4. JOINT USAGE/RESEARCH PROGRAM

Joint Usage/Research Center Program
“Zero Emission Energy Research”

It is an urgent task to find out the best solutions against the energy and environmental problem for ensuring the sustainable society on the earth. The new energy system for this purpose has to be an environmentally friendly or ecological one. Here, we should consider not only the energy sources but also the efficiency in each phase of energy usage. The former should have good quality and enough quantity. The latter should be considered including the so-called “three Rs (Reduce, Reuse and Recycle)” in the energy system;

- Reduce of energy consumption, environmental pollutant such as greenhouse gas, waste-heat, hazardous waste, etc.
- Reuse of waste heat/energy, etc.
- Recycle of fuel, etc.

In order to realize them, only the extension of the present technology is not enough. Interdisciplinary studies with innovative ideas are indispensable to realize the energy system for next generation.

We propose a new concept of Zero Emission Energy as a typical model of Advanced Energy. IAE Zero Emission Energy Research aims at the realization of environmentally friendly energy system for sustainable society with minimum emission of environmental pollutants and with maximum utilization of energy and resources. Since FY2011, we had operated a project, “Joint Usage/Research Program on Zero Emission Energy”, which is the program authorized by the MEXT. We have started the second term of the Program from FY2016 and the third phase in FY2022. Here, we aim to (1) promote interdisciplinary joint usage/research studies for Zero Emission Energy Science & Technology, (2) promote education & practical training for young researchers and (3) explore future horizon of Advanced Energy System for sustainable development. IAE provides many unique & attractive facilities for the Joint Usage/Research not only in the field of advanced plasma & quantum energy but also in the field of soft energy.

Many researchers have participated in this program. In FY2023, there were 94 Joint Usage/Research collaboration subjects (including 2 workshops) on Zero Emission Energy, with more than 300 visiting participants, including graduate and undergraduate students, from 40 universities and institutions all over Japan. Researchers from 3 foreign universities also participated in the program. The results of these collaborations are summarized in the report "IAE Joint Usage/Research Program on Zero Emission Energy 2023". On March 28, 2024, a meeting was held online to present some of the outstanding results obtained in FY2023. If you are interested in this collection, please contact the office of Zero Emission Energy Research.

In addition to the Joint Usage/Research collaborations, we organized "The 14th International Symposium of Advanced Energy Science - Research Activities on Zero-Emission Energy Network" on August 30 to September 1, 2023. This symposium was the first full-scale in-person event since the onset of the COVID-19 pandemic and was able to accommodate participants from distant locations. This symposium consisted of oral session, ZE poster session, student poster session, and parallel seminars. The oral session was also simultaneously streamed on YouTube. The oral session was attended by 252 participants and the parallel seminars by 61 researchers, attracting a large number of participants. In total, 324 scientists and students, including 5 foreign and 5 domestic invited speakers, participated in the symposium. At the student poster session, awards were given for outstanding presentations.

We are also operating “Zero Emission Energy Network” to share the knowledge of Advanced Energy and Zero Emission Energy with researchers in the fields of energy science and technology, since world-wide activities for Zero Emission Energy Research are indispensable for the realization of sustainable society.

In FY2022, the Integrated Research Center for Carbon Negative Science was established at the Institute under the new concept of energy science and engineering, which sprouted from zero-emission energy research. We will continue to promote high-quality research and high-quality collaborations in multidisciplinary academic fields and work closely with domestic and international research institutions to contribute to the related communities and to the enhancement of Japan's research capabilities.

