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Preparation of poly(*N*-vinylpyrrolidone)-stabilized ZnO colloid nanoparticles

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Abstract

We propose a method for the synthesis of a colloidal ZnO solution with poly(*N*-vinylpyrrolidone) (PVP) as stabilizer. Stable colloidal solutions with good luminescence properties are obtained by using PVP as stabilizer in the synthesis of ZnO nanoparticles by a sol–gel method assisted by ultrasound. Nanoparticles with sizes of 30–40 nm in a PVP matrix are produced as a solid product. The colloidal ZnO/PVP/methanol solution, apart from the most intense PL band at 356 nm coming from the PVP, exhibits a strong PL band at 376 nm (3.30 eV) which corresponds to the emission of the free exciton recombination in ZnO nanoparticles.

Introduction

Zinc oxide is widely used in various applications such as gas sensors, solar cells, antireflection coatings, varistors, surface acoustic wave devices, light emitting diodes and random lasers [1-4]. Among different processing methods, the sol–gel technique has various advantages such as cost-efficient processing, low-temperature sintering capability, the possibility of coating large and complex surfaces, and the capability to produce high quality coatings with a wide range of easily controlled thicknesses [5]. Preparation of ZnO nanoparticles by a colloidal method in the form of hydrosols was widely investigated in recent years in connection with a possible employment in biology [6]. ZnO nanoparticles have been synthesized in conjunction with different polymers such as polyethylene glycol (PEG) and poly(*N*-vinylpyrrolidone) (PVP). Nanoparticles of various morphologies were formed, and the photoluminescence intensity was increased because of the passivation of surface defects in the nanoparticles [7].

Nanohybrid films with resistivity of 10^8 Ω·cm were obtained by using PVP with molar mass of 400,000 at various Zn^{2+}/PVP ratios [8]. Colloidal solutions of ZnO are obtained by different methods. For instance, a nano-colloid has been synthesized