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Influence of dielectric function properties on the optical response of plasmon resonant metallic nanoparticles NATHANIEL K. GRADY, NAOMI J. HALAS, PETER NORDLANDER, Laboratory for Nanophotonics, Rice University, Houston, TX 77005 — The optical properties of plasmon resonant metallic nanoparticles are of great interest because of their ability to both control optical fields on the nanometer scale and function as sensitive indicators of their local environment. We investigate the relationship between the dielectric function of a metal and the optical properties of the constituent nanoparticle. Using a Drude shell–silica core nanoshell geometry, we examine how systematic changes in the parameters of the Drude dielectric function affect the near and far field properties of the nanoparticle. Surprisingly, we find that not only the electron relaxation time Γ^{-1}, but also the background susceptibility χ_∞ control the spectral linewidth. Further, χ_∞ has the opposite effect depending on the particle size relative to the wavelength of light at the plasmon resonance. The nanoshell geometry is uniquely suited to this study because it allows a clear separation of intrinsic properties and extrinsic phase retardation, or finite size, effects. [N.K. Grady, N.J. Halas, P. Nordlander, Chem. Phys. Lett. 399, 167 (2004)].

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