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Giant magnetoelastic effect in multiferroic $Ba_{0.6}Sr_{1.4}Zn_2Fe_{12}O_{22}$

DIYAR TALBAYEV, RICHARD D. AVERITT, ANTOINETTE J. TAYLOR, Los Alamos National Laboratory, TSUYOSHI KIMURA, Bell Laboratories — Dynamical studies of multiferroic materials help unravel the fundamental interactions between various degrees of freedom and answer technological questions such as achievable switching speeds in multiferroic-based memory elements. We report the results of the ultrafast optical study of multiferroic $Ba_{0.6}Sr_{1.4}Zn_2Fe_{12}O_{22}$, which reveals a giant magnetoelastic effect in the material. The compound exhibits a hexagonal crystal structure and a helical magnetic ground state below $\sim$ 330 K. In applied magnetic field, the hexaferrite undergoes a series of magnetic phase transitions and develops ferroelectric polarization. The magnetoelastic effect is detected via the measurement of the speed of sound in the crystal as a function of magnetic field. The oscillation in the optically induced transient reflectivity resulting from the propagating coherent-phonon strain pulse allows us to measure the field-induced changes in the speed of sound and the corresponding dramatic changes in the elastic stiffness. The dependence of the exchange interaction on the distance between Fe ions gives rise to the observed magnetoelasticity. Our results indicate a route towards the magnetically modulated transducers and piezoelectric devices.

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