Nanocomposites and nanomaterials

Structural and optical properties of ZnO:Tb thin films grown by RF magnetron sputtering

L. Borkovska[1], L. Khomenkova[1], O. Kolomys[1], Yu. Polishchuk[1], X. Portier[2], J. Weimmerskirsh-Aubatin[2], A. Ziani[2], T. Kryshtab[3]

[1] *V. Lashkaryov Institute of Semiconductor Physics, Natl. Acad. of Sci. of Ukraine. Prospect Nauki, 45, Kiev-03028, Ukraine.*
E-mail: l_borkovska@ukr.net

[2] *CIMAP, Normandie Univ, ENSICAEN, UNICAEN, CEA, CNRS, 6 Blvd. Marüchal Juin, 14050 Caen, France*

[3] *Instituto Politücnico Nacional – ESFM, Av. IPN, Ed.9 U.P.A.L.M., 07738 Mexico D.F., Mexico*

Rare earth doping of wide band gap materials is often used to achieve efficient, controllable and stable emission in a specific spectral range. In this work, the results of structural and optical investigations of Tb-doped ZnO thin films by X-ray diffraction (XRD), transmission electron microscopy (TEM), Raman scattering and photoluminescence (PL) methods are presented. The films of about 600 nm thickness were grown on different substrates by RF magnetron sputtering and exposed to conventional thermal annealing at 600 and 900°C for 1 h.

The films were found to be polycrystalline with ZnO grains of preferable orientation in (002) direction. The ZnO grain sizes were estimated to be about 11, 20 and 27 nm for the films as-deposited on sapphire, Si and quartz substrates, respectively. The annealing resulted in the increasing of ZnO grain size and improvement of grain crystal structure. The latter was proved by both the decreasing in the intensity of quasi E_1(LO) phonon band in the non-resonant Raman spectra and the increasing of ZnO exciton emission in the PL spectra. The annealing stimulated also formation of Tb_2O_3 grains with preferable (222) orientation. This was accompanied by the increasing in the intensity of the PL peaks ascribed to $^5D4 \rightarrow {}^7Fi$ (i=6,5,4,3) transitions in the Tb^{3+} ions. The most intense Tb^{3+}emission was found in the films annealed at 900°C. The peculiarities of film crystallization caused by different growth regimes are discussed.

The authors acknowledge the financial support of the “Dnipro” program (project #M/7-2017).