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Highly Efficient, All-Dielectric Huygens Metasurfaces ADAM OLLANIK, NICK FARRAR-FOLEY, JAKE SMITH, MATTHEW ESCARRA, Tulane University — Demonstration of the control of light by the introduction of abrupt phase discontinuities across a subwavelength scale has opened the doors to a new level of wavefront control. All-dielectric Huygens metasurfaces hold significant promise due to their dramatically improved efficiency over plasmonic approaches. We present the successful design, computational modeling, and experimental realization of all-dielectric transmissive Huygens metasurfaces capable of deflection efficiency >90%. Dielectric Huygens sources, taking advantage of spectrally aligned electric and magnetic dipole resonances, are capable of tunable phase delay for transmitted light with near unity efficiency of forward scattering. Using ellipsoidal cylinder nanoantennas, we are able to manipulate the phase response and engineer a metasurface with a spatially gradient phase profile. Through careful design and optimization we mitigate the effects of inter-antenna coupling. We have designed and modeled metasurfaces demonstrating anomalous refraction with very high efficiency (>80%) for wavelength bands from the UV to the near-IR. These surfaces were designed using three distinct nanoantenna materials, Si, TiO_2, and GaP, to demonstrate the flexibility of the technique. Experimentally, Si nanoantennas are fabricated using a combination of electron beam lithography and ICP/RIE-etching. Metasurfaces are characterized using a goniospectrometer capable of mapping light intensity on a cylindrical shell surrounding the metasurface.

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