DS 45: Thin Film Properties: Structure, Morphology and Composition III

Time: Friday 9:30–11:00 Location: CHE 89

DS 45.1 Fri 9:30 CHE 89

$L1_0$-ordered ferrimagnetic $Fe_{100-x}Cr_xPt(001)$ thin films. — •Nataliia Schmidt[1], Ritwik Mondal[2], Andreas Donges[2], Laszlo Szunyogh[3], Ulrich Nowak[2], and Manfred Albrecht[1] — [1]Institute of Physics, University of Augsburg, Germany — [2]Department of Physics, University of Konstanz, Germany — [3]Department of Theoretical Physics, Budapest University of Technology and Economics, Hungary

Tuning the properties of hard magnetic $L1_0$ FePt thin films is of high interest from a fundamental as well as technological point of view[1]. In this regard, 10 nm thick $(Fe_{100-x}Cr_x)_{50}Pt_{50}$ films (where $x = 0-100$ at.%) were prepared by epitaxial growth on MgO(100) substrates at 800°C. All samples reveal pronounced $L1_0$ chemical ordering. Strong perpendicular magnetic anisotropy (PMA) at 300 K persists up to 20 at.% Cr on Fe sites in $L1_0$ lattice. With addition of 45 at.% Cr, PMA gets strongly reduced. The coercive field in out-of-plane direction decreases from 42.94 kOe to 10.82 kOe with addition of 20 at.% Cr, which is attributed to a strong modification of the film morphology changing from island-like to a more continuous film. Depending on the Cr concentration, magnetic moments of Fe and Cr experience strong frustration due to antiferromagnetic coupling of Fe-Cr and Cr-Cr, but ferromagnetic interaction between Fe-Fe. For direct comparison with our experiments ground state as well as thermal properties were calculated within the framework of atomistic spin model simulations where the model parameters rest on first principles calculations.

[1] N. Y. Schmidt et al., Phys. Rev. B **100**, 064428 (2019).

DS 45.2 Fri 9:45 CHE 89

From colloidal Cu2ZnSnS4 (CZTS) nanocrystals to highly conductive p-type thin films — •Oleksandr Selyshchev[1], Alexandra Raevskaya[1], Volodymyr Dzhagan[2,3], Serhiy Kondratenko[3], and Dietrich R.T. Zahn[1] — [1]Semiconductor Physics, Chemnitz University of Technology, D-09107 Chemnitz, Germany — [2]Institute of Semiconductor Physics, Nat. Acad. Sci. of Ukraine, 03028 Kyiv, Ukraine — [3]Department of Physics, Taras Shevchenko National University of Kyiv, 01601 Kyiv, Ukraine

CZTS is object of intensive research due to its perspectives in light harvesting applications. The benefits of the material are the direct tunable bandgap (1.5-2.0 eV), the high absorption coefficient, and the earth abundance and low toxicity of the constituents. In the focus of our research are aqueous colloidal CZTS nanocrystals (NCs) prepared in a green way. Details on the synthesis and spectral characteristics can be found in ref. [1]. Here we report on 50-100 nm thin CZTS films prepared by spin coating of a CZTS NC ink (a concentrated colloidal solution of CZTS NCs) on glass substrates. The conductivity of the films reaches 250 S/cm (300 K). The p-type conductivity is evident from the non-zero density of states at the Fermi edge in the X-ray photoemission spectra (XPS). The kesterite crystal structure of the material was confirmed by Raman spectroscopy. Composition and chemical states of the elements on the surface were examined by XPS. The optical absorption/reflection were studied in the visible, near-, and middle-infrared ranges. [1] Stroyuk et al., Sci Rep,(2018)8,13677, DOI:10.1038/s41598-018-32004-1.

DS 45.3 Fri 10:00 CHE 89

Metal phosphide deposited by atomic layer deposition for efficient electrochemical water splitting — •Haojie Zhang[1], Stefan L. Schweizer[1], and Ralf B. Wehrspohn[1,2] — [1]Institute of Physics, Martin Luther University Halle-Wittenberg, Heinrich-Damerow-Straße 4, 06120 Halle (Saale), Germany. — [2]Fraunhofer Institute for Microstructure of Materials and Systems, Walter-Hülse-Straße 1, Halle (Saale), Germany.

Transitional metal phosphide (TMP) has attracted great research interests due to its tunable crystal phases and excellent catalytic activity for electrochemical water splitting. However, TMP prepared by atomic layer deposition (ALD) has not be reported to date. Therefore, we herein report an improved ALD process to produce well-crystalline TMP ultrathin films. Our optimized ALD recipe demonstrated a controllably layer-by-layer deposition behavior. Furthermore, the deposited TMP exhibited a better hydrogen evolution reaction performance than that prepared by the traditional post-phosphorization method. Our strategy shows a huge application potential in various electrochemical areas.

