Oxide devices utilizing metal-insulator transitions

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Metal-insulator transitions in correlated oxides are an exciting topic from both fundamental science as well as application perspectives. Structural distortions leading to phase transitions that are accompanied by dramatic changes in electrical and optical properties have been extensively studied over the decades, especially in vanadium oxide. Recently, there has been significant interest in exploring electric field assisted phase transitions in complex oxides, one class of them being the Mott transition.

Understanding and advancing the ability to control the conductance of an oxide thin film by electric fields opens up opportunities to fabricate ultra-fast switches. Coupled with the scaling limitations apparent in Si CMOS transistors, this makes a compelling case for further exploration as switches for high-performance computing devices.

I will present a brief overview of some issues in Si CMOS transistors and the need for novel information processing devices. I will then focus on metal-insulator transitions in thin film vanadium oxide, discuss recent advances with emphasis on electric field effects. Challenges in de-coupling electric field and thermally driven transitions in VO_2-based devices will be pointed out. Broader relevance of the electric-field triggered transitions in electronics and related device technologies will be highlighted.

Contributions from group members will be highlighted in the presentation.