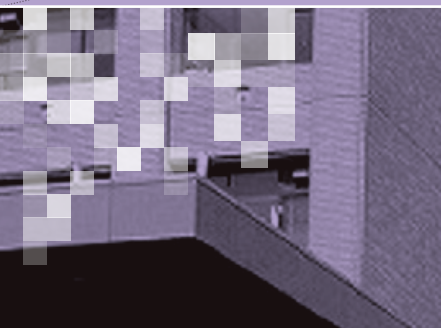




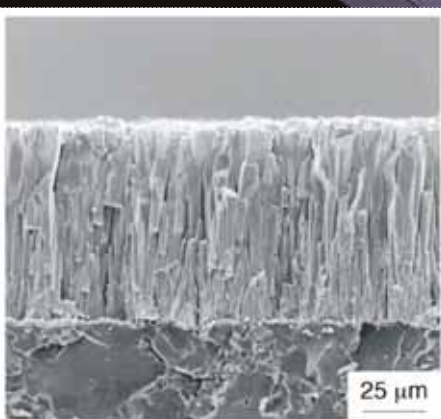
ICC-IMR news No.4

International Collaboration Center

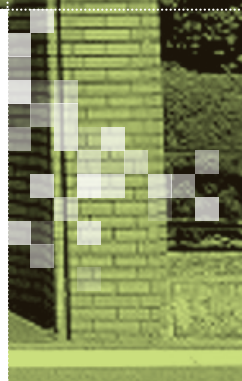
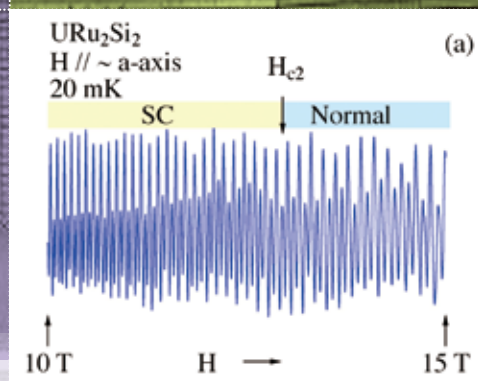
Institute for Materials Research, Tohoku University



Participants of SMS2012



De Haas-van Alphen Oscillations of the Heavy Fermion Superconductor URu₂Si₂



Welcome to ICC-IMR

ICC-IMR was founded in April 2008 as the center for the international collaboration of the Institute for Materials Research (IMR). As one of the centers of excellence in material science, IMR holds 27 research groups and six research centers. ICC-IMR works as a gateway of diverse collaborations between international researchers and IMR members. ICC-IMR has invited 27 visiting professors and conducted nine international research projects since the start-up. The applications are open for foreign researchers and the projects are evaluated by peer-review process by international reviewers. Currently, ICC-IMR coordinates six different programs:

- | | |
|--|--|
| 1) International Integrated Project Research | 4) International Workshops |
| 2) Visiting Professorship | 5) Fellowship for young researcher and PhD student |
| 3) Short Single Research Visits | 6) Material Transfer Program |

We welcome applicants from around the globe to participate in these international programs.

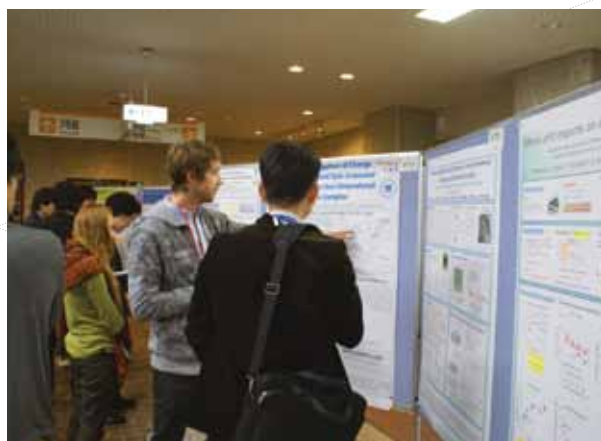
Summit of Materials Science and Materials Science Week 2012 - Nov. 25 - Dec. 1, 2012

Summit of Materials Science and Materials Science Week 2012, were held at IMR from November 25 to December 1, 2012. It is the first international general meeting of materials science organized by IMR. In the 1st Materials Science Week held in 2011, IMR addressed the international declaration of materials science 2011 in Tohoku, with researchers from more than 60 institutes in 20



nations. This illuminates the international solidarity of the materials science community and importance of international exchange in our field. IMR has decided to continue these efforts and to hold "Summit of Materials Science: SMS2012".

