

*National Institute of  
Advanced Industrial Science and Technology [ AIST ]  
Department of Energy and Environment*

**Research Institute for  
Energy Efficient Technologies**

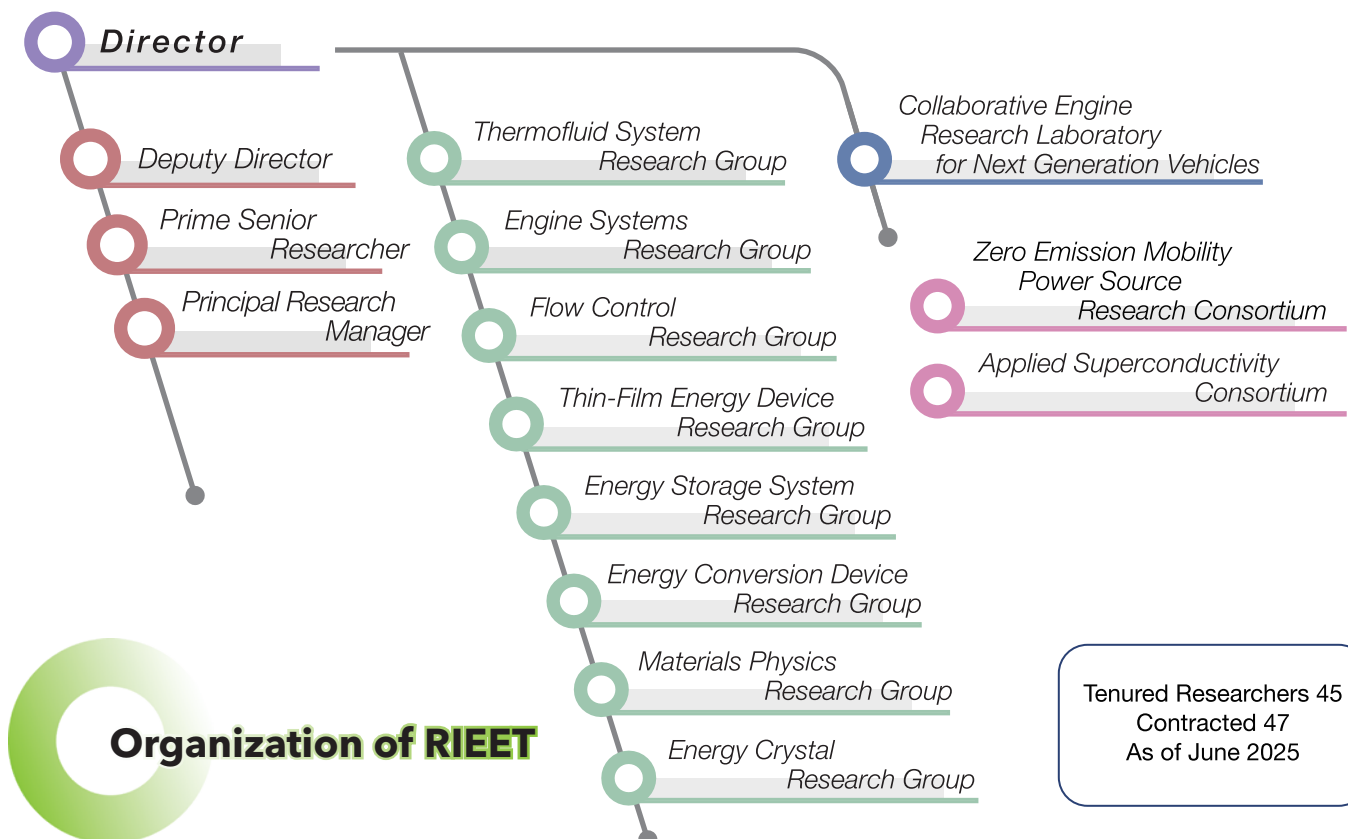


Create the Future, Collaborate Together

## Outline of RIEET

In the global trend towards decarbonization, driven by the need to make effective use of limited resources and address climate change issues, various initiatives are being promoted in Japan to realize green transformation (GX). While transforming the energy supply-demand structure and transitioning to decarbonized power sources, primarily based on renewable energy sources, energy conservation at every stage of the energy flow is essential. Research Institute for Energy Efficient Technologies (RIEET) is engaged in the research and development of innovative energy-saving technologies aimed at achieving further energy efficiency. These include high-efficiency conversion technologies for thermal, electrical, optical, chemical, and mechanical energy, as well as on thermal utilization and electrochemical fields. From fundamental research to practical societal applications, spanning a wide range from basic theory and material development to device innovations and system integration, we play a vital role in advancing green transformation through technology.

