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SYNTHESIS AND PHOTOLUMINESCENCE STUDY OF BLUE EMITTING $MgCuAl_{10}O_{17}:Ce^{3+}$ PHOSPHOR

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ABSTRACT

$MgCuAl_{10}O_{17}:Ce^{3+}$ phosphor was prepared by wet chemical synthesis method and studied its luminescence property. The XRD pattern of the prepared phosphor is well match the JCPDS file. Furthermore, phosphor was analyzed by XRD, SEM, and PL with chromaticity coordinates and effect of energy with relative concentration. In case of Ce^{3+} the photoluminescence emission spectra the phosphors having an excitation at around 350 nm (mercury free) showed emission bands centered at around 445 nm i.e. blue emissions.

Keywords: *Phosphor, luminescence, XRD, SEM*

I. INTRODUCTION

From the last few years, because of their significant role in the development of many optoelectronic devices such as lasers, light converters, sensors, hole burning high-density memories, solid state lighting, optical fibres and amplifiers rare earth ions have been extensively studied in different host materials [1-2]. Cerium-activated materials have received renewed interest for many applications because of the favorable spectroscopic properties of Ce^{3+} and the ability to incorporate Ce^{3+} into many different host materials [3]. These materials combine high light yield, favorable emission wavelength, fast fluorescence decay and temperature stability which make them attractive for use in detectors for high energy physics [4] and medical imaging [4]. Thus, based on excellent luminescence properties, Ce^{3+} doped inorganic materials are applied in lightings, displays and detectors for ionizing radiation [5-6]. Ce^{3+} can also be used as a reference ion to predict the 5d energies of other rare earth ions in same host lattices [7]. Therefore, the investigation on the spectroscopic properties of Ce^{3+} in various host lattices is important for both the actual application and the basic research.White light from UV/blue LED is by coating on LED suitable phosphors excitable by LED light, so that white light is produced either by mixing of basic colors or complementary colors. For such phosphor converted LED (pc-LED) producing white light, suitable phosphor materials are being developed.

II. EXPERIMENTAL

In this work we prepared $MgCuAl_{10}O_{17}:Ce^{3+}$ phosphor activated with Ce^{3+} by using a wet chemical synthesis method. The samples were prepared by a modified wet chemical reaction method. In this process the we obtained a white powder in very fine form as well as the cross contamination is very less, [8] while preparing the samples, the raw materials are $MgNO_3$ (Loba, 99%), $CuNO_3$ (Loba, 99%), $Al(NO_3)_3$ (Loba, 99%) and $CeNO_3$ (HiMedia, 99.9%) were taken in a weight of stoichiometric ratio and go for the synthesis process.Then this material was heated at 200^0C for 3 hour by slowly increasing the temperature in the step of 100^0C, after 3 hour heating the material was again crushed for one hour and finally get the product in powder form. The phase structure of samples obtained in the powder form without dopant was confirmed by taking the X-ray diffraction (XRD. Photoluminescence spectra of the sample were recorded at our workplace.

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III. RESULTS AND DISCUSSION

3.1 X Ray Diffraction

The XRD pattern of the prepared phosphor is shown in figure 1. The XRD pattern of $MgCuAl_{10}O_{17}$ along with JCPDS file is shown in figure 1, is well match the JCPDS file .

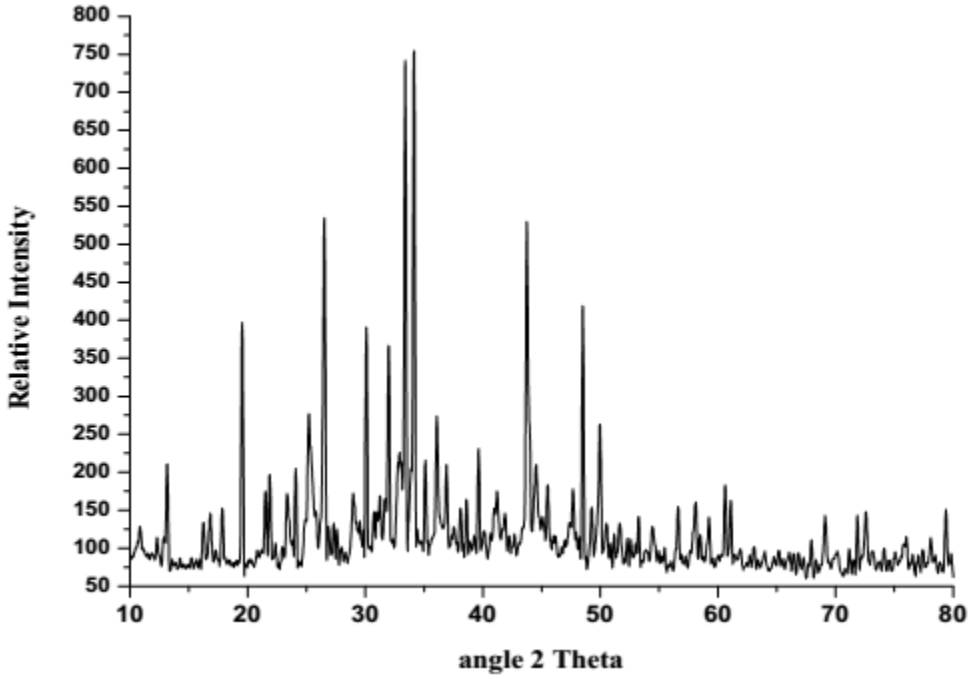

Fig 1: XRD structure of $MgCuAl_{10}O_{17}$ Phosphor

3.2 Scanning electron microscopy

SEM study was carried out to investigate the surface morphology and the crystallite sizes of the synthesized phosphor powder. The synthesis was carried out by wet chemical synthesis reaction. This shows that the wet chemical reactions of the mixtures took place well. The typical morphological images are represented in fig. for $MgCuAl_{10}O_{17}$ phosphor materials respectively. It is clearly seen that the micrographs crystallite sizes vary from few microns to several tens to fifty microns. The crystallites have sharp surface morphology and have crystalline grains. The particles possess foamy like morphology formed from highly agglomerated crystallites. The average crystallite size is in sub-micrometer range as shown in SEM images, the crystallite sizes are nearly same for all the compositions prepared.

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3.3. Photoluminescence study $MgCuAl_{10}O_{17}:Ce^{3+}$

Fig show PL excitation spectra of $MgCuAl_{10}O_{17}:Ce^{3+}$ phosphors which shows a broad absorption band in the range of 280 to 380 nm due to the 4f–5d transition of Ce^{3+} ions peaking at 355 nm. The Pl emission spectra of $MgCuAl_{10}O_{17}:Ce^{3+}$ phosphor as shown in fig. exhibit blue emission band centered at 441 nm(22,675 cm^{-1}). Generally, ground state configuration of Ce^{3+} ion is split in two levels i.e. $^2F_{5/2}$ and $^2F_{7/2}$ whereas the $5d^1$ excited configuration is split by the crystal field in 2-to-5 components. In the reported work, it was observed that, the emission spectra of the samples show broad blue emission band in the range of 400-650 nm peaking at 441 nm. In accordance to the literature [9] it is ascribed to the electron transition from the excited state of ^2D_J to the ground states of $^2F_{5/2,7/2}$ of Ce^{3+} ions in the $MgCuAl_{10}O_{17}:Ce^{3+}$ host materials, the characteristic doublet of Ce^{3+} ion was not observed in the emission spectrum

IV. CONCLUSIONS

$MgCuAl_{10}O_{17}:Ce^{3+}$ phosphor was successfully prepared wet chemical synthesis method. The prepared compound is found to be useful for lamp industry.

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