CRDAM

Cooperative Research and Development Center
for Advanced Materials

Research

Institute for Materials Research (IMR)
Tohoku University
Cooperative Research and Development Center for
Advanced Materials Institute for Materials Research

TOHOKU
UNIVERSITY

Message

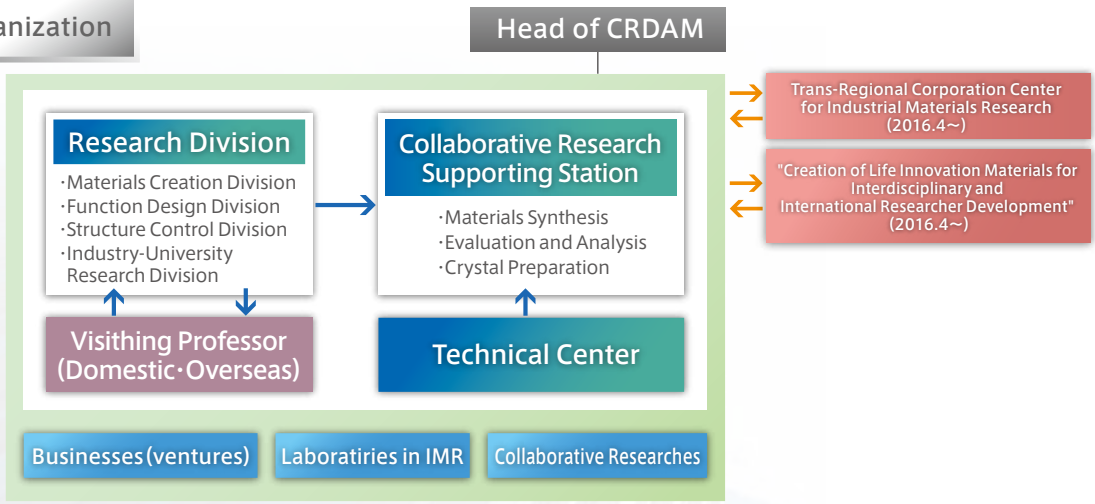
Cooperative Research and Development Center
for Advanced Materials
Head Naoya MASAHASHI

In 1987, the Institute for Materials Research (IMR) was reorganized into a national collaborative research institute, and founded "Laboratory for Development Research of Advanced Materials (LDRAM)" to aim for development of new materials contributing to technological innovations in the 21st century. The center was renamed as "Advanced Research Center of Metallic Glasses (ARCMG)" in 2005, and there was extensive progress on bulk metallic glasses and nanocrystalline soft magnetic materials. In 2013, the center was renamed again as "Cooperative Research and Development Center for Advanced Materials (CRDAM)", and improved the support system by arranging the staff and equipment. Meanwhile, the center has contributed to the development of material science community by releasing equipment for the material production, evaluation and analysis, to the material scientists. In 2004, the Japanese national university became an independent administrative agency under a self-responsible management, and each university aims for activities based on its special characteristics. Turning attention to research, the role of the center has been increasing, because collaboration with related researchers has been recognized as an effective approach for innovation research. In 2018, Global Institute for Materials Research Tohoku (GIMRT) of IMR was certified as "the International Joint Usage/Research Center" in Materials Science by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). IMR welcomes visitors from home and abroad, and conducts collaborative research by providing knowledge of material science and laboratory equipment.
We, all the staff members of CRDAM, also keep contributing to progress of materials science research and providing further support for the research community in collaboration with other research divisions/centers in IMR. Your understanding, support and advice for development of CRDAM are sincerely appreciated.

Philosophy and Purpose

The philosophy of CRDAM is to develop new materials to support the innovation of the 21st century, aiming to establish basic principles and process technologies for material design and fabrication of superior new materials. Furthermore, we will work on the development of seeds in materials, process, and evaluation technology created by IMR in collaboration with other research divisions in IMR. This philosophy and purpose are inherited from the foundation of the center.

