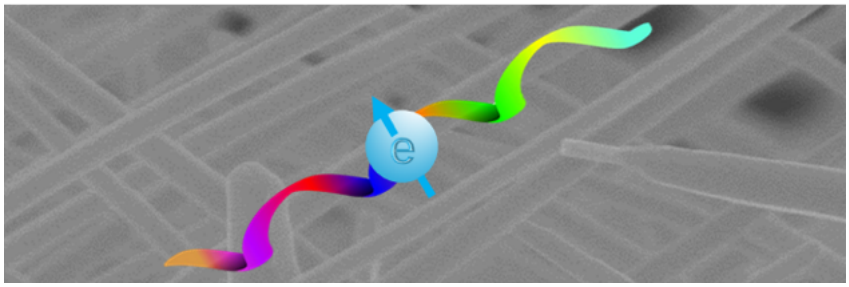
Semiconductor spintronics for future information technology

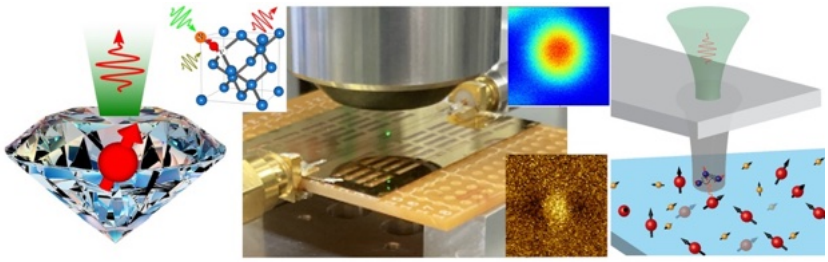


Assoc. Prof. Masashi AKABORI
https://www.jaist-akabori-lab.com/

Information technology supported by the electronics is based on controlling electric charge. Spintronics is controlling not only electric charge but also spin direction for future information technology. We are investigating semiconductor nanowire structures and semiconductor- ferromagnetic metal hybrid structures for spintronic applications. Our works are based on cleanroom and cryogenic technologies.

Key words: *III-V semiconductors, Ferromagnetic metals, 2D materials, Nanowires, Hybrid structures, Cleanrooms, Liquid helium*

Quantum sensing and imaging

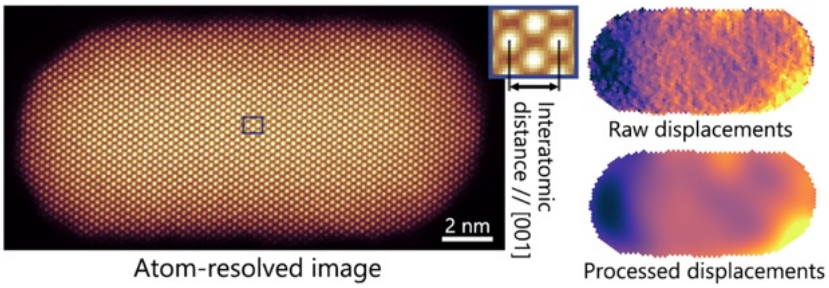


Assoc. Prof. Toshu AN
https://www.an-laboratory.com/

Spin states in diamond's atomic size defect structure: nitrogen-vacancy (NV) center exhibits extraordinary ability as not only a nanoscale sensor for magnetic, electric, and temperature sensing, but also quantum sensing finding wide application to physics, chemistry, biosensing, and quantum technologies. By attaching a tiny NV center to the apex of a scanning probe, we are developing a scanning NV probe enabling nano magnetic resonance imaging (MRI).

