MA 3: Posters Magnetism I

Topics: Surface Magnetism (3.1-3.4), Thin Films: Magnetic Coupling Phenomena / Exchange Bias (3.5-3.11), Thin Films: Magnetic Anisotropy (3.12-3.13), Topological Insulators (3.14-3.15), Micro- and Nanostructured Magnetic Materials (3.16-3.20)

Time: Monday 13:30–16:30 Location: P

MA 3.1 Mon 13:30 P

Yu-Shiba-Rusinov states of Manganese atoms on proximitized Silver layers — •Jennifer Hartfiel, Mira Kressler, Gaël Recht, and Katharina J. Franke — Freie Universität Berlin, Arnimallee 14, 14195 Berlin, Germany

The adsorption of a magnetic adatom on a superconducting substrate perturbes the Cooper pair condensate in close proximity to the surface. The unpaired magnetic moment induces localized bound states, so-called Yu-Shiba-Rusinov (YSR) states, inside the superconducting energy gap, which can be probed by scanning tunneling spectroscopy (STS). The coupling strength between the magnetic moment of the impurity and the Cooper pairs determines the energy needed for tunneling into the YSR state.

In this work we perform STS measurements on Mn adatoms on Ag islands on Vanadium. Vanadium is very reactive and widely reconstructed by oxygen on the surface. This makes it difficult to investigate a possible adsorption-site dependence of the YSR energies. We passivate the surface by expitaxially grown silver monolayers. The Ag is proximitized by the superconducting substrate, and we observe YSR states for Mn on Ag/V. As the coupling of the magnetic impurity with the superconductor depends strongly on the adsorption geometry, we compare the YSR states for Mn atoms on two different crystal orientations of the Vanadium, which influences the structure of the Ag islands grown on top and, hence, the YSR states.

MA 3.2 Mon 13:30 P

Tailoring magnetic anisotropy by graphene-induced skyhook effect of 4f metals — •Alexander Herman[1], Stefan Kraus[2], Shigeru Tsukamoto[3], Lea Spieker[1], Tobias Lojewski[1], Damian Günzing[1], Tobias Hartl[2], Jan Gui-Hyon Dreiser[4], Bernard Delley[4], Katharina Ollefs[1], Thomas Michely[2], Nicolae Atodiresei[3], and Heiko Wende[1] — [1]Faculty of Physics and Center for Nanointegration, Duisburg-Essen — [2]II. Physikalisches Institut, Universität zu Köln — [3]Peter Grünberg Institute and Institute for Advanced Simulation, FZ Jülich — [4]SLS, Paul Scherrer Institut (CH)

From macroscopic heavy-duty permanent magnets to nanodevices the precise control of the magnetic properties in rare-earth metals is crucial for many applications used in our daily life. Therefore, a detailed understanding and manipulation of the 4f-metals magnetic properties represent the key to further boost the functionalization and efficiency of practical applications. We present a proof-of-concept surface-alloy system in which graphene induces a skyhook effect on a 4f metal and therefore modifies its magnetic properties. We demonstrate that by adsorbing graphene onto a long-range ordered two-dimensional dysprosium-iridium surface alloy, the magnetic 4f metal atoms are selectively lifted from the surface alloy and a giant magnetic anisotropy is introduced in dysprosium atoms as a result of manipulating its geometrical structure within the surface alloy. Our combined theoretical simulations and experimental measurements provide an easy and unambiguous understanding of its underlying mechanism. Financial support by DFG through projects WE 2623/17-1, MI 581/23-1, and AT 109/5-1.

MA 3.3 Mon 13:30 P

Step-edge-induced anisotropic chiral spin coupling in ultrathin magnetic films — Anika Schlenhoff, •Stefan Krause, and Roland Wiesendanger — Department of Physics, University of Hamburg, Germany

Step edges represent a local break of lateral symmetry in ultrathin magnetic films. In our experiments, we investigate the spin coupling across atomic step edges on Fe/W(110) by means of spin-polarized scanning tunneling microscopy and spectroscopy.

