Flat optics based on metasurfaces

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Conventional optical components such as lenses rely on gradual phase shifts accumulated during light propagation to shape light beams. We have recently shown how new degrees of freedom in optical design can be attained by introducing in the optical path abrupt phase changes over the scale of the wavelength, which leads to generalized laws for reflection and refraction [1], [2]. Phase discontinuities enable wavefront engineering with unprecedented flexibility, which is promising for a wide variety of planar optical components such as lenses free of monochromatic aberrations [3], axicons [3], background free broadband quarter wave plates and spiral phase plates that create optical vortices [4]. Finally we have recently shown that the phenomenon of thin film interference, known for hundreds of years, which gives rise to vivid coloring when the thickness is on the scale of the wavelength, under appropriate conditions can persist in ultrathin, highly absorbing films of a few to tens of nanometres in thickness [5]. This technology has the potential for a variety of applications from ultrathin photodetectors and solar cells to optical filters, to labelling, and even the visual arts and jewellery.

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[2] F. Aieta, et al. *Nano Lett.* **12,** 1702 (2012)
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[5]. M. A. Kats et al. *Nature Materials* PUBLISHED ONLINE: 14 OCTOBER 2012 | DOI: 10.1038/NMAT3443