Formation of Pure In_2O_3 pallets for OLED Application

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Herein formation of pure In_2O_3 thin film for OLED material is reported. Synthesis and characterization are reported inside the manuscript. PL spectra were recorded for ultraviolet radiation and it shows down-conversion with emission peaks centred at 448 nm (Blue Region), 513 nm (Green Region) and 609 nm (red Region). For this emission spectra CIE coordinated are plotted and found to touches white light boundary with enhance blue emission. For CIE coordinate value of x = 0.27, y = 0.28 are found. The colour rendering index and co-related colour temperature are calculated for its practical/industrial ability. Thermoluminescence glow curve analysis of prepared pallet and it is found good TL glow curve response with UV dose. Now as formed thin film may be useful for energy efficient photovoltaic application.

Introduction

Conducting oxide play a vital role for optoelectronics devices, solar cell application and various display panels [**1-5**]. There are so many reports for indium oxide are useful for OLED applications but no one reported basic studies of indium oxide in photo and thermoluminescence studies and calculation of kinetic parameters [**3-15**].

In the presents work, it is claimed that this is the first ever attempt to synthesis In_2O_3 (Indium Oxide) and measure its optical properties for various optoelectronics applications.

Experimental

The polycrystalline sample of Indium oxide have been prepared by solid state ceramic route method. The chemicals are of AR grade (99.99% purity) In_2O_3 are fined by using agate mortar pestle. Sample are calcined at the temperature of 800ºC. The calcined powder is mixed thoroughly in ambient temperature. Powder is then pelletized with the help of hydraulic press with the applied pressure of 5 – 6 bar. Crushed pellets of the materials are then annealed in the air for 24 hours. Structural analysis by using X ray diffraction measurement Rigaku Dmax source of CuKα radiation λ = 1.54 Å. The surface morphology has been studied with the help of Scanning Electron Microscopy (SEM). The optical properties are characterized by using Photoluminescence studies spectrophotofluron meter Shimadzu made and its CIE coordinate are calculate using colour calculator software. Also, the thermoluminescence properties were calculated using TLD reader (I1009 Nucleonix PVT LTD) and kinetic parameters are calculated using CGCD method.

Results and discussion

As formed sample of indium oxide was examined by its surface morphology, scanning electron microscopic technique and it shows agglomeration of prepared sample shown in (**Fig. 1** & **Fig. 2**). Surface morphology was seen scattered and so many scattered particles are observed as spherically distributed.

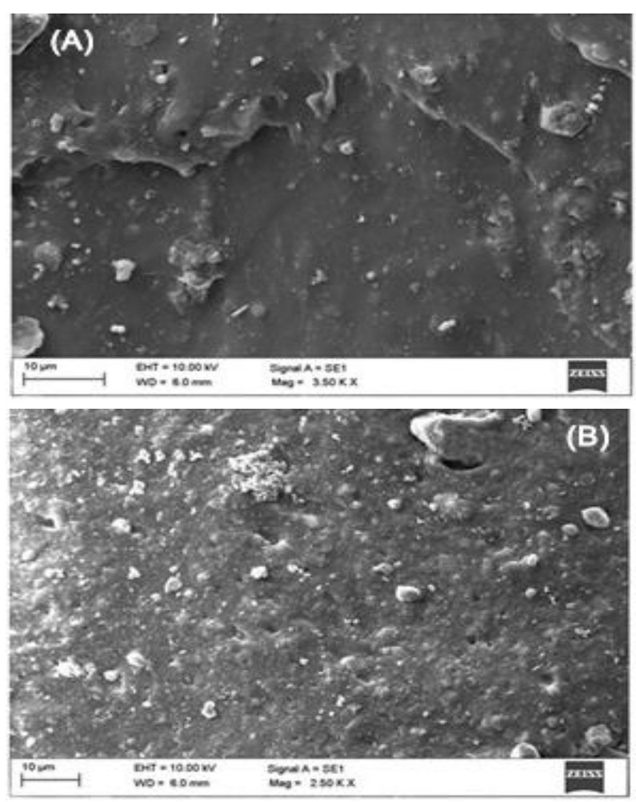

Fig. 1. (A & B) SEM image of prepared sample.

Photoluminescence study of indium oxide

Prepared samples were analysed by PL study and it is observed, three distinct peaks for red, green and blue region 609 nm (red), 513 nm (green) and 448 nm (blue) (**Fig. 2**).

