Giant Magnetoelectric Effect in $HoAl_3(BO_3)_4$ at Low Temperatures

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The magnetoelectric effect in the system $RAl_3(BO_3)_4$ (R = Tb, Er, Tm, Ho) is investigated between 2 K and room temperature and at magnetic fields up to 70 kOe. We show a systematic increase of the magnetoelectric effect with decreasing magnetic anisotropy of the rare earth moment. A giant magnetoelectric polarization is found in the magnetically (nearly) isotropic $HoAl_3(BO_3)_4$. The polarization value in transverse field geometry at 70 kOe reaches 3600 $\mu C/m^2$ which is significantly higher than reported values for the field-induced polarization of the known bulk magnetoelectric materials, including linear magnetoelectric or even multiferroic magnetoelectric compounds. The magnetostrictive effect is also measured and compared with the magnetoelectricity. The results cannot solely be explained by the piezoelectric effect that originates from a field-induced change of lattice parameters but they rather suggest the ionic displacements in the unit cell and a change of the polar distortion on a microscopic scale. $HoAl_3(BO_3)_4$ may be a candidate for a technological utilization of the magnetoelectric effect.
This work is supported by the US Air Force Office of Scientific Research, the US Department of Energy, the T.L.L. Temple Foundation, the J. J. and R. Moores Endowment, and the State of Texas through the TCSUH.