Luminescence and up-conversion of Er doped TeO_2-$PbCl_2$-WO_3 glasses

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Tellurite glasses are attracting attention for their excellent properties for optoelectronic applications. The glass network consisting exclusively of tellurium oxide is highly unstable and results in rapid devitrification of the glass melt. However, the addition of a wide variety of modifiers leads to stabilization of the tellurite glass network and to the formation of glasses with very different properties. Tungsten oxide is a relatively heavy glass network modifier that effectively stabilizes the TeO_4 network reducing the network's phonon energies and contributing to a high refractive index due to high polarization ability of tungsten valence orbitals. Lead compounds also have a significant stabilizing effect on the tellurium network. Lead chloride has the advantage that it introduces chlorine in addition to heavy lead atoms, which, by its presence, further disrupts the symmetry of structural units present when substituting the oxygen atoms, thus reducing the devitrification tendency of the glass melt and stabilizing its amorphous structure.

In this work, we focus on photoluminescence (PL) properties of erbium-doped TeO_2-$PbCl_2$-WO_3 (TBW:Er) glasses, IR to VIS/NIR up-conversion, and the temperature dependence of selected PL bands. We have demonstrated that the investigated glasses show promising spectroscopic properties. The visible PL under 514.5 nm excitation is dominated by two green bands centred at 528 and 550 nm; the highest luminescence intensity in near infrared region was observed for the transition at 1530 nm. The FWHM the band centred at 1530 nm exhibits broadening from 54 to 71 nm, when Er^{3+} ions concentration increased from 0.25 to 1 mol%. This result indicates that TBW:Er glass is a good candidate for application as a broadband optical amplifier. We obtained green, red, and NIR up-conversion emissions under 980 nm excitation. The square dependence of the emission on excitation power indicates that two photon absorption dominates to the up-conversion mechanism. The strong green emission was obtained under both VIS (514.5 nm) and NIR (980 nm) excitation. Based on the LIR technique we evaluated the optical temperature sensing abilities of the TBW:Er glass and we conclude that these glasses are suitable for temperature sensing at low temperatures

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