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Angle resolved photoemission spectroscopy of the electronic structure of complex oxide interfaces

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Engineering interfaces between complex oxides has proven to be a powerful technique for tuning their electronic and magnetic properties. To fully understand how these interfaces can control these electronic properties, one requires advanced spectroscopic tools to uncover their electronic structure. Angle-resolved photoemission spectroscopy (ARPES) is the leading tool for probing energy and momentum resolved electronic structure. To understand the physics of these complex oxide interfaces, we have developed an approach which combines state-of-the-art oxide molecular beam epitaxy with high-resolution ARPES. As one example, we describe our work on oxide superlattices ($[LaMnO_3]_{2n}$ / $[SrMnO_3]_n$) with alternating $LaMnO_3$ and $SrMnO_3$ blocks. Our ARPES measurements reveal that as a function of separation between the $LaMnO_3$-$SrMnO_3$ interfaces, the interfacial quasiparticle states evolve from a quasi-three-dimensional ferromagnetic metal, to a two-dimensional spin-polarized electron liquid, and ultimately to a pseudogapped ferromagnetic insulator with increasing superlattice thickness, n. I will also describe our work on other oxide thin films $SrTiO_3$ and Sr_2TiO_4-based interfaces where the quasiparticle interactions can be tuned as a function of dimensionality, and work on cuprate and ruthenate thin films.