Organization



ResearchSubjects

Research Division

Materials Creation Division

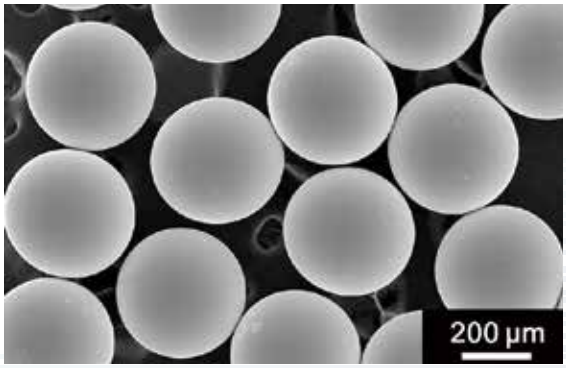
▲Metal forming by roll grooving method

The purpose of this division is to fabricate and evaluate advanced metallic materials for structural, electrical, biomedical, environmental, corrosion-resistant and magnetic etc through alloy design and microstructural and/or crystal structural controlling by applying thermo-mechanical treatment based on phase stability. We establish the mechanism of the properties and provide guideline for a design of advanced material through material characterization by using analysis equipment in IMR and theoretical consideration under collaboration with other university or research institute.

Professor N. Masahashi	[Keywords] Nonferrous metallic materials, Material processing and treatment
Associate Prof. S. Semboshi	[Keywords] Microstructural control, Nonferrous metals
Assistant Prof. Y. Zhang	[Keywords] Soft magnetic, Amorphous, Nanocrystalline

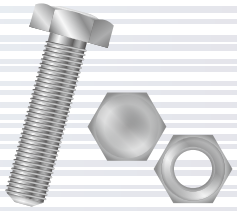
Function Design Division

In this research division, exploratory and developmental researches for new functional materials are carried out. Our aim is to propose new materials based on the metallic alloys and compounds, having excellent functions on their mechanical, electrical and magnetic properties, such as nano-crystalline magnetic materials, electronic materials, magnetic shape memory alloys, environmental materials. We are dealing with manufacturing processes of new advanced materials with micon or nano based-structure.These materials are produced by manipulating atomic arrangement with using vapor condensation, rapid-solidification and solid-state-reaction techniques.



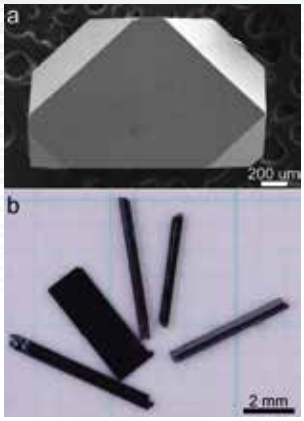
▲Mono-sized $Fe_{76}Si_9B_{10}P_5$ metallic glassy particles prepared by container-less solidification process

Associate Prof. R. Umetsu	[Keywords] Magnetism, Magnetic metal and alloy, Solid state physics
Assistant Prof. N. Yodoshi	[Keywords] Non-equilibrium material, Powder metallurgy, Materials processing
Assistant Prof. Y. Kimura	[Keywords] Shape memory alloys, Martensitic transformation, Ti-Ni based alloys



Research Division

Structure Control Division



▲Single crystals grown by the flux method, (a) ITO and (b) SmB_6

This group is actively engaged in the improvement of bulk single crystal high-functional compounds through the research and development of crystal growth techniques from liquid, gas and solid phases. By assessing the properties of the target materials including metals, semiconductors, oxides, and halides, an appropriate single crystal growth method is selected from Czochralski-, Bridgman-, floating zone-, and flux growth methods. The appropriate selection of growth method and optimal growth conditions will lead to high quality crystals. In addition, using effective simulation methods and powerful computer systems installed at the Institute for Materials Research, Tohoku University, the group aims to develop a thorough understanding of the atomic-scale chemical and physical properties of various complex materials in order to accelerate the realization of novel materials, hand-in-hand with experiment, and propose these materials for various applications.

