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NANOCRYSTAL FORMATION AND PHOTOLUMINESCENCE IN Yb³⁺-Er³⁺-DOPED PHOSPHOSILICATE GLASS

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Abstract: We report a new way to prepare Yb³⁺-Er³⁺-doped transparent phosphosilicate glass-ceramics containing nanocrystals with size of 20-30 nm. The nanocrystals were generated during cooling of the melt with a properly designed composition. The effect of alkali oxides on the crystallization of phosphosilicate melts was studied by means of differential scanning calorimetry, X-ray diffraction, and transmission electron microscopy. The infrared-to-visible frequency upconversion in the nanocrystal containing glass-ceramic was observed and quantified using the absorption and emission spectroscopy. It is likely that tetrahedral coordination of Mg²⁺ with oxygen contributes to the high transparency of the glass-ceramics. High efficient upconversion luminescence of Er³⁺ at 520, 545 and 656 nm was observed in the glass-ceramics under 980 nm excitation. However, the trend of the intensity change of red emission with crystalline types and contents is different from that of green emission. We clarify how the Yb³⁺→Er³⁺ energy transfer and the intensified local field effect simultaneously influence the upconversion luminescence. These glass-ceramics are promising candidates for upconversion luminescence.

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