Quantum Electronic Properties of Nanoscale Thin Films Explored Using Angle-Resolved Photoemission.

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The physical properties of nanoscale structures are influenced by quantum electronic effects stemming from the system's interfaces. This is evident, for example, in the existence of "magic thicknesses" or preferred island heights in metallic thin film growth. The possibility to grow atomically-uniform metal films has been demonstrated in several material systems, and angle-resolved photoemission has been used to characterize them and determine a number of physical properties, including the absolute thickness, band structure, quasiparticle lifetimes, electron-phonon interaction, thermal stability, and work function. In this talk, results from several systems are presented, including Ag/Fe, Ag/Ge, and Pb/Si. Measurements of thermal stability are compared to theoretical energy calculations based on the quantized electronic structure, which demonstrates how the electronic structure can influence film morphology. From band structure measurements the effect of the substrate electronic structure on the in-plane dispersions in the film can be seen. In the caseof Ag/Ge rich structure is observed that is related to the film morphology and to an anticrossing behavior between the quantized states in the film and the continuum in the substrate. Photoemission "quantum well spectroscopy" can reveal features due to a "buried" interface; in particular, the changes in the Schottky barrier height induced by interfactant atoms beneath a film can be measured.

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