DS 45.4 Fri 10:15 CHE 89

Investigation of early stage kinetics of SBS glasses in aqueous solutions using a slow positron beam — •Eric Hirschmann[1,3], Maik Butterling[1], Oskar Liedke[1], Ahmed Gamal Attallah[1], Andreas Wagner[1], Dirk Enke[2], and Reinhard Krause-Rehberg[3] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]Universität Leipzig, Leipzig, Germany — [3]Martin-Luther-Universität Halle-Wittenberg, Halle(Saale), Germany

Thin porous layers at the surface of sodium borosilicate glass(200-2000 nm) were generated via a combination of phase separation and selective leaching. It is possible to control the range of pore size by modifying the heat treatment and the layer thickness by varying the leaching process. The kinetic reaction of the leeching process in SBS is currently described by Sirenek et al. Unfortunately, all approximations base on experiments with high acid concentrations and long leeching periods. Furthermore, due to the thickness and roughness of the thin porous layer it becomes hard to analyse the layer with standard methods like SEM or liquid nitrogen adsorption. In thin porous layers the amount of material becomes so small that most conventional techniques fail caused by a leak of accessibility. Also, an imaging procedure like SEM is difficult due to the isolating properties of glass. Therefore, we used the mono energetic positron source (MePS) at HZDR in Dresden to characterize the layer thickness and pore size simultaneously. As a result we could calculate the layer thickness for different samples using Makhovian profiles and additionally the pore size as well as the pore size distribution based on the extended Tao-Eldrup model.

DS 45.5 Fri 10:30 CHE 89

Si nanopillar deformation by heavy polyatomic ion impacts — •Lothar Bischoff[1], Wolfgang Pilz[1], Hans-Jürgen Engelmann[1], Xiaomo Xu[1], Wolfhard Möller[1], Karl-Heinz Heinig[1], Sadegh Ghaderzadeh[1], Gregor Hlawacek[1], Ahmed Gharbi[2], and Raluca Tiron[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Bautzner Landstr. 400, 01328 Dresden — [2]CEA-Leti, Grenoble, France

Si nanopillars for the fabrication of vertical nanowire gate-all-around Single Electron Transistors [1], have been irradiated with Si^{++}, Pb^{+}, Pb^{++}, Au^{+}, Au^{++}, $Au_2{}^{+}$, and $Au_3{}^{+}$ ions accelerated by 30 kV. A FIB of mass separated ions, extracted from a Liquid Metal Alloy Ion Source [2], has been scanned over regular arrays of Si nanopillars of different diameters and pillar distances. The irradiations have been performed at RT and 400°C. Different morphological changes of the pillars like thinning, height reduction, tilting etc. have been observed which can be attributed to ion erosion (sputtering), impact-induced viscous flow or even transient nanosecond-scale melting [3]. The pillars were imaged by AFM, SEM, TEM and HIM. 3D Monte Carlo simulations [4] of ion and recoil trajectories based on the Binary Collision Approximation and Molecular Dynamics calculations have been carried out in order to discriminate the dominating processes.

[1] EU project Ions4SET, Horizon 2020 grant No. 688072 [2] L. Bischoff, et al., Appl. Phys. Rev. 3 (2016) 021101 [3] C. Anders, K.-H. Heinig, H. Urbassek, Phys. Rev. B87 (2013) 245434 [4] W. Möller, NIM B322 (2014) 23

DS 45.6 Fri 10:45 CHE 89

Magneto-dielectric Effect in Relaxor Dipolar Glassy Tb_2CoMnO_6 Film — •Rajesh Mandal[1,2], Mohit Chandra[3], Vladimir Roddatis[4], Malvika Tripathi[3], Ram Janay Choudhary[3], and Vasily Moshnyaga[1] — [1]Department of Physics, Indian Institute of Science Education and Research, Pune 411008, India — [2]Erstes Physikalisches Institut, Georg-August-Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany — [3]UGC-DAE Consortium for Scientific Research, Indore Centre, University Campus, Khandwa Road, Indore 452017, India — [4]Institut für Materialphysik, Georg-August-Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany

Relaxor ferroelectrics are recognized as a family of disordered or partially ordered materials that are classified as a special class of dipolar glass with the formation of weakly interacting polarized nano domains (PNR) bellow a certain temperature. Here we report the observation

of magneto-dielectrically coupled ferroelectric relaxation at quite high temperature (200K) in Tb_2CoMnO_6/STO(100) double perovskite thin film. Partially B site disordered film has been grown by means of a metal-organic aerosol deposition (MAD) technique. This material is reported as ferromagnetic insulator with TC around 90K. Here we observe an enhanced transition temperature of 110K due to in plane strain. The deviation from the Curie-Weiss law far above TC indicates the development of short range spin correlation which is getting coupled with the electric dipoles present in the system.