

## ABSTRACT

The optical properties or the performance of photonic devices are mainly determined by the electronic density of states (depends on their geometry) as well as defect states of reduced semiconductor cluster size. The study of intermediate phase between Zn and ZnO is of crucial importance not only for technological point of view but also for basic understanding the underlined physics to correlate the structure-property relationship. Therefore, to tune the physical properties for desired applications, we have started with cost-effective vacuum-carbon-arc technique to restrict the grain boundary interaction through the incorporation of intervening medium during synthesis. In the present work, we have prepared (a) Zn embedded ZnO nanostructure (b) Zn-ZnO core-shell nanostructure (c) Zn-ZnO nanostructured thin film in carbon matrix and (d) ZnO thin films. The Zn embedded ZnO nanostructure exhibits visible emission with excitation of Xenon lamp, whereas with excitation of He-Cd laser near-band-edge PL emission spectra with some multiphonon peaks are observed. Blue shifting in optical absorption band (due to local fluctuation of number of carrier density) and the prominent SO phonon mode in Raman scattering (due to surface defects leading to symmetry breaking mechanism) are also observed. The core-shell Zn-ZnO nanostructure provides very strong UV emission at 388 nm (due to free exciton transition through exciton-exciton collision process) and blue shift of absorption shoulder occurs due to coupling between exciton absorption as well as core metallic Zn interband absorption. Rietveld analysis of GIXRD pattern and the TEM technique provide the microstructural evolution of Zn-ZnO nanostructures. The defect related emission and some allowed as well as forbidden (SO) Raman scattering band are observed (due to stacking fault and dislocation arrangement). The ZnO thin films exhibit oxidation temperature dependence visible photoluminescence investigated systematically by microstructural analysis. The downshift and line width broadening of  $E_2^{\text{high}}$  phonon mode in ZnO are also analyzed systematically.

Key words: Zn-ZnO nanostructures, vacuum-carbon-arc method, Rietveld method, visible emission, surface optical phonon mode,  $E_2^{\text{high}}$  phonon mode.