MM 29: Nanomaterials

Synthesis and Characterization

Time: Wednesday 10:15–11:15 Location: H 0106

MM 29.1 Wed 10:15 H 0106

Solution-based synthesis of copper nanowires and automated diameter analysis — •Josef Mock[1], Marco Bobinger[1], Markus Becherer[1], and Paolo Lugli[2] — [1]Technical University of Munich, Institute for Nanoelectronics, Munich, Germany — [2]Free University of Bozen-Bolzano, Faculty of Science and Technology, Bozen, Italy

The demand for applications that require transparent conducting electrodes (TCEs) is rapidly growing and therefore, a low cost alternative to indium tin oxide (ITO), the prevailing TCE material, is needed. In this contribution, we present an environmentally friendly synthesis for CuNWs in aqueous solution at mild process temperatures. The synthesis employs Copper(II) chloride dihydrate as the copper-containing precursor, L-Ascorbic acid as the mild reducing agent and Oleylamine as the capping agent that directs the uniaxial wire growth. The optimum process temperature is found at 81 °C, which produces nanowires with a mean diameter of 100 nm and a mean length of 40 μm, respectively. With the aid of DiameterJ, the diameters of the CuNWs were analyzed in an automated and reproducible way from SEM-images. DiameterJ is a plugin developed for ImageJ and consists of two main components: the i) the segmentation part and ii) the analyzing part. The segmentation part of DiameterJ transforms the SEM image to a binary image, which is used for the analyzing part. As a result from the analyzing part, DiameterJ extracts two different diameters, the so called super pixel diameter and a fiber diameter histogram. Further, both diameters show good agreement to the manual analysis for the same SEM-images.

MM 29.2 Wed 10:30 H 0106

3D X-ray Diffraction Microscopy (3DXRD) using high resolution X-ray nanodiffraction — •Hergen Stieglitz, Christina Krywka, and Martin Müller — Helmholtz-Zentrum Geesthacht, 21502 Geesthacht, Germany

The existing technology called 3DXRD, is a well-established technique to map the grain structure of polycrystalline systems (e.g. metals). This technology is based on reconstruction algorithms which trace the positions of multiple Bragg-Peaks as a function of the rotation angle during the rotation of the sample. Due to a given beamsize and the software-based limit only a few grains can be tracked, resulting in a minimum mappable grainsize.

The planned experiment shall utilize a nano-focused synchrotron beam (e.g. Nanofocus Endstation of P03, PETRA III) to examine very fine-grained systems. The small beamsize allows detecting grains below the size limit of standard 3DXRD. With respect to the small beamsize of about 100 nm cross section, the precise positioning of the sample becomes more important to secure a constant scanned volume (the so called gauge volume). Otherwise some grains may be outside the gauge volume in some scans therefore they cannot be traced and produce mistakes while reconstructing.

To meet this challenge a stable and wobble-free rotary stage is planned to ensure a constant gauge volume. We are planning to use an interferomenter-based feedback loop to compensate the runout of the sample with a XY-stage. A further step is the adjustment of the existing software for the needs of a nano-focused beam.

MM 29.3 Wed 10:45 H 0106

Cryo-Atom probe tomography of soft matter and biological materials — •Jonas Ott, Patrick Stender, and Guido Schmitz — Institut für Materialwissenschaft, Lehrstuhl für Materialphysik, Stuttgart, Deutschland

Atom probe tomography (APT) is a well-established technique of chemical analysis with sub-nanometer resolution for metals, semiconductors and ceramics. Initially limited to metals (atom probe analysis available since 1968), the extension by pulsed laser enabled regular APT investigations of non-conductive materials since 2004. Still organic materials, soft matter or even liquids have not become a reasonable part of APT investigations, which is mainly due to the difficult sample preparation and unsuitable mechanical properties of the produced tips. Regarding biological materials such as cells and proteins in nanobiology or porous soft matter for catalysis, the expansion of APT technique to organic materials would offer exciting new opportunities. In our studies, we successfully created a new instrument by combining a dual beam FIB and a miniaturized atom probe chamber which allows the fast direct cryo-transfer and innovative measurement protocols. With this instrument, preparation of the required needle even of frozen liquids becomes possible, avoiding complex lift-out and gluing processes becomes. Measurements of natural honey and supersaturated glucose solution are presented and discussed.

MM 29.4 Wed 11:00 H 0106

A novel 3D test pattern for full-field transmission x-ray microscopy * nanoporous gold — •Emanuel Larsson[1], Malte Storm[2], Fabian Wilde[1], Markus Ziehmer[1], Kaixiong Hu[1], Doga Gursoy[3], Francesco de Carlo[3], Erica Lilleodden[1,4], Martin Müller[1], and Imke Greving[1] — [1]Institute of Materials Research, Helmholtz-Zentrum Geesthacht, 21502 Geesthacht, Germany — [2]Diamond Light Source Ltd, Didcot, UK — [3]Advanced Photon Source, Argonne National Laboratory, Argonne, 60439, USA — [4]Institute of Advanced Ceramics, Technische Universität Hamburg, 21073 Hamburg, Germany

Nanoporous gold (NPG) is the structure resultant from dealloying of an Ag-rich AgAu alloy (Mameka et al., 2016).

The high absorbing capabilities of NPG together with the possibility to tailor the ligament diameters (from 20 nm up to 1 μ m) with respect to the achievable resolution of a given synchrotron or lab-based Full-field Transmission X-ray Microscopy (XTM) setup makes NPG an optimal 3D test pattern for XTM.

Reconstructed slices of NPG were analyzed with both qualitative and quantitative image parameters, e.g. Contrast-to-Noise Ratio, Percentage Volume, Ligament Thickness, Specific Surface Area, Sphericity etc. using the Pore3d software package (Brun et al., 2010). These parameters can then be used to compare the efficiencies in-between different XTM-setups.