JAEA

for The Advanced Research Infrastructure

for Materials and Nanotechnology in Japan

Advanced Energy Materials Development by Synchrotron Radiation and Informatics

ARIM JAEA

ARIM Japan

Implementing Agency JAPAN ATOMIC ENERGY AGENCY

Project Overview

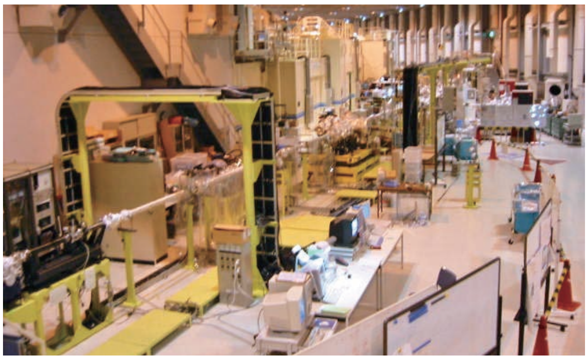
The Advanced Research Infrastructure for Materials and Nanotechnology in Japan (ARIM) is a nationwide initiative designed to advance data-driven research and development in materials science—an area of growing significance. The project leverages cutting-edge equipment, efficient data collection systems, and infrastructure optimized for the strategic use of experimental data to drive innovation.

This project comprises 25 universities and research institutions across Japan, organized into seven key technology areas. Operating under a hub-and-spoke system, the hub institutions of the project provide advanced facilities specializing in these areas, while spoke institutions offer unique equipment and specialized technologies. Together, these institutions collaboratively support and enhance research and development activities of the users.

JAEA's Beamlines

In addition to the two exclusive beamlines shown below, JAEA also has a BL14B1 device owned by QST.

BL22XU: JAEA Actinide Science I Beamline



BL23SU: JAEA Actinide Science II Beamline

EXPERIMENTAL DEVICE

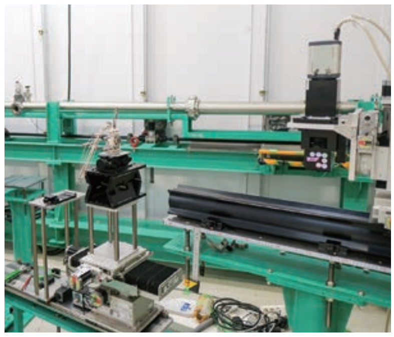
BL14B1: QST Quantum Dynamics II Beamline

Energy-dispersive XAFS measuring system

- Standard X-ray absorption spectroscopy (XAFS) measurements using a double-crystal monochromator
- Fluorescence method based on a 36-element semiconductor detector
- Sample temperature range: 20–1073 K
- Gas control system for carbon monoxide
- Atmosphere control capabilities, including nitric oxide and gas component analysis using a quadrupole mass spectrometer

*Time-resolved XAFS measurements enabled by a curved crystal monochromator.

[Usage Examples] *In-situ* XAFS analysis of hydrazine hydrate oxidation catalysts and elucidation of reaction mechanisms in secondary batteries using polyoxometalate compounds as electrode materials, among others.

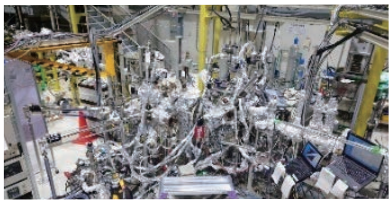


BL23SU: JAEA Actinide Science II Beamline

Surface chemistry experiment apparatus

- *In-situ* observation and real-time measurement of chemical reaction dynamics, such as adsorption/desorption and oxidation/reduction, on metal and semiconductor surfaces
- Surface cleaning in the preparation chamber using Ar ion sputtering and heating up to 1450 K.
- LEED and AES instruments for observing reconstructed surfaces and chemical compositions.
- Gas molecules with varying kinetic energies supplied to the sample surface using a gas doser or supersonic molecular beam apparatus.

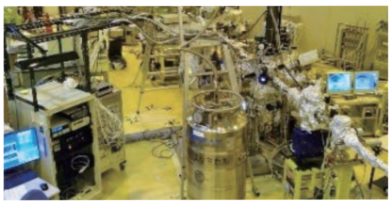
[Usage Examples] Investigation on formation processes of graphene and insulating films on SiC surfaces, surface and interface analysis for the development of GaN-based power electronics, and observation of chemical bonding states during the oxidation process of hafnium silicide, among others.



Soft X-ray photoelectron spectrometer

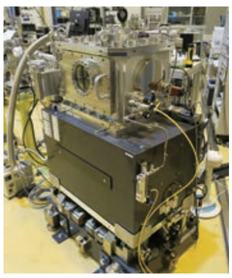
- Photoelectron spectrometer capable of determining band structures through Angle-Resolved Photoelectron Spectroscopy (ARPES).
- Precise electronic structure measurements of rare earth elements and 3d transition metal compounds.