Key words: *NV center, quantum technology, NV center, spintronics, nano MRI*

Unveiling Novel Nanomaterial Properties through Nanometer-Scale Imaging

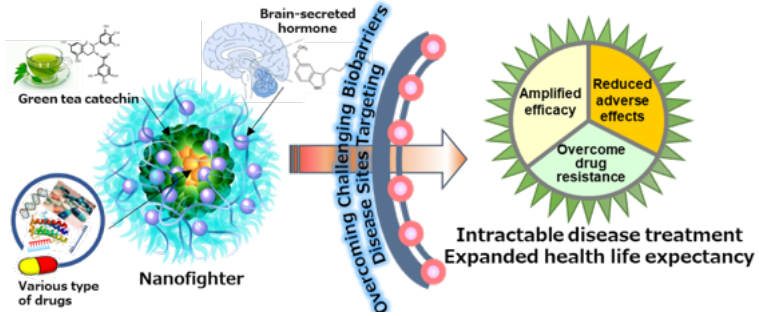


Senior Lecturer Kohei ASO
https://www.jaist-oshima-labo.com/english/

Toward discovering novel properties of materials from the atomic to the nanometer scale, we are developing advanced analytical techniques. Specifically, we apply image processing to electron microscopy images to extract information such as interatomic distances and crystal structures. Through our analysis, we aim to contribute to the advancement of materials research.

Key words: *Electron Microscopy, Image Processing, Data science, Nanomaterials*

Nature-inspired nanoparticles to fight intractable diseases and aging

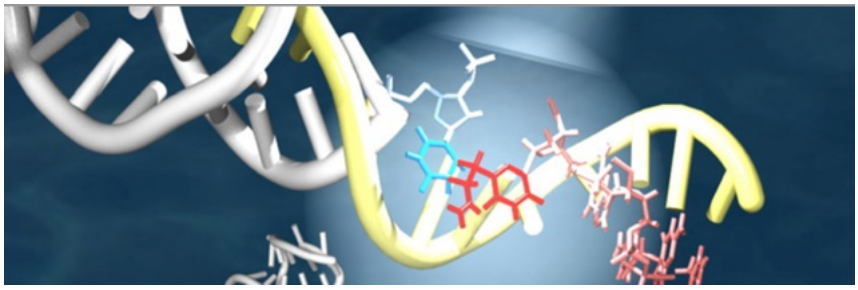


Prof. Joo Eun CHUNG
https://chungje-lab-en.labby.jp

We have been developing innovative nanoparticles derived from the human body and nature to treat intractable diseases and age-related diseases. For examples, we use the inherent therapeutic and physicochemical properties of hormones and plant-derived active ingredients to design nanomedicine that overcomes various problems and limitations of today's drug therapies (insufficient drug efficacy, side effects due to nonspecific drug distribution, drug resistance, immunogenicity, limited and highly invasive administration methods, low quality of life, etc.). Our research has pioneered a new paradigm in nanomedicine that synergizes and amplifies drug efficacy in addition to targeted delivery.

Key words: *drug delivery system (DDS), biomaterials, nanomedicine, cancer therapy, antiaging*

Challenges in nucleic acid therapeutics and DNA robotics

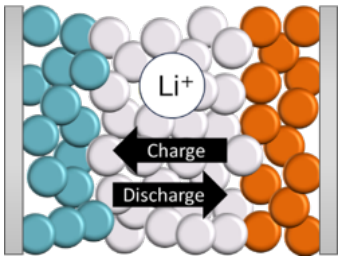


Prof. Kenzo FUJIMOTO
https://www.jaist.ac.jp/ms/labs/fujimoto/fujimotohp/

Fujimoto Laboratory will create innovative technologies, especially in the fields of nucleic acid therapeutics and DNA robotics, by integrating information, biotechnology, environment, and nanotechnology. The creation of intelligent nucleic acids with unprecedented functions is expected to lead to new pharmaceuticals, molecular sensors, molecular devices, and materials.

Key words: *nucleic acid therapeutics, DNA robotics, nucleic acid chemistry*

Nanospace Chemistry
— Development of observation technology and controlling nanostructure —

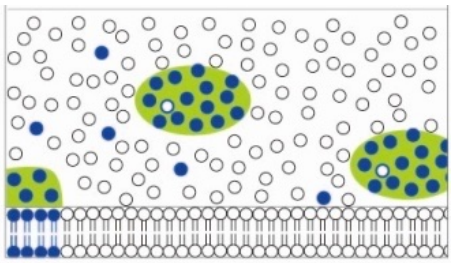


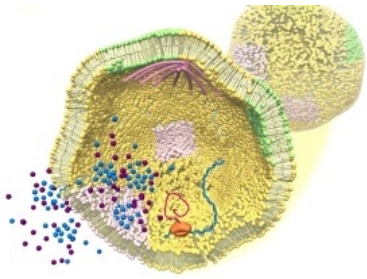
Prof. Kazuma GOTOH
https://www.jaist.ac.jp/nmcenter/labs/gotoh-www/

Our group emphasizes understanding microscopic and mesoscopic structures in nanospace of porous and layered materials such as carbon and inorganic compounds using analytical methods such as solid-state nuclear magnetic resonance (SSNMR). We contribute to revealing the mechanisms of secondary batteries containing these materials as electrode materials.

