Nanooptics and nanophotonics

Impact of intermolecular interactions on the self-organization of laser dye in the nanostructured films and electronic processes therein

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Dependence of the spectral-luminescent properties of organic dyes from their electronic and chemical structure had been studied in liquid or vapor phases, while for most practical applications, more condensed matter is necessary. In a hybrid nanostructured film, the electronic states of the dye molecules and processes largely determined by the ratio of intermolecular and intramolecular interactions. Fluctuations of the intermolecular interaction energy lead to the experimentally observed broadening of the electronic level's energy of organic dye and alternate their fluorescent properties.

In the present study, we show the possibility to fabricate of the mesoscopically organized nanocomposites, doped with dyes, prepared for use as photochromic materials, optical waveguides or optoelectronic devices. Unusually effect of the impact of dye concentration on the effectiveness of fluorescence was established. The interaction of the dye molecules, template molecules and the inorganic matrix leads to significant changes of the intensities of the absorption and photoluminescence and the position of band's maximum. Increasing the concentration of dye in nanocomposites accompanied by a decrease of the intensity of a fluorescence band. Reduction of intensity of luminescence occurs as the result of the nonradiative energy transfer of polaritons matrix. The further increase of the concentration leads to mesoscopic ordering, toward oblique aggregates and increasing of the fluorescence intensity due to the confinement of the dye molecules involved in the intermolecular and intramolecular interactions within the film structure.