List of Publications

Journal Papers:

1. Thermoluminescence kinetic features of Eu^{3+} doped strontium pyrophosphate after beta irradiation.

   Nimesh P. Patel, Vishwnath Verma, Dhaval Modi, K. V. R. Murhty and M. Srinivas.

   RSC Advances, 2016, 6, 77622-77628.

2. Investigation of dosimetric features of beta–irradiated Er^{3+} doped strontium pyrophosphate.

   Nimesh P. Patel, M. Srinivas, Vishwnath Verma, Dhaval Modi, K.V.R.Murthy. *Advanced Materials Letters*, 2016, **7**(6), 497-500.

3. Optimization of luminescence properties of Tb^{3+}-doped α- $Sr_2P_2O_7$ phosphor synthesized by combustion method.

   Nimesh P. Patel, M. Srinivas, Vishwnath Verma, Dhaval Modi, K. V. R. Murthy.

   Rare Metals,2016.

4. Synthesis and photoluminescence studies of Eu(III), Er(III) doped strontium gadolinium tantalum oxide.

   Verma Vishwnath, M. Srinivas, **Nimesh P. Patel**, Dhaval Modi, K. V. R. Murthy.

   Journal of Fluorescence, 2015, 26(1), 277-282.

5. Luminescence study and dosimetry approach of Ce on an α-$Sr_2P_2O_7$ phosphor synthesized by a high-temperature combustion method.

   Nimesh P. Patel, M. Srinivas, Dhaval Modi, Verma Vishwnath, K. V. R. Murthy.

   International journal of Luminescence and its Application, 2015, 30(4), 472-478.

6. Hydrothermal synthesis and photoluminescence properties of cerium-doped cadmium tungstate nanophosphor.

   Dhaval Modi, M. Srinivas, D. Tawde, K. V. R. Murthy, V. Verma, **Nimesh P. Patel**.

   Journal of Experimental Nanoscience, 2014, 10(10), 777-786.

7. Photoluminescence studies and core–shell model approach for rare earth doped $CdWO_4$ nano phosphor.
   M. Srinivas, Dhaval B. Modi, **Nimesh P. Patel**, V. Verma, K. V. R. Murthy.
   Journal of Inorganic and Organometallic Polymers and Materials, 2014, 24, 988-993.
8. Characterization of newly synthesized strontium cerium niobate nanophosphor.
   M Srinivas, Vishwnath Verma, **Nimesh P. Patel**, Dhaval Modi, D Tawde, K.V.R. Murthy.
   Journal of Luminescence, 2012, 147, 324-327.

Conference Papers:

1. Synthesis and Thermoluminescence Dosimetry application of Dy^{+3} activated $Sr_2P_2O_7$.
   Nimesh P. Patel, M. Srinivas, Vishwnath Verma, Dhaval Modi and K. V. R. Murhty.
   International Journal of ChemTech Research, 2014, 6(3), 1708-1711.
2. The effect of Tb^{+3} on α-$Sr_2P_2O_7$ phosphor for green LED phosphor application.
   Nimesh P. Patel, M. Srinivas, Vishwnath Verma, Dhaval Modi.
   AIP conference proceedings, 2015, 1665, 110017-1–110017-3. **DOI**: 10.1063/1.4918073
3. Characteriztion and luminescence studies of Dysprosium Titanate by two synthesis methods. Verma Vishwnath, M. Srinivas, Dhaval Modi, **Nimesh P. Patel**, B. P. Shah.
   Inverties Journal of Science and Technology, 2016, 9(2), 67-71.

Research article

LUMINESCENCE
The Journal of Biological and Chemical Luminescence

Received: 25 May 2014, Revised: 7 July 2014, Accepted: 4 August 2014 Published online in Wiley Online Library

(wileyonlinelibrary.com) DOI 10.1002/bio.2762

Luminescence study and dosimetry approach of Ce on an α-$Sr_2P_2O_7$ phosphor synthesized by a high-temperature combustion method

Nimesh P. Patel,[a] M. Srinivas,[a]* Dhaval Modi,[a] Verma Vishwnath[a] and K. V. R. Murthy[b]