Associate Prof. R. Belosludov
[Keywords] Energy related materials, Computational material design, Physical chemistry

Industry-University Research Division

Purpose of Joint Industry-University Research Division is to introduce academic output found in Cooperative Research and Development Center for Advanced Materials to industries, with the aim of applying such output to society. It is expected to create fruitful success in academia-industrial cooperation by sharing social need and expectation for university collected at Trans-Regional Corporation Center for Industrial Materials Research, with the visiting collaborative researchers. Further, the Division utilizes the actual experiences, educating materials scientists and researchers in enterprises and exhibiting to appeal research outputs, to collaborative activities in IMR.

Professor N. Masahashi	[Keywords] Nonferrous metallic materials, Material processing and treatment
Professor T. Furuhara	[Keywords] Microstructure control, Strengthening of metallic materials, Thermomechanical Processing, Surface hardening
Professor A. Chiba	[Keywords] Hot forging, High temperature deformation, Sintering, Phase transformation
Associate Prof. S. Semboshi	[Keywords] Microstructural control, Nonferrous metals

▲Seminar for industry personnel held in Osaka

We have three collaborative research supporting stations; Materials Synthesis, Performance Evaluation, and Crystal Making. These stations are equipped with various experiment facilities and support research works within CRDAM and joint researches with the outside of CRDAM.

Materials Synthesis Station

To produce various kinds of materials

- Electron Beam Lithography & Ion Milling System
- Multi-Target Reactive Sputtering (Ion Beam Sputtering)
- Reflection High Energy Electron Diffraction System
- Multi-Ion Vapor Deposition System
- Multi-Layer Chemical Vapor Deposition Reactor
- 3 Cathode-Equipped Compact Sputtering System
- Hot Deformation Simulator
- Spark Plasma Sintering SPS-1050
- Spark Plasma Sintering SPS-3.20 Mark IV
- Electron-Beam Melting Furnace
- Gas-Atomization
- High Frequency Induction Tilt Casting
- Single Roll Melt Spinning


Spark Plasma Sintering SPS-3.20 Mark IV


Multi-Ion Vapor Deposition System


Gas-atomization


Single Roll Melt Spinning

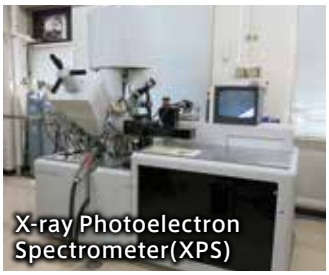
Collaborative Research Supporting Station

Evaluation and Analysis Station

To evaluate various states/properties of materials

- Magnetic Property Measurement Unit System
- X-ray Diffractometer (Micro Area Type)
- X-ray Diffractometer (Horizontal Sample Setting Type)
- X-ray Photoelectron Spectrometer(XPS)
- Field Emission Scanning Electron Microscope (FE-SEM)
- Field Emission Electron Probe Micro Analyzer (FE-EPMA)
- Scanning Electron Microscope (tungsten filament) (W-SEM)
- Superconducting Quantum Interference Device (SQUID) Magnetometer
- Instron Tensile Test
- Differencial Scanning Calorimetry (DSC)
- Conventional Type Thermal Analysis Measurement System (DTA, DSC, TMA)
- Multi-purpose X-ray Diffractometer
- Single Crystal X-ray Diffractometer
- Micro X-ray Diffractometer (Rotating Anode, Micro Area Type with 2D Detector)
- Vibrating Sample Magnetometer (VSM)
- Laue X-ray Back Scattering by Digital CCD Camera
- Seebeck Coefficient/Electrical Resistivity Measurement System


X-ray Diffractometer (Micro Area Type)


X-ray Photoelectron Spectrometer(XPS)


Field Emission Electron Probe Micro Analyzer (FE-EPMA)


Vibrating Sample Magnetometer (VSM)

Crystal Preparation Station

To prepare mother alloys or single crystals

- Solidification Control Equipment from Liquid Phase
- Crystal Growth Equipment with Horizontal Magnetic Field Application System
- Crystal Growth Equipment for Bridgman Method
- IR Image Furnace for Floating Zone Melting
- Electron-beam Furnace for Floating Zone Melting
- Crystal Growth Furnace with HF-inductive Heating System
- Tungsten Resistivity Element Furnace for Vacuum Heating
- High-frequency Induction Furnace
- High Temperature Floating Zone Furnace for Composite Ceramics
- Conventional Type Arc-melting Furnace
- Arc-melting Furnace with Horizontal-traveling Hearth
- Programmable Furnace with MoSi2 Heater
- Programmable Furnace for Flux Growth
- μ-PD Apparatus for Smaller-diameter Crystal Growth


