DS 5: Nanoengineered Thin Films

Time: Monday 15:45–17:15 Location: H8

DS 5.1 Mon 15:45 H8

Artificial granularity of two-dimensional arrays of nanodots prepared by electron-beam-induced-deposition (EBID) — •Fabrizio Porrati[1], Roland Sachser[1], Mike Strauss[2], Iryna Andrusenko[3], Tatiana Gorelik[3], Ute Kolb[3], and Michael Huth[1] — [1]Physikalisches Institut, Goethe-Universität, Frankfurt am Main — [2]MPI für Biophysik, Frankfurt am Main — [3]Institut für Physikalische Chemie, Gutemberg-Universität, Mainz

We have prepared 2D arrays of metallic nanodots embedded in an insulating matrix by means of EBID using the $W(CO)_6$ precursor. By varying the electron beam parameters, i.e. beam current and energy, and the array pitch we obtain granular media with tunable electrical properties. The analysis of the current-voltage characteristic suggests that the transport takes place by electron tunneling between the artificial grains. In order to understand the nature of the granularity and thus, the origin of the electron transport behaviour, we perform TEM and micro-Raman investigations. Independently of the deposition beam parameters, TEM measurements show that the dots are constituted by non-crystalline W-C clusters embedded in a non-crystalline carbonaceous matrix. Raman spectra show two peaks, around 690 cm^{-1} and 860 cm^{-1}, associated to W-C stretching modes, supporting the TEM data. Furthermore, the so called G and D peaks, at about 1560 cm^{-1} 1350 cm^{-1}, associated to vibration modes in disordered and amorphous carbon, are also detected. The analysis of the position of the peaks and of their relative intensity suggests that the microstructure of the matrix is between nanocrystalline and amorphous.

DS 5.2 Mon 16:00 H8

Strain-dependent conductivity of granular metals prepared by focused particle beam induced deposition — •Christina Grimm[1], Markus Baranowski[1], Friedemann Völklein[2], and Michael Huth[1] — [1]Physikalisches Institut, Goethe-Universität, D-60438 Frankfurt am Main, Germany — [2]Institut für Mikrotechnologien, Hochschule RheinMain, D-65428 Rüsselsheim, Germany

We report on the strain-dependence of the electrical conductivity of granular metals prepared by focused particle beam induced deposition. The samples were prepared in a dual-beam electron / Ga ion scanning microscope using selected precursors, such as $W(CO)_6$. Stripe-like deposits were fabricated on dedicated cantilevers pre-patterned with contact pads made from Cr/Au. The cantilever deflection was induced in-situ by means of a four axes nano-manipulator and the conductivity change was recorded by lock-in technique employing a Wheatstone resistance bridge. Current-voltage characteristics and strain-dependence were measured for samples of various thicknesses and composition. For selected samples time-dependent conductivity data were taken as the samples were slowly epxosed to air.

DS 5.3 Mon 16:15 H8

Direct comparision of large scale simulation of nanostructuring of metals with the experiment — •Dmitry Ivanov and Baerbel Rethfeld — TU-Kaiserslautern, Physcis Department, 67663

The process of short pulse laser nanostructuring of materials currently is a subject of active research interest from the side of rapidly progressive and promising scientific fields: IT- and BIO- technologies. The structures on sub wavelength scale obtained on metals [1] semiconductors [2] and insulators [3] exhibit unique properties from the point of both fundamental physics and possible technological applications. However, transient and nonequilibrium character of processes occurring simultaneously and on relatively wide time and spatial scales makes the experimental study limited and expensive on one hand and the applicability of the theoretical models difficult on the other one. In this work, the complete process of femtosecond laser nanostructuring of Au film on a substrate is modeled on the experimental scale in a super-large scale simulation based on Molecular Dynamics. [1] A.I. Kuznetsov, J. Koch, and B.N. Chichkov, Appl. Phys. A 94, 221 (2009). [2] J. Gottmann and R. Wagner, Proc. of SPIE 6106, 61061R (2006). [3] E. Akcöltekin, S. Akcöltekin, O. Osmani, A. Duvenbeck, H. Lebius and M. Schleberger, New J. of Phys. 10, 053007 (2008). [4] D.S. Ivanov, B.C. Rethfeld, G.M. O*Connor, T.J. Glynn, A.N. Volkov, and L.V. Zhigilei, Appl. Phys. A. 92, 791 (2008).

DS 5.4 Mon 16:30 H8

Thin films of $CoFe_2O_4$, ZnO, and $BaTiO_3$ patterned by micromoulding — •Ole F. Göbel, Tomasz Stawski, Sjoerd Veldhuis, Dave H.A. Blank, and Johan E. ten Elshof — Inorganic Materials Science, MESA+ Institute for Nanotechnology, University of Twente, the Netherlands

Thin films of functional oxides such as $CoFe_2O_4$, ZnO, or $BaTiO_3$ were derived from polymeric or sol-gel precursor solutions. Patterning the still liquid precursor films by simple micromoulding, followed by drying and pyrolysis, eventually yielded patterned oxide films, patterns having feature sizes of a few micrometer. The features, such as lines or dots, were completely isolated from each other. This low-cost technique requires very simple equipment and is applicable to a number of oxide material.

DS 5.5 Mon 16:45 H8

Diffuse Röntgenstreuung an Dünnschichtsystemen — •Malte Ernst, Dieter Lott, Wolfgang Kreuzpaintner und Andreas Schreyer — GKSS Research Centre Geesthacht, Germany

Diffuse Röntgenstreuung liefert wichtige Informationen über Grenzflächen von technologisch wichtigen Dünnschichtsystemen. Aus der diffusen Röntgenreflektivität lassen sich Größen wie Rauhigkeit, Korrelationslänge bzw Informationen über periodische Strukturen gewinnen. Dabei sind sowohl laterale wie auch vertikale Periodizitäten sichtbar. Zur Beschreibung der diffusen Streuung wird die *Distorted Wave Born Approximation* (DWBA) genutzt [1]. Dabei spielt im Dünnschichtsystem die Selbstkorrelation der einzelnen Grenzfläche und im Mehrschichtsystem auch die Kreuzkorrelation der einzelnen Grenzflächen eine wichtige Rolle. Mit Hilfe dieser Korrelationsfunktionen lässt sich unter Verwendung der DWBA der Strukturfaktor und somit die Streuintensität in Abhängigkeit des Impulsübertrages bestimmen. Die berechneten Reflektivitäten werden an realen Systemen getestet.
[1] S.K. Sinha et al., Phys.Rev.B 38, 2297 (1988)

DS 5.6 Mon 17:00 H8

High Temperature Interface Superconductivity — •Gennady Logvenov[1,2], Ivan Bozovic[2], and Adrian Gozar[2] — [1]Max-Planck-Institute for Solid State Research, Heisenbergstr.1, D-70569, Stuttgart — [2]Brookhaven National Laboratory, Upton, NY 11973,USA

Using atomic-layer molecular beam epitaxy we synthesize cuprate bilayers which show interface superconductivity. The superconducting critical temperature (T_c) in the bilayers structures depends on the deposition sequence: $T_c = 15$ K in insulator-metal bilayers, while $T_c = 36$ K in metal-insulator hetero-structures. In this talk I will present a comprehensive study of the high-temperature interface superconductivity, including transport measurements, crystal structure determination, and quantitative evaluation of Sr-La intermixing and of redistribution of mobile carriers across the interface. By a new technique, *delta-doping tomography* using isovalent Zn markers, we have demonstrated that in these heterostructures high-T_c superconductivity occurs within a single CuO_2 plane.