Nanocomposites and nanomaterials

Polymer nanocomposite films with embedded CdS nanocrystals

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During last decades the increasing attention is paid to nanoobjects of different nature (nanolayers, nanorods, quantum dots) because of its unique properties that differ from those of bulk materials. Sol-gel techniques for nanoparticle synthesis under conditions of restricted crystal growth as well as the development of simple and accessible methods for obtaining hybrid organic-inorganic nanocomposites are of special interest. This work is devoted to the elaboration of a new approach to fabrication of thin-film nanocomposites with cadmium sulphide nanocrystals (NC) embedded on the basis of reactive polyperoxides (RC) grafted to the solid surface via combination of adsorption, network formation and sol-gel technique.

Thin polymer films were formed on the basis of reactive peroxide-containing copolymers and polyethyleneglycols of diverse molecular weight via spin-coating technique. Obtained data reveals that network formation occurs due to the radical reaction of peroxide groups and esterification reactions between maleic anhydride units of RC and PEG hydroxyl groups. PEG introduction into polymer layer composition allows to reach the film cross-linking degree of 95-96% as well as to reach cross-linking degree of 80-90% at the temperatures 20-30 K lower as comparing with the films obtained without PEG. The network formation is accompanied with the increase of polymer film hydrophobicity owing to the change of the conformation of polymer macromolecules during thermal treatment. The formation of cured homogeneous polymer layer containing nanopores that can serve as nanoreactors for the synthesis of mineral nanoclusters is proved with the use of IR-spectroscopy, atomic-force microsopy and small-angle X-ray scattering techniques.

The introduction of Cd^{2+} ions into polymer film followed by treatment of the samples with gaseous H_2S results in the formation of semiconductor nanoclusters with the size of 4-6 nm. It has been shown that the size of CdS nanocrystals and nanocomposite film optical properties depends on the nature of RC and PEG molecular weight, PEG to RC ratio, quantity of nanocomposite layers as well as Cd^{2+} ion concentration.