

5. COLLABORATION WORKS IN THE LABORATORY FOR COMPLEX ENERGY PROCESSES

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1. Introduction

The laboratory was established for research on advanced energy by the collaborative projects among the researchers in the Institute of Advanced Energy to promote joint activity of our knowledge and wisdom to find solutions to these interdisciplinary energy/environmental problems. From such a viewpoint, the research targets of the laboratory are focused on two specific fields, (i) "advanced studies of science and technology on plasma energy and quantum energy" and (ii) "innovative studies of nano-bio functional materials for power generation". For this purpose, two sections (A2 and A3 mentioned below) are founded. In addition, A1 section promotes international or domestic collaborative research and assists activities such as academic meetings and seminars. In the fiscal year of 2025, strong advancement of the collaboration was achieved.

Close connection between related research fields in the institute have yielded unique and interesting outcomes from the collaboration. The laboratory takes charge of organizing and promoting the cooperative research project as a center of research activity in the Institute. The research teams were formed by mostly young generation staffs and students in the institute lead by associate professor or assistant professor, and participated in specific projects to carry out their subjects. The cooperative research activities will be published in a publication edited in the laboratory at the end of the fiscal year. Management of the technical staffs for large scale equipment are also under the responsibility of the laboratory.

A1 Division of International and Industrial Partnership

This division promotes international collaborative research on advanced energy to lead the field of energy science and technology as a worldwide pioneer. For this purpose, the symposium and the workshop organized by institution member are supported. Following disappearance of the threat of COVID-19, meetings or exchanges were energetically held.

A2 Division of Plasma and Quantum Energy Research

This section promotes studies on advanced plasmas and quantum energy for realizing future energy systems, integrating plasma energy science and advanced energy material research. In particular, based on the results obtained in our related groups, we aim at extending the research fields and contributing to human society by utilizing the existing key devices such as Heliotron J, MUSTER and inertial electrostatic confinement (IEC) device, which have been developed in the institute.

A3 Division of Soft Energy Science Research

This division promotes studies on emergent materials and systems for realizing next generation soft energy system. In particular, functional nano- and bio-materials to efficiently utilize solar energy and bio-energy are studied by integrating laser science, nanotechnology, and bio-technology. We aim at extending our research fields by utilizing the existing devices such as System for Creation and Functional Analysis of Catalytic Materials, SEMs, SPM, NMRs including 800 MHz LC-MS/NMR, Solar Simulator, KU-FEL and various laser systems.

2. The cooperative research program

In the fiscal year of 2025, two categories were set up: (1) "Cooperative Research" for cross sectional research and (2) "Sprouting Research" for challenging research proposal. The submitted proposals were evaluated by the selection committee organized by a center director, a program chair and three division chairs. Five "Sprouting Research" proposals were approved. The number of research subjects is listed in Table 1 according to the division. A brief summary of the cooperative research subjects carried out in FY2025 is shown in the next page.

Table 1 Number of the accepted research subjects according to the division

Category			Total
A1	A2	A3	
6	2	3	11

The individual research subjects are as follows.

Supporting Activities on International and Industrial Collaborative Research

A1

“The 12th Korea-Japan Joint Summer School on Accelerator and Beam Science, Nuclear Data, Radiation Engineering and Reactor Physics”

- H. Ohgaki, H. Zen (Institute of Advanced Energy, Kyoto University)
- H.-J. Kwon, K.-J. Mun (KAERI)
- B. Zhuang, K. Nishimoto (Graduate School of Energy Science, Kyoto University)
- K. Masuda (National Institutes for Quantum Science and Technology)
- N. Shigyo (Kyushu University)

“2nd Symbio Community Forum Lecture 2025 - Establishing an R&D hub for next-generation solar cells in the Kansai region”

- K. Morishita (Institute of Advanced Energy, Kyoto University)
- S. Yoshikawa, T. Morii, M. Shioji (Kyoto University)
- M. Abe (Graduate School of Energy Science, Kyoto University)
- A. Gofuku (Okayama Prefectural University)
- K. Ishihara (Office of Institutional Advancement and Communications, Kyoto University)
- J. Nitta (Arcadia Systems Inc.)
- T. Matsuoka (Utsunomiya University)
- H. Iwakiri (University of the Ryukyus)
- T. Miyasaka (Toin University of Yokohama)
- M. Ohshima (Panasonic Corporation / ESL Laboratory)
- D. Hino (Nippon chemicals Co., Ltd.)
- A. Nakazawa (GUALA Technology)
- K. Takata (Takata Planning)

“Synthesis of defect engineered nanomaterials and their applications for CO₂ conversion into fuels and useful compounds”