ABSTRACT: We report synthesis of a cerium-activated strontium pyrophosphate ($Sr_2P_2O_7$) phosphor using a high-temperature combustion method. Samples were characterized by X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FT-IR), photoluminescence (PL) and thermoluminescence (TL). The XRD pattern reveals that $Sr_2P_2O_7$ has an α-phase with crystallization in the orthorhombic space group of Pnam. The IR spectrum of α-$Sr_2P_2O_7$ displays characteristic bands at 746 and 1190 cm^{-1} corresponding to the absorption of $(P_2O_7)^{-4}$. PL emission spectra exhibit a broad emission band around 376 nm in the near-UV region due to the allowed 5d–4f transition of cerium and suggest its applications in a UV light-emitting diode (LED) source. PL also reveals that the emission originates from 5d–4f transition of Ce^{3+} and intensity increases with doping concentration. TL measurements made after X-ray irradiation, manifest a single intense glow peak at around 192°C, which suggests that this is an outstanding candidate for dosimetry applications. The kinetic parameters, activation energy and frequency factor of the glow curve were calculated using different analysis methods. Copyright © 2014 John Wiley & Sons, Ltd.

Keywords: pyrophosphate; combustion method; X-ray diffraction; photoluminescence; thermoluminescence

Introduction

At present, high luminescence efficient phosphors are synthesized using various methods. Most attention has been given to developing new phosphors in the near-UV range to increase the efficiency of white light emission in solid-state devices (1,2). Rare earth (RE)-doped inorganic pyrophosphate phosphors have large areas of application, for example as a thermoluminescence (TL) dosimeter material, and in the lighting industry, color displays, scintillation and X-ray imaging (3).

Strontium pyrophosphate ($Sr_2P_2O_7$) is an important host for luminescence phosphors doped with lanthanides and transition metals (4). $Sr_2P_2O_7$ phosphors have been reported for phototherapy applications (5,6). RE-doped $Sr_2P_2O_7$ has extensive applications due to its good luminescent, semiconducting, catalyst and energy-transfer properties (5). $Ca_2P_2O_7:Eu^{2+}$, Mn^{2+} phosphor has good application as a lamp phosphor through energy transfer from Eu^{2+} to Mn^{2+} (6).

Ce^{3+}-activated $Sr_2P_2O_7$ shows very efficient luminescence properties in the UV–blue region of the spectrum, which have been shown to be due to the energy difference between the $4f^1$ and $5d^1$ configurations of Ce^{3+}. The 5d–4f transitions observed in the phosphor were strongly dependent on both the type of activator and the host (4–7). Ce^{3+}-doped AP_2O_7 (A = Ca, Mg, Sr, Ba) alkali rare earth pyrophosphate should have potential in fast scintillation because of its rapid decay time (8,9). In a recent study, we observed that cerium is responsible for the generation of nonradiative traps (10,11).

Phosphate compounds are emerging as important luminescent materials because of their high abundance, low-cost, environmental friendliness, and thermal and charge stabilities (12). Eu^{2+}-doped $LiSrPO_4$ and $KSrPO_4$ have application as a blue phosphor (13,14); Eu^{2+}-doped $NaCaPO_4$ and $KCaPO_4$ can be used as a green phosphor (15,16) and Mn^{2+}-doped $LiZnPO_4$ can be used as a green–yellow phosphor (17). All phosphors have been reported to have potential applications in the formation of white light-emitting diodes (WLEDs) (13). Europium-activated nanoparticles of biometric calcium pyrophosphate with an apatite structure can be used as luminescent biological probes for monitoring fluorescence (18). It is believed that Ce-activated α-$Sr_2P_2O_7$ phosphor can act as a near-UV emitting phosphor for UV LEDs with high luminescence quantum efficiency. In this study, we successfully synthesized Ce-doped α-$Sr_2P_2O_7$ phosphor for radiation dosimeter and near-UV LED source applications.

Experimental

Cerium-doped $Sr_2P_2O_7$ phosphor was synthesized by the combustion method. In this method, the reactants $SrCO_3$ (A.R.), $(NH_4)_2HPO_4$ (A.R.) and CeO_2 (99.99%) (A.R.) were taken in a stoichiometric ratio and ground in an agate mortar. The mixture was then ground with urea (A.R.; 15% of the mass of the mixture), which is taken as a flux in this method. The mixture was heated in an alumina crucible at 1200°C for 2 h in a muffle furnace in air and allowed to cool naturally at room temperature. The obtained samples were in

* Correspondence to: M. Srinivas, Luminescent Materials Laboratory, Physics Department, Faculty of Science, The M. S. University of Baroda, Vadodara-390002, India. E-mail: mnsmsu@gmail.com

