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Elastic constants in multiferroic Bi2Mn4O10

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Mullite-type Bi2Mn4O10 [1] is an example for a multiferroic compound with a Néel temperature of 39 K, although its crystal structure [2] is not typical for allowing ferroelectricity. The dipoles of the constituent Mn4+O6 (along c-axis, bond valence sum BVS = 3.90(2) v.u.) and Mn3+O5 (along b-axis, BVS = 3.04(2) v.u.) polyhedra are oriented in different directions [3]. Both its nuclear and magnetic structural features differ from those of other rare-earth members of the R2Mn4O10 family. While each member of R2Mn4O10 family possesses incommensurate magnetic character [4], Bi2Mn4O10 exhibits a commensurate [5] magnetic structure. In order to characterize its lattice dynamical properties we have studied the acoustic phonon branches of a single crystal of Bi2Mn4O10 at room temperature using inelastic neutron scattering (INS). Experiments have been performed at the three-axes spectrometer PUMA@FRM II. The dispersion curves of the acoustic phonon branches in the Brillouin zone have been measured for different propagation directions close to the zone center (Gamma-point) and for different polarization vectors. The linear slopes of the corresponding dispersion curves are related to a specific combination of the elastic constants cij. We were able to determine the complete set of nine elastic constants cij provided by the orthorhombic crystal (Pbam). The results clearly demonstrate the pronounced mechanical anisotropy of Bi2Mn4O10.

References

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