STS OF ADATOM AND SINGLE ATOM CONTACTS

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We discuss recent recent experimental investigations of single adatoms on metal surfaces performed with low-temperature scanning tunnelling microscopes along with theoretical modelling [1,2].

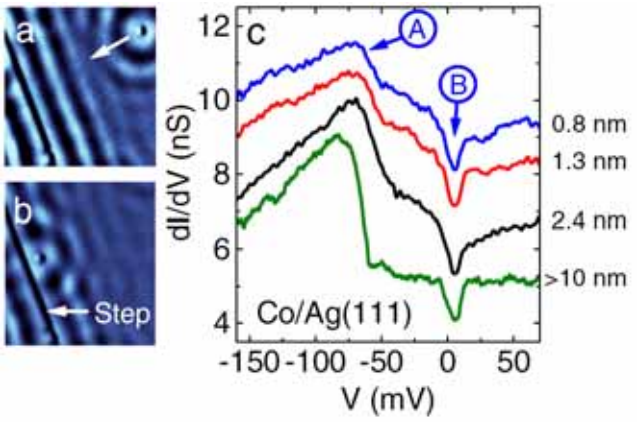
Low-temperature scanning tunneling spectroscopy of magnetic and nonmagnetic metal atoms on Ag(111) and on Cu(111) surfaces reveals the existence of a common electronic resonance at an energy below the binding energies of the surface states. Using an extended Newns-Anderson model, we assign this resonance to an adsorbate-induced bound state, split off from the bottom of the surface-state band, and broadened by the interaction with bulk states. A line shape analysis of the bound state indicates that Ag and Cu adatoms on Ag(111) and Cu(111), respectively, decrease the surface-state lifetime, while a cobalt adatom causes no significant change.

The point contact of a tunnel tip approaching towards Ag(111) and Cu(111) surfaces is investigated with a low temperature scanning tunneling microscope. A sharp jump to contact, random in nature, is observed in the conductance. After point contact, the tip-apex atom is transferred to the surface, indicating that a one-atom contact is formed during the approach. In sharp contrast, the conductance over single silver and copper adatoms exhibits a smooth and reproducible transition from tunneling to contact regime. Numerical simulations show that this is a consequence of the additional dipolar bonding between the adatom and the surface atoms.

References:

[1] L. Limot, J. Kröger, E. Pehlke, R. Berndt, Phys. Rev. Lett. **94** (2005) 036805.
[2] L. Limot, J. Kröger, R. Berndt, A. Garcia-Lekue, W. A. Hofer, Phys. Rev. Lett. **94** (2005) 126102.

Figures:



dI/dV images of a Co adatom near a monoatomic step of Ag(111). (a) Prior to and (b) after moving the atom with the tip at a distance of 0.8 nm from the step. (c) dI/dV spectra of Co as a function of the distance from the bottom edge of the step. (From Ref. 1.)