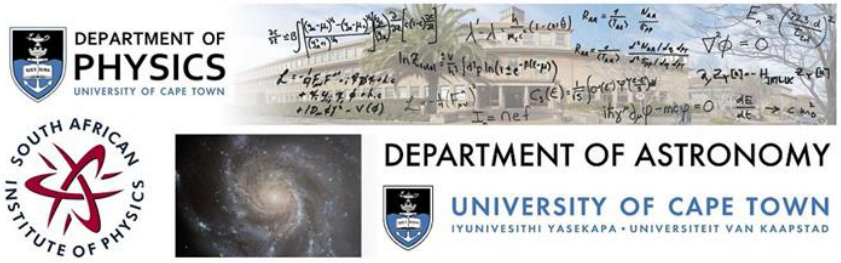

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Effect of Eu3+ ion concentration on phase transition, site symmetry and quantum efficiency of ZrO2 nanocrystal rods

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Abstract content
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This work report the influence of Eu3+ ion concentration on the photophysical properties of zirconia nanocrystal rods including its intrinsic quantum efficiency (IQE). A simple chemical route was employed in the synthesis of the nanocrystal rods. X-ray diffraction results show mixed phases of monoclinic and tetragonal structures. Phase transition occurred at low (1 mol%) and high (7 and 8 mol%) Eu3+ concentrations. There are three forms of excitations for this phosphor; band edge excitation at 232 nm, charge transfer state transition at 274 and 263 nm, and direct excitation at 362, 395 and 535 nm. Photoluminescence emission for all the doped samples are entirely intraconfigurational Eu3+ emissions and depends both on the site symmetry as well as the Eu3+ concentration. The Eu3+ ions were distributed in both phases especially at high ion concentrations (7 and 8 mol% Eu3+). Two multipolar processes where found to be responsible for the luminescence quenching process in the mixed-structure; the dipole-dipole and the dipole-quadrupole transitions. The intensity parameters (,), asymmetry ratio, R0 and the average decay lifetime of the nanocrystals show dependence on concentration and excitation wavelength. High IQE values were obtained at 1, 7 and 8 mol% Eu3+ where the monoclinic phase is dominant. The CIE coordinates values are comparable to existing red phosphors and in combination with the high average IQE of 55% makes this phosphor a good candidate for red emitting phosphor application.

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