

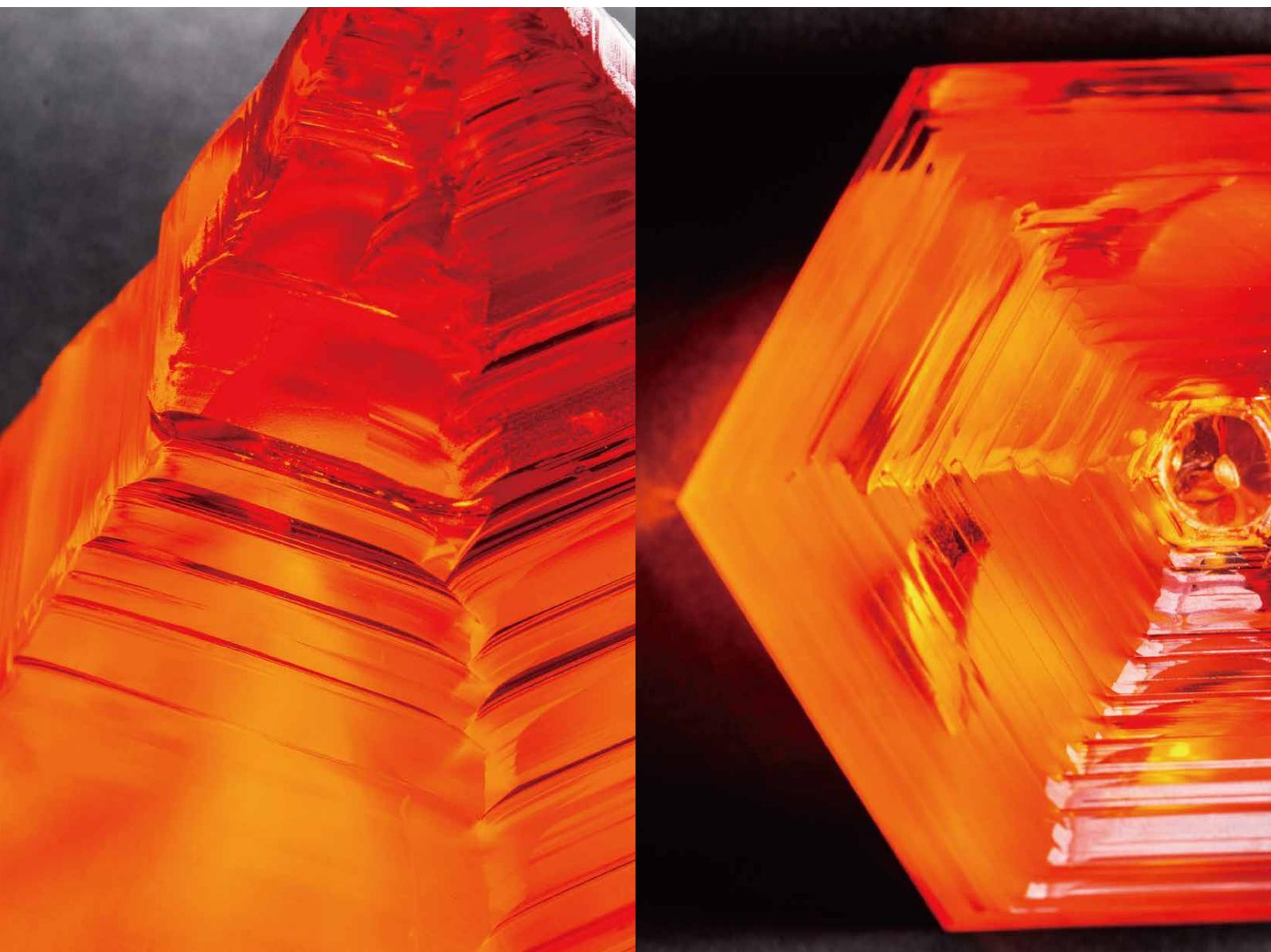
ICC-IMR

NEWS

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**International
Collaboration
Center**

Institute for Materials Research
Tohoku University

<http://www.icc-imr.tohoku.ac.jp/>



ICC-IMR Director
Gerrit E. W.
BAUER

Welcome to the ICC-IMR

On August 29, 2017, the whole population of Northern Japan was alarmed at 6 a.m. on all television channels and by individual smart phone messages. We were sternly advised to avoid open spaces and immediately seek shelter in concrete buildings. Fortunately, North Korea's ballistic missile only practiced an overflight. Nevertheless, it was a warning that the long period of peace that brought prosperity to Japan (and others) cannot be taken for granted. Fortunately, the international community has unequivocally expressed its sympathy with Japan, its well-integrated and highly appreciated member.