Key words: *NMR, carbon materials, lithium ion batteries, sodium ion batteries, operando analysis*

Membrane biophysics: Design of an artificial cell model





Assoc. Prof. Tsutomu HAMADA
https://www.jaist.ac.jp/ms/labs/hamada/index.html

Living cells are a form of self-assembled soft matter. Lipid bilayer membranes are essential components of living organisms. We use a soft matter physics approach to cell-mimicking systems so that we can understand the physical principles of biological systems. We construct artificial lipid vesicles which produce cellular dynamics, such as micro-domain transformation and membrane fusion, and conduct quantitative analyses based on soft condensed matter physics.

Key words: *lipid membrane, liposome, protocell, phase separation, soft matter*

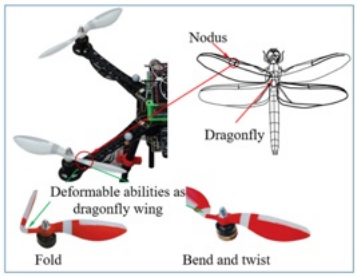
New robotics opened up by protein engineering

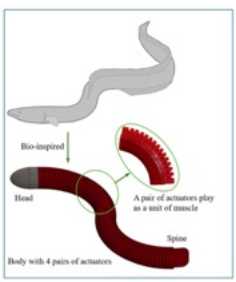
Assoc. Prof. Yuichi HIRATSUKA
https://www.youtube.com/watch?v=akl-glALo2IAaa

Proteins with various functions are attractive molecular building blocks for micro-robots. In our laboratory, we are working on the development of microrobots that are powered by artificial muscles made from engineered protein molecules, with a particular focus on motor proteins.

Key words: *molecular robotics, protein engineering, biophysics, micro/soft-robot, artificial muscle, micro-fabrication*

Harnessing the softness for next generation of robots



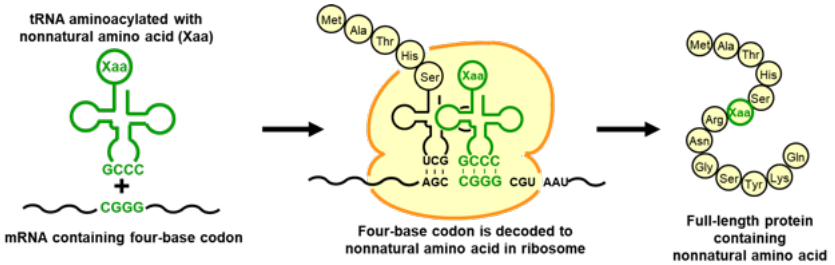


Prof. Van Anh HO
https://www.jaist.ac.jp/ms/labs/vanho/index-

Soft robotics has ushered in a new frontier at the intersection of robotics, materials science, and physical intelligence. From the development of innovative sensors and actuators using functional materials to the integration of advanced systems, this field enables the creation of robots that are soft yet capable of performing tasks beyond the reach of traditional rigid industrial robots. Join us in exploring groundbreaking functionalities for robots through the power of materials science.

