MAR05-2004-001351
Abstract for an Invited Paper
for the MAR05 Meeting of
the American Physical Society

End States in One-Dimensional Chains

JASON CRAIN, NIST

As a consequence of the lower dimensionality, a new kind of state is observed at the boundaries of one-dimensional atomic chains that are self-assembled by depositing gold on the vicinal Si(553) surface. Such end states can be thought of as zero-dimensional analogs to two-dimensional states that occur at a bulk surface. Scanning tunneling microscopy images taken at positive and negative polarities reveal contrast reversal at the end atoms that provides evidence for the formation of end states. To confirm this attribution, spatially resolved scanning tunneling spectroscopy along finite chains maps the density of states revealing the formation of quantized states. Further, we observe a transfer of spectral weight from the empty to the filled states over the end atoms. These end states lead to a breakdown in the simple particle in a box model for states along the chains. A comparison to a tight-binding model demonstrates how the formation of end electronic states transforms the density of states and the quantized levels within the chains. As a confirmation of the tight-binding model and the end electronic effects, calculated STM topography profiles at positive and negative biases reproduce the experimentally observed contrast at the end atoms. This work is done in collaboration with Daniel T. Pierce and is supported in part by the office of naval research.