GteX Green Technologies of Excellence

ALCA-Next
Advanced Technologies for Carbon-Neutral

24 » 25

JST Japan Science and Technology Agency

Management System of GteX and ALCA-Next

In FY2023, we launched the GteX program, and have promoted R&D in the areas of storage batteries, hydrogen, and biomanufacturing with an awareness of final systems leading to social implementation under a team-based research system in which top-level researchers collaborate with each other. In addition, as a complementary project, we launched the ALCA-Next program, which targets a wider range of areas and aims to create game-changing technologies. As shown in the figure below, by operating both projects in same committee and promoting collaboration between them, we aim to encourage the participation and collaboration of researchers from different fields, achieve results in R&D related to carbon neutrality, foster young researchers, promote international collaboration, and make Japan the core of a global network for GX promotion.

＊1 ：PD：Program Director、PO：Program Officer

＊2 ：In Full-scale R&D area, R&D projects that have passed the stage-gate evaluation under JST-Mirai “Low Carbon Society” mission are required to accelerate R&D to reach a stage (proof of concept: POC) where the feasibility of practical application is validated.

GteX Green Technologies of Excellence

The Green Technologies of Excellence (GteX) Program aims to contribute to the realization of GX by fully harnessing the high potential and accumulation of basic research capabilities in Japan's academia. This program supports R&D and human resource development at universities and national institutes, focusing on creating innovative technology seeds and nurturing human resources.

Management System

PD **UOSAKI Kohei**
Professor Emeritus,
Hokkaido University/
Emeritus Fellow, NIMS/
Principal Fellow, JST

Innovative GX Technology Promotion Committee

Storage Battery

PO **KUWABATA Susumu**
Emeritus professor
Osaka University

Advanced-LIB KANAMURA Kiyoshi	Magnesium batteries ICHITUBO Tetsu
Sulfide-based solid-state batteries HAYASHI Akitoshi	Lithium-sulfur batteries ISHIKAWA Masashi
Oxide-based solid-state batteries IRIYAMA Yasutoshi	Lithium-air batteries NAKANISHI Shuji
Sodium-ion batteries KOMABA Shinichi	Battery Research Platform MASUDA Takuya

Hydrogen

PO **UCHIDA Hiroyuki**
Project Professor
University of Yamanashi

Water electrolysis TAKANABE Kazuhiro
Fuel cell INABA Minoru
Hydrogen storage ORIMO Shin-ichi

Biomanufacturing

PO **KONDO Akihiko**
Professor
Kobe University

Microorganisms HONDA Kohsuke
Plants OHKUMA Moriya
Interactions between organisms NOMURA Nobuhiko
Evaluation using artificial systems NOJI Hiroyuki
Information analysis BAMBA Takeshi

GteX-related institutions: 78 in total
● Battery Area…53 institutions ● Hydrogen Area…32 institutions ● Biomanufacturing Area…30 institutions

∗ As of October 1, 2024

Characteristics of GteX

- Team-Based Research
- Active Development of Young Researchers
- Intellectual Property Management: Open-Close Strategies
- Overseas Cooperation
- Promotion of Shared Use of Research Facilities

Storage Battery Area

PO KUWABATA Susumu

Emeritus professor,
Osaka University

In this area, universities, national institutes, and companies will collaborate to develop innovative next-generation storage battery technology, which is one of the most important technologies for achieving carbon neutrality in 2050. We promote team-based research and development that spans from establishing academic principles to solving technological issues in the industrial sector. To accelerate research and development, we will not only develop materials for individual battery components, but also comprehensively evaluate the performance of developed batteries as a total system. Additionally, we will build a database to search for new battery systems and establish fundamental technologies for next-generation storage batteries. We also aim to foster human resources with broad perspectives and development capabilities.

Program Officer (PO) KUWABATA Susumu Osaka University

Senior Team Leader KANAMURA Kiyoshi

Advisors

IBA Hideki (Toyota Motor Corporation)
IWASAKI Hironori (PwC Advisory LLC)
UE Makoto (Waseda University)
TAKAMI Norio (Toshiba Corporation)
TATSUMI Kuniaki (AIST)
YOSHIMOTO Nobuko (Yamaguchi University)
WATANABE Masayoshi (Yokohama National University)

Advanced Lithium-Ion batteries Team
KANAMURA Kiyoshi

- Cathode G: YABUUCHI Naoaki
- Anode G: NISHIKAWA Kei
- Electrolyte G: YAMADA Yuki
- Interfacial Control G: MAEYOSHI Yuta
- Analysis G: ORIKASA Yuki
- Computational Science G: SODEYAMA Keitaro
- Cell Manufacturing G: KANAMURA Kiyoshi

19 institutions

Sulfide-based all-solid-state batteries Team
HAYASHI Akitoshi

- Cathode G: HIRAYAMA Masaaki
- Anode G: HAYASHI Akitoshi
- Solid Electrolyte G: SUZUKI Kota
- Analysis・Computational Science G: MORI Sigeo
- Battery Process G: KITAURA Hirokazu

16 institutions

Oxide-based solid -state batteries Team
IRIYAMA Yasutoshi

- Solid Electrolyte G: IRIYAMA Yasutoshi
- Fundamental Research G: AMEZAWA Koji
- Device G: OKUMURA Toyoki

18 institutions

Sodium-Ion batteries Team
KOMABA Shinichi

- Material Development G: OKUBO Masashi
- Fundamental Research G: TATEYAMA Yoshitaka
- Cell Evaluation G: KOMABA Shinichi

14 institutions

Magnesium batteries Team
ICHITUBO Tetsu

- Cathode G: ICHITUBO Tetsu
- Electrode Interface Coating G: KAJIHARA Koichi
- Anode G: MATSUI Masaki
- Electrolyte G: MANDAI Toshihiko
- Computational Science G: NAKAYAMA Masanobu
- Analysis G: KITAMURA Naoto
- Cell Evaluation G: YAGI Shunsuke

11 institutions

Lithium-sulfur batteries Team
ISHIKAWA Masashi

- Cathode Material: ISHIKAWA Masashi
- Electrolyte G: DOKKO Kaoru
- Lithium Management G: KATAYAMA Yasushi
- Material Process G: SAKAEBE Hikari
- Full Cell System G: MOMMA Toshiyuki

12 institutions

Lithium-air batteries Team
NAKANISHI Shuji

- Battery Integration G: NAKANISHI Shuji
- Material Synthesis G: NISHIHARA Hirotomo
- Theoretical Analysis G: MIZOGUCHI Teruyasu

8 institutions

Battery Research Platform (Constructing a Common Infrastructure for Measurements and DX)

MASUDA Takuya

- Analysis Infrastructure G: MASUDA Takuya
- DX G: DEMURA Masahiko
- Automated Experiments G: MATSUDA Shoichi

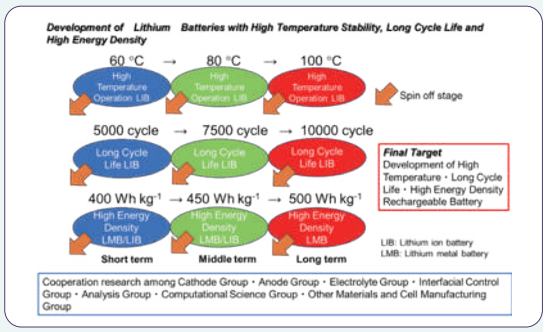
Storage Battery Area | Innovation in Practical Batteries (Advanced Lithium-Ion Batteries)