I like to believe that, on a very small scale, the International Collaboration Center (ICC), founded by the Institute for Materials Research (IMR) of Tohoku University in April 2008, has contributed to the strong international solidarity. We have been charged to foster top research by facilitating open exchange of

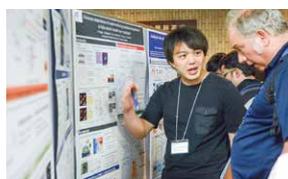
ideas and results between the IMR and rest of the world. We welcome applications for joint activities between IMR and overseas researchers, sponsoring junior and senior scientists in the form of integrated projects, guest professorships and shorter research visits, as well as support international workshops and schools. Any of these activities may be initiated by international scientists who seek collaboration with IMR faculty members. With advice from external referees the ICC-IMR Steering Committee prioritizes applications three times per year, whereby quality and impact are the main considerations.

In this ICC-IMR News Bulletin we present a concise summary of activities and exciting results that emerged from the collaborations supported by the ICC-IMR in the past year. We hope that this report will stimulate many new research results as well as mutual international friendship and understanding.

❖ Highlight of ICC-IMR International Workshop

Summit of Materials Science 2016, May 18-20, 2016, Chairperson K. Takanashi (IMR)

The Summit of Materials Science (SMS) is an international forum, held by the IMR and initiated after the catastrophic earthquake in 2011. It covers a broad range of topics in solid-state physics and chemistry, as well as materials science. This time, SMS 2016 was organized as a part of our centennial celebration. It started by the opening speech, entitled "Past and Present of IMR", by the director Koki Takanashi, which was followed by 25 invited talks, on Spintronics, Magnetism, Crystal Growth, Energy-related Materials, Structural Alloys and Ceramics, Phase Transformation, etc. Immediately prior to this forum, a Young Scientist Workshop was held. 18 oral and 64 poster presentations were given in English by burgeoning researchers from the institute. The central objective of this meeting was, along with scientific interactions, to exchange opinions and discuss the future of materials science. Under the motto "My Dream, My Ambition", every presentation radiated uplifting enthusiasm. In this way, SMS 2016, with 166 participants including 48 from overseas, contributed a memorable milestone to the history of IMR.



❖ Comments from Visitors

Ilya Sheikin, LNCMI, CNRS (France)

2016.4.4-2016.6.3



Research Proposal: Electronic and Superconducting Properties of Ce-Based Heavy-Fermion Compounds with Quasi-Two-Dimensional Fermi Surfaces

My two-months stay in Oarai as a visiting professor of the ICC-IMR was very fruitful scientifically and enjoyable personally. It appeared as a natural continuation of our long-standing collaboration with Prof. D. Aoki.

During my stay, we have tested and selected several new samples of Ce-based heavy fermion compounds for future high field dHvA measurements. In these materials, such as Ce_2RhIn_8 and $CePt_2In_7$, quantum critical points can be induced by either pressure or high magnetic field. Some of these experiments have already been realized. Furthermore, we have finished the data analysis and discussion of the results of our previous de Haas-van Alphen measurements in $CeRh_2Si_2$. This gave rise to a high-level publication in Physical Review Letters related to a drastic change of the Fermi surface across the

metamagnetic transition in this material.

During my stay in Japan, I have also had a pleasure to give a talk at the International Conference "Summit of Materials Science" dedicated to the 100th anniversary of the IMR. It was a great honor for me to participate in the celebration of this even after the workshop.

