

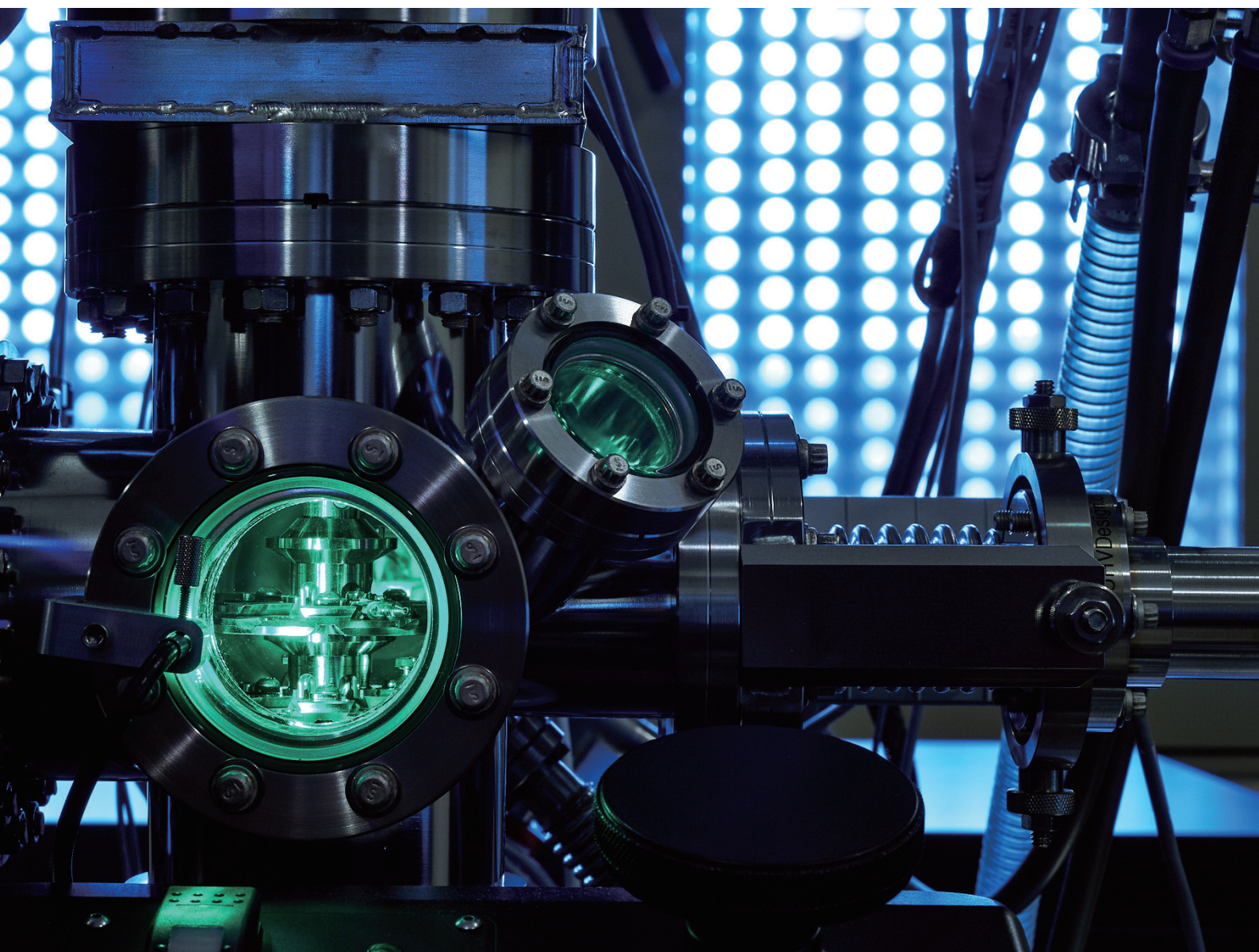
# ICC-IMR

*NEWS*

No. **10**  
Nov. 2019

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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**

## Top Message

In November of last year, after a hearing at the Ministry and stiff competition, the Japanese government designated our IMR as an international joint usage/research center with substantial additional funding for a few years

<http://www.imr.tohoku.ac.jp/en/news/news/detail---id-1069.html>. We named the new center "Global Institute for Materials Research Tohoku (GIMRT)". This great success reflects the inspiring leadership and great personal commitment of Profs. Takahashi, Furuhashi and Nojiri as well as the efficient support of everyone involved. The GIMRT builds on the many years of experience accumulated by the ICC-IMR but does not replace it, and all funding opportunities and

procedures remain intact.