Key words: *Soft robotics, Tactile sensing, Soft actuators, Bio-inspired robots, Embodied intelligence, Machine learning*

Unnatural Protein & Peptide Investigation

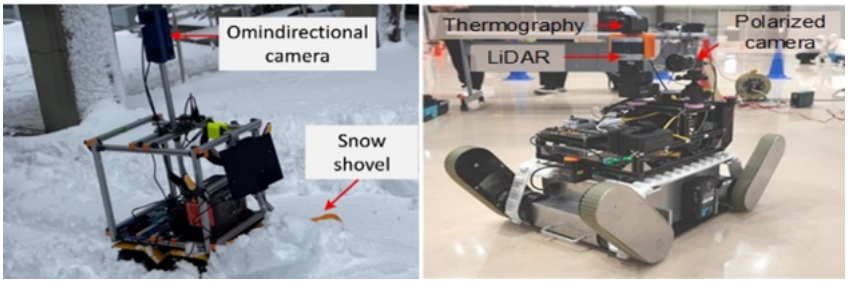


Prof. Takahiro HOHSAKA
https://www.jaist.ac.jp/ms/labs/hohsaka/

Living organisms synthesize various proteins using only 20 types of amino acids. By introducing unnatural amino acids through expansion of the genetic code, our laboratory investigates the design and synthesis of novel proteins and peptides with artificial functions for bioengineering and biomedical applications.

Key words: *unnatural amino acid, genetic code expansion, cell-free translation*

Intelligent Environmental Sensing Using Unmanned Mobile Robot

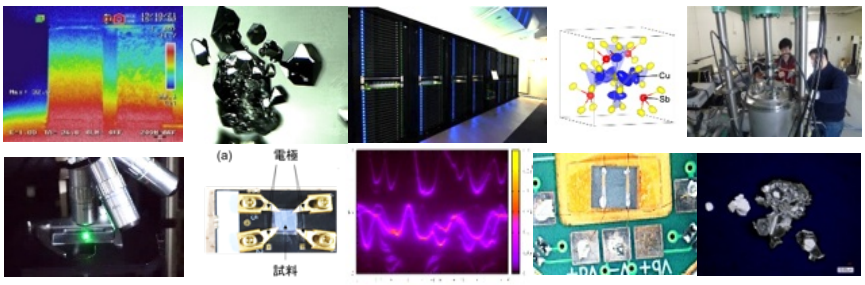


Assoc. Prof. Yonghoon JI
http://robotics.jaist.ac.jp

Our group conducts various research required for real-world applications through robot technology. Specifically, we analyze data from the various sensors mounted on the unmanned mobile robot and extract shape information or physical properties distributed in the environment such as material information to utilize them to solve various problems in our society.

Key words: *mobile robot, robot vision, environmental sensing, SLAM*

Physics of Thermoelectric materials and Low-dimensional Materials



Prof. Mikio KOYANO
https://www.jaist.ac.jp/ms/labs/kotai/koyano/

Don't you like to utilize waste heat as useful electric power? Do you like to know how energy is dissipated in matter? Do you like to work with mysterious layered materials? Don't you try to improve your ability in Japan? Do you love science and technology?

Our laboratory develops environmentally friendly thermoelectric materials and studies how heat energy is converted to electricity in the thermoelectric materials. We also study the physics of low-dimensional materials and the intercalation compounds.

Key words: *thermoelectrics, energy conversion, materials design, low-dimensional materials*

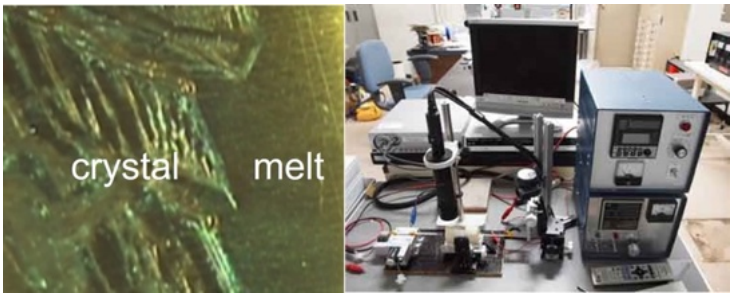
Enhancing Healing Power with Functional Biomaterials

Prof. Motoichi KURISAWA
https://kurisawa-lab.labby.jp/

Kurisawa Laboratory specializes in developing innovative nanomedicine for treating challenging diseases. Our pioneering work includes the development of green tea-based nanomedicine with inherent anticancer properties and synergistic effects with various therapeutics. Moving forward, we aim to tackle intractable diseases, including cancer, using green tea catechin derivatives.

