Optical properties of ZnO nanoparticles over the effect of magnesium doping

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Magnesium doped zinc oxide nanoparticles (Mg-ZnO) show excellent biocompatibility and adopted as good luminescent label in bio-applications. ZnO nanoparticles have interesting applications in the field of electronics, optics, optoelectronics and UV laser devices. Magnesium doped zinc oxide nanoparticles were synthesized by non-aqueous method at low temperature. The effect of magnesium doping on the optical properties of ZnO nanoparticles with the change in bandgap and photoluminescence properties was reported. The morphology of Mg-ZnO nanoparticles was changed from spherical to elongated particle after magnesium doping (Figure 1). The band gap of Mg-ZnO nanoparticles has been varied after the incorporation of magnesium acetate and a blue shift of band gap was observed. The optical properties of Mg-ZnO characterized by UV-Vis and photoluminescence techniques and band gap of Mg-ZnO nanoparticle was calculated using Kubelka Munk equation.

Zinc oxide (ZnO) is a wide band gap (3.37 eV) semiconductor with a large excitonic binding energy (60 meV) [1]. These binary oxides have a large difference in the band gap (3.3 eV for ZnO and 7.5 eV for MgO) that shows potential application in the development of short wavelength lasers and hetero-structure devices [2]. It is reported that the doping of magnesium ions in zinc oxide nanoparticles proved feasible to realize the band gap modulation of zinc oxide [3]. Magnesium doped zinc oxide nanoparticles is a good example of LEDs because of $Mg_xZn_{1-x}O$ alloys have larger band gap and lattice constants that are very close to ZnO.

Mg-ZnO nanoparticles were synthesized using different methods like solvothermal, coprecipitation, sonochemical, thermal decomposition, microwave, polymer based process, sol-gel, non-hydrolytic, thermolysis, pulsed laser, thermal oxidation, flame spray synthesis, solution decomposition, sputtering

and rheological phase reaction precursor method.

In the present study magnesium doped zinc oxide nanoparticles have been synthesized without using any surfactant and ligands at room temperature within 15 minutes. The morphological changes with the doping of magnesium acetate during the synthesis have been observed. The pure zinc oxide nanoparticles show spherical shape nanoparticles but after incorporation of magnesium acetate spherical particles change into small rod shape morphology.

Figure 1: Photoluminescence and TEM images pure ZnO (0:100) and Mg-ZnO nanoparticles1 (8:100)

References

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