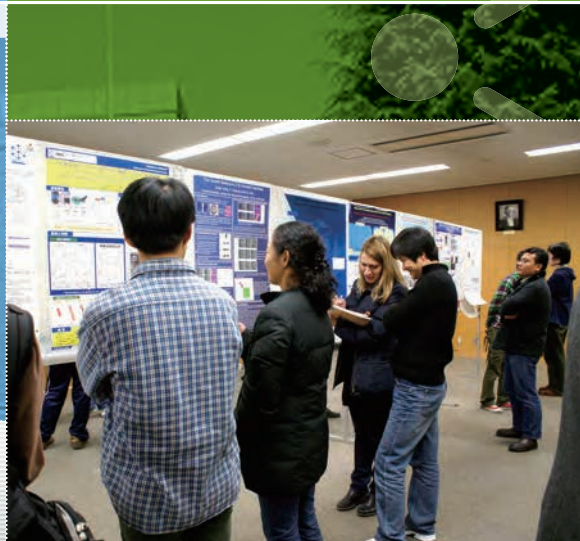




ICC-IMR news No.2

International Collaboration Center

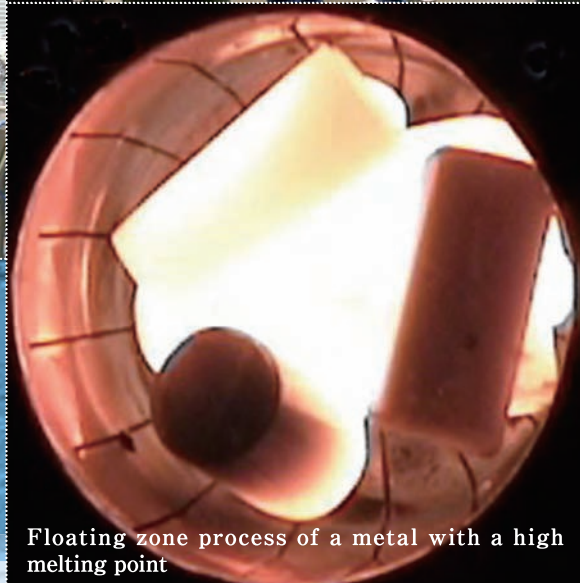
Institute for Materials Research, Tohoku University



Poster Session at the 120 IMR Symposium



Molecular-Beam Epitaxial Growth Instrument



Floating zone process of a metal with a high melting point

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 24 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 19 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
- 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.

Comments from a Visitor

Arndt Remhof, EMPA, Swiss Federal Laboratories for
Materials Science and Research

Aug.25-Oct.16, 2010

Research Proposal : Lithium Fast-Ion Conduction in Complex Hydrides



The IMR visiting program was a great opportunity to strengthen the existing collaboration between IMR scientists and to build new ones. It also gave me an interesting insight into the rich Japanese culture. The scientific results of the visit have already been presented on international conferences and will be published in peer-reviewed journals.

We studied LiBH_4 and LiBH_4 based compounds in view of their potential applications as hydrogen storage materials and as fast Li-ion conductors. Therefore we investigated the electrical conductivity of pure LiBH_4 as well as of the LiBH_4 based complex hydrides $\text{Li}_2(\text{BH}_4)(\text{NH}_2)$ and $\text{Li}_4(\text{BH}_4)(\text{NH}_2)_3$ in the solid as well as in the liquid state. The two (NH_2) - containing hydrides show lithium fast-ion conductivities

of about 1×10^{-4} S/cm at room temperature. After melting, the total ion conductivities of $\text{Li}_2(\text{BH}_4)(\text{NH}_2)$ and $\text{Li}_4(\text{BH}_4)(\text{NH}_2)_3$ increase up to 6×10^{-2} S/cm (378 K) and 2×10^{-1} S/cm (513 K), respectively.

We also investigated the hydrogen release reactions of LiBH_4 . In the past, different routes were suggested and different intermediate products have been found experimentally. We could show that by carefully choosing parameters such as temperature and applied hydrogen pressure, the preferred decomposition route may be selected. The highly motivated scientist and the excellent instrumentation at IMR made the program a great success.

ICC-IMR Programs

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.

