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Optical properties of Ag nanoparticle arrays: Tuning the plasmon resonance[1] J.R. SIMPSON, H.D. DREW, S.H. GUO, R. PHANEUF, Department of Physics, University of Maryland, College Park, MD 20742 and Laboratory for Physical Sciences, College Park, MD 20740 — Potential applications in the optical spectral range of meta-materials displaying negative permittivity and negative permeability has driven recent interest in nanostructured materials. Electromagnetic radiation incident on metallic nanoparticles induces a collective electronic excitation, or plasmon, which results in a detectable optical resonance. We report polarization-dependent transmission measurements of Ag nanoparticle arrays in the near-infrared to visible frequency range. E-beam lithography patterns arrays of nanoparticles from Ag deposited on transparent ITO-glass substrates. The array grid spacing is several hundred nanometers and the nanoparticle thickness and width are approximately 75 nm. We vary the length to provide an in-plane aspect ratio (length to width) from 1 : 1 to 4 : 1. The resonance shifts to lower (higher) energy with increasing aspect ratio for polarizations parallel to the long (short) axis. This work demonstrates the ability to tune optical resonance energies and widths in nanostructured materials with quality factors Q exceeding 10. Additionally, we discuss the effects of radiation damping, carrier scattering, and inhomogeneous broadening on the resonance widths.

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