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

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Abstract

We present infrared spectra of Gd2 BaNiO5, which is isostructural to a prototype S=1 Haldane compound Y2 BaNiO 5 containing Ni2⊃+ 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⊃-1 polarized along the chains (a axis) emerges below ~150 K. A midinfrared absorption peak at 1306 cm⊃-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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