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Contribution ID: 31

Type: **Poster Presentations**

Synthesis and Characterization of a Novel Rare-Earth Oxyorthosilicates (R_2SiO_5) ($R = La, Gd, Y$) Doped Dy^{3+} Nanophosphors

Wednesday, 6 May 2015 13:30 (1h 30m)

1. Introduction Nowadays, phosphors have found applications in solid state lighting, phototherapy, information display technologies, and solar cells, among other things. Rare earth oxyorthosilicates of the form R_2SiO_5 ($R = La, Gd, Y$) doped with rare earth elements, have been of interest for the past decades due to their wide band gap, fast decay times, high quantum efficiency, high density and minimal self-absorption. Using urea-assisted solution combustions method, we prepared both single and mixed rare-earth oxyorthosilicates doped with Dy^{3+} powder nanophosphors.

2. Results

The structures of our phosphors analysed using X-ray diffraction (XRD) confirmed that the phosphors crystallized in the pure monoclinic phases of La_2SiO_5 , Gd_2SiO_5 and Y_2SiO_5 or in the mixture of any of the three compounds. We also analysed the morphologies, elemental composition, and the chemical and electronic states of our powders using field emission scanning electron microscopy (FE-SEM), energy dispersive X-ray spectroscopy (EDS) and X-ray photoelectron spectroscopy (XPS) respectively. The photoluminescence (PL) (Fig. 1) measured when the samples were excited using a 325 nm He-Cd laser showed broad blue emission assigned to self-trapped excitons in SiO_2 [1] (which were not observed in the PL spectra measured in phosphorescence mode when the samples were excited using monochromatic xenon lamp) and $4F_9/2 \rightarrow 6H_{15/2}$ and $4F_9/2 \rightarrow 6H_{13/2}$ transitions of Dy^{3+} [2]. The colour purity of the samples calculated using the CIE coordinate calculator confirmed that the phosphors can emit tunable colours and white light. Furthermore, there was even distribution of the atomic and molecular ionic species on the surfaces of the samples as shown in the time-of-flight secondary ion mass spectrometer images in Fig 2.

3. References

- [1] C. Itoh, K. Tanimura, N. Itoh. J. Phys. C. Solid State Phys. 21(1988) 4693.
[2] K.G. Sharma, N.R. Singh. New J. Chem. 37 (2013) 2784.

Are you currently a postgraduate student? (Yes/No)

Yes

At what level of studies are you currently? (Hons/MSc/PhD)

MSc

Please provide the name and email address of your supervisor.

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Session Classification: Poster

Track Classification: SACPM