[a] Luminescent Materials Laboratory, Physics Department, The M. S. University of Baroda, Vadodara-390002, India

[b] Display Materials Laboratory, Applied Physics Department, The M. S. University of Baroda, Vadodara-390001, India

RSC Advances

PAPER

Cite this: *RSC Adv.*, 2016, **6**, 77622

Thermoluminescence kinetic features of Eu^{3+} doped strontium pyrophosphate after beta irradiation†

Nimesh P. Patel,[a] Vishwnath Verma,[a] Dhaval Modi,[a] K. V. R. Murhty[b] and M. Srinivas[a]

Received 16th June 2016
Accepted 6th August 2016

DOI: 10.1039/c6ra15672j

www.rsc.org/advances

Strontium pyrophosphate ($Sr_2P_2O_7$) doped with various concentrations of Eu^{3+} as a doping agent is synthesized using a combustion method and to study the thermoluminescence dosimetry [TLD] and applications. The synthesized phosphors with different concentrations of doping ions were irradiated using a ^{90}Sr β-source for different doses from 5 Gy to 50 Gy. TL glow curves of all the samples were measured with a heating rate of 6 K s^{-1} from room temperature [325] to 550 K. Each time 5 mg of irradiated phosphor was taken for TL measurement. The TL exhibited by the phosphor shows a single bell-shaped curve at a peak temperature of around 415 to 420 K. From the TL glow curves the kinetic parameters of phosphors were calculated using the initial rise method (IR), whole glow peak method, peak shape method (PSM) and Kitis *et al.* second-order equation and also necessary statistical analysis was done. The TL glow curve parameters like activation energy (E_a), frequency factor (s) and order of kinetics (b) found from all analytical methods of all beta irradiated phosphor samples revealed that the glow curves have second-order kinetics with an activation energy of 0.90–1.10 eV and a frequency factor 10^{10} to 10^{11} s^{-1}. All samples showed a linear response of TL as a function of dose from 5 Gy to 50 Gy. The sensitivity, fading effect and TL glow curve shape are unaffected by the doping concentration which implies that the phosphor shows consistent TL output except for intensity variation. The calculated TL parameters and results are consistent and well matched with the theoretical aspects.

Introduction

Rare earth activated inorganic pyrophosphate phosphor materials have generated enormous interest and considerable attention because of their easy synthesis processes, low cost, chemical and thermal stabilities, and low environmental impact as well as favourable properties like luminescent, dielectric, semiconductor, catalytic, magnetic, fluorescent, and ion-exchange.[1–7] Rare earth elements have been widely used in luminescence phosphors as activators which play a crucial role in the host phosphor because of their emission color based on 4f–4f and 5d–4f transitions. The trivalent europium ion is a red emitting activator due to its $^5D_0 \rightarrow {}^7F_J$ ($J = 0 \rightarrow 6$) allowed electronic or dipole transitions. Europium doped inorganic materials are extensively used in red phosphors.[5] Natarajan *et al.* investigated fluorescence and TL properties after gamma irradiation of europium doped strontium pyrophosphate prepared *via* a chemical precipitation method. They reported that gamma irradiated europium-ion doped $Sr_2P_2O_7$ show the presence of two thermoluminescence glow peaks at 465 K and 565 K. They reported the correlation between the TSL and EPR results of europium-ion doped $Sr_2P_2O_7$, and identified the mechanism for the glow peak at 565 K.[1] Yazici *et al.* studied the thermoluminescent property of $Sr_2P_2O_7$ doped with copper and some rare earth elements synthesised by the solid state method. They reported, Pr, Er, Ho, and Nd along with Cu doped $Sr_2P_2O_7$ showed two glow peaks, one of them is remains preset at around 90 °C and the second TL peak is around 180, 225, 275, and 285 °C, for Pr, Er, Ho, and Nd, respectively. They also suggested that the first peak at 90 °C in all samples is related to the host samples but the second peak observed above 150 °C from first peak, comes from the doped elements.[2] Patel *et al.* studied photoluminescence and TL dosimetry studies of Ce doped α-$Sr_2P_2O_7$ and Dy doped α-$Sr_2P_2O_7$ phosphor synthesized by a high-temperature combustion method after X-ray irradiation. They reported that TL glow curve showed a stable single glow peak at 192 °C for Ce doped $Sr_2P_2O_7$ and a single glow peak at 182 °C for Dy doped $Sr_2P_2O_7$.[3,4] Xu *et al.* reported the influence of Gd^{3+} doping on the luminescent properties of $Sr_2P_2O_7{:}Eu^{3+}$ orange-red phosphor synthesised by solid state method.[5] Dhoble reported photoluminescence

