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Nonlinear Optical Enhancement in Epsilon-Near-Zero Metamaterial Thin Films[1] ANNA SHELTON, MARIAMA DIAS, University of Richmond — Nonlinear optical phenomena, such as second and third harmonic generation, phase conjugation, and negative refraction, are of interest in several fields of optics and photonics for their applications to hologram technology, signal processing, and sensing among many others. Nonlinear optical phenomena often require large intensities of incident electromagnetic fields in order to be visible, but through the use of metamaterials, incident electromagnetic field energy can be locally amplified, and the nonlinear optical response can be greatly magnified. In this work, we simulated six different metamaterials, each a thin film and lattice of gold nano-antennae, around the point at which the real part of the thin film's permittivity crossed zero. We found that by coupling nano-antennae to thin films local energy density increased by as much as two orders of magnitude, greatly enhancing the probability of nonlinear response. This presents metamaterials as favorable candidates for nonlinear optical applications.

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Anna Shelton
University of Richmond

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