Key words: *drug delivery system (DDS), nanomedicine, cancer therapy, green tea catechin*

Direct Observation of Crystal Growth Process

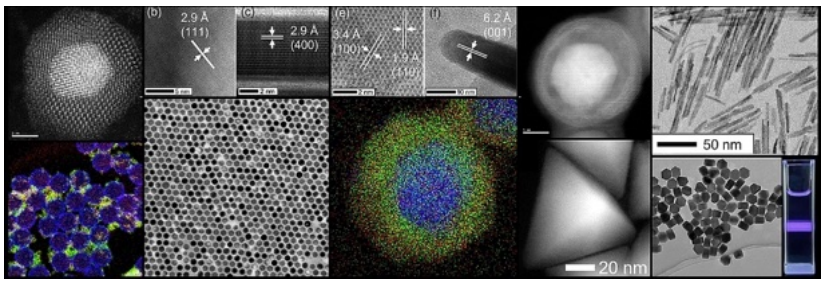


Senior Lecturer Kensaku MAEDA

To enhance electronics and optoelectronics, high-quality crystals are essential. Crystals, formed by atom arrangement during growth, require precise control for high performance. Observing the growth process helps understand mechanisms and develop advanced growth technologies.

Key words: *Crystal growth, Semiconductor, Optical crystal*

Nanoparticle Science and Technology From Synthesis to Applications

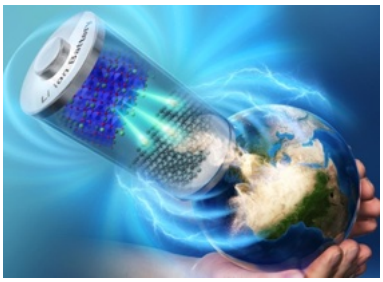


Prof. Shinya MAENOSONO
https://www.jaist.ac.jp/
~shinya/index-en.html

Nanoparticles (NPs) have intermediate properties between atoms (molecules) and bulk crystals. Based on nanomaterials chemistry, we conduct comprehensive and cross-disciplinary research from the frontiers of synthesis and functionalization of various NPs to the application of these NPs in the energy and biomedical fields.

Key words: *nanoparticles, energy-conversion materials, bio-nanotechnology*

Organic polymer/compounds to boost performance of Metal-ion Secondary Batteries

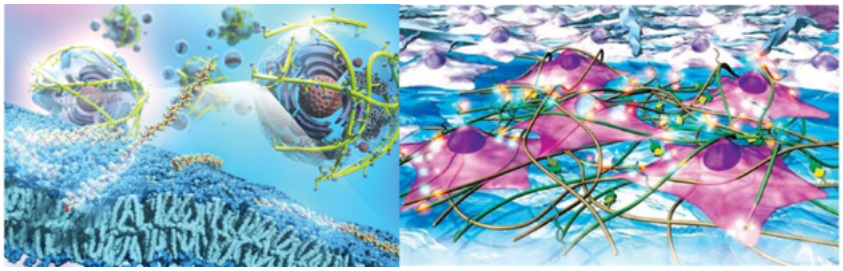


Prof. Noriyoshi MATSUMI
https://www.jaist.ac.jp/ms/labs/matsumi/

Our group is working on strategic design of functional polymer materials/compounds to enhance the performance of advanced Li-ion secondary batteries/Na ion secondary batteries through optimization of interfacial properties. These approaches have been effective in stabilizing Si based anode/LiNMC based cathode and enabling high rate charge-discharge performance in various battery systems.

Key words: *polymer binders, electrolytes, additive, active materials, artificial SEI/CEI, metal-ion secondary batteries*

