CaSO₄: Eu²⁺ nanophosphor for photoluminescence liquid crystal display (PLLCD)

Anita Patle^{1*}, R.R.Patil¹ and S.V.Moharil²

¹Department of Physics, Institute of Science, R. T. Road Civil Lines Nagpur, 440001, India

²Department of Physics, R.T.M Nagpur, University Nagpur, India

*Email: patle.anita25@gmail.com

CaSO₄:RE³⁺ has been extensively reported for its thermoluminescence (TL) and radioluminescence (RPL) properties related to radiation dosimetry [1, 2] CaSO₄:Eu²⁺ phosphor possessing narrow PL emission located near the UV-visible border was found to be suitable as backlight phosphor for application in photoluminescent liquid crystal displays [3]. In this paper, we report the intense PL emission in nanocrystals than for bulk in Eu²⁺ doped CaSO₄ phosphor. It is claimed that it will improve the back light efficiency which will improve the PLLCD (photoluminescent liquid crystal displays) display.

CaSO₄ phosphor activated with Eu was prepared by precipitation. It is well known that molarity of starting solution has profound effect on particle size. Therefore, particles were synthesized with 0.1 and 0.01 molar solutions of precursors. The dried powder of CaSO₄ was in nano range. A suitable co-dopant was also added to get the desired property. The doped bulk powder was also prepared in equimolar ratio. The dried sample were heated at 900°C for 1 h and quenched.

The powder XRD pattern of the phosphors CaSO₄: Eu²⁺ was compared with the standard JCPDS files and found to be good agreement with the ICDD file No.:72-0916. The average size of particles prepared with 0.01 M solution was found to be 80-100 nm with Hexagonal morphology as could be observed from the TEM photograph (Figure 1).

Figure 1: TEM image of CaSO₄: Eu

Figure 2: Photoluminescence of CaSO₄:Eu prepared with various molar concentration of precursor solution a) Excitation and Emission : (b) Bulk (c) 0.1 M and (d) 0.01 M

PL emission is observed around 380 nm in all samples prepared with different molarities (Figure 2). This corresponds from the lowest band of 4f⁶5d¹ configuration to ⁸S_{7/2} state of 4f⁷ configuration of Eu²⁺ ion. The excitation is a typical 2+ excitation of CaSO₄:Eu, the excitation bands of Eu²⁺ are around 270,319, 338 and 352 nm (Figure 2a). Intense PL emission for nanocrystalline sample (Figure 2d) which is double compared to that of microcrystalline sample(Figure 2c) A phosphor with narrow emission band around 390 nm is desirable, for PLLCD applications since with this wavelength various RGB phosphors can be excited. The transmission of standard glass, polarizing plastic, other coating and LCD material is also at acceptable level. Strong Eu²⁺ emission is observed in CaSO₄:Eu nanophosphor which will increase the light yield of the backlight thus improving the display.

References

1. Yamashita T., Nada N., Onishi H., Kitamura S. 1971. Health Phys. 21, 295
2. Calvert R.L., Denby R.J. 1984. Phys. Stat. Solidi 83, 597
3. Vecht A., Newport A.C., Bayley P.A., Crossland W.A. 1998.J. Appl. Phys. 84, 3827