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Synthesis of Sr_2CeO_4 nano Phosphor using various fluxes

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Abstract

The photoluminescence characteristics of Sr_2CeO_4 nano phosphor with and without fluxes are studied here. This phosphor was synthesized through solid state reaction technique. At 254nm excitation, the PL emission peaks of pure Sr_2CeO_4 show broad emission from 350 – 650nn. When urea used as a flux, the intensity of 470nm emission peak of Sr_2CeO_4 increased by 500%.. Surprisingly when Citric acid is used as flux the intensity of 470nm emission peak of Sr_2CeO_4 is increased by 600%. The Sr_2CeO_4 phosphor with and without fluxes are characterized by using XRD reveled single phase. The calculated average crystallite size of pure Sr_2CeO_4 using Scherrer's formula is 15nm and with flux as 8nm. This confirms the formation of nano phosphors with good PL. It is concluded that the citric acid plays a major role in formation of nano Sr_2CeO_4 phosphor.

Keywords: *Photoluminescence, Phosphor, Flux, Crystallite*

1. Introduction

Much attention has been paid to oxide-based luminescent materials for exploring their luminescence properties .Oxide-based materials appear to be the focus of extensive research interest in the past few decades because of their good stability upon excitation by electron beam [1]. The popularity of oxide-based luminescent materials is due to the fact that they exhibit superior photoluminescence (PL) and cathodoluminescence (CL) properties which make them useful as important components of color emission in field emission displays (FEDs), plasma display panel devices, and lamps [2–5]. Among these luminescent materials, Sr_2CeO_4 is a promising one for FEDs and lamps due to its efficient luminescence under ultraviolet, cathode ray, and X-ray excitation [6–9]. Sr_2CeO_4 has an orthorhombic structure, which consists of one-dimensional chains of edge-sharing CeO6 octahedral linked by strontium ions [6]. This structure of Sr_2CeO_4 can absorb energy by itself and acts as a sensitizer to transfer the absorbed energy to the luminescence centers CeO6 octahedral responsible for the occurrence of blue emission [10]. The luminescence of Sr_2CeO_44 is considered to originate from charge-transfer (CT) transition [11]. Sr_2CeO_4 powders are usually prepared via a conventional solid-state route which generally requires prolonged heating at elevated temperatures and thus results in coarsening of the obtained powders [7–11]. In order to improve the processes, citric acid (CA) and urea was used as flux in this study for synthesizing Sr_2CeO_4 powders.

Immobilization of metal complexes in rigid organic polymer networks is considered to decrease segregation of metal ions, thereby improving the compositional homogeneity in the starting materials of Sr_2CeO_4. Therefore, the formed metal complex will enhance the formation of Sr_2CeO_4 and suppress the formation of impurity phases. Increasing the CA/metal ion molar ratio was reported to produce more carboxylic group and polymer resin and enhance the formation of pure phases [12].

2. Experimental

Sr_2CeO_4 was prepared via the solid state reaction method, stoichiometric amounts of strontium Nitrate 2Sr $(NO_3)_2$ and cerium oxide (CeO_2) in stoichiometric ratio 2:1 were ground with agate motor Pestle and then heated in air at 1200^0C temperature in a muffle furnace for 2 hrs with a heating rate of 5^0C/min. Urea and Citric acid are used as fluxs. The obtained pure Sr_2CeO_4 and flux added samples were characterized via X-ray diffraction analysis using ADXRD BL-12 (λ =0.8592nm). The PL spectra was recorded at room temperature using Spectrofluorophotometer [Fluro Max-3] using a Xenon lamp as an excitation source.

3. Results and discussion

Figure-1 shows PL excitation and emission peaks of Sr_2CeO_4 with and without fluxes, It is observed that for 254nm excitation, pure Sr_2CeO_4 without flux shows broad emission from peaks from 350 – 650nm and observed more intensity peak at 470nm.When urea used as a flux, the intensity of 470nm emission increased by 500%. Surprisingly when citric acid is used as flux, the intensity of 470nm emission is increased by 600%. XRD pattern of phosphor with flux shown in figure-2, 3.From XRD data the calculated average crystallite size using Scherer's formula is 15nm, whereas crystallite size is around 8nm when the flux is added. This confirms the formation of nano phosphors with good PL .It is concluded that the citric acid plays a major role in formation of nano Sr_2CeO_4 phosphor.