[Usage Examples] Uranium and rare earth compounds



Scanning Transmission X-ray microscope apparatus (STXM)

- Element-selective chemical analysis tool with nanoscale spatial resolution
- Soft X-rays, focused to tens of nanometers, for sample irradiation, enabling two-dimensional mapping of transmitted (absorbed) light intensity by scanning the sample
- High effectiveness in analysis of particulate samples or samples with significant heterogeneity
- Analysis of elemental distribution, valence states, and chemical bonding states for a wide range of elements, including lanthanides, actinides, 3d transition metals, and nitrogen/oxygen in organic compounds
- Photon energy: 400–1900 eV; maximum spatial resolution: 30 nm (with 25 nm FZP); sample temperature: 300 K



Role of the Japan Atomic Energy Agency

The National Research and Development Agency, Japan Atomic Energy Agency (JAEA) operates two dedicated beamlines at a large synchrotron radiation facility called SPring-8, and collaborates with the University of Tokyo (hub institution) and Hiroshima University (spoke institution) to support the technical domain of "Materials Enabling Innovative Energy Conversion." In its efforts to address pressing environmental challenges, such as achieving carbon neutrality, JAEA provides advanced microstructure analysis and microfabrication technologies. Additionally, JAEA fosters an environment conducive to strategic data exploitation.

By leveraging eight analytical instruments installed across its two dedicated beamlines and one beamline owned by the National Institutes for Quantum Science and Technology (QST), JAEA facilitates a broad range of material analyses, including material composition, electronic states, crystal structures, interface structures, and local structures. These capabilities support the development of advanced materials, such as novel solar cells and power devices. The use of high-intensity synchrotron radiation enables precise analysis of minute samples and ultra-thin surface and interface structures, advancing cutting-edge research and innovation in material science.

Technical Consultation

Even if you have no prior experience with synchrotron radiation experiments, please feel free to consult us regarding potential usage. Consultations are free of charge. For further details, please contact JAEA's dedicated office or visit the official website.

Contact Office – JAEA Research and Development Promotion Department, Research Promotion Division
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〈JAEA Facility Sharing System in General〉
https://tenkai.jaea.go.jp/facility/
〈JAEA Device Usage〉
https://tenkai.jaea.go.jp/facility/3-facility/05-support/index-141.html
〈JAEA ARIM〉
https://arim.jaea.go.jp

Data and Results Obtained

Projects supported under this program are required, as a general rule, to provide the experimental data obtained, with results made publicly available. For those seeking confidentiality, support is available through JAEA's independent programs. For further information, please contact the designated office.

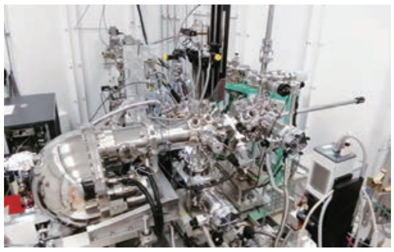
*New equipment may be added in the future.
For the latest registered devices, please consult our website (https://arim.jaea.go.jp).

BL22XU: JAEA Actinide Science I Beamline

Hard X-ray photoelectron spectrometer

- Reduction of the impact of surface contamination, enabling the acquisition of bulk information
- Effective in analysis of the electronic structure of samples that are difficult to clean and devices with internal nanoscale multilayer structures
- Selection of excitation light energies (6, 8, 10 keV), enabling adjustment of the detection depth according to specific objectives

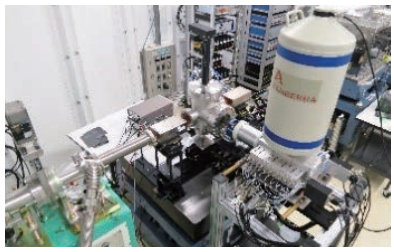
[Usage Example] Analysis of damage in radiation-resistant spin-driven thermoelectric devices



XAFS measuring system

- XAFS measurements based on high-brightness, high-energy X-rays from an undulator.
- Time-resolved rapid measurements (Quick-XAFS)
- Various detectors, including ion chambers, NaI scintillation detectors, and Ge semiconductor detectors
- Cryostat for low-temperature measurements

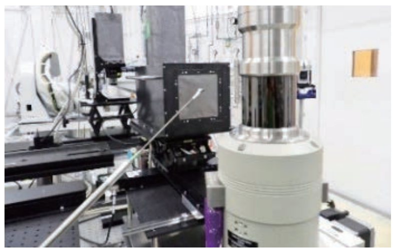
[Usage Examples] Structural and electronic state analysis for the design of functional molecules and for the development of Rh(III) extraction agents, among others.



