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Optical properties of metal-dielectric based epsilon near zero metamaterials[1] GANAPATHI SUBRAMANIA, ARTHUR FISCHER, TING LUK, Sandia National Labaoratories — Epsilon(ε) near zero(ENZ) materials are metamaterials where the effective dielectric constant(ε) is close to zero for a range of wavelengths resulting in zero effective displacement field (D = εE) and displacement current. ENZ structures are of great interest in many application areas such as optical nanocircuits, supercoupling, cloaking, emission enhancement etc. Effective ENZ behavior has been demonstrated using cut-off frequency region in a metallic waveguide where the modal index vanishes. Here we demonstrate the fabrication of ENZ metamaterials operating at visible wavelengths ($\lambda \sim 640$nm) using an effective medium approach based on a metal-dielectric composites(App. Phys. Let.,**101**,241107(2012)) that can act as "bulk" ENZ material. The structure consists of a multilayer stack composite of alternating nanoscale thickness layers of Ag and TiO_2. Optical spectroscopy shows transmission and absorption response is consistent with ENZ behavior and matches well with simulations. We will discuss the criteria necessary in the design and practical implementation of the composite that better approximates a homogenous effective medium including techniques to minimize the effect of optical losses to boost transmission. The potential for hosting gain media in the gratings to address losses and emission control will be discussed.

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