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Spin filtering with magnetic oxide tunnel barriers

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Interesting physical phenomena and potential new devices arise when the barrier of magnetic tunnel junctions is made of a ferroic material. In the most studied case of ferromagnetic barriers, carriers are spin-polarized by the spin-filter effect, which gives rise to tunnel magnetoresistance (TMR). We will present results on the use of ultrathin ferrimagnetic and ferromagnetic layers as tunnel barriers. We have use thin films of $NiFe_2O_4$ (NFO), T_C=850K, to filter electrons according to their spin with an efficiency of $\sim$25%, as evidenced by a TMR of up to 60% in $La_{2/3}Sr_{1/3}MnO_3$(LSMO)/NFO/Au junctions. We will discuss these results in the frame of a model describing tunneling through epitaxial magnetic barriers. We will also show results on ferromagnetic films of $BiMnO_3$ and $La_{0.1}Bi_{0.9}MnO_3$ (LBMO) and their use as spin-filter barriers. Interestingly, LBMO films are also ferroelectric and therefore exhibit a multiferroic character, that is retained down to thicknesses of only 2 nm. Accordingly, LSMO/LBMO/Au junctions exhibit four different resistance states, instead of two with conventional spin-filters. We will discuss the origin of this behavior on the basis on the combination of the spin-filter effect and the influence of ferroelectricity on tunneling.