北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Seminar

Cognitive devices based on ion currents in oxide thin films

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Time: 11:00am, May 14, 2015 (Thursday)
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Venue: Room W563, Physics Building, Peking University
地点：北京大学物理楼 西563

Abstract

Conventional silicon based electronic computing devices use about one million times more energy to carry out a computing operation than does a mammalian brain. The devices, interconnections, and information processing paradigms in the latter are profoundly different from those used in today's computers. Approaches to the development of extremely energy efficient computing will likely rely on devices that operate on entirely different principles, that are mutable, and which likely possess innately three dimensional structures and architectures. We discuss one possible approach that relies on the control of the conductivity of oxide thin films via tiny but reversible ionic currents of oxygen ions that are induced by very large electric fields at the interface with ionic liquids[1]. Removal of sub atomic percent concentrations of oxygen from structures that have open channels for the ready migration of oxygen gives rise to giant structural distortions[2] and metallization of what were initially insulating layers. This may allow a path to innately mutable, cognitive switches.

1. Jeong, J. *et al.* Suppression of Metal-Insulator Transition in VO_2 by Electric Field–Induced Oxygen Vacancy Formation. *Science* **339**, 1402-1405, (2013).
2. Jeong, J. *et al.* Giant reversible, facet-dependent, structural changes in a correlated-electron insulator induced by ionic liquid gating. *Proc. Natl. Acad. Sci.* **112**, 1013-1018, (2015).

About the Speaker

Dr. Stuart Parkin is an IBM Fellow, Manager of the Magnetoelectronics group at the IBM Almaden Research Center, and a Consulting professor in the Dept. of Applied Physics at Stanford University. Recently Dr. Parkin was appointed Director, Max Planck Institute for Microstructure Physics, Halle Germany, and an Alexander von Humboldt Professor at the Martin Luther University Halle-Wittenberg. Dr. Parkin's research interests include oxide thin film heterostructures, high-temperature superconductors, and, magnetic thin film structures and spintronic materials and devices for advanced sensor, memory, and logic applications. Parkin's discoveries in magneto-resistive thin film structures enabled a 1000 fold increased in the storage capacity of magnetic disk drives. Most recently, Parkin's research is focused on a novel storage class memory device, "Racetrack Memory", and cognitive materials that could enable very low power computing technologies. Parkin is a Member of the National Academy of Sciences, and the National Academy of Engineering, a Fellow of the American Academy of Arts and Sciences, a Fellow of the Royal Society (London), an Honorary Fellow of the Indian Academy of Sciences and a Fellow of TWAS, the World Academy of Sciences. Parkin is the recipient of numerous awards and honors including, most recently, the 2012 von Hippel Award from the Materials Research Society, 2013 Swan Medal of the Institute of Physics (London), and the 2014 Millennium Technology Award from the Technology Academy Finland (worth 1,000,000 Euros). Parkin was recently elected an Honorary Fellow of Trinity College, Cambridge. Parkin has published ~450 papers and has an h-index of 87