O 22 Rastersondentechniken I

Zeit: Samstag 10:45–13:00 Raum: TU EB407

O 22.1 Sa 10:45 TU EB407

Long-range energy dissipation in non-contact AFM — •Domenique Weiner[1,2], André Schirmeisen[1,2], and Harald Fuchs[1,2] — [1]Physikalisches Institut, Westfälische Wilhelms-Universität Münster, Wilhelm-Klemm-Str. 10, 48149 Münster — [2]CeNTech, Center for Nanotechnology, Gievenbecker Weg 11, 48149 Münster

The dissipated energy between tip and sample of an AFM driven in the non-contact mode is the subject of current research. The long-range dissipation and its underlying mechanisms are not well understood [1]. The dependence of the dissipation on the oscillation amplitude and the temperature can give a better insight in this effect. We are using a UHV-VT-AFM (Omicron), which enables us to get the frequency shift and the damping signal as a function of the distance between tip and sample. From these values it is possible to calculate the conservative forces and the dissipation. We apply a voltage between tip and sample to measure the electrical dissipation. We are using commercial silicon cantilevers covered with a PtIr-layer, which is about 30 nm thick to guarantee a metallic contact. The investigated Au (111) surface is sputtered and annealed under ultra-high vacuum conditions. This single crystal shows a dissipation signal, which roughly depends on the distance by the power law 1/zn where n=3.5 at RT, which is comparable to other investigations [2,3]. In particular we focus on the temperature dependence of the non-contact friction in order to understand the origin of the dissipation, which might be linked to van der Waals friction [1] or electrical dissipation [4].[1] Volokitin et al., PRL 91, 2003, [2] Gotsmann et al., PRL 86, 2001, [3] Stipe et al., PRL 87, 2001, [4] Denk et al., APL 59, 1991

O 22.2 Sa 11:00 TU EB407

Force-Distance studies by Atomic Force Microscopy using a Double Tuning Fork Sensor at Low Temperature — •Markus Heyde, Maria Kulawik, Hans-Peter Rust, and Hans-Joachim Freund — Fritz-Haber-Institute of the Max-Planck-Society, Faradayweg 4-6, D-14195 Berlin, Germany

A double quartz tuning fork sensor for low temperature ultrahigh vacuum atomic force and scanning tunneling microscopy [1] has been developed. The noise performance of the force sensor as well as the tip preperation is important for optimizing the resolution in the non-contact mode of an atomic force microscope. The features of the new sensor are discussed and compared to previous designs. A set of frequency shift versus distance curves measured at low temperature will be presented. Force and energy versus distance has been calculated from frequency versus distance data [2] . Recent measurements performed on Ag(100) and a thin Al_2O_3 film on NiAl(110) will be shown.

[1] M. Heyde *et al.*, Rev. Sci. Instrum. 75, 2446 (2004).

[2] J. E. Sader and S. P. Jarvis, Appl. Phys. Lett., 84, 1801 (2004).

O 22.3 Sa 11:15 TU EB407

Thermal atomic force microscopy in vacuum — •Martin Hinz[1], Bernd Gotsmann[2], Mark A. Lantz[2], Urs Dürig[2], Johannes Windeln[2], and Othmar Marti[1] — [1]Department of Experimental Physics, University of Ulm, 89069 Ulm, Germany — [2]IBM Research GmbH, Säumerstrasse 4, 8803 Rüschlikon,Switzerland

In conventional atomic force microscopy (AFM) studies a sharp tip located on the end of a cantilever beam is used to image the topography of a sample surface. Variations on this technique have also been developed to probe a variety of other surface properties on the nm-scale, such as mechanical, tribological , magnetic and electrical properties. In this study, purpose-designed heatable cantilevers are used to perform heat transfer measurements of point contacts. An AFM is operated at high vacuum (10^{-6} mbar) where the heat conduction through air is suppressed and the heat flow from the tip to the sample can be measured. The corresponding thermal tip sample contact resistance is measured on different samples such as silicon and thin polymer films. Finally, thermal imaging of a two phase sample system will be presented.

O 22.4 Sa 11:30 TU EB407

Capacitive force detection in dynamic mode Atomic Force Microscopy — •A.-D. Müller, F. Müller, T.D. Long, and M. Hietschold — Chemnitz University of Technology, Institute of Physics, Solid Surfaces Analysis Group, 09107 Chemnitz

Non-optical methods for the deflection detection of a cantilever beam have many advantages concerning the adjustion and applicability to multi-cantilever applications. The capacitive detection based on a second electrode placed behind the cantilever beam has never achieved to get in use, because its sensitivity was estimated to be too low. This contribution restarts the considerations about the capacitive detection of the cantilever deflection for dynamic mode applications with stiff cantilever beams. Distance dependent curves of the force derivative detected capacitively allow to estimate and compare the method with other detection mechanisms.