- A. Rajendran (Institute of Advanced Energy, Kyoto University)
- D. Rangappa, V. A. Niranjana, M. B. Ravindranath, Shaguftha (Visvesvaraya Technological University)
- N. R. Marilingaiah (Nagarjuna College of Engineering & Technology)

“Finalizing the Operational Design of an International VHH Epitope Prediction Challenge and Establishing a CAPRI-Compliant Evaluation Platform”

- T. Nagata (Institute of Advanced Energy, Kyoto University)
- S. Burley (Rutgers, The State University of New Jersey/ RCSB PDB)
- B. Zhang, Z. Yue, J. Wang (Icahn School of Medicine at Mount Sinai)
- A. Fiser (Albert Einstein College of Medicine)
- A. Imura (COGNANO Inc.)

“4th Symbio Community Forum Lecture 2025 - Latest Trends and Challenges in Renewable Energy”

- K. Morishita, J. Yagi, K. Nagasaki (Institute of Advanced Energy, Kyoto University)
- H. Yoshikawa, S. Yoshikawa, M. Shioji, K. Yoshikawa (Kyoto University)
- K. Ishihara (Office of Institutional Advancement and Communications, Kyoto University)
- J. Nitta (Arcadia Systems Inc.)
- T. Terai (The Institute of Applied Energy)
- K. Akimoto (Research Institute of Innovative Technology for the Earth)
- Y. Hayashi (Yamato University)
- T. Nakamura (The University of Osaka)
- K. Mishima (Kansai Atomic Energy Conference)
- Y. Tsujikura (Japan Society of Maintenance)

“Organization of the Biophysics seminar on nucleic acid research”

- Y. Yamaoki, T. Nagata, K. Kondo, M. Katahira (Institute of Advanced Energy, Kyoto University)
- T. Sakamoto (Tokyo University of Pharmacy and Life Science)

Cooperative Research

A2

None

A3

None

Sprouting Research

A2

“Application of the regularized tomography method to sawtooth oscillations on plasma parameters in Heliotron-J”

- Shinichiro Inagaki, K. Nagasaki, Shigeru Inagaki, S. Kobayashi, S. Kado, F. Kin (Institute of Advanced Energy, Kyoto University)
- M. Zanini (Max Planck Institute for Plasma Physics)

“Development of a Heterojunction Control Method on Two-dimensional Semiconductors through Nano-fabrication Process”

- S. Matano (Institute of Advanced Energy, Kyoto University)

A3

“Engineering Advanced Catalysts for the Photoelectrochemical Conversion of Carbon Dioxide”

- A. Rajendran, T. Nohira, E. Nakata, T. Kajio (Institute of Advanced Energy, Kyoto University)
- V. A. Niranjana (Visvesvaraya Technological University)

“In-cell NMR study on the effect of intracellular environmental change on nucleic acid structure”

- Y. Yamaoki, T. Nagata, M. Katahira (Institute of Advanced Energy, Kyoto University)

“Conversion of CO₂ into diamond using molten salt electrolysis and liquid metal electrode”

- Y. Norikawa (Institute of Advanced Energy, Kyoto University)

The Laboratory Seminars

Laboratory Seminars

The Laboratory promotes topical academic seminars in order to strengthen the research activities in each research section and to enhance the mutual cooperation among a lot of academic fields. In the fiscal year of 2025 the aims and progress reports of seven cooperative researches were presented and discussed, as summarized below. The Laboratory also planned a symposium on April 3, 2026 for presentation of the cooperative research results in FY2025.

(1) September 5, 2025

Shinichiro Inagaki

“Application of the regularized tomography method to sawtooth oscillations on plasma parameters in Heliotron-J”

Institute of Advanced Energy, Kyoto University

(2) October 3, 2025

S. Matano

“Observation of Quantum Optical Phenomena in Interlayer of Two-Dimensional Semiconductors”

Institute of Advanced Energy, Kyoto University

(3) October 3, 2025

A. Rajendran

“Engineering Advanced Catalysts for the Photoelectrochemical Conversion of Carbon Dioxide”

Institute of Advanced Energy, Kyoto University

(4) November 7, 2025

Y. Norikawa

“CO₂ utilization technology via molten salt electrolysis”

Institute of Advanced Energy, Kyoto University

(5) November 7, 2025

Y. Yamaoki

“In-cell NMR study on the effect of intracellular environmental change on nucleic acid structure”

Institute of Advanced Energy, Kyoto University

(6) November 10, 2025

D. Rangappa

“Defect Engineered Nanostructures for Energy Storage and Generation”

Visvesvaraya Technological University

(7) November 10, 2025

N. R. Marilingaiah

“Advanced Nanostructure Materials and their Applications in Energy, Environment, and Biomedical Fields”

Nagarjuna College of Engineering & Technology