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Thermoluminescence and Mechanoluminescence studies of $(Cd_{0.95}\ Zn_{0.05})S$: Ag doped phosphor

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Abstract
Through the execution of experimental investigation, mechanoluminescence of (Cd,Zn)S: Ag phosphor was studied which is synthesized by solid state reaction. In the observation, the peak value of ML depends on different concentration. It is seen that ML intensity increases with Ag ion concentration in (Cd, Zn)S phosphor. The peak value of TL depends on the different UV-irradiation time. It is seen that as UV-irradiation exposure increases the TL intensity also increases.

Keywords: Mechanoluminescence, Thermoluminescence, Solid state reaction synthesis, (Cd,Zn)S: Ag

INTRODUCTION

(Cd, Zn)S alloys, having a direct and wide band gap energies ranging from 2.42 to 3.67 eV in their bulk state, are one of the most proficient material in the field of photonics and optoelectronics due to its dominance behavior of the composition over the size of the nanophosphors [1, 2]. Because of their luminescence and nonlinear optical properties, and other excellent physical and chemical properties, semiconductors of group II-VI have potential applications in many technical fields, including photo catalysts, gas sensors, imaging, solar cells, photo conductors, biological detection and UV sensors, short wavelength laser diodes and various luminescence devices. The optical band gap (E_g) tunability of the (Cd, Zn)S for various Zn^{2+} concentrations was successfully demonstrated [3]. Also the related ternary compounds CdxZn1-xS are promising materials for high density optical recording and for blue or even UV laser diodes. These applications are based on the structure of $Cd_xZn_{1-x}S$ which exhibit fundamental absorption edges that can varied from green to UV [4]. The control of the composition of $Cd_xZn_{1-x}S$ nano particles may lead to the development of ideal materials for short wavelength diode laser applications [5]. Highly luminescent Ag-ion-doped (Cd,Zn)S Phosphor were successfully synthesized by a solid state reaction method. It was observed that (ML and TL) intensity corresponding to Ag impurity, which are potentially important for white light generation. Among them, the wide band gap phosphors materials have opened avenue in fundamental studies and tremendous potential applications in diverse areas such as solarcell, photo-catalysis, sensors, photonic and other optoelectronic devices [6]. (Cd, Zn)S phosphor doped with Ag ion has been paid a great devotion by several researches because of its commercial application as a blue emitting phosphor.

EXPERIMENTAL DETAILS

For the synthesis of $(Cd_{0.95}\ Zn_{0.05})S$:Ag phosphors by solid state reaction method raw materials CdS and ZnS are mixed according to stoichiometric calculation in presence of 2% of NaCl used as flux. After mixing of host material CdS, ZnS and impurity material $AgNO_3$ powder, mixture was placed in crucible and fired in a furnace at 600^0C for 3 to 5 hours.

RESULTS

Fig. 1 shows the characteristics of ML induced by the impact of a moving piston onto the phosphors. The luminescence intensity depends upon the concentrations of silver. Maximum intensity of the phosphor is obtained for 4mole% of silver. It is seen that the luminescence intensity increases with increase in concentration of silver.

Fig.2 show the TL glow curve for UV irradiated (Cd, Zn)S: Ag phosphors. It is seen that TL intensity increases with increasing UV radiation time. The TL glow peak occurs at 112^0C, this TL peak suggesting the existence of trapping levels in the phosphors. TL glow curve recorded for 4mol% of Ag.

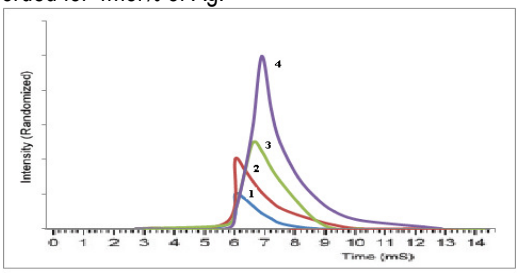

Fig 1. Mechanoluminescence behavior of (Cd, Zn) S: Ag doped phosphor when load of 400gm was dropped from 50 cm height for different concentrations (1) 1 mole, (2) 2 mole, (3) 3 mole, (4) 4 mole.

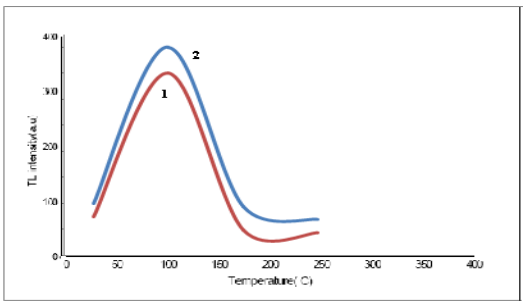

Fig 2. Thermoluminescence behavior of (Cd, Zn) S: Ag doped phosphor for different radiation time (1) 5 min, (2) 10 min

DISCUSSION

Synthesis of high quality luminescent and free standing $Cd_{1-x}Zn_xS$ phosphors doped with Ag ion is prepared by by solid state reaction method. The phenomenon of ML in silver doped (Cd, Zn)S phosphor are related to the movement of dislocations and the recombination of activated electrons and holes.

From fig. 1, it is found that as the concentration of Ag ion increases the mechanoluminescence intensity of the (Cd, Zn)S phosphor increases. It can be concluded that as the concentration of Ag ion in (Cd, Zn)S phosphor increases the density of trap center increases, that gives higher, mechanoluminescence intensity.

Fig. 2 shows that as the UV irradiation time increases the peak of thermoluminescence intensity also increases. It seems that longer irradiation time creates more electron- hole pairs, consequently more color centers formed, that gives the higher thermoluminescence intensity.

CONCLUSIONS

We have investigated the Mechanoluminescence phenomena in the (Cd,Zn)S silver doped. The phosphor was prepared by solid state reaction method. It was found that ML intensity strongly depends upon the concentration of silver. The TL intensity increases with increase in UV exposure time and it is maximum for irradiation time 10 min.

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