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Atom Chains at Surfaces: A Playground for Low-Dimensional Physics

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One-dimensional physics is particularly elegant because of its mathematical transparency. However, it is not easy to realize a one-dimensional system experimentally. Using self-assembly techniques, it has become possible to produce atomic chain structures at silicon surfaces and to control their dimensionality, their band filling, and their magnetic moment [1]. The atoms are locked to the surface, but metallic electrons are de-coupled from the substrate due to the band gap of silicon. In a sense, these are the ultimate nanowires, each consisting of a single chain of orbitals. Angle-resolved photoemission reveals surprising features, such as a fractional band filling [2], a spin-splitting at a non-magnetic surface [3], and the one-dimensional analog of stripes (alternating metallic and semiconducting sections).

[1] Crain and Himpsel, Appl. Phys. A **82**, 431 (2006).
[2] Crain et al., Phys. Rev. Lett. **90**, 176805 (2003).
[3] Barke et al. Phys. Rev. Lett., in press (2006).