[a]Department of Physics, The M. S. University of Baroda, Vadodara-390002, India. E-mail: nimesh.0112@gmail.com; mnsmsu@gmail.com

[b]Department of Applied Physics, The M. S. University of Baroda, Vadodara-390003, India

† Electronic supplementary information (ESI) available: Experimental and theoretical glow curve fitting of all sample by whole glow peak method, IR method and Kitis GCD method. See DOI: 10.1039/c6ra15672j

Rare Met.
DOI 10.1007/s12598-015-0688-x

RARE METALS
www.editorialmanager.com/rmet

CrossMark

Optimization of luminescence properties of Tb^{3+}-doped α-$Sr_2P_2O_7$ phosphor synthesized by combustion method

Nimesh Prafulbhai Patel*, Mangalampalli Srinivas, Dhaval Modi, Vishwnath Verma, Kota Venkata Ramana Murthy

Received: 6 July 2015 / Revised: 28 August 2015 / Accepted: 18 December 2015

Abstract In this paper, thermoluminescence (TL) properties of rare earth Tb^{3+}-doped α-$Sr_2P_2O_7$ were examined after β-irradiation and photoluminescence (PL) properties of samples were examined for proper excitation. All the samples were synthesized by high-temperature combustion method. The X-ray diffraction (XRD) and Fourier transform infrared (FTIR) spectroscopy characterization confirms the formation of pure α-phase with crystallized in orthorhombic structure of samples. The PL emission spectra of all samples exhibit characteristic green emission peaks of Tb^{3+} where the peak at 545 nm has the highest emission intensity for Tb^{3+} concentration of 5.0 mol%. The TL glow curves of β-irradiated Tb^{3+}-doped α-$Sr_2P_2O_7$ phosphors were recorded at different heating rates of 2, 4, and 6 $K \cdot s^{-1}$. TL curves of all sample exhibit combination of two peaks: peak at 420 K shifts toward higher temperature, while peak at 525 K remains unaffected with the increase in Tb^{3+} concentration as well as fading effect. The activation energy and kinetic parameters of the samples were evaluated using thermoluminescence peak shape method.

N. P. Patel*, M. Srinivas, D. Modi, V. Verma
Luminescence Material Laboratory, Department of Physics, Faculty of Science, The M. S. University of Baroda, Vadodara 390002, India
e-mail: nimesh.0112@gmail.com

K. V. R. Murthy
Display Materials Laboratory, Applied Physics Department, Faculty of Technology and Engineering, The M. S. University of Baroda, Vadodara 390001, India

Keywords Rare earth doping; Strontium pyrophosphate; β-Irradiation; Photoluminescence; Thermoluminescence

1 Introduction

Pyrophosphate-based materials are scientifically important because of their luminescent, dielectric, semiconducting, catalytic, magnetic, fluorescent, and ion-exchange properties. Because of remarkable properties, the synthesis of inorganic pyrophosphate materials is a dynamic field of research, especially in luminescence aspects [1–10]. The thermoluminescence (TL) dosimetry properties of $Sr_2P_2O_7$: Cu, Pr compounds have been studied [1]. In previous work, photoluminescence (PL) and dosimetry properties of Ce-activated α-$Sr_2P_2O_7$ phosphor were synthesized by a high-temperature combustion method and X-ray-irradiated TL properties of Dy^{3+}-doped α-$Sr_2P_2O_7$ were studied [2, 3]. Eu^{2+}- and Mn^{2+}-co-doped $Sr_2P_2O_7$ phosphors were suggested as the potential phosphors for obtaining white-light emission from ultraviolet-light-emitting diode (UV-LED) devices [4].