Poster of the 14th International Symposium

List of Zero Emission Energy Joint Usage/Research Subjects in FY 2023

(Subject, Principal Researcher, IAE Key Person)

Ionics of super-locally-concentrated electrolytes, Atsushi Kitada, Masato Katahira

Development and evaluation of Fe_2M type bulk Laves compounds, Ryuta Kasada, Keisuke Mukai

Structural analysis of lignocellulosic biomass by NMR spectroscopy toward decarbonized society, Hiroshi Nishimura, Masato Katahira

Fermentation of a useful polysaccharide using hydrogen sulfide as energy source, Minoru Takeda, Masato Katahira

Influence of Alloying Elements on Radiation Damage Formation and Hydrogen Isotope Trapping in Tungsten, Yuji Hatano, Kiyohiro Yabuuchi

Visualization of mitochondrial temperature fluctuation towards the development of energy production system mimicking mitochondria, Reiko Sakaguchi, Takashi Morii

Determining the conditions of heat treatments for extending the lifetime of nuclear reactors (2), Yoshitaka Matsukawa, Kiyohiro Yabuuchi

Development of anode/electrolyte interface for advanced Na-ion battery, Hiroki Sakaguchi, Toshiyuki Nohira

Formation of buffer layer on lithium-ion conductive electrolyte diaphragm for electrodialysis, Kazuya Sasaki, Keisuke Mukai

Photoinduced electron-transfer reactions of photosensitizers bound to the active site of enzyme, Hiroshi Takashima, Eiji Nakata

Constructing fluorescent biosensor for visualizing nuclear localization signal of transcription factor Sp1 involved in regulating metabolic pathway, Shunsuke Tajima, Eiji Nakata

Isolation of phase-separation regulatory long noncoding RNA and NMR analysis of its molecular mechanism, Riki Kurokawa, Masato Katahira

Novel pulsed terahertz source by super-radiance free electron laser oscillator, Kazuyuki Sakaue, Heishun Zen

Structural basis of DNA recognition by the replication initiator ORC, Shou Waga, Yudai Yamaoki

Application of mode-selective phonon-excitation method in semiconductors of energy functionality with mid-infrared free-electron laser, Kan Hachiya, Hideaki Ohgaki

Generation of High intensity THz pulse by superposition of undulator superradiant, Shigeru Kashiwagi, Heishun Zen

Research for control of cell growth mechanism using viral protein-derived peptides, Hideki Kusunoki, Takashi Nagata

Change in hardness by hydrogen charging in tungsten irradiated with Fe and He ions, Koichi Sato, Kiyohiro Yabuuchi

Observation of a distribution of mode-selectively excited phonon on SiC, Kyohei Yoshida, Hideaki Ohgaki

Wavelength-dependent degradation of polyurethane with molecular vibrational excitation, Takayasu Kawasaki, Heishun Zen

Study on development of compound-based anode for K-ion battery and on compatibility with ionic liquid electrolyte, Yasuhiro Domi, Takayuki Yamamoto

Ionaization energy of Ce3+ ion in multicomponent garnets determined by photoinduced free carier plasma absorption spectroscopy using a MIR free-electron laser, Mamoru Kitaura, Heishun Zen

Analysis of transition from axisymmetric torus to helical axis toroidal plasma, Akio Sanpei, Kazunobu Nagasaki

Experimental verification of hydrogen adsorption and desorption behavior for advanced neutron multipliers, Jae-Hwan Kim, Keisuke Mukai

Development of Solid-State Emitters Applicable to Luminescent Solar Concentrators, Masaki Shimizu, Hiroshi Sakaguchi

Study of Hydrogen Isotope Separation Technology by Molten Salt, Hisayoshi Matsushima, Toshiyuki Nohira

Evaluation of Irradiation Effects on High-Entropy Compound Superconductors, Naoko Oono, Kiyohiro Yabuuchi

Irradiation and Material Variables Dependence of Bubbles/Voids Formation in Fusion Reactor Structural Materials, Takuya Yamamoto, Kiyohiro Yabuuchi

Irradiation Effects on Ceramics Coatings, Sosuke Kondo, Kiyohiro Yabuuchi

Study and experiment of an interaction process between a low-density stacked CNT and a high-power, Ryutaro Matsui, Kazunari Matsuda

NMR analysis of biomolecules for development of novel biomaterials, Taiichi Sakamoto, Takashi Nagata

Irradiation damage effect on plasma driven hydrogen isotope permeation for plasma facing materials, Yasuhisa Oya, Kiyohiro Yabuuchi

Investigation on interaction structure and dynamics of room-temperature ionic liquid solvation using pulse-selected MIR free-electron laser, Sakhorn Rimjaem, Hideaki Ohgaki

