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# Thermal and Structural Characterization of a Niobium Phosphotellurite Glasses

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Tellurite glasses are promising materials for nonlinear optics applications due to their high nonlinear refractive index ($n_2$) and third-order susceptibility ($\chi^3$).These glasses also exhibit relatively low characteristic temperatures, such as the glass transition ($T_g$) and the onset of crystallization ($T_x$) temperatures. However, tellurite glasses are conditional glass formers and require specific synthesis and compositional conditions to form glass [1] successfully. Phosphate glasses, on the other hand, are well-known glass formers with many applications.Despite their versatility, they exhibit poor chemical durability due to their high reactivity with hydroxyl groups (-OH) [2].Combining the advantages of both glass families leads to the development of phosphotellurite glasses, which offer low characteristic temperatures, improved chemical resistance, and desirable linear and nonlinear optical properties. The incorporation of niobium ions ($Nb^{5+}$) into the glass matrix contributes to a more cross-linked structure, enhancing thermal stability against crystallization as well as improving the optical response [3]. Pseudo-binary glasses of the type (100–x)$TeO_2$–xNbP(x = 1–20 mol%) were synthesized, yielding ceramics, glasses, and glass-ceramics. At 1 mol% NbP, the sample was ceramic and non-transparent. At 20 mol%, a glass-ceramic with opaque optical appearance was obtained. Transparent yellowish glasses with good optical quality in the visible range were produced for x=5–15 mol%. Differential Scanning Calorimetry (DSC) showed that as NbP increased, the Tg rose from 323 °C to 398 °C, and the thermal stability parameter ΔT (Tx–Tg) widened from 46 °C to 120 °C. Increasing NbP also led to decreased density and increased molar volume, suggesting a more open glass network. Raman spectroscopy confirmed the presence of Te–O–Te linkages and $TeO_4$/$TeO_{3+1}$/$TeO_3$ units, bands from Nb–O in $NbO_6$ octahedra, and broad features attributed to P-O vibrations in ortho-pyro-metaphosphates species.

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