O 40: Focus Session: Charge Transport at Surfaces and Nanostructures with Multi-probe Techniques II

Time: Tuesday 14:00–15:15 Location: WIL C307

Invited Talk O 40.1 Tue 14:00 WIL C307

Performances of the new low temperature ultrahigh vacuum 4 scanning tunneling microscopes — •christian Joachim[1,2], Delphine Sordes[1], Corentin Durand[1], We-Hyo Soe[1], and Marek Kolmer[3] — [1]CEMES-CNRS, 29 rue J. Marvig, 31055 Toulouse Cedex, France — [2]MANA-NIMS, 1-1 Namiki, Tsukuba, Ibaraki 305-0044, Japan — [3]NANOSAM, Jagiellonian University, Lojasiewicza 11, 30-348 Krakow, Poland

The performances of our new ScientaOmicron LT-UHV 4-STM are presented by a series of single tip experiments on the Au(111) surface [1]. Each of the 4 STM have performances equivalent to a single tip state-of-art LT-UHV-STM. We have also started to explore passivated Si(100)H surfaces with this instrument with 1 cm lateral size surfaces prepared from a 200 mm wafer [2] essential for the fabrication of atomic scale circuits [3]. Atomic resolution imaging confirms the position of the surface dimers relative to the surface atomic structure [4]. A gentle mechanical jump to contact was observed on a single H atom with very low G/Go contact conductance. Our LT-UHV 4-STM was transformed for the first international molecule car race in Toulouse, spring 2017 [5]. This competition will be shortly described with registered teams from Germany, France, Japan, Switzerland, Austria and US. A poster per team is presented in the poster session. [1] J. Yang et al. Eur. Phys. J. AP, 73, 10702 (2016) [2] M. Kolmer et al. Appl. Surf. Sci., 288, 83 (2014) [3] M. Kolmer et al., Nanoscale, 7, 12325 (2015). [4] T. L. Yap et al. Surf. Sci., 632, L13 (2015) [5] F. Eisenhut et al., Eur. Phys. J. AP, 76, 10001 (2016).

O 40.2 Tue 14:30 WIL C307

New Perspectives in Scanning Tunneling Potentiometry — Philip Willke[1], Thomas Kotzott[1], Jan Voigt[1], Rainer G. Ulbrich[1], M. Alexander Schneider[3], Thomas Pruschke[2], and •Martin Wenderoth[1] — [1]IV. Physikalisches Institut, Universität Göttingen, Göttingen, Germany — [2]Institut für Theoretische Physik, Universität Göttingen, Göttingen, Germany — [3]Lehrstuhl für Festkörperphysik, Universität Erlangen-Nürnberg, Erlangen, Germany

We present a new STP setup with a home-built low-temperature STM operating at 6 K and applicable magnetic field of up to 6 T. First, we study high-resolution STP of scattering centers on a sub-nanometer scale, especially the spatial evolution of the electrochemical potential for 1D defects in graphene.[1] We show that the voltage drop at a monolayer-bilayer boundary in graphene clearly extends spatially up to a few nanometers into the bilayer and hence is not located strictly at the structural defect. We explain this behaviour by the weak coupling between the two bilayer sheets extending the voltage drop at the interface due to the required current transfer. Second, we perform magnetotransport STP measurements mapping the local electrochemical potential as a function of the applied magnetic field.[2] Thus, we are able to extract graphene's charge carrier concentration locally by the emerging Hall field. Additionally, we show that the defect resistance of local defects such as steps, wrinkles and ML/BL-junctions remains constant for all magnetic fields. This work was supported by SPP 1459 'Graphene'. [1] P. Willke et al. Nature Commun. 6399 (2015) [2] P. Willke et al., under consideration (2016)

O 40.3 Tue 14:45 WIL C307

Kelvin probe force microscopy as a tool to measure local transport properties in graphene on SiO2 — Philip Willke[1], •Anna Sinterhauf[1], Christian Möhle[1], Thomas Kotzott[1], Hak Ki Yu[2,3,4], Alec Wodtke[2,3], and Martin Wenderoth[1] — [1]IV. Physical Institute, University of Göttingen, 37077, Göttingen, Germany — [2]Institute for Physical Chemistry, University of Göttingen, 37077, Göttingen, Germany — [3]Max Planck Institute for Biophysical Chemistry, 37077, Göttingen, Germany — [4]Department of Materials Science & Engineering, Ajou University, Suwon, 443-749, South Korea

We combine the AFM-based method of Kelvin probe force microscopy (KPFM) with an additionally applied electric field across the sample to map the electrostatic potential on a nanometer scale. Thus we investigate the local voltage drop in graphene on SiO2 under ambient conditions and room temperature [1]. We can quantify the variation of the local sheet resistance and resolve a localized voltage drop at folded wrinkles for the first time. Furthermore, we map local resistances as a function of temperature by using Joule heating. These measurements show that the local monolayer sheet resistance reflects the macroscopic increase in resistance with temperature while the defect resistance for folded wrinkles is best described by a temperature-independent model which we attribute to interlayer tunneling. This work was supported by SPP 1459 'Graphene'.

[1] Willke et al., Carbon 102, 470-476 (2016)

O 40.4 Tue 15:00 WIL C307

Two-probe measurements on the atomic scale wires: ballistic transport through surface states of Ge(001) — •Marek Kolmer[1], Piotr Olszowski[1], Rafal Zuzak[1], Szymon Godlewski[1], Christian Joachim[2,3], and Marek Szymonski[1] — [1]Centre for Nanometer-Scale Science and Advanced Materials, NANOSAM, Faculty of Physics, Astronomy and Applied Computer Science, Jagiellonian University, Lojasiewicza 11, 30-348 Krakow, Poland — [2]Nanoscience Group & MANA Satellite, CEMES/CNRS, 29 rue Marvig, BP 94347, 31055 Toulouse, France — [3]International Center for Materials Nanoarchitectonics (MANA), National Institute for Materials Science (NIMS), 1-1 Namiki, Tsukuba, Ibaraki 305-0044, Japan

We will present our recent results obtained on the new Scienta-Omicron low temperature ultra-high vacuum 4-probe STM (LT-Nanoprobe). Firstly, we will show our methodology for fine relative positioning of two STM probes on Ge(001) and Ge(001):H surfaces with unprecedented atomic precision and with a lateral exact probe to probe distance below 50 nm. Moreover, we will discuss our design of the 2-probe experiment, which allows a direct testing of the electronic transport through atomic-scale structures in a fully planar geometry. That will be shown on an example of a model system: bare Ge dimer wire supported on Ge(001) and Ge(001):H surface. In this case we determine ballistic transport regimes in the atomic wire by systematic 2-probe experiments on the probe to probe distances below 50 nm.