Control of Magnetic Properties across Metal to Insulator Transitions

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ABSTRACT:
Controlling the magnetic properties of ferromagnetic thin films without magnetic fields is an ongoing challenge in condensed matter physics with multiple technological implications for low-energy consumption memory and logic devices. External stimuli and proximity effects are the most frequently used methods to control the magnetic properties. An interesting possibility arises when ferromagnets are in proximity to materials that undergo metal-insulator and structural phase transitions. In a first example we have investigated the magnetic properties of different combinations of ferromagnetic (Ni, Co and Fe) and vanadium oxide thin films. I will show that the coercivities and magnetizations of the ferromagnetic films grown on vanadium oxides are strongly affected by the phase transition. The changes in coercivity can be as large as 168% and occur in a very narrow temperature range. These effects can be controlled by the thickness and deposition conditions of the different ferromagnetic films. In a second example I will show that the creation of a Fe$_3$O$_4$ interface in Permalloy (Ni$_{80}$Fe$_{20}$) / V$_2$O$_3$ bilayers gives rise to exchange bias and a vertical shift in the magnetization. Both effects are due to the change in the easy axis of the magnetization across the Fe$_3$O$_4$ Verwey transition.


BIO: I am a postdoctoral researcher at UC San Diego. I received my Ph.D. in Physics from the Universidad Complutense of Madrid in 2009, where I studied the magnetic and optical properties of gold nanoparticles. Since 2010 I have been working in the Physics Department and the Center for Advanced Nanoscience at UCSD. My research focuses on two different areas. The first is the search for new superconductors using a novel methodology. The methodology is based on the parallel synthesis of inhomogeneous alloys combined with a fast, microwave-based method which allows the identification of small superconducting portions of the sample. My second research area is the study of interactions between complex oxides and magnetic materials.