MM 46: Nanostructured Materials III

Time: Thursday 10:15–11:45 Location: H16

MM 46.1 Thu 10:15 H16

Dreidimensionale Morphologie von Nanopartikeln und Nanodrähten — •Christina Möller, Z.-A. Li, M. Spasova und M. Farle — Fakultät für Physik und Center for Nanointegration Duisburg-Essen (CeNIDE), Universität Duisburg-Essen

Der Beitrag wurde abgesagt.

MM 46.2 Thu 10:30 H16

Structure, morphology and ageing of dumbbell Ag-Fe nanoparticles — •Anna Elsukova, Zi-An Li, Mehmet Acet, Marina Spasova, and Michael Farle — Fakultät für Physik and CENIDE, Universität Duisburg-Essen, 47048, Duisburg, Germany

Dumbbell-shaped nanocomposites are attracting much attention recently. Multifunctional properties of such systems offer possibilities for various diagnostic and therapeutic applications in biomedicine. [1] We have prepared dumbbell Ag-Fe nanoparticles by magnetron sputtering with subsequent in-flight annealing [2]. As-prepared particles have been aged in ambient atmosphere for 5 months. Structural properties and chemical composition of as-prepared and aged particles were examined by means of analytical electron microscopy including high-resolution imaging, energy dispersive x-ray spectroscopy (EDX) and electron energy-loss spectroscopy (EELS). As-prepared nanocomposites consist of a faceted 4-nm Ag *hat* sitting on a 10-nm Fe@gamma-Fe2O3 particle of more spherical shape. Ageing leads to the changes in the particles crystallinity and morphology. The aged nanocomposite consists of a silver spherical particle that may be attached to a hollow iron oxide sphere containing one or several silver clusters inside. Supported by DFG, SFB445. [1] Chenjie Xu et al., Angew Int Ed Engl. 2008 47(1) 173-176 [2] S. Stappert et al., J. of Cryst. Growth, 252 (2003), 440

MM 46.3 Thu 10:45 H16

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

We explore the behaviour of argon in mesoporous Vycor glass focusing on the process of freezing and the elastic properties of the adsorbate itself. For this purpose we perform ultrasonic measurements of the effective shear modulus and of the longitudinal modulus. Isothermal filling cycles at temperatures above 66 K reveal that the first few wall-layers remain liquid-like, so that freezing starts only above a threshold [1]. From these measurements we infer the elastic properties of adsorbed wall layers with the aid of an effective medium analysis. In order to understand the behaviour of the wall layers we also conduct thermal cycles of partially filled pores down to about 15 K. At higher filling fractions, the macroscopic properties of the porous sample change abruptly, an effect that we discuss in terms of capillary sublimation.

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

MM 46.4 Thu 11:00 H16

Cluster deposition on self-assembled thiol monolayers: mechanisms from simulation and experiment — •Tommi Järvi[1], Leila Costelle[2], Minna Räisänen[3], Jyrki Räisänen[2], and Vladimir Tuboltsev[2] — [1]Fraunhofer-Institut für Werkstoffmechanik IWM, Freiburg, Germany — [2]University of Helsinki, Helsinki, Finland — [3]University of St Andrews, St Andrews, UK

Controlled deposition of clusters on surfaces is of vital importance in many applications of nanotechnology. Recently, cluster deposition on self-assembled monolayers (SAMs) of thiols on gold has raised interest, but open questions remain as to how the clusters interact with the thiol-covered surface on the atomic level.

Whether clusters immobilize, and retain their as-synthesized size distribution and properties, depends on the bonding between the cluster and gold substrate. Experiments show, that deposition energies of ca. 0.2-0.5 eV/at result in cluster penetration through the SAM [1,2]. High energies cause cluster deformation, however, and a thorough understanding of the cluster-SAM interaction at the atomic level is required so that desired properties can be achieved.

We address these questions using a combination of experiments and molecular dynamics simulations with a recently developed interatomic potential. We elucidate the physics of cluster landing, and show how the interplay between cluster-surface binding, deposition energy, and cluster size affects the structure of the deposited particles.

[1] Lando et al., Phys. Chem. Chem. Phys. 11, 1521 (2009).
[2] Costelle et al., unpublished.

MM 46.5 Thu 11:15 H16

Experimental demonstration of hyperbolic wave vector surfaces in silver nanowire arrays — •Jörg Schilling[1] and Jyotirmayee Kanungo[2] — [1]ZIK "SiLi-nano", Martin-Luther-Universität Halle-Wittenberg, Halle — [2]Queen's University Belfast, Belfast, UK

Arrays of metal nanowires represent uniaxial metamaterials, whose principal effective permittivities perpendicular and parallel to the wire axis have opposite sign in the infrared and visible spectral range. This property leads to a hyperbolic equi-frequency surface for the extraordinary rays in wave vector space allowing the propagation of waves with unusally large wave vectors. Here we present an experimental mapping of the hyperbolic equi-frequency surfaces of TM (p-) polarised light propagating within a silver nanowire array. To this purpose we performed angular resolved transmission measurements on a 1.7micron high alumina film containing the silver nanowire array. From the order of the observed Fabry-Perot resonances the wave vector component kz is determined, while the lateral wave vector component kx, is obtained from the angle of incidence. The resulting markings in kx-kz wave vector diagram then result in a hyperbolic equi-frequency surface for the TM polarisation. Fitting the relationship between spectral position of the Fabry-Perot peaks and angle of incidence by a simple linear equation, we furthermore determined the values of the principal permittivities for TE and TM polarisation in a wide spectral range. All experimental results agree well with simulations based on the Maxwell-Garnett effective medium theory.

MM 46.6 Thu 11:30 H16

Plasmonic Nano Structures via Electron Beam Induced Deposition — •Katja Höflich[1,2], Ulrich Gösele[2], Jörg Petschulat[3], Norik Janunts[3], Renbin Yang[2], Andreas Berger[1,2], Thomas Pertsch[3], and Silke Christiansen[1,2] — [1]IPHT Jena — [2]MPI Halle — [3]IAP, FSU Jena

A wealth of methods have been used to create plasmonic nanostructures. Many of them lack the control needed to realize nanostructures of choice. We in our group use a dual beam instrument (FEI xP Dual Beam Nova Nanolab 600) for the direct write of nanostructures by locally cracking an organo-metallic precursor gas (dimethyl-gold(III)-acetylacetonate) with the electron beam. Therewith, it is possible to fabricate high precision structures of a few tens of nanometers in diameter with various shapes on any conductive substrate. We will present needles and pillars with tip diameters down to 10 nm as well as spirals with up to 7 windings with a diameter of 150 nm. The structures that form during decomposition of the organo-metallic precursor gas contain a matrix of carbonaceous material in which metal single crystalline nanocrystals of a few nanometers in diameter are dispersed. To densify the gold content and realize pure gold nano-needles, the carbon is oxidized out of the structures which thereby largely retain their shapes, using ozone and water vapor treatment at moderate temperatures. We present optical spectra of as-written composite and ozone treated multi-crystalline gold nanostructures that are realized on indium-tin-oxide (ITO) coated glass substrates. From these nanostructure ensembles an effective permittivity is calculated.