Planar Optics with Metasurfaces

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Abrupt modifications of the fields across an interface can be engineered by depositing an array of sub-wavelength resonators specifically tailored to address local amplitude, phase and polarization changes [1]. Physically, ultrathin nanostructure arrays (δ≪λ), also called ''optical metasurfaces'', control light by engineering artificial boundary conditions of Maxwell's equations. Metasurfaces have been implemented to obtain various sorts of optical functionalities, ranging from the basic control of the transmission and reflection of light[1], to the control of the radiation patterns for comprehensive wavefront engineering and holography[3].

After transmission or reflection, however, the amount of propagation phase shift required to achieve any optical function depends on the wavelength, therefore, a specific phase profile imposed at interface will shape the light in a desired manner only for a single wavelength. This basic dispersion effect, which already affects bandwidth of conventional devices, is also limiting the operation of metasurfaces to a narrow bandwidth. We will discuss how to manage dispersion effect directly at interface to create multi-wavelength achromatic metasurfaces for broadband control of light[4]. This approach is applied to fabricate dispersion-free beam deflectors and achromatic flat lenses in the near-infrared[5]. To conclude, we will talk about our recent results on free-standing dielectric metasurfaces.

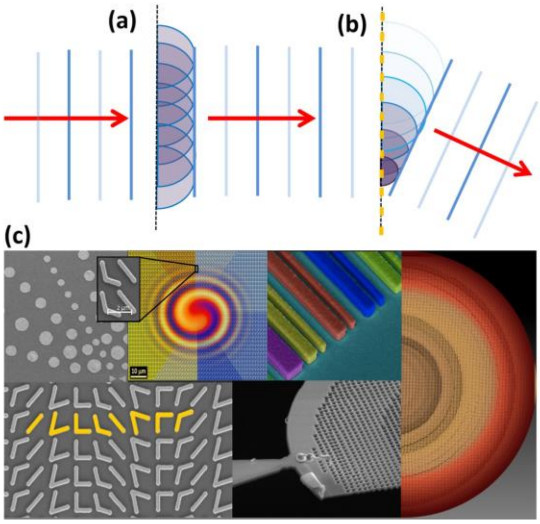

Fig. 1: (a) Huygens construction of a propagating wave. (b) Huygens construction of a transmitting metasurfaces. (c) From left top to right bottom, multi-wavelength metasurface antenna [2], vortex plate[1], multi-wavelength achromatic lens [5], plasmonic V-shape metasurface[1], free standing flat lens.

References:
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