T_CSUH Special Seminar

Texas Center for Superconductivity at the University of Houston

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Half-Metallic Oxides for Spintronics

Friday, December 8, 2006
Room 102, University of Houston Science Center
12:00 noon – 1:00 p.m.

Abstract

The emerging field of spintronics aims to exploit the electron spin, in addition to its charge, to create a new class of devices that scale down to much smaller dimensions with possibly added functionalities. Of particular relevance are magnetic tunnel junctions (MTJs), consisting of two ferromagnetic thin film electrodes separated by an insulating barrier, that exhibit large tunneling magnetoresistance (TMR) at relatively low fields. The MTJs are promising for a host of applications including magnetic memory (MRAM), sensors, and storage devices. Most of the studies on MTJs have thus far focused on using transition metal ferromagnets (Fe, Ni, Co) and their alloys—typically with spin polarization values less than 50%—where the maximum observed TMR is limited to about 40–50% at room temperature using an amorphous aluminum oxide barrier. There is obvious interest in further enhancing the TMR by using materials with a higher degree of spin polarization. Half-metallic systems, which contain a gap in one spin band at the Fermi level and no gap in the other spin band, are expected to have a spin polarization value approaching 100%. We have fabricated MTJ devices using half-metallic oxides, such as the mixed-valence manganites ($La_{1-x}A_xMnO_3$, A=Ba, Sr, or Ca) and chromium dioxide (CrO_2), that exhibit reproducible tunneling characteristics with high TMR values. However, the TMR enhancement has thus far been limited to low temperature. I will present an overview of MTJs, particularly related to the MRAM application, and then focus on the fabrication and properties of tunnel junctions using the half-metallic oxides and the challenges.

Bio

Prof. Gupta is the MINT Professor at the University of Alabama and is affiliated with the Chemistry and Chemical and Biological Engineering Departments. He joined the University in 2004 prior to which he was a Research Manager in the Magnetoelectronics Department at the IBM Thomas J. Watson Research Center. He received his undergraduate degree from the Indian Institute of Technology and Ph.D. degree in Chemical Physics from Stanford University. He has worked in a wide range of materials- and physics-related topics, including laser processing, high temperature superconductivity, semiconducting oxides, dielectrics, and magnetic materials, and their device applications. Prof. Gupta has published over 200 journal articles and holds 27 U.S. patents. He is a fellow of the American Physical Society and a member of the Materials Research Society.

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