

Magnetic and optical properties of laser-deposited Co-doped ZnO thin films

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Abstract

We report the optical and magnetic properties of laser-deposited Zn_{1-x}Co_xO ($x = 0.05-0.3$) thin films with no intentional electrical carrier doping. The analysis of the high-temperature magnetization data provides unambiguous evidence that antiferromagnetic superexchange interaction is the dominant mechanism of the exchange coupling between Co ions in Zn_{1-x}Co_xO alloy, yielding the value of the effective exchange integral J_1/k_B to be about -27 K. The low-temperature magnetization data reveals a spin glass transition in Zn_{1-x}Co_xO alloy with the Co content $x = 0.15$, giving the value of the spin freezing temperature T_f to be 8 K and 12 K for $x = 0.2$ and 0.25 , respectively. Optical spectra analysis shows an increase of the band gap E_g with increasing the Co content following $E_g = 3.231 + 1.144x$ eV.