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Study of the Dispersion of the Nonlinear Refractive Index in Tellurite-Based Glasses with Niobium Phosphate

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Tellurite glasses are distinguished by their relatively high linear refractive index compared to silicate-based systems, a feature that renders them compelling platforms for developing next-generation photonic devices. In parallel, the widespread adoption of ultrashort pulse laser technologies places increasing emphasis on nonlinear refractive index dispersion as a critical parameter in studying materials for broadband applications. However, a meaningful evaluation of novel glass systems must also consider the inherent trade-off between refractive properties and loss mechanisms—notably, nonlinear absorption. In this work, we characterize the nonlinear refractive index and the two-photon absorption coefficient of tellurite glass samples with the composition (100-x)TeO2-xNbOPO4, where x=5,10,15. We determined spectrally-resolved optical properties employing the open- and closed-aperture Z-scan technique in the femtosecond regime. Our results revealed a high nonlinear refractive index for these samples, roughly forty times higher than that of silica. We also examined the nature of the refractive dispersion in this system through the nonlinear Kramers–Kronig relation formulated for amorphous semiconductors [1]. We show that although the nonlinear refractive index reaches its highest values in regions with strong absorption, a mismatch emerges between the dispersion of refraction and absorption toward the infrared, where the material still exhibits high refractive indices despite negligible absorption. We conclude that tellurite glasses may offer a favorable combination of high refractive index and vanishing nonlinear absorption for applications in telecommunication bands.

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References

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