Crystallization behavior of niobium phosphate glasses

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Amorphous materials containing high Nb_2O_5 contents are promising materials as rare earth hosts due to drastic structural changes induced by the niobium insertion inside the covalent former network and resulting changes in several physical properties such as higher refractive index, lower phonon energy as well as several distinct rare earth sites resulting in non homogeneous broadening of the emission bands[1]. Precipitation of crystalline Nb_2O_5 by suitable heat treatments further improves several luminescence properties, resulting in even higher quantum efficiency and increased broadening of the emission signals[2]. Such behaviors were identified in SiO_2-based materials prepared by sol-gel. In his work, transparent and homogeneous glasses were prepared by melt-quenching in the KPO_3-Nb_2O_5 binary system and the thermal properties determined by DSC. Higher Nb_2O_5 contents result in higher glass transition temperatures and lower thermal stability against devitrification. Composition $50KPO_3$-$50Nb_2O_5$ exhibited two distinct crystallization events related with hexagonal Nb_2O_5 at lower temperatures and niobium potassium phosphate corresponding to crystallization of the residual glass at higher temperature. Less Nb_2O_5-concentrated samples only presented precipitation of this latter crystalline phase. The crystallization parameters (temperature, time) were carefully investigated in sample $50KPO_3$-$50Nb_2O_5$ for a controlled precipitation of hexagonal Nb_2O_5 nanocrystallites and obtaining of a transparent glass-ceramic which is promising as a rare earth host for improved luminescent properties.

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