Development of Lithium Batteries with High Temperature Stability, Long Cycle Life and High Energy Density

Team Leader **KANAMURA Kiyoshi**

Senior Leading Professor, Faculty of Urban Environmental Sciences, Tokyo Metropolitan University

In order to reduce GHG, high performance rechargeable new lithium batteries will be developed in this research team. The first challenge is achieving a high temperature operation of LIBs, at 60℃~100℃. The second challenge is extending a long cycle life, 10000 cycle for LIB. The third one is attaining a high energy density 500 Wh/kg^{-1} for LIB & LMB. These three research and development targets will be achieved and installed in our society to reduce GHG and realize new energy social system. In this research team, material science, computational science, interfacial control technology, analysis by using synchrotron radiation and cell design will cooperate with each other, based on discussions aimed at realizing new LIB and LMB. Our final goal is to reveal the ultimate form of lithium-based batteries.



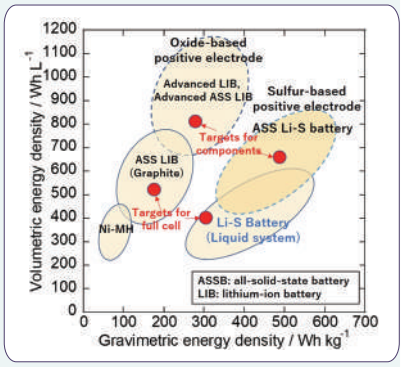
Storage Battery Area | Development of Batteries with Enhanced Safety

Development of sulfide-based all-solid-state batteries with high energy density and high safety

Team Leader **HAYASHI Akitoshi**

Professor, Graduate School of Engineering, Osaka Metropolitan University

The development of all-solid-state batteries (ASSBs) with high energy density and high safety is expected. The main challenge in using high-capacity negative electrodes such as lithium metal and silicon, and high-capacity positive electrodes such as sulfur-based and Li-rich oxide materials, is that the active materials of the positive and negative electrodes undergo large volume changes during charging and discharging. In this project, we aim to develop solid electrolytes that combine mechanical properties, electrochemical stability, and ion conductivity suitable for these high-capacity electrodes.



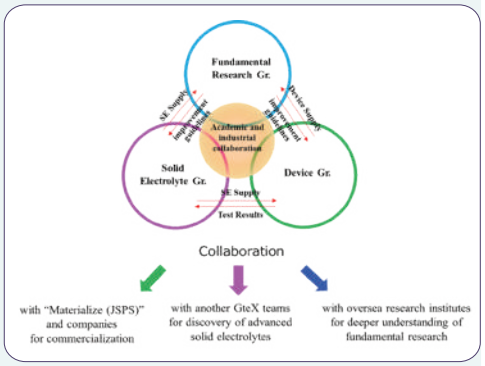
Storage Battery Area | Development of Batteries with Enhanced Safety

Developments of Safety & Long-Life Oxide-Based Solid State Batteries

Team Leader **IRIYAMA Yasutoshi**

Professor, Graduate School of Engineering, Nagoya University

This research aims to develop safe and long-life oxide-based solid-state batteries (SSBs). The goals are to develop "sintered-type" SSBs for small- and medium-size devices such as stationary use, "non-sintered-type" SSBs for large-size devices such as electric vehicle, and "high-energy-density-type" SSBs for the next generation. The three groups, Fundamental Research Gr. (Leader: Prof. Amezawa, Tohoku Univ.), Solid Electrolyte Gr. (Leader; Prof. Iriyama, Nagoya Univ.), and Device Gr. (Leader: Dr. Okumura, AIST), collaborate closely beyond academia and industry to achieve the commercialization, discovery of advanced solid electrolytes, and deeper understanding of fundamental research.

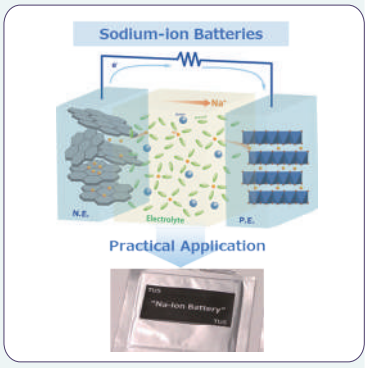


Storage Battery Area | Development of Batteries Free from Resource Constraints

Development of Sodium-Ion Batteries Free from Resource Constraints

Team Leader **KOMABA Shinichi**
Professor, Department of Applied Chemistry, Tokyo University of Science

The lithium-ion battery, first commercialized in Japan, is indispensable for the realization of GX technology due to its notably high energy density among practical rechargeable batteries. However, the price of lithium raw materials is fluctuating and expected to increase due to the uneven global distribution of lithium resources and growing demand. Lithium-ion batteries also require scarce and/or toxic metal elements, such as cobalt, nickel, and copper. As the application range of rechargeable batteries continues to expand, developing lithium-free, high-performance batteries that avoid geopolitical risks and resource constraints is one of the main challenges in innovative GX technology. Building on our vast knowledge from lithium-ion batteries, we will engage in materials development, cell optimization, mechanism analysis, and computational chemistry aimed at the social implementation of the "sodium-ion battery" as the next-generation rechargeable battery.

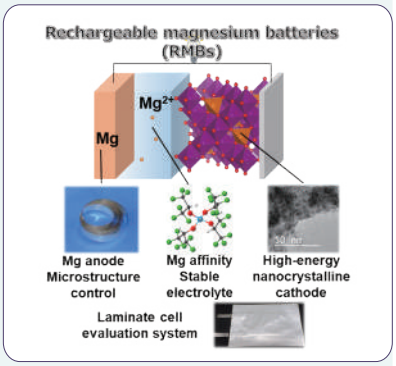


Storage Battery Area | Development of Batteries Free from Resource Constraints

Research and development of resource-constraint-free rechargeable magnesium batteries (RMBs)

Team Leader **ICHITSUBO Tetsu**
Professor, Institute for Materials Research, Tohoku University

In this R&D project, we are working on the development of RMB using a Mg metal negative electrode as a battery that is free from resource constraints. The aim of this research is to develop an RMB that is safe, inexpensive, and has a high energy density. This storage battery is not expected to replace lithium-ion batteries (LIBs), but to be used as a safe, large storage battery for the electrification processes that will be required in the future, not only for mobile vehicles, but also as a stationary batteries for distributed power sources. In the current storage battery configuration, which relies heavily on LIBs, it is necessary to have a lineup of different types of storage batteries, and this RMB project will contribute to this.