Not a newcomer to Japan, I have, nonetheless, gained new experience related to Japanese culture. It was a real pleasure to take part in *Hanami*, the Japanese traditional ceremony of enjoying the sakura blossom. The introduction to *Kendo*, a popular Japanese martial art using bamboo swords, by Dr. F. Honda was another unforgettable experience.

Arthur Seiji Nishikawa,
University of São Paulo (Brazil)

2016.6.29-9.6



Research Proposal: Characterization of Products of Competitive Reactions during Quenching and Partitioning Applied to a Ductile Cast Iron

The IMR visiting program provided me an amazing and rewarding experience. My project focused on characterizing phase transformation products in ferrous alloys. I was able to attain my main goal thanks to the organization, competence of the technical staff, and excellent facilities of the "Microstructure Design of Structural Metallic Materials", Furuhashi Laboratory. Besides, through discussions with Professor Goro Miyamoto, Xinfu Gu, and the other group members, I learnt a lot about crystallography and the Electron Backscattered Diffraction (EBSD) technique. As a byproduct of our collaboration we've written open-source software for analyzing EBSD data and determining the

orientation relationships between parent and product phases. On the personal side, as a Japanese descendant, visiting for the first time the land of my ancestors was very special. Being raised by a Japanese family in Brazil allowed me having a privileged view of how the Japanese culture evolved in different ways in Japan and in Brazil. I was very lucky of being in Sendai during the Tanabata Matsuri celebrations, a very beautiful expression of the Japanese culture. Everything summed up to help me mature scientifically and grow up as person. I thank everybody for this great experience.

❖ Highlight of Research Project

Development of the Next Generation Detector for High Energy Physics (FY2015-2016)

PI: M. Nikl (Inst. of Phys, CAS, Czech Republic) and A. Yoshikawa (Advanced Crystal Engineering Division, IMR)

The Standard Model of particle physics is a theory unifying the electromagnetic, weak and strong interactions, as well as classifying all the known subatomic particles. Although this model assumes that neutrino mass is zero, the researchers found the evidence of the neutrino mass related to the neutrino oscillation. Moreover, we cannot describe dark matter by this model up to now. Thus, new theory should be developed, especially with focus on the description of weak interaction.

New theories have emerged recently, such as Supersymmetric theory, extra dimensions theory and so on, however, their experimental proof is missing. The particle identification, which means to discriminate generated particle such as pion, neutron, electron and others at the moment of the collision, is important to evaluate the collision event. At this collision event, we can find new physics or new particle. The position-sensitive detector can be used for the particle identification.

For position-sensitive detectors fiber type scintillators can be used. The candidates for the new materials are inorganic crystals such as oxides due to their higher radiation hardness when compared with plastic ones which are usually used in the form of fibers for high energy physics experiments.

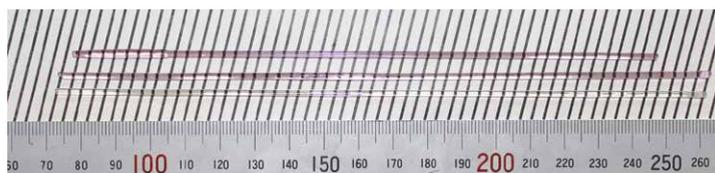


Fig.1 Photograph of fiber scintillator.

Our ICC-IMR teams are members of “Intelligentsia supporting world-famous research institute to develop next-generation particle detectors” project (INTELUM) which is one of the CERN-coordinated projects with focus on development of the next-generation detectors for high energy physics experiment such as a hadronic detector. In this project, we develop a new fiber scintillator with a fine spatial resolution and good light output using our original crystal growth technique: the micro-pulling-down method.

We grew several inorganic fibers such as RE-doped CaF_2 , RE:(Gd, Lu) $_3$ (Ga, Al) $_5\text{O}_{12}$, RE:(Gd, La) $_2\text{Si}_2\text{O}_7$ by the micro-pulling down method as shown in Fig.1., where RE are rare-earths such as Ce or Nd. Moreover, we have developed and assembled some photon detector systems using Si-based diodes to evaluate the scintillation properties (Fig. 2).

