



# CRDAM

Cooperative Research and Development Center  
for Advanced Materials



Institute for Materials Research (IMR)  
Tohoku University



TOHOKU  
UNIVERSITY



## Message

Cooperative Research and Development Center  
for Advanced Materials

Head **Tadashi FURUHARA**



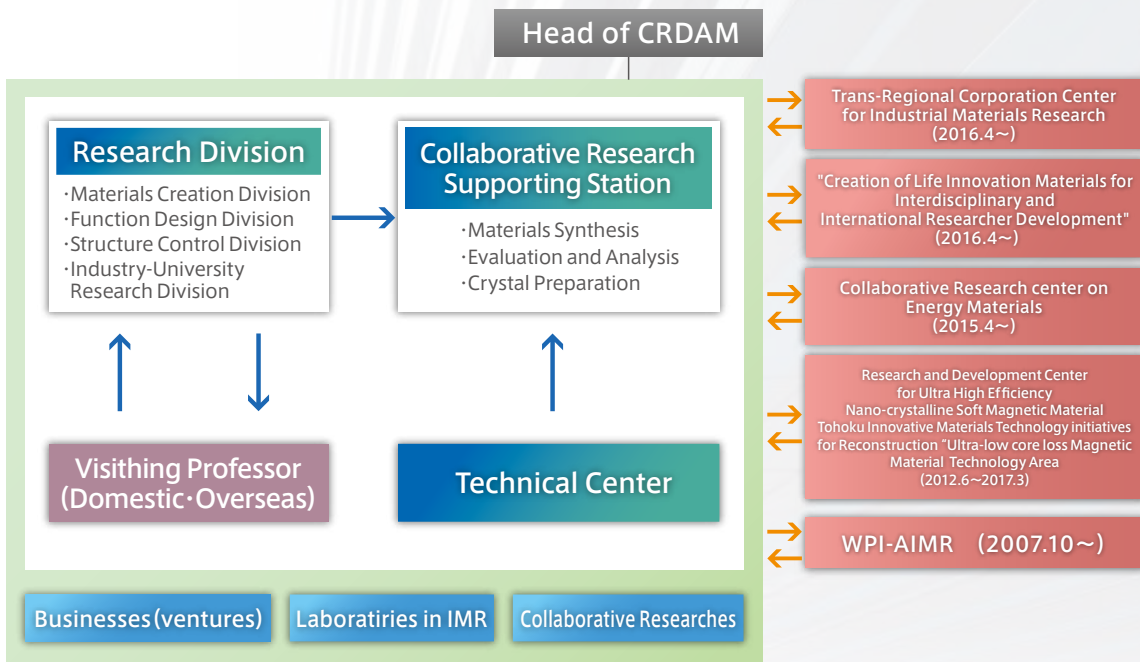
The Cooperative Research and Development Center for Advanced Materials (CRDAM) was originally founded as 'Laboratory for Developmental Research of Advanced Materials (LDRAM)' to aim for development of new materials for supporting technological innovations in the 21st century when the Institute for Materials Research (IMR) was reorganized into a national collaborative research institute in 1987. Since then, our center has been carrying world-leading materials research and providing supports in wide range of materials production and characterization of materials to research communities in Japan. After renamed as 'Advanced Research Center of Metallic Glasses (ARCMG)' in 2005, in particular, there was extensive progress in research on bulk metallic glasses and recent development of nanocrystalline soft magnetic materials. The center was renamed as CRDAM in 2014 and, now in April of 2016, reorganized to a simpler structure for clarifying its purposes.

We, all the staff members of CRDAM, keep contributing to progress of materials science research and providing further and support for the research community worldwide in collaboration with other research divisions/centers in IMR. Your understanding, support and advice for development of CRDAM are sincerely appreciated.