As we show in our experiments, atomic step edges induce a chiral spin coupling, with outreaching consequences on the local spin texture in the film [1]. Local modifications of the spin texture toward step edges separating double from single layer areas of Fe on W(110) are observed, and selection rules indicate a chiral spin coupling that significantly changes with the propagation along different crystallographic directions. The experimental results will be presented, and the findings are explained in terms of anisotropic Dzyaloshinskii-Moriya interaction arising from the broken lateral symmetry at atomic step edges.

Our experiments strongly indicate that surface roughness and interface quality on the atomic scale is of high relevance for spin manipulation and transmission in terms of tailored magnetic coupling for future spintronic applications.

[1] A. Schlenhoff, S. Krause, and R. Wiesendanger, Phys. Rev. Lett. **123**, 037201 (2019).

MA 3.4 Mon 13:30 P

Cation- and lattice-site-selective magnetic depth profiles of ultrathin Fe_3O_4(001) films — Tobias Pohlmann[1,2], •Timo Kuschel[3], Jari Rodewald[1], Jannis Thien[1], Kevin Ruwisch[1], Florian Bertram[2], Eugen Weschke[4], Padraic Shafer[5], Joachim Wollschläger[1], and Karsten Küpper[1] — [1]Uni Osnabrück, Germany — [2]DESY, Hamburg, Germany — [3]Uni Bielefeld, Germany — [4]HZB Bessy II, Berlin, Germany — [5]ALS, Berkeley, USA

We present x-ray magnetic circular dichroism (XMCD) and x-ray resonant magnetic reflectivity (XRMR) measurements on ultrathin Fe_3O_4(001) films to obtain magnetic depth profiles of the different cation species Fe^{2+}_{oct}, Fe^{3+}_{tet}, and Fe^{3+}_{oct} located on octahedral and tetrahedral sites of the inverse spinel structure of Fe_3O_4. Performing XRMR on the three resonant XMCD energies yields magnetic depth profiles that each correspond to one specific cation species.

The depth profiles of both Fe^{3+} cations reveal a (3.9±1.0)-Å-thick surface layer of enhanced magnetization, which is likely due to an excess of these ions at the expense of the Fe^{2+}_{oct} species in the surface region. The magnetically enhanced Fe^{3+}_{tet} layer is additionally shifted about 2.9±0.4 Å farther from the surface than the Fe^{3+}_{oct} layer [1].

Moreover, we compare the depth profiles with the recently revealed cation vacancy reconstruction of the Fe_3O_4(001) surface [2] as well as the unreconstructed Fe_3O_4(111) surface that is Fe_{oct}-terminated [3].

[1] T. Pohlmann et al., Phys. Rev. B 102, 220411(R) (2020)
[2] R. Bliem et al., Science 346, 1215 (2014)
[3] S. Brück et al., Appl. Phys. Lett. 100, 081603 (2012)

MA 3.5 Mon 13:30 P

Interlinking ferro- and antiferromagnetic thickness dependencies of macroscopic magnetic characteristics with microscopic properties of polycrystalline exchange-biased bilayers — •Maximilian Merkel, Meike Reginka, Rico Huhnstock, and Arno Ehresmann — Universität Kassel

A systematic investigation of the exchange bias shift and the coercive field exhibited by prototypical polycrystalline exchange-biased bilayers is conducted in dependence of the thicknesses of the participating ferro- and antiferromagnetic layer. Columnar grain growth is verified via thickness dependent grain size analysis by means of atomic force microscopy. Formulating analytic expressions for the named thickness dependencies allowed us to establish a quantitative link between the macroscopically observable magnetic characteristics and the microscopic properties. Relations depending on measurement conditions and parameters describing the microstructure of the granular antiferromagnetic layer in the context of a generalized description of polycrystalline exchange-bias systems were hereby thoroughly considered. This is facilitated by an extended time-dependent Stoner-Wohlfarth approach in combination with angular-resolved measurements of magnetization reversal curves utilizing magneto-optical Kerr magnetometry validating the consistency of the generalized model approach.

