Transparent 80SiO2-20LnF3 sol-gel oxyfluoride glass-ceramics for photonics

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Abstract

The usual method to prepare oxyfluoride glass-ceramics (OxGCs) is traditional glass melt-quenching (MQ) [1,2]. Nevertheless, the MQ method presents some drawbacks, such as the high melting temperatures (1400-1700 °C) that lead to significant fluorine loss, up to 30-40 wt%, thus limiting the final crystal content (_˜ 10 wt%). In addition, due to frequent phase separation, it is a challenge to prepare samples with high optical quality. To overcome these limitations, the Sol-Gel (SG) route has been considered as a promising alternative process to obtain transparent OxGCs. In fact, SG is a practical, very flexible and relatively cheap method to fabricate novel and innovative materials at temperatures much lower than those used for MQ materials. The low temperature allows higher amounts of fluoride nanocrystals to be introduced with much better dispersion than in MQ compositions. Moreover, higher homogeneity can be obtained with no phase separation. However, to date results concerning SG OxGCs have treated very small active-phase concentrations (< 10 mol%) and all the benefits that this process offers have not been exploited.. In this work, we present the synthesis and properties of novel 80SiO2-20LnF3 GCs (Ln=La, Gd) doped with Rare-Earth (RE) ions [3]. Structural features obtained by XRD, HRTEM, EDXS, XAS, FTIR and NMR are studied. A crystal fraction of 18 wt%, the highest value reported for SG OxGCs, was obtained by Rietveld refinement. The incorporation of RE ions in fluoride crystals will also be shown, along with photoluminescence properties. Enhanced optical emissions are obtained for the GC samples due to the low phonon energy of the fluoride crystals.
References

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