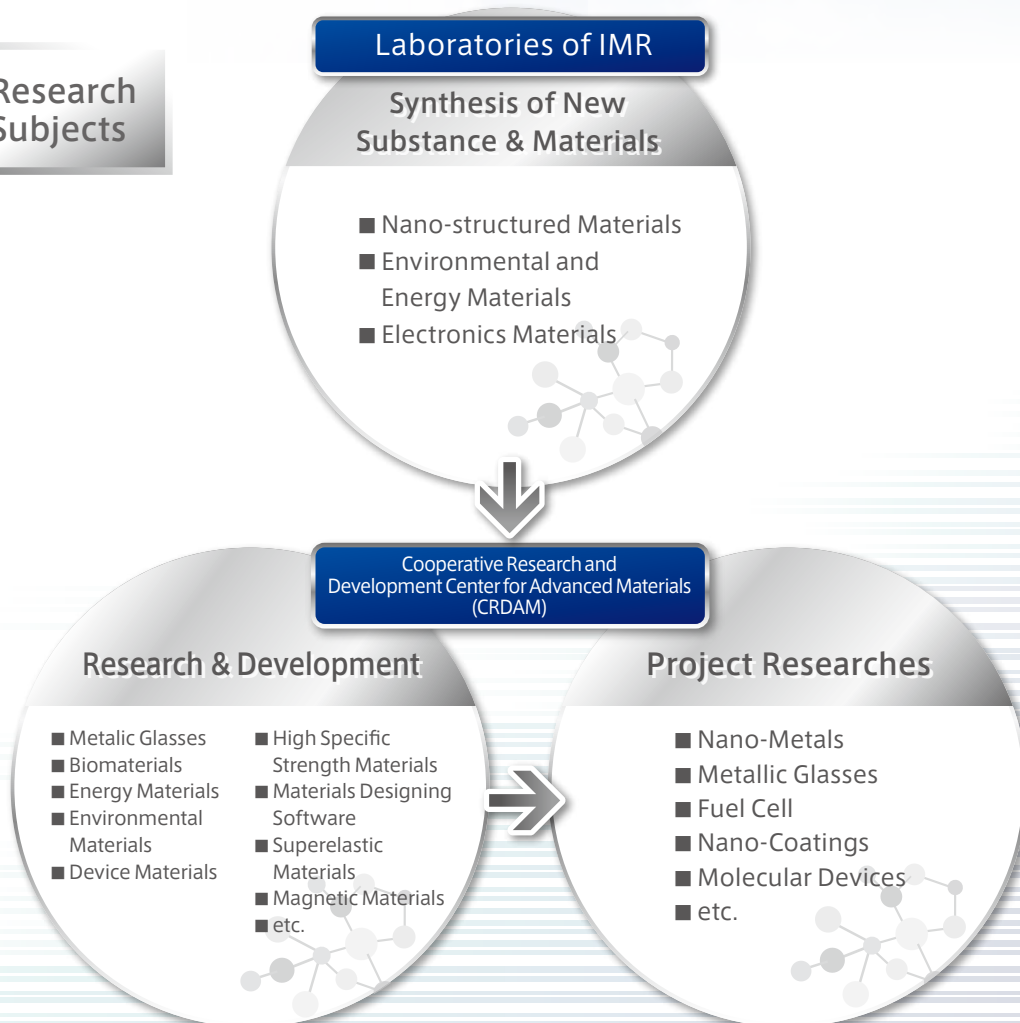
## Philosophy and Purpose

Underlying philosophy of the Cooperative Research and Development Center for Advanced Materials (CRDAM) is to find and establish fundamental principles and technology for synthesizing new materials and controlling exotic materials functions and developing new materials fabrication processes, and to seek for the possibility of applying them as multi-functional materials for high technology, such as energy saving, environmental and ecology, structural application, electronics and information, biomedical application, etc. Furthermore, the purpose of the center is creating and developing 'seeds' of new materials and processing/characterization technology, in collaboration with other research divisions in IMR. We are continuing our research by inheriting such a spirit over years since the foundation of the center as 'Laboratory for Developmental Research of Advanced Materials (LDRAM)'.

