国立研究開発法人

産業技術総合研究所
中部センター

AIST Chubu, National Institute of Advanced Industrial Science and Technology (AIST)

Innovative Functional Materials Research Institute

Multi-Material Research Institute

GaN Advanced Device Open Innovation Laboratory

AIST

Create the Future, Collaborate Together

Greeting

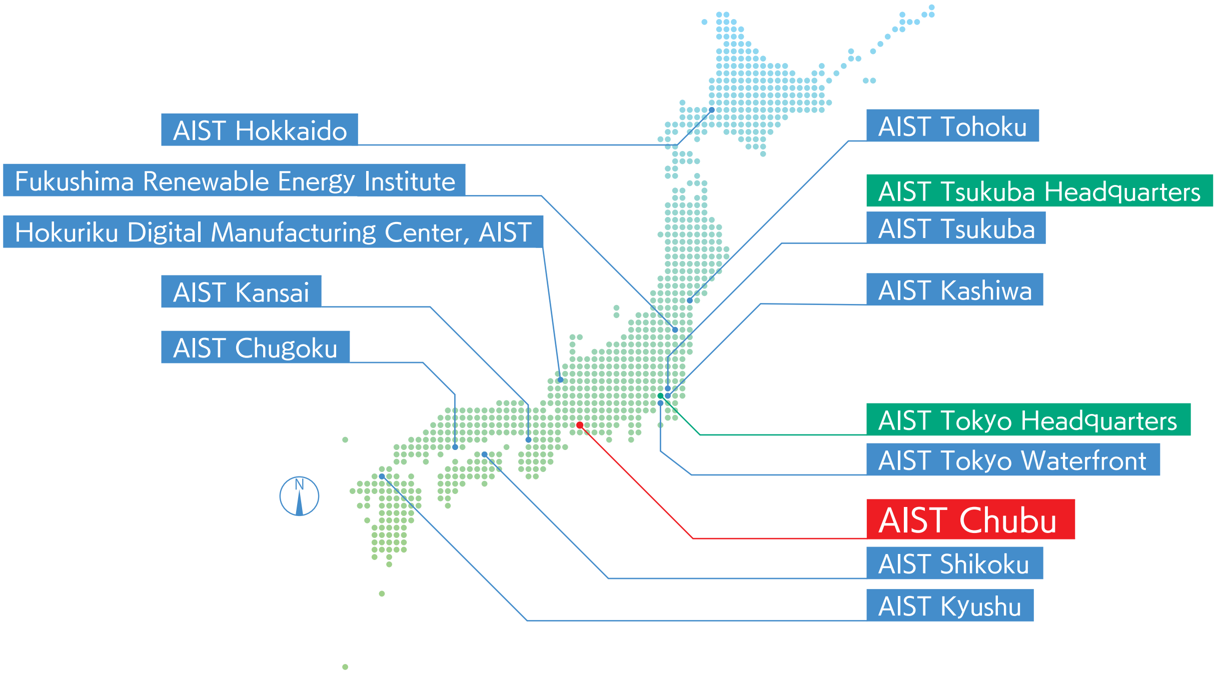
Director-General,
AIST Chubu,
Ichiro Matsubara

Of the many industrial sectors covered by the National Institute of Advanced Industrial Science and Technology, AIST Chubu promotes research and development focusing on materials such as ceramics and metals, as well as their respective manufacturing processes.
We promote the research and development of all functional parts and materials based on their potential for use in these research fields, and aim to lead the way in rapidly finding solutions to many issues facing society, and help strengthen industrial competitiveness through close exchange and cooperation aimed at implementing technologies in society.
We aim to play a role as the core of the national innovation ecosystem through 1) the steady execution of the action plan indicated in the Japanese government's "Toward Government Strategies for Enhancing Material Innovation Power", 2) the promotion of Regional Innovation, and 3) by contributing to future mobility.