Solidification Control Equipment from Liquid Phase


IR Image Furnace for Floating Zone Melting


High-frequency Induction Furnace


Conventional Type Arc-melting Furnace

Procedures for Collaborative researches

Guideline for applicants

Collaborative research proposals using the equipment and the devices, etc. set up in this center are invited from researchers working on design and development of various new materials. Higher priority will be given to joint collaborative research in the process of selection. In collaborative research, proposals that do not need the use of equipment is also possible. Moreover, among the approved proposals, one or two that report excellent results will be selected by referees and awarded every year.

Researchers who can apply for the collaborative research

Researchers, who can apply, should be members with national, public, and private universities, and technical colleges, and researchers in independent administrative agencies, and public corporations, all in Japan. The technical service members, the graduate course students, graduate students in a technical collage and undergraduate students (a guidance teacher must be clear) could be included in the research organization

Application Process

Using facilities equipment

Contact with equipment manager to make arrangements research task and period.

Check the list of the experimental equipment

Collaboration with the CRDAM researchers

Team

Contact with CRDAM research staff to make arrangements research task and period.

Check the list of the Research Division of CRDAM

Research Proposals

Apply for collaborative research in Web Support for collaborative research.

A reference Research cooperation Section, Institute for Materials Research
TEL.022-215-2183 ✉imr-kenkyo@imr.tohoku.ac.jp

Acceptance or rejection

The director of CRDAM decides the acceptance or rejection through the adoption technical committee at CRDAM and the collaborative research committee. The results will be notified directly to the applicants in the end of March. In the selection process we will give higher priority to the applications which agree with the purpose and the subjects at CRDAM.

Period for the collaborative research

From 1st April to the end of March, next year

Report and research results

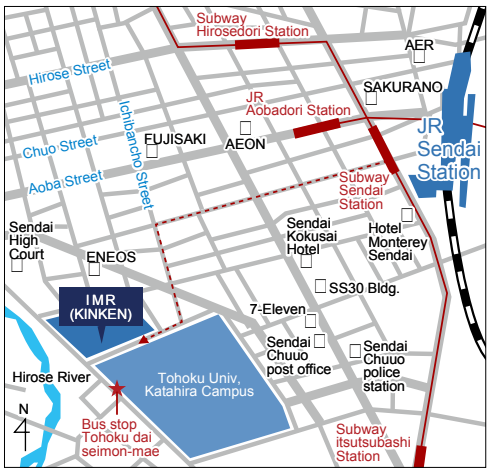
Early April, next year

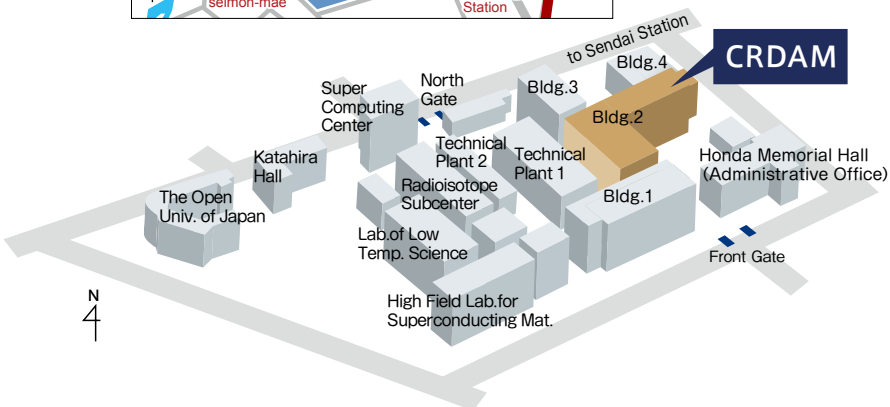
Submit a collaborative research report and research results included oral presentations and papers etc. in Web Support for collaborative research.

