

Exploration of Nanoscale Functionalities of Complex Oxides via Scanning Probe Microscopy

Complex oxides are one of the main foci of condensed matter research due to the plethora of emergent phenomena such as ferroelectricity and magnetism that can be exploited as novel functionalities for technological applications. The complex interplay of multiple degrees of freedom including spin, charge, orbital and lattice gives rise to such phenomena, resulting in novel functional properties of complex oxides. Therefore, understanding fundamentals of how complex oxides behave with their own structures and functional properties is the key for development of next generation technologies.

For this, nanoscale characterization via scanning probe microscopy (SPM) has played a crucial role to probe and characterize materials, spatially correlate local responses, and manipulate and write features directly, offering fundamental insights to develop novel functionalities and nanodevice concepts. In this seminar, I will talk about SPM-based studies to show nanoscale structures and functional properties associated with phase transitions, electronic and ionic conduction, magnetism, and piezoelectricity under illumination [1-4]. These results unveil fundamentals of structure-related functionalities of complex oxides for their potential implementation in next generation nanoelectronics.

[1] Heo, et al., *Advanced Materials* 26 (45), 7568 (2014)

[2] Heo, et al., *ACS Nano* 11, 2805 (2017)

[3] Heo, et al., *Applied Physics Letters*, 113, 221904 (2018)

[4] Heo, et al., *Advanced Materials*, 34, 2105845 (2022)