

Crystal field and exchange interactions in the SmFe₃(BO₃)₄ multiferroic

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Abstract

The optical spectra of oriented SmFe₃(BO₃)₄ single crystals are studied in the region of the f-f transitions in the Sm³⁺ ion by Fourier spectroscopy. The energies, the symmetry properties, and the exchange splittings of the Stark sublevels of the ground and 17 excited multiplets of the Sm³⁺ ion in a crystal field of symmetry D₃ are determined from the measured temperature dependences of polarized-radiation absorption spectra. The parameters of the crystal field acting on samarium ions and the parameters of the exchange interaction between Sm³⁺ and Fe³⁺ ions are found. The anisotropy of the effective exchange interaction is shown to be substantially stronger than the magnetic anisotropy, due to a strong crystal-field-induced mixing of the ground and excited multiplets. © 2014 Pleiades Publishing, Inc.

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