Observation of inverse magnetoresistance in perovskite oxide tunnel junctions

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We have observed a distinct inverse magnetoresistance in a hybrid tunnel junction. Two types of perovskite oxides, $La_{0.67}Sr_{0.33}MnO_3$ and $SrRuO_3$, were used as ferromagnetic electrodes with an $SrTiO_3$ barrier in between them. Micron-scale junctions were fabricated from 90° off-axis sputtered trilayers, using standard optical lithography. Homo-junctions that incorporate either $La_{0.67}Sr_{0.33}MnO_3$ or $SrRuO_3$ as both electrodes showed only normal positive magnetoresistances. In contrast, a clear inverse magnetic switching was found at 10K for the hybrid junction, with switching fields of 200~400 Oe for $La_{0.67}Sr_{0.33}MnO_3$ and 1~1.5 Tesla for $SrRuO_3$. The spin polarization of $SrRuO_3$ is about -9% as calculated based upon Julliere model, which is in quantitative agreement with the value (-10%) determined by the earlier tunneling experiment on $SrRuO_3/SrTiO_3/Al$ structures. This is not only the manifestation of the existence of a negatively polarized material at the Fermi level, but also demonstrates that the widely-cited Julliere model is applicable even to a negative polarization case. However, the reproducibility of such a magnetoresistive behavior and resistance scaling to junction area and barrier thickness were poor for the hybrid junction, and bias dependence of magnetoresistance was heavy. These issues will also be discussed in comparison with homo-junction cases in this presentation.

References

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