Spectroscopy of Atomic Chains at Surfaces

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Atomic chains can now be created by self-assembly at stepped surfaces. Particularly interesting are metallic chain structures on silicon surfaces [1,2]: The atoms are locked rigidly to the substrate but the electrons near the Fermi level completely de-couple from the substrate because they lie in the band gap of silicon. This talk will demonstrate the use of synchrotron radiation for mapping low-dimensional electronic states by angle-resolved photoemission, as well as for determining the structure of the chains by surface x-ray diffraction [3]. The dimensionality can be controlled by adjusting the step spacing with coupling ratios between 10:1 and >70:1 along the chains and between chains [2]. The surface band structure exhibits several unusual features, such as a fractional electron count of 8/3 electrons per chain atom [2], a doublet of half-filled bands [4], and nanoscale phase separation into metallic and insulating chain sections [5]. Spin chains can be created by using rare earth atoms.

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