Available online at **www.joac.info**

ISSN: 2278-1862

Journal of Applicable Chemistry

2018, 7 (4): 933-948

(International Peer Reviewed Journal)

Influence of Pr^{3+} ions on Physical, Optical and Structural Properties of Lead borate Glasses and Effect of γ Irradiation

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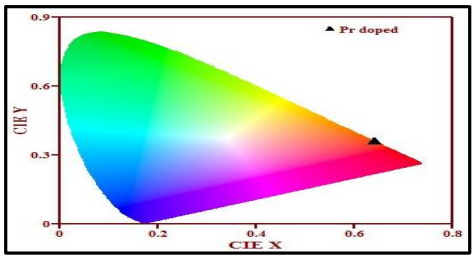
Accepted 3rd July, 2018

ABSTRACT

The UV–Visible, Raman, Fourier transform infrared (FTIR) and Photoluminescence spectra of sodium lead calcium borate glasses doped with Pr^{3+}have been investigated. The same spectral measurements were repeated after gamma irradiation. The amorphous nature of the prepared glass samples was confirmed by analysis of the Powder X-Ray diffraction, before and even after gamma irradiation. The impact of pr^{3+} ions on absorption, Emission, Raman and FTIR spectra of the present glasses before and after γ irradiation were compared and discussed in detail. The UV-Visible absorption spectra after gamma irradiation show enhancement in the intensities of adsorption bands. FT infrared absorption spectra of the glasses samples reveal the characteristic vibrational bands arises from the sharing of modes due to triangular borate and tetrahedral borate groups. FTIR spectra have shown only minor effects on gamma irradiation but within the glass network due to the loose bonding, bands due to the water molecules was strongly affected by irradiation. Indicating the presence of Pr^{3+} ions in sodium lead calcium borate glass the Photoluminescence and Raman spectra were in compatibility with the UV–Visible and FTIR data. The CIE 1938 color chromaticity diagram has been used to demonstrate the color of the emission. With varied concentration of pr^{3+} ions the impact on physical properties of the glasses has been examined. Few physical parameters of the glasses like refractive index(n), density (ρ), Molecular weight(M.W), molar volume (V_m), polarizabilities (α_m), molar refractivity (R_m), concentration of rare earth ion (N_i), inter ionic distance (r_i), polaron radius (r_p), reflection loss (R_L%), field strength(F) and dielectric constant (ε) were calculated using standard formulae, before and after irradiation. The variable induced defects have been generated on synthesized samples which are clearly due to gamma irradiation. The gamma ray dose induced defects on the present glasses are interpreted and analyzed.

Graphical Abstract



CIE of Pr^{3+} incorporated calcium sodium lead borate glasses after irradiation.

Keywords: Pr^{3+} ions, UV/Visible, FTIR, Photoluminescence, gamma irradiation and Induced defects.