9.7 cm

# MANGANITE-BASED MAGNETIC TUNNEL JUNCTIONS: NEW IDEAS ON SPIN-POLARISED TUNNELING

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Magnetic tunnel junctions (MTJs) consist of two ferromagnetic electrodes separated by a thin insulating layer. In these heterostructures, large magnetoresistance ratios (TMR), $\sim 40\%$, are currently attained at room temperature and applications are foreseen in magnetic read heads, magnetic field sensors and non-volatile memories. Even though applications are actually close to the market, the process of spin-polarised tunneling is not yet well understood. In the simplest model to explain the magnetoresistance in MTJs, the TMR depends only on the spin polarisation of the electrodes TMR(%)=100x2x$P_1P_2/(1+P_1P_2)$, and neglects the effect of the barrier [M. Jullière, *Phys. Lett.* **54A** (1975) 225].

We have studied the role played by the barrier in magnetic tunnel junctions. We have prepared three types of junctions with the same ferromagnetic electrodes ($La_{0.7}Sr_{0.3}MnO_3$ and Co) but three different insulating barriers ($Al_2O_3$, $Ce_{1-x}La_xO_{2-x/2}$, and $SrTiO_3$). Due to its half metallicity (P=+1), $La_{0.7}Sr_{0.3}MnO_3$ is used as a spin analyser of the spin polarisation of Co. Whereas with the $Al_2O_3$ barrier we find a *normal* TMR effect (higher resistance in the antiparallel magnetic configuration), in the two last types of junctions we have found an *inverse* tunnel magnetoresistance (higher resistance in the parallel magnetic configuration), which can be explained with a negative spin polarisation of the tunneling electrons from Co. Moreover, in the MTJs with $SrTiO_3$ barrier the bias dependence of the TMR reproduces the essential features of the negatively spin-polarised "*d*" band density of states of Co [J.M. De Teresa et al., *Phys. Rev. Lett.* **82** (1999) 4288]. Contrary to current ideas on the subject, we propose that the barrier can change and even reverse the spin polarisation of Co acting as a *spinfilter* and selecting the tunneling electrons ("*s*" or "*d*" type).

We conclude that a unique and characteristic spin polarisation for each ferromagnetic electrode does not exist but depends on the interface electrode/barrier (bonding effects could account for this behaviour). Consequently, the barrier is another free parameter to tailor the TMR in MTJs. The perspectives opened in the field will be discussed.

13.4 cm

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