MA 22 Internal Symposium "50 Years AG Magnetism"

Time: Wednesday 15:15–18:00 Room: HSZ 03

Invited Talk MA 22.1 Wed 15:15 HSZ 03

Fifty Years "Arbeitsgemeinschaft Magnetismus" - History of Magnetism in Germany — •H. Kronmüller — Max-Planck-Institut für Metallforschung, Heisenbergstr. 3, 70569 Stuttgart, Germany

The "Arbeitsgemeinschaft Magnetismus (AM)" has been founded in 1956 as a united organization of four different scientific societies (DPG, DGM, VDE, VDEH). The AM supports basic research and technical applications of magnetism. To promote advanced knowledge on magnetism the AM organizes conferences and workshops and participates in international conferences. From the first meeting held in 1957 the central idea was the interdisciplinary collaboration between basic and applied research. Within the last 50 years the AM has been involved in all innovative developments in the field of magnetic materials. The main activities so far are the following ones: 1. Investigation of magnetic ground states and excited states by ab-initio electron theory and model Hamiltonians, as e.g. the Hubbard model. 2. High-coercivity intermetallic compounds, high-permeability ferrites, (nano-)crystalline and amorphous alloys. 3. High-quality magnetic materials with outstanding properties as spin glasses, heavy-fermion compounds, perovskites, invar and shape memory alloys. 4. Thin film systems for sensor applications and high-density recording, GMR and CMR systems. 5. Micromagnetic analysis of domain patterns, domain walls and magnetization processes in thin films and small particles, development of computational micromagnetism. 6. Development of high-standard measuring techniques as NMR, Mößbauer effect, STM, MFM, Lorentz microscopy, neutron diffraction, XMCD, spin-polarized electron methods.

Invited Talk MA 22.2 Wed 15:45 HSZ 03

Making magnets harder — •J. M. D. Coey — School of Physics and CRANN, Trinity College, Dublin 2, Ireland

The 20th century was a period when the energy product of permanent magnets, the simplest figure of merit, improved exponentially. This growth is now over, and the prospects of another doubling look dim. Permanent magnets however have myriad uses in electromagnetic drives, and hundreds of millions of them are produced annually. Further progress may come from integrating micron-scale magnets into silicon-based MEMS structures, especially in view of the favorable scaling of dipole-dipole interactions. Current challenges to produce useful magnetic thick films will be discussed, and potential for further materials development will be reviewed.

Invited Talk MA 22.3 Wed 16:15 HSZ 03

Industrial Rare-Earth Permanent Magnets and their Applications — •Matthias Katter — Vacuumschmelze GmbH Co. KG, Grüner Weg 37, 63450 Hanau

The production route and the main applications of high end sintered permanent magnets based on Nd-Fe-B and Sm-Co are reviewed. For Nd-Fe-B, the influence of the grain size on the magnetic properties and the corrosion resistance is reported. Commercial Nd-Fe-B magnets meanwhile reach energy densities of up 53 MGOe, whereas for lab magnets about 58 MGOe are obtained which is close to the theoretical limit of 64 MGOe. The magnetization behaviour of Sm2(Co,Fe,Cu,Zr)17 magnets, which is determined by pinning of domain walls, is discussed. Industrial magnet grades of this type can be applied up to 350 - 550°C. The main applications for Nd-Fe-B magnets are in hard disc drives and in any kind of motors. A large increase is expected in the next years for automotive applications like steering by wire and hybrid electric vehicles. From the scientific side, there are challenging demands for very homogenous magnets for beam guiding systems like wigglers and undulators.

— 15 min. Break —

Invited Talk MA 22.4 Wed 17:00 HSZ 03

Spin transfer phenomena in layered magnetic structures — •Peter A. Grünberg, Daniel E. Bürgler, and Claus M. Schneider — FZ-Jülich, IFF

The discovery of interlayer exchange coupling (IEC) in 1986 was followed in 1988 by the first detection of "Giant Magnetoresistance" (GMR) and in 1995 by a rediscovery of tunnel magnetoresistance (TMR). Finally after its theoretical prediction in 1995, in 1999 there was the first experimental observation of current induced magnetic switching (CIMS). All mentioned phenomena rely on the transfer of electron spin between neighbouring magnetic layers across nonmagnetic interlayers in layered magnetic structures. Here we want to give an overview of this worldwide activity.

The phenomena can be classified according to the nature of the interlayer material used: metallic, semiconducting, insulating. Generally IEC is only obtained across metallic interlayers, but there are exceptions like IEC of Fe across Si and MgO. Furthermore IEC across well ordered Si turns out to be surprisingly strong. Likewise TMR is expected and indeed observed across semiconductors and insulators but so far could not be detected across Si, despite many efforts due to technical relevance. On the other hand values as big as a few hundred percent have been observed for TMR across MgO, in agreement with a theoretical prediction. We shall present and discuss the mentioned phenomena in the framework of associated band structures, where emphasis will be given to a basic physical understanding. Already existing and possible future applications will also be considered.

Invited Talk MA 22.5 Wed 17:30 HSZ 03

Interplay between Incipient Magnetism and Superconductivity in Heavy Fermions — •Frank Steglich — Max Planck Institute for Chemical Physics of Solids, 01187 Dresden, Germany

Strong electronic correlations on partially filled 4f or 5f shells, weakly hybridized with ligand valence-electron orbitals, cause the formation of extremely heavy quasiparticles composed of a dominating local f part as well as contributions from conduction-band states. As discovered in 1979 for $CeCu_2Si_2$, these "heavy fermions" (HF) may form Cooper pairs. In most HF metals, the superconducting glue seems to be of magnetic origin. In fact, for UPd_2Al_3 magnetic-exciton mediated pairing could be convincingly demonstrated, i.e. by comparing quasiparticle-tunneling and inelastic neutron-scattering results.

For a number of Ce-based HF metals superconductivity was found to be intimately related to the existence of an antiferromagnetic (AF) instability which, at least in the case of $CeCu_2Si_2$, is of the conventional (spin-density-wave) type. On the other hand, an AF magnetic-field induced "quantum critical point" of unconventional nature originating in a break up of the "composite" HFs was recently established in $YbRh_2Si_2$. For this compound, we found dominating 2D ferromagnetic quantum critical fluctuations in wide regions of the phase diagram, but no superconductivity at temperatures down to 10 mK.

Work done in collaboration with: M. Deppe, G. Donath, J. Ferstl, P. Gegenwart, C. Geibel, H.S. Jeevan, R. Küchler, T. Lühmann, M. Nicklas, N. Oeschler, J. Sichelschmidt, O. Stockert, P. Thalmeier, F. Weickert, S. Wirth.