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Noble electronic properties of In, Au, Gd atomic wires on silicon

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Metal atoms can self-organize on semiconductor surfaces, in particular on silicon surfaces, to form one-dimensional (1D) chains of atoms (atomic wires) locally or sometimes uniformly as a periodic array of wires. Some of these metal atomic wires or metal-induced Si atomic chains on silicon surfaces were found to have 1D metallic band structures. The notable examples are 4x1-In on Si(111) [1, 2], 5x2-Au on Si(111) [3], 1x2-Au on Si(5 5 7) [4], 1x2-Au on Si(5 5 12) [5], and 1x2-Au on Si(5 5 3) [6]. A few interesting 1D electronic properties have been discussed on these systems such as Peierls instability with charge density wave ground state [1-4], and non Fermi liquid behaviors [7]. In the present talk, I will discuss, as based on our recent ARP (angle-resolved photoemission) and STM (scanning tunneling microscopy) studies, the intrinsic instability of 1D metallic wires, which leads to metal-insulator transitions and broken-symmetry ground states at low temperature. The important physical mechanisms underlying the above phenomena will be introduced such as electron-lattice interaction, interband interaction in multi-band systems, electron-electron interaction, interwire interaction, and impurity interactions.I will try to provide a systematic overview of above systems along with introducing another 1D metallic system of Gd-silicide wires on Si(001) [8].

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