

CSU PHYSICS COLLOQUIUM

“Imaging ultrafast and ultrasmall: Unraveling nanoscale correlations in complex oxide heterostructures using time-resolved coherent x-ray scattering”

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Monday, April 11th at 4:00pm

120 Engineering (Hammond Auditorium)

Abstract

Complex oxide heterostructures provide access to emergent functional and structural phases which are not present in the bulk constituent materials. Controlling ionic distribution, stoichiometry and epitaxial strain in complex oxide heterostructures have been utilized to significantly alter the electronic, magnetic, and structural properties. However, in order to fully understand and tailor nanoscale functionalities of correlated materials, detailed access to the nanoscale regime, correlation length scales and their temporal evolution is required. In this talk, I will discuss advanced synchrotron characterization techniques used by my group to investigate nanoscale properties of complex oxides heterostructures. The first part of my talk will focus on Gd/La_{0.67}Sr_{0.33}CoO₃ (LSCO) heterostructures, which have shown promises for magneto-ionic control of functional properties through the presence of oxygen getter layers such as Gd. We have utilized x-ray nanodiffraction to directly image the nanoscale morphology of LSCO thin films as they are progressively transformed from the equilibrium perovskite phase to the metastable brownmillerite (BM) phase with increasing Gd and Al thickness. The second part of my talk will focus on spatially dependent ultrafast response is observed in complex oxides such as rare-earth nickelates across laser-driven insulator-to-metal phase transition. These intriguing observation suggests preferential, texture-dependent paths for structural rearrangements at picosecond to nanosecond timescales. These measurements provide us with a unique way to study and manipulate spin, charge and lattice degrees of freedom at ultrafast and ultrasmall frontier.

Biography

Roopali Kukreja joined Materials Science and Engineering department at UC Davis as an Assistant Professor in Fall 2016. She received her B.S. in Metallurgical Engineering and Materials Science from the Indian Institute of Technology Bombay in 2008 and then her M.S. and Ph.D. degrees in Materials Science and Engineering from Stanford University in 2011 and 2014, respectively. Prior to her appointment at UC Davis, Kukreja worked as a postdoctoral researcher at the UC San Diego, with Profs. Oleg Shpyrko (Physics Department) and Eric Fullerton (Center for Magnetic Recording Research). Her research interests at UC Davis focuses on ultrafast dynamics in nanoscale magnetic and electronic materials, time resolved X-ray diffraction and imaging techniques, thin film deposition and device fabrication. She is recipient of Melvin P. Klein Scientific development award (2015), AFOSR Young Investigator Award (2018), NRC Faculty Development Award (2019), DOE Early Career Award (2021) and NSF Early Career Award (2022).