Claims

1. An optical system comprising:

   a plurality of color filters, a first color filter of the plurality of color filters configured to select light of a first wavelength range representing a first color channel, and a second color filter of the plurality of color filters configured to select light of a second wavelength range different from the first wavelength range, the light of the second wavelength range representing a second color channel, such that the plurality of color filters provide different color channels; and

   a plurality of metalenses with quadratic phase profiles, each of the plurality of metalenses associated with a respective color channel of the plurality of color channels;

   wherein each of the plurality of metalenses has a focal length, the plurality of metalenses having equal focal lengths such that the different color channels are combined on a common focal plane to form a multi-color image;

   wherein each of the plurality of metalenses comprises a plurality of nanostructures and has a field of view of more than 30 degrees; and

   wherein each of the plurality of metalenses has a desired working spectral bandwidth dependent on an extended depth of focus, a central wavelength of the associated color channel, and the focal length at the central wavelength.

2. The optical system according to claim 1, further comprising:
   one or more detectors defining the common focal plane.

3. The optical system according to claim 2,

   wherein the plurality of color filters are internal bandpass filters of the one or more detectors.

4. The optical system according to claim 2,
   wherein the plurality of color filters are external to the one or more detectors.

5. The optical system according to claim 1,
   wherein the plurality of color filters are arranged between the plurality of metalenses and the common focal plane, such that each of the plurality of metalenses is configured to direct a broadband light to an associated color filter of the plurality of color filters to generate the respective associated color channel.

6. The optical system according to claim 1,

wherein the plurality of metalenses are arranged between the plurality of color filters and the common focal plane, such that each of the plurality of metalenses is configured to direct the light of the respective associated color channel onto the common focal plane.

7. The optical system according to claim 1,
wherein each of the plurality of metalenses has a Fresnel number, the plurality of metalenses having different Fresnel numbers, such that the plurality of metalenses have equal focal lengths.

8. The optical system according to claim 1,
wherein the nanostructures of each of the plurality of metalenses are arranged in a periodic lattice having a predetermined period;
wherein Fresnel numbers of different metalenses of the plurality of metalenses are different due to the different predetermined periods of the different metalenses.

9. The optical system according to claim 8,
wherein the periodic lattice is a square lattice, a rectangular lattice, a hexagonal lattice, or a periodic or quasi-periodic Bravais lattice.

10. The optical system according to claim 1, further comprising:
a plurality of apertures arranged before the plurality of metalenses,
preferably wherein each of the plurality of apertures is associated with a respective metalens of the plurality of metalenses.

11. The optical system according to claim 1,
wherein the plurality of metalenses is made of a material having a refractive index equal to or greater than 2.

12. The optical system according to claim 1,
wherein the plurality of metalenses comprise a dielectric material or a semiconductor material.

13. The optical system according to claim 1,
wherein the plurality of metalenses comprises silicon, hafnium oxide, titanium dioxide, silicon nitride, sapphire, diamond, silicon carbide, a III-V semiconductor, or a II-VI semiconductor.

14. The optical system according to claim 1,

wherein heights of the plurality of metalenses are equal; and

wherein the optical system comprises a substrate, the plurality of metalenses on the substrate.

15. The optical system according to claim 1,
wherein the plurality of nanostructures are nanopillars.

16. The optical system according to claim 1,
wherein the plurality of nanostructures are nanoantennas.

17. The optical system according to claim 1,
wherein the plurality of color channels represent different spectral ranges of electromagnetic light.

18. The optical system according to claim 1,
wherein the plurality of color channels are spectrally adjacent to one another or are overlapping.

19. A method of forming an optical system, the method comprising:
providing a plurality of color filters, a first color filter of the plurality of color filters configured to select light of a first wavelength range representing a first color channel, and a second color filter of the plurality of color filters configured to select light of a second wavelength range different from the first wavelength range, the light of the second wavelength range representing a second color channel, such that the plurality of color filters provide different color channels; and

providing a plurality of metalenses with quadratic phase profiles, each of the plurality of metalenses associated with a respective color channel of the plurality of color channels;

wherein each of the plurality of metalenses has a focal length, the plurality of metalenses having equal focal lengths such that the different color channels are combined on a common focal plane to form a multi-color image;
wherein each of the plurality of metalenses comprises a plurality of nanostructures and has a field of view of more than 30 degrees; and
wherein each of the plurality of metalenses has a desired working spectral bandwidth dependent on an extended depth of focus, a central wavelength of the associated color channel, and the focal length at the central wavelength.

20. A method of forming a multi-color image, the method comprising:

providing a broadband light to an optical system, the optical system comprising:

a plurality of color filters, a first color filter of the plurality of color filters configured to select light of a first wavelength range representing a first color channel, and a second color filter of the plurality of color filters configured to select light of a second wavelength range different from the first wavelength range, the light of the second wavelength range representing a second color channel based on the broadband light, such that the plurality of color filters provide different color channels; and

a plurality of metalense with quadratic phase profiles s, each of the plurality of metalenses associated with a respective color channel of the plurality of color channels;

wherein each of the plurality of metalenses has a focal length, the plurality of metalenses having equal focal lengths such that the different color channels are combined on a common focal plane to form the multi-color image;

wherein each of the plurality of metalenses comprises a plurality of nanostructures and has a field of view of more than 30 degrees; and

wherein each of the plurality of metalenses has a desired working spectral bandwidth dependent on an extended depth of focus, a central wavelength of the associated color channel, and the focal length at the central wavelength.