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Author

Kuz'menko AM. Mukhin AA. Ivanov VY. Kadomtseva AM. Bezmaternykh LN.

Title

Effects of the Interaction between R and Fe Modes of the Magnetic Resonance in RFe(3)(BO(3))(4) Rare-Earth Iron Borates

Source

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Abstract

Resonance modes that are due to magnetic excitations in the exchange-coupled subsystems of rare-earth ions (R = Nd(3+), Sm(3+), and Gd(3+)) and Fe(3+) ions have been detected in submillimeter transmission spectra (0.1-0.6 THz) of RFe(3)(BO(3))(4) iron borate-multiferroic single crystals. The strong interaction between spin oscillations of the Fe and R subsystems has been revealed, which determines the behavior of the modes depending on the anisotropy of the exchange splitting of the ground doublet of the R ion. It has been shown that the intensities of coupled modes (contributions to the magnetic permeability) depend strongly on the difference between the g factors of Fe and R ions. This dependence makes it possible to determine the sign of the latter g factor. In particular, a noticeable intensity of exchange Nd modes in NdFe(3)(BO(3))(4) is due to an increase in their contribution at g(perpendicular to,parallel to)(Nd) < 0, while in GdFe(3)(BO(3))(4) with g(Gd) approximate to g(Fe) approximate to 2, the Fe and Gd contributions compensate each other and the exchange (Gd) mode is not observed. In spite of the weak interaction of Sm ions with the magnetic field, SmFe(3)(BO(3))(4) exhibits resonance modes, which are attributed to the excitation of Sm ions through the Fe subsystem.