Structural Analysis of Cell Wall Lignin for Advanced Biomass Utilization: Precise analysis of differences in lignin structure in each cell wall layer, Yasuyuki Matsushita, Masato Katahira

Chemical approach to surface reaction of ablation on organic material, Jun Fujioka, Heishun Zen

Development of strong superconducting bulk magnets with high shape-flexibility, Takanori Motoki, Toshiteru Kii

Development of negative ion source using microwave and its application to nano processing, Haruhiko Himura, Shigeru Inagaki

Identification of quadruplexes that can regulate gene expression, Yoichiro Tanaka, Takashi Nagata

Analysis and Design of Electrode/Electrolyte Interface for All Solid State Battery, Ikuma Takahashi, Keisuke Mukai

Development of the crystalline cellulose degradation system consisting of the psychrophilic fungus-type hybrid enzymes., Masataka Horiuchi, Takashi Nagata

Physical properties of heterostructures of atomic layer materials, Susumu Okada, Kazunari Matsuda

Development of highly efficient fabrication technique of two-dimensional heterostructures., Ryo Kitaura, Yuhei Miyauchi

Surface processing of semiconductors using graphene nanoribbons, Kazuhiro Fukami, Hiroshi Sakaguchi

Development of reduced activation high entropy materials for high energy reactor, Naoyuki Hashimoto, Kiyohiro Yabuuchi

Fabrication and characterization of two-dimensional heterostructures for energy conversion applications, Wenjin Zhang, Yuhei Miyauchi

A small-molecule-based technology for live-cell imaging of energy metabolism, Shin-ichi Sato, Takashi Morii

High performance nanocarbon material development based on molecularly functionalized carbon nanotubes for zero emission energy society, Tomohiro Shiraki, Yuhei Miyauchi

Highly efficient photochemical reactions induced by optimal laser pulses, Yukiyoshi Ohtsuki, Takashi Nakajima

Study of temporal evolution of coherent edge radiation during free-electron laser oscillations, Norihiro Sei, Hideaki Ohgaki

Development of hydrogen-oxidizing bacteria strains with high prolifiration capability in low hydrogen concentration condition, Yasunori Aizawa, Takashi Morii

Rooftop PV Hosting Capacity in AC Low Voltage Distribution Systems: Future Perspective in Cambodia, Vannak Vai, Hideaki Ohgaki

Structural studies on hierarchical molecular architectures created in microfluidic device, Munenori Numata, Eiji Nakata

Oxidation behavior of mechanically alloyed oxide dispersion strengthened alloy powders, Noriyuki Iwata, Kiyohiro Yabuuchi

AFM/EM imaging of intracellular metals with nanostructures constructed via signal amplification systems, Ippei Takashima, Eiji Nakata

Elucidation of the novel competitive function between microorganisms of genus Rhizoctonia by genomic approach, Yuh Shiwa, Tomijiro Hara

Development of an RNA eiding oligonucleotide to regulate the biological energy system in the cell, Masatora Fukuda, Takashi Morii

Development of novel guanine-tethered antisense oligonucleotides, Masaki Hagihara, Takashi Morii

Bactericidal effect of the infrared free electron laser, Toshizo Toyama, Heishun Zen

Study of minor element addition (Ni, Si) on irradiation hardening of pressure vessel model steels, Ken-ichi Fukumoto, Kiyohiro Yabuuchi

Gas Ionization with Ultrafast Intense Long-Wavelength Infrared Pulses, Ryoichi Hajima, Heishun Zen

High intensity broadband THz pulse generation using external optical cavity, Yosuke Honda, Heishun Zen

Ultra Sensitive Electrochemical Nucleic Acid Sensor, Kazushige Yamana, Takashi Morii

Enzyme-free selective structural control of glycan by means of molecular vibrational excitation, Takashi Honda, Heishun Zen

Application of infrared free electron laser to insulin ball seen in diabetes patients, Kazuhiro Nakamura, Heishun Zen