MA 3.6 Mon 13:30 P

Influence of strain on the magnetic ground state in multiferroic $BiFeO_3$ studied from First Principles — •Sebastian Meyer[1], Bin Xu[2,3], Matthieu Verstraete[1], Laurent Bellaiche[2], and Bertrand Dupé[1,4] — [1]Nanomat/Qmat/CESAM, University of Liége, Belgium — [2]Physics Department and Institute for Nanoscience and Engineering, University of Arkansas, USA — [3]Jiangsu Key Laboratory of Thin Films, School of Physical

Science and Technology, Soochow University, China — [4]Fonds de la Recherche Scientifique (FNRS), Bruxelles, Belgium

We study the influence of compressive and tensile strain on the magnetic ground state in thin films of the multiferroic $BiFeO_3$ by means of density functional theory. Using two different methods, we determine the strength of the magnetic exchange, the Dzyaloshinskii-Moriya interaction and the anisotropy energies. The first one is based on the generalized Bloch theorem which allows the self-consistent computation of the total energy of spin spirals. This has already been applied to successfully determine the magnetic ground state in $R3c$ bulk $BiFeO_3$ [1]. The second one is based on the evaluation of a tight-binding Hamiltonian parameterized via Wannier functions and solved via Green functions methods as implemented in TB2J [2]. Using both methods, we explore the change of magnetic ground state of strained $BiFeO_3$ and compare the results with experimental findings.

[1] Xu, B., *et al.*, Phys. Rev. B **103**, 214423 (2021)
[2] He, Y., *et al.*, Comp. Phys. Comm. **264**, 107938 (2021)

MA 3.7 Mon 13:30 P

Tilted magnetization stripe domain reversal in Co/Pt multilayer systems — •Peter Heinig[1], Olav Hellwig[1,2], Ruslan Salikhov[2], Fabian Samad[2], Rico Ehrler[1], and Benny Böhm[1] — [1]Chemnitz University of Technology — [2]Helmholtz-Zentrum Dresden-Rossendorf

Co/Pt multilayer systems with total thickness above 10 nm are well-known for their highly periodic perpendicular stripe domain structures. Here we study $[Co(3.0\ nm)/Pt(0.6\ nm)]_X$ multilayers with constant Co and Pt thickness in the regime of tilted stripe domains, where we vary the number of repeats X to tune the remanent state from the well-known out-of-plane stripe domain via a tilted stripe domain to a purely in-plane domain state. Vibrating Sample Magnetometry (VSM) and Magnetic Force Microscopy (MFM) are used to study three characteristic samples with $X = 22$; 11 and 8, which represent the three above mentioned remanent states respectively. While for conventional perpendicular stripe domains the field reversal is characterized by irreversible hysteretic nucleation, propagation and annihilation of stripe domains across a broad field range, strikingly the tilted stripe domain regime reveals a collapse of all irreversible hysteretic switching down to a single point. The dramatically changed field reversal behavior will be discussed, also in the light of possible future applications.

MA 3.8 Mon 13:30 P

Nucleation site density & magnetization reversal in exchange-biased 1D nanostructures — •Sapida Akhundzada[1,3], Meike Reginka[1], Maximilian Merkel[1], Kristina Dingel[2,3], Bernhard Sick[2,3], Arno Ehresmann[1,3], and Michael Vogel[1,3] — [1]Institute of Physics & Center for Interdisciplinary Nanostructure Science and Technology (CINSaT), University of Kassel, Heinrich-Plett-Str. 40, D-34132 Kassel — [2]Intelligent Embedded Systems, University of Kassel, Wilhelmshöher Allee 73, D-34121 Kassel — [3]AIM-ED - Joint Lab Helmholtzzentrum für Materialien & Energie, Hahn-Meitner-Platz 1, D-14109 Berlin

