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Quantum engineering of apparent tunneling height in ultra thin Pb films[1] JUNGDAE KIM, SHENGYONG QIN, CHIH-KANG KEN SHIH, Department of Physics, University of Texas at Austin — The thickness dependence of tunneling decay constant (κ) for ultra thin Pb films is studied with various sample biases by using low temperature STM. It is found that quantum well states (QWS) have a strong influence on the tunneling decay constant κ. While the decay constant versus layer thickness (κ vs. L) clearly shows bilayer oscillations, we found that the apparent contrast in κ vs. L also show strong bias dependence. Depending on the bias voltage, contrast reversal in the apparent oscillation of κ vs. L can be precisely tuned when the tunneling into the sample empty states. This result also shows that κ-oscillation does not necessarily imply the work function oscillation. We further show that in this case, the parallel component of crystal momentum plays a critical role in tunneling process and is largely responsible for the observed phenomena. On the other hand, at negative sample bias, we show that the measured decay constants well reflect the variation of surface workfunction. In this case, the layer-dependent surface work functions indeed show bi-layer oscillations and the signature of phase slip due to non-perfect phase matching between Fermi wavelength and the vertical lattice constant.

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