Atomic scale growth behavior and properties of Pb nanoclusters and quantum islands on Si(111) surfaces

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Quantum effects can affect the dynamic properties of surface atoms and the growth behavior of nanometer size clusters and ultrathin islands. Using scanning tunneling microscopy (STM), we have studied: 1) How the electronic property affects the atomic scale growth behavior of Pb ultra-thin quantum-islands on the Si(111) surface. We find the low temperature growth of Pb quantum-islands on the Si(111)-7×7 surface is affected by the electronic standing wave states formed in the normal direction of these islands. They show magic and critical thickness. The scaling behavior in the growth of these multilayer flat-top quantum islands can be described by a scaling theory of growth of single layer 2D islands with minor modifications. 2) Observed the vertical Friedel oscillation of the electronic Morié patterns formed at the Pb-Si interface and found the decay of the amplitude to follow the inverse square of the distance to the interface. 3) At a very low coverage, Pb atom diffusion is confined by the electronic Morié pattern of the Pb quantum islands, thus they form a self-organized array of magic clusters on these islands. 4) Observed the dynamics of a structure phase transition of monolayer quasi two dimensional Pb islands and its size effect. These and other recent interesting observations of ours will be presented.

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