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Effects of Ce^{3+} concentration, beam voltage and current on the cathodoluminescence intensity of SiO_2:Pr^{3+}–Ce^{3+} nanophosphor

G.H. Mhlongo[a,b], O.M. Ntwaeaborwa[b,*], M.S. Dhlamini[a], H.C. Swart[b], K.T. Hillie [a,b,**]

[a] National Centre for Nanostructured Materials, CSIR, PO Box 395, 1 Meiring Naude Road, Brummeria, Pretoria 0001, South Africa

[b] Department of Physics, University of the Free State, Bloemfontein 9300, South Africa

* Corresponding author at: University of the Free State.

** Corresponding author at: National Centre for Nanostructured Materials, CSIR, PO Box 395, 1 Meiring Naude Road, Brummeria, Pretoria 0001, South Africa.

Tel.: +27 12 841 3874; fax: +27 12 841 2229.

Email addresses: ntwaeab@ufs.ac.za (O.M. Ntwaeaborwa), thillie@csir.co.za (K.T. Hillie).

ABSTRACT

SiO_2:Pr^{3+}–Ce^{3+} phosphor powders were successfully prepared using a sol-gel process. The concentration of Pr^{3+} was fixed at 0.2 mol% while that of Ce^{3+} was varied in the range of 0.2–2 mol%. High resolution transmission electron microscopy (HRTEM) clearly showed nanoclusters of Pr and Ce present in the amorphous SiO_2 matrix, field emission scanning electron microscopy (FESEM) indicated that SiO_2 clustered nanoparticles from 20 to 120nm were obtained. Si-O-Si asymmetric stretching was measured with Fourier transformer (FTIR) spectroscopy and it was also realized that this band increased with incorporation of the activator ions into the SiO_2 matrix. The broad blue emission from the Ce^{3+} ions attributed to the $5d^1$-$4f^1$ transition was observed from the SiO_2:0.2 mol% Pr^{3+}–1 mol% Ce^{3+} phosphor. This emission was slightly enhanced compared to that of the singly doped SiO_2:1 mol%Ce^{3+} phosphor. Further investigations were conducted where the CL intensity was measured at different beam voltages and currents from 1 to 5 kV and 8.5 to 30mA, respectively, in order to study their effects on the CL intensity of SiO_2:0.2 mol% Pr^{3+}–1 mol% Ce^{3+}. The electronbeam dissociated the SiO_2 and as a result an oxygen-deficient surface dead or non-luminescent layer of SiO_x, where $x < 2$ on the surface, was formed.