The TL properties of pure and doped strontium pyrophosphates were widely examined, because the rare earth activated inorganic phosphors are extensively used in a variety of applications in lamp phosphors, color displays, radiation dosimetry, and X-ray imaging [5]. Singly and doubly doped strontium phosphate α-$Sr(PO_3)_2$ was compared with equivalently doped diphosphates α-$Sr_2(P_2O_7)$ and $SrZn(P_2O_7)$, and the crystal structure determination of $SrZn(P_2O_7)$ based on single-crystal data was evaluated [6]. Eu^{2+}-activated $SrCaP_2O_7$ phosphor was suggested as blue-emitting phosphor [7]. Alkaline earth metal pyrophosphates $M_2P_2O_7$ (M = Ca, Sr, Ba) were proposed for their potential applications as luminescent materials, for

www.vbripress.com/aml, DOI: 10.5185/amlett.2016.6160 Published online by the VBRI Press in 2016

Investigation of dosimetric features of beta – irradiated Er^{3+} doped strontium pyrophosphate

Nimesh P. Patel[1*], M. Srinivas[1], Vishwnath Verma[1], Dhaval Modi[1], K. V. R. Murthy[2]

[1]*Department of Physics, Faculty of Science, M. S. University of Baroda, Vadodara 390002, India*
[2]*Department of Applied Physics, Faculty of Technology and Engineering, The M. S. University of Baroda, Vadodara 390003, India*

[*]Corresponding author. Tel: (+91) 85-11122925; E-mail: nimesh.0112@gmail.com

Received: 12 September 2015, Revised: 05 December 2015 and Accepted: 10 May 2016

ABSTRACT

Thermoluminescence (TL) of $Sr_2P_2O_7$: Er^{3+} phosphors had been studied in order to investigate the nature of the trapping centers created due to doping ions. The effect of beta – irradiation was analyzed for various doses given to the samples. The measurements of TL glow curves have been done at the heating rate 6 K/s. The TL measurements done for the study of the dosimetric properties of samples showed that the β-dose response is linear from 5 Gy to about 50 Gy. The experimental glow curves had been analyzed by glow curve fitting technique which revealed that the glow curve is consist of three curves with peak temperature 400 K, 430 K and 464 K. The activation energy 'E_a' of the peaks had been calculated to be 0.90 ± 0.03 eV, 1.10 ± 0.04 eV and 1.05 ± 0.03 eV, respectively. The geometrical factor 'μ_g' having values 0.51, 0.52 and 0.48, imply that the glow curve having second order kinetics. The linear dose response, fading effect after exposed and reusability of samples are very reliable for dosimetry applications. Copyright © 2016 VBRI Press.

Keywords: Strontium pyrophosphate; thermoluminescence (TL); peak shape method; activation energy.

Introduction

TLDs are effective tools to assess personal radiation exposure from substances or equipment that emits radiation. To achieve accurate measurement of the absorbed dose, the dosimeter material should have a similar response as the medium being irradiated. The performance of TLD is evaluated by taking into account properties such as linearity, dose range, energy response, reproducibility and stability of stored information (fading effect) [**1**]. To developing efficient TLD phosphor is good research area, because it has large applications in radiation dosimetry, personal dosimetry and environmental dosimetry. Rare earth doped pyrophosphates potential phosphors for TLD application because of its favorable semiconducting and luminescence properties [**2-5**]. Thermally stimulated luminescence (TSL) of europium-ion doped strontium pyrophosphate was reported by V. Natarajan, *et al.* [**2**]. Thermoluminescent properties of $Sr_2P_2O_7$ doped with copper and some rare earth elements had been investigated by A. N. Yazici, *et al.* [**3**]. Thermoluminescence approach of Ce doped α-$Sr_2P_2O_7$ and Dy doped α-$Sr_2P_2O_7$ were reported by our group [**4, 5**]. Energy migration and characterization of trap level distribution was reported by S. Som, *et al.* [**6**].

The motivation of this research is regarding to the less work had been done on this phosphor in radiation dosimetry. Only few research groups had been reported radiation dosimetry approach of the alkali earth pyrophosphate phosphors on the basis of gamma and x-ray irradiation, while in this report we are proposing the phosphor for beta irradiation dosimetry. The effect of beta dose on the phosphor shows it potential application in dosimetry.

In these paper, Er^{3+} doped $Sr_2P_2O_7$ phosphor was synthesized by combustion method and TL property of samples was investigate in order to understand the role of doping ions on the TL properties to make useful the phosphor for TLD applications. We have investigated some of the necessities for TLD phosphor application such as dose response, fading effect and reusability of phosphor.