The first international conference and user meeting of the GIMRT will be held from 27 to 28 November 2019 as a "Summit of Material Science", the successful conference series organized by the IMR since 2012.

GIMRT User System

<https://imr-kyodo.imr.tohoku.ac.jp/?lang=en>

SMS2019 & GIMRT User Meeting 2019

<https://www.sms2019.imr.tohoku.ac.jp>

## ❖ Highlights of ICC-IMR International Workshops

### KINKEN WAKATE 2018 & FINEMET 30:15th Materials Science School for Young Scientists & Symposium of 30th Anniversary of Nano Crystalline Soft Magnetic Alloys, August 29-31, 2018, Chairperson H. Kato (IMR)

The year 2018 was the 30th anniversary of the first paper that reported nanocrystalline soft magnetic alloys, FINEMET, by Yoshizawa et al. The importance of soft magnetic materials is still growing and further developments by young researchers are strongly expected. The aim of KINKEN WAKATE 2018 & FINEMET 30 was to learn "How did those new ideas & materials come out?" directly from the inventors or proposer of FINEMET, NANOPERM, HITPERM and Random Anisotropy Model, and to bring new idea or strategy for making something "New" to the young researcher.

KINKEN WAKATE 2018 began with an opening talk by Masato OHNUMA (Hokkaido University, Japan) and followed by four tutorial lectures.

Tutorial 1: "Fe-based nanocrystalline soft magnetic alloys and their applications"

By Yoshihito YOSHIZAWA (High Energy Accelerator Research Organization (KEK), Japan)

Tutorial 2: "Amorphous and Nanocrystalline Materials for Soft Magnetic Applications"

By Giselher HERZER (Vacuumschmelze GmbH & Co. KG, Germany)

Tutorial 3: "Fe-M-B (M = IVa TO VIa METAL) NANOCRYSTALLINE SOFT MAGNETIC MATERIALS, A Review of Alloy Development"

By Kiyonori SUZUKI (Monash University, Australia)

Tutorial 4: "METAL AMORPHOUS NANOCOMPOSITE (MANC) MATERIALS & DEVICES FOR POWER MAGNETIC APPLICATIONS"

By Michael E. MCHENRY (Carnegie Mellon University, USA)

Following to the tutorial lectures, three young researchers gave 20 minutes oral presentations on their research. Moreover, we had some students do poster presentations in the intervals.

We had 44 members of participants (9 from overseas + 35 from domestic areas), joined from 8 countries (USA, Australia, Germany, Romania, Slovakia, China, Korea and Japan). We had enthusiastic discussions and a chance to share the latest research results with the world's top scientists.



Fig. 1 Lecture by Giselher HERZER



Fig. 2 Group photo



## ❖ Comments from Visitors

Mukannan Arivanandhan,  
Anna University, India

2018.11.12~2019.1.30



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**Research Proposal:**  
**Defect Engineering in SiGe Alloy Semiconductor for  
Thermoelectric Applications**

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The ICC-IMR visiting program has been a pleasant and rewarding experience for me. It gave me the opportunity to strengthen the collaborations with IMR. Really I enjoyed the three months stay in Sendai and recollected the old memories of my earlier stay at IMR. So, I thank the ICC-IMR, Tohoku University for inviting me as a visiting Associate Professor. Further, I thank Prof. Satoshi Uda and Prof. Koza Fujiwara and their group members for their support for establishing the long-term collaborations.