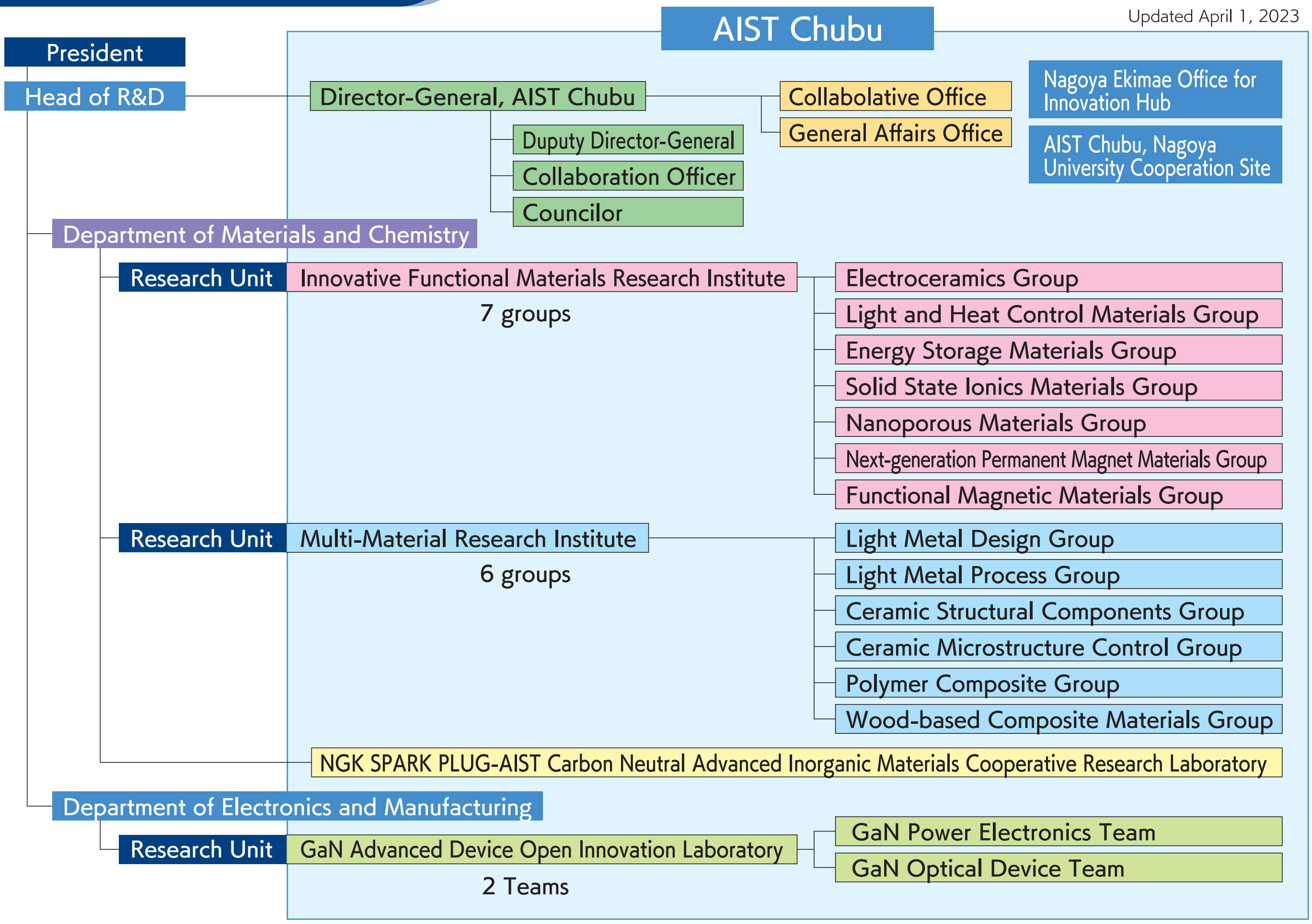
AIST Chubu

AIST Chubu is the only AIST research base in the Chubu region.
We are a comprehensive research base for materials-based manufacturing, focusing on functional materials technology in the Chubu region, the manufacturing industry's hub.
We have three research units, including the "Innovative Functional Materials Research Institute", "Multi-Material Research Institute", and "GaN Advanced Device Open Innovation Laboratory (GaN-OIL)". About 100 researchers engage in research activities every day.
In addition, AIST Chubu has collaborative research sections named after partner companies: the NGK SPARK PLUG-AIST Carbon Neutral Advanced Inorganic Materials Cooperative Research Laboratory.

Research Bases in AIST



Organizaion of AIST Chubu



Organization History

AIST was established as the Nagoya Industrial Technology Laboratory in 1952 with the goal of comprehensive research in different fields in terms of academic and technological fields and has continued through the following transitions.

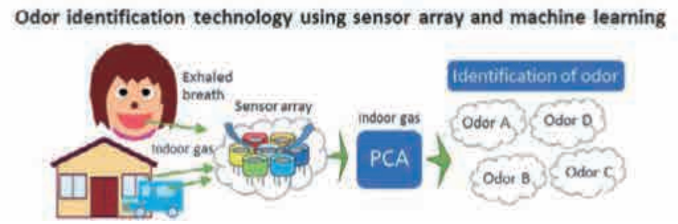
April, 1952	Integrated "Government of Mechanical Laboratory, Nagoya", "Ceramics Division of Government Chemical Industrial Research Institute, Tokyo", "Nagoya branch of Government Chemical Industrial Research Institute, Tokyo", and "Government Research Institute of Ceramics", established as Government Industrial Research Institute, Nagoya, Agency of Industrial Science and Technology. (6 research departments)
July, 1986	Reorganized all of research department. (name system is adopted)
October, 1993	Organization name changed to "Government Industrial Research Institute, Nagoya".
Janually, 2001	Due to the reorganization of ministries and agencies, it became "National Institute of Advanced Industrial Science and Technology" as a national research institute under the jurisdiction of the Ministry of Economy, Trade and Industry.
April, 2001	Established "National Institute of Advanced Industrial Science and Technology". (Ceramic Research Institute, Basic Materials Research Institute, Synergy Material Research Center)
November, 2001	Relocated from Kita ward to Moriyama ward in Nagoya city.
October, 2003	Established "Open Space Laboratory, Chubu".
April, 2004	Reorganized AIST Chubu. (3 units of "Advanced Manufacturing Research Institute", "Materials Research Institute for Sustainable Development" and "Research Institute of Instrumentation Frontier")
July, 2008	Established "Nagoya Ekimae Site".
March, 2012	Closed "Seto site".
April, 2014	Established "Green-Innovative Magnet Material Research Center".
April, 2015	Reorganized AIST Chubu. (2 units of "Inorganic Functional Materials Research Institute" and "Structural Materials Research Institute")
April, 2016	Established "Magnetic Powder Metallurgy Research Center" and "GaN Advanced Device Open Innovation Laboratory". Opened "AIST Chubu, Nagoya University Cooperation Site", and "Ishikawa site".
April, 2020	Reorganized AIST Chubu. ("Innovative Functional Materials Research Institute", "Multi-Material Research Institute", "Magnetic Powder Metallurgy Research Center" and "GaN Advanced Device Open Innovation Laboratory")
April, 2022	Established "Material Process Innovation Platform" Established "NGK SPARK PLUG – AIST Carbon Neutral Advanced Inorganic Materials Cooperative Research Laboratory"
April, 2023	Reorganized AIST Chubu. ("Innovative Functional Materials Research Institute", "Multi-Material Research Institute", and "GaN Advanced Device Open Innovation Laboratory")

Innovative Functional Materials Research Institute

We have started our new institute aiming for contributing to the fields of advanced mobility, energy, and environment, and so on. We focus our efforts on the development of the technologies such as controlling the micro-structure and interface of functional materials to realize innovative inorganic functional materials.

