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Nonlocal Response of the Plasmonic Nanowire Metamaterials
BRIAN WELLS, Department of Physics and Applied Physics, University of Massachusetts Lowell, ANATOLY ZAYATS, Department of Physics, King's College London, VIKTOR PODOLSKIY, Department of Physics and Applied Physics, University of Massachusetts Lowell — Nanowire metamaterials are a class of composite photonic media formed by an array of aligned plasmonic nanowires embedded in a dielectric matrix. Depending on exact composition, geometry, and excitation wavelength, nanowire structures are known to exhibit elliptical, hyperbolic, or epsilon-near-zero (ENZ) responses. In the ENZ regime optical response of the composite becomes strongly nonlocal. Excitation of an additional wave, caused by nonlocality, has been experimentally demonstrated in nanowire-based metamaterials. Here we present numerical and analytical studies of the nonlocal optical response of plasmonic nanowire metamaterials. Dispersion of photonic modes of plasmonic metamaterials has been studied in finite-element-method (FEM) simulations as a function of wavelength, geometry, and material parameters. Analytical description of nonlocal effective permittivity tensor has been developed. These analytical results are in agreement with FEM simulations and experimental data.

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