Abstract:

Complex oxides have attracted great interest since they exhibit a rich spectrum of physical properties such as ferromagnetism, antiferromagnetism, colossal magnetoresistance, ferroelectricity, dielectricity, and superconductivity. Novel heteroepitaxial devices based on these complex oxides, like spin-polarized ferromagnetic tunnel junctions, superconducting devices and piezoelectric devices, have great potential and are currently under investigation in many groups.

The nature of the above-mentioned physical properties in complex oxides is determined by very small characteristic length scales, comparable to the unit cell lattice parameters of complex oxide. Because of these small characteristic length scales, growth control on an atomic level is essential in epitaxial heterostructures. Furthermore, the terminating atomic layer of each complex oxide thin film in these structures influences the interface properties and, consequently, the device performance. Interfaces therefore play an important role in the physical and electrical properties of the complex oxide devices and growth control on an atomic level is essential.

Recently, a new “degree of freedom” has been recognized. By atomic control of interfaces between oxide materials, i.e., the chemical composition and crystalline structure, new phenomena are observed. A heterointerface between perovskites (ABO$_3$) introduces polarity discontinuities when both elements A and B on either side of the interface have different valence states. This resulted in the discovery of electronic conduction at oxide interfaces, which has attracted a lot of interest in recent years. In this contribution, I will address the recent progress in obtaining high-mobility electron gasses at oxide interfaces as well as recent developments in growth control of oxide heterostructures.