O 47: Methods: Scanning probe techniques II

Time: Thursday 10:30–12:30 Location: SCH A316

O 47.1 Thu 10:30 SCH A316

Investigation of Locally Stored Charges in Silica by Kelvin Probe Force Microscopy — •Carsten Maedler, Harald Graaf, and Christian von Borczyskowski — Center of Nanostructured Materials and Analytics, Chemnitz University of Technology, D-09107 Chemnitz, Germany

The storage and dissipation of positive and negative charges in thin silicon oxide films were studied in a local manner using Kelvin Probe Force Microscopy. The charges were injected into the oxide by applying a voltage between an electric conductive tip and the silicon beneath the oxide while the tip was in close proximity to the silicon oxide surface. The method used for investigation of the charges, Kelvin Probe Force Microscopy allows the simultaneous imaging of the electrical and topographical properties of a surface. Various patterns were created, where the smallest achieved structures were about 100 nm wide. Because silanol groups are supposed to be the main trapping site for charges we studied the charging properties of silica with various pre-treatment and thus different amounts of silanol groups. A different approach is to passivate the surface with hydrophobic monolayers. We achieved a considerable decrease in charge spreading by the attachment of a layer of Octadecyltrichlorosilane forming a hydrophobic monolayer on the silica surface.

O 47.2 Thu 10:45 SCH A316

Towards a quantitative tunneling spectroscopy: Using differential barrier heights for a deconvolution of the tip and sample density of states — •Holger Pfeifer, Berndt Koslowski, Anna Tschetschetkin, and Paul Ziemann — Institut für Festkörperphysik, Universität Ulm, D-89069 Ulm, Germany

Based on the recently developed method for recovering the electronic density of states (DOS) from scanning tunneling spectroscopy (STS) data [1], we analytically calculate the differential barrier ($\partial_z \partial_V I$) for an energy-dependent DOS of either the sample or the tip. It turns out that (i) considering a peaked DOS the sign of the peak reveals whether this peak belongs to the sample or the tip, and (ii) the formula for the differential barrier can be rewritten to form an additional Volterra integral equation of the second kind for both the DOS of sample and tip, respectively. Additionally to the equations obtained earlier from the differential conductivity ($\partial_V I$), these equations can be exploited by using the Neumann approximation to optimize iteratively the recovered DOS' being then self-consistent with the WKB approximation and measured data (I, $\partial_V I$, and $\partial_z \partial_V I$). By comparing these results with experimental data obtained on Nb(110) we analyze how far the proposed scheme enables deconvolution of the DOS' of sample and tip.

[1] B. Koslowski, Ch. Dietrich, A. Tschetschetkin, P. Ziemann, Phys. Rev B 75, 035421 (2007)

O 47.3 Thu 11:00 SCH A316

Dynamic Force Microscopy with Small Amplitudes at Ambient Conditions — •Elisabeth Köstner and Franz J. Giessibl — Institut für Experimentelle und Angewandte Physik, Universität Regensburg, 93040 Regensburg

Yamada et al. [1] have shown that it is possible to obtain atomic resolution on cleaved mica in water with frequency-modulation force microscopy. These impressive results have been acquired with a very sophisticated setup. This setup enabled them to get a very low deflection noise density, which is decisive for atomic resolution in their measurement scheme.

In our case we tried to image surfaces at ambient conditions with quartz tuning fork based cantilevers. We tried to simplify our setup by using stiff cantilevers (spring constant of some thousand N/m) with small amplitudes (some nanometers) and—most importantly—a higher Q factor. Some first results made in amplitude-modulation force microscopy mode with this setup are presented showing atomic resolution on graphite in air.

[1] T. Fukuma, K. Kobayashi, K. Matsushige, and H. Yamada, Appl. Phys. Lett. 87, 034101 (2005)

O 47.4 Thu 11:15 SCH A316

Structural investigations of membrane electrode assemblies (MEA) in fuel cells via environmental scanning electron microscopy (ESEM) — •Susanne Zils[1], Nathalie Benker[2], and Christina Roth[1] — [1]Institute for Materials Science, TU Darmstadt, Petersenstr. 23, 64287 Darmstadt, Germany — [2]Institute of Applied Geosciences, TU Darmstadt, Schnittspahnstraße 9, 64287 Darmstadt, Germany

Detailed studies to investigate the contact between the ion- and electron-conducting parts of a MEA of a polymer electrolyte membrane fuel cell (PEMFC) have only been performed by SEM and TEM up to now. These methods exclude the investigation of MEAs under realistic conditions. To obtain significant information of the structure under quasi in-situ conditions ESEM is used in this work. This technique allows for studying the MEAs under different temperatures as well as under different relative humidities.

