

Low Temperature PVP Capping Agent Synthesis of ZnO Nanoparticles by a Simple Chemical Precipitation Method and Their Properties

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Abstract : We are reporting a simple and low-cost chemical precipitation method adopted to prepare zinc oxide nanoparticles (ZnO) using polyvinyl pyrrolidone (PVP) as a capping agent. The Differential Scanning Calorimetry (DSC) and Thermo Gravimetric Analysis (TGA) was applied on the dried gel sample to record the phase transformation temperature of zinc hydroxide Zn(OH)₂ to zinc oxide (ZnO) to obtain the annealing temperature of 800C. The thermal, structure, morphology and optical properties have been employed by different techniques such as DSC-TGA, X-Ray Diffraction (XRD), Fourier Transform Infra-Red spectroscopy (FTIR), Micro Raman spectroscopy, UV-Visible absorption spectroscopy (UV-Vis), Photoluminescence spectroscopy (PL) and Field Effect Scanning Electron Microscopy (FESEM). X-ray diffraction results confirmed the wurtzite hexagonal structure of ZnO nanoparticles. The two intensive peaks at 160 and 432 cm⁻¹ in the Raman Spectrum are mainly attributed to the first order modes of the wurtzite ZnO nanoparticles. The energy band gap obtained from the UV-Vis absorption spectra, shows a blue shift, which is attributed to increase in carrier concentration (Burstein Moss Effect). Photoluminescence studies of the single crystalline ZnO nanoparticles, show a strong peak centered at 385 nm, corresponding to the near band edge emission in ultraviolet range. The mixed shape of grapes, sphere, hexagonal and rock like structure has been noticed in FESEM. The results showed that PVP is a suitable capping agent for the preparation of ZnO nanoparticles by simple chemical precipitation method.

Keywords : ZnO nanoparticles, simple chemical precipitation route, mixed shape morphology, UV-visible absorption, photoluminescence, Fourier transform infra-Red spectroscopy

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