MA 5: Magnetic Instrumentation and Characterization

Time: Monday 9:30–10:30 Location: H48

MA 5.1 Mon 9:30 H48

Cubic magneto-optic Kerr effect in Ni(111) thin films with and without twinning — •Maik Gaerner[1], Robin Silber[2], Tobias Peters[1], Jaroslav Hamrle[3], and Timo Kuschel[1] — [1]Bielefeld University, Germany — [2]IT4Innovations, VŠB - Technical University of Ostrava, Czech Republic — [3]Charles University, Prague, Czech Republic

In most studies utilizing the magneto-optic Kerr effect (MOKE), the detected change of polarized light upon reflection from a magnetized sample is supposed to be proportional to the magnetization $\boldsymbol{M}$. However, MOKE signatures quadratic in $\boldsymbol{M}$ have also been identified and utilized, e.g., to sense the structural order in Heusler compounds [1]. In our study, we employ the eight-directional method [2] to separate different MOKE contributions in Ni(111) thin films. We observe a strong anisotropic longitudinal MOKE contribution of third order in $\boldsymbol{M}$ which we attribute to a cubic magneto-optic tensor proportional to $\boldsymbol{M}^3$ [3]. We further show that the angular dependence of cubic MOKE (CMOKE) is affected by the amount of structural domain twinning (two structural (111) phases with 60° in-plane rotation) in the sample [3]. Our detailed study on CMOKE for two selected photon energies will open up new opportunities for CMOKE applications with sensitivity to twinning properties of thin films, e.g. CMOKE spectroscopy and microscopy or time-resolved CMOKE.

[1] R. Silber et al., Appl. Phys. Lett. 116, 262401 (2020)
[2] K. Postava et al., J. Appl. Phys. 91, 7293 (2002)
[3] M. Gaerner et al., arXiv: 2205.08298 (2022)

MA 5.2 Mon 9:45 H48

A cryogen-free 10T asymmetric neutron scattering magnet with 50mm sample space and temperature range from 300mK to 375K — •Tom Ritman-Meer, Marc Savey-Bennett, and Roger Mitchell — Cryogenic Ltd, 6 Acton Park Estate, The Vale, London, W3 7QE, United Kingdom

Cryogenic Ltd has built and delivered a Cryogen-Free ring-separated magnet for polarised neutron scattering experiments with 10T central field and integral VTI cooled from a single 1.8W cryocooler.

The magnet has a novel dual power-supply control unit to provide an asymmetric field when required, allowing the twin requirements of minimal depolarisation and maximum homogeneity to be managed. The magnet consists of inner and outer pairs which are separately controlled to minimise the impact of the asymmetry. The zero field point can be shifted by up to 20mm from the central plane.

The system has a sample space of 50mm diameter, housed within a closed-cycle refrigeration system, offering a temperature controlled environment of 1.5K-375K. Sample exchange is into an inner *static column* eliminating the risk of accidental blockage.

The system includes a specially designed helium-3 insert with >40mm working space inside an aluminium IVC of just 1mm thick allowing continuous operation at 280mK for 76 hours within the main VTI space. Total aluminium in the beam path is limited to just 15mm (sample to outer wall).

The system also includes an automated z-axis and rotation manipulator stage for both the He-3 unit and standard sample probes.

MA 5.3 Mon 10:00 H48

Detection of nanowire vibrations with a co-resonantly coupled cantilever system — •Maneesha Sharma, Aniruddha Sathzadharma Prasad, Bernd Büchner, and Thomas Mühl — Leibniz Institute for Solid State and Materials Research, IFW Dresden, Germany

Nanowires can constitute the basis for high-sensitivity sensing of masses and magnetic properties of nanoparticles. We report a novel and efficient yet simple method for detecting nanowire flexural vibrations. In this work we present a co-resonantly coupled cantilever system consisting of a microcantilever and a nanocantilever. Achieving co-resonance involves matching the resonance frequencies of the individual systems. It allows us to measure the coupled system*s eigenmodes at the microcantilever. In the co-resonant state weak force gradients acting at the nanowire end have a considerable impact on the eigenmodes of the coupled system and thus can be easily sensed at the microcantilever.

We analyze mechanical properties of the nanowire subsystem and of the coupled system by exploiting thermally induced fluctuations which are measured by recording time-resolved secondary electron signals when using an electron beam and, in case of the microcantilever, by optical laser deflection. Finally, we discuss applications of the coupled cantilever sensor for high-sensitivity magnetometry.

MA 5.4 Mon 10:15 H48

A Ti/Pt/Co Multilayer Stack for Transfer Function Based Magnetic Force Microscopy Calibrations — •Baha Sakar[1], Sibylle Sievers[1], Osman Öztürk[2], and Hans Werner Schumacher[1] — [1]Physikalisch-Technische Bundesanstalt, Braunschweig, Germany — [2]Gebze Technical University, Kocaeli, Turkey

Magnetic force microscopy (MFM) is a widespread technique for imaging magnetic structures with a resolution of some 10 nanometers. MFM can be calibrated to obtain quantitative (qMFM) spatially resolved magnetization data in units of A/m by determining the calibrated point spread function of the instrument, its instrument calibration function (ICF), from a measurement of a well-known reference sample. Beyond quantifying the MFM data, a deconvolution of the MFM image data with the ICF also corrects the smearing caused by the finite width of the MFM tip stray field distribution. However, the quality of the calibration depends critically on the calculability of the magnetization distribution of the reference sample. Here, we discuss a Ti/Pt/Co multilayer stack that shows a stripe domain pattern as a suitable reference material. A precise control of the fabrication process, combined with a characterization of the sample micromagnetic parameters, allows reliable calculation of the sample*s magnetic stray field, proven by a very good agreement between micromagnetic simulations and qMFM measurements. A calibrated qMFM measurement using the Ti/Pt/Co stack as a reference sample is shown and validated, and the application area for quantitative MFM measurements calibrated with the Ti/Pt/Co stack is discussed.