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RESEARCH ARTICLE

OPTICAL PROPERTIES OF $SRAL_4O_7$: DY NANOPHOSPHORS

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ABSTRACT

Dy doped SrAlO nano phosphors were synthesized by adopting a simple Sol-Gel Method. X-Ray Diffraction (XRD) profile confirms the monoclinic nature of Dy doped $SrAl_4O_7$ nano phosphors. The results show that SrAlO: Dy with an average particle size of 60 nm is formed. Crystalline structure of the nano particles was studied by Scanning electron microscopy (SEM). 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. The efficiency of the prepared phosphors was analyzed by means of its emission spectral profiles.

INTRODUCTION

Nanoparticles have been the subjects of focused research interests in recent years due to their unique electronic, optical, mechanical, magnetic and chemical properties that are attributing from their small sizes and large specific surface area. The long lasting phosphors (LLP) oxide materials have been developed to replace the conventional sulfide afterglow materials because of their improved luminescent properties such as high initial brightness, long lasting time, suitable emission color and satisfactory chemical stability (Holsa *et al*., 2001; Nag and Kutty, 2003; Lin *et al*., 2000), which result in an unexpectedly large field of applications e.g. luminous paints in highways, airports, buildings and ceramic products (Murayama *et al*., 1995). With the development of newer technologies, several kinds of chemical synthesis techniques such as co-precipitation (Segall *et al*., 2004), sol–gel (Peng *et al*., 2004), reverse micro emulsion (8) and combustion methods (Peng *et al*., 2004; Fu *et al*., 2004) have been employed to prepare $SrAl_2O_4$ and its phosphors (Kshatri *et al*., 2013). Comparing these methods, sol-gel synthesis possesses some benefits, namely, relatively low preparation temperature, easy control of the stoichiometry, high levels of product homogeneity, and no need for the use of expensive equipment. In this article, we reported the synthesis of nanostructured $SrAl_4O_7$ doped with Dy via Sol Gel synthesis and effects on PL properties were investigated. Using Xpert PRO diffractometer with a CuKα radiation (Kα = 1.5406 A°), the X– ray diffraction (XRD) patterns of the powdered samples were recorded. Scherer's equation ($D=k\lambda/\beta\cos\theta$), using scanning electron microscopy (SEM; JSM-6390).

Experiment

The materials used for synthesis are strontium nitrate and aluminium nitrate and all other materials are 99.9% pure.The procedure of synthesizing nanoparticles is thoroughly described as follows: 98 wt.% of 2M Strontium acetate ($(CH_3.COO)_2$ $Sr.2H_2O$) was dissolved in 25ml of 2-methoxyethanol with vigorous stirring. 1 wt. % of 2M Dysposium nitrate ($(CH_3.COO)_2$ $Mn.2H_2O$) was dissolved in 25ml of 2-methoxyethanol with vigorous stirring. Simultaneously, 1 wt. % of 2M Aluminum acetate ($C_4H_6AlO_4.4H_2O$) was dissolved in 25ml of 2-methoxyethanol with vigorous stirring and subsequently, it was added to the to the first solution to reach 50 ml in total. Then it was stirred for 30 min at room temperature for the second time.

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Ammonia 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 ratio1:1 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 5h to obtain Dy doped $SrAl_4O_7$ nanopowders. For the preparation of the gel precursors with different wt%, the same procedure was repeated with the wt% of Dysposium nitrate being varied to 0.5,2, 3,4 and 5.

Characterization

SEM Analysis

The SEM study is carried out to investigate the surface morphology and the average crystallite size of the synthesized phosphors. Fig. 1 shows the representative SEM micrographs taken for $SrAl_4O_7$: Dy phosphors at different Dy concentrations. Generally the particles are of irregular shape. SEM was used to study the surface morphology of the films. The micrograph also showed that the particles were interlinked with each other, leading to the formation of big crystals and irregular aggregations formed in the sample. The particle sizes are 80,77,78,75,40,49 respectively.

