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Nonequilibrium Band Mapping of Unoccupied Bulk States Below the Vacuum Level by Two-Photon Photoemission[1] JERRY I. DADAP, ZHAOFENG HAO[2], KEVIN R. KNOX, MEHMET YILMAZ[3], NADER ZAKI, RICHARD M. OSGOOD JR., Columbia University, New York, NY, PETER D. JOHNSON, Brookhaven National Laboratory, Upton, NY — We demonstrate two-photon photoemission (2PPE) to map a bulk unoccupied band, *viz.* the Cu *sp*-band 0 to 1 eV below the vacuum level, in the vicinity of the L point. This short-lived bulk band is seen due to the strong optical pump rate, and the observed transition energies and their dispersion with photon energy, are in excellent agreement with tight-binding band-structure calculations. A careful analysis of the 2PPE spectra permits unambiguous assignment of the transitions. The variation of the 2PPE final-state energy with photon energy has a measured slope of ∼1.64, in contrast with values 1 or 2 observed for 2PPE from two-dimensional states, i.e., image and surface states.

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