# Optical properties and energy transfer of fluorotellurite glasses doped with $Sm^{3+}$ and $Sm^{3+}$:$Yb^{3+}$ in visible and near-infrared wavelength under three different excitation sources.

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**Abstract:** Here, we fabricated $Sm^{3+}$ singly doped and $Sm^{3+}$: $Yb^{3+}$ codoped barium fluorotellurite-based glasses and examined their spectroscopic properties. New series of near-IR photoluminescence emissions of $Sm^{3+}$ were observed under 405 and 450 excitation lasers.

Fluorotellurite-based glasses have been investigated for numerous optical applications such as lasers, fibre optics, waveguides, and Raman gain devices. The fluorotellurite materials exhibit high linear and nonlinear refractive indices of ~2.0, and extended UV- and IR transparency (0.35 to 5.0μm). Above all, the glass host promotes the retention of large concentrations of $RE^{3+}$-ions in an environment of depleted OH-ion, which is advantageous from the point of view of enhanced spectroscopic properties for light amplification in visible and near-IR.

In this presentation, we have selected the $Sm^{3+}$:$Yb^{3+}$ codoped barium fluorotellurite glasses with the composition (in mol%): $(80\text{-}x)TeO_2$-$(10)ZnO$-$(10)BaF_2$-$(1.0)Yb_2O_3$–$(x=0\text{-}1.0Sm_2O_3)$, which were synthesised by employing controlled atmosphere of melting in dry oxygen and quenching. The powder mixtures were melted in a gold crucible at 750 -800 $^oC$ in an oxygen atmosphere for 3 hrs using an electrical furnace. The molten glass was transferred into a pre-heated brass mould at 300 $^oC$ and then annealed at the same temperature for 3 hrs to remove stress. The glass was cut and polished for optical characterisation. We report on the UV-visible-NIR Raman spectroscopy, absorption spectra, Judd-Oflet parameters, and photoluminescence properties. The photoluminescence emission of $Sm^{3+}$ and $Sm^{3+}$-$Yb^{3+}$ doped glasses prepared were collected by exciting with 405 nm, 450 nm, and 980 nm laser sources for comparison. The 405 nm and 450 nm excitations reveal new series of NIR photoluminescence emissions from $Sm^{3+}$ ions, corresponding to $^6F_{11/2}$ state to $^6H_J$ ($J$=7/2, 9/2, 11/2) transitions. In addition, we analysed the dominant interaction and energy transfer processes such as non-resonant phonon-assisted, non-radiative process, and cross-relaxation between $Sm^{3+}$-$Sm^{3+}$ and $Yb^{3+}$-$Sm^{3+}$ ions upon exciting with a 976 nm laser.

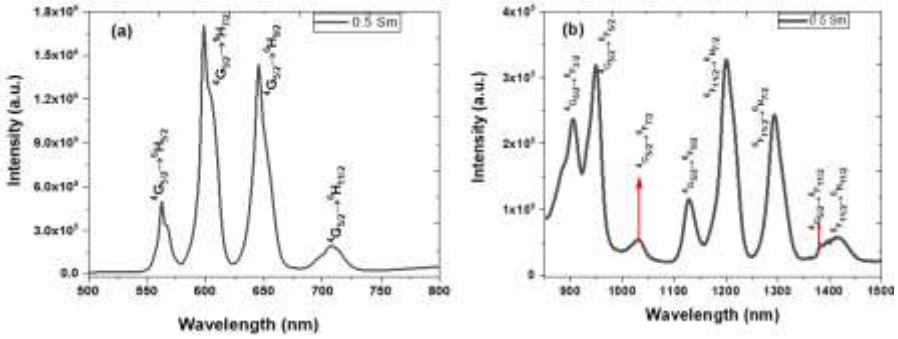


**Figure 1**: (a) Visible and (b) near-infrared (NIR) wavelengths photoluminescence spectra of 0.5 mol% $Sm^{3+}$ doped barium fluorotellurite glass series under 450 nm excitation.

## References:

E. Kumi-Barimah et al. Effect of $Yb^{3+}$ on the Structural and Visible to Near-Infrared Wavelength Photoluminescence Properties in $Sm^{3+}$-$Yb^{3+}$-Codoped Barium Fluorotellurite Glasses. Materials, 15, 3314 (2022).