Quantum well states and Rashba-type spin-orbit splitting in ultrathin Bi films — **Gustav Brühmayer**, Yury M. Koroteev1, Eugey V. Chulkov1, and Stefan Barzykin1 — 1Institut für Festkörperforschung, Forschungszentrum Jülich, 52425 Jülich, Germany — **3Institute of Physics and Materials Science, RAS, 634021, Tomsk, Russia — 2Donostia International Physics Center (DIPC), 20018 San Sebastián, Spain — 4Departamento de Física de Materiales, UPV/EHU, 20080 San Sebastián, Spain

In this contribution a systematic study of the electronic properties of thin (1–6 bilayers) films of the semimetal bismuth in (111) and (110) orientation is presented. The band structure of the films is found, ranging from small-bandgap semiconducting to semimetallic and metallic. The evolution of the Bi(111) and Bi(110) surface states is studied as a function of the film thickness and compared to other experiments and simulations of the semimetallic crystals. Interesting features arise from the strong spin-orbit effects in Bi and the resulting Rashba-type spin-splitting of the surface states. The spin-polarization of these states can be seen to change as these states transform into quantum well states at the Brillouin zone boundary. This strength is described by the mass enhancement parameter $\lambda$. An anisotropic coupling might account for this discrepancy, as these results are obtained along different crystal directions.

This study is aimed at obtaining a full description of EPC at this surface. Experimentally, the Eliashberg function and $\lambda$ can be determined from the renomalized dispersion of the $\Gamma$ surface state at the Fermi energy crossing. Preliminary results show that there is indeed a substantial variation of $\lambda$ between the $\Gamma M$ and the $\Gamma K$ directions. The same trend is observed in a first principles study of this system.

Electronic transport over single atoms — **Martyna Polok**, Dmitry V. Fedorov, Peter Zahn, and Ingrid Mertig — Department of Physics, Martin Luther University Halle-Wittenberg, 06099 Halle (Saale), Germany

Scanning Tunneling Microscope (STM) experiments are important examples of the tunneling through single atoms. We try to develop a general understanding of the transport phenomena in complex structures through a case study of the STM setup.

The density functional theory (DFT) in the Kohn–Rostoker (KKR) Green’s function formulation is implemented to obtain the ground state electronic structure of the system. The transport properties are calculated in the linear response limit using the Baranger and Stone formalism.

In our ab initio investigation we consider a Cu and Co STM tip approaching a Cu (001) surface decorated with a single Cu or Co adatom. Depending on the chemical and geometrical structure of the constriction different transport channels contribute to the total conductance. Based on the spatial current distribution we can classify the open channels according to the symmetry of different angular momentum contributions i.e. the type of vector orbitals available at the Fermi energy.

The aim of this work is to demonstrate the interplay between the structure of the conduction and the electronic transport properties.
In this talk, we show the results of our experiments concerning friction vs. scan-speed curves for different temperatures. Furthermore we compare our experimental results to the thermally activated Prandtl-Tomlinson-model as described by Sang et al. [3]. This allows us the direct evaluation of crucial parameters like the energy barrier and the microscopic damping coefficient, which is often assumed to be in the lower limit of aperiodic damping.


O 65.7 Thu 13:30 MA 141
Temperature dependence of the energy dissipation in dynamic force microscopy

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Operating an atomic force microscope under UHV conditions can be used to study energy loss processes. This can be achieved by measuring the energy necessary to maintain the amplitude of the cantilever (damping) at a given frequency shift. The dissipation of energy is usually described in terms of an adhesion hysteresis mechanism. This mechanism should become less efficient with increasing temperature. To verify this prediction we have measured topography and dissipation data with dynamic force microscopy in the temperature range from 100 K up to 300 K. We used 3,4,9,10-perylenetetracarboxylic-dianhydride (PTCDA) grown on KBr(001). At room temperature, the energy dissipated into the sample (or tip) is 2.5 eV/cycle for PTCDA and 1.5 eV/cycle for KBr, respectively, and is in good agreement with an adhesion hysteresis mechanism. The energy dissipation over the PTCDA surface decreases with increasing temperature yielding a negative temperature coefficient. For the KBr substrate, we find the opposite behaviour: an increase of dissipated energy with increasing temperature. While the negative temperature coefficient in case of PTCDA agrees rather well with the adhesion hysteresis model, the positive slope found for KBr points to a hitherto unknown dissipation mechanism.

O 65.8 Thu 13:45 MA 141
The Surface state of Au(111) and characterization of the tunneling tip in STM — Berndt Koslowski, Anna Tschetschulin, Stefania C. Bobaru, and Paul Ziemann — Institut für Festkörperphysik, Universität Ulm, D-89069 Ulm, Germany

Based on a recently developed method for recovering the electronic density of states (DOS) from Scanning Tunneling Spectroscopy (STS) data [1], we re-examine the well-known Shockley-like surface state (SS) of Au(111) at 6.2K. To do so, we employ the 3D WKB approximation for the special case of a 2-dimensional SS leading to an analytical solution for the DOS recovery. The goal of this contribution is threefold: firstly, we show why the SS does not show up as a step function in STS. Secondly it will be demonstrated, how the SS can be exploited to extract information about the tip DOS resulting in a calibrated* tunneling sensor. Thirdly, we discuss details of the tunneling spectra such as the cross-over from 2D to 3D tunneling below the band edge of the SS.


O 65.9 Thu 14:00 MA 141
Dynamic superhysterisis on insulating and conductive surfaces — Enrico Gnecchi, Pascal Steierner, Anisogara Socolić, Sabine Maier, Thilo Glätzel, Jonas Gessler, Alexis Baratoff, and Ernst Meyer — 1Department of Physics, Klingelbergstr. 82, 4056 Basel, Switzerland — 2Nanonis GmbH, Technoparkstr. 1, 8005 Zürich, Switzerland — 3Materials Science Division, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, USA

Friction between a sharp silicon tip and various atomically flat surfaces (NaCl, KBr, graphite, mica) is minimised by piezo-induced oscillations at well-defined resonance frequencies. This procedure extends an electro-capacitive way to achieve the same effect, which was recently introduced by our group and tested on insulating alkali halide crystals in ultra-high vacuum [1]. A controlled reduction of friction is observed now also on conductive surfaces like graphite, and in ambient conditions, which is quite promising for technological applications to micro-electromechanical devices. The theory previously used to interpret ‘dynamic superhysterisis’ under general conditions is supported by new experimental observations showing that the contact between tip and sample is well maintained when the oscillations are applied.