CLAIMS

1. An optical component comprising:

a substrate;

an opaque layer on a first side of the substrate, the opaque layer defining an aperture to refract visible or near-infrared light; and

a meta-surface, on a second side of the substrate opposite the first side, to focus the visible or near-infrared light refracted through the aperture through the substrate.

2. The optical component of claim 1, wherein the substrate is planar.

3. The optical component of claim 1, wherein the substrate is curved.

4. The optical component of claim 1, wherein the substrate has a thickness t_{sub} and a refractive index at a wavelength of the visible or near-infrared light of n_{sub}, the aperture has a diameter of D_{in}, and the meta-surface has a diameter $D_{meta} = D_{in} + t_{sub} \tan[\sin^{-1}(1/n_{sub})]$.

5. The optical component of claim 1, wherein the meta-surface is configured to focus the visible or near-infrared light incident over all of the field of view to a focal plane parallel to the second side of the substrate.

6. The optical component of claim 5, further comprising:

a detector array, in the focal plane, to detect the visible or near-infrared light focused by the meta-surface.

7. The optical component of claim 5, further comprising:

a light source array in the focal plane, and

wherein the meta-surface is configured to collimate a beam emitted by the light source array and the aperture is configured to emit the beam.

8. The optical component of claim 7, wherein the meta-surface and/or the aperture are further configured to modulate the beam emitted by the light source array.

9. The optical component of claim 1, wherein the meta-surface is configured to focus the visible or near-infrared light incident over all of the field of view with a Strehl ratio of at least 80%.

10. The optical component of claim 1, wherein the meta-surface comprises an array of at least 1000 meta-atoms × 1000 meta-atoms.

11. The optical component of claim 1, wherein the meta-surface has different yet continuous portions configured to capture input beams at different angles of incidence.

12. The optical component of claim 1, wherein the meta-surface is configured to correct at least one third-order Seidel aberration.

13. The optical component of claim 1, wherein the meta-surface is a first meta-surface, and further comprising:

a second meta-surface, disposed in at least a portion of the aperture, to modulate and/or filter the visible or near-infrared light refracted through the aperture.

14. The optical component of claim 13, wherein the second meta-surface is configured to modulate the visible or near-infrared light refracted through the aperture with a spatial modulation pattern that depends on an angle of incidence of the visible or near-infrared light refracted through the aperture.

15. A method comprising:

refracting visible or near-infrared light through an aperture formed on a first side of a substrate; and

focusing the visible or near-infrared light with a meta-surface on a second side of the substrate opposite the first side.

16. The method of claim 15, wherein focusing the light comprises focus the visible or near-infrared light incident over all of the field of view to a focal plane parallel to the second side of the substrate.

17. The method of claim 16, further comprising:

detecting the visible or near-infrared light focused by the meta-surface with a detector array in the focal plane.

18. The method of claim 16, further comprising:

collimating a beam emitted by the light source array in the focal plane with the meta-surface; and

emitting the beam through the aperture.

19. The method of claim 15, wherein focusing the visible or near-infrared light comprises focusing the visible or near-infrared light incident over all of the field of view with a Strehl ratio of at least 80%.

20. The method of claim 15, wherein focusing the visible or near-infrared light comprises correcting at least one third-order Seidel aberration.

21. The method of claim 15, further comprising:

modulating at least of a phase, an amplitude, a polarization, or a wavelength of the visible or near-infrared light refracted through the aperture with another meta-surface disposed in at least a portion of the aperture based on an angle of incidence of the visible or near-infrared light refracted through the aperture.

22. The method of claim 15, further comprising:

filtering the visible or near-infrared light refracted through the aperture with another meta-surface disposed in at least a portion of the aperture.

23. An optical component comprising:

a substrate;

an opaque layer on a first side of the substrate, the opaque layer defining an aperture to transmit light;

a first meta-surface, disposed in the aperture on the first side of the substrate, to reshape or modulate light incident on the first side of the substrate at different angles; and

a second meta-surface, on a second side of the substrate opposite the first side, to generate an optical pattern that varies as a function of an angle of incidence, a phase, an

amplitude, a polarization, and/or a spectral property of the light reshaped, modulated, and/or transmitted by the aperture and the first meta-surface.

24. The optical component of claim 23, wherein the first meta-surface is configured to modulate the light as a function of a phase, an amplitude, an angle of incidence, a polarization, and/or a spectral property of the light.

25. The optical component of claim 23, where the optical component is immersed in another material.

26. A sensor comprising:

the optical component according to claim 23, wherein the substrate is a first substrate;

a second substrate;

a light source array, supported by a first portion of the second substrate and facing the optical component, to emit light through the optical component toward an object over a field of view;

a wide field-of-view meta-lens, in optical communication with the object, to collect the light scattered and/or reflected by the object over the field of view; and

a detector array, supported by a second portion of the second substrate and in optical communication with the wide field-of-view meta-lens, to detect the light collected by the wide field-of-view meta-lens.

27. The sensor of claim 26, wherein the optical component is configured to project a pattern into free-space with an angular range of at least 120°.

28. The optical component of claim 23, wherein the optical pattern is a two-dimensional optical pattern.

29. The optical component of claim 23, wherein the optical pattern is a three-dimensional optical pattern.

30. The optical component of claim 23, wherein the optical pattern is an array of dots or stripes.

31. The optical component of claim 23, wherein the second meta-surface is configured to generate different sparse arrays of dots as a function of incidence angle.

32. The optical component of claim 23, wherein the first meta-surface is configured to collimate the light.

33. The optical component of claim 1, wherein the aperture has an apodized edge.

34. The optical component of claim 1, wherein the meta-surface has a phase profile engineered to provide diffraction-limited focusing over a field of view of nearly 180° in air.

35. The optical component of claim 1, wherein the meta-surface has different yet continuous portions with phase profiles optimized against a figure of merit that accounts for focusing quality at multiple angles of incidence.