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Interplay of quantum size effects, electron-phonon interactions, and superconductivities in ultra-thin Pb films on Si(111) - An STM/S study DAEJIN EOM, CHIH-KANG SHIH, The University of Texas at Austin — We report a LT-STM study of quantum size effect upon the superconductivity in ultra-thin Pb films on Si(111). Ultra-thin Pb films (10 – 30 ML) on Si(111) were grown with two different methods: (a) room temperature deposition leading to a morphology of separated 2D islands; and (b) low temperature deposition followed by room temperature annealing leading to a uniformly covered film. A home-built STM with the operation temperature ranging from 2.5 K to 300K is used to study the electronic properties. The local thickness of the Pb film is directly determined by probing the quantum well states (QWS). Clear superconducting gap was observed on the Pb film at low temperature (< 5.5 K) and disappeared at higher temperature (e.g. 8.7 K). Temperature dependence study allows us to determine the T_c unambiguously. In addition to the superconducting gap, we observed pronounced phonon-related features. Interestingly, these phonon-related features show spatial modulation even on the film of uniform thickness. On the other hand, the superconducting gap depends primarily on the layer thickness. More detailed analysis of the interplay of quantum size effects, electron-phonon interactions, and superconductivities will be reported.

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