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(G*) Stimulated Rayleigh Scattering in Metallic Nanofiber Doped with Ensemble of Metallic Nanoparticles and Quantum Dots

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The development of nanotechnology has brought a great opportunity to study the linear and nonlinear optical properties of plasmonic nanohybrids made of metallic nanoparticles and quantum emitters. Rayleigh scattering is a nonlinear scattering mechanism occurring due to the elastic collision of electromagnetic radiation from bound electrons in atoms or molecules after they have been excited to virtual states far from resonances. A theory for stimulated Rayleigh scattering (SRS) has been developed for metallic nanohybrids composed of an ensemble of metallic nanoparticles and quantum dots (QDs). The intensity of the output stimulated Rayleigh scattered light is obtained using the coupled-mode formalism of Maxwell's equations and evaluated by the density matrix method. An analytical expression of the SRS intensity is calculated in the presence of surface plasmon polaritons (SPPs) and dipole-dipole interactions (DDIs). We have compared this theory with experimental data for a nanohybrid doped with an ensemble of Ag-nanoparticles and rhodamine 6G dye. There was found to be good agreement between experiment and theory. We have also predicted an enhancement of the SRS intensity due to the extra scattering mechanisms of the SPP and DDI polaritons with QDs. It was also found that at low values of DDI coupling the SRS intensity spectrum contains two peaks. However, when the DDI coupling is increased there is only one peak in the SRS spectrum. The findings of this paper can be very useful. For example, the analytical expressions can be valuable for experimental scientists and engineers who can use them to compare their experiments and make new types of plasmonic devices. The enhancement in the SRS intensity can also be used to fabricate SRS nanosensors. Similarly, our finding about the SRS intensity having two peaks to one peak due to the DDI coupling can be used to fabricate SRS nanoswitches where the two peaks can be thought of as the ON position and the one peak can be considered as the OFF position.

Keyword-1

Plasmonic Nanorods

Keyword-2

Stimulated Rayleigh Scattering

Keyword-3

Dipole-Dipole Interactions

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