Interdisciplinary Polymeric Biomaterial Innovation

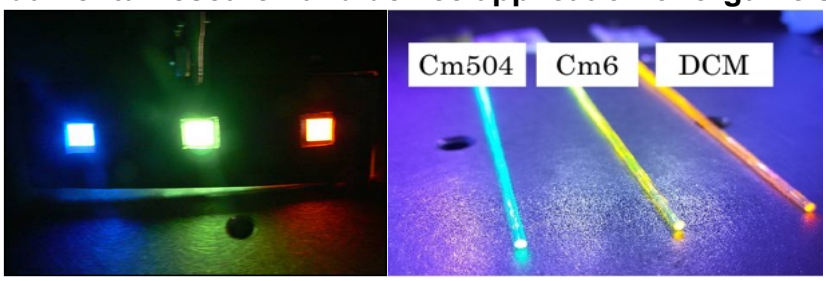


Prof. Kazuaki MATSUMURA
https://matsu-lab.info/

Matsumura Laboratory focuses on developing functional polymeric biomaterials for applications in drug delivery, tissue engineering, and cryopreservation. Our research emphasizes polyampholytes, zwitterionic polymers, biodegradable polymers and hydrogels. We aim to create materials that interact seamlessly with living systems, fostering interdisciplinary approaches combining chemistry, biology, and medicals science.

Key words: *polyampholytes, zwitterionic polymers, drug delivery system, tissue engineering, hydrogels, cryopreservation*

Fundamental research and device application of organic semiconductors



Prof. Hideyuki MURATA
https://www.jaist.ac.jp/ms/labs/murata/index.html

We aim to apply the results of our fundamental research on organic semiconductors to developing practical devices, including organic light-emitting diodes (OLEDs) and optical antennas for visible light wireless communications. Through joint research with the private sector, we develop precision evaluation equipment for OLEDs and vacuum sublimation refining equipment for organic semiconductor materials. In cooperation with Kanazawa City, we are developing conductive filler materials for conductive paste using Kanazawa gold leaf as a raw material. We aim to contribute to society through research on organic semiconductor devices.

Key words: *organic semiconductors, organic light-emitting diodes, visible light wireless communication, gold leaf particles for conductive paste*

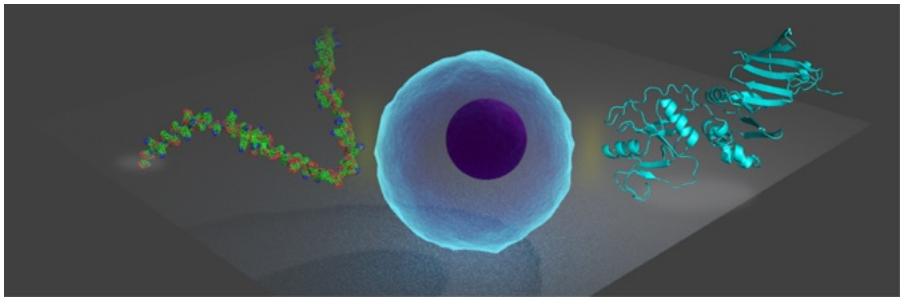
Innovating for a Greener Future through Advanced Materials Science

Prof. Yuki NAGAO
https://www.jaist.ac.jp/ms/labs/nagao-www/?lang=en

Nagao lab focuses on the advancement of next-generation fuel cells, batteries, supercapacitors, sensors, and protonic transistors, aiming for sustainable development. To support the global shift toward a decarbonized society, we are dedicated to researching ion-conducting polymer materials, inorganic materials, and organic-inorganic hybrid materials.

Key words: *hydrogen society, sustainable energy development, nanoprotonics*

Design of next-generation biomedical materials

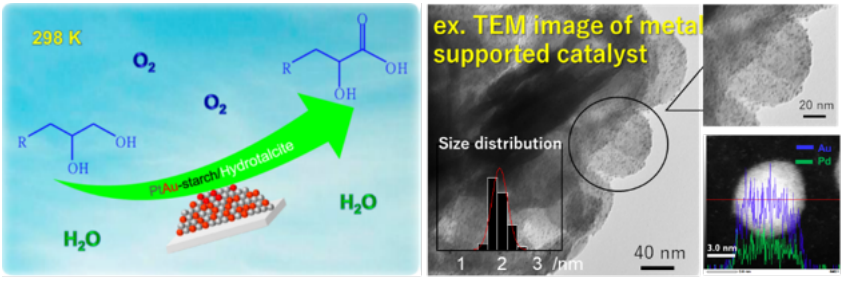


Senior Lecturer Kei NISHIDA

Medical materials consisting of synthetic polymers or proteins are essential materials for developing advanced medical technology and devices. We design next-generation medical materials for developing the treatments and diagnostic technology for cancer and other diseases, which are based on synthetic polymer, protein engineering, and cell engineering. Furthermore, the challenge is to elucidate the interactions between living organisms and medical materials.