Development of high-sensitivity gas sensor by electronic property control of ceramic nanomaterials

Exhaled breath, indoor gas and odor identification technology with machine learning

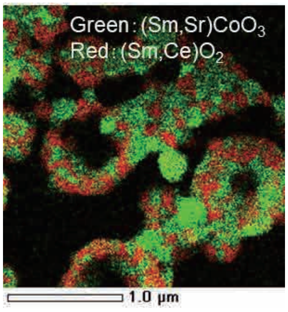


Electroceramics Group develops ceramic nanomaterials and electronic ceramic devices. Our research includes:

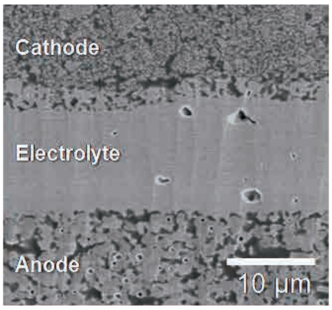
- Development of ceramic nanomaterials with aqueous solution processes
- Development of platinum-substituting high-temperature conductive oxide
- Development of "bulk-response type" gas sensor materials
- Development of gas sensors for VOCs, exhaled breath, skin gas, indoor gas, etc.
- Development of odor identification technology using sensor array and machine learning
- Development and commercialization of thermoelectric power generation modules

Ultra-high efficiency energy conversion electrochemical device using innovative sintering technology

In order to realize solid oxide fuel cell (SOFC) and protonic ceramic fuel cell (PCFC), which are energy and matter conversion systems with high efficiency, we are developing new solid state ionics materials such as nanocomposite electrodes, and innovative fabrication processes such as low temperature sintering for electrolytes.



Nanocomposite electrode with 10 nm in diameter

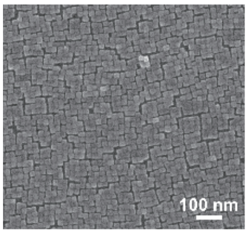


PCFC electrolyte thin-film sintered at lower temperatures

Development of next-generation energy storage materials using ceramic materials and processes

Energy Storage Materials Group promotes research and development on novel ceramic materials, process technologies, characterization technologies, and numerical simulation to realize next-generation energy storage devices such as all-solid-state batteries and ceramic capacitors, which are expected to be applied to mobility systems and IoT devices.

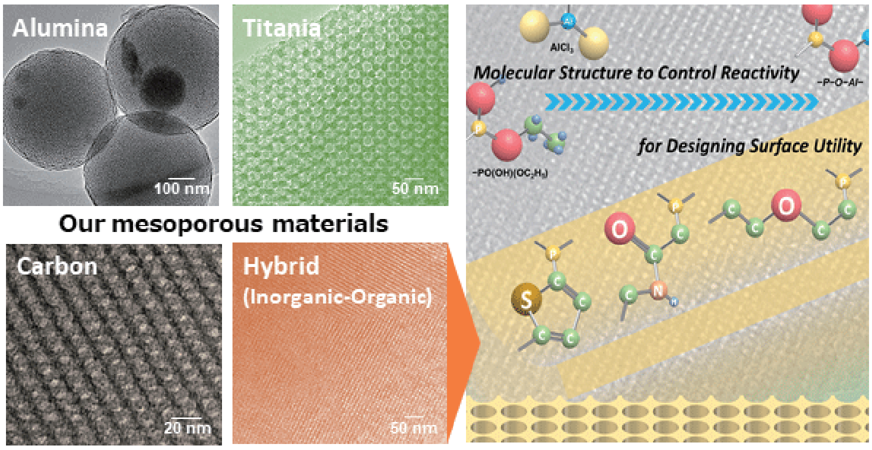
Electrolyte ceramic sheet for next generation all-solid-state batteries



Self-assembly process of nanocrystals for high-performance ceramic capacitors

Innovative utilization technology of surface active sites of inorganic nano-porous materials

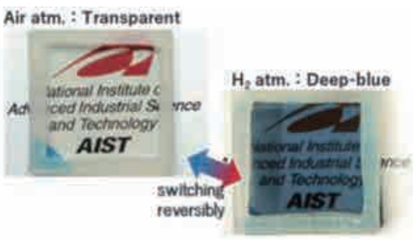
Towards the proposal of a new industrial structure including the realization of a circular economy through the design of function, the renewal of property, the exploring of novel applications, etc., that cannot be completed by using conventional technologies only, we are aiming to develop inorganic based materials for chemical transformation and then enhance their utilization technologies by making a full use of various nanostructural controls based on our original approach for the porous materials design as the core technology.

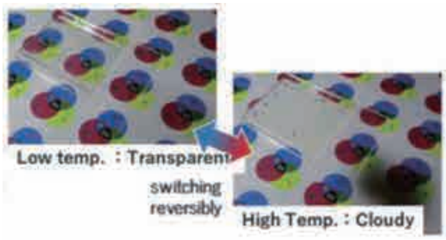


Development of materials that realize energy-saving and comfortable spaces by controlling light and heat

Thermotropic elements using polymer network liquid crystals (PNLC)

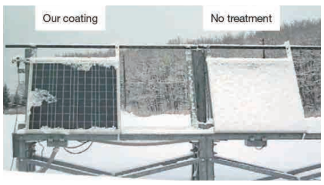
We study novel optical switching materials, which change their transmittance by changing the gas atmosphere or temperature and develop the low cost fabrication methods. To apply these switching materials to windows of buildings or next generation vehicles, we aim to realize comfortable living space with saving energy by controlling solar radiation flowing into the space through windows.



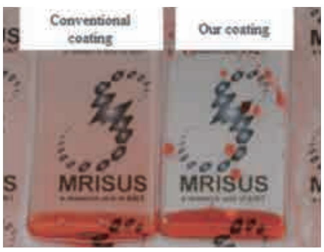


Developing novel coating materials based on the control of dynamic wettability

Until now, the magnitudes of static contact angles (CAs) have been used to quantify the wettability (hydrophobicity and hydrophilicity) of solid surfaces. Recently, dynamic wettability (advancing/receding CAs, CA hysteresis, sliding/tilt angle) has been recognized as the performance index in evaluating liquid removal from solid surfaces. Based on the control of this dynamic wettability, our research group is developing novel coating materials that minimize interactions between substrate surfaces and liquid or solid contaminants to prevent their adhesion, and make it easy for them to slide off.