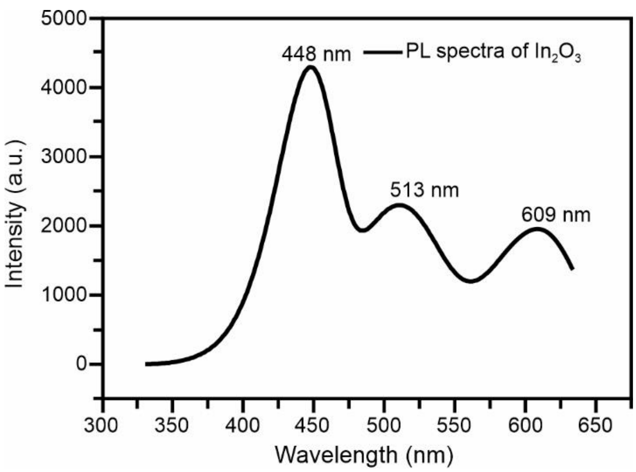

Fig. 2. Photoluminescence emission spectra of In_2O_3 phosphors.

The composed spectra showed all the peaks related to white light formation in this context CIE coordinate showed very rich colour which touches boundary of the white light and enhance the blue region (**Fig. 3**).

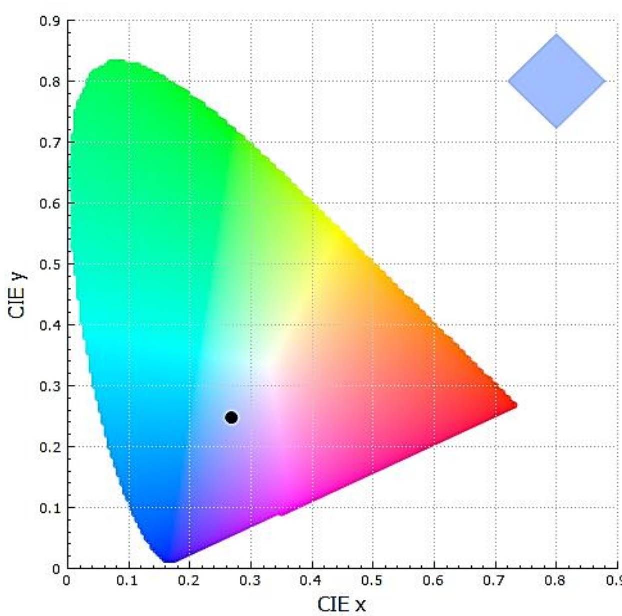

Fig. 3. CIE coordinate related to photoluminescence emission spectra of In_2O_3 phosphors.

Fig. 3 & **Fig. 4** showed up CIE coordinate of prepared phosphor and it shows well consistent with Figure 2 (PL emission Spectra). Here it shows very good response with UV 254 nm excitation and found several dominant peaks centred at blue, green and red region. It covers all visible light and shows white light (x = 0.27, y = 0.28) nearer too white light.

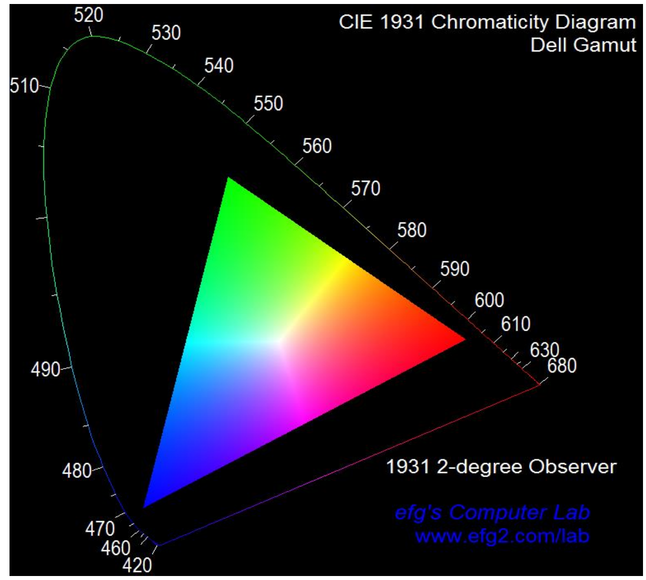

Fig. 4. CIE coordinate spectrum.

