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An effective medium formulation to estimate the plasmonic dispersion of a randomly distributed gallium nanoparticle ensemble YANG YANG, Physics Dept, Duke University, JOHN M. CALLAHAN, Nanogenesis Div, AEgis Technology, TONG-HO KIM, APRIL S. BROWN, ECE Dept, Duke University, MARIA LOSURDO, GIANNI BRUNO, IMIP-CNR, HENRY O. EVERITT, Physics and ECE, Duke University; Army Aviation and Missile RD&E Center — Quantum confinement causes the dielectric function of nanometer-sized metal particles to depart from metallic bulk dispersion in a manner correlating with the size, shape, and spacing of the nanostructures. An improved effective medium approximation is formulated to reconcile angle-dependent ultraviolet/visible spectroscopy and spectroscopic ellipsometry measurements of the collective optical dispersion of randomly distributed hemispherical gallium nanoparticles deposited on a sapphire surface using ultra high vacuum molecular beam epitaxy. Atomic force microscopy and scanning electron microscopy analyze the size distribution of the nanoparticle ensembles to estimate their volume fraction. The optical constants are then estimated using a modified Maxwell-Garnett effective medium approximation that treats the ambient vacuum as a host and the bare sapphire substrate as a semi-infinite layer. The refined dielectric function improves estimates of the collective plasmonic response of the nanoparticle ensemble.

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