At the SMS2012, total of 24 top-class researchers around the world were invited to give leading presentations and/or to contribute as chairpersons. The topics are spintronics, crystal growth, functional materials, material processing, advanced ceramic and metal, superconductivity, nanostructure, nano-device, magnetic and ferroelectric. It was very precious occasion to exchange views with those world leading experts who can give deep insight in their fields to enrich ideas. Moreover, the topics cover all aspects of materials science and condensed matter science. The interdisciplinarity shows the uniqueness of IMR with broad and diverse activities in materials science. In the conference, about 300 people participants have enjoyed the 130 presentations including posters and short talks by younger researchers. The event has also encouraged and stimulated the international exchange and collaborations in materials science, we were once again determined to promote our mission in the declaration in 2011 "Contributions in the field of Materials Science to build a better society" and continue to challenge in every field.



Matthias Benjamin Jungfleisch,
University of Kaiserslautern, Germany,
April 2 - June 7, 2012

Research Proposal: Heat-induced Magnetic Damping Variation in Yttrium Iron Garnet/Platinum Hetero-structures



The ICC-IMR Fellowship program was for me an unique and flourishing experience. I had the chance to work closely with excellent scientists in the field of spintronics at the IMR and to intensify already existing collaborations. To get to know better the Japanese culture and the way of living was very impressing for me.

The joint scientific results of my visit have been published in two international peer-reviewed journals. The stay at the IMR was very stimulating for me and opened up the way to new ideas and perspectives.

During my time at the IMR, we investigated how a longitudinal temperature difference across the thickness of an yttrium iron garnet/platinum (YIG/Pt) bi-layer affects the magnetization relaxation in the YIG film. It turned out that the magnetic damping is either increased or decreased depending on the sign of the temperature gradient. We conclude that this effect might be explainable by a thermally induced spin torque on the magnetization precession.

Integrated Project

International integrated projects between IMR and foreign institutions/groups provide world-class collaborative research for a period of up to two years. Diverse research teams with members from multiple countries are encouraged. International referees evaluate each project.

Visiting Professorships

Individuals staying more than a month can apply for a visiting professorship. Successful applicants are employed as formal visiting professors of IMR, and travel costs are supported.

Single Research Visits

Applicants accepted for a short research visit are allowed access to IMR, including its research centers and divisions, and travel expenses are partially supported. Collaborating with several IMR groups is encouraged during a single research visit.

International Workshops

ICC-IMR supports international workshops held at IMR. These can be independent workshops or ones cosponsored with other organizations.

Fellowship for young researcher and PhD student

Applicants are supported partially up to two months of research under the IMR supervisor.

Material Transfer Program

The products of IMR can be transferred to foreign research institution based on the international exchange agreement and are used for the international collaborative research in abroad.

ICC-IMR activities in FY 2012



Research Projects

Development of Functionalized Molecule-based Magnetic Materials (FY2011-2012)

PI: J. Schnack (Bielefeld University, Germany) and H. Nojiri (Magnetism, IMR)

Theoretical Challenges in Spintronic Materials (FY2011-2012)

*PI: Y. Tserkovnyak (University of California, Los Angeles, USA) and
G. E. W. Bauer (Theory of Solid State Physics, IMR)*

Visiting Professors

D. Kim, Dong-A University, Korea, June 1 - July 30, 2012

“Hot Ductility Behavior of High Mn Steel with Various Deformation Conditions”

G. Boulon, Claude Bernard Lyon 1 University, France, Nov. 15 - Dec. 15, 2012

“Crystal Growth and Spectroscopic Properties of Laser Single Crystals/Ceramics”

A. Kovács, Ernst-Ruska Centre, Forschungszentrum Jülich, Germany, Nov. 22, 2012 - Jan. 31, 2013

“High-Resolution Chemical, Structural and Magnetic Study of
Hard Magnetic Nanocrystals using Advanced Electron Microscopy and Spectroscopy”

Workshops

Spin Caloritronics IV, June 2 - 5, 2012

International Workshop on Biomaterials in Biosis-Abiosis
Intelligent Interface Science, Aug. 2 - 3, 2012

Workshop on Nitride Semiconductors ~ Current Status and
Future Prospects based on Intimate Discussion~, Oct. 22 - 23, 2012

The 7th General Meeting of ACCMS-VO, Nov. 23 - 25, 2012

KINKEN-WAKATE2012 : 9th Materials Science School for
Young Scientists and Students, Nov. 26, 2012

Advanced 0-D to 3-D Electron Microscopy: From the Detection of Single Atoms
in Doped YAG to 3D Information on Functional Nanomaterials, Nov. 27, 2012

