COLLOQUIUM

Metasurfaces: from the generalized Snell's law to flat optics

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The design of fundamental optical components such as lenses, relying on textbook refractive and diffractive optics, has remained essentially unchanged for decades. Subwavelength structured surfaces known as metasurfaces are leading to a fundamental reassessment of such designs with the emergence of optically thin, ultracompact components that circumvent the limitations of standard optics and have the ability to shape the wavefronts of light in arbitrary ways. Our formulation of the generalized Snell law for metasurfaces1 has led us to demonstrate single planar metalenses that correct aberrations.2,3 Using a novel atomic layer deposition process we have fabricated high numerical aperture diffraction limited lenses at visible wavelengths with subwavelength imaging capabilities and new phase plates that generate complex wavefronts such as helical beams with arbitrary orbital angular momentum and Bessel beams of any order. Metalenses are expected to find high volume applications in areas such as cameras, displays, wearable optics for virtual/augmented reality, microscopy, white lighting.

1. N. Yu et al. Science 334, 333 (2011)
2. F. Aieta et al. Science 347, 1342 (2015)
3. M. Khorasaninejad et al. Science 352, 1190 (2016)
4. Metalens: https://www.youtube.com/watch?v=ETx_fjM5pms