corrugation maxima and minima. We find good agreement between our measurements and simulations for the K^+-terminated tip for both sample positions confirming a previous analysis [2].

[1] R. Hoffmann *et al.*, Phys. Rev. Lett. **92**, 146103 (2004).
[2] K. Ruschmeier *et al.*, Phys. Rev. Lett. **101**, 156102 (2008).

O 27.7 Tue 18:30 P2

Indium microsoldering of graphene on silicon dioxide substrate — •Ann-Katrin Michel[1], Viktor Geringer[1], Tim Echtermeyer[2], Marcus Liebmann[1], and Markus Morgenstern[1] — [1]II. Physikalisches Institut, RWTH Aachen and JARA-FIT, Otto-Blumenthal-Straße, 52074 Aachen — [2]Advanced Microelectronic Center Aachen (AMICA), Otto-Blumenthal-Straße 25, 52074 Aachen

Electron beam lithography is the standard method to produce electrical contacts for nanostructures made e.g. from graphene. A major disadvantage of this method is, apart from high costs, the contamination of the sample due to the residual photoresist. This problem gets even more severe, if scanning probe techniques are applied. Therefore, a more simple technique to make ohmic contacts to graphene without contamination is desirable and has been developed recently [1].

We reproduced this method by designing a setup for microsoldering of graphene flakes on silicon dioxide with multiple indium solder contacts. Mobility measurements on graphene samples using four point indium contacts have been used to characterize the contacts. Moreover, we describe the application to scanning tunneling microscopy (STM) of the microsoldered graphene samples.

[1] C. Ö. Girit and A. Zettl, Appl. Phys. Lett. 91, 193512 (2007)

O 27.8 Tue 18:30 P2

Controlled nanoparticle manipulation along defined vector pathways — •Michael Feldmann, Dirk Dietzel, and André Schirmeisen — Institute of Physics and Center for Nanotechnology, University of Münster, Germany

Manipulation of nanoparticles with an atomic force microscope (AFM) is a very promising approach to measure friction of nanoscale objects with well defined contact area. For example, the phenomenon of frictional duality was revealed for Sb nanoparticles on graphite in vacuum [1]. However, so far the manipulation was performed during conventional image scanning with a commercial AFM control unit [2]. To optimize the control over the manipulation process a new AFM control system has been developed. This system enables AFM tip translations along arbitrary programmable vector pathways while allowing to select distinct control parameters like normal force and velocity for each single vector. Due to the systems ability to simultaneously record the lateral force along the x axis, it is thus possible to conduct nanotribological experiments with individually chosen nanoparticles in a highly controlled and reproducible fashion.

[1] Dietzel *et al.*, Phys. Rev. Lett., 101, 125505 (2008)
[2] Dietzel *et al.*, J. Appl. Phys., 102, 84306 (2007)

O 27.9 Tue 18:30 P2

Nanoscale charge transport measurements using a multi-tip scanning tunneling microscope — Philipp Jaschinsky, Jakob Wensorra, Mihail Ion Lepsa, and •Bert Voigtländer — Institute of Bio- und Nanosystems (IBN) and JARA-Fundamentals of Future Information Technology, Forschungszentrum Jülich, D-52425 Jülich, Germany

We demonstrate the ability of a multi-tip scanning tunneling microscope (STM) combined with a scanning electron microscope (SEM) to perform charge transport measurements on the nanoscale. The STM tips serve as electric probes that can be precisely positioned relative to the surface nanostructures using the SEM control and the height reference provided by the tunneling contact. The tips work in contact, noncontact, and tunneling modes. We present vertical transport measurements on nanosized GaAs/AlAs resonant tunneling diodes and lateral transport measurements on the conductive surface of 7x7 reconstructed Si(111). The high stability of the double-tip STM allows nondestructive electrical contacts to surfaces via the tunneling gaps. We performed two-point electrical measurements via tunneling contacts on the Si(111)(7x7) surface and evaluated them using a model for the charge transport on this surface.

