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Optical and Luminescence Studies on Dy^{3}+ Singly Doped and Dy^{3}+/Ce^{3}+ Co-doped Alumina Borosilicate Glasses for Photonics Device Application

Authors : M. Monisha, Sudha D. Kamath

Abstract : We investigate the optical and photoluminescence properties from Dy^{3}+ singly doped and Dy^{3}+ co-doped with Ce^{3}+alumino borosilicate glasses prepared using high temperature melt-quenching technique. The glass composition formula is $25SiO_2$-(40-x-y)$B2O_3$-$10Al_2O_3$-15NaF-10ZnO-xDy_2O_3 yCe_2O_3 where, x = 0.5 mol% and y = 0, 0.1, and 0.5 mol%. The XRD study reveals the amorphous nature of both singly doped and co-doped glasses. Absorption study on Dy3+ singly doped glass shows nearly twelve absorption peaks arising from the ground level of Dy^{3}+ ions ($^{6}H_{15/2}$) to various upper levels, and for Dy^{3}+/Ce^{3}+ co-doped glasses, few of the transitions in the visible region are suppressed. The absorption band edge is shifted towards the higher wavelength region on increasing Ce3+concentration. The decrease in indirect energy bandgap and increase in Urbach energy of the prepared glasses is observed due to codoping with Ce3+ ions. The photoluminescence studies on singly doped glass under 350 nm excitation showed three peaks at the blue (482 nm), yellow (575 nm), and red (663 nm) region. For codoped glasses, the emission peak at 403 nm is raised due to the 4d to 5f transition of Ce3+ ions. Lifetime values (ms) of co-doped glass is found to be higher than singly doped glass. Under 350 nm excitation, CIE coordinates of the co-doped glasses moved towards the bright white light region. The correlated color temperature (CCT) values were obtained in the range 4500 – 4700 K. Thus, the prepared glasses can be used for photonics device applications.

Keywords : absorption spectra, borosilicate glasses, Ce^{3}+, Dy^{3}+, photoluminescence
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