Contribution ID: **7** Type: **Poster Presentations**

Structural and luminescence properties of SrAl2O4:Eu2+, Dy3+/Nd3+ phosphor thin films grown by pulsed laser deposition

Tuesday, 5 May 2015 15:15 (1h 45m)

1. Introduction

Long afterglow or persistent phosphors have the ability of absorbing energy from UV or sunlight and then release it slowly in the dark [1,2]. Inorganic phosphors doped with rare earth elements show broad band emission from blue to red which makes them suitable for a variety of industrial applications, such as luminescent pigments, fluorescent lamps, color display, plasma display panels (PDP), radiation dosimetry and X-ray imaging [3]. The type and duration of emission from a phosphor is affected by a number of parameters such as the type and amount of activators or dopants, the structure of the host lattice, the method of preparation or growth conditions and other post-treatments. These parameters play a significant role in inducing a crystal field effect within the host matrix which in turn influences the emission wavelength, its intensity and lifetime. The main task would therefore be to optimize these factors to obtain a phosphor that gives the best performance for the desired application. In this study thin films of SrAl2O4:Eu2+, Dy3+ /Nd3+ were prepared using Pulsed Laser Deposition (PLD). The effect of varying argon gas pressure and substrate temperatures on the structure and photoluminescent (PL) properties of the SrAl2O4:Eu2+, Dy3+ /Nd3+ thin films were investigated.

1. Results

X-ray diffraction (XRD) patterns of the SrAl2O4:Eu2+, Dy3+ /Nd3+ phosphor thin films deposited on Si(100) in vacuum, 10, 20 and 30 mTorr argon partial pressure as compared with that of the as-prepared powder are shown in figure 1. The peaks fitted well with the powder and the JCPDS card number 74-0794 for the monoclinic SrAl2O4 of space group P1211 (4). It can be seen that with increasing the argon pressure the peaks in the (220) direction shifted to the lower 2-theta angles from 29.1o in vacuum to 27.9o in 30 mTorr argon partial pressure. Ar has a higher mass density and therefore tends to reflect lighter atoms in the plume more and these results in a film with big particles [4] which results in lattice expansion inducing crystal field effect in host lattice causing the XRD peak shift to lower angles. Figure 2 shows PL emission spectra recorded with He-Cd laser at excitation of 325 nm from SrAl2O4:Eu2+, Dy3+/Nd3+ thin films deposited under different argon atmospheres whereby emission peaks are observed to shift towards the higher wavelength side. Larger particles will cause lattice expansion and increase the crystal-field interaction of Eu2+ resulting in red shift.

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

Yes

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

PhD

Please provide the name and email address of your supervisor.

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Session Classification: Poster

Track Classification: SACPM