MM 32: Nanomaterials: Surface Effects

Time: Thursday 11:45–13:00 Location: H45

MM 32.1 Thu 11:45 H45

Effects of post anodization processes on the surface stability of anodic aluminum oxide — •Lydia Daum, Stefan Ostendorp, and Gerhard Wilde — Westfälische-Wilhelms-Universität, Münster, Germany

The wide spectrum of different aluminum alloys enables the industry an economically advantageous material with the desired mechanical properties. In contrast to high-purity aluminum, the formation of a thin protective alumina layer is suppressed, which leads to a lower chemical corrosion resistance. Here anodization and the generation of anodic aluminum oxides (AAOs) are mandatory to obtain a necessary protective coating. The participating alloying elements are obstacles for mechanical stresses inside the AAOs which promotes the formation of nano- and microcracks at the surface. Thus, chemical attacks of the aluminum alloy are more favorable.

The use of post anodization processes will densify the pores and flatten the surface, which enhances the chemical resistance. A combination of nanoindentation studies and electron microscopy measurements are analyzing the surface stability of AAOs. By varying the methods in duration and medium, different wear, hardness and ductility characteristics are visible.

MM 32.2 Thu 12:00 H45

Surfaces of nanoporous gold: rough and faceted? — •Stefan A. Berger[1], Ulrike Dette[1,2], Lingzhi Liu[3], Jürgen Markmann[1,2], and Jörg Weissmüller[2,1] — [1]Helmholtz Zentrum Hereon — [2]Technische Universität Hamburg — [3]Shenyang National Laboratory for Materials Science

Nanoporous gold is an interesting model system for studying the impact of surfaces on the properties of nanomaterials. The surface morphology, faceted or rough, is of interest in that context. Scanning electron micrographs almost invariably show smoothly curved surfaces at the scale of the ligament size, suggesting roughness as opposed to faceting. Here, we show that proper imaging conditions to reveal facets, suggesting that the roughness may be an artifact of imaging. We find that the roughness is most pronounced after annealing in oxygen atmosphere. While low index facets are expected to prevail on gold, we regularly also observe high index facets.

MM 32.3 Thu 12:15 H45

Understanding of the underlying field evaporation mechanism of pure water tips in high electric fields — •Tim Maximilian Schwarz[1], Guido Schmitz[1], Nico Segreto[2], Johannes Kästner[2], and Patrick Stender[1] — [1]University of Stuttgart, Institute for Materials Science, Chair of Materials Physics, Heisenbergstr. 3, 70569 Stuttgart, Germany — [2]University of Stuttgart, Institute for Theoretical Chemistry, Pfaffenwaldring 55, 70569 Stuttgart, Germany

Frozen liquids are challenging and rather new in the investigation by atom probe tomography. However, recent progress in instrumentation, especially the introduction of cryo transfer shuttles, and the development of the required preparation routes to shape nanometric needles of frozen liquids enable measurements of sufficient quality and size of data sets to discover the typical features of this material class. In this talk, we present the fragmentation behaviour of bulk frozen water as an important matrix for biomolecules or solvent of electrolytes. The obtained mass spectra are complex. However, this support of DFT calculations of the molecule stabilities, we identify a systematic series of protonated (H2O)nH3O+ events that represent a clear "fingerprint" for the existence of water. Remarkably, tailing and the exact mass position of the two series differ, which provides evidence that the protonated fragments are permanently positively charged and therefore, slightly drawn out of the dielectric surface before the evaporation event.

MM 32.4 Thu 12:30 H45

Synthesis of superparamagnetic iron oxide nanoparticles by electron beam irradiation — •Johannes Dietrich[1,2] and Stefan Mayr[1,2] — [1]Leibniz-Institut für Oberflächenmodifizierung e.V. (IOM), Permoserstraße 15, 04318 Leipzig — [2]Universität Leipzig, Fakultät für Physik und Geowissenschaften, Abteilung Oberflächenphysik, Linnéstraße 5, 04103 Leipzig

Nanoparticles based on iron oxides are a highly versatile material used in a broad range of applications, for instance embedding magnetic particles in polymer matrices to create ferrogels. A common procedure is to synthesize the particles in separate processes, add them to the gel and crosslink the polymer chains with nanoparticles by electron beam treatment. Combining synthesis and crosslinking would offer the possibility to create ferrogels by an one-step process.

In our work, we show a procedure to synthesize superparamagnetic nanoparticles with a narrow size distribution and an average size of approximately 5 nm directly by electron beam irradiation. The formation of small amounts of nanoparticles could already observed for doses of 50 kGy, but these particles showed a low crystallinity and a higher percentage of amorphous particles. For higher doses increasing crystallinity and yield could be observed, which is also reflected in the higher saturation magnetization for samples irradiated with higher doses. Additionally, particles irradiated with doses starting from 150 kGy show a tendency to form bigger cluster with sizes from 34 nm to 73 nm.

MM 32.5 Thu 12:45 H45

Probing the oxide formation on Pt, Pd and Pt/Pd catalysts during NO oxidation by Atom Probe Tomography (APT) — •Yoonhee Lee[1], Daniel Dobesch[2], Ute Tuttlies[2], Patrick Stender[1], Ulrich Nieken[2], and Guido Schmitz[1] — [1]Institute of Materials Science, University of Stuttgart, Heisenbergstr. 3, 70569 Stuttgart, Germany — [2]Institute of Chemical Process Engineering, University of Stuttgart, Böblinger Str. 78, 70199 Stuttgart, Germany *Yoonhee.lee@mp.imw.uni-stuttgart.de

Inverse hysteresis behavior of Pt, Pd and PtPd alloy catalysts during NO conversion can be attributed to the formation of metal oxides. Even though there were many efforts to study the oxidation of these noble metals experimentally, still the surface change of the pure catalyst has not been observed yet. In this work, NO conversion measurements were carried out with nanoparticles of Pt, Pd and Pt/Pd alloy, produced by spark discharge method, in an isothermal flatbed reactor. The catalyst was subjected to alternating heating and cooling ramps in conditions prone to surface oxide formation. Besides, the oxygen content formed on the surface of catalyst was determined during Temperature-Programmed Reduction(TPR) in H2 atmosphere. The same conditions (gas concentration, heating and cooling rate) of the NO conversion experiments have been achieved in a reaction chamber directly connected to the Atom Probe Tomography (APT) under ultra-high vacuum conditions. The samples were exposed to the gas and measured in APT. The 3D chemical structure was reconstructed and the effective thickness of formed oxides was determined.