Recent Progress on Spectroscopies and High- T_c Superconductors, Aug. 9-11, 2010, Organizer Masaki Fujita (IMR)

In this workshop, we select the cuprate and iron-based high- T_c superconductors as main target systems to discuss the prospect of future development in the quantum beam spectroscopy. Participants were 90 scientists and students, including 20 from abroad. Various views among experimental and theoretical studies were exchanged. For example, we discussed the multi-structure of the electronic states in the real, momentum and energy spaces in cuprate superconductor studied by neutron, X-ray, Raman, photoemission, STM/STS, NMR, and mu-SR. We confirmed the importance of complementary use of quantum beam spectroscopy to clarify the peculiar charge and spin dynamics.



KINKEN WAKATE: 7th Materials Science School for Young Scientists, Dec. 2-3, 2010, Sendai, Japan, Organizer Y. Nagai and H. Abe (IMR)

KINKEN WAKATE on "Challenge of Radiation for Advanced Materials Science" was held with wide range of young researchers including 91 COE fellows and research assistants, which was one and a half times as many compared to the last year. The lecturers, Dr. R.E. Stoller (ORNL), Prof. Yamana (Kyoto Univ.), Dr. P. Garin (CEA) and Prof. Yasuda (Kobe Univ.) gave presentations entitled "***Modeling radiation-induced microstructural evolution: different phenomena at different length and time scales***", "***Importance of advanced material research and heavy element chemistry for the successful use of nuclear energy in the future***", "***Nuclear fusion energy and its developments***" and "***Electron-irradiation-induced phase transformations by TEM***". The discussion during the lectures as well as poster sessions were exciting and stimulus. We appreciate all participants for helping make this school a great success.



ICC-IMR Activities in FY2010

Research Projects

Development of IMR Neutron Spectrometer for Novel Material Science in J-PARC (FY2010-2011)

PI: L-P. Regnault (ILL-Institut Laue-Langevin, France) and K. Ohyama (Metal Physics with Quantum Beam Spectroscopy, IMR)

Lithium Fast-Ion Conduction in Complex Hydrides (FY2010-2011)

PI: A. Remhof(EMPA - Swiss Federal Laboratory for Materials Testing and Research, Switzerland) and S. Orimo (Hydrogen Functional Material, IMR)

Structural and Chemical Analysis on Doped Ceramics by Transmission Electron (FY2010-2011)

PI: T. Epicier(INSA de Lyon and CNRS, France) and T. J. Konno(Advanced Analysis of Material, IMR)

Development of a Compact Pulsed Magnet for High-Field Magneto-optical Studies of Carrier and Exciton Dynamics in Nanostructures (FY2010-2011)

PI: J. Kono(Rice University, USA) and H. Nojiri(Magnetism Division, IMR)

Visiting Professors

C. Hao, Fudan University, China, June 15- Sep.14, 2010

"Theoretical Study on Electron Transport"

T. Epicier, INSA de Lyon and CNRS, France, July 10- Aug.9, 2010

"Development of Quantitative STEM Analysis"

A. Remhof, EMPA-Swiss Federal Laboratory for Materials Testing and Research, Switzerland, Aug.25- Oct.16, 2010

"Lithium Fast-ionic Conductivity in Complex Hydrides"

B. Shen, Ningbo Institute of Materials Technology and Engineering, Chinese Academy of Sciences, China, Oct.1- Dec.26, 2010

"Fe-based Nanocrystalline Soft-magnetic Alloys with High B_s and High Curie Temperature"

Y. In-Keun, Changwan National University, Korea, Oct.1- Dec.31, 2010

"Feasibility Study of a Toroid-type HTS SMES Application to Power Quality Enhancement using Power-Hardware-in-the-Loop Simulation"

V. Garcia, National Polytechnic Institute, Mexico, Jan.1- March 31, 2011

"Ceria-based Films Prepared by Laser CVD"

Workshops

The 5th International Workshop on BIO and AMORPHOUS Materials, Aug. 9-10, 2010

Recent Progress on Spectroscopies and High- T_c Superconductors, Aug. 9-11, 2010

7th Material Science School for Young Scientists (KINKEN-WAKATE2010)

"Challenge of Radiation for Advanced Materials Science", Dec. 2-3, 2010

The 5th General Meeting of ACCMS-VO, Dec.10-12, 2010

ICC-IMR Workshop on Novel Material Science using Polarized Neutron, Jan. 6-8, 2011.

