HETEROGENEOUS SYSTEMS WITH AG NANOPARTICLES

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In this paper we report on a study of the optical properties of the two hybrid nanosystems, which are composed of silver nanoparticles (Ag NPs) with methylene blue (MB) dye and Ag NP with CdS quantum dots (CdS QDs).

CdS QDs grown by colloid chemistry methods and had a mean radius of 2-5 nm [1]. Silver NPs of spherical form synthesized by chemical reduction of silver salt by sodium citrate [2]. The size of the Ag NP was equal to 20 ÷ 30 nm. The resulting silver nanoparticles show in the spectrum an absorption band caused by local surface - plasmon resonance (LSPR). The maximum of Ag NPs LSPR is localized at λ_{max} = 410 nm. The absorption spectrum of MB dye consists of bands (λ_{max} = 633 nm). The absorption spectrum of Ag NPs / MB dye nanocomposite, in addition to the absorption bands of the silver nanoparticles (λ_{max} = 410 nm) and the absorption band of the MB dye in the molecular form (λ_{max} = 633 nm), contains a new band with λ_{max} = 590 nm. \The nature of this band is associated with the aggregation of dye molecules (dimers). The intensity of the band due to aggregation of the dye molecules (λ_{max} = 590 nm) was increased (Fig. 1). The dye without silver nanoparticles (at specified concentrations of the dye) were not observed aggregation processes. Moreover, the maximum of 700 nm appear, the nature of which, according to the literature [3], is associated with the formation of complex aggregates consisting of several dimers (called J-aggregates). Characteristically, the appearance of aggregates in the composite solution Ag NPs / MB dye reduces the intensity of luminescence. This effect explained by the formation of nonluminescent aggregates of dye in the nanosystems with Ag NPs. Molecular aggregates (dimers) are not involved in the radiative processes of the dye, resulting in reduced intensity of its luminescence. It has been shown, that the luminescence intensity of CdS QDs is enhanced by increasing the probability of spontaneous transitions in QDs on the condition observing localized surface plasmon resonance (LSPR) in the absorption spectrum of the Ag (Fig.2.).

Thus, has shown that the addition of Ag NP into the composite containing organic MB dye and inorganic CdS QDs compounds, leads to changes of their properties, both in structural and radiation characteristics.

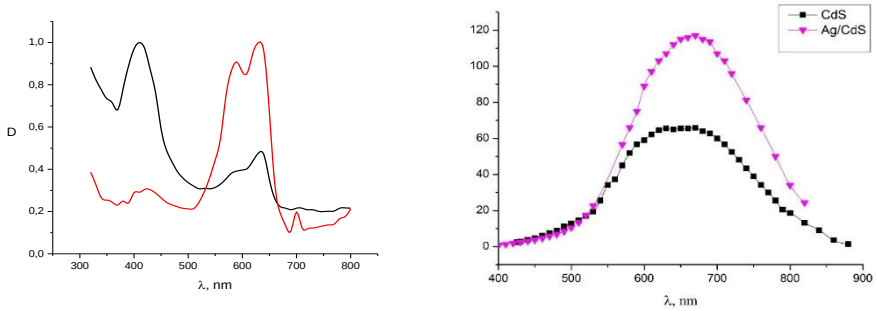

Fig.1. 1) Absorption spectra of Ag NPs (λ_{max} = 410 nm) with the addition of MB dye, concentration: 5×10^{-6} M (black lines); 5×10^{-5} M (red lines) 2) Influence Ag NPs on the intensity of the CdS QDs luminescence.

References:

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