Observation of a novel orbital selective Mott transition in Ca$_{1.8}$Sr$_{0.2}$RuO$_4$

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The growing evidence for coexistence of itinerant electrons and local moments in transition metals with nearly degenerate d-orbitals suggests that one or more electron orbitals undergo a Mott transition while the others remain itinerant. We report the observation of such an orbital selective Mott transition (OSMT) in Ca$_{1.8}$Sr$_{0.2}$RuO$_4$ by angle-resolved photoemission spectroscopy. While we observed two sets of dispersing bands and Fermi surface associated with the doubly degenerated d$_{xy}$ and d$_{zx}$ orbitals, the Fermi surface associated with the wider d$_{xy}$ band is missing as a consequence of selective Mott localization. Our theoretical calculations demonstrate that this novel OSMT is mainly driven by the combined effects of inter-orbital carrier transfer, super lattice potential, and orbital degeneracy, whereas the bandwidth difference plays a less important role.