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Building Nanoscale Oxide Thin Films and Interfaces One Atomic Layer at a Time

By

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Abstract

Advancements in nanoscale engineering of oxide interfaces and heterostructures have led to discoveries of emergent phenomena and new artificial materials. Combining the strengths of reactive molecular-beam epitaxy and pulsed-laser deposition, we show that atomic layer-by-layer laser molecular-beam epitaxy significantly advances the state of the art in constructing oxide materials with atomic layer precision. Using Sr1+xTi1-xO3 and Ruddlesden–Popper phase Lan+1NinO3n+1 (n = 4) as examples, we demonstrate the effectiveness of the technique in producing oxide films with stoichiometric and crystalline perfection. By growing LaAl1+yO3 films of different stoichiometry on TiO2-terminated SrTiO3 substrate at high oxygen pressure, we show that the behavior of the two-dimensional electron gas at the LaAlO3/SrTiO3 interface can be quantitatively explained by the polar catastrophe mechanism. In LaNiO3 films on LaAlO3 substrate with LaAlO3 buffer layer, we observed the metal insulator transition in 1.5 unit cells, which is driven by oxygen vacancies in addition to epitaxial strain and reduced dimensionality.

Biography

Xiaoxing Xi is the Laura H. Carnell Professor of Physics at Temple University. Prior to joining Temple in 2009, he was a Professor of Physics and Materials Science and Engineering at the Pennsylvania State University. He received his PhD degree in physics from Peking University and Institute of Physics, Chinese Academy of Science, in 1987. After several years of research at the Karlsruhe Nuclear Research Center, Germany, Bell Communication Research/Rutgers University, and University of Maryland, he joined the Physics faculty at Penn State in 1995.

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