Study of structural and optical properties of new TeO_2-GeO_2-PbF_2 glasses

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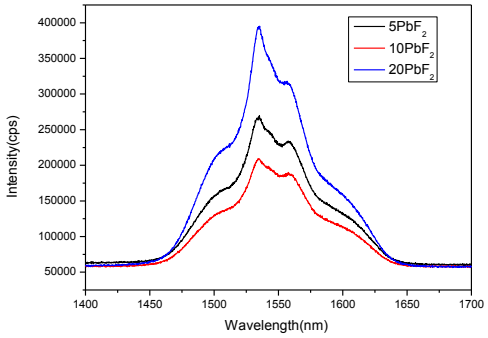
Heavy metal fluoride glasses have attracted attention because of several optical properties related with their low phonon energy [1]. Fluoride glasses suffer with poor chemical resistance, but in oxide systems, this problem can be resolved. The new glass system TeO_2-GeO_2-PbF_2 was investigated in all extension. (90-x)TeO_2-GeO_2-xPbF_2 composition was studied to identify the influence of composition in thermal, structural and optical properties. Glass samples with x= 5 to 30% were prepared by melt-quenching method. Characterizations by XRD, DSC, Raman and Eu^{3+} photoluminescence studies were realized. The XRD measurements indicated glass character and DSC analysis show results about thermal properties. From these results, it was inferred that insertion of PbF_2 in germanium tellurium network causes a change in Tg value and decreases glass stability against crystallization. Raman spectroscopy suggests progressive PbF_2 incorporation with conversion of TeO_4 to TeO_3 units. For TeO_2 rich samples, TeO_4 units are predominant, in contrast with high PbF_2 molar concentrations where TeO_3 units are presents. For study of structural evolution, Eu^{3+} photoluminescence showed that PbF_2 content causes a symmetry increase around Eu^{3+} ions. This study demonstrates relation with macroscopic properties, such as Tg with microscopic properties, such as structural elucidation and connectivity. Increases in the proportion of PbF_2 cause an increase in emission intensity in the region of 1.5µm, as shown in Figure 1 and upconversion phenomena are benefited for green and red emissions, as shown in Figure 2.



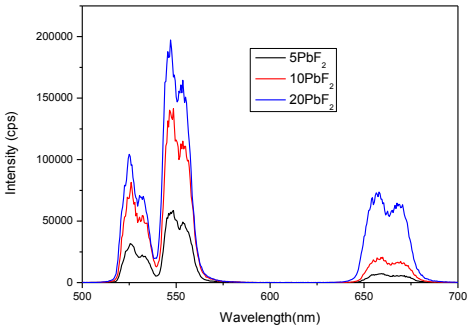


Figure 1. IR emission for doped and codoped samples. Figure 2. Upconversion spectra under 980 nm excitation.

[1] SILVA, M. A. P. et al, J. Phys. Chem. Solids. 2011, 63, 605-612.

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