

CORE-CM SEMINAR
Michigan State University

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Ultrafast Dynamics in Complex Oxide Electronic Materials

The fundamental physical phenomena responsible for the electronic properties of complex oxides often involve significant distortions of the underlying crystal structure. Phenomena including piezoelectric and dielectric response, ferroelectric nanodomain dynamics, and field-induced phase transformations result from the interaction between applied electric fields and the crystal structure. These phenomena can have dynamics as fast as ultrafast timescale associated with the propagation of acoustic impulses across nanoscale dimensions. Developments in time-resolved synchrotron x-ray nanobeam methods now allow the crystallographic structure of complex oxides to be probed at the fundamental timescale of these phenomena in individual nanoscale structures. We will discuss the recent development of x-ray diffraction techniques that allow optically and electrically excited nanostructures, thin films, and devices to be studied. Our group has recently applied these techniques to understand the mechanisms of electric-field driven transformations in the polarization of disordered nanodomains in ferroelectric/dielectric superlattices. Electric fields in multiferroics can be large enough to induce phase reversible phase transitions in multiferroics. Ultrafast characterization and control of the structure of materials promises the possibility of using electric fields to modulate the functional properties of these materials at the nanosecond timescale.

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Prof. Chong-Yu Ruan – Host