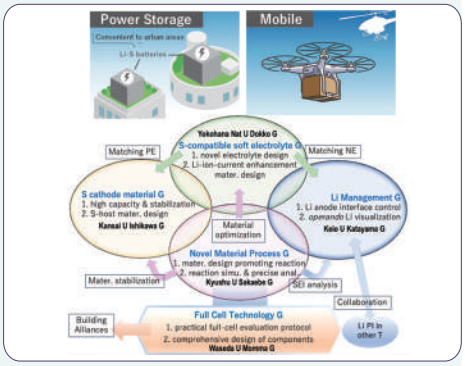


Storage Battery Area | Development of Lightweight, Compact, High-Capacity Batteries

Development of lithium-sulfur batteries with low environmental impact and high performance

Team Leader **ISHIKAWA Masashi**
Professor, Department of Chemistry and Materials Engineering, Faculty of Chemistry, Materials and Bioengineering, Kansai University

The aim is to develop a room-temperature operating lithium-sulfur (Li-S) battery that uses a soft electrolyte such as an ionic solution to achieve a long life and high energy density twice that of current LIBs. This battery is theoretically the lightest sealed battery available, and will enable power storage in various locations, such as on building rooftops and in homes. This will encourage the introduction of renewable electricity and contribute to the reduction of greenhouse gases. The cathode requires virtually no rare metals, and its low environmental impact during production is also attractive. In order to realize this battery, this team consists of 5 groups, each focusing on specific technology. The world's most advanced R&D on Li-S is underway!



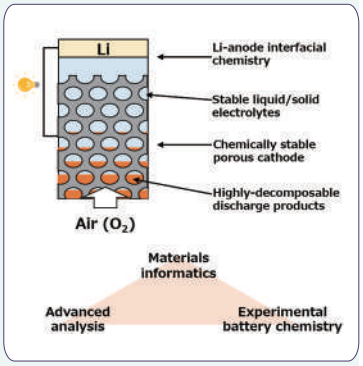
Storage Battery Area | Development of Lightweight, Compact, High-Capacity Batteries

Development of Lithium-Air Secondary Batteries Characterized by Lightweight, Compact, and High Capacity

Team Leader **NAKANISHI Shuji**

Professor, Graduate School of Engineering Science, Osaka University

Lithium-air batteries offer the highest theoretical gravimetric energy density among various types of secondary batteries, providing the potential for lightweight, compact, and high-capacity storage. However, current challenges include the lack of stable battery materials that are tolerant against the reactive oxygen species generated during battery reactions, as well as the large charging overvoltage caused by the poor decomposability of discharge products, resulting in insufficient charge-discharge cycle performance. This study proposes a fundamental solution based on the new concept of "discharge product engineering". Through deep collaborations between materials informatics, advanced analytical chemistry, and experimental battery chemistry, we aim to achieve both high gravimetric energy density and favorable cycle performance.



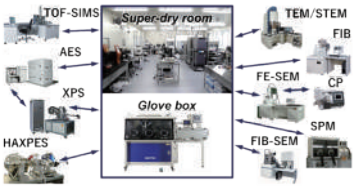
Storage Battery Area | Constructing a Common Infrastructure for Measurements and DX

Research Platform Integrated with Advanced Characterization and Digital Transformation Techniques for Batteries and Hydrogen Technologies

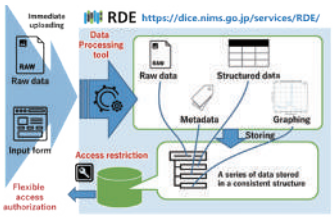
Team Leader **MASUDA Takuya**

Director, Research Center for Energy and Environmental Materials (GREEN),National Institute for Materials Science (NIMS)

We build and operate a research platform for batteries and hydrogen technologies, integrated with advanced characterization and digital transformation techniques.
The platform provides the infrastructure with researchers in GteX for prototyping test cells, for evaluating the cell performance, and for characterizing the structure of materials / electrodes / cells under one roof.



Advanced research equipment under one roof



System used to build an integrated database

Those experimental data are efficiently collected to construct an integrated database for high-throughput R&D. We develop various AI analysis tools to analyze the data and link it to the search for new materials and structures to improve the cell performance and durability.

Hydrogen Area

PO UCHIDA Hiroyuki
Project Professor,
University of Yamanashi

In this area, we will contribute to the realization of a hydrogen society by developing technologies for the production, storage, and utilization of hydrogen. Our goals are to develop technologies in order to break through current bottleneck issues in an innovative manner, to create new concepts for hydrogen-related materials and systems, and to research and develop the practical application of these technologies. We also aim to foster human resources with broad perspectives and development capabilities.

Program Officer (PO)
UCHIDA Hiroyuki Yamanashi University

Area Advisor

IZUMIYA Kouichi (Kanadevia Corporation)
EGUCHI Koichi (Kyoto University)
OKAJIMA Hiroshi (Toyota Motor Corporation)
KURIYAMA Nobuhiro (National Institute of Advanced Industrial Science and Technology)
KOBAYASHI Tetsuhiko (Osaka Research Institute of Industrial Science and Technology)
SAKURAI Teruhiro (Fuel Cell Commercialization Conference of Japan)
SHIMOTORI Soichiro (Toshiba Energy Systems & Solutions Corporation)
FUKUI Hiroyuki (Japan Science and Technology Agency)
HOMMA Takayuki (Waseda University)
MITSUSHIMA Shigenori (Yokohama National University)

Water Electrolysis Team

TAKANABE Kazuhiro
The University of Tokyo

- PEMWE · AWE G: NAKAMURA Ryuhei
- Neutral pH & Sea Water Electrolysis G: TAKANABE Kazuhiro
- AEMWE · Membrane G: MIYATAKE Kenji
- Interfacial Analysis & Design G: YAMAUCHI Miho

14 institutions

Fuel Cell Team

INABA Minoru
Doshisha University

- PEMFC G: INABA Minoru
- AEMFC G: YAMAGUCHI Takeo
- PCFC G: OKUYAMA Yuji
- System Evaluation G: KANESAKA Hiroyuki
- Analysis & DX-MI G: ISHIKAWA Atsushi

15 institutions

Hydrogen Storage Team

ORIMO Shin-ichi
Tohoku University

- Material G: KONDO Takehiro
- Analysis G: SAITO Hiroyuki
- DX G: KUTSUKAKE Kentaro
- System G: HANADA Nobuko

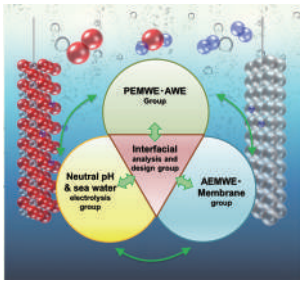
16 institutions

Hydrogen Area

Development of Innovative Water Electrolysis Systems for Green Hydrogen Production

● Team Leader **TAKANABE Kazuhiro**
Professor, School of Engineering, The University of Tokyo

The goal is to establish water electrolysis systems with low cost, high efficiency, and high durability by fundamentally solving the problems each system faces. The research targets include the proton exchange membrane (PEM) type, the strong alkaline solution (AWE) type, and the anion exchange membrane (AEM) type. The project will work on water electrolysis under conditions that cannot be achieved in existing systems, such as the near neutral pH or direct use with seawater. The project will comprise an all-Japan team capable of performing the entire process from material synthesis to evaluation and practical application. This will lead to the development of new electrode catalyst materials and electrolyte/cell materials. Eventually, the project will connect the established technology to social implementation, making a significant contribution to GX.