Development of Thermoresponsive coatings allowing to protect adhesion of ice and snow.

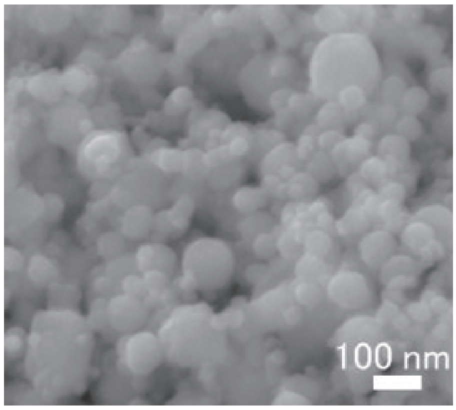


Development of water/oil repellent coatings without the use of perfluorinated compounds.

Development of permanent magnets with excellent high-temperature characteristics

We are working on the development of post-neodymium magnets such as samarium alloy magnets and metastable alloy magnets in order to overcome the resource problems and low heat resistance problems of neodymium magnets, which are the key to EV motors. In particular, since magnet performance is significantly affected by various microstructures inside materials, we are focusing on the creation of new powder metallurgy processes, such as low-oxygen powder metallurgy technology that can suppress oxide film formation to the utmost limit, and rare earth alloy nanoparticle synthesis method for ultrafine crystalline magnets.

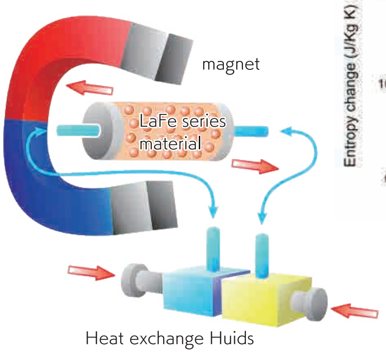
Development of post-neodymium magnets by low-oxygen powder metallurgy technology

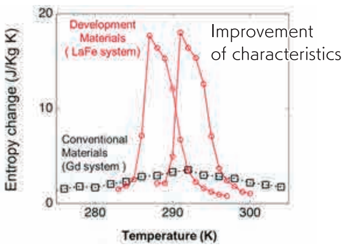


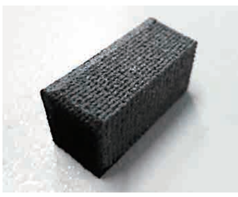
Synthesis of rare earth magnet alloy nanomagnetic powder

Development of post-neodymium magnets by low-oxygen powder metallurgy technology

In order to realize a sustainable decarbonized society, in addition to soft magnetic materials that contribute to energy conservation in power electronics and mobility, we are developing solid refrigerants and heat storage materials that realize heat control using magnetic-derived entropy. In particular, Fe-based magnetocalorime materials and VO_2-based and NiTi-based heat storage materials are aimed at social implementation in collaboration with new applications such as magnetic refrigeration and active heat storage.

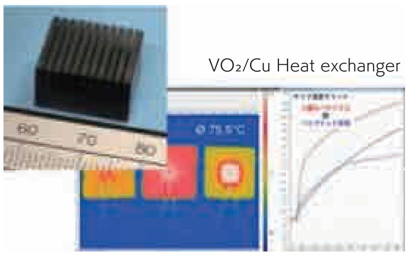


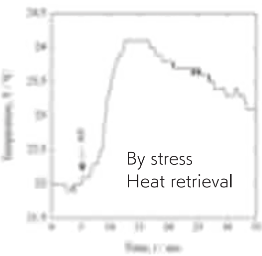




Heat exchange part formation

Development and modeling of magnetic refrigeration materials





Development of solid heat storage materials

Multi-Material Research Institute

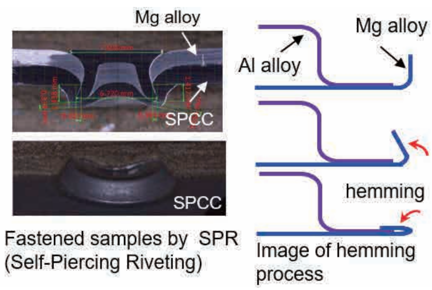
AIST, Multi-Material Research Institute was established with the aim of industrial research supporting "Multi-Material" technology, which are in increasing need for high technology product design and development. Specifically, we have been researching improvement of the total performance of parts and components that cannot be achieved with a single material by combining several materials.
In particular, we are a professional groups specializing in the Advanced Structural Materials and Processing Research such as Combining Lightweight Metals (Mg and Al etc.), Fine Ceramics, CFRP, Composite Materials, Carbon Neutral Materials, and Nano Materials. Also, we are developing New Jointing Process, Upgrade Recycling Technology, and Innovative High Reliability Material Design and Characterization etc.
Our research contributes to reduction of transportation energy by reducing the weight of transportation equipment, heat control in a wide temperature range from low temperature to high temperature used in industrial fields such as power devices and factories, safety and security, and improvement of living environment.

Multi-Material
Research Institute

Research on Multi-Materials technology, lightweight and high recyclable materials for future sustainable society

Research on metal materials technology for lightweight, multi-material and highly recyclable transportation equipment

Development of multi-materialization of magnesium (Mg) alloys with other materials

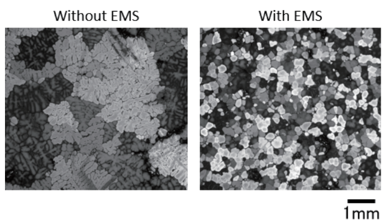


Development of Mg alloys with excellent plastic workability for mechanical fastening.

