Nanocomposites and nanomaterials

Structural, optical and magnetic properties of individual Mn doped ZnO nanorods

Rarata S.[1,4], Kolomys O.[1], Strelchuk V.[1], Lytvyn P.[1], Tronc P.[2], Chan Oeurn Chey[3], Omer Nur[3], and Magnus Willander[3]

[1] *V. Lashkaryov Institute of Semiconductor Physics, NAS Ukraine, Kyiv, Ukraine. E-mail: rarata@ukr.net*

[2] *École Supérieure de Physique et de Chimie Industrielles (ESPCI), Paris, France.*

[3] *Department of Science and Technology, Linköping University, 601 74 Norrköping, Sweden.*

[4] *Taras Shevchenko National University of Kyiv, 64 Volodymyrs'ka str., 01601 Kyiv, Ukraine.*

The systematic study of structural, optical, and magnetic properties of undoped and Mn doped ZnO nanorods (NRs), synthesized by aqueous chemical growth with nominal Mn concentrations of 15 and 30%, has been reported. The SEM images clearly show that ZnO:Mn NRs have hexagonal shapes and their diameters varies from 60 to 650 nm with respect to the concentration of the incorporated Mn atoms.

Optical absorption spectra show a red shift of the absorption edge with increasing of Mn^{2+} concentration. This shift is due to strong sp-d exchange interaction between valence band holes and localized spins of the Mn^{2+} ions.

Using scanning Raman microspectroscopy obtained lateral Raman maps of the spatial distribution of intensity and frequency position of E_2^{high} phonon modes along the single nanorod with lateral scanning step of about 0.1 μm. The Raman spectra of individual ZnO:Mn nanorod show the Raman-active vibrational modes of wurtzite phase ZnO and local vibration mode (LVM) associated with Mn-V_O complexes at near 526 cm^{-1}. At high Mn concentration (15% or more), strong vibrational modes related to spinel phase $ZnMn_2O_4$ and Mn_3O_4 were found in the down two-dimensional seed layer. Both phases coexist in the seed layer of the samples with NRs. Non-uniform spatial distribution of structure phases both wurtzite structure ZnO and spinel structure $ZnMn_2O_4$ and Mn_3O_4 were obtained.

Magnetic atomic force microscopy (MFM) is used to record 2D magnetization maps simultaneously with topography of single ZnO:Mn NRs. Obtained 2D magnetization maps shows clear magnetic contrast at room temperature provides a strong evidence of in-plane ferromagnetic magnetization in individual upright standing ZnO:Mn NRs.