CLAIMS

1. An electrically tunable lens, comprising:

a first alignment layer and a second alignment layer;

an array of elastic polymer posts in a gap between the first alignment layer and the second alignment layer, posts in the array extending from the first alignment layer to the second alignment layer;

liquid crystal confined in the gap between the first and second alignment layers around posts in the array; and

one or more electrodes arranged to induce an electric field in the liquid crystal to control lens power of the lens.

2. The electrically tunable lens of claim 1, wherein the at least one of the first and second alignment layers and the array of posts comprise a polymer of a common mesogen.

3. The electrically tunable lens of claim 1, wherein the first and second alignment layers include liquid crystal moieties aligned near the surfaces adjacent to the gap.

4. The electrically tunable lens of claim 1, wherein the gap has an average thickness X prior to bending over a fold radius less than 10 mm, and an average thickness Y after recovering from the bending, wherein $Y=X\pm10\%\ X$.

5. The electrically tunable lens of claim 1, wherein at least one post in the array of posts is disposed within the optical zone of the lens.

6. An electrically tunable lens, comprising: a first alignment layer and a second alignment layer; an array of elastic polymer posts in a gap between the first alignment layer and the second alignment layer, posts in the array extending from the first alignment layer to the second alignment layer; liquid crystal confined in the gap between the first and second alignment layers around posts in the array; and one or more electrodes arranged to induce an electric field in the liquid crystal, including a third alignment layer and a second array of elastomer posts in a second gap located between the second alignment layer and the third alignment layer; and liquid crystal confined in the second gap around posts in the second array.

7. The electrically tunable lens of claim 6, wherein the second alignment layer includes liquid crystal moieties having directors aligned orthogonal to an optical path and parallel near a first surface adjacent to the first mentioned gap, and directors aligned orthogonal to an optical path near a second surface adjacent to the second mentioned gap and orthogonal to the directors near the first surface.

8. The electrically tunable lens of claim 7, wherein the first and third alignment layers are configured for vertical alignment, inducing directors near the first alignment layer in the liquid crystal in the first mentioned gap and directors near the third alignment layer in the liquid crystal in the second gap to align parallel to the optical path.

9. The electrically tunable lens of claim 7, wherein the first and third alignment layers are configured for alignment orthogonal to an optical path, inducing directors near the first alignment layer in the liquid crystal in the first mentioned gap and directors near the third alignment layer in the liquid crystal in the second gap to align orthogonal to the optical path.

10. The electrically tunable lens of claim 7, wherein at least one of the first and third alignment layers has passive lens power.

11. The electrically tunable lens of claim 6, wherein the first, second and third alignment layers comprise polymeric alignment layers.

12. A method for manufacturing a liquid crystal lens, comprising:

assembling a first flexible alignment layer and a second flexible alignment layer with a gap therebetween;

forming elastic polymer posts extending across the gap from the first flexible alignment layer to the second flexible alignment layer;

providing liquid crystal material in the gap surrounding the posts; and

forming one or more electrodes arranged to induce an electric field in the liquid crystal material in the gap to control lens power of the lens.

13. The method of claim 12, including forming the elastic polymer posts by placing a polymer pre-cursor in the gap, and inducing polymerization in the gap.

14. The method of claim 13, wherein the polymer pre-cursor comprises combination of a monomer and a photo-initiator compound.

15. The method of claim 13, wherein said forming elastic polymer posts includes exposing the polymer pre-cursor in the gap to actinic radiation through a patterned mask.

16. The method of claim 13, wherein the polymer pre-cursor comprises combination of a mesogen and a photo-initiator compound.

17. The method of claim 12, including filling the gap with the liquid crystal and a polymer precursor, and forming the elastic polymer posts by inducing polymerization of the polymer precursor according to a pattern.

18. The method of claim 12, wherein the first flexible alignment layer and the second flexible alignment layer comprise polymeric films.

19. The method of claim 12, wherein the first flexible alignment layer and the second flexible alignment layer comprise polymeric films with embedded liquid crystal moieties.

20. The method of claim 12, wherein the first and second flexible alignment layers and the posts comprise a polymer of a common mesogen.

21. The method of claim 12, including assembling a third flexible alignment layer with the first and second flexible alignment layers, with a second gap between the second alignment layer and the third flexible alignment layer; and forming elastomer posts extending across the second gap; and

filling the second gap with a liquid crystal material surrounding the posts in the second gap.

22. The method of claim 21, wherein the first, second and third flexible layers are alignment layers arranged to induce alignment in a first orientation of liquid crystals in the liquid crystal material in the first mentioned gap, and alignment in a second different orientation of liquid crystals in the liquid crystal material in the second gap.

23. The method of claim 12, wherein at least one post in the array of posts is disposed within the optical zone of the lens.