We succeeded in growing several fibers with good light outputs of over 30,000 photons/MeV, fast decay time of 40 – 90 ns and good radiation hardness of over 1 Gy/h for some samples, which means that the goals of the ICC-IMR project were achieved. Thus, our results have supported INTELUM activities, and our teams could play a very important role in the INTELUM.

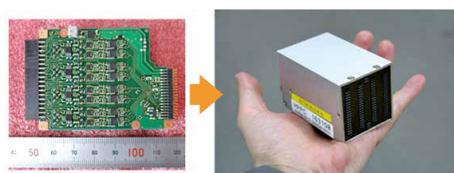


Fig. 2 photograph of evaluation system for light outputs, energy resolution: Si-Photo Multiplier.

Appendix and acknowledgement

Regarding the ICC-IMR project and INTELUM projects, over 10 foreign researchers have visited in Sendai in the past 2 years, while 9 Japanese researchers including 5 students visited collaborating laboratories such as CERN, Institute of Physics /Czech Academy of Sciences, University of Milano-Bicocca and Université Claude Bernard Lyon 1. Additionally, INTELUM meeting was held in Sendai in 2016 (Fig. 3). Travel expenses of some researcher were supported by this ICC-IMR project. Moreover, we have published several papers regarding as this project.



Fig. 3 Group photograph of INTELUM meeting in Sendai (Tohoku Univ. IMR)

ICC-IMR Activities in FY 2016

Visiting Professors



I. Sheikin,
LNCMI, CNRS, France,
Apr. 4-June 3, 2016

"Electronic and Superconducting Properties of Ce-Based Heavy-Fermion Compounds with Quasi-Two-Dimensional Fermi Surfaces"
(Host: D. Aoki, IMR)



W. Cui,
Northeast University, China,
July 12-Sep. 1, 2016

"Magnetotransport Properties Caused by Magnetic Doping in Topological Insulators"
(Host: K. Takanashi, IMR)



Y. Li,
Central South University, China,
July 8-Aug. 9, 2016

"Influence of Alloying Element on Twinning Boundary Mobility of Mg and Its Alloys"
(Host: A. Chiba, IMR)



M. Kläui
Johannes Gutenberg-Universität
Mainz, Germany,
Oct. 6-Dec. 2, 2016

"Investigation of Insulator Spintronics and the Spin Seebeck Effect in Ferrioc Compounds"
(Host: E. Saitoh, IMR)

Research Project

Development of the Next Generation Detector for High Energy Physics (FY2015–2016)

PI: M. Niki, Institute of Physics, Academy of Sciences of the Czech Republic and A. Yoshikawa, IMR

Investigation of Magnetic and Charge Dynamics by Combining Pulsed Neutron-X-ray Sources and Pulsed High Magnetic Fields (FY2015–2016)

PI: P. Manuel, ISIS, STFC RAL and H. Nojiri, IMR

Developments of RE123 Insert Magnet (FY2016–2017)

PI: X. Chaud, LNCMI-CNRS and S. Awaji, IMR

Investigation of Structure and Properties of Nanoporous Metals Formed by Dealloying in Metallic Melt (FY2016–2017)

PI: E. Maire, INSA Lyon and H. Kato, IMR

International Workshop

International Conference "Summit of Materials Science 2016", May 18–20, 2016

Chairperson: K. Takanashi, IMR

The 11th International Workshop on Biomaterials in Interface Science (Innovative Research for Biosis-Abiosis Intelligent Interface Summer Seminar 2016), Aug. 30–31, 2016

