

Europium luminescence in zinc aluminosilicate glasses containing SrF₂ and CaF₂ nanocrystals

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Photoluminescence (PL) and absolute PL quantum efficiency (QE) spectra of SiO₂-Al₂O₃-ZnF₂-SrF₂ (SAZ-SrF₂) and SiO₂-Al₂O₃-ZnF₂-CaF₂ (SAZ-CaF₂) zinc aluminosilicate glasses and glass ceramics have been investigated; for optical activation the glasses are doped with trivalent europium ions. QE values between 60-70 % are found. The Eu³⁺-related emissions from the excited state ⁵D₀ to the ground states ⁷F₁ (580-600 nm) and ⁷F₂ (600-625 nm) can be assigned to electrical and magnetic dipole transitions, respectively. The asymmetry ratio, which is defined as the ratio between the integrated emission intensities of the ⁵D₀ → ⁷F₂ and ⁵D₀ → ⁷F₁ transition, is an indicator for the symmetry of the Eu³⁺ surrounding: The ratio is high for sites with low symmetry and vice versa [1]. After a subsequent thermal processing step, the asymmetry ratio changes in favour of the ⁵D₀ → ⁷F₁ transition, i.e. the high-symmetry site. X-ray diffraction on the thermally-processed samples indicates the formation of SrF₂ and CaF₂ crystallites in the glass. The crystallite sizes are in the range of a few tens of nanometers. Preliminary PL experiments have shown that a part of the trivalent europium ions have been converted to divalent europium and incorporated into the SrF₂ and CaF₂ nanocrystals.

Participation is supported by ERAF project No. 2015/0014/2DP/2.1.1.2.0/14/APIA/VIAA/010

References

1. T. Montini, A. Speghini, P. Fornasiero, M. Bettinelli, M. Grazini, J. Alloys Compounds, 617 (2008)