Nanocomposites and nanomaterials

Correlation between photoluminescence and EPR signals in the Y doped ZrO2 nanopowder

Yu. O. Polischuk[1], N. Korsunska[1], M. Baran[1], T. Stara[1], A. Zhuk[1], V. Kladko[1], Yu. Bacherikov[1], Ye. Venger[1], T. Konstantinova[2], L. Khomenkova[1]

[1] *V. Lashkaryov Institute of Semiconductor Physics, 45 Pr. Nauky, Kyiv 03028, Ukraine, Natl. Acad. of Sci. of Ukraine.*
E-mail: justis@ukr.net

[2] *Donetsk Institute for Physics and Engineering named after O.O. Galkin of the NASU, 72 R. Luxemburg str., Donetsk 83114, Ukraine.*

Luminescence and structural properties of Y_2O_3-doped ZrO_2 nanopowders sintered by co-precipitation of Zr and Y nitrates with different Y_2O_3 content were investigated by XRD, TEM and Raman scattering, photoluminescent (PL) methods. It was found that at constant calcination temperature, the increase of Y_2O_3 content stimulates the transformation of crystalline phase from monoclinic through the tetragonal to cubic one that can be the reason of the dependence of nanocrystal sizes on Y content. The observed difference in size value estimated from different XRD peaks (more pronounced for monoclinic phase) reflects the anisotropic character of crystal growth. Room temperature PL spectra of the samples with different Y content under extrinsic excitation consist of several overlapped bands (at ~440, 510 and 560 nm) in visible spectral range which is the same for the samples with different Y content. Their contribution slightly depends on Y content but changes with the variation of nanocrystal sizes the component at 440 nm being higher in the small nanocrystals. In EPR spectra of the non-annealed samples no EPR signals were observed. The annealing of the samples in N_2 or H_2 flow results in appearance of the signal from Zr^{3+} at the crystal surface. In last case the signal assigned to F^+-center also arises. The observed anti-correlation between PL intensity and intensity of EPR signal from Zr^{3+} testifies that this center is the center of fast non-radiative recombination. At the same time no correlation between the intensity of the signal assigned to F-centers and observed PL bands was found.