CLAIMS

1. Apparatus for ophthalmic treatment, comprising:

an optical unit, comprising:

a camera, which is configured to capture an image of an eye of a patient;

a laser, which is configured to emit pulses of laser radiation; and

beam conditioning and scanning optics, which are configured to focus and direct the laser radiation to impinge on an anterior surface of the eye; and

a controller, which is configured to analyze the image so as to identify a limbus of the eye, and to control the optical unit so that the laser radiation impinges on a set of one or more locations on the anterior surface of the eye that are in a vicinity of the limbus with a pulse duration that is less than 1 μs and an energy that is less than 5 mJ per pulse, whereby the laser radiation stimulates stem cells at the one or more locations.

2. The apparatus according to claim 1, wherein the laser radiation is focused to impinge on each of the one or more locations with a beam diameter no greater than 1 mm.

3. The apparatus according to claim 1, wherein the pulse duration is less than 100 ns.

4. The apparatus according to claim 3, wherein the pulse duration is less than 10 ns.

5. The apparatus according to claim 4, wherein the pulse duration is less than 5 ns.

6. The apparatus according to claim 1, wherein the energy per pulse is less than 3 mJ.

7. The apparatus according to claim 1, wherein the laser radiation is focused to impinge on each of the one or more locations with a fluence less than 0.4 J/cm^2.

8. The apparatus according to any of claims 1-7, wherein the controller is configured to actuate the laser so as to apply multiple pulses to each of the one or more locations.

9. The apparatus according to claim 8, wherein the multiple pulses comprise no more than 200 pulses at each location.

10. The apparatus according to claim 9, wherein the multiple pulses comprise no more than 100 pulses at each location.

11. The apparatus according to claim 8, wherein the multiple pulses deliver the laser radiation with a cumulative energy that is no greater than 100 mJ at each location.

12. The apparatus according to claim 11, wherein the cumulative energy is no greater than 70 mJ.

13. The apparatus according to claim 12, wherein the cumulative energy is no greater than 40 mJ.

14. The apparatus according to any of claims 1-7, wherein the one or more locations on the anterior surface of the eye are displaced by at least 1 mm from the limbus.

15. The apparatus according to claim 14, wherein the one or more locations on the anterior surface of the eye are displaced by at least 2 mm from the limbus.

16. The apparatus according to any of claims 1-7, wherein the beam conditioning and scanning optics are configured to direct the laser radiation to impinge on the anterior surface of the eye at an oblique angle relative to a direction of an optical axis of the eye.

17. The apparatus according to claim 16, wherein the beam conditioning and scanning optics comprise a ring mirror, which is positioned around the optical axis of the eye so as to reflect the beam toward multiple locations in the vicinity of the limbus at oblique angles.

18. Apparatus for ophthalmic treatment, comprising:

an optical unit, comprising:

a camera, which is configured to capture an image of an eye of a patient;

a laser, which is configured to emit pulses of laser radiation; and

beam conditioning and scanning optics, which are configured to focus and direct the laser radiation to impinge on an anterior surface of the eye; and

a controller, which is configured to analyze the image so as to identify a limbus of the eye, and to control the optical unit so that the laser radiation impinges on a set of one or more locations on the anterior surface of the eye in a vicinity of the limbus with a pulse duration that is between 1 ms and 500 ms and an energy that is less than 100 mJ per pulse, whereby the laser radiation stimulates stem cells at the one or more locations.

19. The apparatus according to claim 18, wherein the laser radiation is focused to impinge on each of the one or more locations with a beam diameter no greater than 1 mm.

20. The apparatus according to claim 18, wherein the pulse duration is less than 50 ms.

21. The apparatus according to claim 20, wherein the pulse duration is less than 10 ms.

22. The apparatus according to claim 21, wherein the pulse duration is less than 5 ms.

23. The apparatus according to claim 18, wherein the energy per pulse is less than 50 mJ.

24. The apparatus according to claim 20, wherein the energy per pulse is less than 5 mJ.

25. The apparatus according to claim 18, wherein the laser radiation is focused to impinge on each of the one or more locations with a fluence less than 30 J/cm^2.

26. The apparatus according to any of claims 18-25, wherein the controller is configured to actuate the laser so as to apply multiple pulses to each of the one or more locations.

