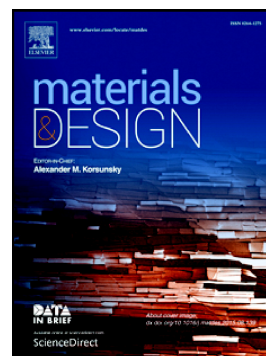


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Optical Bandgap Tuning in Nanocrystalline ZnO:Y Films via Forming Defect-Induced Localized Bands

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Abstract

Understanding of optical bandgap-tuning in terms of defect natures and their distribution in the nanocrystalline material proposes a fertile ground for the emergent optoelectronic device applications. In this contribution, nanocrystalline Y-doped ZnO (ZnO:Y) thin films with various thicknesses (50 – 300 nm) were prepared on quartz substrates by spin-coating techniques, and their morphological, structural, and optical properties were thoroughly investigated. The surfaces of the films, consisting of uniformly-distributed nanograins, showed an improved crystallinity as the thickness of the nanocrystalline film was increased. The optical bandgap of nanocrystalline ZnO:Y thin films was decreased from 3.25 to 3.09 eV because of the formation of the localized energy band, which arises from the charged defects at the boundaries of nano-grains. The correlations between the optical bandgap tunability and the distribution of charged defects are systematically examined, and the mechanisms of optical bandgap-tuning in nanocrystalline ZnO:Y thin films are discussed on the basis of the defect-induced localized band model.

Keywords: ZnO:Y; Nanocrystalline films; Optical bandgap engineering; Native defects; Localized bands.

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