

Electronic structure of metal surfaces resolved with scanning tunneling spectroscopic imaging

*Ignacio Pascual
Freie Universität Berlin, Germany*

Scanning tunnelling spectroscopy has become an alternative technique for the inspection of electron dynamics at metal surfaces. Its high resolution in energy and the possibility of investigating both, occupied and unoccupied electronic states are major advantages compared to other electron spectroscopies. With the STM we investigate the density of electronic states by plotting spatial maps of the differential tunnel conductance in the proximity of scattering centers like defect sites or step edges. At these sites, the phase of electron waves is fixed, producing standing-wave like oscillations in the vicinity of the scattering centers. This is the closer we can get to “see” electrons of a metal. The wavelength of these oscillations in real space can be easily transformed to reciprocal space information by means of a Fourier transformation [1]. From the analysis of these local modulations on the density of states, we can explore fundamental text-book like phenomena regarding to quantum interference of electronic states. In this seminar, we will illustrate the performance of this technique with several results on metal and semimetal surfaces:

- On Ag(110) we resolve the topology of an unoccupied surface state [2]. Phenomena like quantization (particle in a box like) of the electronic states between steps are observed.
- On copper surfaces we analyze the dynamics of electronic states created the vacuum level by the tip-induced potential, the so-called field emission states. We find that these electronic states disperse as quasi-free electrons, in a similar way as image states do [3].

References:

[1] L. Petersen et al. Phys. Rev. B 57, R5868 (1998).

[2] J.I. Pascual, Z. Song, J.J. Jackiw, K. Horn, and H.-P. Rust. Phys. Rev. B 63, 241103(R) (2001).

[3] J.I. Pascual, C. Corriol, G. Ceballos, H.P. Rust, K. Horn, J.M. Pitarke, P.M. Echenique, and A. Arnau. Phys. Rev. B 165326 (2007)