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Photoluminescence properties of $ZnWO_4$: Dy^{3+} phosphor

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Abstract
Zinc tungstate ($ZnWO_4$) exhibits interesting photoluminescent properties and $ZnWO_4$ single crystal was first introduced for microwave devices, fiber optical communications, scintillating materials etc. In this paper reported the photoluminescence property of Dy^{3+} activated $ZnWO_4$ synthesized by solid state rout at temperature 850^0 C. Formation of compound was tested by X-ray diffraction pattern. The photoluminescence characteristic of Dy^{3+} doped $ZnWO_4$ was studied by excitation and emission spectrum. PL excitation spectrum of $ZnWO_4$:Dy^{3+} phosphor shows the broad excitation peaks ranging from 220 nm to 320 nm because of $[WO_6]^{6-}$ group. The emission spectrum shows the peaks at 488 nm (blue) due to transition $^4F_{9/2} \rightarrow {}^6H_{15/2}$ with broad background due to self emission of $ZnWO_4$ and 575 nm (yellow) due to transition $^4F_{9/2} \rightarrow {}^6H_{13/2}$.

Keywords: $ZnWO_4$, Photoluminescence, XRD, SEM

INTRODUCTION

Zinc tungstate ($ZnWO_4$) exhibits interesting photoluminescent properties and $ZnWO_4$ single crystal was first introduced for microwave devices, fiber optical communications, scintillating materials etc. in the middle of the 20th century [1,2]. Tungstate materials are considered to be, technically important because they posses various properties such as high chemical stability, high refractive index, high X-ray absorption coefficient and also their displaying efficiency in outputs [3, 4]. $ZnWO_4$ has been synthesized by various methods such as $ZnWO_4$ has been prepared by different routes such as the Czochralski method [5], precipitation [6], sol-gel reaction [2], etc.

It is well established that Dy^{3+} used as activator to obtain yellow and red laser emission correlative with $^4F_{9/2} \rightarrow {}^6H_{13/2}$, $^4F_{9/2} \rightarrow {}^6H_{11/2}$ transition of Dy^{3+} ion.

Keeping these advantages of $ZnWO_4$ with Dy^{3+} as activator in view, we have made an attempt here to prepare $ZnWO_4$ and Dy^{3+} activated $ZnWO_4$ phosphor ceramic powder by a solid-state reaction method to characterize its photoluminescence properties.

RESULTS AND DISCUSSION

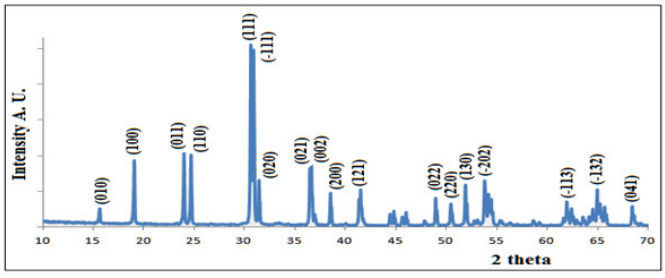

Fig 1. X-ray diffraction pattern of $ZnWO_4$ phosphor.

X-ray diffraction pattern of $ZnWO_4$ phosphor has been shown in Fig. 1 revealing that it is in monoclinic nature most of the observed peaks have been indexed to the pure phase of monoclinic wolframite using the JCPDS Card No: 15-0774.

The SEM micrograph of the $ZnWO_4$ phosphor has been shown in Fig. 2, displaying that the particles are noticed to be agglomerated and the average size of the grain is about 2-3 µm.

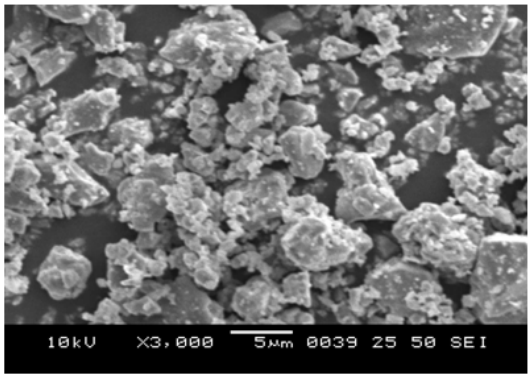

Fig 2. SEM Micrographs of as synthesized $ZnWO_4$ phosphor.

Fig. 3 represents PL excitation spectrum of $ZnWO_4$: Dy^{3+} phosphor monitored at 575 nm shows the broad excitation ranging from 220 nm to 320 nm corresponds intrinsic transition of wolframite structured $[WO_6]^{6-}$ group of ZnWO4 [7].

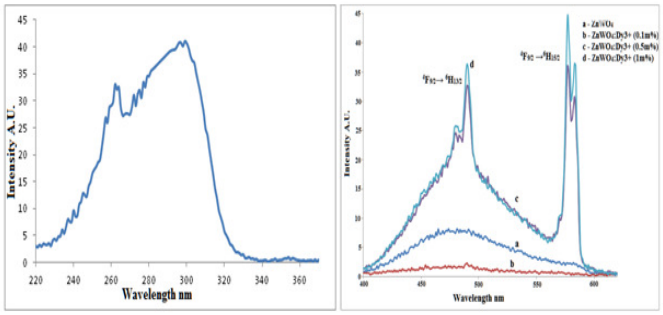

Fig 4 a). PL Excitation spectra monitored at 575 nm b) PL emission spectra of excited at 292 nm of Dy^{3+} activated $ZnWO_4$

The emission spectrum has shown in fig. 4 which shows broad emission corresponds to C-T transition of $[WO_6]^{6-}$ with sharp

characteristic line emission at 488 nm (blue) and 575 nm (yellow) due to transition $^4F_{9/2} \rightarrow {}^6H_{15/2}$ and $^4F_{9/2} \rightarrow {}^6H_{13/2}$ corresponds to Dy^{3+} ion [5].

CONCLUSION

In conclusion, $ZnWO_4$ and Dy^{3+} doped $ZnWO_4$ phosphor were successfully synthesized by solid state rout at 850°C. Crystallinity and formation of compound was tested by X-ray diffraction pattern. The SEM micrographs show the agglomerated morphology of the $ZnWO_4$. The PL properties of $ZnWO_4$ and Dy^{3+} doped $ZnWO_4$ phosphor shows the broad excitation curve of $ZnWO_4$ and emission shows characteristic line emission of Dy^{3+} ion at 488 nm (blue) and 575 nm (yellow) due to transition $^4F_{9/2} \rightarrow {}^6H_{15/2}$ and $^4F_{9/2} \rightarrow {}^6H_{13/2}$ of Dy^{3+} ion along with broad emission of host lattice.

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