27. The apparatus according to claim 26, wherein the multiple pulses comprise no more than 2000 pulses at each location.

28. The apparatus according to claim 27, wherein the multiple pulses comprise no more than 500 pulses at each location.

29. The apparatus according to claim 28, wherein the multiple pulses comprise no more than 200 pulses at each location.

30. The apparatus according to claim 26, wherein the multiple pulses deliver the laser radiation with a cumulative energy that is no greater than 10 J at each location.

31. The apparatus according to claim 30, wherein the cumulative energy is no greater than 1 J.

32. The apparatus according to claim 31, wherein the cumulative energy is no greater than 400 mJ.

33. The apparatus according to any of claims 18-25, wherein the one or more locations on the anterior surface of the eye are displaced by at least 1 mm from the limbus.

34. The apparatus according to claim 33, wherein the one or more locations on the anterior surface of the eye are displaced by at least 2 mm from the limbus.

35. The apparatus according to any of claims 18-25, wherein the beam conditioning and scanning optics are configured to direct the laser radiation to impinge on the anterior surface of the eye at an oblique angle relative to a direction of an optical axis of the eye.

36. The apparatus according to claim 35, wherein the beam conditioning and scanning optics comprise a ring mirror, which is positioned around the optical axis of the eye so as to reflect the beam toward multiple locations in the vicinity of the limbus at oblique angles.

~~37. A method for ophthalmic treatment, comprising:~~

~~identifying a limbus of an eye of a patient; and~~

directing pulses of laser radiation to impinge on a set of one or more locations on an anterior surface of the eye in a vicinity of the limbus with a pulse duration that is less than 1 μs and an energy that is less than 5 mJ per pulse, so as to stimulate stem cells at the one or more locations.

38. The method according to claim 37, wherein directing the pulses of laser radiation comprises focusing the laser radiation to impinge on each of the one or more locations with a beam diameter no greater than 1 mm.

39. The method according to claim 37, wherein the pulse duration is less than 100 ns.

40. The method according to claim 39, wherein the pulse duration is less than 10 ns.

41. The method according to claim 40, wherein the pulse duration is less than 5 ns.

42. The method according to claim 37, wherein the energy per pulse is less than 3 mJ.

43. The method according to claim 37, wherein directing the pulses comprises focusing the laser radiation to impinge on each of the one or more locations with a fluence less than 0.4 J/cm^2.

44. The method according to any of claims 37-43, wherein directing the pulses of laser radiation comprises applying multiple pulses to each of the one or more locations.

45. The method according to claim 44, wherein the multiple pulses comprise no more than 200 pulses at each location.

46. The method according to claim 45, wherein the multiple pulses comprise no more than 100 pulses at each location.

47. The method according to claim 44, wherein applying the multiple pulses comprises delivering the laser radiation with a cumulative energy that is no greater than 100 mJ at each location.

48. The method according to claim 47, wherein the cumulative energy is no greater than 70 mJ.

49. The method according to claim 48, wherein the cumulative energy is no greater than 40 mJ.

50. The method according to any of claims 37-43, wherein the one or more locations on the anterior surface of the eye are displaced by at least 1 mm from the limbus.

51. The method according to claim 50, wherein the one or more locations on the anterior surface of the eye are displaced by at least 3 mm from the limbus.

52. The method according to any of claims 37-43, wherein directing the pulses comprises directing the laser radiation to impinge on the anterior surface of the eye at an oblique angle relative to a direction of an optical axis of the eye.

53. The method according to claim 52, wherein directing the laser radiation comprises positioning a ring mirror around the optical axis of the eye so as to reflect the beam toward multiple locations in the vicinity of the limbus at oblique angles.

54. A method for ophthalmic treatment, comprising:

identifying a limbus of an eye of a patient; and

directing pulses of laser radiation to impinge on a set of one or more locations on an anterior surface of the eye in a vicinity of the limbus with a pulse duration that is less than 100 ms and an energy that is less than 100 mJ per pulse, so as to stimulate stem cells at the one or more locations.

55. The method according to claim 54, wherein directing the pulses of laser radiation comprises focusing the laser radiation to impinge on each of the one or more locations with a beam diameter no greater than 1 mm.