Key words: *Medical polymer, Protein engineering, Nanomedicine, Bio-interface*

Functionalized Solid Catalyst for Energy & Resources Supply



Assoc. Prof. Shun NISHIMURA
https://www.jaist.ac.jp/~s_nishim/index

Solid catalyst has a key role on energy & resources supply in our society. Our aim is developing highly-functionalized catalyst process and revealing its mechanism by means of spectroscopic studies. In particular, we have focused on the transformation processes such as renewable biomass resources and wasted materials such as used oil and carbon dioxides.

Key words: *metal nanoparticle, solid acid/base catalyst, catalyst design, mechanistic study*

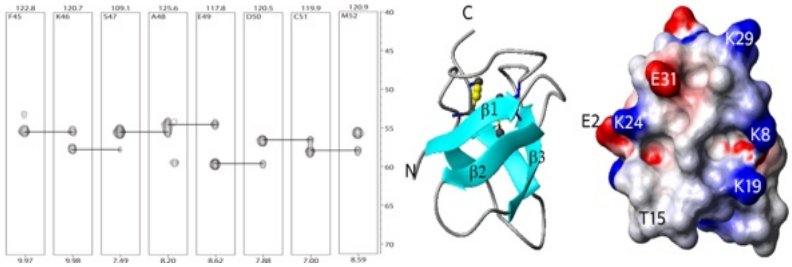
Development of Next-Generation Si-based Solar Cells

Prof. Keisuke OHDAIRA
https://www.jaist.ac.jp/ms/labs/ohdaira/

Expanding the use of photovoltaics is an urgent task toward achieving carbon neutrality. Our group focuses on the development of novel technologies to achieve higher performance and lower cost of silicon-based solar cells. We also study the long-term reliability and of photovoltaic modules including encapsulant-less novel module structures.

Key words: *silicon solar cell, photovoltaic module*

Exploring structure-based protein function

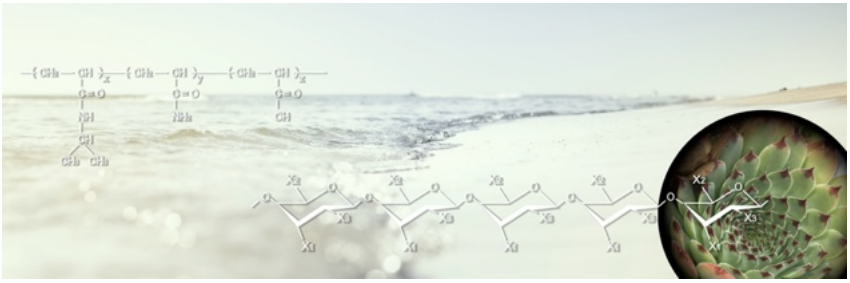


Prof. Shinya OHKI
https://www.jaist.ac.jp/nmcenter/labs/s-ohki-www/

Understanding functional mechanism of intriguing proteins at atomic resolution is undoubtfully important for developing new drugs, enhancing food production, improving environment and so on. To gain the deep understanding, we extensively employ solution NMR (nuclear magnetic resonance), one of the analytical tools, to uncover three-dimensional structure, dynamics and interaction of proteins.

Key words: *protein science, structural biology, biophysics, biochemistry, NMR (nuclear magnetic resonance)*

