CLAIMS

1. A lens precursor form comprising:

a lens edge that defines the outer perimeter of the lens precursor form; and

a lens edge feature that is present along or adjacent to at least part of the lens edge;

in which the lens edge feature comprises a fence structure that is configured to contain a fluent lens reactive media present within the perimeter of the lens precursor form.

2. The lens precursor form of claim 1 in which the fence structure decreases in thickness from a maximum with increasing distance from the lens edge, thereby forming an inwardly-facing fence surface.

3. The lens precursor form of claim 2 in which the maximum thickness of the fence structure is spaced from the lens edge.

4. The lens precursor form of claim 3 in which the decrease in thickness is continuous.

5. The lens precursor form of claim 4 in which the inwardly-facing fence surface is concave in a plane containing the axis of the lens.

6. The lens precursor of claim 5 in which the lens edge feature is continuous around the lens precursor form.

7. The lens precursor of claim 6 in which the lens edge feature is present in discrete, non-continuous zones.

8. The lens precursor of claim 7 in which the height of the lens edge feature is between 0.001 mm and 1 mm.

9. The lens precursor of claim 8 in which the lens edge feature is higher in some discrete parts of the lens edge to control fluent lens reactive media and provide a lens with a thicker edge in those portions.

10. The lens precursor of claim 9 in which the radial extent of the lens edge feature is from 0.001 mm to 2 mm.

11. A lens precursor form comprising:

a lens edge that defines the outer perimeter of the lens precursor form; and

a moat feature that is present within the outer perimeter of the lens precursor form;

in which the moat feature is defined by a substantially discontinuous reduction in height of the lens precursor form.

12. The lens precursor form of claim 11 in which the moat feature is defined by a region of the lens precursor form of a thickness between zero and 0.2 mm.

13. The lens precursor form of claim 11 in which the moat feature is defined by a region of the lens precursor form of substantially zero or zero thickness.

14. A lens precursor form comprising:

a lens edge that defines the outer perimeter of the lens precursor form; and

a moat feature that is present within the outer perimeter of the lens precursor form;

in which the moat feature is defined by a region of the lens precursor form of substantially zero or zero thickness.

15. A lens precursor form comprising:

a lens edge, wherein the lens edge defines the outer perimeter of the lens precursor form; and

a plurality of drain channel features, each comprising an elongate depression, the drain channel features being placed side by side and configured to enable the flow of fluent lens reactive media across the lens precursor form.

16. The lens precursor form of claim 15 in which each drain channel feature is a continuous depression.

17. The lens precursor form of claim 15 in which each drain channel feature comprises discrete segmented depressions.

18. The lens precursor form of claim 17 in which the drain channel features radiate from a particular region of the lens precursor form so as to draw fluent lens reactive media away from that region.

19. The lens precursor form of claim 18 in which the drain channel features radiate in substantially all directions.

20. The lens precursor form of claim 18 in which the drain channel features radiate in a limited number of directions, thereby forming a fan-shaped drain sector.

21. The lens precursor form of claim 20 in which the fan-shaped drain sector has an included angle of between 2 and 360 degrees, for example between 30 and 120 degrees or between 60 and 90 degrees.

22. The lens precursor form of claim 21 in which the drain channel features further comprise circumferential drain channels at or towards their outer ends, at or towards their inner ends, or elsewhere, or in any combination of positions.

23. A lens precursor form comprising:

a lens edge that defines the outer perimeter of the lens precursor form;

a plurality of lens features selected from the group consisting of a lens edge feature that is present along at least part of the lens edge, an optic zone that is present within the outer perimeter of the lens precursor form, and a stabilization zone feature that is present within the outer perimeter of the lens precursor form; and

a volumator feature that is present within the outer perimeter of the lens precursor form between at least two of the said plurality of lens features and configured to control the flow of a fluent reactive mixture between them and/or the shape to which the fluent reactive mixture settles after a given period of time.

24. The lens precursor form of claim 23 in which the volumator feature is configured to control the desired height, depth, angular width, length, shape, and/or angle, of minimal energy surfaces of the fluent reactive mixture to produce desired lens precursor geometries.

25. The lens precursor form of claim 24 in which the volumator feature comprises a section made up of two parts, a lower shelf, and a higher shelf that abuts a relatively higher thickness region of a stabilization zone feature.

26. The lens precursor form of claim 25 in which the volumator feature comprises a section that is a shelf of about the same height as an adjacent stabilization zone feature.

27. The lens precursor form of claim 26 in which the volumator feature is continuous around a perimeter of at least one of the said plurality of lens features.

28. The lens precursor form of claim 26 in which the volumator feature is non-continuous.

29. The lens precursor form of claim 28 in which the volumator feature is adjacent to a stabilization zone feature and extends circumferentially around the lens axis by between 30 and 120 degrees, for example between 45 and 90 degrees or between 50 and 70 degrees.

30. The lens precursor form of claim 29 in which a portion of the volumator feature has a height from 0.001 mm to 1 mm.

31. The lens precursor form of claim 30 in which a portion of the volumator feature has a radial extent from 0.001 mm to 4.5 mm.

32. The lens precursor form of claim 31 in which the volumator feature is a moat feature having a radial extent from 0.001 mm to 1 mm, for example about 0.5 mm.

