World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:11, No:04, 2017

Studies on Distribution of the Doped Pr3+ Ions in the LaF3 Based Transparent Oxyfluoride Glass-Ceramic

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Abstract : Current years have witnessed a phenomenal growth in the research on the rare earth-doped transparent host materials, the essential components in optoelectronics that meet up the increasing demand for fabrication of high quality optical devices especially in telecommunication system. The combination of low phonon energy (because of fluoride environment) and high chemical durability with superior mechanical stability (due to oxide environment) makes the oxyfluoride glass–ceramics the promising and useful materials in optoelectronics. The present work reports on the undoped and doped (1 mol% Pr2O3) glass ceramics of composition 16.52 Al2O3•1.5AlF3• 12.65LaF3•4.33Na2O•64.85 SiO2 (mol%), prepared by melting technique initially that follows annealation at 450 ºC for 1 h. The glass samples so obtained were heat treated at constant 600 ºC with a variation in heat treatment schedule (10- 80 h). TEM techniques were employed to structurally characterize the glass samples. Pr2O3 affects the phase separation in the glass and delays the onset of crystallization in the glass ceramic. The modified crystallization mechanism is established from the analysis of advanced STEM/EDXS results. The phase separated droplets after annealing turn into 10-20 nm of LaF3 nano crystals those upon scrutiny are found to be dotted with the doped Pr3+ ions within the crystals themselves. The EDXS results also suggest that the inner LaF3 crystal core is swallowed by an Al enriched layer that follows a Si enriched surrounding shell as the outer core. This greatly increases the viscosity in the periphery of the crystals that restricts further crystal growth to account for the formation of nano sized crystals.

Keywords : advanced STEM/EDXS, crystallization mechanism, nano crystals, pr3+ ion doped glass and glass ceramic, structural characterization
Conference Title : ICMSEE 2017 : International Conference on Material Science and Environmental Engineering
Conference Location : London, United Kingdom
Conference Dates : April 24-25, 2017