In-situ measurement of periodic nanostructures on semiconductor surface induced by mid-infrared free electron lasers, Masaki Hashida, Heishun Zen

Development of 3 dimensional radiative distribution measurement system using incoherent digital holography in Heliotron J., Hayato Kawazome, Shinichiro Kado

Development of dispersion strengthened high entropy alloys for high burn-up core materials, Hiroshi Oka, Kiyohiro Yabuuchi

Optimization of reactive oxygen radical production process by atmospheric pressure plasma irradiation, Hiroto Matsuura, Shinichiro Kado

Experimental study on the advanced methods of fault diagnosis and reliability evaluation to be applied for complex energy systems, Hidekazu Yoshikawa, Kazunori Morishita

Raman Spectroscopy of Molten Salts Containing Boron Ions, Yumi Katasho, Yutaro Norikawa

Synthesis of apatite-coated surface-modified organic polymer microspheres at ambient temperature and pressure, Takeshi Yabutsuka, Kiyohiro Yabuuchi

Study of nanomaterials toward efficient and high-performance energy conversion, Satoru Konabe, Yuhei Miyauchi

Development of a New Method for Controlling Thermal Radiation by Quantum Metamaterials, Atsushi Sakurai, Yuhei Miyauchi

Development of automated algorithms for high-speed camera image analysis, Nobuhiro Nishino, Shinichiro Kado

Study on reaction mechanism of visible-light-inducedliving radical polymerization for high energy efficiency, Yusuke Miyake, Hiroshi Sakaguchi

NMR analysis of the three-dimensional solution structure of the sequence-specific RNA-binding protein Musashi1 involved in translation control of the downstream target RNA, Takao Imai, Takashi Nagata

High beta plasma formation in advanced heliotron configuration using stochastic acceleration, Masayuki Yoshikawa, Shinji Kobayashi

Analysis of reaction mechanism of haloacid dehalogenase, Takashi Nakamura, Takashi Morii
Kinetic study on the Paraquat Dichloride removal in the water., Pannipha Dokmaingam, Hideaki Ohgaki

High-efficient plasma current drive by electron cyclotron waves in fusion reactor, Kenji Tobita, Kazunobu Nagasaki

Development of New Semiconductor Power Control Devices Aiming for Carbon Neutrality, Kensho Okamoto, Kazunori Morishita

Laser decontamination using a high repetition-rate nanosecond fiber laser, Atsushi Kosuge, Takashi Nakajima

Thermal properties of photoluminescence in single-walled carbon nanotubes for optical thermometry, Shun Aota, Yuhei Miyauchi

Hydrogen and Oxygen evolution on the micro/nano-structured electrode, Kota Ando, Takashi Nakajima

Study on emission process and evaluation of light outputs for novel scintillation materials using the one electron beam II, Shunsuke Kurosawa, Hideaki Ohgaki

Development of a method for compsiting Li_2TiO_3 and nanocarbon by microwave irradiation, Sadatsugu Takayama, Keisuke Mukai

Radial Correlation Analysis on Edge Plasma Turbulence in a Toroidal Plasma and its Dependence on Plasma Configuration, Yoshihiko Nagashima, Shinsuke Ohshima

Deuterium desorption from heavy ion irradiated tungsten using isothermal desorption method, Naoko Ashikawa, Kiyohiro Yabuuchi

Role of irradiation defects in the formation of plasma induced surface structures on tungsten, Mingzhong Zhao, Kiyohiro Yabuuchi

Study of ion irradiation effects on oxide dispersion strengthened ferritic steel, Jingjie Shen, Kiyohiro Yabuuchi

Lithium Migration Phenomena in Graphite - SiO Composite during Relaxation, Shigeomi Takai, Takashi Morii

Intracellular calcification of Corynebacterium matruchotti by FEL irradiation, Tetsuro Kono, Hideaki Ohgaki

Distributed Workshop on "Physics and control of non-linear and non-equlibrium plasma based on the concept of broad-band energy science", Yasuaki Kishimoto, Kazunari Matsuda

Active Learning for Public Outreach in Energy Science, Takeshi Yao, Kazunori Morishita