FURUSE Mitsuho  
Director



Tenured Researchers 45  
Contracted 47  
As of June 2025

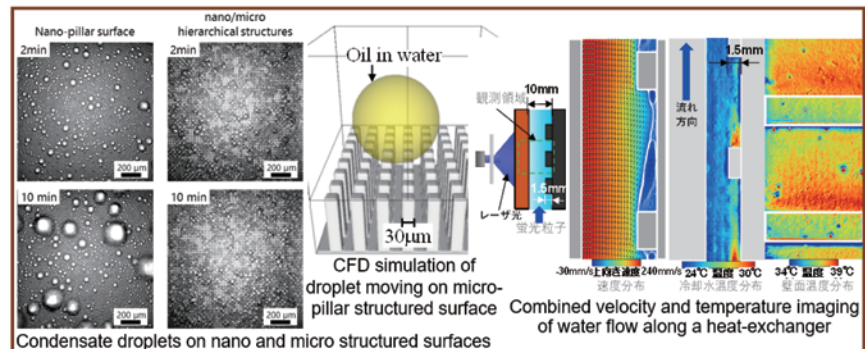
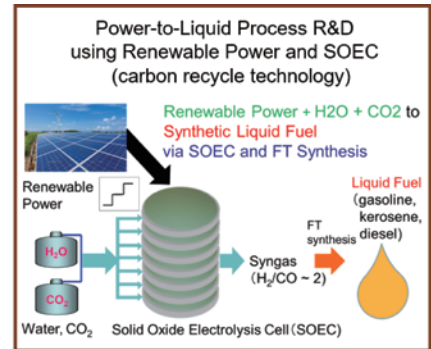
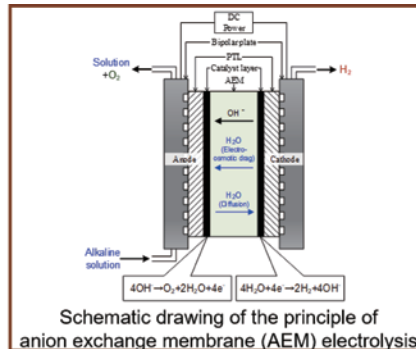
# Thermofluid System Research Group

<https://unit.aist.go.jp/rieet/tfsrg/>

Our main mission is to construct a technical foundation for the approaching of the “sustainable society”. Our research topics include microfabrication, numerical simulation, and visualization technologies related to electronic device cooling, heat-pumps, and power generation cycles. In addition, our research covers the electrochemical energy conversion devices such as fuel cells, water electrolyzers, and co-electrolyzers.

## Keywords :

Water electrolysis  
Solid oxide cell  
Boiling cooling  
Heat exchangers  
Heat pipe (Vapor chamber)  
Heat and flow visualization  
CFD (Computational fluid dynamics)



# Engine Systems Research Group

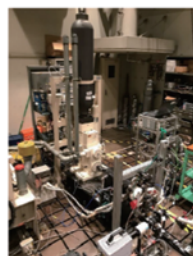
<https://unit.aist.go.jp/rieet/egsrg/>

We are conducting research that contributes to the development of zero-emission mobility technologies for vehicles in order to achieve carbon neutrality by 2050. Specifically, we are engaged in basic and pioneering research on fuel, spray, combustion, and emission purification technologies for the development of highly efficient engine systems, as well as the development of vehicle simulation models and energy management research includes power source electrification.

