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Coupling of Acoustic Vibrations to Plasmon Resonances in Metal Nanoparticles AFTAB AHMED, Argonne National Laboratory, MATTHEW PELTON, University of Maryland, Baltimore, JEFFREY GUEST, Argonne National Laboratory — Measurements of acoustic vibrations in nanoparticles provide a unique opportunity to study mechanical phenomena at nanometer length scales and picosecond time scales. Phonon vibrations of plasmonic nanoparticles are of particular interest, due to their large extinction efficiencies, and high sensitivity to surrounding medium. There are two mechanisms that transduce the mechanical oscillations into plasmon resonance shift: (1) changes in polarizability; and (2) changes in electron density. These mechanisms have been used to explain qualitatively the origin of the transient-absorption signals, however, a quantitative connection has not yet been made except for simple geometries. Here, we present a method to quantitatively determine the coupling between vibrational modes and plasmon modes in noble-metal nanoparticles including spheres, shells, rods and cubes. We separately determine the parts of the optical response that are due to shape changes and to changes in electron density, and we relate the optical signals to the symmetries of the vibrational and plasmon modes. These results clarify reported experimental results, and should help guide the optimization of future experiments.

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