Excitation energy dependent tunable emission in $SrZnO_2$ nanophosphors

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Oxide nanophosphors are widely explored for their utility in lasing and solid-state lighting, owing to the presence of lattice defects [1-4]. $SrZnO_2$ nanophosphors, synthesized by combustion synthesis using monoethanolamine fuel, are found to be exhibiting energy dependent tunable luminescence. HR-TEM images indicated about presence of defects in the lattice, the effect of which was observed on local electronic structure of the material also. Experimental X-ray absorption near edge structure at Zn and Sr *K*-edges were studied using simulated absorption spectra for defect free structure based on full multiple scattering theory. The presence of extra feature in Zn *K*-edge and broadened near edge structure at Sr *K*-edge in experimental spectra were supposed as signature of lattice distortion due to presence of lattice defects in system. Extended X-ray absorption fine structure analysis of first coordination shell around Zn and Sr absorbers indicated oxygen vacancies in the system, accompanied by decreased Zn-O bond lengths and increased Sr-O bond lengths. The observed structure disorder was believed to be responsible for formation of band tail states with Urbach energy 247.1 meV near the edges of optical band gap of 3.95 eV. Thermoluminescence glow curve analysis obtained at varying gamma irradiation revealed presence of shallow and deep defect states in the band gap. A collective consequence of all the results were summed up in band model, shown in Fig. 1, depicting blue emission due to radiative recombination from shallow defect state to tail states above valence band and white emission due to radiative transition between shallow to deep defect states in the forbidden gap. The energy dependent dual visible emission in $SrZnO_2$ is expected to be utilized for various technological applications.

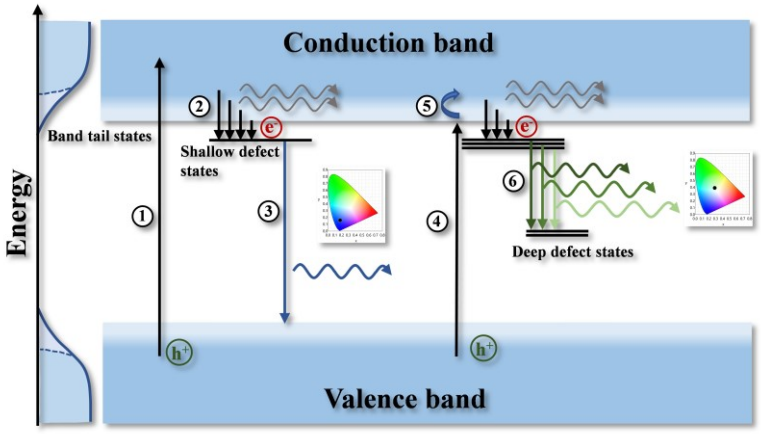

Figure 1. Schematic band model of photoluminescence in $SrZnO_2$ nanophosphors, showing excitation and expected transitions. The transitions are explained as (1) above band gap excitation; (2) non-radiative energy loss during transition from upper conduction band to shallow defect states via band tail states; (3) radiative transition from shallow defect states to tail states of valence band; (4) below band gap excitation; (5) electron hoping from below band gap levels to conduction band in some probable cases and; (6) radiative transition from shallow defect states to deep defect states. (The energy levels are shown for the purpose of illustrating the phenomenon. These may differ from actual energy levels.)

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