Thermal, structural and optical study of new TeO_2-Sb_2O_3-GeO_2 ternary system

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Nowadays many studies on tellurite glasses which have high percentage of tellurium oxide (TeO_2) have been reported. This interest is due to some attributes that have these materials, such as: wide area of transparency, good glass stability against crystallization, high linear and nonlinear refractive index and low energy phonons [1]. Since the glass base Sb_2O_3 can exhibit nonlinear optical applications and luminescence, optical fiber and glass ceramics manufacturing. Finally, the addition of GeO_2 glass matrix will can give high thermal stability, increase the area of transparency and chemical durability. Based on these attributes the preparation and study of glasses in this new system becomes interesting for future applications in photonics. In this work the new glass system TeO_2-Sb_2O_3-GeO_2 was investigated and promising glass compositions were selected for specific studies. Glass samples in the (80-0.8x)TeO_2-20-0.2x)Sb_2O_3–xGeO_2 molar composition were prepared by the melt-quenching method with a glass-forming domain from x=10 to x=90. Samples were investigated by XRD, DSC, FTIR and Raman spectroscopy. The XRD and DSC results showed evidence about the non-crystalline state and thermal properties of these materials. It has been observed that higher GeO_2 concentration lead to higher glass transition temperatures and thermal stabilities against crystallization. FTIR and Raman spectroscopies suggest a progressive incorporation of GeO_2 in the covalent network of TeO_2 with conversion of structural units TeO_4 to TeO_3. Er^{3+} doped and Er^{3+}/Yb^{3+} codoped samples were also studied with respect to their infrared emission properties and higher GeO_2 contents lead to an increase in IR emission intensity at 1,5µm as well as longer radiative lifetimes, showed in Figure 1. Finally, according Figure 2, upconversion emission in the visible were also recorded and were shown to be strongly dependent of the composition.

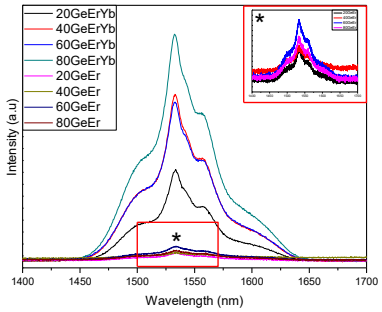

Figure 1. IR emission for doped and codoped samples.

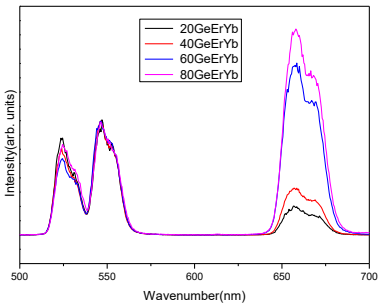

Figure 2. Upconversion spectra under 980 nm excitation.

[1] KOSTKA, P. et al, Phys. Status Solidi. 2011, 208, 1821-1826.