Physics Colloquium

Michigan Technological University

Thursday, February 26, 2009, 4:00 pm

Room 139, Fisher Hall

Controlling Interlayer Exchange Coupling in Fe/Pt Multilayered Nanowire

Puspamitra Panigrahi

Advisor: Dr. Ranjit Pati

Abstract: Interest in the study of magnetic/non-magnetic multilayered structures took a giant leap since Grünberg and his group established that, the value of interlayer exchange coupling is a function of the non-magnetic spacer width. This interest was further fuelled by the discovery of the phenomenal Giant Magnetoresistance (GMR) effect. In fact, in 2007 the Nobel Prize in Physics has been awarded to Albert Fert and Peter Grünberg for their contribution to the discovery of GMR. GMR is the key property that is being used in the read-head of the present day computer hard drive as it requires a high sensitivity in the detection of magnetic field. The recent increase in demand for device miniaturization compelled researchers to look for GMR in nanoscale multilayered structures. In this context, multilayerd nanowire structure has shown tremendous promise as a viable candidate for ultra sensitive read head sensors. In this talk, I will discuss the usage of first principles density functional theory (DFT) in predicting the interlayer exchange coupling (IEC) in one dimensional Fe/Pt multilayered nanowire. Particularly, I will focus on the increased magnetic moment of the interfacial Fe atoms compared to that of the Fe atoms away from the interface and the switching behavior of calculated IEC with the width of the non-magnetic Pt spacer in the Fe/Pt multilayered nanowire. I will give the mechanism [1], based on *multi-step electron transfer* between the layers and *spin-flip* within the layer to explain the magnetic moment enhancement at the interface. I will also explain how the competition among short and long range direct exchange and the super exchange is playing a key role for the non-monotonous sign in IEC [2] depending upon the width of the Platinum spacer layer.

Orthodox-Theory Based Modeling of a Single-Electron Device.

Madhusudan Savaikar

Advisor: Dr. Paul Bergstrom

Co-Advisor: Dr. John Jaszczak

Abstract: Devices in which the storage and transport of single electrons are systematically controlled could lead to a new generation of nanoscale devices. Researchers have taken keen interest in the fabrication and modeling of charging effect based Single electron devices (SEDs) ever since the charging effects were experimentally observed. Important features of these devices are low power operation and extremely high charge sensitivity. As a first step towards the modeling of 2-D and 3-D SEDs, we present an Orthodox-Theory based theoretical analysis for a system composed of three ultrasmall-capacitance tunnel junctions coupled in series which can be extended to an array of 1-D dots. We show that for the right set of parameters, the device displays voltage-offset and distinct steps in its I-V characteristics which can be used for the switching action in a transistor.

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