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RESEARCH ARTICLE

SOL GEL SYNTHESIS AND OPTICAL CHARACTERIZATION OF THE SRAL0: MN NANO PHOSPHOR

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ABSTRACT

Mn doped SrAlO nano phosphors were synthesized by adopting a simple Sol-Gel Method. X-Ray Diffraction (XRD) profile confirms the monoclinic nature of Mn doped SrAlO nano phosphors. The results show that SrAlO:Mn with an average particle size of 80 nm is formed. In addition, Scanning electron microscopy (SEM), Energy Dispersive X-ray Spectroscopy (EDS) and Fourier-Transform IR spectroscopy (FTIR) were also used to characterize the synthesized phosphor. The efficiency of the prepared phosphors was analyzed by means of its emission spectral profiles. We also observed a rich IR emission from the prepared phosphors under a Ultra-Violet (UV) source. Such luminescent powders are expected to be applied as IR sensor and MRI device applications.

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INTRODUCTION

Semiconductor nanomaterials have received great attention. Among these various semiconductor oxide nanomaterials, strontium aluminium oxide is a versatile material because of its physico-chemical properties such as; mechanical, electrical, optical, magnetic and chemical sensing properties. Now a days, various routes have been used for the synthesis of SrAlO nanomaterials, such as; sol-gel synthesis, hydrothermal/solvothermal methods, microemulsion method, precipitation, and physical vapor deposition. Sol-gel method gives homogenous, high-purity, and high-quality nanopowders. The morphology of the nanoparticles can be changed by changing the solvents. By Sol-gel method CaOSrAl₂O₃ thin films using metal alkoxides were prepared and its characteristics were analysed (<http://www.sciencedirect.com/science/article/pii/S027288421100530X>). Structural and optical properties of CaOSrAl₂O₃ thin films were derived by sol-gel dip coating process (<http://www.sciencedirect.com/science/article/pii/S002230931000669>). Doped alkaline earth aluminates processed doped alkaline earth aluminates were synthesized by using sol-gel method (<http://www.sciencedirect.com/science/article/pii/S0925838802000683>). Luminescent properties of europium-activated phosphors were synthesized by using sol-

gel method (<http://www.sciencedirect.com/science/article/pii/S0022231309001161>). Characterization study of ZnO nanoparticles were synthesized by using solar lamp and plasma display phosphors are based on compounds in the alkaline-earth-rare-earth-aluminate systems. A variety of activators were used of which the most important are Eu, Ce, Tb, and Mn. This work is concerned with the systematic relations between luminescence emission and crystal structure for Dy and Mn-activated alkaline earth aluminates.

Experiment

In our paper we prepared SrAl₄O₇: Mn powder using Sol-gel method. All the reagents used in the experiments were in analytical grade and used without any further purification. The procedure of synthesizing nanoparticles is thoroughly described as follows: 98 wt.% of 2M Strontium acetate [(CH₃COO)₂ Sr.2H₂O] was dissolved in 25ml of 2-methoxyethanol with vigorous stirring. 1 wt.% of 2M Manganese nitrate [(CH₃COO)₂ Mn.2H₂O] was dissolved in 25ml of 2-methoxyethanol with vigorous stirring. Simultaneously, 1 wt.% of 2M Aluminum acetate [C₄H₆AlO₄.4H₂O] was dissolved in 25ml of 2-methoxyethanol with vigorous stirring and subsequently, it was added to the first solution to reach 50 ml in total. Then it was stirred for 30 min at room temperature for the second time. Ammonia

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was slowly added to this solution with a constant stirring until a pH of 10.5 was achieved. After the stirring of the solution for 30min, acetic acid and ethylene glycol in the ratio 1:1 was added to the solution. The sol was heated at 80°C while being mechanically stirred with a magnetic stirrer. As the evaporation proceeded, the sol turned into a viscous gel. The gel was aged for 2h and then dried at 100°C for about 5h. The resulting materials were well grinded and annealed at 950°C for 2h to obtain Mn doped SrAl₄O₇ nanopowders. For the preparation of the gel precursors with different wt%, the same procedure was repeated with the wt% of Manganese nitrate being varied to 0.5, 2, 3, 4 and 5.