During the visit, we studied the crystallization and re-melting process of  $\text{Si}_{1-x}\text{Ge}_x$  ( $x=0.1, 0.2$  and  $0.3$ ) alloy semiconductors under rapid and slow cooling. The crystallized  $\text{Si}_{1-x}\text{Ge}_x$  samples were analyzed by EDX and EBSD to study the compositional variation and grain structures. The grain size and structures are almost the same for both crystals despite of different cooling rates. The dendrites are easily formed

under rapid cooling as well as slow cooling in  $\text{Si}_{1-x}\text{Ge}_x$  samples. Whereas the dendrites are formed in Si during the rapid cooling alone and flat interface with no dendrites are observed under slow cooling. During rapid cooling, initially grown fine dendrites were completely re-melted and recrystallized on further cooling. No re-melting was occurred in Si under rapid cooling. The re-melting of initially grown dendrites and recrystallization of  $\text{Si}_{1-x}\text{Ge}_x$  is the possible reason for the similar grain structures as inferred from in-situ observation experiments. I was happy about the outcome of the research. The defect analysis, nano structuring of the prepared  $\text{Si}_{1-x}\text{Ge}_x$  and their thermoelectric studies are under progress.

The scientific outcome of the short visit has been published in an International journal and opened the route for further research collaborations and new ideas.

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Denis Rybin, Lavrentyev Institute  
of Hydrodynamics, Russia  
2018.7.1~2018.8.13



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**Research Proposal:**  
**Structural Investigation of Nanoscale Detonation Carbon Obtained  
Using a Pulse Gas-Detonation device**

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I am very grateful to the ICC-IMR program for young researchers for the valuable experience gained. Organization, excellent equipment and of course qualified assistance from Kato's laboratory staff – all of this allowed me to provide extensive and successful study of properties of nanoscale detonation carbon (NDC) which was obtained by Pulse Gas Detonation Device. The scientific outcome of a short visit has been published in one paper in an international journal and opened the route to more to come and to new ideas.

The central focus in our work was the investigation of properties of NDC samples which were obtained at various oxygen to carbon ratios in initial explosive mixture of acetylene and oxygen.

It was found that the morphology of NDC significantly changing when oxygen content increasing in initial explosive mixture – from

completely amorphous to graphitized. In our opinion the sample which was obtained at oxygen to carbon ratio equal 0.68 is graphene nanosheets with thickness of 10-20 nm. Also this research addressed mechanisms of influence on NDC structure. In particular it was shown that the presence of argon as a purge gas in process and increasing of the barrel length increase the graphitization degree of NDC. It confirms the Raman data which was obtained at active help of Prof. Hidemi Kato.

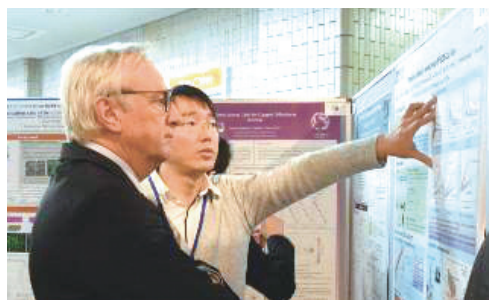
I express my deep gratitude to the entire Kato laboratory staff. It would be a great success for me to work with such professionals again. In turn, the city of Sendai will forever remain in my heart and memory as a beautiful and blooming green city.

## ❖ Topics

### Summit of Materials Science 2018, October 29-30, 2018



6 invited speakers gave presentations



Poster Session



Winners of a Young Scientist Poster Presentation Award

The Summit of Materials Science (SMS) is an international conference, 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. After the first conference, SMS 2016 was organized as a part of our centennial celebration. This time, IMR held the 3<sup>rd</sup> international general conference as SMS2018 on October 29<sup>th</sup>-30<sup>th</sup>.

The topics of this conference are “Spintronics and Computational Materials Science”, “Materials for Energy”, “Materials for Infrastructure and Analytical Science”, “Materials Physics”, “Chemistry and Electronics”, and “Collaborating Research Facilities (Nuclear Engineering/High Magnetic field/Quantum Beam/ Industry) ”.