Recent Advance in Analytical Techniques for Steelmaking Industry:
RATEC2012, Dec. 1, 2012

International Workshop on Development of Functionalized Molecule-based
Magnetic Compounds, Feb. 19 - 21, 2013

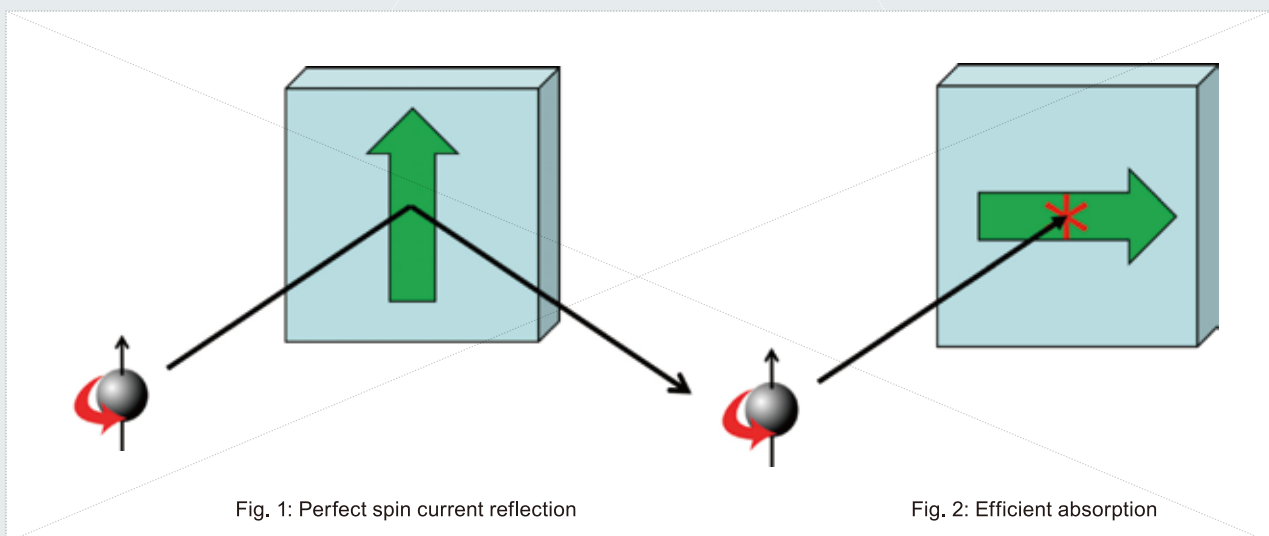
Japan-Russia Workshop on Advanced Materials Synthesis Process and
Nanostructure, March 7 - 8, 2013

Theoretical Challenges in Spintronic Materials

Principal investigators: Y. Tserkovnyak (University of California, Los Angeles) & G. E. W. Bauer (IMR)

Collaborators: E. Saitoh (IMR), Y. Chen (Delft), S. Gönnerwein (Munich)

The ICC-IMR collaboration between experimentalists at the TU Munich and the IMR and theoreticians at the TU Delft and the IMR discovered a new magnetoresistance effect in bilayers of a normal metal (Pt) and a magnetic insulator (Yttrium Iron Garnet, YIG). The experiments found a modulation of the electrical resistance depending on the angle between the YIG magnetization and the electric current direction. Since the conduction electrons cannot penetrate the insulator, this effect is fundamentally different from the anisotropic magnetoresistance of ferromagnetic metals. Instead, the experiments prove that YIG is a switchable mirror for spin currents that are generated in the Pt by the spin Hall effect. As indicated in the Fig. 1, a spin current with polarization parallel to the magnetization is perfectly reflected, while a spin current polarized normal to the magnetization is efficiently absorbed by the magnet (Fig. 2). This mechanism does not work for metallic ferromagnets that absorb spin currents for both configurations. When the spin current is reflected, the inverse spin Hall effect generates an additional charge current, which can be easily measured. This effect can be used to read out the magnetization direction of insulators. Effective spin current absorption implies a large spin-transfer torque and power savings in information storage or logic devices based on magnetic insulators.



Publications

- 1) H. Nakayama *et al.*, Phys. Rev. Lett., 110, 206601, 2013
- 2) Y. Chen *et al.*, Phys. Rev. B, 87, 144411, 2013



Visitors supported by ICC-Programs Graph on the world map

Visitors

Germany(22), Korea(15), USA(15), China(10), Russia(7), UK(7), France(6), Netherlands(6), Hong-Kong(1),
India(3), Taiwan(3), Norway(2), Ukraine(2), Canada(1), Italy(1), Poland(1), Slovenia(1), Spain(1), Switzerland(1)

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