The interface-driven exchange bias (EB) effect [1] is a well-studied phenomenon observed in ferromagnetic (FM)/antiferromagnetic (AFM) thin film systems. In numerous studies, asymmetric hysteresis loops have been observed in EB thin films mainly caused by defects in the FM or AFM layer contributing to a locally inhomogeneous EB landscape. In full film samples, Romanens et al. [2] were able to correlate these asymmetries to higher domain nucleation densities for an antiparallel configuration of the applied field and the EB field. Here we report on the correlation between the nucleation site density and asymmetric remagnetization process in in-plane magnetized EB nanowires investigated by high-resolution optical Kerr microscopy. The influence of the structural dimensions, the EB material system, and additional modification of the interface by keV He ion bombardment are shown.

[1] W. H. Meiklejohn, J. Appl. Phys. 33, 1328 (1962)
[2] F. Romanens et al, Phys. Rev. B 72, 134410 (2005)

MA 3.9 Mon 13:30 P

Magnetic Coupling in YIG/GIG Heterostructures — •Sven Becker[1], Zengyao Ren[1,2,3], Felix Fuhrmann[1], Andrew Ross[1,4], Sally Lord[1,5], Shilei Ding[1,2,6], Rui Wu[1,7], Jinbo Yang[6], Jun Miao[3], Mathias Kläui[1,2,7], and Gerhard Jakob[1,2] — [1]University of Mainz, Germany — [2]Graduate School of Excellence 'MAINZ', Germany — [3]USTB, Beijing, China — [4]Université Paris-Saclay, France — [5]University of Manchester, UK — [6]Peking University, China — [7]University of Trondheim, Norway

We study the magnetic coupling in epitaxial $Y_3Fe_5O_{12}/Gd_3Fe_5O_{12}$ (YIG/GIG) heterostructures grown by pulsed laser deposition. From bulk sensitive magnetometry and surface sensitive spin Seebeck effect and spin Hall magnetoresistance measurements, we determine the alignment of the heterostructure magnetization as a function temperature and external magnetic field. The ferromagnetic coupling between the Fe sublattices of YIG and GIG dominates the overall behavior of the heterostructures. Because of the temperature-dependent gadolinium moment, a magnetic compensation point of the total bilayer system can be identified. This compensation point shifts to lower temperatures with increasing YIG thickness due the parallel alignment of the iron moments. We show that we can control the magnetic properties of the heterostructures by tuning the thickness of the individual layers, opening up a large playground for magnonic devices based on coupled magnetic insulators. These devices could potentially control the magnon transport analogously to electron transport in giant magnetoresistive devices.

MA 3.10 Mon 13:30 P

Growth, structure, and magnetic properties of artificially layered NiMn in contact to ferromagnetic Co on $Cu_3Au(001)$ — •Tauqir Shinwari[1], Ismet Gelen[1], Melek Villanueva[1], Ivar Kumberg[1], Yasser A. Shokr[1,2], and Wolfgang Kuch[1] — [1]Institut für Experimentalphysik, Freie Universität Berlin, Arnimallee 14, 14195 Berlin, Germany — [2]Faculty of Science, Department of Physics, Helwan University, 17119 Cairo, Egypt

Single-crystalline artificially layered [Ni/Mn] antiferromagnetic films with 1 atomic monolayer (ML) of Ni and 1, 2, or 3 ML of Mn have been deposited under ultrahigh-vacuum conditions on $Cu_3Au(001)$ and covered by ferromagnetic Co layers. Their structural and magnetic properties are characterized by low-energy electron diffraction (LEED) and magneto-optical Kerr effect (MOKE), respectively, and compared with disordered Ni_xMn_{100-x} alloy films with the same Ni/Mn ratio and the same film thickness. We find from LEED I(V) curves that the perpendicular interatomic lattice distance is decreased by 2% in the artificially layered [Ni/Mn] samples in comparison to the disordered Ni_xMn_{100-x} alloy films. This change in the structure causes higher coercivity, exchange bias, and stronger exchange coupling in artificially layered [Ni/Mn] samples compared to disordered Ni_xMn_{100-x} alloy films.