Organization



Research Subjects



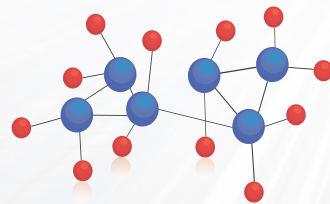
## Research Division

### Materials Creation Division

The mission of this division is to help the visiting scientists out of IMR to study new advanced materials through collaborative research in materials design, fabrication, characterization, and theoretical calculation. Various advanced materials such as amorphous, advanced crystals, quasi-crystals and nanocomposite with excellent and attractive properties could be fabricated and analyzed by using equipment installed in CRDAM. So far, numerous materials for magnetic, biomedical, corrosion resistant, environmental purification and energy conservations were produced and studied, which could contribute to developing new materials and materials science.

### 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 of the metallic alloys and compounds, having excellent functions on their mechanical, electrical, thermal and magnetic properties, such as nano-crystalline magnetic materials, electronic materials, magnetic shape memory materials, environmental materials. Furthermore, we study manufacturing processes of new advanced materials with micron- and/or nano-scale microstructure which are produced by manipulating atomic arrangement with using vapor condensation, rapid-solidification and solid-state-reaction techniques.



### Collaborative Research Supporting Station

In this collaborative research supporting station consists of three rooms, Materials Synthesis, Evaluation and Analysis, and Crystal Preparation. This station equipped with various experiment facilities, supports research work within CRDAM and joint researches with the outside of CRDAM.

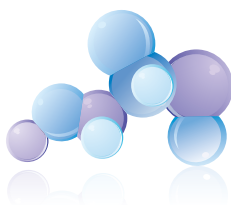


## Structure Control Division

This group is actively engaged in the improvement of bulk single crystals of 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 such as metals, semiconductors, oxides, and halides, and appropriate single crystal growth method is selected from Czochralski-, Bridgman-, floating zone-, flux growth methods. The appropriate selection of the growth method and growth under optimum conditions will permit to realize high quality crystals. In addition, this group aims to establish a new materials design software system so as to clarify physical properties and developing processes of various materials.

## Industry-University Research Division

Purpose of Joint Industry-University Research Division is to introduce academic output found in CRDAM to industries, with the aim of applying such output to society. It is expected to create fruitful success in academia-industrial cooperation by transferring social needs to University collected at Trans-Regional Corporation Center for Industrial Materials Research, which is established as a special unit within the Institute for Materials Research (IMR) in April 2016. Further, the Division applies the actual experiences as educating materials scientists and researchers in enterprises and exhibiting to appeal research outputs.



## Visiting Professors

There are two posts of visiting professors in CRDAM; one from domestic research institutes and the other one from overseas. We invite those who are actively working in the similar field to that in CRDAM. They study their subjects collaboratively with scholars in CRDAM.



## Material synthesis station

- 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
- Floating Zone Melting for High-Temperature Ceramic Composite
- Electrode Preparation System
- Hot deformation simulator
- Spark Plasma Sintering
- Electron-beam Melting Furnace
- gas-atomization
- high frequency induction tilt casting
- single roll melt spinning



Multi-Target Reactive Sputtering  
(Ion Beam Sputtering)