Thermoluminescence glow curve analysis

TL glow curve were recorded for fixed UV (25 min) exposure time. **Fig. 5(a)** shows well resolved peaks at 190ºC most intense peak with some shoulder peaks 246, 297 and 342ºC. So many peaks show composite nature of the sample and calculation of kinetics can be evaluated by kinetic parameters [**25-35**].

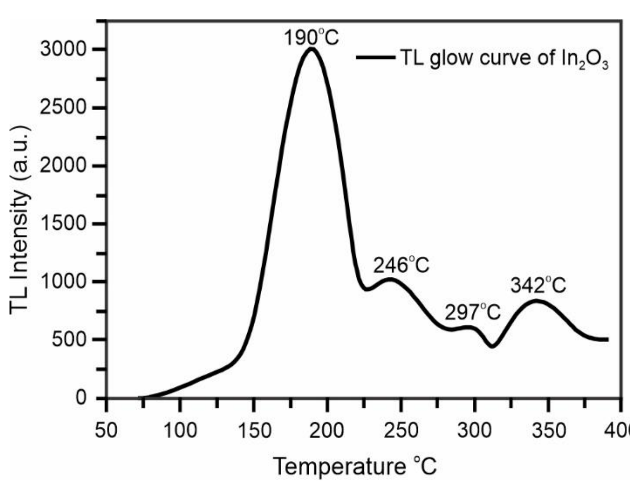

Fig. 5(a). TL peak of indium oxide sample for UV - irradiation of 25 minutes.

Fig. 5(b) shows CGCD pattern of previous explained TL glow curve (**Fig. 5 (a)**. The fitting curves with theoretical simulation programme shows a good arrangement with seven fitted curves. In the context kinetic parameters of fitted glow curve by CGCD method were calculated and peak shape method tabulated in **Table 1**. The figure of observed nearly 3.52 for indium oxide sample. All the peaks show second order of kinetics except one is 0.32 showed first orders. Activation energy is very high for all the peak varies form 1.53 – 4.88 eV.

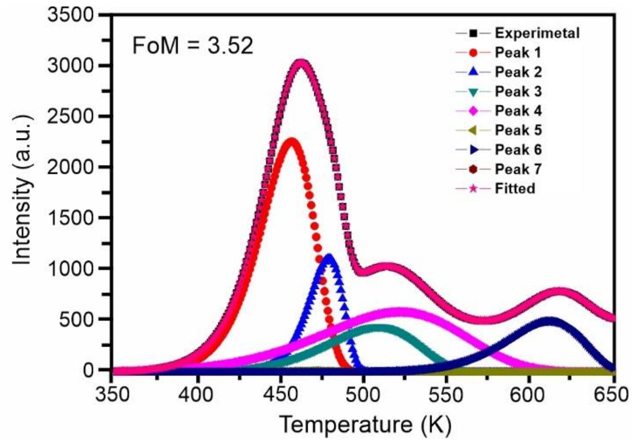

Fig. 5(b). CGCD fits of indium oxide sample for UV - irradiation of 25 minutes. (FOM = 3.52%)

Table 1. Calculated trap parameters for CGCD (experimental and fitted) curve for In_2O_3 (with 25 min UV).

Peaks	T_1 (K)	T_m (K)	T_2 (K)	τ	δ	ω		Activation energy (E) eV	Frequency factor (s) s^{-1}
1	431	445	473	14	28	42	0.66	4.88	6×10^{35}
2	462	479	487	17	8	25	0.32	4.27	1×10^{30}
3	473	510	539	37	29	66	0.43	2.13	6×10^{14}
4	469	522	570	53	48	101	0.47	1.53	4×10^{10}
5	579	611	642	32	31	63	0.49	3.17	2×10^{13}

Conclusion

It is concluded that prepared sample by solid state ceramic method has agglomerated surface morphology and few micron size particles are having spherical shape. PL studies shows the good spectra which touches white light boundary and enhance the spectra in blue region verified by CIE coordinate. TL glow curve showed very good TL peaks had four distinct peaks centred at 190°C, 246°C, 297°C and 342°C showed composite in nature and on the basis for that it was fitted by computerized programme (CGCD technique) shows seven different peaks and had a good figure of merit 3.53% so the applicability of material to determine trap parameters. Values of trap parameters shows second order of kinetics for most of the peaks and activation energy is too high from 1.53 - 4.88 eV shows the both shallower and deep trap formation inside the material. On the basis of PL studies as formed thin film may be useful for display applications.

Keywords

CRI, CCT, display

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