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Abstract

The effect of Cd doping on structural and optical properties of 1 at % Al-doped $Zn_{1-x}Cd_xO$ (x=0-8 %) powders prepared by sol-gel method was systematically investigated. X-ray diffraction (XRD) patterns revealed the powders retained a hexagonal wurtzite structure of ZnO below x=6%, while cubic rocksalt CdO appeared when x=8%. The bandgap and near band emission (NBE) energies determined from ultraviolet-visible (UV-vis) absorbance and photoluminescence (PL) spectra, respectively, decreased linearly with increasing Cd content up to x=6%, it seemed that the Cd worked effectively on ZnO bandgap engineering. However, the Stokes shift unexpectedly decreased from 136 meV to 33 meV with increasing Cd content. According to the fluctuation of integrated intensity of Cd $3d_{5/2}$ X-ray photoelectron spectroscopy (XPS), and redshift for x≤4% and then blueshift for x>4% of the broadening A_1(LO)/E_1(LO) Raman mode, it was concluded that CdO impurity might also exist in the sample of x=6% at least. The redshift of bandgap and NBE could not be simply ascribed to bandgap shrinkage of $Zn_{1-x}Cd_xO$ powders for x>4%, but also due to the existence of CdO impurity with narrower bandgap of 2.3 eV.

Key words: (Cd,Al)-codoped ZnO powders; Sol-gel method; Bandgap engineering; Photoluminescence; Phase segregation

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