MA 3.11 Mon 13:30 P

Inverse proximity effects in superconductor/ferromagnet heterostructures studied by GISANS — •Annika Stellhorn[1,2], Emmanuel Kentzinger[1], Anirban Sarkar[1], Vitaliy Pipich[3], Kathryn Krycka[4], Patrick Schöffmann[1], Tanvi Bhatnagar-Schöffmann[1,5], and Thomas Brückel[1] — [1]Forschungszentrum Jülich GmbH, JCNS-2 and PGI-4, JARA-FIT, Jülich, GERMANY — [2]Lund University, Division of Synchrotron Radiation Research, Lund, Sweden — [3]Forschungszentrum Jülich GmbH, JCNS@MLZ, Garching, Germany — [4]National Institute of Standards and Technology, NIST-NCNR, Gaithersburg, USA — [5]Forschungszentrum Jülich GmbH, PGI-5, Jülich, GERMANY

Understanding the origin of proximity effects at the interfaces of superconducting and ferromagnetic materials is the key for an application in fluxonic devices and in spintronics. Depending on the ferromagnetic magnetocrystalline anisotropy, such proximity effects can lead to domain-wall-superconductivity or a generation of long-ranged spin-triplet Cooper pairs. This work presents a study of the depth-resolved lateral magnetic profile in the superconductor(S)/ferromagnet(F) thin film system Nb(S)/FePd(F) with perpendicular magnetic anisotropy by Grazing-Incidence Small-Angle Neutron Scattering (GISANS) with polarization analysis. In these systems, the transition from the normal-conducting state via a domain-wall-superconducting state to a complete-superconducting state is accompanied by an increase of the domain wall width.

MA 3.12 Mon 13:30 P

Impact of the separate variation of the sputter deposition pressure for seed and multilayer growth on the magnetic properties of Co/Pt multilayer films — •Rico Ehrler, Tino Uhlig, and Olav Hellwig — Chemnitz University of Technology, D-09107 Chemnitz, Germany

The pressure during the sputter deposition process greatly influences the structural as well as magnetic properties of Co/Pt multilayer films with perpendicular anisotropy. Already in 2013 Pierce et al. [1] tuned the lateral heterogeneity and structural order in such systems by changing the sputter deposition pressure for both the Pt seed as well as the multilayer simultaneously. By independent pressure variation of seed and multilayer we achieve an even higher degree of control over the magnetic properties. In a later work, a Ta adhesion layer between substrate and seed was used to achieve a highly oriented Pt(111) texture [2]. This is in accordance with our investigation, where the presence of such a layer greatly influences the growth of the seed.

In this study, a high and low deposition pressure was chosen independently for seed and multilayer, leading to 4 different seed/multilayer combinations. We repeated this variation with an added Ta adhesion layer between the substrate and the Pt seed and will highlight the impact of these systematic variations on the structural and magnetic properties.

[1] M. S. Pierce et al, Phys. Rev. B, vol. 87, no. 18, 2013
[2] Yu. Tsema et al., Appl. Phys. Lett., vol. 109, no. 7, 2016

MA 3.13 Mon 13:30 P

Effect of laser annealing on the magnetic properties of Co/Pt based multilayers — •Lokesh Rasabathina[1], Apoorva Sharma[1], Sandra Busse[3], Benny Böhm[1], Fabian Samad[1,2], Georgeta Salvan[1], Alexander Horn[3], and Olav Hellwig[1,2,4] — [1]Institute of Physics, Chemnitz University of Technology, 09107 Chemnitz, Germany — [2]Institute of Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf, Bautzner Landstraße 400, 01328 Dresden, Germany — [3]Laserinstitut Hochschule Mittweida, Schillerstraße 10, 09648 Mittweida, Germany — [4]Center for Materials, Architectures and Integration of Nanomembranes (MAIN), Chemnitz University of Technology, 09107 Chemnitz, Germany

