TeO2-ZnO-La2O3 glass composition for mid infrared wavelengths generation and transmission in optical fibers

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max. 300 words abstract:

Numerous applications in the Mid-InfraRed (Mid-IR) wavelength region still require basic optical components such as sources and optical fibers as transmission medium. Thanks to its mid-IR transparency and nonlinearity, tellurite glass allows for developing both these types of components. However, practical applications require materials able to handle high optical intensity through enhanced material damage threshold. We report on the synthesis of a tellurite glass in the TeO_2-ZnO-La_2O_3 (TZL) system which presents enhanced thermo-mechanical properties with respect to typical tellurite glass compositions. We measured for the TZL composition a glass transition of 626 K, hence 70 K higher than the glass transition temperature of "standard" TZN compositions. The coefficient of thermal expansion was measured to be $138 \cdot 10^{-6}$/K as compared to typical value of $180 \cdot 10^{-6}$/K for TZN glass. We manufactured two types of fibers to assess the prospect for achieving high average power SC sources and Mid-IR transmission in TZL glass fibers. First, a high Numerical Aperture (NA) aperture fiber was developed through standard rod-in tube technique, where the cladding glass tube was manufactured by extrusion. The 50 µm core fiber presents an optical attenuation value of 0.26 dB/m at 1.55 µm. As an intermediate step towards the fabrication of an antiresonant hollow core fiber for high power transmission, we manufactured a preform and drew it into a cane. A TZL glass tube, 120 mm-long and 9 mm/12 mm of inner/outer diameters (ID/OD) was manufactured via rotational casting technique. This latter tube was drawn into a tube of 2 mm in diameter which was cut into sections 130 mm long. Seven of those were stacked in another tellurite glass tube 6.5 mm/12 mm of ID/OD diameters, respectively. This preform was then drawn into a microstructured cane 1.6 mm in diameter which features tubular structures periodically arranged and of uniform thickness.