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Spin-orbit coupling and the ultimate limit for spin-polarized tunneling from half-metallic electrodes J.D. BURTON, EVGENY Y. TSYMBAL, University of Nebraska - Lincoln — Half-metallic materials, i.e. metals that have free carriers only in one spin channel, should act as ideal materials for spin-polarized transport applications. In magnetic tunnel junctions with identical half-metallic electrodes, for example, there would in principle be zero tunneling transmission (infinite resistance) when the magnetization of the electrodes are aligned anti-parallel, making the tunneling magnetoresistance (TMR) ratio infinite. In practice, however, it is thought that this idealized case can only hope to work at zero temperature and when the electrodes are in a truly mono-domain configuration: effects which are generally very difficult to minimize. Also, however, one factor that can never be suppressed is the mixing of the spin-polarized carriers induced by spin-orbit-coupling (SOC). We will present results of density functional calculations on idealized magnetic tunnel junctions with $La_{0.7}Sr_{0.3}MnO_3$ (LSMO) electrodes and $SrTiO_3$ (STO) tunneling barrier. In the absence of SOC, LSMO is predicted to be a half-metal having Fermi-level density of states only for majority spins, and an electronic gap for the minority spin-channel. Indeed, transport calculations based on a generalized scattering approach predict an infinite TMR effect in LSMO/STO/LSMO junctions. The inclusion of SOC into the calculations, however, opens a channel for transmission through the barrier in the anti-parallel magnetic configuration leading to a large, yet finite, TMR ratio. With all other spin-flip mechanisms suppressed, this represents the ultimate limit for TMR in idealized junctions.

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