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Quantifying covalency and metallicity in pyrochlore ruthenates undergoing metal-insulator transitions ASHISH CHAINANI, RIKEN Harima Institute, AYAKO YAMAMOTO, RIKEN Advanced Science Institute, MASAHARU MATSUNAMI, RITSUKO EGUCHI, MUNETAKA TAGUCHI, YASUTAKA TAKATA, RIKEN Harima Institute, HIDENORI TAKAGI, RIKEN Advanced Science Institute, SHIK SHIN, YOSHINORI NISHINO, MAKINA YABASHI, KENJI KENJI TAMASAKU, TETSUYA ISHIKAWA, RIKEN Harima Institute — We use bulk-sensitive hard x-ray photoelectron spectroscopy to investigate the electronic structure of the cubic pyrochlore ruthenates $Tl_2Ru_2O_7$ and $Hg_2Ru_2O_7$, which show first-order temperature(T)-dependent metal-insulator transitions(MITs). Ru 3d core-level spectroscopy shows drastic changes as a function of T. The metallic-origin features in core-level spectra get quenched upon gap formation in valence band spectra. The results establish temperature-driven Mott-Hubbard MITs in three-dimensional ruthenates and reveals three energy scales : (a) 4*d*-electronic changes occur on the largest (∼eV) energy scale, (b) the band gap energies/charge gaps (E_g ∼160-200 meV) are intermediate, and (c) the lowest energy scale corresponds to the transition temperature T_{MIT}(∼10 meV), which is also the spin gap energy of $Tl_2Ru_2O_7$ and the magnetic-ordering temperature of $Hg_2Ru_2O_7$. The results identify and quantify the role of covalency and metallicity in the pyrochlore ruthenates undergoing T-dependent metal-insulator transitions.

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