Nanocomposites and nanomaterials

Excitation and emission spectra of polyvinylpyrrolidone/ZnO nanocomposites with various interfaces

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Nanometer-size semiconductor nanoparticles/organic polymer composites have attracted considerable interest in recent years due to their size-dependent properties and great potential for many applications such as photoelectrochemical cells, heterogenerous photocatalysis, optical switching, and single electron transistors. Zinc oxide (ZnO) is one of the most promising materials for short-wavelength light emitting devices and for wide range of other technological applications due to its wide band gap energy, high exciton binding energy and optical transparency [1]. The possibility to tune the properties of ZnO-containing composites by varying the particle size and surface conditions finds applications in the design of new composite materials with optimized properties for various purposes. Light emission of ZnO particles depends on the method of fabrication, presence of dopants and surface conditions. Some reports concerning polymer–ZnO luminescence have demonstrated possibility to adjust ZnO photoluminescence for cell imaging. Thus, photoluminescent ZnO nanoparticles modified by polymers promise to have a bright future [2,3].

Synthesis of nanostructured zinc oxide was carried out using zinc acetate dehydrate, hexamethylenetetramine (HMTA), tetramethylammonium hydroxide (TMAH) and polyvinylpyrrolidone (PVP). PVP is non-toxic, non-ionic polymer with C=O, C–N and CH_2 functional groups. It is widely used in nanoparticles synthesis. Three types of nanocomposites were studied. The were synthesized as follows: ZnO was synthesized directly in the polymer using TMAH, ZnO was synthesized using HMT, TMAH and afterwards immersed into polymer, ZnO was synthesized using TMAH and afterwards immersed into polymer.

In the present study, room temperature PL spectra of ZnO/polymer nanocomposites were recorded at different wavelengths of exciting light (from

240nm to 480nm) and compared with the ones of pure polymer. Excitation at different wavelengths produced PL in UV and visible regions. For excitations with λ_{exc} > 370 nm, the spectra are dominated by the emission at 480 nm while in pure PVP where this peak is not seen. PLE spectra of ZnO/polymer nanocomposites were recorded at various detection wavelengths within the observed PL bands. Scheme of the main luminescent mechanisms for ZnO/polymer nanocomposites is suggested.

1. 65 years of ZnO research – old and very recent results / *C. Klingshirn, J. Fallert, H. Zhou, J. Sartor, C. Thiele, F. Maier-Flaig, D. Schneider, H. Kalt* / Phys. Status Solidi B.- 2010.- **247**, №6.- P.1424–1447.

2. Zinc Oxide—From Synthesis to Application: A Review / *A. Kołodziejczak-Radzimska, T. Jesionowski* // Materials.- 2014.-**7**, №4.- P.2833-2881.

3. *H.-M.Xiong* Photoluminescent ZnO nanoparticles modified by polymers / J. Mater. Chem.- 2010.- **20**.- P.4251–4262.