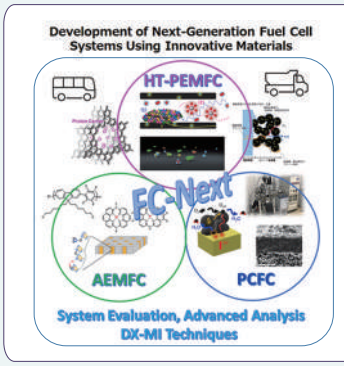


Hydrogen Area

Development of Next-Generation Fuel Cell Systems Using Innovative Materials

● Team Leader **INABA Minoru**
Professor, Faculty of Science and Engineering, Doshisha University

In this project, we develop innovative materials for catalysts, electrolytes, ionomers, bipolar plates, etc., and realize the next-generation fuel cell systems for heavy-duty vehicles.
The fuel cell systems include (1) high-temperature proton-conductive membrane fuel cells (HT-PEMFCs), (2) anion-exchange membrane fuel cells (AEMFCs) and (3) (solid oxide) proton-conductive fuel cells (PCFCs). These fuel cell developments are supported by cross-sectoral (4) the system evaluation group and (5) the advanced analysis, calculation, DX-MI technology group.

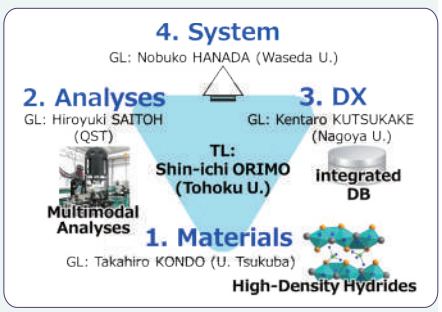


Hydrogen Area

Innovative Hydrogen Storage — Analyses of Hydrogen Reactions and Application of Digital Technologies —

● Team Leader **ORIMO Shin-ichi**
Director/Professor, Advanced Institute for Materials Research, Tohoku University

We will collaborate with related domestic industries and overseas research institutions to promote 3 research innovations in hydrogen storage technology, as follows:
1. Materials: Innovation based on various material functions
2. Analyses: Expansion of analysis conditions under hydrogen
3. DX: Incorporation of DX and MI/PI/mathematical sciences
4. System: Construction of hydrogen storage system
This research is expected to contribute in the future to an increase in the number of HDVs powered by fuel cells, which have a significant effect on reducing GHG emissions, and to promote excellent early-carrier researchers and engineers who will be responsible for R&D on the related technologies.



Biomanufacturing Area

PO KONDO Akihiko

Vice President, Kobe University
Professor, Graduate School of Science, Technology and Innovation

In this area, we will apply biomanufacturing technologies to various industries such as chemical, textile, food and beverage, which emit 80.9 million tons of CO_2 per year. We aim to increase productivity and diversity of chemicals prepared through biomanufacturing system, and to enhance the functions and CO_2 fixation capabilities of various aliphatic and aromatic compounds (raw materials for rubber, plastics and synthetic fibers etc.), Sustainable Aviation Fuel (SAF) and other next-generation fuels. We will promote research that will lead to the next-generation biomanufacturing system infrastructure using microorganisms and/or plants. We also aim to foster human resources with broad perspectives and development capabilities.

Program Officer (PO)
KONDO Akihiko Kobe University

Area Advisor

IIDA Junko (Shimadzu Corporation)
EZURA Hiroshi (University of Tsukuba)
KINOSHITA Toshinori (Nagoya University)
SHIMIZU Hiroshi (Osaka University)
TAOKA Naoaki (Kaneka Corporation)
FUKUOKA Atsushi (Hokkaido University)
MATSUI Tomoko (Novozymes Japan Ltd.)
YAOI Katsuro (New Energy and Industrial Technology Development Organization)
WADA Mitsufumi (Japan Bioindustry Association)

Core research teams

Microorganism focused research T

HONDA Kohsuke
Osaka University

- Basic Cell G — HASUNUMA Tomohisa
- Bioprospecting G — HONDA Kohsuke
- Next-generation DBTL G — MATSUDA Fumio

16 institutions

Plant focused research T

OHKUMA Moriya
RIKEN

- Genome Construction G — AIZAWA Yasunori
- Database G — ARITA Masanori
- Microbial Development G — OHKUMA Moriya
- Plant and Tissue Culture G — SEKI Hikaru
- Data Collection G — HIRAI Masami
- Plant Manufacturing Technology Development G — MIURA Kenji
- Microalgae G — MOCHIDA Keiichi

17 institutions

Platform technology research teams

Interactions between organisms T

NOMURA Nobuhiko
University of Tsukuba

- Plant-Microbe Interactions-based Technology Development G — SHIRASU Ken
- Rhizospheric Interactions-based Technology Development G — SUGIYAMA Akifumi
- Microbial and Plant Interaction Exploration G — TAMAKI Hideyuki
- Microbial Consortia Bioinformatics G — NISHIMURA Yuki
- Microbial Interactions and Imaging G — NOMURA Nobuhiko

5 institutions

Research into evaluation systems using artificial systems T

NOJI Hiroyuki
The University of Tokyo

- Development Group for GX Enzymes — ARAI Munehito
- Development Group for Oligo DNA Assemble System — OTA Sadao
- Development Group for Cell Free System — SUETSUGU Masayuki
- Development Group for Protein Printer — NOJI Hiroyuki

2 institutions

Analytical technologies and mathematical tools for information analysis T

BAMBA Takeshi
Kyushu University

- Useful Microorganism High-throughput Screening G — TAKEYAMA Haruko
- High-throughput Multi-omics G — SOMA Yuki
- Transcriptomics G — HOSOKAWA Masahito
- Proteomics G — MATSUMOTO Masaki
- Metabolomics G — BAMBA Takeshi
- Metabolite Structural Estimation G — IZUMI Yoshihiro
- Organic Synthesis and Structure Determination G — INUKI Shinsuke
- Trans-omics Data Analysis G — UDA Shinsuke

6 institutions

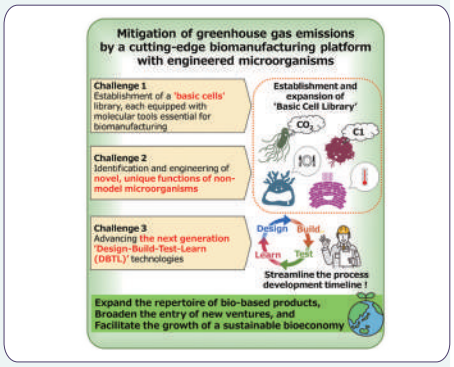
Biomanufacturing Area

Development of DBTL Technologies for Bioengineering to Pioneer Diverse Microbial Functions

● Team Leader **HONDA Kohsuke**
Professor, International Center for Biotechnology, Osaka University

In this project, we strive to mitigate greenhouse gas emissions and ensure a sustainable energy supply by developing a cutting-edge biomanufacturing platform based on the unique and diverse physiology of microorganisms.
Our project specifically focuses on three core areas:

1. Establishing a 'basic cells' library, each equipped with a diverse array of molecular tools essential for biomanufacturing.
2. Identifying and engineering novel and/or unique functions of non-model microorganisms.
3. Advancing the next generation "Design-Build-Test-Learn (DBTL)" technologies to engineer microorganisms.