## Keywords :

Internal combustion engine  
e-fuel  
Spray  
Combustion  
Catalyst  
Vehicle simulation model  
Energy management

- Research on next-generation engines using e-fuel

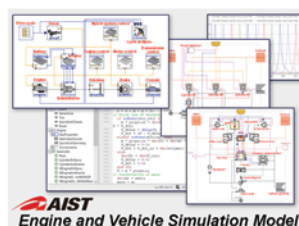


Ignition and combustion characteristics evaluation equipment

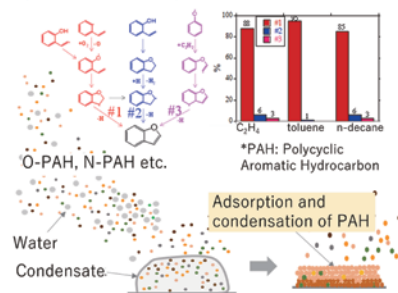


Single-cylinder engine

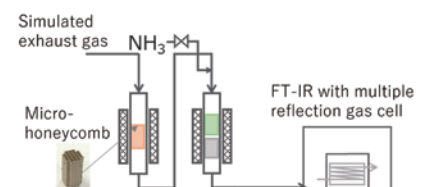
- Vehicle simulation model development and energy management



- Elucidation of deposit generation mechanism by combustion and exhaust gas derived components



- Development of evaluation methods for automotive catalysts



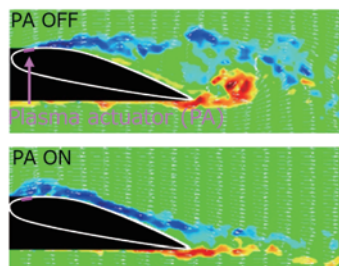
## Flow Control Research Group

<https://unit.aist.go.jp/rieet/fcrg/>

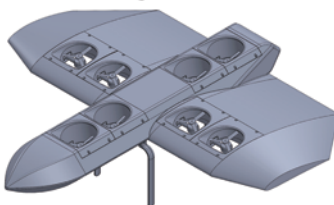
In order to improve the aerodynamic characteristics and efficiency of fluid machinery, it is necessary to develop advanced flow control devices such as sensors/actuators and to build control systems integrated them. This research group is engaged in the following research topics with the aim of realizing green innovation with the Sustainable Development Goals (SDGs) and strengthening industrial competitiveness.

1. Improvement of vehicle aerodynamic characteristics and fuel efficiency by using flow control devices
2. R&D of novel aircraft and flight control technology to improve flight performance and flight efficiency
3. Improvement of aerodynamic performance by secondary flow control of compressor and turbine rotors in turbomachinery

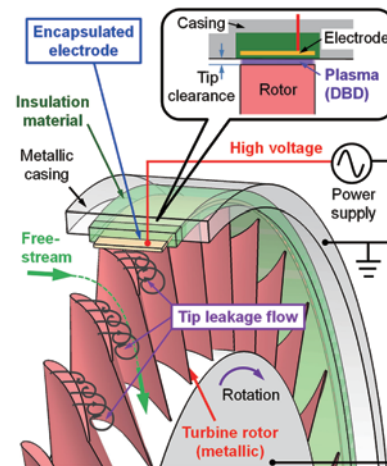
- Feedback control of flow separation on airfoil by PA



- Fixed wing VTOL UAV



- Active flow control for tip leakage vortex reduction of a turbine rotor by ring-type PA



**Keywords :**

Automotive aerodynamics, Drone, Gas turbine, Active flow control, Plasma actuator (PA), Plasma simulation, Sparse sensing, Flight control

## Thin-Film Energy Device Research Group

<https://unit.aist.go.jp/rieet/tfedrg/>

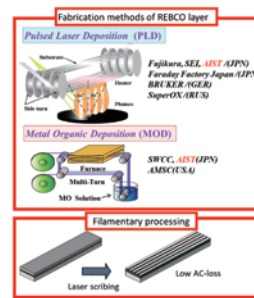
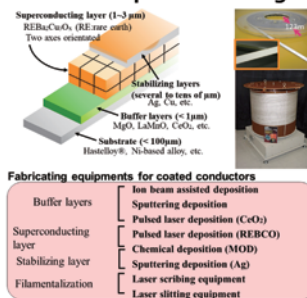
For effective utilization of energy resources and efficient use of energy, we are engaged in the research and development of following subjects.