RESULTS AND DISSECTION

Morphological Study

The SEM image of SrAl₄O₇: Mn. The micrograph indicates that nearly all the powder particles were composed of same shape nanoparticles. The presence of bigger particles is attributed to the growth of small particles, which is a result of the sol-gel synthesis. Under the reaction time and temperature, some of the tiny particles underwent a self-induced process, aggregate and growth forming bigger particles.

X-Ray Diffraction (XRD)

The structure and phase purity of the SrAl₄O₇: Mn phosphor were investigated by XRD. The XRD patterns were obtained and are shown in Fig.1 for SrAl₄O₇: Mn. Diffraction patterns were obtained using CuK α radiation ($\lambda=1.54051 \text{ \AA}$), at 30kV and 15mA. Measurements were made from $2\theta=10^\circ$ to 80° with steps of 0.02° . The XRD patterns of the powders revealed that the structure of SrAl₄O₇ is Monoclinic, which is match with JCPDS data card No. 25-1289. The crystallites are less than approximately 50-90nm in size appreciable broadening in the X-ray diffraction lines. SEM images SrAl₄O₇: Mn, which is un-uniform and may be due to the formation of fractal attribution to sort of self organization. SEM image of SrAl₄O₇ sintered at 900°C for 3hrs appears to irregular shape.

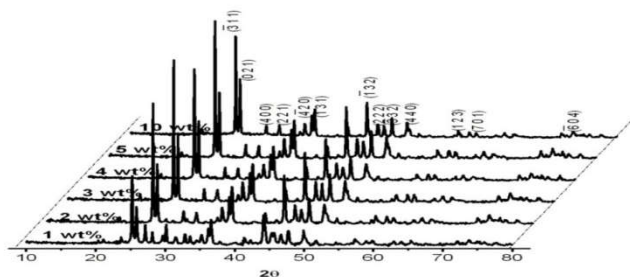


Figure 1. XRD images of Mn doped SrAl₄O₇ at different wt%

Optical Study

The photoluminescence emission spectra of the SrAl₄O₇: Mn shown in the Figure 2, The PL properties of SrAl₄O₇: Mn nanopowders were measured at room temperature. In this figure, the PL spectra of both Dy and Mn doped SrAl₄O₇ consisted of three parts: one weak peak in the blue region, one strong band in bluish green region and other emission bands in red light region. SrAl₄O₇: Mn nanocrystals are found to have increased photoluminescence efficiency associated with the magnetic impurity Mn²⁺. For small particles like the SrAl₄O₇:

Mn nanocrystals, majority of the Mn²⁺ ions are at the near-surface sites and occupy axial or lower symmetry sites.

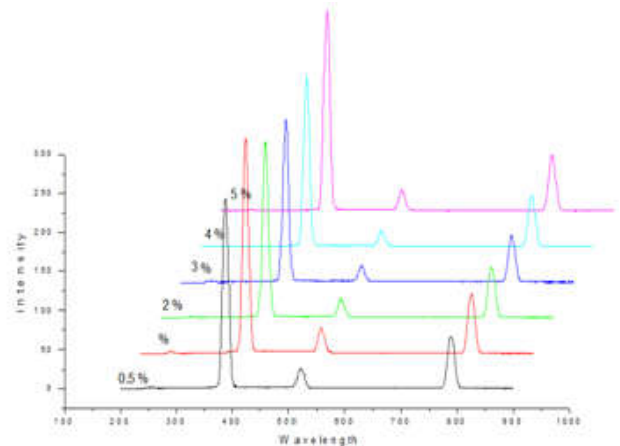


Figure 2. Photoluminescence spectra of Mn doped SrAl₄O₇ at different wt% of Mn

Conclusion

In this paper, by using sol-gel method SrAl₄O₇: Mn nanoparticles were synthesized. Materials characterization such as; X-ray diffraction (XRD), photoluminescence (PL) emission spectra, scanning electron microscopy (SEM) were analysed. In the results, we report the Mn doped phosphor generates a strong emission at 395 nm, 520nm in green region. The prepared SrAl₄O₇: Mn nanoparticles are applicable for fluorescent lamp and plasma display applications. The prepared Strontium Aluminate nano powder exhibits monoclinic structure.

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