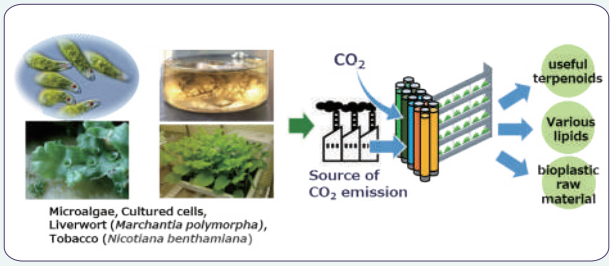


Biomanufacturing Area

Establishment of Cutting-edge Plant Platforms for Biomanufacturing

● Team Leader **OHKUMA Moriya**
Director, Microbe Division, RIKEN BioResource Research Center

Conventional biomanufacturing today utilizes biomass such as sugar produced in agriculture, which does not directly contribute to reducing CO_2 emissions and has problems such as competition with food. Also, the types of compounds produced by microorganisms such as E. coli and yeast are limited due to their metabolic constraints. Therefore, by utilizing the diverse metabolic abilities of plants or others, we will create an innovative manufacturing platform with still under developing plants, microalgae, and new CO_2-fixing microorganisms as hosts using CO_2 as a direct raw material for manufacturing. We will collect their biological information, and develop cutting-edge technologies in metabolic design, artificial genome construction, large-scale genome modification, gene introduction, and differentiation control for them. While applying these technologies, we will expand production and improve the productivity of useful compounds that have been difficult to produce so far.

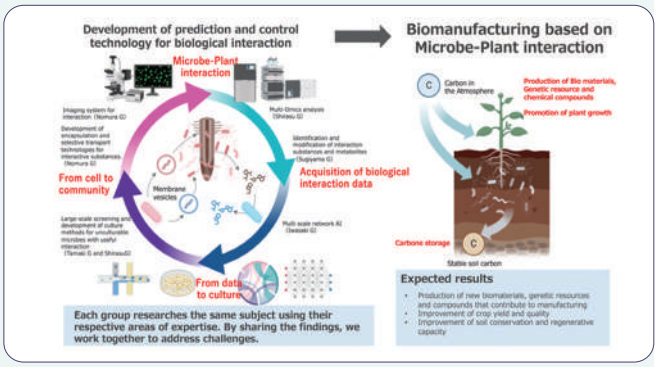


Biomanufacturing Area

Development of Microbe-Plant Interaction Technology for GX

● Team Leader **NOMURA Nobuhiko**
Professor, Institute of Life and Environmental Sciences, University of Tsukuba

The objective of the project is to create next-generation technologies based on a new perspective of "Interaction Technology". We plan to capture and understand interactions between microorganisms and between microorganisms and plants. By utilizing and improving these interactions, we will achieve GX goals such as improved material production and reduced CO_2 emissions.



Biomanufacturing Area

Development of Ultra-parallelized Protein Printer System

● Team Leader **NOJI Hiroyuki**
Professor, Graduate School of Engineering, The University of Tokyo

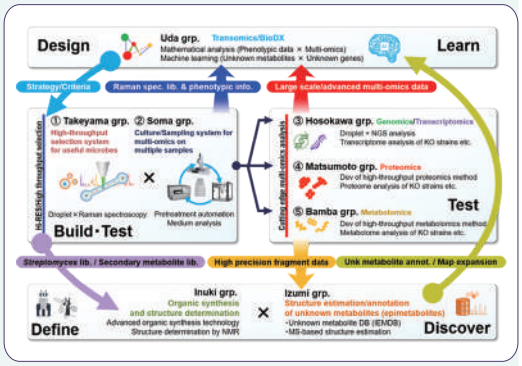
In enzyme screening, conventional protocols employ cell-based cloning, and cell cultivation, which are followed by purification procedures. Due to the laborious and time-consuming procedures, it is practically impossible to synthesize and evaluate more than 10^{3-4} types of enzymes with different origins at once, despite high demands for such high throughput.
In order to address these bottlenecks, we will upgrade our previously developed cell-free enzyme screening technology in order to realize massively parallel and highly precise enzyme screening in a user-friendly and cost-effective way. For this purpose, we will integrate various cell-free technologies such as DNA barcode technology, oligo assembly, recursive DNA isothermal, and cell-free gene expression systems. After effectively integrating these systems in a microchip, we will develop the protein prototyping technology, "protein printer," that enables high-throughput screening for GX enzymes that contribute to carbon neutrality.

Biomanufacturing Area

Development of an Advanced Omics Measurement and Analysis Platform to Drive Next-generation Biomanufacturing

● Team Leader **BAMBA Takeshi**
Professor, Institute of Bioregulatory Medicine, Kyushu University

We are developing a multi-omics measurement and data analysis platform to establish a highly practical biofoundry that will provide a globally robust tool for bio-manufacturing. Within this R&D project, we are focusing on the following key areas: I. Creating target selection and automated culture systems based on novel phenotypic analysis; II. Development of high-precision and high-throughput multi-omics measurement technology; III. Development of strategic identification methods for unknown metabolites to extend metabolic pathway maps; and IV. Development of data analysis methods for interaction networks at multiple omics levels. By integrating these technologies, we aim to create an advanced omics measurement and analysis platform that will drive next-generation biomanufacturing.



ALCA-Next

Advanced Technologies for Carbon-Neutral

ALCA-Next program promotes basic research on innovative technologies that are not just extensions of conventional technologies but that will bring about discontinuous innovation, with the aim of contributing to the realization of carbon neutrality.

Management System

PD **UOSAKI Kohei**
Professor Emeritus, Hokkaido University/Emeritus Fellow, National Institute for Materials Science/ Principal Fellow,CRDS, JST

Innovative GX Technology Promotion Committee

PO **WATANABE Masayoshi**
Distinguished YNU Professor, Yokohama National University

- Energy Conversion and Energy Storage — SP 9, FS 2
- Resource Circulation — SP 9, FS 3

PO **EZURA Hiroshi**
Professor, University of Tsukuba

- Green Biotechnology — SP 10, FS 3

PO **KURODA Tadahiro**
University Professor, The University of Tokyo/ Chancellor, Prefectural University of Kumamoto

- Semiconductor — SP 9, FS 2
- Green Computing and DX — SP 8

PO **KONDO Akihiko**
Vice President and Professor, Kobe University

- Full-scale R&D — Full-scale 1

＊1: Number of the program ＊2: SP:Small Phase ＊3: As of November 2024 ＊4: FS:Feasibility Study
＊5: In Full-scale R&D area, R&D projects that have passed the stage-gate evaluation under JST-Mirai "Low Carbon Society" mission are required to accelerate R&D to reach a stage (proof of concept: POC) where the feasibility of practical application is validated.

Characteristics of ALCA-Next

- Covering a wide range of research fields that realizing carbon neutrality
- Actively adopting challenging proposals based on unconventional ideas of individual researchers
- Fostering technological seeds by improving the levels of technology maturity (TRL) through "stage-gate evaluation"
- Accelerating R&D and bridging the gap by collaborating with other projects such as Green Technologies of Excellence (GteX)

PO WATANABE Masayoshi

Distinguished YNU Professor,
Institute of Advanced Sciences,
Yokohama National University

Energy Conversion and Energy Storage Area

Resource Circulation Area

Energy Conversion and Energy Storage Area

This technology area aims to make renewable energies our primary power sources, develop innovative technologies that utilize hydrogen energy and develop Energy storage technology essential to support the transformation to a sustainable energy system.