1. R&D of basic technologies related to superconducting coated conductors for the promotion of electrification of mobility such as aircraft and automobiles
2. R&D of new materials and evaluation of new structures of chalcogenide and oxide semiconductor for solar cell applications and opto-electronic applications

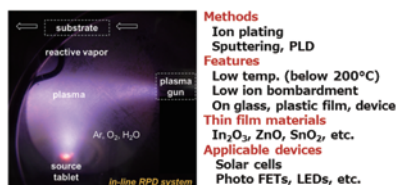
**Keywords :**

superconductivity  
wire  
aircraft electrification  
solar cells  
chalcogenides  
transparent conductive oxide  
photoelectron spectroscopy

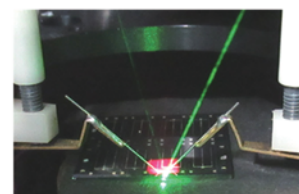
### Superconducting coated conductors



### High-mobility broadband TCOs Optoelectronic Devices



### Fabrication and evaluation of low cost and earth abundant CZTS solar cell





## Energy Storage System Research Group

<https://unit.aist.go.jp/rieet/essrg/>

Our group aims to develop highly efficient energy storage technologies that contribute to the reduction of greenhouse gases and the effective use of energy resources. Specifically, we are engaged in research on various elemental technologies (material and cell development, evaluation of stability and performance, and development of reaction system) that make up energy storage systems, including in addition of redox flow batteries (RFBs), lithium ion batteries (LiBs), and all-solid-state batteries, the development of new storage technologies using hydrogen and CO<sub>2</sub> or N<sub>2</sub> based on chemical/electrochemical reactions.

### Keywords :

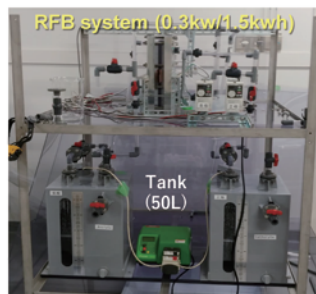
Redox Flow Batteries

Lithium-ion Batteries

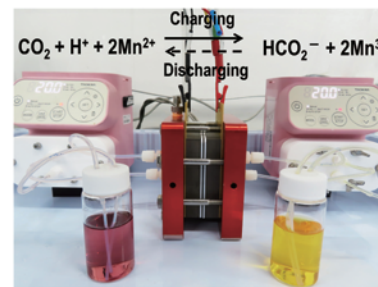
All-Solid-State Batteries

CO<sub>2</sub> electroreduction

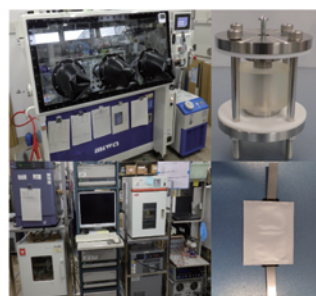
NH<sub>3</sub> electrosynthesis



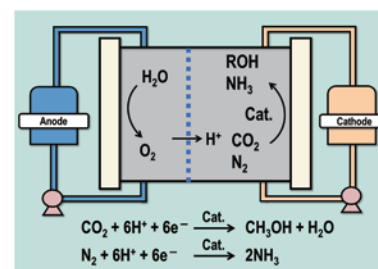
Development of novel high-performance RFBs



RFB with CO<sub>2</sub> as active material



Fabrication and evaluation of all-solid-state batteries



CO<sub>2</sub> electroreduction  
NH<sub>3</sub> electrosynthesis

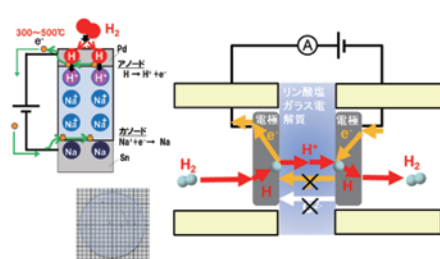
## Energy Conversion Device Research Group

<https://unit.aist.go.jp/rieet/en/groups/>

Research and development of highly efficient energy conversion technology is indispensable in meeting the increasing demands for electrification of energy. Our group is focusing on research and development of energy conservation devices operated at high temperatures – solid oxide fuel cells (SOFC) for converting with high efficiencies diverse types of fuels such as fossil and biomass fuels into electric power, and solid oxide electrolysis cells (SOEC) for converting surplus power from renewable energies into highly efficient and high-value added fuels. In particular, we play an important role as a public research institute in the ongoing efforts for the enhancement of SOFC durability/reliability through collaboration with companies and universities. As a future endeavor, even more highly efficient electrochemical energy conversion devices based on solid state ionic phenomena are envisaged by carrying out comprehensive research and development with advanced evaluation techniques including synchrotron radiation X-ray spectroscopy, and thus further contribute to the realization of a low carbon society.