O 22.5 Sa 11:45 TU EB407

Scanning Ion Conductance Microscopy — •Tilman E. Schäffer, Pia Heidenreich, Matthias Böcker und Harald Fuchs — Physikalisches Institut and Center for Nanotechnology (CeNTech), Universität Münster, Gievenbecker Weg 11, 48149 Münster

We built a scanning ion conductance microscope (SICM) with shear-force distance control. In a SICM, a tapered micropipette with an opening diameter of less than 100 nm is filled with electrolyte and acts as local ion conductance probe while being scanned over a sample surface. To obtain a meaningful interpretation of the measured ion conductance, we keep the pipette-sample distance constant by implementing a complementary shear-force distance control that works under liquid. The vibration amplitude of the pipette we detect optically with the help of a laser beam that we focus onto the thin end of the pipette. In this way, we simultaneously measure two complementary surface properties: topography and ion conductance. We imaged different samples such as CDs, nanogrids and cells, all in liquid. The imaging force was low enough to allow damage-free imaging, even on soft samples.

O 22.6 Sa 12:00 TU EB407

Quantitative Measurement of Tip-Sample Forces by Dynamic Force Microscopy in Ambient Conditions — •Hendrik Hölscher[1], Jan-Erik Schmutz[1], Boris Anzcykowski[2], Marcus Schäfer[1], and Harald Fuchs[1] — [1]Center for NanoTechnology (CeNTech), University of Münster, Gievenbecker Weg 11, 48149 Münster — [2]nanoAnalytics GmbH, Gievenbecker Weg 11, 48149 Münster

Dynamic force spectroscopy (DFS) applied in vacuum is a powerful tool to measure conservative as well as dissipative tip-sample interactions with atomic resolution. In contrast to the often applied measurement of force-vs-distance curves measured in contact-mode dynamic force spectroscopy has the advantage that the full range of tip-sample forces can be continuously detected without hysteresis effects caused by the so-called jump-to-contact of the tip towards the sample surface. Despite of the great capabilities of quantitative dynamic force spectroscopy this technique has not been applied in air or liquids up to now. Nonetheless, a recently introduced algorithm [1] now allows the reconstruction of the tip-sample interactions using the so-called constant excitation mode (CE-mode). Since this mode works in air and liquids dynamic force spectroscopy can also be applied in ambient conditions. We present first experimental applications of this approach for different types of samples.
[1] H. Hölscher, B. Gotsmann, A. Schirmeisen, Phys. Rev. B **68**, 153401 (2003)

O 22.7 Sa 12:15 TU EB407

Cantilever Sensors for Biomolecular Recognition — •Martin Bammerlin and Urs Hubler — Concentris GmbH, Davidsbodenstrasse 63, CH-4056 Basel, Switzerland

Chemically functionalized cantilevers hold a big promise for a multitude of novel sensor applications. We have designed a new cantilever sensor platform taking advantage of the high detection sensitivity for chemical substances and label-free recognition of biomolecules such as DNA or proteins. The "Cantisens Research"system features an integrated two-stage temperature control and a programmable liquid handling system for experiments under stable and controlled conditions. Up to eight surface interaction signals can be measured simultaneously, allowing multiplexed assays and the use of reference channels to cancel out unspecific bindings. In the first part, an overview of the most prominent aspects of the instument design and features will be given. The second part will focus on recent measurement results in the field of biomolecular recognition.

O 22.8 Sa 12:30 TU EB407

FM demodulated Kelvin probe force microscopy for surface photovoltage tracking — •Ulrich Zerweck, Christian Loppacher, Sebastian Teich, Tobias Otto, Elke Beyreuther, Stefan Grafström, and Lukas M. Eng — Institut für Angewandte Photophysik, Technische Universität Dresden, D-01062 Dresden

The surface photovoltage (SPV) of a structured semiconductor surface is deduced via detection of the contact potential difference measured with Kelvin probe force microscopy (KPFM). The experimental setup is based on a quantitative KPFM method complemented with modulated laser illumination in order to measure SPV. In contrast to similar studies based on scanning tunnelling microscopy, KPFM offers the advantage that there is virtually no DC field between tip and sample and, therefore, the SPV is not affected by the presence of the tip.

O 22.9 Sa 12:45 TU EB407

Measurement of the near-field distribution of a wave guide with sub-wavelength aperture on a macroscopic scale — •Oliver Schimek, Georgios Ctistis, Jens J. Paggel, and Paul Fumagalli — Institut für Experimentalphysik, Freie Universität Berlin, 14195 Berlin

The optical near-field is a very useful and interesting experimental tool, which in scalar diffraction theory is well known and widely understood. Scalar diffraction theory however does not include polarization. Very little is known about polarization in the near-field. Also no direct measurement of the field distribution has been presented yet. On the other hand, theoreticians presented a large amount of calculations describing the near-field for a better understanding of the gained experimental results in scanning near-field optical microscopy. We present here our results on the measurements of the near-field of microwaves directed through a wave guide and a sub-wavelength aperture. We used a standard klystron with a wavelength of 3.3 cm and an aluminium tube as wave guide as well as differently shaped apertures. We measured the field intensity in two polarisation directions, its dependence from aperture size, and distance from the aperture. These results are compared with theoretical predictions.