The ESEM measurements were carried out with a Quanta 200F (FEI company, Netherlands) equipped with a field emission gun and an energy dispersive X-ray detector for elemental analysis.

During the experiments, relative humidities between 5% and 100% at defined temperatures have been adjusted. Images and movies have been recorded to investigate structural changes in the electrodes as well as on the interface between the polymer electrolyte membrane and the electrodes. Further experiments shall allow us to investigate the influence of ice formation on the electrode structure and the membrane electrode interface.

O 47.5 Thu 11:30 SCH A316

Distance and material dependence of the near-field thermal heat transfer — •Robert Berganski, Achim Kittel, and Uli F. Wischnath — Energy and Semiconductor Research Laboratory - University of Oldenburg

The heat transfer between the probe and the sample is measured by means of a Near-field Scanning Thermal Microscope (NSThM) which is based on a commercial scanning tunneling microscope. In our setup the standard STM-Probe is replaced by a miniaturized coaxial thermocouple, which records the change in the temperature at the tip. Thus the heat transfer can be measure while the distance between the probe and the sample surface will be varied by a few tens nanometers. The investigated heat transfer relies on evanescent modes of the thermal transfer between the tip at room temperature and the sample at about 110K. All other interfering distant dependent heat transfer mechanisms are excluded by using ultra high vacuum conditions. In the present contribution the focus lies on the material dependence of these evanescent modes which are reaching a few nanometers into the vacuum. The influence of the dielectric properties of the sample material on the heat transfer is studied by varying the material of the sample surface.

O 47.6 Thu 11:45 SCH A316

Transport of product gases in a scanning mass spectrometer setup — •Matthias Roos[1], Dan Zhang[2], Joachim Bansmann[1], Olaf Deutschmann[2], and R. Jürgen Behm[1] — [1]Institute of Surface Chemistry and Catalysis, Ulm University, D-89069 Ulm — [2]Institute for Chemical Technology and Polymer Chemistry, University of Karlsruhe, D-76131 Karlsruhe

The transport and distribution of reaction products above microstructured catalytically active samples was studied by spatially resolved scanning mass spectrometry and by combined Monte Carlo simulations and Fluid Dynamics calculations. For CO oxidation on planar Pt microstructures, the spatial distribution of CO_2 product gas was probed via a thin quartz capillary, which leads the gases to a quadrupole mass spectrometer. To obtain reasonable lateral resolution, the capillary orifice was located a few micrometers above the sample surface during measurement. In this geometry, shadowing by the capillary results in a local reduction of the reactant partial pressures underneath the capillary. To quantitatively analyse the reaction rates, the threedimensional distribution of CO_2 product gas was modeled, considering the flow of educt gases, and their local variation of the pressure and the gas temperature.

O 47.7 Thu 12:00 SCH A316

HarmoniX microscopy: A new scanning probe microscopy technique for high resolution mapping of material properties — •Udo Volz — Veeco Instruments GmbH Dynamostraße 19 D-68165 Mannheim

HarmoniX microscopy is a brand new mode of Scanning Probe Microscopy which provides fast and high resolution nanoscale mapping of material properties such as elasticity, adhesion, and dissipation. HarmoniX imaging utilizes special Tapping Mode probes that are designed for high bandwidth measurements of the forces acting on the probe tip. The variation in tip-sample forces during one period of the tapping oscillation is reconstructed by analyzing the full spectrum of motion of the probe. From the measured force-distance curves the material properties of the sample are then determined independently for each pixel of the image. HarmoniX microscopy is working at typical Tapping Mode imaging speeds and is thus hundreds of times faster than other quantitative material mapping techniques such as force volume imaging, but it retains the high resolution, non-destructive qualities of Tapping Mode Imaging.

O 47.8 Thu 12:15 SCH A316

Nanometer Resolution of Materials Properties with Scanning Microwave Microscopy — •Matthias Fenner, Wenhai Han, and Hassan Tanbakuchi — Agilent Technologies, 61476 Kronberg, Germany

Advances in scanning probe microscopy have led to the introduction of new tools for local characterization of surfaces and materials at the nanoscale, beyond basic topography and structure. We are proposing a new technique that was realized by combining Agilent's core competencies in the interdisciplinary fields of electronic test and measurement, nanotechnology, and life sciences. This new scanning microwave microscopy (SMM) platform enables the simultaneous measurements of AFM data and traditional microwave network analysis. SMM measures the electrical properties of a material (i.e. dielectric properties, capacitance, and complex impedance), providing researchers in polymer science, semiconductors, and bioscience a new analytical tool for advancing research. This presentation will review our SMM implementation and an explanation of the technical challenges in developing this new technology. We will show the latest results followed by potential benefits this new technology might bring other scientific disciplines.