





EPR detection of sphalerite ZnO in mechanically treated ZnO+0.1C nanosystem

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Abstract

The EPR spectrum of Mn^{2+} ions observed in nano-powders of wurtzite ZnO phase (ZnO_{Wt}) with 0.1 wt% of carbon nanoparticles subjected to mechanical processing (MP) for $t_{MP} > 90$ min where different than the well-known EPR spectrum of Mn^{2+} in ZnO_{Wt} . Such spectrum was observed earlier and it was attributed to either a new phase or a highly disordered nanocrystalline ZnO_{Wt} . Spin–Hamiltonian (S–H) parameters and line width (ΔB) have been determined by computer simulation of observed EPR spectrum of Mn^{2+} : $g = 2.0010 \pm 0.0004$, $|A| = (73.6 \pm 0.3) \cdot 10^{-4} \text{ cm}^{-1}$, $|D| = (102 \pm 30) \cdot 10^{-4} \text{ cm}^{-1}$, $\Delta B \approx 0.6 \text{ mT}$. The comparison of S–H parameters of the EPR spectra of Mn^{2+} ions in a new formed phase and in ZnO_{Wt} indicates that the parameter A of the hyperfine structure in a new phase is slightly smaller and that the D parameter is more than two times lower than in ZnO_{Wt} . The content of the newly formed phase (~1% to 2%) is significantly higher than the content of external impurity states in the initial ZnO sample. The observed EPR spectrum is attributed to the Mn^{2+} ions in the zinc blende (sphalerite) ZnO phase (ZnO_{ZB}), created on the surface of ZnO_{Wt} nanoparticles during mechanical processing.

Introduction

ZnO nanopowders are of great interest due to their potential applications in different optic, electronic, spintronic or magnetic devices [1], [2]. The stable ZnO phase at ambient condition is the wurtzite-type crystal structure (ZnO_{Wt}) which has hexagonal symmetry. The ZnO_{Wt} crystal is a II–VI semiconductor compound with a direct band gap of 3.37 eV at room temperature and essential exciton and biexciton