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Title of Thesis: Investigation of the metal-semiconductor hybrid Nnostructure as an active medium for laser

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Abstract:

In this work, Ag NPs with particle size about 37 nm was prepared by chemical reduction method in aqueous phase. CdTe QDs (about 2 nm particle size) in aqueous phase has been prepared by Microwave irradiation method. The particle size, the shape and the crystallinity of the prepared samples were confirmed by high resolution transmission electron microscope and the electron diffraction patterns. Thus, colloidal mixture of Ag NPs and CdTe were prepared with various Ag/CdTe volume ratios to examine the influence of metal nanoparticles on the optical properties of quantum dot semiconductors. We also presented an approach for simultaneously suppressing the defect emission band appeared in CdTe QDs by addition of Ag NPs. For the purpose of comparison and confirmation, we achieved a similar study of LSP effect on a well-known lasing material (organic dye fluorescein). The effect of Ag NPs on the absorption and emission cross sections, decay rates, Forster energy transfer, quantum efficiency and laser performance parameters of the fluorophores have been investigated. The results of adding Ag NPs with different volume concentrations on either of CdTe QDs or fluorescein dye, show a remarkable increase on their optical properties, as follows: Enhancement in fluorescence intensity has been reported with a maximum factor of 11-fold higher achieved for the case of CdTe QDs, while only three-fold enhancement has been achieved in the case of fluorescein dye. Fluorescence narrowing, under laser excitation, of about 54% reduction in case of CdTe QDs while only 20% narrowing in case of fluorescein dye. It was found that, the maximum percentage increase in the stimulated emission cross section was calculated to be ~ 32% for CdTe NPs while (~86%) obtained for fluorescein dye. Reduction in fluorescence lifetime has been observed for both materials. In addition, the laser performance parameters: β min parameter, saturation intensity I sat, minimum pump intensity I min and extraction (gain) efficiency have been calculated for all samples.
Keywords:

Plasmatic nanoparticles; Metal semiconductor hybrid nanostructure; Fluorescein dye; Plasmonic effect; Silver nanoparticles.