Nanocomposites and nanomaterials

Magnetopiezoelectric effect in Sm and Nd ferroborates

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We have investigated piezoelectric responses in samarium and neodymium ferroborates. It appeared that the samarium compound demonstrates a giant magnetopiezoelectric effect—the effective PM is increased more than twice in the antiferromagnetic phase and it is suppressed by a magnetic field [1]. The cause of the PME is caused by the combined action of the elastic and electric fields on the orientation of the magnetic vectors in the reference plane (including the spin-flop phase In general the nature of the MPE effect is alike to magnetocapacitance effect (ME) which is inherent for multiferroics.

The given below results [2] are related to another representative of ferroborate's family – neodymium feroborate - $NdFe_3(BO_3)_4$. The main aim of these investigations was to detect the general laws of manifestation of MPE and ME effects in such compounds. It was obtained that despite some quantitative differences, the characteristics of these effects are similar for all easy-plane ferroborates. At fields that exceed the spin-flop one the relative changes of piezomodulus δe/e and permittivity δε/ε are described by the phenomenological equations:

$$\delta e/e \approx ab\sin^2 2\varphi/e\chi H^2, \quad \delta\varepsilon/\varepsilon \approx 4\pi a^2 \sin^2 2\varphi/\varepsilon\chi H^2$$

Here *a*,*b* are magnetoelectric and magnetoelastic coefficients, φ is angle between magnetic field direction and C2 axe and χ is the magnetic susceptibility. On Fig.1. it is shown that the linear in H^{-2} dependence are well fulfilled. From the slope of the approximating straight lines constants *a* and *b* can be easily determined. For $NdFe_3(BO_3)_4$ at T=1,7K a ≈ 450 μCl/m^2, b ≈ 8 · 10^6 J/m^3.

1. *T. N. Gaydamak, I. A. Gudim, G. A. Zvyagina, I. V. Bilych, N. G. Burma, K. R. Zhekov,and V. D. Fil,* Physical Review B **92**, 214428 (2015).
2 *V. Bilich, K. R. Zhekov, T. N. Gaydamak, G. A Zvyagina., V. D. Fil,* Low Temperature Physics 42, 1112 (2017) [Fiz. Nizk. Temp 41, 792-797].