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Electrically tunable conducting oxide metasurfaces[1] HO WAI HOWARD LEE, Thomas J. Watson Laboratories of Applied Physics, California Institute of Technology, Department of Physics, Baylor University, HARRY ATWATER, Thomas J. Watson Laboratories of Applied Physics, California Institute of Technology — Metasurfaces composed of planar arrays of sub-wavelength artificial structures show promise for light manipulation, and have yielded novel ultrathin optical components such as flat lenses, holographic surfaces and orbital angular momentum manipulation. However the optical properties of metasurfaces developed to date do not allow for versatile tunability of wave amplitude and phase after fabrication, thus limiting their use in many applications. We experimentally demonstrate a gate-tunable metasurface that enables dynamic electrical control of the phase and amplitude of the plane wave reflected from the metasurface in the near-IR. Tunability arises from field-effect modulation of the complex refractive index of conducting oxide layers incorporated into metasurface antenna which are configured in a reflectarray geometry. We measure a phase shift of π and ˜30% change in the reflectance at 1550 nm by applying 2.5 V gate bias. Additionally, we demonstrate modulation at frequencies exceeding 10 MHz, and electrical switching of +/-1 order diffracted beams, a basic requirement for electrically tunable beam-steering phased array metasurfaces. These structures have potential applications for future ultrathin optical components, such as dynamic holograms, tunable ultrathin lens, and reconfigurable beam steering devices.

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