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PHOTOLUMINESCENCE CHARACTERISTICS OF LIF :SnF_2 :Ce^{3+} PHOSPHOR

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ABSTRACT: The photoluminescence (PL) features of LiF:SnF2:Ce phosphor produced by wet chemical synthesis were investigated in this study. A prominent peak in the photoluminescence spectrum can be attributed to transitions between 5d–4f levels of cerium in the host lattice and is located between 210 and 330 nm (SnF2).[1] The structure of tin fluorophosphate glasses and their low melting point properties have recently gotten a lot of interest, however their luminous capabilities haven't gotten nearly as much attention. [2] We discovered that SnF2 had a stronger favourable influence on perovskite optical properties than SnF4. [3]

Key words: - Cadaba fruticosa, Medicinal properties, phytochemistry, Wardha, Maharashtra.

INTRODUCTION :

Low glass transition temperature (Tg) glasses, with Tg values generally less than 200 ^{0}C, have gotten a lot of interest in recent years because of their wide range of applications in science and industry, including glass–metal sealing, IC packaging, photon conversion, and filler. Tick's observation that tin fluorophosphate glasses have a low transition temperature has led to their consideration as viable sealing materials rather than PbO glasses. The fabrication and characteristics of SnO–SnF_2–P_2O_5 glasses have been studied extensively since then. They concluded that the high ratio of non-bridging to bridging oxygen, fluorine in two different chemical states (F–P and F–Sn), two types of Sn-containing building blocks (preferably Sn–O_2F and secondary Sn–F_2O), and P atoms (P–O_3F structural units) in a single chemical environment are the structural features of tin fluorophosphate glasses. [1] Moreover, various procedures were implemented with the goal of achieving high PCE and long-term stability of perovskite. It's a good way to take advantage of SnF_2 and its complicated for an advanced $FASnI_3$ flim, for example. [4] SnF_2-induced redistribution of Sn 5s-derived density of states is visible in the valence band (VB), representing the altered SnII/SnIV ratio. Despite some data variability, we find that adding SnF_2 reduces the energy gap between the VB maximum of CsSnBr3 and the Fermi level, which we explain using defect chemistry. [5]

EXPERIMENTAL :

All chemicals used in this experiment were analytical grade and used as received. Distilled water was used in the preparation of solutions. In the typical synthesis of LiF :SnF_2 :Ce (0.1- 3 mol %), LiF :SnF_2 and $CeCl_3$ were dissolved in distilled water and stirred to prepare clear solution of LiF :SnF_2 and $CeCl_3$ and then for required sample the desired $CeCl_3$ solution and LiF solution were mixed in SnF_2 solution. The mixture was appeared as chemically homogenous transparent liquid. These solutions then were kept in hot air oven at 80 ^{0}C for 4-5 days till the solutions were completely dry. The crystal structure of the product was slightly

crushed to powder. The prepared residue was used for further study. Unquenched samples were used for the study of photoluminescence with spectro flurophotometer RF-5301 PC

RESULTS AND DISCUSSIONS :

Fluorescence spectrometer was used to record the sample's photoluminescence (PL) emission spectra (RF-5301 PC). In each case, the same amount of sample was used. A 1.5 nm spectral slit width was used to record emission and excitation spectra. [6] Ce^{3+} is an excellent choice for studying the behaviour of 5d electrons as both an activator and a sensitizer. Ce3+ only has one outer electron and two 4f spin-orbital splitting states ($^2F_{5/2}$, $^2F_{7/2}$).[7] As a result, it has a simpler excited state energy structure than the other trivalent rare-earth ions. Sn^{2+} species in FP glasses are very stable when exposed to UV light, but not when exposed to a 193-nm laser. Sn^{2+} species are photo-oxidized relatively quickly in P and BS glasses when exposed to UV radiation. The defect generation mechanism should be expected to be two-step. This includes UV photon absorption, as well as an energy transfer process between the excited Sn^{2+} species and the glass matrix's intrinsic precursors and vice versa. [8]

Figure 1 shows the photoluminescence excitation spectra of the LiF:SnF2:Ce^{3+} phosphor. A broad band with a peak at 256 nm is seen. [9] The variation in peak PL intensity with different concentrations of Ce doped in LiF :SnF_2 is shown in Figure 2. The intensity of the prepared samples' excitation spectra was observed to be dependent on the amount of Ce^{3+} doped in the LiF:SnF_2 material. [10] The intensity is decreases linearly from 1 mol% to 3mol% in the prepared LiF :SnF_2 :Ce^{3+} sample. The emission spectra of Ce^{3+} ions in SnF_2 phosphor with varying concentrations under the same excitation (256 nm) wavelengths of light are shown in Fig. 3. [11] On exciting the unirradiated crystal with 256 nm light, emission bands at 340-342 nm were observed. The highest intensity observed at 330 nm. As the concentration of Ce^{3+} ion increases, the brilliance of all peaks decreases, especially at higher Ce^{3+} ion concentrations (1 mol percent). This shows a change in the Ce^{3+} ions' environment in the SnF_2 lattice at greater concentrations. In the event of high Ce^{3+}concentrations, variations in emission intensities could be due to cross relaxation between Ce^{3+} ions. Because of SnF_2's low melting point, about 20% of it is volatilized in all samples. [12] It's supposed to be a good matrix for making white fluorescence glass, because the Sn^{2+} activation centre emits a broad blue-green emission with a short lifetime and high quantum efficiency. As a result, a high-quality white light can be produced simply by doping the relevant activator. [13]

