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Nonlinear energy transfer in metallic nanocomposites

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There is a considerable interest in the development of nanoscale optoelectronic devices by combining different nanomaterials into hybrid structures. These hydride systems can be fabricated by combining two or more nanomaterials such as quantum dots, graphene, carbon nanotubes, semiconductor nanowires, metallic nanoparticles, metallic nanowires and nano biomaterials (DNA). Hence one can fabricate enormous number of these hybrid nanostructures. These structures are also called as nano composites. In this paper, we investigated the nonlinear energy transfer from a quantum dot (QD) and metallic nanorod (MNR) hybrid systems. An intense probe laser field is applied between the ground state and first excited state to study the energy transfer. A control laser field is applied between the first and second excited states to control the energy transfer. Induced dipoles are created in the QD and MNR due to the two laser fields. Hence both are interacting via the dipole-dipole interaction. Surface plasmon polaritons (SPPs) are also created at the interface of the MNR due to a coupling of charge fluctuations and laser fields. Therefore, there is an interaction between excitons in QD and SPPs in MNR. This interaction is called the dipole-dipole interaction. Due to this interaction the energy is transferred from the QD to MNR. Using the density matrix method the energy transfer rate (ETR) between QD and MNR is evaluated. Numerical simulations have been performed on the ETR in the hybrid system. Shifting and enhancement of the peak ETR is due to the dipole-dipole interactions. The present findings can be used to fabricate nanosensors, nano-switches and energy transfer devices.

Biography

Mahi R Singh received PhD (1976) degrees from Banaras Hindu University, Varanasi in Condensed Matter Physics. After that he was awarded an Alenxander von Humbold Fellow in Stuttgart University, Germany from 1979 to 1981. Currently he is Professor in this university. He was a visiting Professor at University of Houston and also worked as a Chief Researcher at CRL HITACHI, Tokyo and he was a visiting Professor and Royal Society Professor at University of Oxford, UK. He was the Director of the Centre of Chemical Physics and theoretical physics program at Western. He has worked on various fields of science and technology such as nanoscience, nanotechnology, nanophotonics, optoelectronics, semiconductor structures, high temperature superconductors, nanophotonics, plasmonics, polarotonics and nanoscience and technology.

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