Plasmons in Metallic Nanoparticles: Towards Enhancement of Metal-Nano-Modified Solar Cell Efficiency

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The random-phase-approximation semiclassical scheme for description of plasmon excitations in metallic nanosphere is formulated in an all-analytical version. The spectrum of plasmons in metallic nanosphere is determined including both surface and volume type excitations and their mutual connections. It is demonstrated that the surface plasmons in nanosphere can be excited by the volume ones, while converselly not. The various channels for damping of surface plasmons are evaluated and the relevant resonance frequency shifts are compared with the experimental data for metallic nanoparticles of different dimensions located in dielectric medium or on the semiconductor substrate. The strong enhancement of the energy transfer from surface plasmon oscillations to the substrate semiconductor is explained in the regime of a near-field coupling in agreement with recent experimental observations for metallically nanomodified photo-diode systems.