Table 1

S.No	Name of the flux	PL Intensity(arb.u)
1	Without flux	250
2	Urea	1020
3	Citric acid	>1500

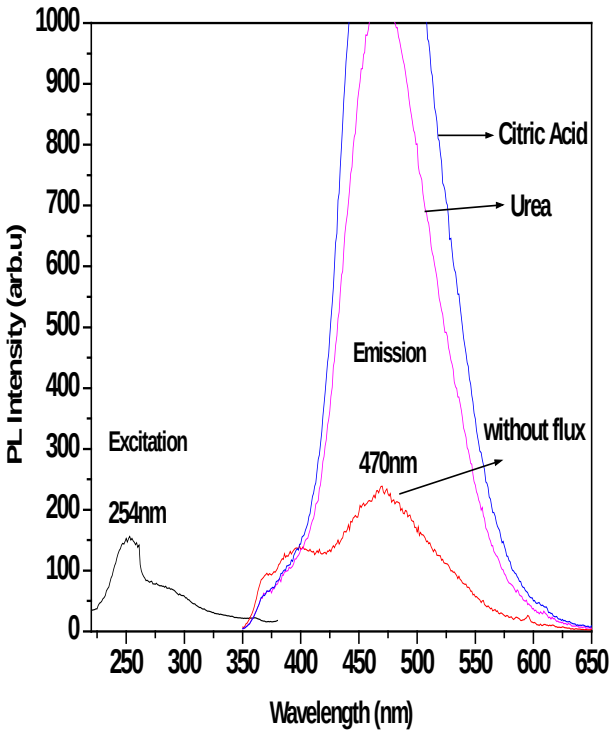

Fig. 1: PL excitation and emission peaks of Sr_2CeO_4 with and without fluxes

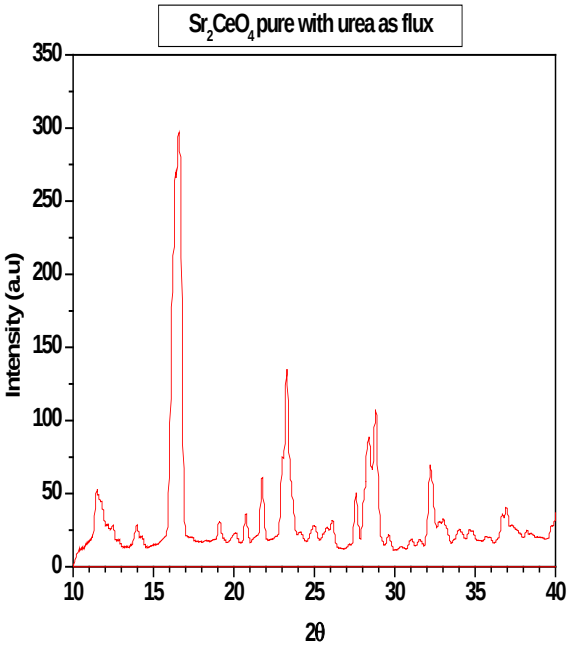

Figure-2: XRD Pattern of Sr_2CeO_4 with urea as flux

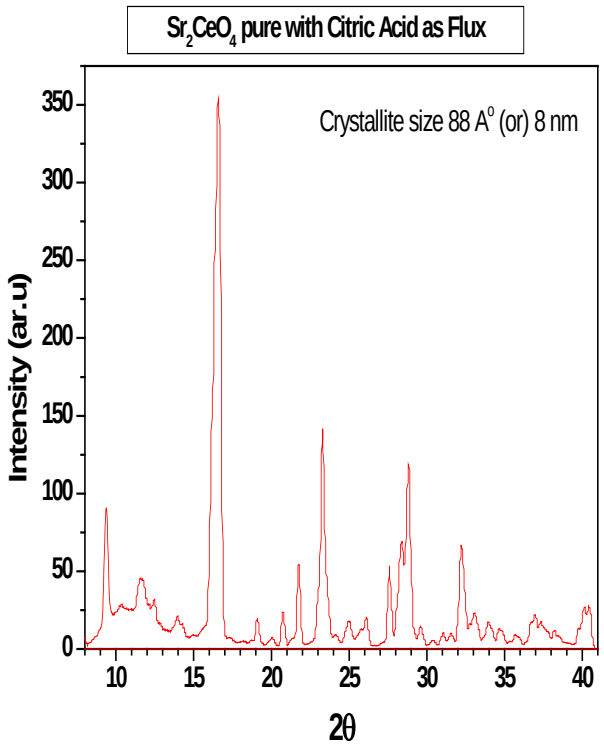

Figure-3: XRD Pattern of Sr_2CeO_4 with Citric acid as flux

4. CONCLUSION

Sr_2CeO_4 phosphor powders using various fluxes (urea & Citric acid) have been synthesized using standard solid state reaction method successfully and their luminescent properties have been investigated. From the XRD analysis single phase compound formed with an orthorhombic structure after comparing with the ICSD Card no.89-6654.

The calculated average crystallite size of pure Sr_2CeO_4 using Scherrer's formula is 15nm and with flux as 8nm. This confirms the formation of nano phosphors with good PL. It is concluded that the citric acid plays a major role in formation of nano Sr_2CeO_4 phosphor.

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