Chapter 2

A Perspective on Plasmonics within and beyond the Electrostatic Approximation

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Additional information is available at the end of the chapter

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Abstract

Plasmonic is an emerging branch of nanophotonics wherein the electromagnetic properties of nanoparticles are studied for variety of applications. The optics of nanoparticles is studied in terms of surface plasmon resonances and optical cross section. Initially the first principle approach has been used to study the plasmonic fundamentals known as electrostatic approach. Under this approach, various parameters are taken into account to observe the electromagnetic properties of plasmonic nanogeometries. This electrostatic model is only used to analyze the optical signature of smaller size plasmonic geometries. Therefore, for the estimation of optical properties of larger size nanoparticle numerical model (Discrete Dipole Approximation) has been used. The observed surface plasmon resonances could be useful in sensing field, SERS signal detection and thin film solar cell application.

Keywords: plasmonics, nanoparticle, surface plasmon resonance, optical cross section

1. Introduction

Plasmonics is the emerging branch of nanophotonics which deals the coupling of light to the collective oscillation of electrons inside the metal nanoparticles. The coupling of light to the metal nanoparticles produces resonances under specific condition known as surface plasmon resonance (SPR) that has tremendous applications [1–5]. The resonant interaction between them will localize the electromagnetic field near the meal surface and drastically enhances the optical scattering phenomenon. When the light interacts with the metallic nanostructures two fundamental excitations are observed. These two fundamental excitations are surface plasmon polaritons (SPP) and localized surface plasmon resonance (LSPR). The surface plasmon

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