Tunneling across a multiferroic barrier.

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Magnetic materials have been massively used for data storage for decades and the development of magnetic multilayers in the 1980's [1] has led to a new type of electronics relying on the electron spin, spintronics [2]. Concurrently, advances in ferroelectric thin film research have led to a large number of technological applications in sensor industry and consumer electronics [3]. While magnetism and ferroelectricity usually exclude each other, it was realized some time ago that they can indeed coexist in a few materials called multiferroics [4]. In these compounds, several degrees of freedom (magnetization, electric charge, etc) are available and provide the ability to exploit multiple functionalities in a single material [5]. A viable approach to simply take advantage of the multifunctional character of multiferroics is to integrate them as a tunnel barrier. Here we report on the fabrication and characterization of magnetic tunnel junctions using a barrier made of a ferromagnetic and ferroelectric 2 nm thick epitaxial layer of $La_{0.1}Bi_{0.9}MnO_3$ (LBMO). With these junctions, we will first explore a concept recently proposed in spintronics, namely spin-dependent tunneling through a ferromagnetic barrier (the so-called spin-filter effect [6]). We will then show that ferroelectricity is preserved in these structures and discuss its influence [7] on tunneling transport.

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