O 42 Symposium Electron transfer processes II

Time: Thursday 15:00–17:30 Room: WIL C207

Keynote Talk

O 42.1 Thu 15:00 WIL C207

Inter- and intraband scattering of electrons at surfaces — •Thomas Fauster — Lehrstuhl für Festkörperphysik, Universität Erlangen-Nürnberg, Staudtstr. 7, 91058 Erlangen

Time-resolved two-photon photoemission is the method of choice to study the electron dynamics at surfaces. With high energy and angular resolution various scattering processes (interband vs. intraband and inelastic vs. elastic) can be unraveled in detail. For image-potential states at Cu(001) surfaces it is shown [1], that adatoms induce mainly elastic scattering. Inelastic scattering processes are attributed to electron-electron scattering which is not significantly influenced by adatoms. The detailed study of scattering processes is particularly important to understand the electron dynamics at semiconductor surfaces [2].

[1] K. Boger, M. Weinelt, and Th. Fauster: Phys. Rev. Lett. **92**, 126803 (2004); New J. Phys. **7**, 110 (2005).
[2] M. Weinelt, M. Kutschera, Th. Fauster, and M. Rohlfing: Phys. Rev. Lett. **92**, 126801 (2004).

Keynote Talk

O 42.2 Thu 15:30 WIL C207

Image potential states on a finite size adsorbate island — •J.P. Gauyacq and A.G. Borisov — Universite Paris-Sud, 91405 Orsay Cedex, France

When adsorbate islands are grown on a metal surface, image potential states can appear localized at two different places: on the adsorbate islands and on clean substrate patches. Confinement of the image states on islands leads to two phenomena deeply influencing their dynamical behaviour: quantisation on the finite size object and scattering at the island edges. This provides a very appealing opportunity to study finite size effects on a 2D-continuum of states. Results of a theoretical parameter-free study of this problem in the case of Ar islands on a Cu(100) substrate will be presented. Two main points will be addressed : i) quantisation of the image state continuum on the Ar island leading to a series of resonance states and ii) scattering at the edges of the island that results in reflection, or transmission into the image states continua of the clean part of the surface, or decay into the substrate bulk states. Transmission at the island edges is highly probable making the image states on small islands very short-lived. The variation of the image state characteristics (energy and lifetime) with the island size will be presented. The question of the observability of finite size effects and the related question of the minimum island size for an image state to 'look like' on an infinite layer will be addressed.

Keynote Talk

O 42.3 Thu 16:00 WIL C207

Dynamics of surface-localised electronic excitations studied with the scanning tunnelling microscope — •J. Kröger — Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel, D-24098 Kiel, Germany

The dynamics of surface-localised electronic states can be influenced by confinement, by the presence of single adsorbed atoms, and, in the case of superstructures, by Brillouin zone backfolding.

On Ag(111) monatomically deep vacancy islands were fabricated to confine the electronic surface state. Depending upon the size of the vacancy island the dominant lifetime-limiting process can be lossy scattering of the electron waves at the vacancy boundary. An analytic expression is derived to take this effect into account. Further, a corrected analysis of the spatial decay of electron interference patterns is presented, which leads to a more consistent description of the Ag(111) surface state lifetime.

Single adsorbed Ag, Cu, and Co atoms on Ag(111) and Cu(111) induce an electronic resonance, which is split off from the bottom of the surface state band. Whereas Ag atoms on Ag(111) and Cu atoms on Cu(111) decrease the surface state lifetime, the impact of Co atoms on the surface state dynamics is found to be negligible.

The role of elastic scattering in the dynamics of quantum well states on Cu(111)-p(2x2)Cs is addressed. We find that elastic scattering is enhanced by Brillouin zone backfolding and contributes appreciably to the observed quantum well state linewidth: Calculations show that 50% of the linewidth are due to the backfolding mechanism.

Keynote Talk

O 42.4 Thu 16:30 WIL C207

Electron induced isomerization — •Karina Morgenstern — Universität Hannover, Institut für Festkörperphysik, Appelstr. 2, 30167 Hannover

With the scanning tunneling microscope (STM) it is possible to induced chemical reactions on a single molecule basis by electrons tunneling inelastically from the STM tip into a molecule. The method is based on high-resolution imaging at low-temperature (5K) that allows us to identify different groups within the molecule. Chemical reactions are induced by injecting selectively electrons into specific parts of the molecule. The success of the manipulation is visualized in the recorded tunneling current during the manipulation and in STM images taken afterwards. We will present isomerization for two molecules of different complexity, specifically substituted benzene molecules (chloronitrobenzene), and photochrome molecules (azobenzene derivate). The energies needed for the reactions are remarkably low and can be best understood in terms of weakened bonds on the surface in connection with direct reformation of a new bond.

Keynote Talk

O 42.5 Thu 17:00 WIL C207

Non-adiabatic Surface Dynamics: Electron Transfer and Femtochemistry at the Adsorbate/Metal Interface — •Martin Wolf — Dept. of Physics, Freie Universität Berlin, 14195 Berlin, Germany

One of the key goals in surface physics is to obtain a microscopic understanding of elementary excitations in surface reaction dynamics. At metals the dynamics of gas surface interactions are governed by ultrafast charge and energy transfer to the substrate, leading to non-adiabatic couplings between electronic and nuclear degrees of freedom. As a consequence electronic excitation of the substrate by ultrafast laser pulses can induce efficiently non-thermal reactions of adsorbed species. In this talk we present recent progress in the application of femtosecond time-resolved laser spectroscopy to investigate electron thermalization dynamics in metals, electron transfer at the adsorbate metal interface as well as surface femtochemistry induced by photoexcited hot electrons. We show that time-resolved photoemission spectroscopy allows to analyze directly the transient non-equilibrium electron distribution in Ru(001) and discuss the role of electronic friction and energy partitioning between various degrees of freedom in the associative formation of hydrogen and CO on Ru(001).