Tunable optical properties of metallic nanoshells

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Recently a considerable amount of research has been devoted to study the optical properties of metallic nanoparticles. Of special interest is the controlled variation of the nanoparticle's geometry since this produces a notable structural tunability of the localized surface plasmon resonance (LSPR), which is absent in solid metallic particles. Metallic nanoshells, which are plasmonic nanostructures having alternating layers of dielectric and metal, are a good example of such strategy. Tunability of plasmon position makes these nanoparticles particularly attractive for applications such as resonant photo-oxidation inhibitors, optical triggers for opto-mechanical materials, photothermal therapy, drug delivery implants, environmental sensors, and Raman sensors. In this work we have studied systematically the optical properties of single and multilayered metal nanoshells as a function of the geometry. Reduction of thickness either of the metallic layers or the intermediate dielectric layers produces red-shifts of the LSPR. A judicious manipulation of these parameters can achieve an even greater shift of the LSPR band towards the near-infrared region, favorable for biological applications. In summary, we have found the optimal geometrical parameters for producing large red-shifts of the LSPR band in multilayered nanoshells, which makes these structures ideal for the various applications that require a LSPR located in the infrared region.