Adopted in FY2023

Deeply supercooled Li salt electrolytes for next-generation Li secondary batteries

UENO Kazuhide (Professor,Department of Chemistry and Life Science,Yokohama National University)

Development of high-performance latent/sensible heat-storage materials for effective utilization of mid- and low-temperature waste heat

OHKOSHI Shin-ichi
(Professor, Department of Chemistry, School of Science, The University of Tokyo)

Development of Heat Storage Oxide Materials Utilizing Environmental Moisture

OKAMOTO Norihiko
(Associate Professor, Institute for Materials Research, Tohoku University)

Energy Saving Hydrogen Production/Storage by Silicon-Based Hydrogen Carrier

SUNADA Yusuke
(Professor, Institute of Industrial Science, The University of Tokyo)

Highly efficient and durable Lead-free metal halide perovskite solar cells with orientation-controlled two-dimensional structure

TAKEOKA Yuko (Professor, Faculty of Science and Technology,Department of Materials and Life Sciences, Sophia University)

Adopted in FY2024

High-Efficiency Ratchet–Intermediate Band Solar Cell Film

OKADA Yoshitaka (Project Professor, Research Center for Advanced Science & Technology, The University of Tokyo)

Development of organic solid electrolytes based on a new conduction mechanism

OYAIZU Kenichi
(Professor, Department of Applied Chemistry, Waseda University)

Innovative ammonia cracking using vacancies as reaction sites

KITANO Masaaki
(Professor, Institute of Integrated Research, Institute of Science Tokyo)

Emergence of highly efficient topological thermoelectric materials by high-throughput properties screening

KOMINE Takashi (Deputy Center Director, Green device education & research center, Ibaraki University)

Feasibility Study

Predicting Electrocatalytic Lifetime from Accelerated Aging Tests

OOKA Hideshi (Researcher, Center for Sustainable Resource Science, RIKEN)

Establishing design guidelines for degasser layers to enhance fuel cell performance

NISHIHARA Masamichi (Professor, International Research Center for Hydrogen Energy, Kyushu University)

Area Advisor

UE Makoto (Guest Professor, Waseda University)
UCHIDA Hiroyuki (Professor, University of Yamanashi)
OKADA Shigeto (Professor, Emeritus, Kyushu University)
KAKIUCHI Hiroyuki (General Manager, Mitsubishi Chemical Corporation)
KUSHIYA Katsumi (Former Adviser, Idemitsu Kosan Co.,Ltd.)
TAKAHASHI Kenji (Professor, Kanazawa University)
TOMISHIGE Keiichi (Professor, Tohoku University)
NAKAI Hiromi (Professor, Waseda University)
HANAMURA Katsunori (Professor Emeritus, Tokyo Institute of Technology / Principal Fellow, Japan Science and Technology Agency)
YOSHIDA Masaru (Director, National Institute of Advanced Industrial Science and Technology)

Resource Circulation Area

In this technology area, we will promote research and development of materials and chemical processes that enable efficient recycling of resources with low environmental impact and contribute significantly to reducing greenhouse gas emissions.

Adopted in FY2023

A new functionalization strategy for biomass: two-stage utilization of polymeric compounds in plants

KAMITAKAHARA Hiroshi
(Professor, Graduate School of Agriculture, Kyoto University)

Development of Catalysts for Synthesis of Carboxylic Acids Using CO_2 as the Sole Carbon Source

SHISHIDO Tetsuya (Professor, Graduate School of Urban Environmental Sciences, Tokyo Metropolitan University)

Elucidation of Structure-Property Relationships of Technical Lignin toward Development of Synthetic Technology for Advanced Materials

SUZUKI Shiori
(Assistant Professor, Research Faculty of Agriculture, Hokkaido University)

Development of innovative CO_2 conversion materials using the chemical loop method

SEKINE Yasushi
(Professor, Department of Applied Chemistry, Waseda University)

Development of green hydrogenation of low concentration CO_2

TERAMURA Kentaro
(Professor, Department of Molecular Engineering, Kyoto University)

Resource circulation of materials with electron-responsive core blocks

NISHIKATA Takashi (Professor, Graduate School of Sciences and Technology for Innovation, Yamaguchi University)

Utilization of Waste Silicon for Carbon Upcycling Reactions

MOTOKURA Ken (Professor, Department of Chemistry and Life Science, Yokohama National University)

Adopted in FY2024

Resource circulation of bio-based high-performance plastics

ENOMOTO Yukiko (Associate Professor, Graduate School of Agricultural and Life Sciences, The University of Tokyo)

Pioneering an Innovative Catalytic Process for Mass Production of Valuable Resources from CO_2 Cultivation

WATANABE Ryo (Associate Professor, Department of Applied Chemistry and Biochemical Engineering, Faculty of Engineering, Shizuoka University)

Feasibility Study

Chemical recycling of polyurethanes via hydrogen gas transfer

IWASAKI Takanori (Associate Professor, Graduate School of Engineering, The University of Tokyo)

Development of resource circulation technology based on acoustodynamic materials engineering

HONDA Satoshi (Assistant Professor, Graduate School of Arts and Sciences, The University of Tokyo)

Construction of CO_2 circulation system using metal carbamate complexes as carriers

HORIKE Satoshi (Professor, Graduate School of Science, Kyoto University)

PO EZURA Hiroshi

Professor, Institute of Life and Environmental Sciences, University of Tsukuba

Green Biotechnology Area

Area Advisor

ICHIKAWA Natsuko (Director, National Institute of Technology and Evaluation)
KAMAGATA Yoichi (Senior Scientist, National Institute of Advanced Industrial Science and Technology)
KAWAGUCHI Masayoshi (Professor, National Institute for Basic Biology / Graduate Institute for Advanced Studies)
KIKUCHI Yasunori (Associate Professor, The University of Tokyo)
KUROKAWA Ken (Professor, National Institute of Genetics)
SAKAI Takako (Former Deputy CEO, Vilmorin-Mikado Co., Ltd.)
TSUJIMOTO Hisashi (Specially appointed Professor, Tottori University)
NISHIYAMA Makoto (Professor, The University of Tokyo)
HATTORI Makoto (Division Manager, Rohto Pharmaceutical Co., Ltd.)
FUKUSAKI Eiichiro (Professor, Osaka University)
MOTOHASHI Reiko (Vice-President, Shizuoka University)

Green Biotechnology Area

In this technology area, we aim to develop biotechnology to create industrial processes with low environmental impact that will enable the control, fixation, and recycling of greenhouse gases in natural environments such as forests, agricultural lands, and oceans.

