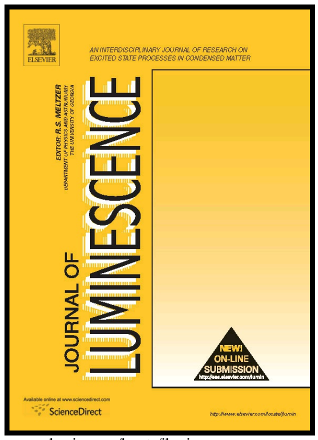

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Cubic and rhombohedral $Ba_4Lu_3F_{17}$:Er^{3+} in transparent glass ceramics: crystallization and upconversion luminescence

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Abstract

Novel Er^{3+} doped glass ceramics containing $Ba_4Lu_3F_{17}$ nanocrystals were successfully prepared by heat treatment of melt-quenched glasses.

Highly efficient upconversion luminescence was detected under near-infrared excitation and it was at least two orders of magnitude higher than that in the precursor glass. The activator content in the crystalline phase was estimated using polycrystalline $Ba_4Lu_3F_{17}$ with different Er^{3+} content as the reference and it was found to be higher than in similar glass ceramics.

The structure and thermal analysis of the glass ceramics revealed the formation of cubic and rhombohedrally distorted cubic modifications of $Ba_4Lu_3F_{17}$. Phase transition between the two modifications was studied using site selective spectroscopy of Er^{3+} as a structural probe.

Unusually efficient incorporation of Er^{3+} ions in the $Ba_4Lu_3F_{17}$ nanocrystals combined with the low phonon energy of the fluoride crystals make this material a desirable host for upconversion luminescence.

Keywords: upconversion, luminescence**,** $Ba_4Lu_3F_{17}$, site-selective spectroscopy, glass ceramics

Introduction

Transparent oxyfluoride glass ceramics have been widely investigated for promising applications in photonics such as in solid state lasers [1], optical thermometry [2,3], X-ray imaging [4,5], non-linear optics [6], holographic recording [7], optical cooling [8] and light conversion devices [9,10]. These composites contain fluoride nanocrystals dispersed in glass matrix and combine the good mechanical and chemical stability of oxides with the excellent optical properties of fluorides [11,12].

Rare earth (RE) doped oxyfluoride glass ceramics are found to be suitable for upconversion luminescence (UCL) – an anti-Stokes process in which photons with lower energy are converted to ones with higher energy [13]. The highest UCL quantum yield has been detected in Er^{3+} doped materials, which are extensively investigated for near-infrared to visible UCL [14]. It is known, that an efficient UCL process requires suitable host with good Er^{3+} solubility, low phonon energy and low