Exciting invited talks were presented by prominent speakers representative of cutting-edge research in various fields. Moreover, IMR professors presented ongoing research activities. Participants were inspired by the contents of the presentations, and many spirited discussions have been observed throughout all sessions.

At the end of the conference, 72 poster presentations were given by burgeoning researchers and about 100 participants enjoyed the posters and fruitful discussions.



# ICC-IMR Activities in FY 2018

## Visiting Professors



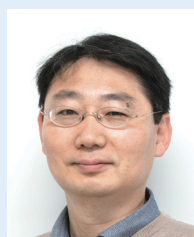
**Z. Qiu**  
Dalian University of Technology, China  
Dec. 25, 2018-March 15, 2019

"Spin Injection and Transport of Cr<sub>2</sub>O<sub>3</sub> Films" (Host: G.E.W. Bauer, IMR)



**A. Mukannan**  
Anna University, India  
Nov. 12, 2018-Jan. 30, 2019

"Defect Engineering in SiGe Alloy Semiconductor for Thermoelectric Applications" (Host: K. Fujiwara, IMR)



**K. Y. Choi**  
Chung-Ang University, Korea  
Jan. 4-Feb. 27, 2019

"Searching for a Kitaev Spin liquid in  $\alpha$ -Ru<sub>1-x</sub>Ir<sub>x</sub>Cl<sub>3</sub>" (Host: H. Nojiri, IMR)



**M. A.-H. Gepreel**  
Egypt-Japan University of Science and Technology (E-JUST), Egypt  
Feb. 1-March 8, 2019

"Advanced Characterization of New High Entropy Alloys That Show Stress-Induced Martensitic Transformation" (Host: A. Chiba, IMR)

## Research Project

### Quantum Matter Research under Extreme Conditions-Networking of Advanced Multiple Tools (2018-2020)

PI: J. Chang, Univ. of Zürich and H. Nojiri, IMR

## International Workshop

### The 10th International Workshop on Crystalline Silicon for Solar Cells (CSSC10), Apr. 8-11, 2018

Organizer: K. Fujiwara, IMR

### KINKEN-KIST Joint Symposium 2018, July 4-5, 2018

Organizer: K. Takahashi, IMR

### 13th International Workshop on Biomaterials in Interface Science, Aug. 2-3, 2018

Organizer: H. Kato, IMR

### Summit of Materials Science (SMS2018), Oct. 29-30, 2018

Organizer: K. Takahashi, IMR

### 4th Intensive Discussion on Crystal Growth of Nitride Semiconductors (IDGN-4), Nov. 19-20, 2018

Organizer: T. Matsuoka, IMR

### International Workshop on Science at X-ray Free Electron Lasers: Chemical Physics and Materials Science in Extreme, Feb. 13-14, 2019