Adopted in FY2023

Development of a new breeding method to improve the function of crop × microbiome holobiont driven by crop improvement

IWATA Hiroyoshi (Professor, Graduate School of Agricultural and Life Sciences, The University of Tokyo)

Development of symbiotic nitrogen-fixing crops adapted to fluctuating environments

SUZAKI Takuya (Associate Professor, Faculty of Life and Environmental Sciences, University of Tsukuba)

Reduction of paddy CH_4 emissions through optimizing the rice-microbe system

TOKIDA Takeshi
(Institute for Agro-Environmental Sciences,NARO)

Advancement of a method for enhancing plant growth through fungal secondary Metabolites

HIRUMA Kei (Associate Professor, Graduate School of Arts and Sciences, The University of Tokyo)

Breeding Innovation of Practical Plants Through a Novel Cis-identification Technology

FUJIWARA Sumire (Group Leader, Plant Gene Regulation Research Group, Bioproduction Research Institute, National Institute of Advanced Industrial Science and Technology)

Functional Bioplastics and Biochemicals Based on Amino Acid Dimerization Biotechnology

MASUO Shunsuke (Assistant Professor, Faculty of Life and Environmental Sciences, University of Tsukuba)

Adopted in FY2024

Development of Rice Varieties that Do Not Flower and their Seed Production System

IZAWA Takeshi (Professor, Graduate School of Agricultural and Life Sciences, The University of Tokyo)

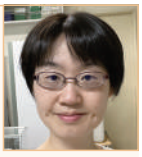
Development of a consecutive carbon utilization process for commodity chemical production by harmonizing bioprocess and chemical process

KATO Junya (Senior Research Scientist, Research Institute for Sustainable Chemistry, National Institute of Advanced Industrial Science and Technology)

Development of mycorrhizal symbiosis with high CO_2 fixation ability

SAITO Katsuharu
(Professor, Faculty of Agriculture, Shinshu Univsersity)

Development of new plant breeding techniques by optimization of codon and translation machinery



MIWA Kyoko (Professor, Faculty of Environmental Earth Science, Hokkaido University)

Feasibility Study

Breeding of highly photosynthetic plants through super Rubisco

SHIMADA Hiroshi (Associate Professor, Program of Mathematical and Life Sciences, Hiroshima University)

Technology for microbiota modulation utilizing bacterial mediators

YOSHIMURA Aya (Assistant Professor, Faculty of Pharmaceutical Sciences, Hokkaido University)

A consolidated bioplastic production from marine biomass

TAKASUKA Taichi (Associate Professor, Research Faculty of Agriculture, Hokkaido University)

PO KURODA Tadahiro

University Professor,Office of University Professor,The University of Tokyo/Chancellor, Prefectural University of Kumamoto

Deputy PO TAKENAKA Mitsuru

Professor, Graduate School of Engineering, The University of Tokyo

Semiconductor Area

Green Computing and DX Area

Semiconductor Area

In this technology area, we aim to drastically reduce power consumption of semiconductors for information and communication infrastructure, which is important for energy conservation in society as a whole.

Adopted in FY2023

Creation of ultra-wideband virtual impedance circuit for highly reliable and high-power density power converter

ITOH Junichi
(Professor, Institute of GIGAKU, Nagaoka University of Technology)

Sense & Drive IC for Energy-Saving of Power Devices

TAKAMIYA Makoto
(Professor, Institute of Industrial Science, The University of Tokyo)

3DIC thermal management based on phonon engineering

NOMURA Masahiro
(Professor, Institute of Industrial Science, The University of Tokyo)

Performance Balance Engineering for Hetero-integrate 3D CFET SRAM

MAEDA Tatsuro (Concurrent post, Semiconductor Frontier Research Center, National Institute of Advanced Industrial Science and Technology)

Spin-functional optoelectronic interface using 0-2D hybrid semiconductors

MURAYAMA Akihiro
(Professor,Faculty of Information Science and Technology, Hokkaido University)

Adopted in FY2024

Development of SiC epitaxial layer growth technology for ultra-high voltage power devices

UJIHARA Toru
(Professor, Institute of Materials and Systems for Sustainability, Nagoya University)

Development of 3D IC Cooling Technology with Ultra-High Thermal Conductivity μLHP Integration

NAGANO Hosei
(Professor, Department of Mechanical Engineering, Nagoya University)

UP-SiC: Unlocking the Future Potential of Silicon Carbide in Power Electronics *

KIMOTO Tsunenobu
(Professor, Graduate School of Engineering, Kyoto University))

Heterogeneous Material Integrated MEMS/NEMS-Photonics Platform for Secure Communication (HetMEPS) *

NISHIYAMA Nobuhiko
(Professor, School of Engineering, Institute of Science Tokyo)

＊ These projects promote collaborative R&D with UK.

Feasibility Study

Development of high performance heat conduction sheets by electric field alignment with rotating electrodes
INABA Masafumi (Assistant Professor, Faculty of Information Science and Electrical Engineering, Kyushu University)

The creation of novel zero-energy-consumption terahertz detector based on the 2D plasmon rectification
TANG Chao (Assistant Professor, Frontier Research Institute for Interdisciplinary Sciences, Tohoku University)

Area Advisor

KANAYAMA Toshihiko (Special Emeritus Advisor, National Institute of Advanced Industrial Science and Technology)
SHIMIZU Toshihisa (Specially Appointed Professor, Tokyo Metropolitan University)
TAKAGI Shinichi (Professor, The University of Tokyo)
TAKAHASHI Ryo (Chief Senior Researcher, National Institute of Information and Communication Technology)
DEGUCHI Jun (Group Manager, Kioxia Corporation)
TORIUMI Akira (Emeritus Professor, The University of Tokyo)
NISHI Hiroaki (Professor, Keio University)
FUJITA Masayuki (Professor, Kanazawa Institute of Technology)
YAMAOKA Masanao (Department Manager, Hitachi, Ltd.)
YUKITA Kazuto (Chief Professor, Aichi Institute of Technology)

Green Computing and DX Area

With the goal of drastically reducing the power consumption of information and communication systems, this technology area aims at a paradigm shift from general-purpose computing with high power consumption to low-power computing with limited application domain.

Adopted in FY2023

Electronics with spontaneous phenomena based on circulation

KIRIYA Daisuke (Associate Professor, Graduate School of Arts and Sciences, The University of Tokyo)

Low-rank computing models and efficient optical implementations of spatial photonic Ising machines

SUZUKI Hideyuki
(Professor, IST, Osaka University)

Development of Ultra-Low Power Material-Based AI Edge System

TANAKA Hirofumi (Professor, Graduate School of Life Science and Systems Engineering,Kyushu Institute of Technology)

Multilane and Multilevel Pipelined Coarse-Grained Reconfigurable Linear Array

NAKASHIMA Yasuhiko
(Professor, Graduate School of Science and Technology, NAIST)

Innovative Nonvolatile Green Computing Platform

NATSUI Masanori (Associate Professor, Research Institute of Electrical Communication, Tohoku University)

Adopted in FY2024

Low-Carbon Imitation Learning for Robotics Transformation

AWANO Hiromitsu
(Associate Professor, Graduate School of Informatics, Kyoto University)

Development of a New Technology for DC High Current Arc Interruption in SF_6-free Gas Circuit Breakers

TANAKA Yasunori
(Professor, Institute of Science and Engineering, Kanazawa University)

Building Silicon Brain Cube for Green and Trustworthy AI *

MOTOMURA Masato
(Professor, Institute of Integrated Research, Institute of Science Tokyo)

＊ This project promotes collaborative R&D with UK.

PO KONDO Akihiko

Vice President and Professor,
Graduate School of Science,
Technology and Innovation,
Kobe University

Full–scale R&D Area

Full–scale R&D Area

In this technology area, R&D projects that have passed the stage-gate evaluation under the JST-Mirai “Low Carbon Society” mission area are required to accelerate R&D to reach a stage (proof of concept: POC) where the feasibility of practical application is validated.