The apparatus for imaging and measuring material stress

- Internal strain and stress distribution measurements and imaging, primarily for metallic materials
- *In-situ* measurements under real-world conditions in high-temperature (up to 900℃) and high-load (up to 5 kN) environments
- Simultaneous operation of multiple two-dimensional detectors for time-resolved measurements, with strain and stress measurements at a maximum speed of 200 Hz and imaging at 2000 Hz

[Usage Examples] Evaluation of stress, strain, and dislocation density during deformation of metallic materials, and observation of melting and solidification phenomena during laser processing, among others.



κ-type X-ray diffractometer

- Suitable for surface structure analysis
- Standard six axes and an additional rotational axis in the horizontal plane of the system for enhanced flexibility
- Simultaneous measurements of electrochemical properties using a potentiostat and other devices
- Sample temperature range: from 10 K (with a helium-circulating cryostat) to 1000 K (with an electric furnace)

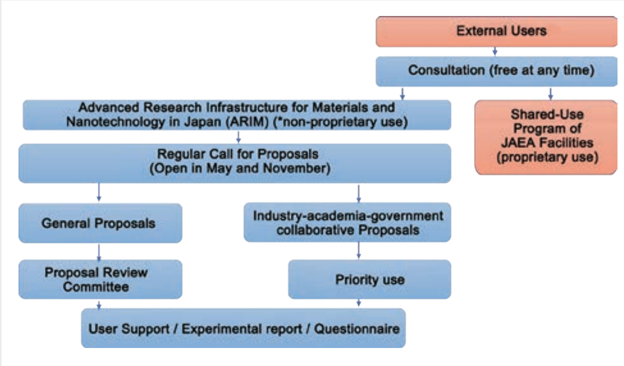
[Usage Examples] Synthesis and microstructure analysis of barium titanate nanocubes.

Utilization Process

An overview is provided below.
For further details, please visit the website or contact the office listed below.

1. Project Recruitment

Individuals interested in using ARIM's registered devices must submit a project application. Recruitment takes place twice annually:A Term (first half of the fiscal year), around November of the previous year; B Term (second half of the fiscal year), around May of the relevant year. Before submitting your application, it is recommended that you consult with the designated contact person for the relevant device. Contact details will be provided upon initiating the consultation. Priority may be given to certain projects funded through a competitive process. All submitted projects undergo a review by the Joint Project Review Committee of JAEA and QST, which will determine approval and utilization schedule.



2. Submission of Reports

Upon project completion, a summary report detailing the implementation must be submitted by the specified deadline.
For SPring-8 projects, reports will be published online on the SPring-8 website 60 days after the end of the term (within two weeks of submission).
*Note: Utilization reports will be disclosed in the following fiscal year.

3. Publication of Results

Project results must be disclosed within three years after the end of the implementation period (e.g., by September 30, 2028, for projects completed in the 2025 A term). Results must be shared through one of the following methods, citing both the SPring-8 and ARIM project numbers:

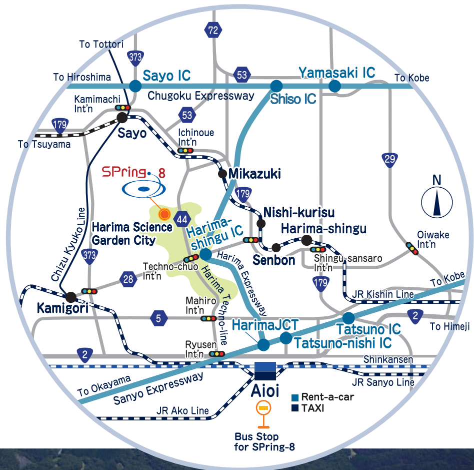
① Peer-reviewed publications (including peer-reviewed proceedings and doctoral thesis)
② SPring-8/SACLA User Results Reports
③ Public technical reports approved by the SPring-8/SACLA Review Committee.

Additionally, research results must be registered in the online database (see "SPring-8 User Information" section on the website). Within two years after the end of the implementation year, please submit a "Results Disclosure Notification Form" along with reprints of any published results, such as journal articles (JAEA).

Utilization Fees and Others

1. Handling fees (tax included): ¥13,300 per project
2. Utilization fees (tax included; per 8-hour shift)

Without data submission: Basic fee ¥19,090; Priority fee ¥62,830
With data submission: Basic fee ¥13,370; Priority fee ¥43,980
*These fees are subject to change based on future circumstances. Please, visit the dedicated website for the latest information.
https://arim.jaea.go.jp



Access to SPring-8

Access by JR Line and bus

・Approximately 40 minutes by bus from Aioi Station on the Sanyo Shinkansen or Sanyo Main Line
*Scan the QR code for the bus timetable.

Access by car

・Approximately 5 minutes from Harima Shingu Interchange on the Harima Expressway

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SPring-8/SACLAの全景 Panoramic view of SPring-8/SACLA
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