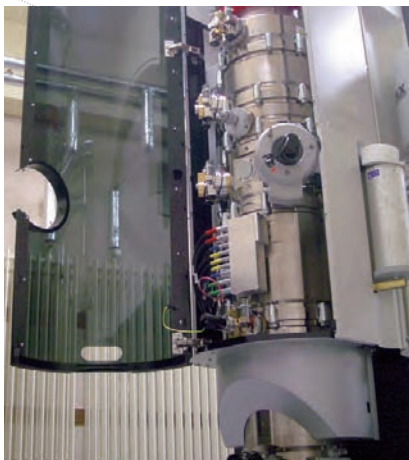
Structural and Chemical Analysis on Doped Ceramics by Transmission Electron Microscopy

Principle investigators: T. J. Konno (Advanced Analytical Laboratory, IMR) and T. Epicier (INSA Lyon, France)

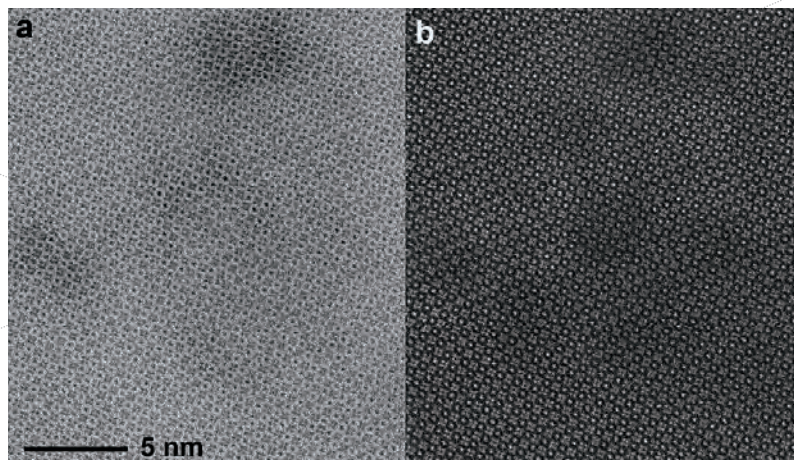
Three Collaborators: K. Sato (IMR), G. Boulon (Lyon University), F. Tournus (INSA Lyon)

In the most of complex oxides, metallic and oxygen atoms occupy several crystallographically non-equivalent sites. The electronic states of the impurities are thus expected to have their origin not only in the nature of impurity atoms themselves, but also in the character and symmetry of the substituted site itself. By employing so-called wave-front reconstruction techniques on high-resolution TEM images taken under Cs-corrected conditions, as well as Z-contrasts in atomically resolved STEM, it is then hoped that we will be able to clarify the favorable sites for dopant atoms directly.

The oxide materials to be investigated in the current proposal includes YAG (yttrium-aluminum garnet) doped with RE (rare-earth), such as cerium or ytterbium, prepared either in a single or polycrystalline form in INSA Lyon. We use FEI Titan 80-300 (S)TEM installed in Tohoku University as a major characterization tool, and the images taken will be analyzed quantitatively with a help of several simulation techniques, including the one developed in INSA Lyon. The joint research has contributed much to strengthen the research in each site as well as the establishment of the international research team.



Cs-corrected TEM



Atomic resolution STEM images of YAG: (a) BF, (b) HAADF

Publications

- 1) W. Zhao et al., Evidence of the inhomogeneous Ce^{3+} distribution across grain boundaries in transparent polycrystalline Ce^{3+} doped $(\text{Gd}, \text{Y})_3\text{Al}_5\text{O}_{12}$ garnet optical ceramics, *J. J. Appl. Phys.* **49** (2010) 022602.
- 2) K. Sato et al., Three-dimensional shapes and distribution of FePd nanoparticles observed by electron tomography using high-angle annular dark field scanning transmission electron microscopy, *J. Appl. Phys.* **107** (2010) 024304.



Visitors supported by ICC-Programs (Except workshop participants) Graph on the world map

Korea(10), USA(9), China(8), France(5), Russia(2), Switzerland(1), UK(2), Germany(1),
India(1), Mexico(1), Netherlands(1), Singapore(1), Taiwan(1), Viêt Nam(1)

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