Area Advisor

OHSAKI Hiroyuki (Professor, The University of Tokyo)
KUWABATA Susumu (Emeritus Professor, Osaka University)
TATSUMI Takashi (Professor Emeritus, Tokyo Institute of Technology)
DOI Yoshiharu (Professor Emeritus, Tokyo Institute of Technology)

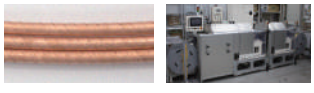
Adopted in FY2024

Low-ac-loss and robust high-temperature-superconductor technology

Project Leader **AMEMIYA Naoyuki** (Graduate School of Engineering Deprtment of Electrical Engineering,Kyoto University)

R&D Team Toshiba Energy Systems & Solutions Corporation, Niigata University, Furukawa Electric Co., Ltd., SuperPower Inc., Victoria University of Wellington

The SCSC cable (Spiral Copper-plated Striated Coated-conductor cable) is our novel concept of high-current high Tc superconductor cable, in which copper-plated multifilament (striated) coated conductors are wound spirally on a metal core in multiple layers in order to reduce ac loss and to improve the robustness against normal transition. It is bendable to any direction.
In the full-scale R&D phase of the project, we aim to demonstrate low ac loss (~1/10th), high current capacity (~2 kA), and the applicability to coils with various shapes by using demonstrator coils.



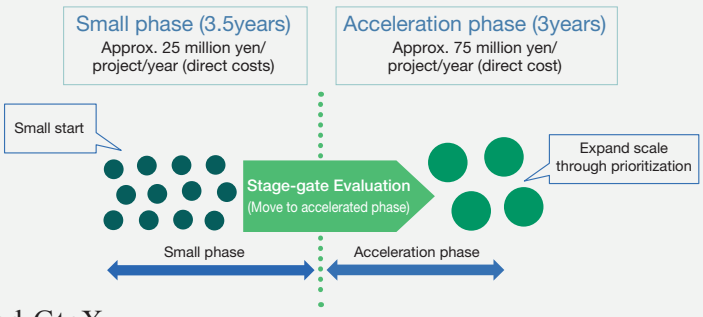
SCSC cable and cabling machine developed in feasibility study

Demonstrator coils in full-scale R&D | SC motor for aircraft propulsion | SMES

Characteristics of ALCA-Next

Stage-gate evaluation

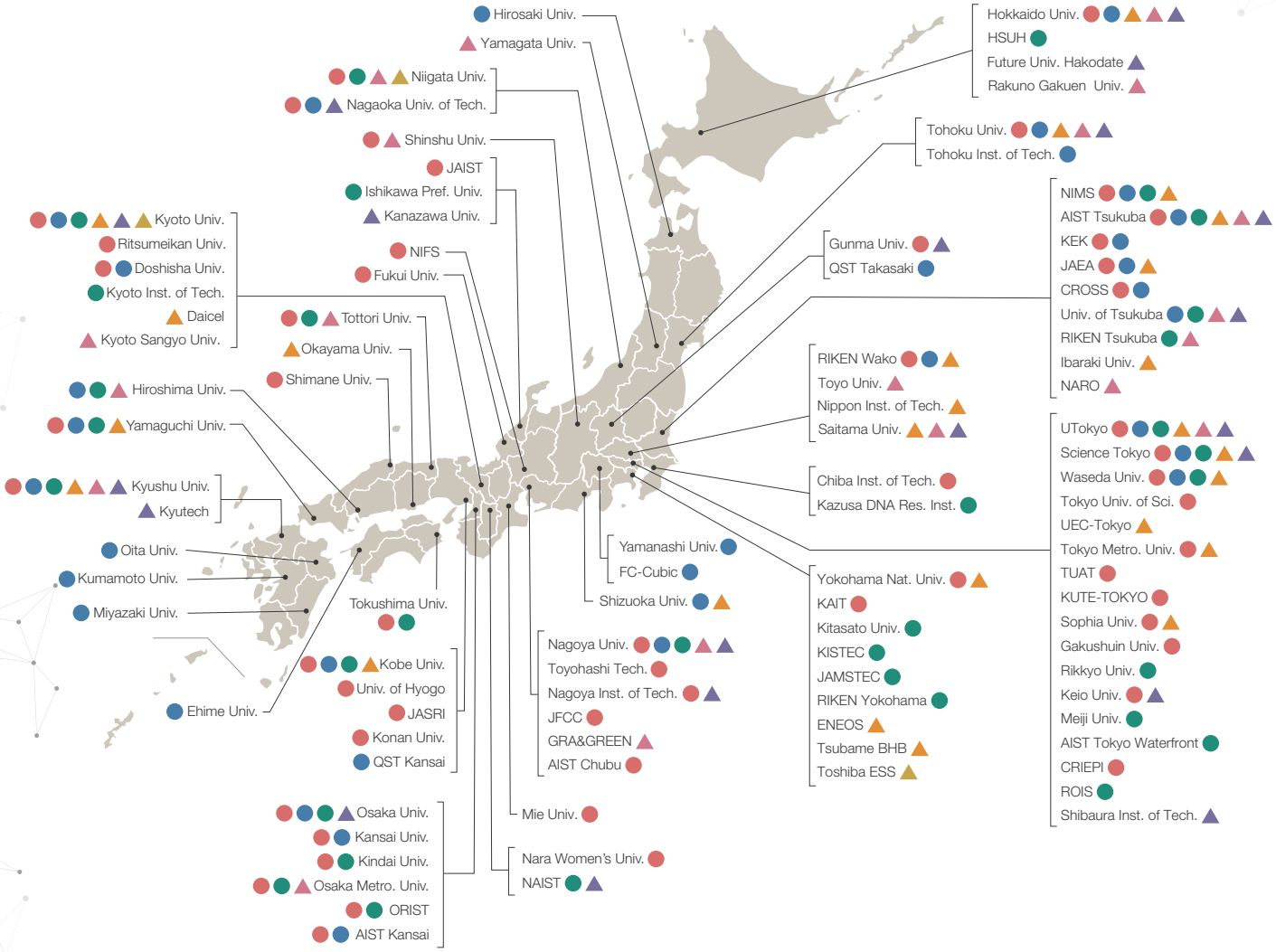
- R&D projects begin on a small scale (small phase). After stage-gate evaluation, intensive investment accelerates promising ones in an acceleration phase.



Linkage between ALCA-Next and GteX

- We will work together on data sharing, international collaboration, and fostering young researchers. In addition, from the viewpoint of promoting the sharing of equipment, we plan to consider a system whereby researchers in the ALCA-Next program can utilize the research equipment and other equipment maintained and used at GteX.
- If the PD, PO, and other management members determine that the results generated by the ALCA-Next projects are effective as elemental technologies for GteX team-based research, those ALCA-Next projects may participate in GteX program.

Researcher Distribution



GteX
- Storage Battery
- Hydrogen
- Biomanufacturing

ALCA-Next
- Energy Conversion/Energy Storage/Resource Circulation
- Green Biotechnology
- Semiconductor/Green Computing & DX
- Full-scale R&D

Contact

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2025.01 発行