

MAR07-2006-000137

Abstract for an Invited Paper  
for the MAR07 Meeting of  
the American Physical Society

### **Coupling Magnetism to Electricity in Multiferroic Heterostructures<sup>1</sup>**

RAMAMOORTHY RAMESH, University of California, Berkeley

Complex perovskite oxides exhibit a rich spectrum of functional responses, including magnetism, ferroelectricity, highly correlated electron behavior, superconductivity, etc. The basic materials physics of such materials provide the ideal playground for interdisciplinary scientific exploration. Over the past decade we have been exploring the science of such materials (for example, colossal magnetoresistance, ferroelectricity, etc.) in thin film form by creating epitaxial heterostructures and nanostructures. Among the large number of materials systems, there exists a small set of materials which exhibit multiple order parameters; these are known as multiferroics. Using our work in the field of ferroelectric (FE) and ferromagnetic oxides as the background, we are now exploring such materials, as epitaxial thin films as well as nanostructures. Specifically, we are studying the role of thin film growth, heteroepitaxy and processing on the basic properties as well as magnitude of the coupling between the order parameters. In our work we are exploring the switchability of the antiferromagnetic order using this coupling. What is the importance of this work? Antiferromagnets (AFM) are pervasive in the recording industry. They are used as exchange biasing layers in MTJ's etc. However, to date there has been no antiferromagnet that is electrically tunable. We believe that the multiferroic BiFeO<sub>3</sub> is one compound where this can be observed. The next step is to explore the coupling of a ferromagnet to this antiferromagnet through the exchange biasing concept. Ultimately, this will give us the opportunity to switch the magnetic state in a ferromagnet (and therefore the spin polarization direction) by simply applying an electric field to the underlying antiferromagnetic ferroelectric. In this talk, I will describe our progress to date on this exciting possibility.

<sup>1</sup>This work is supported by the US Department of Energy and the Office of Naval Research