The Ce^{3+} ion can be used as sensitizer as well as an activator, depending on the splitting of 5d excited levels by the crystal field symmetry. Much work has been done on the Ce^{3+} to different activator ions in different host lattice. Figure 4 illustrates the fluctuation in peak PL intensity of emission spectra with varied Ce doped in LiF:SnF2 concentrations. The nearly linear curve shows that the intensity of emission spectra in the generated samples is also reliant on Ce^{3+} doping concentrations in the SnF_2 material. [14-15] The intensity of emission spectra too decreases linearly from 1 mol% to 3 mol% in the prepared LiF :SnF_2 :Ce^{3+} sample.

CONCLUSIONS :

Wet chemical approach was used to make LiF:SnF2:Ce^{3+} high potential phosphor. The prominent peak at 256 nm in the photoluminescence emission spectrum can be attributed to transitions from Ce^{3+} ion levels 5d–4f in the sample (LiF :SnF_2). Broad band about 330-350 nm may be seen in the emission spectra. The intensity of the PL is shown to decrease linearly as the concentration of Ce in

the host material increases. Researchers had not previously concentrated on the influence of rare earth ions in the aforesaid system and their effect on the luminescence behaviour of the materials, thus material is considered the major endeavour in the current work. For the development of energy transfer based co-activated advanced phosphors for the lamp industry, the LiF:SnF2:Ce^{3+} phosphor demonstrates near UV emission.

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Figure 1: Excitation spectra of the LiF:SnF2:Ce $^{3+}$ phosphor in photoluminescence

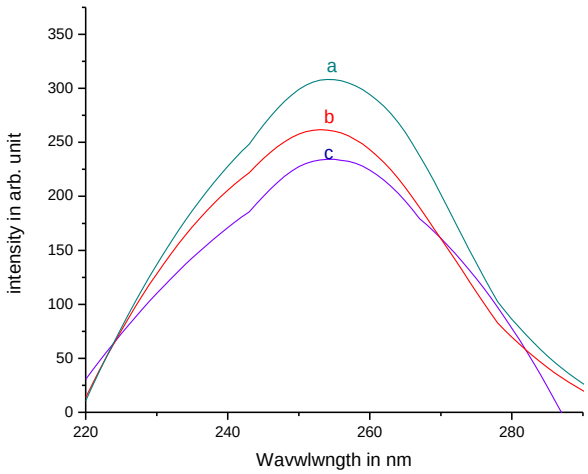

Figure 2: Variation of peak Intensity of exciation spectra with different concentrations of Ce doped in LiF :SnF_2

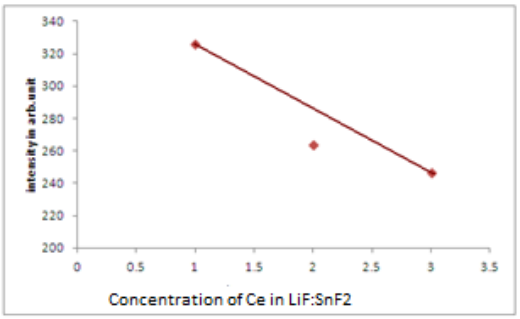

Figure 3: Ce3+ ion PL emission spectra in LiF:SnF_2 phosphor at various concentrations.

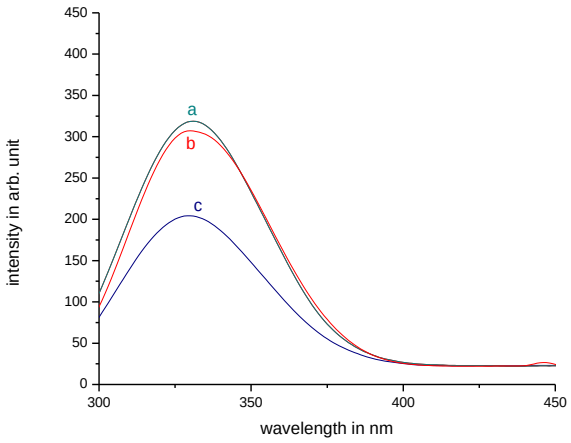

Figure 4: Variation of peak Intensity of emission spectra with different concentrations of Ce doped in LiF :SnF_2.