X-Ray Diffraction (XRD)

XRD structure and phase purity of the $SrAl_4O_7$: Dy phosphor were investigated by XRD. The XRD patterns were obtained and are shown in Fig.1 for SrA1O: Mn. Diffraction patterns were obtained using CuKα radiation (λ=1.54051 A^0), at 30kV. Measurements were made from $2\theta=10^0$ to 80^0 with steps of 0.02^0. The XRD patterns of the powders revealed that the structure of $SrAl_4O_7$ 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 $SrAl_4O_7$: Dy, which is un-uniform. SEM image of $SrAl_4O_7$ sintered at 900ºC

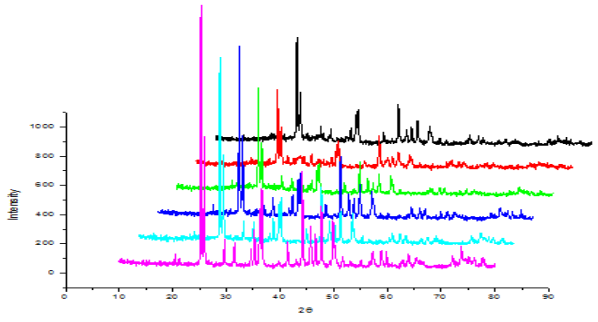

Fig.1. XRD of Dy doped $SrAl_4O_7$ at different wt%

Photoluminescence

The photoluminescence spectra of $SrAl_4O_7$: Dy nanoparticles under 360 nm excitation wavelength is shown in Fig2. The PL emission spectra of all samples exhibit three emission bands with corresponding peak wavelengths of 395 nm, 520 and 790 under excitation of 360nm.

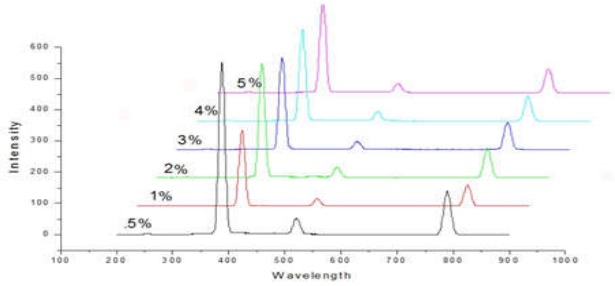

Fig. 2. Photoluminescence spectra of Dy doped $SrAl_4O_7$ at different wt%

The strong peak showing blue emission at 395 nm was due to the exciton emission, and weak green emission at 520 nm was due to oxygen interstitial. The strong UV emission corresponds to the exciton recombination related near-band edge emission of nanoparticles. The green emissions are possibly due to surface defects in the nanoparticles.

Conclusion

The phosphors $SrAl_4O_7$: Dy (at 0.5, 1, 2, 3, 4 and 5 wt% of Dy) with a monoclinic structure were successfully prepared by Sol-Gel method. The characteristic peaks of $SrAl_4O_7$: Dy phosphors were observed in PL spectra and they are located at 395nm, 520nm and 790nm which are corresponding exciton emission and the oxygen interstitial. The maximum intensity was achieved for about 1 mol% Dy3+.The photoluminescence investigations reveals that the emission mechanism is governed mainly by defect controlled processes. The results show that SrAlO: Dy with an average particle size of 60 nm is formed.

REFERENCES

Fu, Z.L., Zhou, S.H., Yu, Y.N., Zhang, S.Y 2004. *Chem. Phys*., Lett. 395, 285.

Holsa, J., Jungner, H., Lastusaari, M. and Niittykoski, J. 2001. *J. Alloys Compd*., 326, 323.

Kshatri, Ayush Khare, Piyush Jha, D. S. 2013. Chalcogenide Letters. Vol. 10, No. 3, March, p. 121 – 129

Lin, Y.H., Zhang, Z.T., Zhang, F., Tang, Z.L. and Chen, Q.M. 2000. *Mater. Chem. Phys*., 65(1), 103.

Lu, C.H., Chen, S.Y., Hsu, C.H. 2007. *Mater. Sci. Engg*. B 140, 218.

Murayama, Y., Takeuchi, N., Aoki, Y. and Matsuzawa, T. 1995. US Patent 5424006.

Nag, A. and Kutty, T.R.N. 2003. J. Alloys Compd. 354(1-2), 221.

Peng, T.Y., Liu, H.J., Yang, H.P., Yan, C.H. 2004. *Mater. Chem. Phys*. 85, 68.

Peng, T.Y., Yang, H.P., Pu, X.L., Hu, B., Jiang, Z.C. and Yan, C.H. 2004. *Mater. Lett*. 58, 352.

Segall, M.D., Lindan, P.L.D., Probert, M.J., Pickard, C.J., Hasnip, P.J. and Clark, S.J. M.C. 2004. Payne, J. *Phys: Cond. Mater*. 14, 2717.

Sharma, S.K., Pitale, S.S., Malik, M.M., Qureshi, M.S., Dubey, R.N. 2009. *J. Alloy Compd*. 482, 468.

Shen, W. Y., Pang, M. L., Lin, J.and Fang, J. 2005. *J. Electrochem. Soc.,* 152, H25.

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