

Physico-Chemical nanomaterials science

Luminescent study of the fluorine-doped ZrO_2 and $\text{ZrO}_2:\text{Eu}$ nanoceramics

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Energy efficiency of the devices is one of the key problems of modern engineering and therefore it specifies the main trends in material science. Recently, great attention was paid to elaboration of phosphor converted white light emitting diodes (pc-WLED) as energy effective devices for solid-state lighting and display applications. Important component of pc-WLED is phosphor material that should yield high luminescence intensity and in the same time must be stable to the effects of water, temperature, intensive light flux etc. All the mentioned conditions are satisfied by using of oxide compounds which doped with rare-earth (RE) ions often possess very intensive luminescence. Thus the effective elaboration of phosphors can be done by doping of oxide compounds with various ions either in cationic or anionic sublattice and the later one is poorly studied.

$\text{ZrO}_2:\text{xEu},\text{yF}$ ($\text{x} = 0$ or 0.5 mol.%, $\text{y} = 0$ or 10.0 mol.%) nanoceramics were synthesized by solid state route. The scanning electron microscope (SEM) images of the powders coated with gold have been obtained at JEOL JSM 6060 LV. The X-ray diffraction patterns were collected using a conventional powder diffractometer Siemens D500 operating in Bragg–Brentano ($\theta/2\theta$) geometry using Ni β -filtered, $\text{CuK}\alpha$ radiation. The PL study under excitations in the UV and visible regions was carried out at 4.2 K temperature with using of SDL-2 spectral complex. The arc Xenon lamp (150 W) was used as excitation source.

The prepared samples possess similar morphology and characteristic particle sizes are in 50 - 150 nm range. From XRD patterns it is follows that fluorination by itself does not lead to stabilization of cubic/tetragonal polymorphs but it promotes zirconia stabilization by Eu^{3+} doping. On the ground of analysis of our data on Eu^{3+} luminescence in $\text{ZrO}_2:\text{F},\text{Eu}$ nanoceramics together with literature data on Eu^{3+} ions PL in three polymorphs of zirconia was made conclusion that fluorine in studied compounds has no direct influence on Eu^{3+} -related electronic transitions. Fluorination has influence on host material structure through variation of oxygen and zirconia vacancies quantity that results in change of host-related PL emission and PL excitation spectra in comparison with non-fluorinated samples.