

O 89: Methods: other (experimental)

Time: Thursday 17:15–18:15

Location: WIL B321

O 89.1 Thu 17:15 WIL B321

Surface science in hell: understanding plasma-surface processes in a fusion reactor — ●GREGORY DE TEMMERMAN — FOM Institute for Plasma Physics Rijnhuizen, Association EURATOM-FOM, Trilateral Euregio Cluster, P.O. Box 1207, 3430 BE Nieuwegein, The Netherlands

In a fusion reactor, power from the core plasma is exhausted by the surrounding plasma-facing materials which are bombarded by high fluxes of energetic neutral and charged energetic particles. Study of the plasma-surface interface is very challenging as surface analysis techniques are often impossible to apply in-situ. Understanding of the plasma-surface processes is only possible by supporting experiments in large devices by dedicated small-scale experiments mimicking some specific conditions. 2 specific illustrations of this approach will be detailed. The systematic study of the co-deposition of beryllium with tritium using NRA, TDS, SEM and XPS allowed derivation of scaling laws able to reconcile discrepancies between different research groups and to identify the role of beryllium hydride formation as an important process. A novel experimental setup has been developed at FOM to study the response of a plasma-immersed surface to intense heat loads expected during plasma instabilities. Fast spectroscopic and infrared measurements allow in-situ diagnosing while high-resolution microscopy is routinely used to investigate the induced surface changes. An unexpected outcome of the system is its ability, by tuning the experimental conditions, to produce nano-particles with very narrow size distribution, bridging the gap with fundamental surface science.

O 89.2 Thu 17:30 WIL B321

Microcalorimetry Based on Thermally Induced Deformations of Ultra-thin Single Crystals — ●CHRISTIAN PUNCKT¹, PABLO SANCHEZ BODEGA², and HARM HINRICH ROTERMUND² — ¹Dept. of Chem. and Biolog. Engineering, Princeton University, Princeton, NJ 08544 — ²Dept. of Physics and Atmospheric Science, Dalhousie University, Halifax, NS B3H 3J5, Canada

We show that ultra-thin metal foils can be used to measure the heat of adsorption of molecular species with a sensitivity of a few nJ by monitoring their thermally induced mechanical deformation. A platinum foil with a thickness of 300 nm and 4 mm diameter has a heat capacity of 10 $\mu\text{J}/\text{K}$. As carbon monoxide (CO) adsorbes on its surface, about 30 μJ of adsorption heat per monolayer are released. Therefore even the adsorption of fractions of a monolayer increases the foil temperature sufficiently, such that thermo-elastic stress leads to buckling of the foil. In order to detect this deformation, we set up an imaging interferometer capable of measuring deflections of a few tens of nanometers. We observe that adsorption of CO and oxygen causes a significant mechanical response of the Pt foil. Additionally, we can detect heat release during the oxidation of CO on the platinum catalyst. Fronts and pulses of deformation are found which we relate to reaction patterns on the catalyst surface. Our work provides a proof-of-concept for the direct measurement of adsorption heat based on a

simple chemo-thermo-mechanical mechanism that operates in a wide temperature and pressure range. The system can be calibrated using continuous or pulsed laser light.

O 89.3 Thu 17:45 WIL B321

Surface stress and MOKE-measurements down to 30K — ●JÖRG PREMPEL, DIRK SANDER, and JÜRGEN KIRSCHNER — Max-Planck-Institut für Mikrostrukturphysik, Weinberg 2, D-06120 Halle

A new combined stress and magneto-optical Kerr-effect (MOKE) experiment under UHV conditions has been developed. The temperature range of an optical 2-beam-stress measurement [1] and for MOKE experiments in the longitudinal and polar geometry in fields of up to 0.7 T has been extended down to 30 K. A liquid helium cooled cryostat is used which allows an accurate control of the sample temperature in the range 30 – 300 K. First results for surface stress and MOKE measurements were performed for H-adsorption and Co-growth on Pt(111), respectively. The low temperature of 30 K is applied to study for the first time the Xe-induced surface stress change on Pt(111), where a compressive stress of $-2.5 \frac{\text{N}}{\text{m}}$ is observed after exposure of 10 L Xe. The results are discussed in view of previous work and new insights into inert gas induced surface stress changes.

[1] D. Sander, Zh. Tian, J. Kirschner: JPCM **21** (2009) 134015

O 89.4 Thu 18:00 WIL B321

Nanojoule adsorption calorimetry (NAC) and its application to metal/organic interfaces — ●HANS-JÖRG DRESCHER, OLE LYTKEN, FABIAN BEBENSEE, HANS-PETER STEINRÜCK, and J. MICHAEL GOTTFRIED — Universität Erlangen-Nürnberg, Lehrstuhl für Physikalische Chemie II

NAC is a technique for measuring adsorption energies on single-crystals surfaces and other well defined substrates in ultrahigh vacuum. Unlike desorption-based methods such as TPD, it can be used for non-reversible adsorbate systems, in which the adsorbate or substrate decomposes before desorption occurs. Examples include large organic molecules on metal surfaces or metals on organic or polymer surfaces. Similar to previous adsorption calorimeters [1-3], NAC relies on the direct measurement of adsorption-induced temperature changes of thin substrates using pyroelectric detectors. In combination with pulsed molecular beam techniques and highly accurate flux, sticking probability and reflectivity measurements, this ensures outstanding sensitivity in the nanojoule and picomole regimes. This contribution covers design considerations for achieving high accuracies and the challenges arising therefrom. Novel methodical solutions for various classes of interfaces, e.g., metals on semiconducting polymers or π -conjugated organic molecules on metals will be presented. Support by the Alexander von Humboldt Foundation, the DAAD and the Universitätsbund Erlangen-Nürnberg e.V. is gratefully acknowledged. [1] S. Černý, Surf. Sci. Rep. 26 (1996) 1. [2] W. A. Brown et al., Chem. Rev. 98 (1998) 797. [3] O. Lytken et al., Chem. Soc. Rev. 37 (2008) 2172.