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TOF SIMS Analysis, Structure and Photoluminescence Properties of Pulsed Laser Deposited CaS:Eu2+ thin films

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1. Introduction

Red-emitting alkali earth sulfide phosphor such as divalent europium (Eu2+) doped calcium sulfide (CaS: Eu2+) is a good material for blue pumped three-band phosphor-converted white LEDs since it has strong absorption in the blue region [1]. CaS: Eu2+ thin films were deposited on Si (100) substrates using the pulsed laser deposition technique to investigate the effect of Argon (Ar), Oxygen (O2), and vacuum deposition atmospheres on the structural, morphological and photoluminescence (PL) properties of the thin films. The phosphor target was ablated using a 266 nm Nd: YAG laser. X-ray diffraction, Atomic force microscopy, scanning electron microscopy, energy dispersive X-ray, fluorescence spectrophotometry, and time-of-flight secondary ion mass spectrometry (TOF-SIMS) were used to characterize the thin films.

1. Results

The PL results for CaS: Eu2+ thin films deposited using different atmospheres are shown in Fig.1. Films prepared in Ar atmosphere showed better PL intensity than the films deposited in an O2, while the least intensity was observed from the films prepared in vacuum. The emission observed at around 650 nm for all the films is attributed to the transitions from the excited state to the ground state of the Eu2+ [2] ions. The emission at 618 nm, which is more prominent in the film prepared in O2, is ascribed to transitions in Eu3+ [3], suggesting that Eu2+ was unintentionally oxidized to Eu3+. TOF-SIMS images indicated that Eu2+ ions were evenly distributed in the CaS host and that the thicknesses of the prepared thin films depend on the atmosphere in which the films were grown. The overlay of Fig. 2 shows Eu in the +3 state, observed as EuO+ (m/z = 168. 8992) in the films prepared in an oxygen atmosphere. It is speculated that less oxidation of Eu2+ occurred during deposition in argon and vacuum atmospheres, since insignificant PL emission due to Eu3+ was observed.

1. References

[1] Jia, X. Wang. Opt. Mater. 30 (2007) 375.
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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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