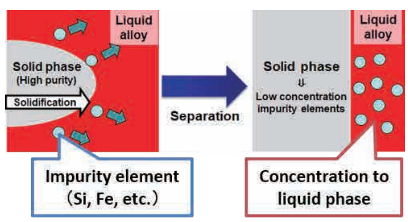
We study new technologies for the multi-materialization of magnesium (Mg) alloys with other materials (such as an aluminum alloy). For example, we develop a new Mg alloy with excellent plastic workability, thereby realizing good mechanical fastening (such as SPR and hemming) between the alloy and other materials. In addition, monitoring technologies for galvanic corrosion and fatigue properties of mechanical joints (between Mg alloy and other materials) are developed.

Development of technology to improve the mechanical property, reliability and recyclability of aluminum alloys

We are mainly engaged in the development of technology to improve the mechanical property, reliability and recyclability of aluminum alloys. For example, we are developing a novel microstructural refinement technique using electromagnetic force without using a grain refiner. In addition, we are conducting research on recycling technologies to remove impurities with high efficiency.



Microstructural refinement by electromagnetic stirring (EMS) technique.

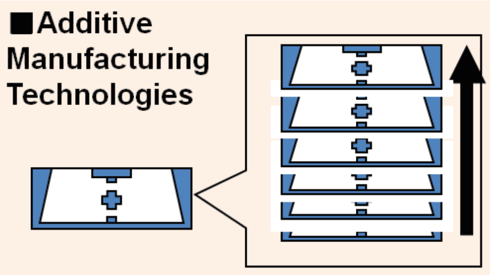


Impurity element removal method in melting and solidification process.

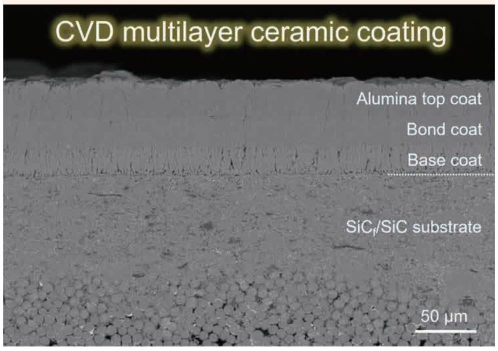
Research on ceramics technology for industrial equipment that controls thermal energy

Development of additive manufacturing and coating technologies for industrial ceramic parts

We develop production technologies of high-performance ceramic components for multi-material, which will actualize industries with high productivity and low energy consumption. Additive manufacturing technologies will give complex shaped or hollow shaped components, which are difficult to make by conventional techniques. Coating techniques will give components with superior resistances to corrosion, wear and erosion by modifying the surface of ceramic and metal.



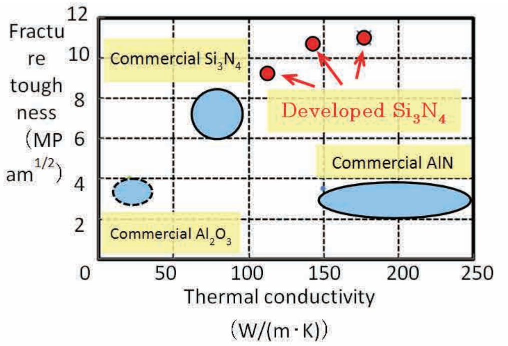
Additive manufacturing (3D printing) technologies
These technologies will give complex shaped or hollow shaped components, which are difficult to make by conventional techniques.



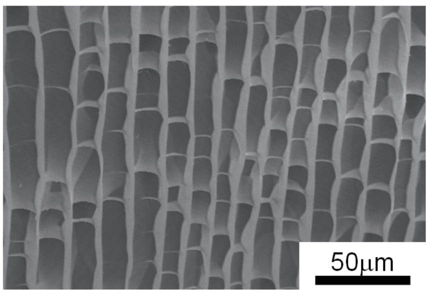
Coating technique by chemical vapor deposition
Ceramic coating techniques will give components with high resistances to corrosion, wear and erosion by modifying the surface of ceramic and metal.

Developments of highly reliable silicon nitride heat-dissipating substrates for high output power modules and ultrahighly porous ceramics

We study novel ceramic materials for the purpose of achieving outstanding performance and good reliability of the composite components fabricated by joining different materials (e.g., ceramics and metals). We have been developing silicon nitride ceramics with both high fracture toughness and high thermal conductivity for application of heat dissipating metallized substrates of the next-generation power modules. We have been also developing ultrahighly porous ceramics for several applications of high performance thermal insulators, filters and catalyst supports, lightweight ceramic materials by our noel gelation freezing technology.



Fracture toughness and thermal conductivity of the developed silicon nitride ceramics
(High thermal conductivity and high fracture toughness were simultaneously attained.)

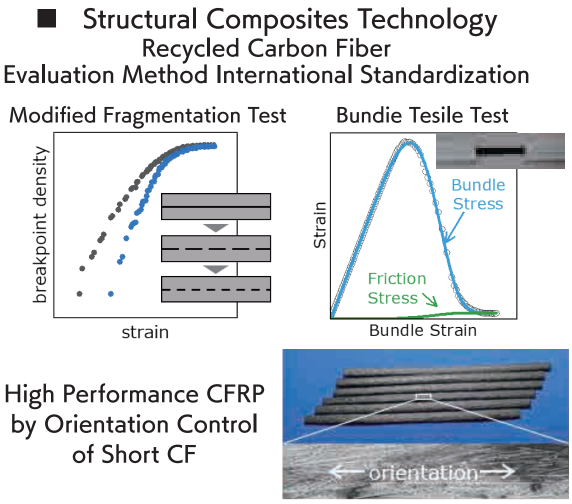


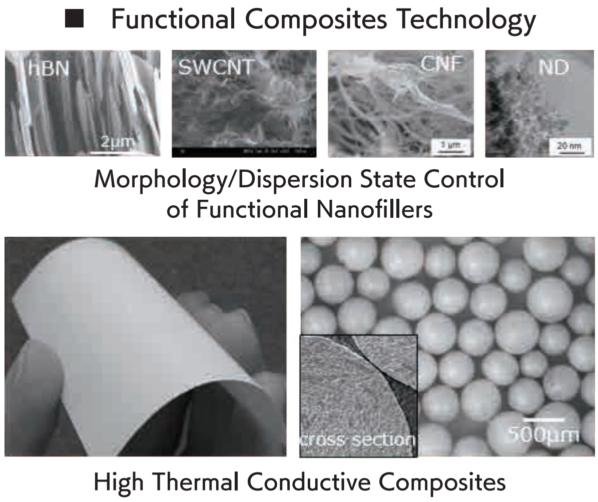
Porous ceramics with partition wall structure prepared by gelation freezing method
(porosity of 98% and thermal conductivity of 0.05 W/(mK))