33. A method of designing a lens precursor form comprising:

defining a lens precursor form design, the design including:

a lens edge that defines the outer perimeter of the lens precursor form;

a plurality of lens features selected from the group consisting of a lens edge feature that is present along at least part of the lens edge, an optic zone that is present within the outer perimeter of the lens precursor form, a stabilization zone feature that is present within the outer perimeter of the lens precursor form, and a volumator feature that is present within the outer perimeter of the lens precursor form between at least two of the said plurality of lens features;

wherein each of the lens features is parametrically defined and wherein the parameters defining at least one lens feature are selected based at least in part upon the parameters defining one or more adjacent lens features and a desired lens shape.

34. The method of claim 33 in which the said at least one lens feature is a volumator feature.

35. The method of claim 34 in which the desired angle that fluent lens reactive media creates as it bridges from an optic zone to a stabilization zone feature is controlled by selecting the parameters defining a volumator feature between them, and optionally the parameters of the optic zone.

36. A method of manufacturing a lens precursor form comprising:

designing the lens precursor form in accordance with any one of claims 33-35; and

manufacturing a lens precursor form to that design.

37. An ophthalmic lens precursor comprising:

a lens precursor form according to any one of claims 1-32 and comprising:

a crosslinkable media comprising a photoabsorptive component; and

a first surface comprising a portion of a first crosslink density degree at least partially polymerized at or above a gel point and including the said features; and

a fluid second surface comprising a second crosslink density degree of cure less than the gel point in which at least a portion of the second surface may be incorporated into an ophthalmic lens.

38. A method of manufacturing an ophthalmic lens comprising processing the lens precursor of claim 37 to stabilize at least a portion of the second fluid surface.

39. The method of claim 38, wherein the processing further comprises fixing at least a portion of the second fluid surface using actinic radiation to a crosslink density degree at least partially polymerized at or above a gel point.

40. Apparatus for executing a method to generate an instruction set for use in an ophthalmic lens precursor form manufacturing tool, the apparatus comprising:

a processor;

a storage for digital data; and

executable software stored on the storage for digital data and executable on demand, the software operative with the processor to cause the apparatus to:

receive digital data descriptive of one or more optical aberrations associated with a wearer of the ophthalmic lens;

receive digital data descriptive of at least one desired mechanical parameter of the ophthalmic lens;

receive input from an operator descriptive of at least one topological feature of the lens precursor form substructure; and

generate the instruction set for use in the ophthalmic lens precursor form manufacturing tool.

41. The apparatus of claim 40 in which the ophthalmic lens precursor form manufacturing tool comprises a stereolithography manufacturing tool including a digital mirror device and the instruction set is a DMD show comprising time based instruction data points that may be used to control activation of the digital mirror device.

42. The apparatus of claim 41 in which the executable software is operative with the processor to cause the apparatus to:

receive digital data comprising a design thickness map of at least a portion of the lens precursor form or a lens precursor;

receive digital data comprising measured thicknesses of at least a portion of a lens precursor form or lens precursor manufactured by the manufacturing tool;

compare the measured thicknesses with the design thickness map to determine conformance to the desired design; and

if necessary, generate an alternate instruction set for use in the ophthalmic lens precursor form manufacturing tool.

43. The apparatus of claim 42 in which the mechanical parameters comprise one or more of a base curve, a diameter, and a center thickness.

44. The apparatus of claim 43 in which the optical aberrations may comprise one or more of low order aberrations, mid order aberrations, and high order aberrations.

45. The apparatus of claim 44 in which at least one feature comprises a portion of the lens precursor form that may be described mathematically by one or more of: height, length, width, shape, and location of the feature.

46. The apparatus of claim 43 in which at least one feature comprises a lens edge feature as defined in any one of claims 1-10.

47. The apparatus of claim 46 in which at least one feature comprises a moat feature as defined in any one of claims 11-14.

48. The apparatus of claim 47 in which at least one feature comprises a drain channel feature as defined in any one of claims 15-22.

49. The apparatus of claim 48 which at least one feature comprises a volumator feature as defined in any one of claims 23-32.

50. The of claim 49 in which a plurality of features are parametrically defined and wherein the parameters defining at least one lens feature are selected based at least in part upon the parameters defining one or more adjacent lens features and a desired lens shape.

51. The apparatus of claim 49 in which at least one feature comprises a stabilization zone feature or an optic zone portion of the lens precursor form.

Claims

1. A lens precursor form comprising:

a concave, optical quality first surface;

an opposing second surface having a substantially convex overall shape; wherein the first and second surfaces are joined at a lens edge, wherein the lens edge defines the outer perimeter of the lens precursor form; and

a plurality of drain channel features, each comprising an elongate depression extending in a radial direction toward the lens edge, the drain channel features being placed side by side and configured to enable the flow of fluent lens reactive media across the lens precursor form.

2. The lens precursor form of claim 1 in which each drain channel feature is a continuous depression.

3. The lens precursor form of claim 1 in which each drain channel feature comprises discrete segmented depressions.

4. The lens precursor form of claim 1 in which the drain channel features radiate from a particular region of the lens precursor form so as to draw fluent lens reactive media away from that region.

5. The lens precursor form of claim 4 in which the drain channel features radiate in substantially all directions.

6. The lens precursor form of claim 4 in which the drain channel features radiate in a limited number of directions, thereby forming a fan-shaped drain sector.

7. The lens precursor form of claim 6 in which the fan-shaped drain sector has an included angle of between 2 and 360 degrees, for example between 30 and 120 degrees or between 60 and 90 degrees.

8. The lens precursor form of claim 7 in which the drain channel features further comprise circumferential drain channels at or towards their outer ends, at or towards their inner ends, or elsewhere, or in any combination of positions.