Two methods of laser annealing, namely, Continuous Wave (CW) and Pulsed Wave (PW) method, are used for modifying the magnetic properties of perpendicular magnetic anisotropy (PMA) multilayers in a controlled manner. For this we compare a set of two samples, a PMA $(Co/Pt)_{10}$ multilayer and an antiferromagnetically interlayer exchange coupled PMA $(Co/Pt)_4/Co/Ir/(Co/Pt)_5$ multilayer. Room temperature hysteresis loops using longitudinal MOKE magnetometry are measured for different laser annealing conditions. Thus, a relationship between the applied laser parameters and the magnetic properties is extracted, which provides insight into the processes that occur during the laser annealing process.

MA 3.14 Mon 13:30 P

Giant Topological Hall Effect in Noncollinear Phase of Two-dimensional Antiferromagnetic Topological Insulator MnBi4Te7 — •Subhajit Roychowdhury, Sukriti Singh, Satya N. Guin, Nitesh Kumar, Tirthankar Chakraborty, Walter Schnelle, Horst Borrmann, Chandra Shekhar, and Claudia Felser — Max Planck Institute for Chemical Physics of Solids, 01187 Dresden, Germany

Magnetic topological insulators provide an important platform for realizing several exotic quantum phenomena, such as the axion insulating state and quantum anomalous Hall effect, owing to the interplay between topology and magnetism. MnBi4Te7 is a two-dimensional Z_2 antiferromagnetic (AFM) topological insulator with a Néel temperature of ~13 K. In AFM materials, the topological Hall effect (THE) is observed owing to the existence of nontrivial spin structures. In this study, we observed that an unanticipated THE starts to develop in a MnBi4Te7 single crystal when the magnetic field is rotated away from the easy axis (c-axis) of the system. Furthermore, the THE resistivity reaches a giant value of ~7 microΩcm at 2 K when the angle between the magnetic field and c-axis is of 75°. This value is significantly higher than the values for previously reported systems with noncoplanar structures. The THE can be ascribed to the noncoplanar spin structure resulting from the canted state during the spin-flop transition in the ground AFM state of MnBi4Te7. The large THE at a relatively low applied field makes the MnBi4Te7 system a potential candidate for spintronic applications.

MA 3.15 Mon 13:30 P

High-throughput screening of the exchange interactions among magnetic impurities in a quantum spin Hall insulator — •Rubel Mozumder, Philipp Rüssmann, and Stefan Blügel — Peter Grünberg Institut (PGI) and Institute for Advanced simulation (IAS), Forschungszentrum Jülich, D-52424 Jülich, Germany

An internal magnetic field in Quantum Spin Hall Insulators (QSHI) breaks the time-reversal symmetry and transforms the QSHI into a Quantum Anomalous Hall insulator (QAHI). This topological phase transition also transforms 1D helical edge states of a QSHI into 1D chiral states, which are topologically protected single spin-transport channels at the edges of QAHIs.

Here we present a high-throughput study of a large number of magnetic impurities (3*d* and 4*d* transition-metal elements) in different combinations, which are embedded into the QSHI Bi_2Te_3. For this, we extend the AiiDA-KKR package [1] that allows to run high-throughput *ab initio* calculations using the JuKKR code [https://jukkr.fz-juelich.de] that is based on full-potential relativistic all-electron density functional theory calculations within the Korringa-Kohn-Rostoker Green-function method. We extract Heisenberg exchange coupling parameters as well as Dzyaloshinskii-Moriya vectors for pairs of impurities to study the tendency toward stable ferromagnetic order, which is a prerequisite for the QAHI state. Furthermore, we investigate the effect of co-doping on the magnetic interactions.

References

[1] P. Rüßmann *et al.*, npj Comput Mater **7**, 13 (2021).