single roll melt spinning



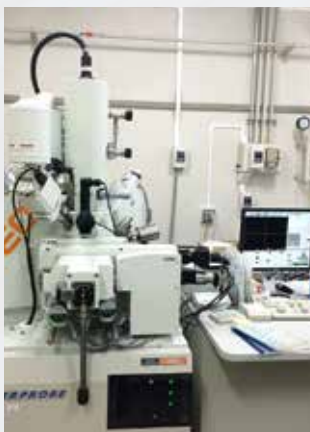
Multi-Ion Vapor Deposition System



gas-atomization

## Performance evaluation station

- Magnetic Property Measurement Unit System
- High-temperature Indentation machine
- X-ray Diffractometer (High Intensity Type)
- 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 MicroAnalyzer (FE-EPMA)
- Scanning Electron Microscope (tungsten filament) (W-SEM)
- Superconducting Quantum Interference Device(SQUID)
- Instron Tensile Test
- Differential Scanning Calorimetry
- 1.7MV Tandem Accelerator for Ion-beam Analysis and Materials Modification
- Transmission Electron Microscope(TEM)
- Multi-purpose X-ray Structural Analysis
- Single Crystal X-ray Diffraction
- Micro X-Ray Diffractometer( $\mu$ -XRD)
- Vibrating Sample Magnetometer (VSM)



Field Emission Electron Probe  
MicroAnalyzer (FE-EPMA)



1.7MV tandem accelerator for ion-beam  
analysis and materials modification



X-ray Photoelectron Spectrometer(XPS)



X-ray Diffractometer (Micro Area Type)

## Crystal making research station

- 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
- Conventional type arc-melting furnace
- Arc-melting furnace with horizontal-traveling hearth
- Programmable furnace with MoSi<sub>2</sub> heater
- Programmable furnace for flux growth
- $\mu$ -PD apparatus for smaller-diameter crystal growth



Solidification control equipment from liquid phase



IR Image Furnace for Floating Zone Melting



Electron-beam Furnace for Floating Zone Melting



Conventional type arc-melting furnace

### Procedures for Collaborative researches

#### Guidelines for applicants

The purpose of the collaborative researches in IMR is not simply sharing experimental equipment but achieving the targets based on research topics in common with applicants and the CRDAM. Applicants are scholars who develop and study new metallic glasses or various kinds of new materials, and are desired to collaborate with the Research Divisions of the CRDAM by using the equipments in the CRDAM. The collaborative researches without using the equipment's are also acceptable. Two applicants are commended for their excellent research results every June by the board of review.

#### Applicants

Researcher who belongs to national, public or private university, or full-time researcher who belongs to independent administrative agency or public research institute can apply as a representative researcher in the application. Academics, graduate students (advanced course students in the colleges of technology), and undergraduate students (Permission was obtained by his/her supervisor) can be organized as co-researchers in the group.

**Public advertisement** from the last ten days of a October to early December

※Since collaborative research is also publicly advertised by the research division of this Institute, please do not be confused.



Using Facilities equipment



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

Check the list of the experimental equipment



**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 ✉ [imrkyodo@imr.tohoku.ac.jp](mailto:imrkyodo@imr.tohoku.ac.jp)



Collaboration with the CRDAM researchers



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

Check the list of the Research Division of CRDAM



**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 February, next year



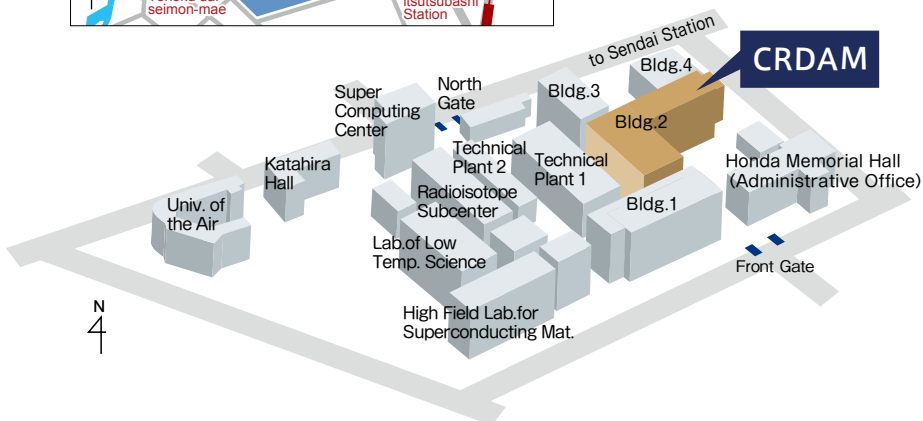
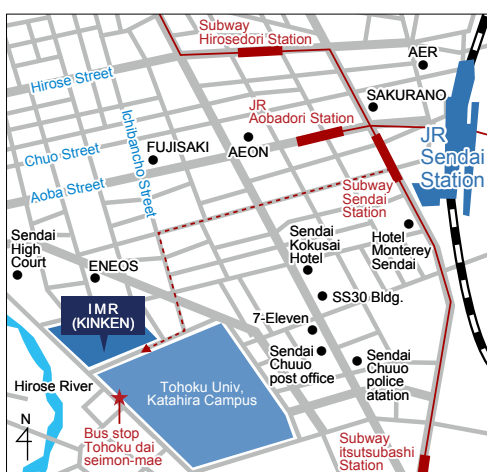
**Report and research results**

