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Quantum Beating Patterns Observed in the Energetics of Pb Film Nanostructures PETER CZOSCHKE, HAWOONG HONG, LEONARDO BASILE, TAI-CHANG CHIANG, University of Illinois at Urbana-Champaign —
We have studied the nanoscale structural evolution of Pb films grown at 110 K on a Si(111) substrate as they are annealed to increasingly higher temperatures. Surface x-ray diffraction from a synchrotron source is used to observe the morphology evolve from an initial smooth film through various metastable states before reaching a state of local equilibrium, at which point the coverage of different height Pb structures is analyzed and related to the thickness-dependent surface energy. Beating patterns are observed in the resulting energy landscape consistent with the Friedel oscillation wavelength of the electronic contribution. The form of the surface energy is explained by a simple model calculation based on the confinement of free electrons to a quantum well.

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