Nebraska Center for Materials and Nanoscience
2017 Fall Seminar Series

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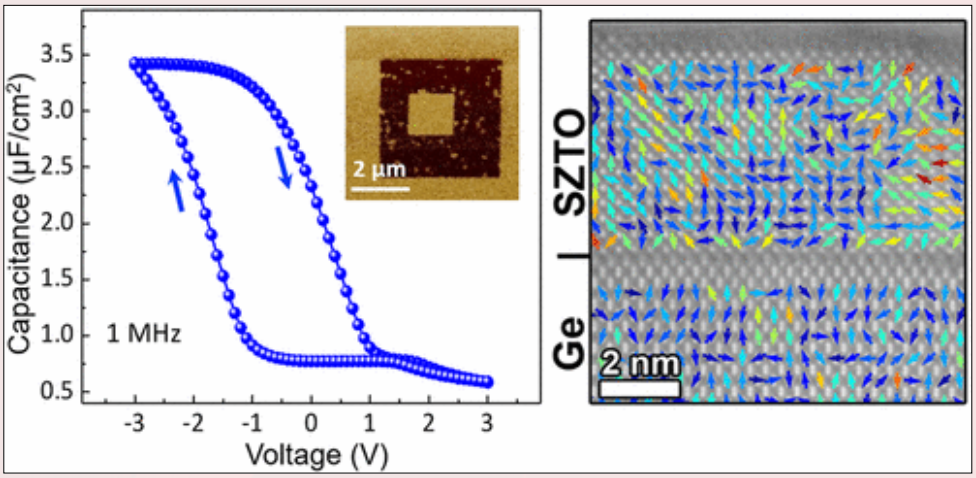
Realizing Novel Material Functionalities in Semiconductor-Crystalline Oxide Heterostructures

Developing materials that exhibit enhanced or novel functionalities is essential to address challenges faced in energy harvesting and information technology. Heterostructures comprised of materials exhibiting dissimilar yet complementary properties could lead to novel functionalities that cannot be achieved in the constituent materials alone. In this regard, monolithic heterostructures comprised of ionically bonded complex oxides and covalently bonded semiconductors (e.g. Si, Ge, etc.) form an ideal complementary system to realize novel functionalities. Dr. Ngai will discuss recent efforts in electrically coupling multi-functional oxides to semiconductors through band-gap engineering, using epitaxial $SrZr_xTi_{1-x}O_3$ (SZTO) grown on Ge. Complex oxide thin films and heterostructures often exhibit surprising material behaviors not found in corresponding bulk samples. Dr. Ngai and colleagues have recently found that ultra-thin epitaxial films of SZTO exhibit relaxor behavior, characterized by a hysteretic polarization that can be exploited to modulate the surface potential of Ge. Strained films as thin as 5nm corresponding to an equivalent-oxide-thickness of just 1.0 nm exhibit a ~2 V hysteretic window in the capacitance-voltage characteristics. The development of hysteretic metal-oxide-semiconductor capacitors with nanoscale gate thicknesses opens new vistas for nanoelectronic devices. This work is supported by NSF DMR-1508530.



Joseph Ngai obtained his B.Sc. from the University of Alberta, and M.Sc. and Ph.D. degrees from the University of Toronto. He was an NSERC Postdoctoral Fellow and Postdoctoral Associate at Yale University. After his Postdoctoral studies he joined the Department of Physics at the University of Texas-Arlington as an Assistant Professor in the fall of 2012.

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November 15 | 4 p.m. | 136 Jorgensen Hall
Refreshments at 3:45 p.m. in 1st floor vending area

Host: Professor Xia Hong
Department of Physics and Astronomy