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Tb³⁺ as a probe for the molecular structure of mixed barium magnesium aluminosilicate glasses

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Abstract

Two series of mixed barium magnesium aluminosilicate glasses with the molar compositions (35-x) BaO · x MgO · 10 Al₂O₃ · 55 SiO₂ (mol%) (peralkaline series: x=0, 2.5, 5, 7.5, 10, 15, 25, 35) and (20-x) BaO · x MgO · 20 Al₂O₃ · 60 SiO₂ (mol%) (metaluminous series: x=0, 10, 20) have been prepared and doped with Tb³⁺ ions with a constant concentration of 1·10²⁰ cm⁻³. Despite the constant doping concentration in all samples, the Tb³⁺ luminescence spectra and lifetimes show clear and systematic effects depending on the BaO/MgO and (BaO+MgO)/Al₂O₃ ratios in the samples. For the peralkaline glass series with 35 mol% network modifier oxides, the strong effect on the luminescence emission peak ratios and the Stark splitting of the emission peaks points to a strong influence of the network modifying ions and systematic changes in the Tb-Tb distances. For the metaluminous series with 20 mol% network modifier oxides and 20 mol% Al₂O₃, these changes are comparably small.

The Tb³⁺ luminescence lifetimes increase with increasing BaO concentrations in the peralkaline series but decrease in the metaluminous series. All effects are discussed with respect to the local surrounding of the doped Tb³⁺ ions.

keywords: terbium, Tb³⁺, aluminosilicate, glass, structure, symmetry

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