9.7 cm

NATURE OF MAGNETOELASTIC INTERACTION IN $YbPO_4$

N.P. Kolmakova and O.A. Shishkina
Technical University, 241035 Bryansk, Russia

The work is devoted to a theoretical analysis of the temperature dependences of elastic constants C^{μ} in the tetragonal paramagnet with the zircon structure $YbPO_4$, that provides a means of resolving a fundamental question concerning the nature of the electron-lattice interaction in oxides, i.e., whether the dominant coupling of the rare earth ions to the lattice is via optic or acoustic phonon modes. In the absence of an optic mode contribution to a pair guadrupole interaction, the ratio of its constant K^{μ} to the magnetoelastic constant $G^{\mu}_{me} = (B^{\mu})^2/C^{\mu}_0$ equals -1/3 (B^{μ} is the magnetoelastic coefficient). In $YbPO_4$ a 20% softening of the C^{γ} elastic constant in the temperature range between 300 and 15 K have been observed[1], this indicates an underlying tendency of the $YbPO_4$ lattice to undergo an orthorhombic distortion of the B_{1g}-symmetry. The best fit of the calculations within the scope of the general crystal field approach to the experimental data gives K^{γ}=347 K and B^{γ}=9.77 10^3 K (C^{γ}_0=1.36 10^6 K/f.u.). These values show that $YbPO_4$, along with $DyVO_4$ and $TmPO_4$, belongs to a group of zircons in which the interaction is mainly via optic phonons, in contrast to the compounds $TmVO_4, TbVO_4, TbPO_4$, where the ratio -1/3 is valid and the acoustic phonon coupling is dominant.

[1] J. Nipko et al., Phys. Rev. B53, 2286 (1996).

13.4 cm

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Corresponding author :
O.A. Shishkina

Address for correspondence :
Chair of Physics,
Technical University,
Bulvar 50-letia Octyabrya,7, 241035 Bryansk, Russia

Email address :
olga@physics.bitmcnit.bryansk.su