**Keywords :** Energy Conversion Devices, Solid Oxide Fuel Cell (SOFC), Solid Oxide Electrolysis Cell (SOEC), Solid State Ionics, Synchrotron Radiation X-ray Spectroscopy

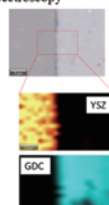
### Development of next-generation fuel cells



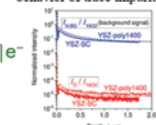
Proton Conducting Phosphate Glass Electrolyte

### Solid Oxide Cell (SOC) Analysis

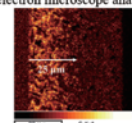
Crystal phase distribution analysis by micro-Raman spectroscopy



SIMS study on the diffusion behavior of trace impurities



Elucidation of air electrode degradation mechanism by electron microscope analysis



## Materials Physics Research Group

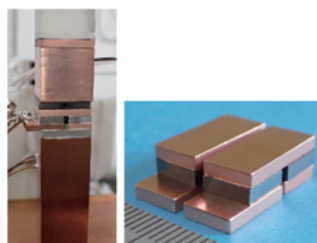
<https://unit.aist.go.jp/rieet/mprg/en/>

As a sustainable low-carbon society, it is strongly desired to develop technologies for efficient use of energy and for reducing carbon dioxide emissions. In order to respond the need of society, Materials Physics Group investigates physicochemical phenomena of thermoelectric materials, developing new materials, and development and evaluation of thermoelectric modules.

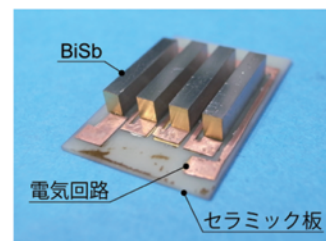
Furthermore, our group develops the post lithium-ion batteries with high capacity and power, which is considered a promising next-generation storage system.

### Keywords :

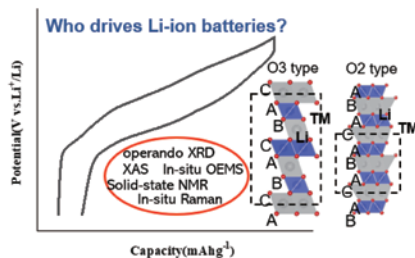
Thermoelectric materials  
Thermoelectric power generation  
Thermoelectric modules  
Electrode materials  
Lithium-S battery  
Lithium-ion battery



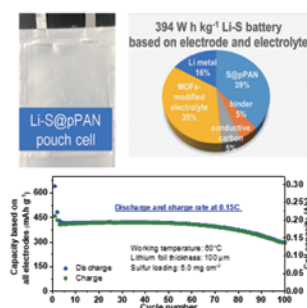
Development and evaluation of thermoelectric modules



Nernst effect modules



Toward high energy density Lithium ion batteries through developing of materials



Development of high-performance lithium-S batteries

## Energy Crystal Research Group

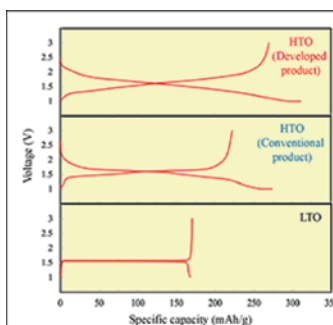
<https://unit.aist.go.jp/rieet/en/groups/>

Lithium secondary battery is expected as devices for future low carbon society by widely use and development for large power supplies of automobiles, stationary, IoT etc. Therefore, it is important to be safety, long life, higher capacity, and low cost.

