Green and red up-conversions in co-doped Er^{3+}/Yb^{3+} telluride fibers pulled from bulk glasses

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Glasses based on TeO_2 are transparent in the visible, near and middle infrared regions; the position of the IR cut-off may be shifted towards longer wavelength as heavier ions enter the glass composition in binary and ternary systems. Tellurite glasses have low phonon energy and nonlinear optical properties because of the high refractive index (∼2.0). The low phonon energy and high refractive index yield low nonradiative decay rates and high radiative emission rates of rare-earth energy levels, as a result, these glasses can provide more efficient up-conversion luminescence intensities. In particular TeO_2-ZnO-Nb_2O_5 glasses have a transmission window ranging from 0.36 μm to 6.5 μm and phonon energy of 700 cm^{-1}, similar to germanate glasses but lower than silicate (1100 cm^{-1}) and phosphate (1200 cm^{-1}). Another essential property of telluride glasses is the suitability to be fibered.

Er^{3+} doped glasses have attracted much interest due to their important optical properties for use in lasers, photonic devices and other communications devices. When 980 nm laser diodes were developed, these interests were stimulated, from the application point of view. The spectral region of the $^2F_{7/2} \rightarrow {}^2F_{5/2}$ transition of the Yb^{3+} ion overlaps that of the $^4I_{15/2} \rightarrow {}^4I_{11/2}$ transition of the Er^{3+} ion, and it becomes possible to achieve an effective Yb^{3+} to Er^{3+} transfer mechanism of the excitation energy.

We produce and characterize two samples of Er^{3+}/Yb^{3+} co-doped telluride glasses with 0.5 wt% of Er_2O_3 and 1 wt% for the first sample and 5 wt% of Yb_2O_3 for the second one and then we pulled fibers from this bulks. As a result we observe an increase of the green and red up-conversion intensities when the concentration of Yb^{3+} increases in the bulks and the same occurred in the fibers.