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Structural and fluorescence properties of Ho³⁺/Yb³⁺ doped germanosilicate glasses tailored by Lu₂O₃

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ABSTRACT: Structural and fluorescence properties of Ho³⁺/Yb³⁺ co-doped germanosilicate glasses have been modified by tailoring the composition using lanthanide additive Lu₂O₃. Raman spectra and X-ray Photoelectron spectra reveal that the addition of Lu₂O₃ can change the structure by increasing non-bridging oxygens (NBO) in this glasses. Meanwhile, an improved thermal stability (ΔT : from 110 to 187 °C) has also been obtained via Lu³⁺ ‘lanthanide contraction’. Furthermore, the positive effect of changed glass structure gives excellent fluorescence properties by the decreasing cross relaxation process which are proved by the experimental upconversion, near-infrared and mid-infrared fluorescence spectra. Additionally, a double enhancement of a 2.0 μm emission has been achieved successfully in this silica-germanate glass with 7 mol% Lu³⁺ addition, which possesses a larger emission cross section ($4.41 \times 10^{-21} \text{ cm}^2$) at 2022 nm. These results indicate that the optimized emission of Ho³⁺ for optical fiber laser can be achieved by tuning the glass structure using lanthanide additive Lu₂O₃.

Keywords: Germanosilicate glasses; Lanthanide additive Lu₂O₃; NBO and BO; Energy transfer.

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