Experimental

Material Synthesis

Er^{3+} doped $Sr_2P_2O_7$ (Strontium pyrophosphate) phosphors were synthesized by combustion synthesis method at 900 ºC by varying doping concentrations (0.5, 1.0, 1.5, 2.0, 2.5 and 5.0 mol %). The reactants $SrCO_3$ (A.R.), $(NH_4)_2HPO_4$ (A.R.) and Er_2O_3 (99.99 %) (A.R.) were taken in a stoichiometric ratio as per the chemical equation balancing. All reactants were grinded in an agate mortar for half hour to make homogeneous mixture. The homogeneous mixture of reactants with urea (A.R.; 15 % of the mass of the mixture) taken as a flux was grinded. The mixture was heated at 900 °C in alumina crucibles for 3h in a muffle furnace and allowed to cool down naturally up to room temperature. Pure white samples were again grind to obtain fine powder [**4, 5**].

Characterizations

All samples were irradiated with Sr^{90} beta source having average energy radiation rate 10 ± 0.05 Gy per minute and received various doses 5, 10, 20, 30, 50 Gy for TL study. The TL glow curve was measured using a NUCLEONIX TL analyzer type TL1009 at heating rate 6 K/s for the range 325 K to 550 K to evaluate dosimetric features of the

The Effect of Tb^{+3} on α-$Sr_2P_2O_7$ Phosphor for Green LED Phosphor Application

Nimesh P. Patel*, M. Srinivas, Vishwnath Verma and Dhaval Modi

Department of Physics, Faculty of Science, The M. S. University of Baroda, Vadodara- 390002, India
**E-mail: nimesh.0112@gmail.com, mnsmsu@gmail.com*

Abstract. A series of Tb^{+3} activated α-$Sr_2P_2O_7$ (Strontium Pyrophosphate) phosphors were synthesized by high temperature combustion synthesis method. The structural analysis has been done by x-ray diffraction and FTIR (Fourier Transform Infrared Spectrum). The results obtained in structural characterization indicate that the doping concentration did not affect the crystal phase and structure of the phosphors. X-ray diffraction pattern reveals that the all samples were consistence with the JCPDS card No. 24-1011. The phosphor was excited at 232 nm wavelength, very intense PL green emission peak have been observed at 545 nm. This illustrates, that the phosphors could be efficiently excited because of the charge transfer band of the host as well as the energy transfer process occurred between host ($Sr_2P_2O_7$) and activator (Tb^{+3}). By increasing the doping concentration of Tb^{+3}, the intensity of 545 nm emission peak has been increased predominantly and it suggest that the phosphor prepared has very good application in green LED phosphor.

Keywords: Strontium Pyrophosphate (SPO); Photoluminescence; X- ray diffraction; FTIR
PACS: 78.55.Hx Other solid inorganic materials

INTRODUCTION

The research on synthesis of luminescence phosphor has achieved much attention regarding to its wide area of applications. The rare earth activated phosphate phosphors have good luminescence properties which are very useful in radiation scintillators, display phosphor, solid state laser, catalyst and ion conductors [1]. The rare-earth activated $NaCaPO_4$ phosphor has become an important luminescent material because of its excellent thermal and charge stabilization [2]. The novel a green-emitting phosphor $NaCaPO_4$: Eu^{2+} was reported for efficient luminescence [3]. The VUV–UV excited luminescent properties of $AREP_2O_7$: Ce^{3+}, Pr^{3+} (A = Na, K, Rb, Cs; RE = Y, Lu) and $NaREP_2O_7$: Ln^{3+} (Ln = Ce, Pr, Tb, Eu, Tm; RE = La, Gd) were reported [4]. The luminescent spectra of α-KYP_2O_7: Ce^{3+}, AYP_2O_7 (A = Rb, Cs) and $ALuP_2O_7$ (A = Na, K, Rb, Cs) under static hard X-ray radiation were presented [1]. $AREP_2O_7$: Ce^{3+} (A = Na, K, Rb, Cs; RE = Y, Lu) alkali rare earth diphosphates having high light yield and fast decay time were reported for fast scintillators application [5]. $Ca_2P_2O_7$:Eu^{2+} phosphors have extensive applications in the fields of luminescence and biomaterials due to its excellent optical and biological characteristics [6]. The alpha-phase of strontium pyrophosphate α-$Sr_2P_2O_7$ is an important host for luminescence of lanthanides and transition metals [7,8]. Thermoluminescence properties of α-$Sr_2P_2O_7$: Dy was reported [9] and $Sr_2P_2O_7$: x,Cu (x = Pr, Nd, Dy, Ho, Er) were reported [10]. Alkali earth pyrophosphate based materials are mostly chosen as host materials for the preparing phosphors because of its flexible chemical, physical and mechanical properties. In this research work we are studying the impact of Tb^{+3} on host α-$Sr_2P_2O_7$ and the energy transfer process between host and activator is needful for green LED phosphor.

