Solid State Technology and Devices Seminar

Electric Field Control of Magnetism

Prof. Ramamoorthy Ramesh
Department of Physics & Department of Materials Science and Engineering
Lawrence Berkeley National Laboratory
University of California, Berkeley

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Abstract: 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 with an eye towards real applications. Over the past decade the oxide community has been exploring the science of such materials as crystals and 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, particularly, the coexistence of ferroelectricity and some form of ordered magnetism (typically antiferromagnetism). The scientific community has been able to demonstrate electric field control of both antiferromagnetism and ferromagnetism at room temperature. Current work under the SRC-JUMP program is focused on ultralow energy (1 attoJoule/operation) electric field manipulation of magnetism as the backbone for the next generation of ultralow power electronics. We are exploring many pathways to get to this goal. In this talk, I will describe our progress to date on this exciting possibility. The talk will conclude with a summary of where the future research is going.

Bio: Dr. Ramamoorthy Ramesh is the Purnendu Chatterjee Chair Professor in the Departments of Physics & Materials Science and Engineering at the University of California, Berkeley. He pursues key materials physics and technological problems in complex multifunctional oxides. Using conducting oxides, he solved the 30-year enigma of polarization fatigue in ferroelectrics. He pioneered research into manganites coining the term, Colossal Magnetoresistive (CMR) Oxides. His work on multiferroics demonstrated electric field control of ferromagnetism, a critical step towards ultralow power memory and logic elements. His extensive publications on the synthesis and materials physics of complex oxides are highly cited (over 65,000 citations, H-factor =110). He is a fellow of APS, AAAS & MRS and an elected member of the U.S. National Academy of Engineering and a Foreign member of the Royal Society of London. His awards include the Humboldt Senior Scientist Prize, the APS Adler Lectureship and McGroddy New Materials Prize, the TMS Bardeen Prize and the IUPAP Magnetism Prize and Neel Medal. He was recognized as a Thomson-Reuters Citation Laureate in Physics for his work on multiferroics. He served as the Founding Director of the successful Department of Energy SunShot Initiative in the Obama administration, envisioning and coordinating the R&D funding of the U.S. Solar Program, spearheading the reduction in the cost of Solar Energy. He also served as the Deputy Director of Oak Ridge National Laboratory and the Associate Lab Director at LBNL.