Research on composite materials technology for advanced structural and functional materials

Development of structural and functional composite materials includes both reinforcement fibers such as carbon fibers and functional particulates

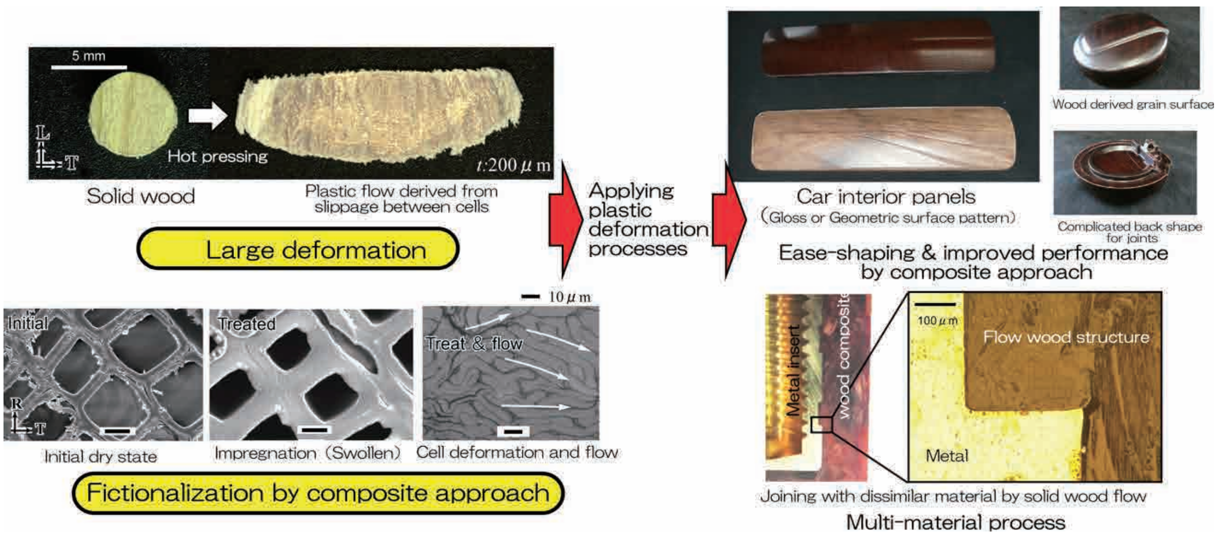
Working on research and development of structural and functional composite materials. Research target includes both reinforcement fibers such as carbon fibers and functional particulates such as high thermal conductive ceramics. Developing technologies on dispersion/orientation control process, interface control process, evaluation methods of composite structure/functions to realize high performance composites.





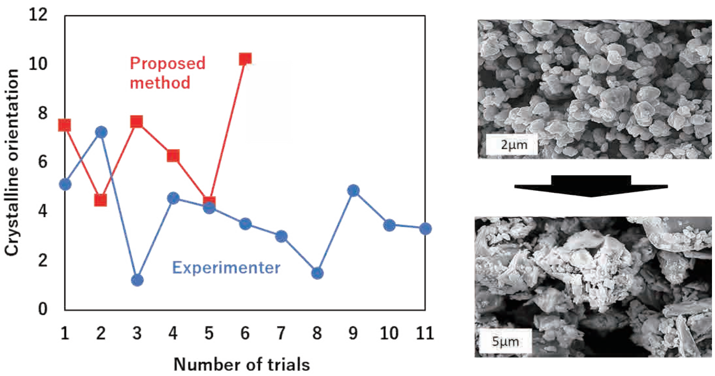
Development of advanced wood-based composites and multi-material processes

Wood resources are renewable and sustainable if used by proper planning. Wood and wood-based materials act as a carbon sink during use as materials. Long-term uses and recycling of wood resources for materials, while keep capturing & storaging atmospheric CO_2 into wood materials, can contribute the creation of lower carbon society. We have been developing wood-based composites for building and automotive interior components that improve the energy efficiency as well as the comfortability, based on materials science and industrial aspects. By introducing functional matters in the fine structure of wood, novel properties such as large deformability and improved durability can be obtained. With the multi-material process combining other industrial materials, the wood flow molding techniques make it possible to create feasible and scalable applications.



Research on process informatics for advanced structural and functional materials

Development of materials informatics and process informatics for enhanced material processing



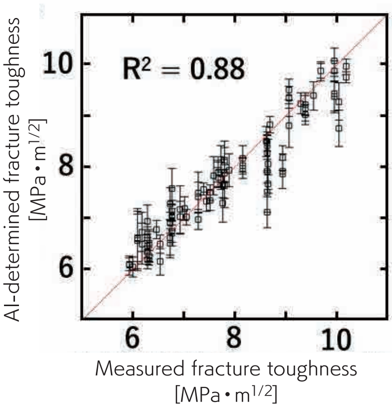
Transition of crystalline orientation by experimenter and Bayesian optimization with data screening

We study informatics technologies for material processing in order to enhance manufacturing capability. For instance, learning data is fundamental of informatics, therefore we are trying to develop data acquisition and argumentation techniques.

