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Coherent Oscillations of Vibrational Modes in Metal Nanoshells[1]

ARMAN S. KIRAKOSYAN, TIGRAN V. SHAHBAZYAN, Jackson State University — We study coherent oscillations of vibrational modes in metal nanoparticles with a dielectric core[1]. Vibrational modes are excited by the rapid heating of the particle lattice that takes place after laser excitation, while the energy transfer to the surrounding dielectric medium leads to their damping[2]. In nanoshells, the presence of two metal surfaces results in a substantially different energy spectrum of acoustic vibrations. The lowest and first excited modes correspond to in-phase (n=0) and out-of-phase (n=1) motions of core-shell and shell-medium interfaces, respectively. We calculated the energy spectrum as well as the damping of nanoshell vibrational modes and found that, in contrast to solid particles, the size/geometry dependences of in-phase and out-of-phase modes are different. We also found that, in thin nanoshells, the interplay between geometry and core-shell interface leads to overdamping of the fundamental mode. At the same time, the oscillator strength of the fundamental mode is larger than that in solid nanoparticles, resulting in stronger oscillations in thin nanoshells that can be observed using ultrafast pump-probe spectroscopy. [1] R. D. Averitt et. al., Phys. Rev. Lett. 78, 4217 (1997). [2] N. Del Fatti et. al., J. Chem. Phys. 110, 11484 (1999).

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