Contribution ID : **98**

Type : **Oral**

High-resolution neutron depolarization microscopy of the ferromagnetic transitions in Ni3Al and HgCr2Se4 by using Wolter mirrors

Thursday, 6 September 2018 11:10 (20)

Imaging with polarized neutrons has in recent years increasingly gathered interest due to its ability to visualize bulk magnetic properties and magnetic fields in 2D and 3D. Currently the spatial resolution of typical setups is limited to ~500µm by the space consumed by the polarization analyzer which needs to be placed between sample and detector. This increases the minimum sample to detector distance which is achievable and results in such mediocre spatial resolution.
To obtain higher spatial resolution, we employed a novel neutron microscope equipped with Wolter mirrors as a neutron image-forming lens and a focusing neutron guide as a neutron condenser lens at the instrument ANTARES at FRM II. The Wolter optic creates a magnified image of the sample at the detector position while at the same time removing the general requirement in neutron imaging to place the sample as close as possible to the detector. With the current prototype Wolter mirrors we could achieve a magnification factor of four and a spatial resolution of ~100µm was reached. The spatial resolution was in our case mainly limited by the surface quality of the employed neutron optical mirrors in the prototype optic and we see potential for the improvement by another order magnitude.
To demonstrate the potential of the technique we performed spatially resolved bulk imaging of ferromagnetic transitions in Ni3Al and HgCr2Se4 crystals. These neutron depolarization measurements discovered magnetic inhomogeneities in the ferromagnetic transition temperature with spatial resolution of about 100 µm.
The images of Ni3Al show that the sample does not homogeneously go through the ferromagnetic transition. The improved resolution allowed us to identify a distribution of small grains with slightly off-stoichiometric composition. Additionally, neutron depolarization imaging experiments on the chrome spinel, HgCr2Se4, under high pressures up to 15 kbar highlight the advantages of the new technique especially for small samples or sample environments with restricted sample space. The improved spatial resolution enables to observe domain formation in the sample while decreasing the acquisition time despite having a bulky pressure cell in the beam.

Primary author(s) : JORBA, Pau (Technische Universität München); Dr SCHULZ, Michael (Technische Universität München, Heinz Maier-Leibnitz Zentrum); HUSSEY, Daniel S. (National Institute of Standards and Technology); ABIR, Muhammad (Nuclear Reactor Laboratory, Massachusetts Institute of Technology, Cambridge, MA, United States); SEIFERT, Marc (Technische Universität München); VLADIMIR, Tsurkan (Center for Electronic Correlations and Magnetism, University of Augsburg, Augsburg, Germany); LOIDL, Alois (Center for Electronic Correlations and Magnetism, University of Augsburg, Augsburg, Germany); PFLEIDERER, Christian (Technische Universität München); KHAYKOVICH, Boris (Nuclear Reactor Laboratory, Massachusetts Institute of Technology, Cambridge, MA, United States)

Presenter(s) : Dr SCHULZ, Michael (Technische Universität München, Heinz Maier-Leibnitz Zentrum)

Session Classification : Speaker Sessions and Seminars

Track Classification : Material Science