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Investigation of the influence of transition metal ions in niobium-borotellurite glasses through vibrational and nonlinear optical spectroscopy

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Tellurite glasses are know as good candidates to photonic devices' production because they exhibit third-order nonlinear optical susceptibilities larger than conventional silicate and borate glasses. In addition, for glass materials such nonlinearity can be increased by adding transition or heavy metal ions. In this direction, this work analyzed the influence of Ta^{5+} and Zr^{2+} on the physical, structures, and nonlinear optical properties of niobium-borotellurite (TBN) glasses. The samples were synthesized by the melt-quench technique using a melting temperature of around 1000 ºC. DSC measurements were performed to obtain the glass transition temperature. The densities were determined by the Archimedes method. To analyze the local structure of the samples FTIR and Raman spectroscopies were used . The spectrum of nonlinear refractive index (n_2) for the TBN glass doped with Ta^{5+} and Zr^{2+} ions was measured using the tunable femtosecond Z-scan technique [1]. Such results were compared with the BGO model, which involves empirical relations between the linear and nonlinear refractive index. The addition of metal transition ions did not lead to meaningful changes in the glass transition temperatures (T_g). The formation of non-bridging oxygen and BO_3 units was observed from the structural analysis. The n_2 value determined indicates that the nonlinear optical responses are associated with the glass matrix. The structural changes caused by the addition of Ta^{5+} and Zr^{2+} demonstrated a decrease followed by an increase in the value of the molar electronic polarization of the samples, respectively.

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