

WHAT IS CLAIMED IS:

1. A method of manufacturing a thin film optical apparatus, the method comprising:
providing a substrate;
applying an alignment layer over the substrate, wherein the alignment layer ranges from about 50 to 100 nm in thickness;
imprinting a hologram with a desired optic pattern onto the alignment layer; and
applying at least one layer of mesogen material over the alignment layer.
2. The method of Claim 1, further comprising curing and polymerizing the mesogen layer.
3. The method of Claim 1, wherein the applying the layer of mesogen material comprises spin coating the layer of mesogen material onto the alignment layer and aligning the layer of mesogen material over the alignment layer.
4. The method of Claim 1, wherein the alignment layer comprises a thin layer having a magnitude of one half of a wavelength or less.
5. The method of Claim 1, wherein the imprinting the hologram onto the alignment layer comprises producing a hologram with a desired optic pattern by setting up a desired wavefront in a holographic interferometer.
6. The method of Claim 5, wherein producing the hologram with a desired optic pattern comprises imparting a geometric phase utilizing a polarization based holographic interferometer.
7. The method of Claim 6, wherein imparting the geometric phase comprises converting a binary amplitude hologram to a phase hologram.
8. The method of Claim 6, wherein the polarization based holographic interferometer comprises a Mach-Zehnder interferometer.
9. The method of Claim 5, wherein producing the hologram with a desired optic pattern comprises rastering an incident light beam with phase control.

10. The method of Claim 9, wherein rastering the incident light beam with phase control comprises:
- moving the substrate along the Z-axis in order to accurately position the substrate within focus;
 - controlling polarization of the incident light beam; and
 - moving the substrate along X- and Y-axes of motion to yield the hologram with the desired optic pattern.
11. The method of Claim 9, wherein rastering the incident light beam with phase control comprises:
- controlling polarization of the incident light beam; and
 - performing X-Y angle control of the incident light beam to accurately position the substrate within focus.
12. The method of Claim 1, wherein the applying at least one layer of mesogen material comprises applying at least two orthogonally oriented layers of mesogen material over the alignment layer.
13. A method of manufacturing an optical apparatus, the method comprising:
- providing a substrate;
 - applying at least one alignment layer above the substrate;
 - writing a polarization phase hologram into the at least one alignment layer to impart the phase transform of a desired optical pattern; and
 - applying at least one layer of birefringent material over the alignment layer, wherein the at least one layer of birefringent material ranges from about 200 nm to 2000 nm thick.
14. The method of Claim 13, further comprising positioning a layer of reflective material and a retarder between the alignment layer and the substrate.
15. The method of Claim 14, wherein the applying at least one alignment layer and the applying at least one layer of birefringent material comprise:
- applying a first alignment layer over the retarder;
 - applying a first layer of birefringent material over the first alignment layer;
 - applying a buffer layer over the first layer of birefringent material;
 - applying a second alignment layer over the buffer layer; and

applying a second layer of birefringent material over the second alignment layer, the second layer of birefringent material being oriented orthogonally relative to the first layer of birefringent material.

16. The method of Claim 15, further comprising:
annealing the first and second alignment layers and the first and second layers of birefringent material; and
curing the first and second alignment layers and the first and second layers of birefringent material with ultraviolet (UV) radiation in an oxygen free environment.

17. The method of Claim 13, wherein the applying at least one alignment layer and the applying at least one layer of birefringent material comprise:
applying a first alignment layer over the substrate;
applying a first layer of birefringent material over the first alignment layer;
applying a second alignment layer over the first layer of birefringent material; and
applying a second layer of birefringent material over the second alignment layer, the second layer of birefringent material being oriented orthogonally relative to the first layer of birefringent material.

18. The method of Claim 17, further comprising positioning a buffer layer between the first layer of birefringent material and the second alignment layer.

19. The method of Claim 18, further comprising:
applying a third alignment layer over the second layer of birefringent material;
applying a third layer of birefringent material over the third alignment layer;
applying a fourth alignment layer above the third layer of birefringent material;
and
applying a fourth layer of birefringent material over the fourth alignment layer, the third layer of birefringent material being oriented orthogonally relative to the fourth layer of birefringent material.

20. The method of Claim 19, further comprising:
positioning a first buffer layer between the first layer of birefringent material and the second alignment layer; and

positioning a second buffer layer between the third layer of birefringent material and the fourth alignment layer.