5. COLLABORATION WORKS IN THE LABORATORY FOR COMPLEX ENERGY PROCESSES

Collaboration Works in
The Laboratory for Complex Energy Processes

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 of2024, 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 2024, two categories were set up: (1) “Cooperative Research” for cross sectional research and (2) “Sprouting Research” for challenging research proposal by Assistant and Associate Professors. The submitted proposals were evaluated by the selection committee organized by a center director, a program chair and three division chairs. Three “Cooperative Research” proposals and four “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 FY2024 is shown in the next page.

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

Category			Total
A1	A2	A3	
5	3	4	12

The individual research subjects are as follows.

Supporting Activities on International and Industrial Collaborative Research

A1

"Organization of the seventh research seminar on RNA research, and presentation and exchange of information in the seminar"

- M. Katahira, T. Nagata (Institute of Advanced Energy, Kyoto University)
- R. Kurokawa, R. Yoneda (Saitama Medical University)
- T. Yamashita (Hoshi University)
- N. Shiina (National Institute for Basic Biology)
- S. Ishigaki (Nagoya University)
- T. Oyoshi (Shizuoka University)
- T. Mannen (Ritsumeikan University)
- A. Takeuchi (Ehime University)
- T. Ohyama (RIKEN)
- K. Furugori (Yokohama City University)
- T. Nobeyama (Kyoto University)

"Support to the Eco-Energy and Materials Science and Engineering Symposium 2025 (EMSES2025)"

- H. Ohgaki, M. Katahira, K. Nagasaki, E. Nakata (Institute of Advanced Energy, Kyoto University)
- S. Pivsa-Art, S. Pavasupree, K. Bhumkittipich, B. Plangklang, S. Niamlang (Rajamangala University of Technology Thanyaburi)
- T. Sagawa, T. Yabutsuka (Graduate School of Energy Science, Kyoto University)
- H. Kamitakahara (Graduate School of Agriculture, Kyoto University)
- Y. Aso, K. Yamada (Kyoto Institute of Technology)
- M. Tanaka, H. Tarao (National Institute of Technology Kagawa College)

"The 31st FEL and High-Power Radiation Workshop"

- H. Ohgaki, H. Zen (Institute of Advanced Energy, Kyoto University)
- T. Hara, T. Kii (RIKEN)
- T. Kanai (Institute for Molecular Science)
- R. Hajima, M. Kando, K. Kawase (KPSI, QST)
- M. Hashida (Tokai University)
- M. Kato (Hiroshima University)
- N. Sei (AIST)
- J. Fujioka (Tokyo University of Science)
- Y. Hayakawa (Nihon University)
- Y. Takashima (Nagoya University)
- S. Miyamoto (Osaka University)
- K. Yoshida (Kumamoto Industrial Research Institute)

"4th Switzerland-Japan Biomolecular Chemistry Symposium (SJBCS2024)"

- E. Nakata, A. Rajendran, P. Lin, C. Surachada (Institute of Advanced Energy, Kyoto University)
- S. Futaki, M. Imanishi, Y. Kawaguchi (Institute for Chemical Research, Kyoto University)
- I. Hamachi (Graduate School of Engineering, Kyoto University)
- A. Steinauer, B. Fierz (EPFL)
- Liang, A.D., P. Rivera-Fuentes (University of Zurich)
- M. Frei, D. Hilvert , J. Bode (ETH Zurich)
- C. Cao, S. Hoogendoorn, N. Winssinger, S. Matile (University of Geneva)
- T. Ward (University of Basel)
- H. Suga, K. Sugihara (The University of Tokyo)
- K. Matsuura (Tottori University)
- K. Kinbara, M. Kamiya (Institute of Science Tokyo)
- H. Abe (Nagoya University)
- S. Tsukiji (Nagoya Institute of Technology)
- Y. Hori (Kyushu University)
- R. Watanabe (RIKEN)
- P. Laurino (Okinawa Institute of Science and Technology)
- N. Fujieda (Osaka Metropolitan University)
- H. Ishida (Kansai University)

"5th Symbio Community Forum Lecture 2024 - Japan's Energy Policy: Seventh Strategic Energy Plan"

- K. Morishita (Institute of Advanced Energy, Kyoto University)
- H. Yoshikawa, S. Yoshikawa, T. Morii, M. Shioji, K. Mishima (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 (Department of Education, University of the Ryukyus)
- T. Terai (The Institute of Applied Energy)
- K. Akimoto (RITE)

Cooperative Research

A2

“Nitride/Oxide double coating using dielectric barrier discharge”

- J. Yagi, S. Kobayashi, S. Inagaki (Institute of Advanced Energy, Kyoto University)
- T. Ishii, Y. Ito (Graduate School of Energy Science, Kyoto University)

A3

“Optimization of Synthesis of functional molecules from carbon dioxide”

- E. Nakata, J. Yagi, S. Onishi (Institute of Advanced Energy, Kyoto University)

“Flattening DNA Origami by Intercalators and its Application for Enzymatic Reactions: Steady-State and Time-Resolved Fluorescence Analyses”

- A. Rajendran (Institute of Advanced Energy, Kyoto University)

Sprouting Research

A2

“Simultaneous measurement of electron density and electron temperature fluctuations in Heliotron J”

- F. Kin (Institute of Advanced Energy, Kyoto University)

“Reproducing Aurora Green Emission in Laboratory Plasma”

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

A3

“Woody biomass degradation in membrane bioreactor using lytic polysaccharide monooxygenase”

- K. Kondo (Institute of Advanced Energy, Kyoto University)

“Electrochemical synthesis of MXene compounds using molten salts”

- T. Yamamoto, K. Kawaguchi (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 2024 the aims and progress reports of eight cooperative researches were presented and discussed, as summarized below. The Laboratory also planned a symposium on April 4, 2025 for presentation of the cooperative research results in FY2024.

(1) July 12, 2024
Daniel A. Scherson
"In situ Spectroscopy: Energy Storage and Electrosynthesis Applications"
Department of Chemistry, Case Western Reserve University

(2) August 30, 2024
F. Kin
"Turbulent transport in magnetically confinement fusion plasmas and studies in Heliotron J"
Institute of Advanced Energy, Kyoto University

(3) August 30, 2024
S. Kado
"Auroral emission spectroscopy and its laboratory reproduction trial"
Institute of Advanced Energy, Kyoto University

(4) September 13, 2024
J. Yagi
"Activities in Advanced Atomic Energy section for the development of the advanced breeding blanket system in fusion reactors"
Institute of Advanced Energy, Kyoto University

(5) October 4, 2024
E. Nakata
"Optimization of Synthesis of functional molecules from carbon dioxide"
Institute of Advanced Energy, Kyoto University

(6) October 4, 2024
K. Kondo
"Application of oxidative enzymes for woody biomass decomposition"
Institute of Advanced Energy, Kyoto University

(7) December 20, 2024
A. Rajendran
"Stable DNA nanomaterials for practical applications"
Institute of Advanced Energy, Kyoto University

(8) December 20, 2024
T. Yamamoto
"Toward the development of rare-metal-free batteries"
Institute of Advanced Energy, Kyoto University