



Surface Plasmon Photonics: From Optical Properties of Nanoparticles to Single Molecule Surface-enhanced Raman Scattering

Hongxing Xu

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This thesis deals with the optical properties of Localized surface plasmon resonances (SPR) determine the main optical properties of Ag and Au nanoparticles in the visible. Under certain conditions, SPR can give rise to single molecule sensitivity in surface-enhanced Raman scattering (SERS). The experimental observation of dimer structures, where two Ag particles are bridged by a single hemoglobin molecule, probably reveal the simplest nanoparticle system that can amplify Raman scattering to the extent that vibrational spectra of single molecules can be recorded. More controllable interparticle coupling effects are observed for nanofabricated Ag particles on Si. The generalized Mie theory (GMT) has been used to analyze the mechanisms of single molecule SERS, which indicates that the electromagnetic enhancement mechanism is the main contributor to SERS. GMT is also used to theoretically quantify optical forces associated with Ag nanoparticles. The results indicate that molecules can be trapped and particle aggregates deformed by the optical forces induced at SPR excitation.

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