Contribution ID: **73** Type: **Oral Presentation**

The thermal quenching process of the La₂O₂S:Eu(III) phosphor material

Tuesday, 26 June 2018 12:20 (20 minutes)

This study is concentrating on the measurement of the emission of commercially available lanthanum oxysulphide doped with europium(III) (La₂O₂S:Eu(III)) phosphor material at various temperatures. For the thermal quenching process, the average activation energies for the emission from the ⁵D₂, ⁵D₁ and ⁵D₀ excited states were determined as 0.49 eV, 0.55 eV and 0.77 eV, respectively and the average pre-exponential constant was determined as 9.5×10⁷ s⁻¹. The optical band gap of La₂O₂S:Eu(III) was determined as 2.75 eV. It was also established that the sulphur(II) to europium(III) (Eu(III)) charge transfer band absorbs ultraviolet light and transfers the excited electrons to the excited states of the Eu(III) ions from where emission can take place. The lifetime of the luminescence results indicated that the higher excited states have a double exponential lifetime that results from the emission from both the conventional Eu(III) ions and Eu(III) ions that are in the vicinity of a defect or impurity group. It was determined that in the case of the La₂O₂S:Eu(III) phosphor material, the presence of defect or impurity groups is due to the hydroxide groups that forms when the material was exposed to water vapour in the atmosphere at room temperature. The average emission decay constants of the ⁵D₂, ⁵D₁ and ⁵D₀ excited states were determined as 10 ns, 80 ns and 340 ns respectively. It was also revealed that La₂O₂S:Eu(III) can be utilised as a temperature sensor by using the fluorescence intensity ratio of the emission from the ⁵D₁ and ⁵D₀ excited states. This worked well for the temperature range from 80 ℃ to 180 ℃.

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Session Classification: Physics of Condensed Matter and Materials

Track Classification: Track A - Physics of Condensed Matter and Materials