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Synthesis and Photoluminescent Properties of Cerium Doped Strontium Sulfide

D.N. Game[1*], N.B. Ingale[2] and S.K. Omanwar[3]

[1]Institute of Diploma in Pharmacy, Borgaon (Meghe), Wardha
[2]Prof. Ram Meghe Institute of Technology and Research, Badnera, Amravati
[3]Department of Physics, Sant Gadge Baba Amravati University, Amravati

Abstract— *A simple method for preparing strontium sulfide phosphor by carbo-thermal reduction method useful for solid state lighting is given in this paper. $SrSO_4:Ce^{3+}$ was first synthesized by the co-precipitation method. Then this $SrSO_4:Ce^{3+}$ was heated in a closed assembly at 700°C for 6 h in reducing atmosphere in presence of charcoal and then allowed to cool slowly. This result in light blue color powder of $SrS:Ce^{3+}$ phosphor. Its photo luminescent properties are studied. The PL spectra shows the intense blue emission at λ_{em}= 484 nm for λ_{ex} = 254nm. $SrS:Ce^{3+}$ phosphor synthesized in this case can be used in lamp industry and display technology.*

Keywords— *Phosphor; sulfide; cerium; photoluminescence; co-precipitation; carbo-thermal reduction*

1. INTRODUCTION

Sulfide based luminescent materials have attracted a lot of attention for a wide range of photoluminescence, cathodoluminescence and electroluminescence applications. Upon doping with Ce^{3+} and Eu^{2+}, the luminescence can be varied over the entire visible region by appropriately choosing the composition of sulfide host. The luminescence of impurity doped, alkaline earth sulfides like MgS, CaS, SrS and BaS has been extensively studied in the past century. For instance the rare earth ions (broad band d-f emitters like Eu^{2+} and Ce^{3+}) are all known to luminescence in one or more of the above mentioned hosts [1]. The emission wavelength strongly depends on the synthesis conditions, suggesting the presence of multiple optically active centers [2,3]. In the middle of 1980s it became clear that rare earth doping of ZnS would not lead to sufficiently bright EL materials. As a result, several new activator-host combinations were tested and found to yield bright emission, CaS:Ce (green) [4], SrS:Ce (blue-green) [5], CaS:Eu (red) [6] and SrS:Eu (orange) [7] being the most successful combination. Luminescence of SrS doped with Ce^{3+} shows peak emission wavelength of 480 nm at room temperature [5]. Sulfide phosphors could be the phosphors in future for color conversion for white LEDs.

1.1 Experimental

Conventionally host sulfides are prepared by carbo-thermal reduction method. Same method is used for preparation of $SrS:Ce^{3+}$. All ingredients used were of AR grade. $SrSO_4:Ce^{3+}$ was first synthesized by the co-precipitation method by reacting $Ca(NO_3)_2.4H_2O$ (10.5 gm, Loba Chem.) and 0.5 mole% $Ce(NO_3)_3.6H_2O$ (0.1081 gm, 99.99%, IRE) with dilute sulfuric acid.

The precipitate was washed repeatedly by double distilled water and then dried slowly at 40°C. The dried $SrSO_4:Ce^{3+}$ was heated in a closed assembly at 700°C for 6 h in reducing atmosphere in presence of charcoal and then allowed to cool slowly. The light blue color powder of $SrS:Ce^{3+}$ phosphor was thus obtained.

1.1.1 Results and Discussion

PL spectrum of $SrS:Ce^{3+}$ is shown in figure 1. The curve on left hand side represents the PL excitation spectrum monitored at λ_{em} = 484nm. The excitation spectrum of $SrS:Ce^{3+}$ phosphor showed two excitation bands centered at 268nm and 357 nm. The band centered at 268 nm was sharp with highest intensity in the excitation spectrum whereas a very weak excitation band was also observed at 357nm wavelength.

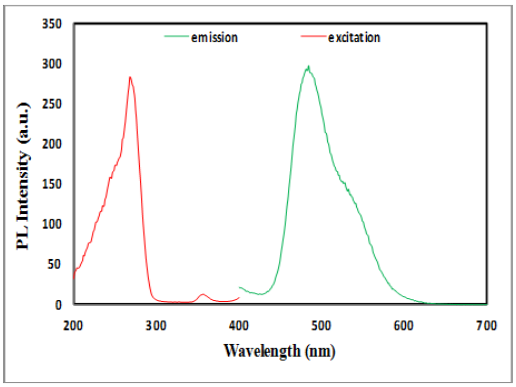

Fig. 1: Excitation and Emission spectra of $SrS:Ce^{3+}$.

The curve on right hand side represents the emission spectrum of $SrS:Ce^{3+}$ phosphor monitored at λ_{ext} = 254 nm. An intense blue emission corresponding to emission band peaking at 484nm wavelength with shouldering at 534 nm was observed.

* *Corresponding Author Email: deorao.game@gmail.com*

2. CONCLUSION

The PL excitation and emission spectra of this SrS:Ce^{3+} phosphor prepared by carbo-thermal reduction method are in good agreement with those reported in the literature. From the above discussion the phosphor SrS:Ce^{3+} can be used in lamps industry and in the display technology.

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