Direct Observation of a Thickness-Induced Mott Transition in $LaTiO_3$ films

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Engineering quantum materials into dimensionally-confined heterostructures allows for control of their structural and electronic properties. These modifications may influence many-body phenomena that have a crucial impact on fundamental research and numerous applications. In this study, we observed strong electron-electron and electron-boson interactions in monolithic, thickness-varied $LaTiO_3/SrTiO_3$ heterostructures grown by pulsed laser deposition. Quasi-two dimensional $LaTiO_3$, a Mott insulator in the bulk, exhibits a tetragonal structure due to interface stress from the underlying $SrTiO_3$ layer. We observed a delayed Mott transition, where metallic states with in-plane dominated orbitals at lower thicknesses transition into Mott insulating states at higher thicknesses, as evidenced by the appearance of a lower Hubbard band below the Fermi level using angle-resolved photoemission spectroscopy, which is explained by the evolution of the electron-electron interaction. These discoveries and the visualization of the Mott transition expand the understanding of Mott physics and provide valuable insights for electronically reconfigurable devices.

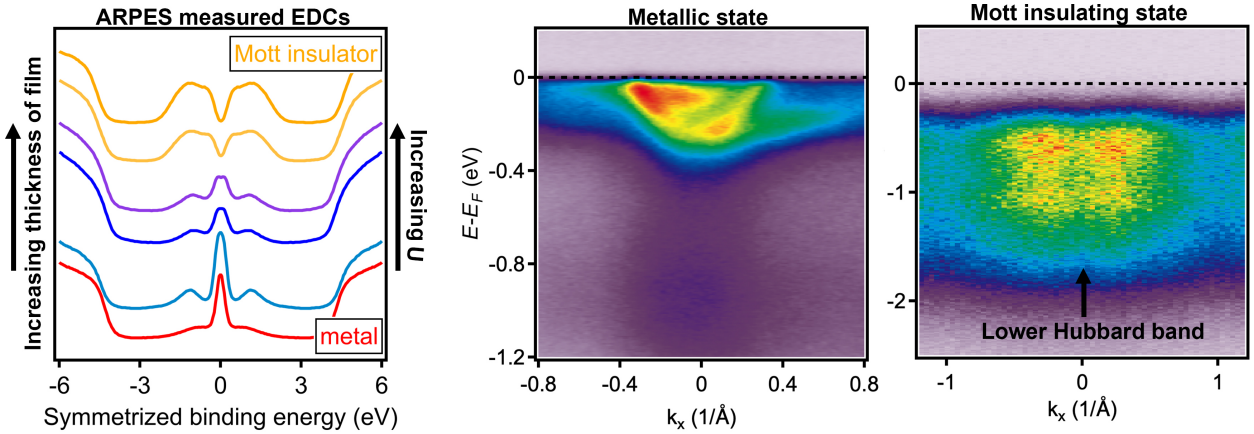

Figure 1. Mott transition in $LaTiO_3/SrTiO_3$ heterostructures