MA 3.16 Mon 13:30 P

Complex nanostructured magnetic thin films investigated by x-ray absorption spectroscopy — •Damian Günzing[1], Shalini Sharma[2,3], Alexander Zintler[3], Johanna Lill[1], Debora Motta Meira[4], Harish K Singh[3], Ruiwen Xie[3], Georgia Gkouzia[3], Márton Major[3], Iliya Radulov[3], Philipp Komissinskiy[3], Hongbin Zhang[3], Konstantin Skokov[3], Yukiko K Takahashi[2], Lambert Alff[3], Leopoldo Molina-Luna[3], Heiko Wende[1], and Katharina Ollefs[1] — [1]Faculty of Physics, University of Duisburg-Essen — [2]National Institute for Materials Science, Tsukuba — [3]Institute of Materials Science, Technical University of Darmstadt — [4]Sector 20, Advanced Photon Source, Argonne National Laboratory

Understanding the interplay of the structural phase composition and the corresponding magnetic properties is at the heart of hysteresis design of e.g. hard magnetic materials. Here, we investigated a $SmCo_5$ Sm_2Co_{17} nano composite film manufactured via MBE on an Al_2O_3 substrate without additional buffer layers [1]. We established a multi-absorber fitting and simulation method for non-destructive extended x-ray fine structure (EXAFS) spectra of complex magnetic materials to quantify the two phases, $SmCo_5$ and Sm_2Co_{17}. In combination with transmission electron microscopy and magnetometry we found that the high magnetization and strong perpendicular anistropy originates from the nanoscale composition of these two phases with coherent interfaces. (Supported by the DFG Project-ID 405553726*CRC 270).

[1] S. Sharma et al., *ACS Appl. Mater. Interfaces* (2021) 13, 27, 32415-32423

MA 3.17 Mon 13:30 P

Topographic and magnetic characterization of periodically curved organic/metallic hybrid thin film systems — •Christian Janzen[1], Sekvan Bagatur[2], Maximilian Merkel[1], Meike Reginka[1], Michael Vogel[1], Thomas Fuhrmann-Lieker[2], and Arno Ehresmann[1] — [1]Institute of Physics and Center for Interdisciplinary Nanostrcuture Science and Technology (CINSaT), University of Kassel, Heinrich-Plett-Str. 40, D-34132 Kassel — [2]Institute of Chemistry and CINSaT, University of Kassel, Heinrich-Plett-Str. 40, D-34132 Kassel

In this work, a low-molecular azo-glass material (AZOPD [1]) is structured by a two-beam-interference-patterning process. Thereby, a periodically curved topography with a structure height and a structure wavelength at the nanoscale is obtained, whereby the latter is constant over the sample area. The periodically curved organic layer is used as a topographic template for the deposition of a ferromagnetic thin film. Non-contact atomic force microscopy measurements were conducted in order to investigate the alteration of the topography after sputter deposition. By spatially resolved magneto-optical Kerr magnetometry, a direct correlation between the local topography of the heterostructure and its coercive field is observed. The occurence of an uniaxial magnetic anisotropy, originating from the periodically curved topography, is examined by varying the ferromagnetic layer thickness. Finally, the influence of the sample topography on the alignment of magnetic domains is investigated via Kerr-microscopy.

[1] Fuhrmann *et al.* Chem. Mater. 1999, 11, 8, 2226-2232

MA 3.18 Mon 13:30 P

Simulation of the FEBID process — •Alexander Kuprava[1] and Michael Huth[2] — [1]Goethe Universität Frankfurt, Germany — [2]Goethe Universität Frankfurt, Germany

Focused electron beam induced deposition is a direct-write nanofabrication technology with unique advantages for free-form 3D deposition. However, a shape-true transfer from a 3D CAD model target structure to the actual nano-deposit is a non-trivial task. Here we present our modular computer simulation framework that was developed to simulate FEBID process in order to assist the study of the growth of 3D structures. The program includes an electron-beam generation and an electron-solid interaction module, a diffusion module and a reaction equation solver. A Monte Carlo (MC) simulation was utilized for scattered electron trajectories generation and inelastic electron-solid interaction on a cellular structured 3D grid. The simulation details are discussed which include applied structured grid-based simulation practices, the numerical solution of the reaction equation, the diffusion simulation concept and the MC simulation of primary and secondary electron flux. The program was used to simulate the growth of high aspect-ratio Pt-based nanoscale pillars with a stationary Gaussian electron beam using (CH3)3CpCH3Pt(IV) as a precursor. The simulation results were compared to the experimentally grown structures regarding shape trueness and growth rate.