EXPERIMENTAL

The series of Strontium pyrophosphate phosphors $Sr_2P_2O_7$: xTb^{+3} (x=0.5, 1.0, 1.5, 2.0, 2.5 mol%) were synthesized by high temperature combustion synthesis method in which 15% urea of total mass of phosphor can taken as flux. All the reagents, $SrCO_3$ (A.R.), $(NH_4)_2HPO_4$ (A.R.), Tb_4O_7 (99.99%) were taken as starting materials and ground stoichiometrically in agate mortar with Urea for 30 minute. The grounded mixture was heated in alumina crucible at 900°c for three hours in air. After cooling down final product was ground again which is in white color.

The x-ray diffraction data of phosphors were recorded using Bruker D8 advance x-ray diffrectometer with the Cu-Kα radiation having

Solid State Physics
AIP Conf. Proc. 1665, 110017-1–110017-3; doi: 10.1063/1.4918073

International Journal of ChemTech Research
CODEN (USA): IJCRGG ISSN : 0974-4290
Vol.6, No.3, pp 1708-1711, May-June 2014

ICMCT-2014 [10th – 12th March 2014]
International Conference on Materials and Characterization Techniques

Synthesis and Thermoluminescence Dosimetry application of Dy^{+3} activated $Sr_2P_2O_7$

Nimesh Patel[1]*, M.Srinivas[1], Verma Vishwnath[1], Dhaval Modi[1]and K.V.R.Murthy[2]

[1]Luminescent Materials Laboratory, Department of Physics, Faculty of Science, The M. S. University of Baroda, Vadodara-390002, India
[2]Display Materials Laboratory, Applied Physics Department, Faculty of Technology and Engineering, The M. S. University of Baroda, Vadodara – 390001, India

*Corres. author: nimesh.0112@gmail.com

Abstract: In this work, we have synthesisDy^{+3} activated$Sr_2P_2O_7$ based thermoluminescence phosphor for radiation dosimetry applications by high temperature combustion method.Thermoluminescence characteristicof the prepared phosphor was observed for different dose response of beta ray as well as for various heating rates. Analysis of the TL glow curvefor evaluation of the activation energy and other kinetic parameters of the phosphorwas done by initial rise method and peak position method. TL analysis of the phosphor shows linear dose response and proper glow peak for radiation dosimetry application which is around at (180-210)°c temperature.The characteristics of the phosphor were observed though x-ray diffraction and FTIR (Fourier Transform Infrared Spectroscopy).Photoluminescence of the phosphor was studies for optical application of the phosphor.
Keywords – Pyrophosphate;Combustion method; X-ray diffraction; TLD.

Introduction

Wide band gap rare earth doped pyrophosphates materials are given more preference due to the crystal filed optical energy level structures of the rare earth elements. Rare earth based phosphors have potential applications in X-ray, beta and gamma-radiation detectors,display phosphors, light-emitting diodes and scintillators because phosphates are highly transparent, easily shaped, and cost-effective [1].The TL glow curves of Eu-doped $Sr_2P_2O_7$ was studied and it is observed that twoglowpeaksat192 and 292°cexist when irradiated β-rays [2]. Photoluminescence properties of europium activated calciumpyrophosphates were studied[3]. The crystal structure and luminescence spectra of potassium erbiumpyrophosphatedihydrate $ErKP_2O_7.2H_2O$ were published[4]. Ce-doped luminescence of the first lutetiumdiphosphate$NH_4LuP_2O_7$ was studied [1]. In this work, we have studied thermoluminescence properties of Dy activated $Sr_2P_2O_7$ for it dosimetry application.

Experimental

In combustion method, $SrCO_3$(A.R.); $(NH_4)_2HPO_4$ (A.R.);Dy_2O_3(99.99%)(A.R.)were taken as starting materials. The materials were grounded in an agate mortar for one hour to make homogeneous mixture. Then the mixture was grounded with 15% Urea (A.R.) of the total weight of the sample which is taken as a flux in