Claims

1. An ophthalmic lens the lens having a layer having a base refractive index provided on a surface of the lens, and the layer comprising a plurality of gradient index optical elements that are distributed over an area of the layer; wherein each gradient index optical element is a lens, each gradient index optical element has a volume of between 100 μm^3 and 3 mm^3, and each gradient index optical element has a radial variation in refractive index or a transverse variation in refractive index across the element.

2. The ophthalmic lens according to claim 1, wherein the layer is provided on an anterior surface of the lens.

3. The ophthalmic lens according to claim 1 or claim 2, wherein the layer is a film that has been applied to a surface of the lens.

4. The ophthalmic lens according to any of claims 1-3, wherein the layer is a coating provided on a surface of the lens.

5. The ophthalmic lens according to any preceding claim, wherein the lens is a spectacle lens.

6. The ophthalmic lens according to any of claims 1-4, wherein the lens is a contact lens.

7. The ophthalmic lens according to claim 6, wherein the lens is a rigid contact lens.

8. The ophthalmic lens according to any preceding claim, wherein the plurality of gradient index optical elements are distributed on lattice points of a triangular lattice across an area of the layer.

9. The ophthalmic lens according to any preceding claim, wherein the layer is a photopolymer layer, wherein each plurality of gradient index optical elements is a photocured gradient index optical element.

10. The ophthalmic lens according to any preceding claim, wherein each of the plurality of gradient index optical elements has a radially varying refractive index profile defined by a quadratic function.

11. The ophthalmic lens according to any preceding claim, wherein each of the plurality of gradient index optical elements has a diameter or width of between 10 μm and 2 mm.

12. The ophthalmic lens according to any preceding claim, wherein the plurality of gradient optical elements occupy between 20% and 80% of a surface area of the layer.

13. The ophthalmic lens according to any preceding claim, having a central region and an annular region surrounding the central region, wherein the layer that includes each of plurality of gradient index optical elements covers a portion of the annular region.

14. The ophthalmic lens according to claim 13, wherein a plurality of gradient index optical elements are arranged periodically around the annular region.

15. The ophthalmic lens according to claim 13 or claim 14, wherein the layer includes a plurality of concentric annular regions, each annular region including at least one gradient index optical element.

16. The ophthalmic lens according to claim 15, wherein at least one gradient index optical element in a first annular region is out of phase with at least one gradient index optical element in an adjacent second annular region.

17. The ophthalmic lens according to claim 15 or claim 16, wherein the annular regions radially separated by a region of the layer having the base refractive power.

18. The ophthalmic lens according to claim 15 or claim 16, wherein the annular regions are adjacent to each other.

19. The ophthalmic lens according to any preceding claim, wherein the layer has a thickness of between 1μm and 70μm.

20. The ophthalmic lens according to any preceding claim, further comprising an adhesive provided between the layer and the surface of the lens.

21. The ophthalmic lens according to any preceding claim, further comprising a protective layer provided on an anterior surface of the layer that includes the plurality of gradient index optical elements.

22. A method of manufacturing an ophthalmic lens, the method comprising:

providing an ophthalmic lens; and

forming a layer on a surface of the lens, wherein the layer has a base refractive index and includes a plurality of gradient index optical elements that are distributed over an area of the layer, wherein each gradient index optical element is a lens, each gradient index optical element has a volume of between 100 μm^3 and 3 mm^3, and each gradient index optical element has a radial variation in refractive index or a transverse variation in refractive index across the element.

23. The method according to claim 22, wherein forming the layer comprises applying a coating or film to the surface of the lens.

24. The method according to claim 23, wherein the layer is a film and wherein the step of applying the film to the lens comprises adhering the film to the lens using an adhesive.

25. The method according to claim 23, wherein the layer is a coating, and wherein plasma coating is used to apply the layer to the lens.