is as flexible as said flexible refractive optic.

3. The flexible electro-active lens of claim 1 or claim 2, wherein said flexible electro-active element comprises at least one of a polysulphone and a polyetherimide material.

4. The flexible electro-active lens of any one of the preceding claims, wherein the majority of the optical power is provided by said flexible refractive optic.

5. The flexible electro-active lens of any one of the preceding claims, further comprising a photovoltaic cell electrically connected to said flexible electro-active element for providing power thereto.

6. The flexible electro-active lens of any one of the preceding claims, further comprising a kinetic energy driver electrically connected to said flexible electro-active element for converting the motion of the eye into electrical power for providing said flexible electro-active element with said electrical power.

7. The flexible electro-active lens of any one of the preceding claims, further comprising a piezo-electric film adapted for connecting the lens to an eye structure, wherein the tension of said piezo-electric film is changed by the motion of the eye for transducing said change in tension into electrical power.

8. The flexible electro-active lens of any one of the preceding claims, wherein said flexible electro-active element is adapted for remote tuning.

9. The flexible electro-active lens of any one of the preceding claims, wherein the lens is one of an intraocular lens, intraocular optic, contact lens, corneal inlay, and corneal onlay.

10. A flexible electro-active lens comprising:

a flexible housing having a fixed optical power;

a flexible electro-active element embedded in said housing, wherein said flexible electro-active element has an optical power adapted for changing within an optical power range of from a minimum optical power to a maximum optical power, wherein said fixed optical power is greater than said maximum optical power.

11. The flexible electro-active lens of claim 10, further comprising a photovoltaic cell electrically connected to said flexible electro-active element for providing power thereto.

12. The flexible electro-active lens of claim 10 or claim 11, further comprising a kinetic energy driver electrically connected to said flexible electro-active element for providing power thereto, wherein said kinetic energy driver is adapted for converting the motion of the eye into electrical power.

13. The flexible electro-active lens of any one of claims 10 to 12., further comprising a piezo-electric film electrically connected to said flexible electro-active element for providing power thereto, wherein the tension of said piezo-electric film is changed by the motion of the eye for transducing said change in tension into electrical power.

14. The flexible electro-active lens of any one of claims 10 to 13, further comprising concentric ring shaped electrodes electrically connected to said flexible electro-active element, wherein when electrical power is applied to said flexible electro-active element said element is diffractive.

15. The flexible electro-active lens of any one of claims 10 to 14, wherein said flexible electro-active element further comprises a flexible film.

16. The flexible electro-active lens of claim 15, wherein said flexible film comprises at least one of a polysulphone and a polyetherimide material.

17. The flexible electro-active lens of any one of claims 10 to 16, wherein said housing comprises a refractive optic.

18. The flexible electro-active lens of any one of claims 10 to 17, further comprising a rigid housing, wherein the lens is embedded in said rigid housing for use as a spectacle lens.

19. The flexible electro-active lens of any one of claims 10 to 18, further comprising memory material.

20. The flexible electro-active lens of any one of claims 10 to 19, wherein the lens is one of an intraocular lens, intraocular optic, contact lens, corneal inlay, and corneal onlay.

21. A flexible electro-active lens, comprising:

a first flexible film having a surface relief diffractive pattern;

a second flexible film;

a liquid crystal layer disposed between said first and second films, wherein said liquid crystal layer has an alterable refractive index; and

electrodes electrically connected to said liquid crystal layer, wherein when power is applied thereto the refractive index of said liquid crystal layer is altered.

22. The flexible electro-active lens of claim 21, wherein each of said first and second flexible films are adapted for moving between a folded and an unfolded state and the lens further comprises a memory material for biasing the lens toward said unfolded state.

23. The flexible electro-active lens of claim 21 or claim 22, wherein said first and second films comprise at least one of a polysulphone and a polyetherimide material.

24. The flexible electro-active lens of any one of claims 21 to 23, further comprising a kinetic energy driver electrically connected to said liquid crystal layer for converting the motion of the eye into electrical power for providing said liquid crystal layer with electrical power.

25. The flexible electro-active lens of any one of claims 21 to 24 further comprising a photovoltaic cell electrically connected to said liquid crystal layer for providing power thereto.

26. The flexible electro-active lens of any one of claims 21 to 25, further comprising a piezo-electric film adapted for connecting the lens to an eye structure, wherein the tension of said piezo-electric film is changed by the motion of the eye for transducing said change in tension into electrical power.

27. The flexible electro-active lens of any one of claims 21 to 26, wherein the lens is one of an intraocular lens, intraocular optic, contact lens, corneal inlay, and corneal onlay.

28. The flexible electro-active lens of any one of claims 21 to 26, wherein the lens is an inter-ocular lens.

29. The flexible electro-active lens of any one of claims 21 to 28, further comprising a rigid housing, wherein said flexible electro-active lens is embedded in said rigid housing for use as a spectacle lens.

30. The flexible electro-active lens of any one of claims 21 to 29, wherein said refractive index of said liquid crystal layer is adapted for remote tuning.

31. The flexible electro-active lens of any one of claims 21 to 30, wherein said liquid crystal layer comprises bi-stable liquid crystals.

32. The flexible electro-active lens of any one of claims 21 to 31, wherein at least one of said electrodes comprises a patterned electrode.

33. The flexible electro-active lens of any one of claims 21 to 32, wherein said electrodes comprise transparent conductive oxides.

34. The flexible electro-active lens of any one of claims 21 to 33, wherein said electrodes are flexible.

35. The flexible electro-active lens of claim 1, wherein said lens is a contact lens.

36. The flexible electro-active lens of claim 7, wherein, when implanted in the eye, the piezo-electric film is connected to at least one of the ciliary body and the iris.

37. The flexible electro-active lens of claim 10, wherein said lens is a contact lens.

38. The flexible electro-active lens of claim 13, wherein, when implanted in the eye, the piezo-electric film is connected to at least one of the ciliary body and the iris.

39. The flexible electro-active lens of claim 21, wherein said lens is a contact lens.

40. The flexible electro-active lens of claim 21, wherein the refractive index of said liquid crystal layer is approximately equal to a refractive index of said first flexible film when no power is applied to the electrodes.

41. The flexible electro-active lens of claim 26, wherein, when implanted in the eye, the piezo-electric film is connected to at least one of the ciliary body and the iris.