Chairperson: T. Goto, IMR

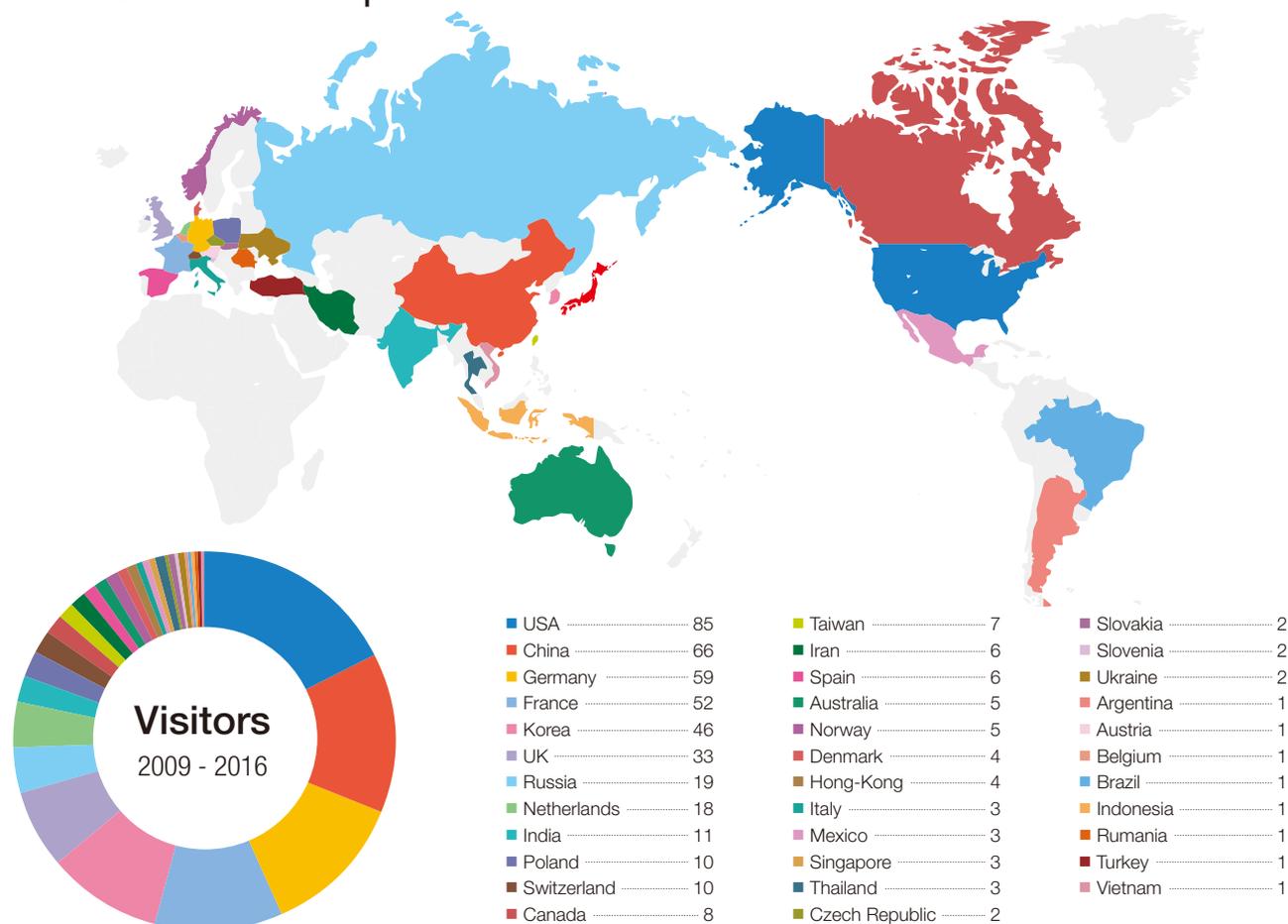
13th Materials Science School for Young Scientists (KINKEN-WAKATE 2016), "Workshop for Young Investigators on Functional Molecular Magnetism and Molecular Related Magnetism", Sep. 3–4, 2016

Chairperson: H. Miyasaka, IMR

3rd Intensive Discussion on Crystal Growth of Nitride Semiconductors (IDGN-3), Jan. 16–18, 2017

Chairperson: T. Matsuoka, IMR

🌐 Visitors supported by ICC-Programs Graph on the world map



🌐 ICC-IMR Programs

ICC-IMR was founded in April 2008 as the center for 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 five research centers. ICC-IMR works as a gateway of diverse collaborations between international researchers and IMR members. ICC-IMR has invited 51 visiting professors and conducted 20 international research projects since the start-up. The applications are open for foreign researchers and the projects are evaluated by a peer-review process involving international reviewers. Currently, ICC-IMR coordinates six different programs:

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

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

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On the Cover

La₃Ga₅SiO₁₄ Single Crystal
 Photo Credit: Uda Laboratory, IMR

