Infrared study of lattice and magnetic dynamics in a spin-chain compound Gd2 BaNiO5

Klimin S., Kuzmenko A., Popova M., Malkin B., Telegina I. Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

We present infrared spectra of Gd2 BaNiO5, which is isostructural to a prototype S=1 Haldane compound Y2 BaNiO 5 containing Ni2 \supset + chains, in the spectral range 2 meV-0.55 eV. Unlike Y2 BaNiO5, the studied compound contains magnetic rare-earth sublattices and orders antiferromagnetically at TN =58 K. Detailed information on optical phonons is given. Temperature dependences of frequencies and half widths for the two lowest-frequency phonons polarized along the Ni-chain direction evidence the interaction of these lattice vibrations with magnetic excitations. With the help of lattice-dynamics calculations, we find relative displacement vectors of ions for all the phonon modes and use them to discuss the mechanism of phonon-magnon interaction. The optical spectra exhibit a broad absorption continuum for radiation polarized along the chains, probably of magnetic origin, gradually decreasing with lowering temperature. A new mode at about 30 cm \supset -1 polarized along the chains (a axis) emerges below ~150 K. A midinfrared absorption peak at 1306 cm \supset -1 (0.16 eV) is observed and found to sharpen and shift significantly at TN. We argue that it can be attributed to a phonon-assisted magnetic absorption and discuss its nature in the framework of the Lorenzana-Sawatzky-Eder model. © 2010 The American Physical Society.

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