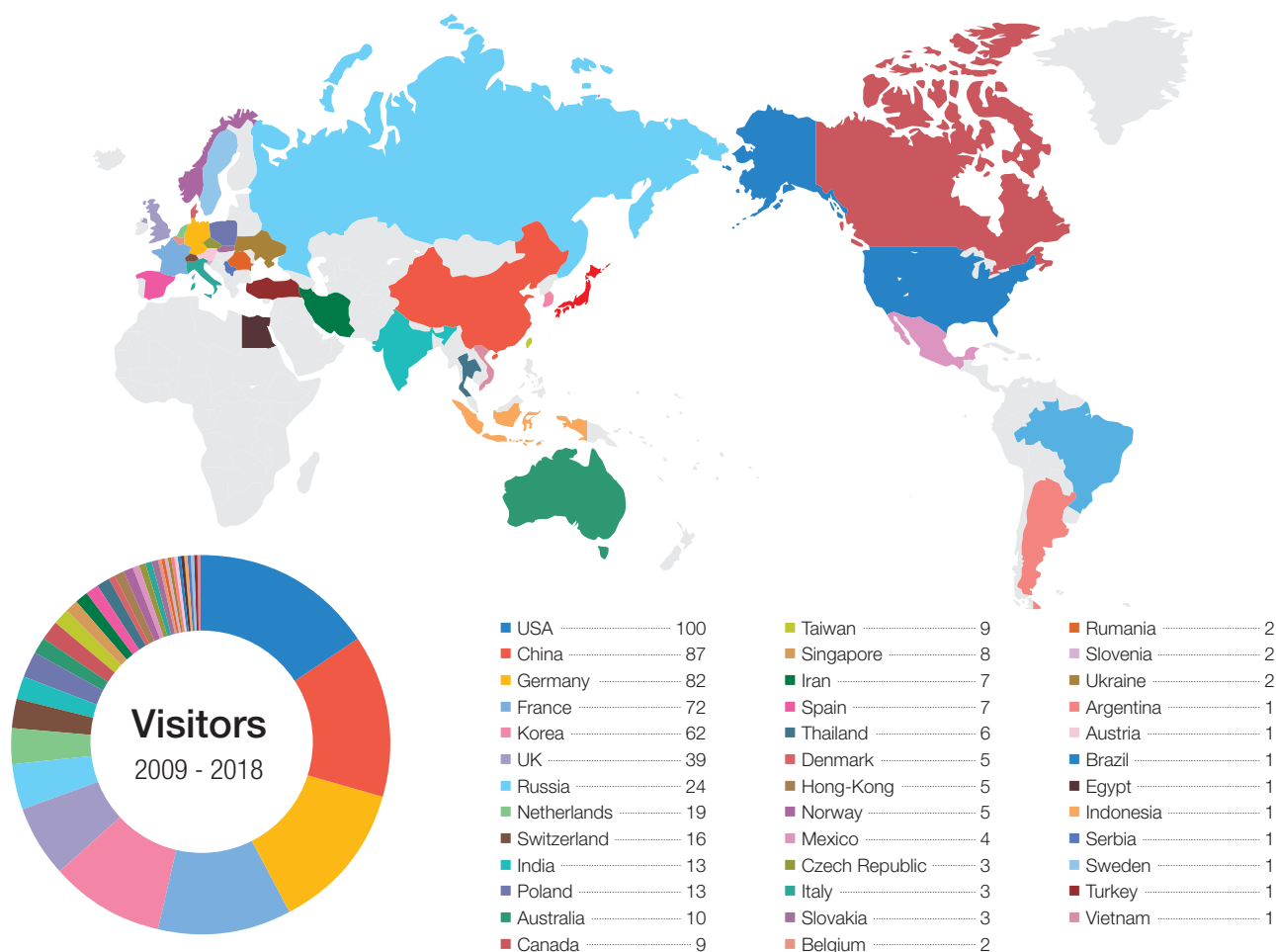
Organizer: H. Nojiri, IMR

### IMR-HZB Workshop on Material and Quantum-Beam Sciences, March 25-26, 2019

Organizer: M. Fujita, IMR



## Visitors supported by ICC-Programs



## 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 58 visiting professors and conducted 21 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 five different programs:

- 1 **International Integrated Project Research**
- 2 **Visiting Professorships**
- 3 **International Workshops**
- 4 **Fellowships for Young Researchers and PhD Students**
- 5 **Material Transfer Program**

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

### Contact Information

Website : <http://www.icc-imr.imr.tohoku.ac.jp/>  
 E-mail : [icc-imr@imr.tohoku.ac.jp](mailto:icc-imr@imr.tohoku.ac.jp)  
 Address : International Collaboration Center,  
 Institute for Materials Research, Tohoku University  
 Katahira 2-1-1, Sendai 980-8577, Japan  
 Tel/Fax : +81-22-215-2019

### On the Cover

Three dimensional atom probe: able to characterize three-dimensional element distributions in atomic-scale in various materials.  
 Photo Credit: Furuhabara Laboratory, IMR

