MA 4: Disordered Magnetic Materials

Time: Monday 9:30–10:30 Location: H47

MA 4.1 Mon 9:30 H47

Destruction of long-range magnetic order in the Cu_2GaBO_5 ludwigite in a magnetic field — A. Kulbakov[1], R. Sarkar[1], O. Janson[2], S. Dengre[1], E. M. Moshkina[3], P. Y. Portnichenko[1], H. Luetkens[4], F. Yokaichiya[5], A. S. Sukhanov[1,6], R. M. Eremina[7], A. Schneidewind[8], H.-H. Klauss[1], A. Korshunov[9], and •D. S. Inosov[1] — [1]TU Dresden, Germany — [2]IFW Dresden, Germany — [3]Krasnoyarsk, Russia — [4]PSI, Villigen, Switzerland — [5]HZB, Berlin, Germany — [6]MPI CPfS, Dresden, Germany — [7]Kazan, Russia — [8]JCNS @ MLZ, Forschungszentrum Jülich, Germany — [9]ESRF, Grenoble, France

The quantum spin system Cu_2GaBO_5 with the ludwigite structure consists of a structurally ordered Cu^{2+} sublattice interpenetrated by a disordered sublattice with a random site occupation by magnetic Cu^{2+} and nonmagnetic Ga^{3+}. In zero magnetic field, antiferromagnetic long-range order with the propagation vector $q_m = (0.45, 0, 0.7)$ sets in below $T_N = 4.1$ K, corresponding to a complex noncollinear structure with a large magnetic unit cell. Gapless spin dynamics in the form of a diffuse quasielastic peak is evidenced by neutron scattering. Remarkably, a magnetic field of ∼1 T destroys the static long-range order, which is manifested in the gradual broadening of magnetic Bragg peaks. Such a crossover to a spin-glass regime may result from orphan spins on the structurally disordered magnetic sublattice, which are polarized in magnetic field and act as a tuning knob for field-controlled magnetic disorder. For details, see Phys. Rev. B **103**, 024447 (2021).

MA 4.2 Mon 9:45 H47

Transport properties of FeAl under ion irradiation — •Serhii Sorokin[1], Gregor Hlawacek[1], Shadab Anwar[1], João Salgado-Cabaço[1], Richard Boucher[2], Kay Potzger[1], Jürgen Fassbender[1], Jürgen Lindner[1], and Rantej Bali[1] — [1]Institute of Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]Institute for Materials Science, Technische Universität Dresden, Dresden, Germany

In $Fe_{60}Al_{40}$ ion irradiation can be used to control the saturation magnetization (M_s) due to the gradual transition from paramagnetic (ordered B2-phase) to ferromagnetic (disordered A2-phase) as a function of ion fluence. The corresponding changes to the transport properties occurring during this phase transition are lesser known. Here we track the variation of electronic transport properties in parallel with gradual ion irradiation. A sample is inserted into a He/Ne-ion microscope on top of a permanent magnet and contacted with feedthrough probes to enable step-wise measurements during Ne^+-irradiation. The variation of the resistance and the Hall voltage are tracked as a function of the Ne^+-fluence, as the ordered B2 structure transforms into a disordered A2 structure. Peaks in the electrical resistance and the Hall voltage are observed corresponding to the existence of a partial B2/A2 state, thereby hinting at the important role of the induced ferromagnetic clusters and their distribution on the transport properties. The state of disorder is reversible by annealing with higher electric current.

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MA 4.3 Mon 10:00 H47

Magnetostructural phase transition in $Fe_{60}V_{40}$ alloy thin films — •Md Shadab Anwar[1,2], Hamza cansever[1], Benny Boehm[3], Rudolfo Gallardo[5], René Hübner[1], Shengqiang Zhou[1], Ulrich Kentsch[1], Benedikt Eggert[4], Simon Rauls[4], Heiko Wende[4], Kay Potzger[1], Jürgen Fassbender[1], Kilian Lenz[1], Jürgen Lindner[1], Olav Hellwig[1,3], and Rantej Bali[1] — [1]HZDR, Germany — [2]TU Dresden, Germany — [3]TU Chemnitz, Germany — [4]UDE Duisburg, Germany — [5]UTF Santa María, Chile

Ferromagnetism can be induced in non-ferromagnetic alloys such as B2 $Fe_{60}Al_{40}$[1] and B2 $Fe_{50}Rh_{50}$[2] through lattice disordering. Here we study a magnetostructural transition in $Fe_{60}V_{40}$ thin films using ion-irradiation. We show that the as-grown films possess an M_s of 17 kA/m and irradiation with 25 keV Ne^+-ions at a fluence of 5 x 10^{15}ions/cm^2 leads to an increase of M_s to ∼ 750 kA/m. A structural short-range order is observed in the as-grown films that transforms to A2 phase via ion-irradiation. Mössbauer spectroscopy and Ferromagnetic Resonance have been applied to track the variation of local magnetic ordering and dynamic behaviour respectively.

Financial support by DFG grants BA 5656/1-2 and WE 2623/14-2 is acknowledged.

[1]Ehrler, J.*et al., New J. Phys.*,22,073004(2020)
[2]Eggert, B.*et al., RSC Adv.*,10,14386(2020)

MA 4.4 Mon 10:15 H47

Understanding the ion induced reordering of amorphous $Fe_{60}V_{40}$ thin films — •Simon Rauls[1], Benedikt Eggert[1], Shadab Anwar[2], Damian Günzing[1], Philipp Klassen[1], Alexander Herman[1], Rantej Bali[2], and Heiko Wende[1] — [1]Faculty of Physics and CENIDE, University of Duisburg-Essen — [2]Interface Magnetism, Helmholtz-Zentrum Dresden-Rossendorf

For efficient spintronic devices, magnetic materials possessing both low moment and low Gilbert damping are highly demanded [1]. In this field, binary alloys consisting of Fe and easily polarizable elements like V are promising candidates, as they are reported to have a Gilbert damping parameter of $\alpha \sim 0.001$ which is about one order of magnitude lower as compared to the much-used permalloy [2]. Additionally, FeV can be grown as amorphous, paramagnetic thin films which reorder to the A2 structure upon ion irradiation. This can be exploited in such a way that ferromagnetic nanostructures can be written into the paramagnetic template in a single ion irradiation step using focussed ion beams or broad ion beams with masks.
Using Mössbauer spectroscopy and EXAFS, we will provide further insights into the reordering mechanics of amorphous $Fe_{60}V_{40}$ thin films by comparing the evolution of short range order and the hyperfine fields across the ion irradiation- and annealing-induced phase transition.

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[1] A. Barman et al. *J. Phys.: Condens. Matter* **33** 413001 (2021)
[2] D. Smith et al., *Phys. Rev. Applied* **14**, 034042 (2020)