Reversible electric control of exchange bias in a multiferroic field-effect device

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Abstract: Electric-field control of magnetization has many potential applications in magnetic memory storage, sensors and spintronics. One approach to obtain this control is through multiferroic materials. Instead of using direct coupling between ferroelectric and ferromagnetic order parameters in a single-phase multiferroic material, which only shows a weak magnetoelectric effect, a unique method using indirect coupling through an intermediate antiferromagnetic order parameter can be used. In this article, we demonstrate electrical control of exchange bias using a field-effect device employing multiferroic (ferroelectric/antiferromagnetic) BiFeO 3 as the dielectric and ferromagnetic La 0.7 Sr 0.3 MnO 3 as the conducting channel; we can reversibly switch between two distinct exchange-bias states by switching the ferroelectric polarization of BiFeO 3. This is an important step towards controlling magnetization with electric fields, which may enable a new class of electrically controllable spintronic devices and provide a new basis for producing electrically controllable spin-polarized currents.

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