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Study on upconversion luminescence and thermal properties of Ho<sup>3+</sup>/Yb<sup>3+</sup> co-doped La<sub>2</sub>O<sub>3</sub>-TiO<sub>2</sub>-ZrO<sub>2</sub> glasses

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**Study on upconversion luminescence and thermal properties of Ho<sup>3+</sup>/Yb<sup>3+</sup> co-doped  
La<sub>2</sub>O<sub>3</sub>-TiO<sub>2</sub>-ZrO<sub>2</sub> glasses**

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**ABSTRACT:**

Bulk Ho<sup>3+</sup>/Yb<sup>3+</sup> co-doped La<sub>2</sub>O<sub>3</sub>-TiO<sub>2</sub>-ZrO<sub>2</sub> glass spheres were fabricated by aerodynamic levitation method. High concentration of Yb<sup>3+</sup> ions was successfully doped in glasses. The effects of Yb<sup>3+</sup> concentration on mechanical properties, Raman, absorption spectra, thermal stability, and glass forming ability were studied systematically. Green, red, and infrared emissions centered at 550, 662, and 758 nm were obtained at 980 nm excitation. Yellow light from glass spheres can be easily observed by naked eyes. As Yb<sup>3+</sup> concentration increases, the upconversion luminescence can be improved obviously. The upconversion luminescence mechanism is a two-photon process of energy transfer, excited state absorption, and energy back transfer. The emission intensity can be enhanced in the samples with high Yb<sup>3+</sup> concentration, since the absorption for the incident laser and the energy transfer efficiency are increased, and the nonradiative relaxation probability is reduced. The light color referring

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