Early April, next year

Submit a collaborative research report and research results included oral presentations and papers in Web Support for collaborative research. Collaborative research other than the topics of research adopted in the adoption technical committee are not accepted.

# History

The Head	Year		Collaborative Research
Tsuyoshi MASUMOTO	1987	"Laboratory for Developmental Research of Advanced Materials (LDRAM) " was founded in IMR	
	1988	Four divisions. "materials Synthesis", "Materials Quality Control", "Evaluation and Analysis" and "Development of Technology" were organized.	
	1989		Collaborative Researches were started with IMR & extramural research institutes. "Joint Research" with a Private Company (YKK)
	1990		"Joint Research" with a Private Company (TOYOTA)
Yuichiro NISHINA	1991	Two divisions, "Micron-Scale Controlled Materials" and "Nano-Structured Materials" were organized.	NISHINA Project (3 years)
	1992	"Developmental Division" was organized. Visiting Professors System was Introduced.	
Tsuyoshi MASUMOTO	1993		
	1994		
Hiroyasu HUIJIMORI	1995		
	1996	Recognized to a research laboratory from an research support organization.	MAEDA Project (3 years), SUMIYAMA Project (5 years)
	1997	"Project Research Division", "Technical Serviced Division", "Materials Design and Development" and "Materials Functions Search" were organized.	
Toshio HIRAI	1998	Introduction of Responsibility Laboratory System.	
	1999		
Tsuguo FUKUDA	2000	Renamed to " Laboratory for Advanced Materials (LAM)" "Research Division", "Project Division" and "Development Division" was renamed and reorganized as "Fundamental Research Division", "Joint Industry university Research division" and "research station".	
	2001		INOUE Project (4 years), FUKUDA Project (3years)
Shuji HANADA	2002	"Applied Research Division" and "Visiting Professors Division" were organized.	
	2003		
	2004	External Evaluation	
Akihisa INOUE	2005	Renamed as "Advanced Research Center of Metallic Glasses", "Metallic Glasses division" and "Advanced materials Division" were organized.	Metallic Glasses - Inorganic Materials Joining Development Collaboration Research Project (5 years)
	2006		
Takashi GOTO	2007	"Bulk Crystal Materials of Tailored Structure" were organized.	RIMCOF/Tohoku Univ.Lab(4.5 years)
	2008		WPI-AIMR (10 years) Nedo Laboratory for Metallic Glass Research Collaboration and Promotion(3.5 years)
	2009		
	2010		Advanced Materials Development and Integration of Novel Structured Metallic and inorganic Materials (6years)
	2011		
Akihiro MAKINO	2012		Tohoku Innovative Materials Technology Initiatives for Reconstruction "Ultra-low Core Loss Magnetic Materials Technology Area (5years)
	2013	Renamed as "Cooperative Research and Development Center for Advanced materials" were organized.	
	2014		
Tadashi FURUHARA	2015		
	2016	Structure was re-organized into three research divisions, i.e., "Materials Creation", "Function Design", "Structure Control", "Industry-University Research Division", and "Collaborative Research Supporting Station"	



## ■ 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 exit 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(2 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

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