MM 2: Topical Session Nanoporous Functional Materials II

Time: Monday 12:00–13:00 Location: IFW A

Topical Talk MM 2.1 Mon 12:00 IFW A

Plastic deformation of macroscopic nanoporous metals — •Hai-Jun Jin — Institut für Nanotechnologie, Forschungszentrum Karlsruhe, Germany

Mechanical behavior of nanoporous metals reflects the collective deformation of extended arrays of nano-objects. Studies of their intrinsic mechanical properties have been prevented by high density of preformed cracks and thereby the severe brittleness of bulk nanoporous samples. This presentation will focus first on the strategies to fabricate macroscopic crack-free and high strength nanoporous metals, and then the experimental studies on the mechanical performance of monolithic and crack-free nanoporous gold samples. Millimeter-sized nanoporous gold samples can be prepared with excellent ductility in compression, enabling studies of the yield phenomenon and strain rate sensitivity along with the microstructure evolution. A distinguishing collective feature of deformation will be discussed in this material, in relation to its long range coherent crystal lattice at a scale much larger than the ligament size. (The following collaborations are acknowledged: D. Kramer, L. Kurmanaeva, Y. Ivanisenko, J. Weissmüller, INT, FZ Karlsruhe; J. Schmauch, Uni. Saarlandes; H. Rösner, Uni. Münster; DFG Forschergruppe 714 'Plastictiy of Nanocrystalline Solids')

MM 2.2 Mon 12:30 IFW A

Elastic properties and freezing of argon confined in mesoporous glass — •Klaus Schappert and Rolf Pelster — Universität des Saarlandes, FR 7.2 Experimentalphysik, Campus E 2.6, 66123 Saarbrücken, Germany

We study the properties of argon adsorbed in mesoporous Vycor glass with a mean pore diameter of 8 nm. Our ultrasonic measurements show, that below the freezing point of argon the adsorption process proceeds in three steps [1]. The first few adsorbed wall-layers remain liquidlike; i.e., freezing starts only at a temperature dependent filling of the pores. At a somewhat higher filling of the porous sample, we observe an abrupt increase of the effective shear modulus to a plateau value. From the dependence of the effective shear modulus on the filling fraction and the temperature, we infer some elastic properties of the adsorbed argon itself.

[1] Klaus Schappert and Rolf Pelster, Phys. Rev. B 78, 174108 (2008)

MM 2.3 Mon 12:45 IFW A

Nanoporous Superalloys by Selective Phase Extraction: Processing, Properties, Applications — •Joachim Rösler, Oliver Näth, and Fabian Schmitz — Technische Universität Braunschweig, Langer Kamp 8, D-38106 Braunschweig

Nanoporous Ni-based superalloys are a new material class [1]. They are fabricated from sheets of the two phase g/g* base material by thermomechanical processing, followed by selective phase extraction of either the g- or g*-phase. As a result, a porous membrane is obtained, containing extremely regular and fine channel-like porosity on the nanoscale. First, manufacturing of these materials is described and considerable flexibility in controlling the pore morphology is demonstrated. Furthermore, (micro-)structuring of the membranes in solid and porous domains as well as coating processes for external and internal material deposition are illustrated. These options are of particular interest, e.g. for the design of micro-chemical reactors, heat exchangers or Pd-based oxygen membranes. Secondly, microstructure-property correlations are discussed and it is demonstrated that the thermomechanical processing parameters critically control mechanical strength and gas permeability. Tensile strength levels of up to 100 MPa are achieved when the processing parameters are adjusted accordingly. At the same time, molecular separation of gas mixtures is possible as the pore dimensions are comparable to the mean free path of the gas molecules. This may be of particular interest for the separation of hydrogen.

[1] J. Rösler, O. Näth, S. Jäger, F. Schmitz and D. Mukherji, Acta Mater., 53, 1397 (2005)