

Nanocomposites and nanomaterials

Influence of Mn doping on the nucleation and growth kinetics of colloidal CdS nanoparticles

V.V. Nosenko¹, G.Yu. Rudko¹, V.I. Fediv², A.I. Savchuk³, E.G. Gule¹, I.P.

Vorona¹

¹ V. Lashkaryov Institute of Semiconductor Physics, Natl. Acad. of Sci. of Ukraine. Prospect Nauki, 45, Kiev-03028, Ukraine.

E-mail: vvnosenko@ukr.net

² Department of Biophysics and Medical Informatics, Bukovinian State Medical University. Kobylianska st., 42, Chernivtsi-58000, Ukraine.

³ Chernivtsi National University. Kotsyubynsky st., 2, Chernivtsi-58012, Ukraine.

Colloidal undoped CdS and doped CdS:Mn nanoparticles (NPs) were synthesized in the solution of polyvinyl alcohol polymer and the process of NPs growth was monitored by optical absorption measurements. We have studied the absorption of both types of colloidal NPs at different stages of synthesis and have demonstrated that the absorption edge, and, consequently, the band gap of NPs varies differently: at early stages of synthesis the band gap of both types of NPs is the same while it differs drastically when NPs grow larger. The results obtained demonstrated that the rate of the band gap value decrease during NPs growth is slower for the Mn-doped NPs as compared to the undoped ones.

The inclusion of Mn²⁺ impurity was checked by electron paramagnetic resonance measurements. EPR spectra of polymer composite evidenced that the content of Mn²⁺ does not exceed a couple of percents. This latter fact leads to the conclusion that the dominating effect that controls the band gap of NPs is quantum confinement. Thus, the growth of NPs in the solution containing Mn ions is inhibited, the size of doped NPs is smaller as compared to the undoped ones and doping leads only to minor variation of the band gap. The model of the adsorptive doping of CdS NPs with manganese is proposed.