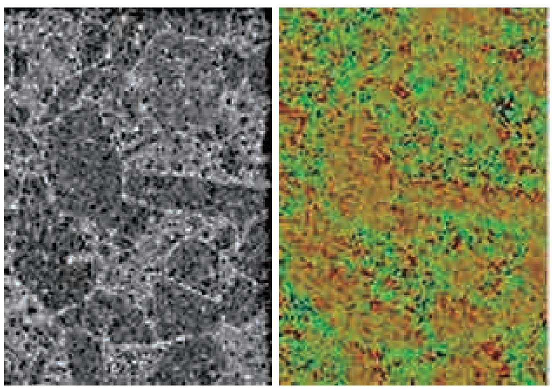
We also create the models that predict properties from material information and develop algorithm to optimize process condition at early stage, such as Bayesian optimization with combination of kernel function selection and data screening.

In addition, we challenge to create informatics technologies for optimum process design.

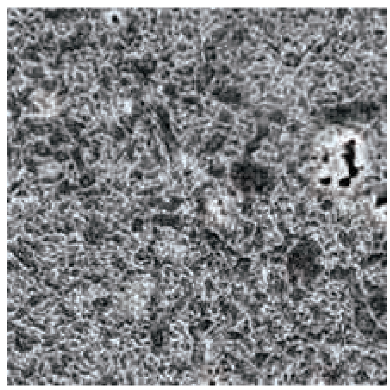
Digital transformation technology to accelerate the development of ceramic materials



Testing results of CNN regression models



Grad-CAM visualization results



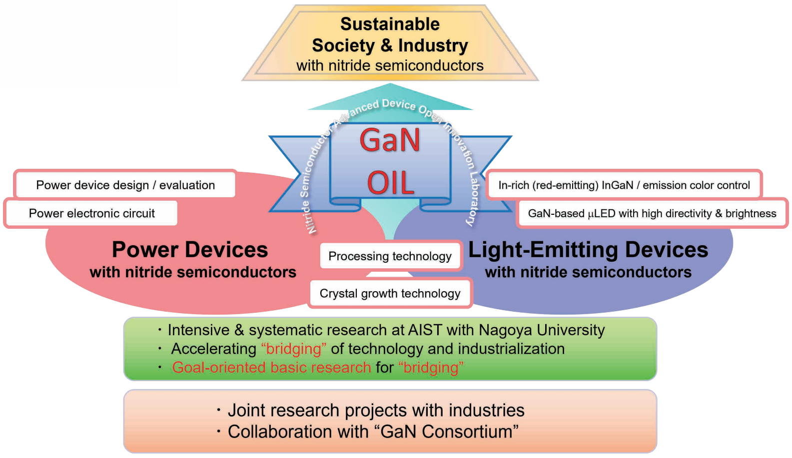
Microstructures created by C-GAN

In order to automatically and rapidly propose optimal manufacturing conditions through virtual experiments, we conduct research works on predicting engineering properties and creating microstructures using various artificial intelligence (AI) technology. We are developing AI technology to predict mechanical properties of silicon nitride ceramics, which is expected to be used as metallized ceramic substrates for next-generation power modules, as well as to create microstructures with desired engineering properties. Our digital transformation technology that focuses on "manufacturing" and “characteristic evaluation" in cyberspace can be expected to shorten the material development period in the future.

Related information would be shown by QR code

GaN Advanced Device Open Innovation Laboratory

Gallium nitride (GaN) power devices and light-emitting devices represent key technology to achieve high-performance and high-efficiency use of energy. Our aim is bridging the gap between academic research and industry, and promoting R&D on GaN and related compounds through all the stages from material science to their device applications.



Crystal Growth of III-Nitride Semiconductors and Power Device Applications

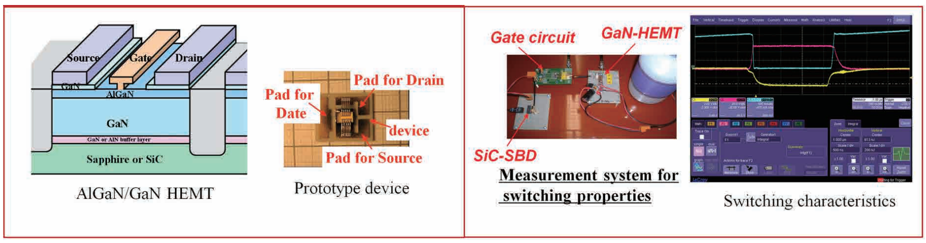
Development of high-frequency power supply and high-frequency communication technology utilizing the high-speed operation of GaN power devices is underway; high-speed operation of GaN power devices makes it possible to downsize power supplies, which is expected to be applied to drones and IoT-related equipment. High-frequency devices using GaN are expected to be applied in post-5G.

We are working on crystal growth technology for nitride semiconductors, process technologies of GaN devices including AlGaN/GaN-HEMTs and GaN-MOSFETs, and power downsizing technology that uses switching operation at MHz or higher.

Optical Device Applications

Wavelength extension to red/near infrared and ultraviolet spectral ranges and adding novel functionalities are indispensable for widespread use of nitride-semiconductor optical devices.

We are working on realizing highly directional micro-LEDs in the whole visible spectral range based on our unique directionality control technique, and the development of crystal growth techniques of red-emitting In-rich InGaN by means of an MOCVD system equipped with an in-house developed quasi-atmospheric pressure plasma source. We also focus on developing advanced packaging technologies of micro-LEDs towards the application to head-mounted displays with high intensity, high resolution and low power consumption, which may be required for novel information devices such as "smart glasses" for virtual reality (VR)/augmented reality (AR) technologies.

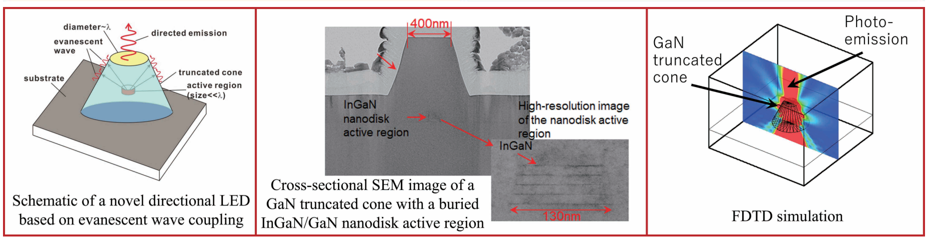


AlGaN/GaN HEMT

Prototype device

Measurement system for switching properties

Switching characteristics



Schematic of a novel directional LED based on evanescent wave coupling

Cross-sectional SEM image of a GaN truncated cone with a buried InGaN/GaN nanodisk active region

FDTD simulation

Collaboration Affairs Office

The Collaboration Affairs Office promotes AIST's collaboration in the Chubu region. To contribute to the development of local industries, the office conducts matching activities for technology transfer of the AIST research results, supports for implementation of joint research and commissioned research, and provides technical training and technical consultations cooperating with AIST Solutions Co..