MA 3.19 Mon 13:30 P

Spray deposition of ferromagnetic $SrFe_{12}O_{19}$ nanoplates colloid at Si and cellulose substrate — •Andrei Chumakov[1], Calvin Brett[1,2], Artem Eliseev[3], Evgeny Anokhin[3], Lev Trusov[3], Lewis Akinsinde[4], Marc Gensch[1,5], Dirk Menzel[6], Matthias Schwartzkopf[1], Wei Cao[5], Shanshan Yin[5], Manuel Scheel[5], Micheal Rübhausen[4], Peter Müller-Buschbaum[5,7], Daniel Soederberg[2], Andrei Eliseev[3], and Stephan V. Roth[1,2] — [1]DESY, Hamburg, Germany — [2]KTH RIT, Stockholm, Sweden — [3]MSU, Moscow, Russia — [4]CFEL, Universität Hamburg, Hamburg, Germany — [5]TU München, Garching, Germany — [6]TU Braunschweig, Braunschweig, Germany — [7]TU München, MLZ, Garching, Germany

Ferromagnetic $SrFe_{12}O_{19}$ nanoparticles with a hard magnetic moment perpendicular to their plane and stabilized by a positive charge can form a self-ordered coating under the influence of magnetic fields drying from dispersion. We investigated the film formation of a stable colloid dispersion of ferromagnetic nanoplates and nanoblocks onto a silicon substrate and cellulose nanofilm without and under the action of an external magnetic field during scalable layer-by-layer spraying. The formation of a film of ferromagnetic particles from an aqueous colloid makes it possible to form a stable magnetic coating of agglomerates of nanoparticles. An external magnetic field in the deposition process leads to the appearance of residual magnetization in the film. Particles with a smaller aspect ratio form a periodic structure of agglomerates of nanoparticles with signs of an artificial opal-like structure.

MA 3.20 Mon 13:30 P

Magnetization switching of dipolar coupled elongated permalloy nanostructures of high shape anisotropy — Neeti Keswani[1], Yoshikata Nakajima[2], Neha Chauhan[2], Tomofumi Ukai[2], Himadri Chakraborti[3], Kantimoy Das Gupta[3], Tatsuro Hanajiri[2], Sakthi Kumar[2], Yukio Ohno[4], Hideo Ohno[4], and •Pintu Das[1] — [1]Department of Physics, Indian Institute of Technology Delhi, New Delhi-110016 — [2]Bio Nano Electronics Research Centre, Toyo University, Kawagoe, Saitama-3508585, Japan — [3]Department of Physics, Indian Institute of Technology Bombay, Mumbai-400076 — [4]Research Institute of Electrical Communications, Tohoku University, Sendai, Japan - 9808577

Behavior of nanomagnets of strong shape anisotropy can be studied by modelling them as Ising-like macrospins. Due to the potential use of such macrospin-like nanomagnets in devices such as in nanomagnetic logic etc., a detailed understanding of the exact switching behavior of such nanomagnets coupled via dipolar interaction is essential.

In this work, we have used 2-dimensional electron gas based micro-Hall magnetometry in ballistic transport regime to measure the stray fields emanating from the lithographically patterned elongated nanomagnets of $Ni_{80}Fe_{20}$ arranged in a double ring like structure. Our results demonstrate that although the magnetic images of the nanomagnets show single-domain behavior, however, their switching process may involve formation of other complex structures such as magnetic vortices, etc. The experimental results are analyzed by performing micro-magnetic simulations for the nanostructures.