56. The method according to claim 54, wherein the pulse duration is less than 50 ms.

57. The method according to claim 56, wherein the pulse duration is less than 10 ms.

58. The method according to claim 57, wherein the pulse duration is less than 5 ms.

59. The method according to claim 54, wherein the energy per pulse is less than 50 mJ.

60. The method according to claim 59, wherein the energy per pulse is less than 5 mJ.

61. The method according to claim 54, wherein directing the pulses comprises focusing the laser radiation to impinge on each of the one or more locations with a fluence less than 30 J/cm^2.

62. The method according to any of claims 54-61, wherein directing the pulses of laser radiation comprises applying multiple pulses to each of the one or more locations.

63. The method according to claim 62, wherein the multiple pulses comprise no more than 2000 pulses at each location.

64. The method according to claim 63, wherein the multiple pulses comprise no more than 500 pulses at each location.

65. The method according to claim 64, wherein the multiple pulses comprise no more than 200 pulses at each location.

~~66. The method according to claim 62, wherein applying the multiple pulses comprises delivering the laser radiation with a cumulative energy that is no greater than 10 J at each location.~~

~~67. The method according to claim 66, wherein the cumulative energy is no greater than 1 J.~~

~~68. The method according to claim 67, wherein the cumulative energy is no greater than 400 mJ.~~

~~69. The method according to any of claims 54-61, wherein the one or more locations on the anterior surface of the eye are displaced by at least 1 mm from the limbus.~~

~~70. The method according to claim 69, wherein the one or more locations on the anterior surface of the eye are displaced by at least 3 mm from the limbus.~~

~~71. The method according to any of claims 54-61, wherein directing the pulses comprises directing the laser radiation to impinge on the anterior surface of the eye at an oblique angle relative to a direction of an optical axis of the eye.~~

~~72. The method according to claim 71, wherein directing the laser radiation comprises positioning a ring mirror around the optical axis of the eye so as to reflect the beam toward multiple locations in the vicinity of the limbus at oblique angles.~~

37~~73~~. Apparatus for treating an eye of a patient, the apparatus comprising:

an optical unit, comprising:

a laser, which is configured to emit laser radiation;

one or more mirrors positioned around an optical axis of the eye; and

beam conditioning and scanning optics, which are configured to focus and direct the laser radiation to reflect from the one or more mirrors so as to impinge on an anterior surface of the eye at an oblique angle relative to the optical axis; and

a controller, which is configured to control the optical unit so that the laser radiation impinges on the eye at the oblique angle in a set of one or more locations in a vicinity of the limbus with a fluence selected so as to stimulate stem cells at the one or more locations.

38~~74~~. The apparatus according to claim 37~~73~~, wherein the one or more mirrors comprise a ring mirror, which surrounds the optical axis.

39~~75~~. The apparatus according to claim 37~~73~~ or 38~~74~~, wherein the controller is configured to control the optical unit so that the laser radiation impinges on and stimulates the stem cells in a epithelium of the eye.

4076. The apparatus according to claim 3773 or 3874, wherein the controller is configured to control the optical unit so that the laser radiation impinges on and stimulates the stem cells in a stroma of the eye.

4177. The apparatus according to claim 3773 or 3874, wherein the controller is configured to control the optical unit so that the laser radiation impinges on and stimulates the stem cells in an endothelium of the eye.

~~78. A method for ophthalmic treatment, comprising:~~

~~placing a gonioscope in contact with a cornea of an eye of a patient; and~~

~~directing pulses of laser radiation through the gonioscope to reflect from a side mirror surface of the gonioscope and then to pass obliquely through the cornea and impinge on endothelial tissue in a vicinity of a trabecular meshwork of the eye with a pulse energy and duration selected so as to stimulate stem cells in the endothelial tissue.~~

~~79. The method according to claim 78, wherein the pulses have a pulse duration that is less than 1 μs and an energy that is less than 0.1 mJ per pulse.~~

~~80. The method according to claim 79, wherein directing the pulses comprises controlling the laser radiation to impinge on the endothelial tissue with a fluence no greater than 0.1 J/cm^2.~~

~~81. The method according to any of claims 78-80, wherein the pulses have a pulse duration that is between 1 and 500 ms and a fluence no greater than 10 J/cm^2.~~