O 27.10 Tue 18:30 P2

s-SNOM from IR to the THz with tuned scatterers — •Hans-Georg von Ribbeck[1,2], Marc Tobias Wenzel[1], and Lukas Matthias Eng[1] — [1]Institute of applied photo physics, TU Dresden, Germany — [2]Forschungszentrum Dresden-Rossendorf, Dresden, Germany

Here we present a scattering near-field optical microscope (s-SNOM) set-up established at the free-electron laser source (FEL) at the Forschungszentrum Dresden-Rossendorf. This microscope is capable to perform optical observations at nanometer scale resolution over the full wavelength range of the FEL, i.e. 3 to 250 micron (1.2 to 100 THz). Furthermore, the optical resolution governed by the near-field interaction between tip and sample and the signal-to-noise ratio is enhanced by specially designed, optically resonant probes. This ultimately results in a much better spatial confinement achieving a resolution preferably of lambda/1000 for the THz region. Also, coupling both a resonant tip and sample will lead to giant polaritonic resonances. Finally the described setup will grant access to new areas of nanoscale applications, such as observing the optical behavior of strained and mixed silicon structures, high-Tc superconductors, single quantum dots, and superlattices at THz frequencies.

Basis to our approach is the recent work [1] where an optical confinement of the near field in z-direction was achieved through tuned scatterers in the form of metallic nanoparticles (MNPs) attached to the AFM tip, serving as non-resonant antennas. Tunability in the THz range will be achieved through geometrically tuned metal wires [2].

O 27.11 Tue 18:30 P2

High Order Field Emission Resonances on W(110) and Fe/W(110) studied by Scanning Tunneling Spectroscopy — •Anika Emmenegger, Stefan Krause, André Kubetzka, Gabriela Herzog, and Roland Wiesendanger — Institute of Applied Physics, University of Hamburg, Jungiusstr. 11, 20355 Hamburg, Germany

Above metal surfaces a Rydberg-like series of states exists close to the vacuum level due to the potential well created by the attractive image potential and the surface projected bulk band gap [1]. In scanning tunneling microsopy (STM) experiments these so-called image-potential states (IPS) experience a Stark Shift [2], hence they are often called field emission resonances in this context.

Neglecting the influence of the image potential, a simple triangular potential model can be applied to determine the effective electric field in the constant current spectroscopy of IPS [3]. Whereas commercial STM electronics typically provide a maximum gap voltage of 10 V, we present scanning tunneling spectra of field emission resonances above the W(110) and Fe/W(110) surface up to the order of n=30 and voltages up to 20 V. The results will be discussed in terms of electric field determination, revealing that the assumption of a constant electric field is only applicable to voltages exceeding 10 V.

[1] U. Thomann et al., Phys. Rev. B 61, 16163 (2000).
[2] S. Crampin, Phys. Rev. Lett. 95, 46801 (2005).
[3] J. H. Coombs and J. K. Gimzewski, J. of Microsc. 125, 841 (1988).

O 27.12 Tue 18:30 P2

Microscopically high speed friction measurements — •Fengzhen Zhang[1], Othmar Marti[1], Stefan Walheim[2], and Thomas Schimmel[2,3] — [1]Institute of Experimental Physics, Ulm University, 89069 Ulm — [2]Forschungszentrum Karlsruhe — [3]University of Karlsruhe

Quartz crystals have been found to be the best substrates for the Atomic Force Microscopy (AFM) high speed friction measurements. To prove the oscillation of the quartz crystals, we prepared Fischer Patterns on the surface. During the oscillation of the quartz crystals, the topographies of the Fischer Pattern show clearly the oscillation information (in tapping mode AFM). The result of the comparison of the friction under different oscillation speeds and after oscillation will be discussed. We will also present the measurement data of friction at high speeds of surfaces without and with adsorbed monolayers.

O 27.13 Tue 18:30 P2

Non-contact Atomic Force Spectroscopy using Field Ion Microscope characterized Tips — •Jens Falter[1], Daniel-Alexander Braun[1,2], Udo Schwarz[4], Hendrik Hölscher[3], André Schirmeisen[1,2], and Harald Fuchs[1,2] — [1]Physikalisches Institut, Universität Münster, Germany — [2]CeNTech, Münster, Germany — [3]IMT, Forschungszentrum Karlsruhe, Germany — [4]Department of Mechanical Engineering, Yale University, New Haven, USA

Although atomic force microscopy (AFM) is a tool for resolving surfaces with atomic resolution, the underlying contrast mechanisms is not yet fully understood. Beyond imaging this technique is capable