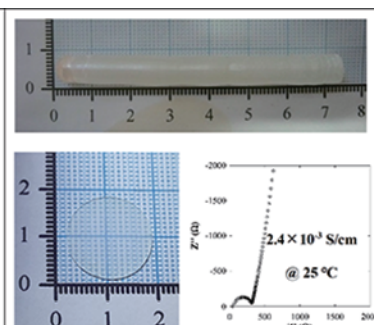
In our group, advanced oxide based materials, such as new electrode materials and solid electrolyte materials, have been developed for next generation liquid type lithium secondary battery and all solid lithium secondary battery. In addition, advanced material design has been promoted by development of new synthesis processes, and application of techniques such as crystal structure analysis and physical properties evaluation.

### Keywords :

Inorganic material synthesis, Single crystal growth, Crystal structure analysis, Lithium secondary battery, All-solid lithium secondary battery



AIST original material,  $\text{H}_2\text{Ti}_{12}\text{O}_{25}$  (HTO).  
Highest capacity in titanium oxide negative electrode materials.



World's first large single crystal of solid electrolyte (LLZ) and the single crystal separator developed by AIST original technique.  
Highest lithium ion conductivity in the oxide based materials at room temperature.

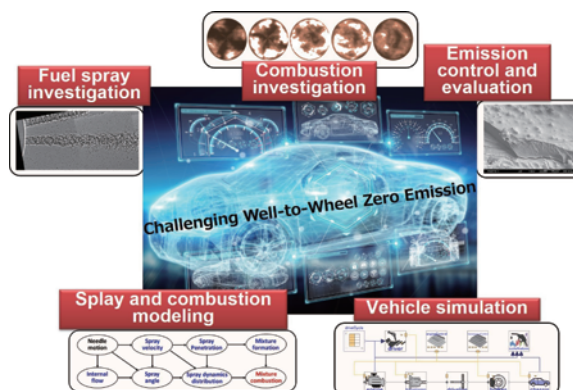
## Collaborative Engine Research Laboratory for Next Generation Vehicles

<https://unit.aist.go.jp/rieet/en/groups/>

Electrifying cars, including hybrid cars, is essential for a sustainable mobility society. On the other hand, the combination of power trains is wide-ranging, the development process has become extremely complicated, and development in the automobile industry is shifting to Model-based development (MBD). In this lab, an MBD platform for evaluation as an automobile system is building with open source software, then, linked the results of various phenomena elucidation research and device development research undertaken by AIST. to. We are taking on the challenge of R&D on the ultimate (dream) automobile "zero-emission vehicle" with the comprehensive strength of AIST.

### Keywords :

Internal combustion engine, Electrification, Automotive fuel, Fuel spray, Engine combustion, Emission catalyst, Standardization, Vehicle simulation model, Well to Wheel, Zero emission



Model-based research image for zero-emission vehicles

## Zero Emission Mobility Power Source Research Consortium

<https://unit.aist.go.jp/rieet/egsrg/zemconso/>



### ●Objectives and Purpose of Establishment

Aiming to realize zero-emission mobility through research into power sources, mainly engine systems, ZEM consortium promotes industry-academia collaboration while mutual improvement together through the discussion between academic members and corporate members, mainly The Research association of Automotive Internal Combustion Engines (AICE), on an equal footing.

### Keywords :

Mobility, zero emissions, engine (internal combustion engine), power source, fuel, spray, combustion, catalyst, industry-academia collaboration, human resource development



## Applied Superconductivity Consortium

<https://unit.aist.go.jp/rieet/AISupercoN/>



Superconductivity is a physical property exhibited by certain materials, where their electrical resistance becomes zero at cryogenic temperatures. This cutting-edge energy-conservation technology is expected to offer effective solutions to a wide range of global challenges.

To accelerate the widespread adoption of superconductivity-based innovations in society, it is essential to promote open innovation involving a broad collaboration between industries, universities, and public research institutions across the entire spectrum — materials, cooling technologies and applied system development. Additionally, nurturing the next generation of talent is crucial. The 'Applied Superconductivity Consortium (AISupercoN)' aims to facilitate information sharing and dialogue among its members, providing opportunities for open innovation. Additionally, it focuses on accelerating the development of next-generation industrial talent.

### Keywords :

High Temperature Superconductivity, Superconducting Wire and Bulk, High Field Magnet, Fusion/Accelerator, NMR/MRI, Superconducting Power Apparatus, SQUID, Quantum Computer, Cryogenics

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