Joint Research

Research with us

We welcome joint research ranging from basic to applied phase that utilizes the research potential of AIST.

Commissioned Research

Commission your research to us

AIST conducts research that takes advantage of our technical potential, or research related to the social implementation of our research results, as commissioned by requesting organizations.

Technology Consulting

Utilizing AIST's technical capabilities

We support technical issues, providing advanced technical survey, technical advice, analysis and evaluation, and commercialization advice to answer your consultation needs.

Visiting Lectures

Onsite visits by experts

The AIST researchers are available for visiting lectures, etc., upon request from external organizations.

Intellectual Property

Using intellectual property

AIST holds our research results such as patents, know-how, and programs as intellectual property. We transfer the technology of our research results and promote practical application.

Technical Assistance

Technical Advice

AIST staff responds to technical issues by phone, email, writing, or in-person meetings.

Technical Training

Research at AIST

AIST provides training for researchers sent from companies, universities, etc., to acquire specialized skills essential for technological development and research.

Commissioned Committee Members

Expert committee members

External committees commission AIST researchers to cooperate in committee activities.

Coordination of Industry-Academia-Government Collaboration Research

We plan and coordinate projects through industry-academia-government collaboration to respond to local needs.

Collaboration with Graduate Schools

AIST researchers are appointed as visiting professors at graduate schools, and students are accepted to AIST for research guidance.

AIST Research Assistant Program

AIST employs students with excellent R&D skills as AIST research assistants (contract employees).

Dissemination of Research Results

AIST research results are introduced through research lectures and exhibits at various events.

国立研究開発法人

産業技術総合研究所　中部センター

AIST Chubu,
National Institute of Advanced Industrial Science and Technology (AIST)

https:www.aist.go.jp/chubu/

Related information would be shown by QR code

Japanese only

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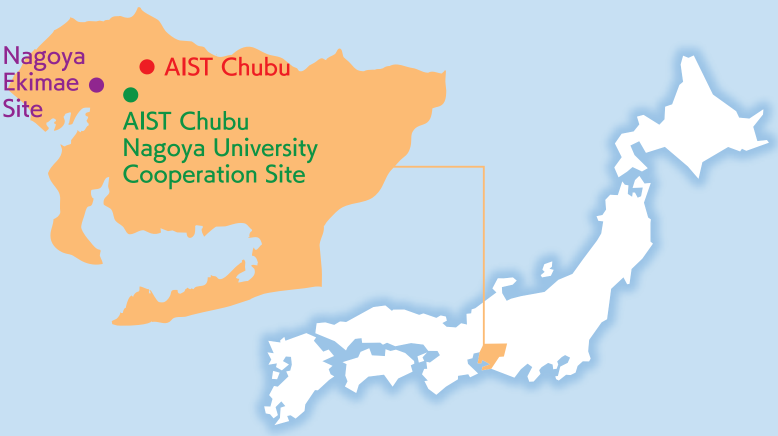

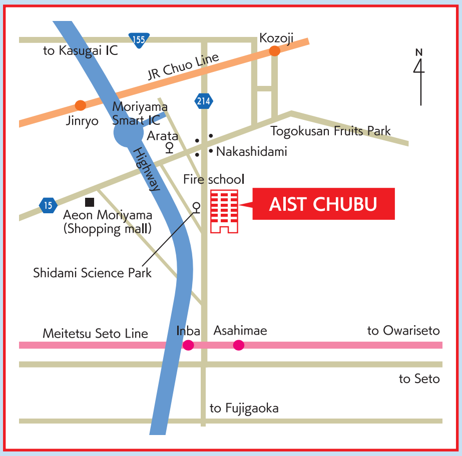

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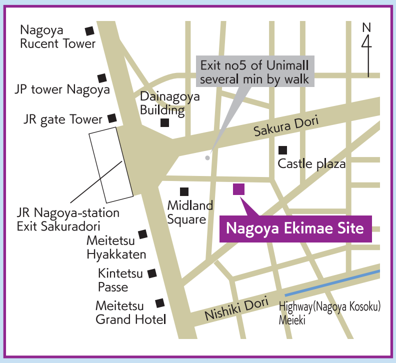

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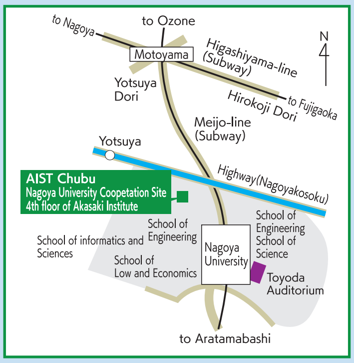

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Visiting AIST Chubu

In case of getting on JR Chuo Line from JR Nagoya Station.

1)Get off at Ozone Station. transfer to Yutorito Line(or Guideway Bus) which will pass Shidami Sports Land Station. for "Shidami kotsu Hiroba" or "Shidami kotsu Hiroba(via Science Park)". get off at Shidami Science Park Station then by walking to AIST Chubu 1 min.
2)Get off at Kozoji Station, then by Taxi to AIST Chubu 15 min.

In case of getting on Subway from JR Nagoya Station.

Transfer to subway Higashiyama Subway Line, get off at Fujigaoka Station. transfer to the Fujigaoka 12 system city bus for Nakashidami Station. get off at Shidami Science Park bus stop, then by walking to AIST Chubu 1 min.

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