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Direct time-domain observation of attosecond final-state lifetimes in photoemission from solids WENJING YOU, ZHENSHENG TAO, CONG CHEN, Univ of Colorado - Boulder and JILA, TIBOR SZILVASI, University of Wisconsin, Madison, MARK KELLER, National Institute of Standards and Technology (NIST), Boulder, MANOS MAVRIKAKIS, University of Wisconsin, Madison, HENRY KAPTEYN, MARGARET MURNANE, Univ of Colorado - Boulder and JILA — Recently, attosecond spectroscopic techniques have made it possible to measure differences in transport times for photoelectrons from localized core levels and delocalized valence bands in solids. Here, we report the application of attosecond pulse trains to directly and unambiguously measure the difference in lifetimes between photoelectrons born into free-electron-like states and those excited into unoccupied excited states in the band structure of nickel (111). A significant increase in lifetime of 212 $\pm$ 30 as occurs when the final state coincides with a short-lived excited state. Moreover, a strong dependence of this lifetime on emission angle is directly related to the final-state band dispersion as a function of electron transverse momentum. This finding emphasizes the importance of the material band structure on photoemission lifetimes and corresponding electron escape depths.

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