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Study of the impact of polarization and shape factor on the nonlinear optical response of a hybrid molecule including a semiconductor quantum dot coupled two metallic nanoparticles: second harmonic generation

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Abstract

In this paper, the generation of second-harmonic from a hybrid molecule composed of two metal nanoparticles with ellipsoidal shape coupled to a semiconductor quantum dot when a control laser field is applied to the system by using the density matrix approach is investigated. This applied field induces a polarization in the semiconductor quantum dot and both different plasmonic nanoparticles, and the polarized metal nanoparticles interact with the quantum dot through dipole–dipole interaction. We demonstrate that SHG strongly depends on the shape factor and the light polarization for oblate and prolate spheroidal plasmonic nanoparticles coupled with a quantum dot when the applied field is parallel or perpendicular to the axis of the system. The study of the light-matter interaction in such hybrid molecule can be useful to design the optical devices based on the plasmon-exciton-plasmon interaction.

Keywords: hybrid molecule, second-harmonic generation, metal nanoparticle, quantum dot

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