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Publication date:
2012

Document Version
Accepted author manuscript, peer reviewed version

Link to publication from Aalborg University

Citation for published version (APA):
NANOCRYSTAL FORMATION AND PHOTOLUMINESCENCE IN Yb$^{3+}$-Er$^{3+}$-DOPED PHOSPHOSILICATE GLASS

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Abstract: We report a new way to prepare Yb$^{3+}$-Er$^{3+}$-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 Mg$^{2+}$ with oxygen contributes to the high transparency of the glass-ceramics. High efficient upconversion luminescence of Er$^{3+}$ 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 Yb$^{3+} \rightarrow$ Er$^{3+}$ energy transfer and the intensified local field effect simultaneously influence the upconversion luminescence. These glass-ceramics are promising candidates for upconversion luminescence.

Acknowledgments

This work was supported by the Natural Science Fund of Elite Young Researchers of Shandong Province No. 2008BS04004, Science and Technology Star Plan of Young Researchers of Jinan City No. 20080118 and the Taishan Scholar Fund of Shandong Province.

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