On your actual application, please refer the following website.
IMR collaborative research (https://imr-kyodo.imr.tohoku.ac.jp/?lang=en)
CRDAM collaborative research (http://www.crdam.imr.tohoku.ac.jp/en/index-en.html).

History

The Head	Year	
Prof. T. Masumoto (1987-1991)	1987	"Laboratory for Developmental Research of Advanced Materials (LDRAM)" was founded in IMR.
	1988	Four divisions of "Materials Synthesis", "Materials Quality Control", "Evaluation and Analysis", and "Development of Technology" were organized.
	1991	Two divisions, "Micron-Scale Controlled Materials" and "Nano-Structured Materials", were organized.
Prof. Y. Nishina (1992-1993)	1992	"Developmental Division" was organized.
		Visiting Professors System was introduced.
Prof. T. Masumoto (1994-1995)		
Prof. H. Fujimori (1996-1997)	1996	Reorganized to a research laboratory from a research support organization.
		"Materials Design and Development", "Materials Functions Search", "Project Research Division" ,"Technical Service Division" were organized.
Prof. T. Hirai (1998-1999)	1998	Introduction of Responsibility Laboratory System.
Prof. T. Fukuda (2000-2001)	2000	Renamed to "Laboratory for Advanced Materials (LAM)".
		Reorganized to "Fundamental Research Division", "Joint Industry-University Research Division" and "Research Station".
Prof. S. Hanada (2002-2004)	2002	"Applied Research Division" and "Visiting Professors Division" were organized.
	2004	External Evaluation
Prof. A. Inoue (2005-2006)	2005	Renamed to "Advanced Research Center of Metallic Glasses (AMCMG)".
		"Metallic Glasses Division" and "Advanced Materials Division" were organized.
Prof. T. Goto (2007-2011)	2007	"Bulk Crystal Materials of Tailored Structure" was organized.
	2009	Certified as Joint Usage/Research Center for materials science.
Prof. A. Makino (2012-2014)	2013	Renamed as "Cooperative Research and Development Center for Advanced Materials (CRDAM)".
		External Evaluation
Prof. T. Furuhara (2015-2018)	2016	Reorganized to "Materials Creation Division", "Function Design Division", "Structure Control Division", "Industry-University Research Division" and "Collaborative Research Supporting Station"
	2018	Certified as Joint Usage/Research Center for materials science.
		External Evaluation
Prof. N. Masahashi (2019-)		





From Tokyo Station

JR Tokyo Station - > JR(Tohoku-Shinkansen, about 2 hours) - >
JR Sendai Station 3F - > 1F Taxi Station -> Taxi(10 min) - >
Institute for Materials Research

From Sendai Station

1F west exit - > on foot(about 15 min) -> Institute for Materials Research
1F west exist bus terminal number 11 -> via Otamayabashi
- go to Yagiyama-Zoo
- go to Mukaiyama-High School
- go to Yagiyama-Minami-Danchi
- go to Midorigaoka 3-tyoume
- > Tohoku University Seimon-Mae
(Bus(10min), 180yen, on foot(5 min))

From Narita Airport

Narita Airport -> Narita Express(50 min) -> JR Tokyo Station ->
JR(Tohoku-Shinkansen, about 2 hours) - > JR Sendai Station 3F - >
1F Taxi Station -> Taxi(10 min) - > Institute for Materials Research

From Kansai Airport

Kansai Airport -> Airplane(1.5 hours) -> Sendai Airport ->
Sendai Airport Line(25 min) -> JR Sendai Station -> Taxi(10 min) - >
Institute for Materials Research

From Sendai Airport

Sendai Airport -> Sendai Airport Line(25 min) -> JR Sendai Station ->
Taxi(10 min) - > Institute for Materials Research

CRDAM
Research
Cooperative Research and Development Center for Advanced Materials Institute for Materials Research (IMR) Tohoku University

E-mail: crdam@imr.tohoku.ac.jp
URL: http://www.crdam.imr.tohoku.ac.jp
TEL.022-215-2371 FAX.022-215-2137
2-1-1 Katahira, Aoba-ku, Sendai, Miyagi 980-8577, JAPAN