Beyond Polymeric Organization: DRY & WET

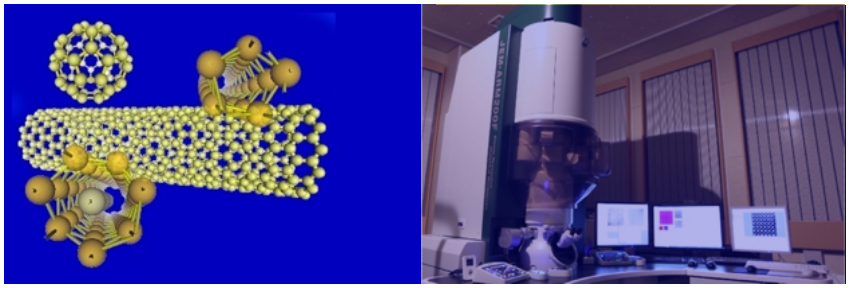


Assoc. Prof. Kosuke OKEYOSHI
https://sites.google.com/oke-acgroup.com/web

Inspired by history of natural environment and biomaterials, we are designing and fabricating functional soft materials through organizing polymeric materials. To propose advanced energy transforming systems, materials living with water are the target. Simultaneously, we are learning natural phenomena for design of polymer networks.

Key words: *polymeric gels, water, soft matter, photo-functional materials, energy transformation*

Microscopic exploration of nano-scale properties



Prof. Yoshifumi OSHIMA
https://www.jaist-oshima-labo.com/english/

Nanoscale and atomic-scale materials have a variety of functionalities that have the potential to outperform current electronic devices and sensors. We are conducting research to reveal the properties of such nanoscale and atomic-scale materials by establishing our own nano-measurement methods based on transmission electron microscopy. We are developing our research internationally through collaborations both domestically and internationally.

Key words: *transmission electron microscope, nanomaterials, 2D materials, design and development of measurements, data science, nanophysics*

Compound semiconductor devices for future electronics

Prof. Toshi-kazu SUZUKI
https://www.jaist.ac.jp/nmcenter/labs/suzuki-www/

Suzuki laboratory conducts researches on compound semiconductor devices, which are important for future electronics, in particular for high-speed and energy-saving applications. We develop compound semiconductor device fabrication technologies, as well as device characterization methods in order to obtain deeper insights into device operations.

Key words: *compound semiconductors, high-speed devices, energy-saving devices, device characterization methods*

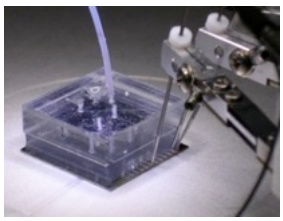
Nanobiotechnology

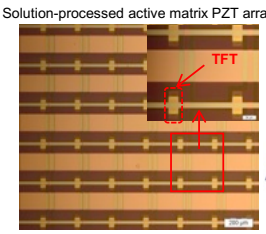
Senior Lecturer Mari TAKAHASHI
https://www.jaist.ac.jp/laboratory/nd/mari.html

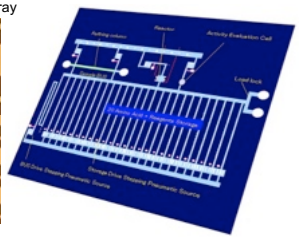
Bioapplications of nanoparticles (NPs) are attracting more attention every year. We utilize the characteristic features of NPs, which are different to those of bulk materials, for a variety of applications. We mainly focus on the following three areas. 1: Isolation of cellular organelles using magnetic NPs; 2: immunoassays using magnetic particle spectroscopy; 3: optogenetics using upconversion NPs.

Key words: *Nanoparticles, Inorganic materials, Cell biology*

Biomedical devices and sensors using cutting-edge nanotechnology





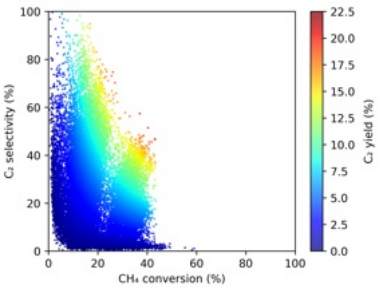


Prof. Yuzuru TAKAMURA
https://www.jaist.ac.jp/ms/labs/takamura

Yuzuru Takamura Laboratory is developing novel biochips for biomedical and environmental applications employing semiconductor, nano-Biomaterial, micro/nanofluidcs, and lab-on-a-chip techniques. Our interest extends to understanding of phenomena in nano & micro scale, new fabrication processes for biochips, and practical applications such as high sensitive point of care testing, analysis of single cell and ultra-compact analytical devices.

Key words: *bioMEMS, microfluidics, analytical chemistry, biosensor, single cell analysis*

Data-driven catalysis with high-throughput experimentation

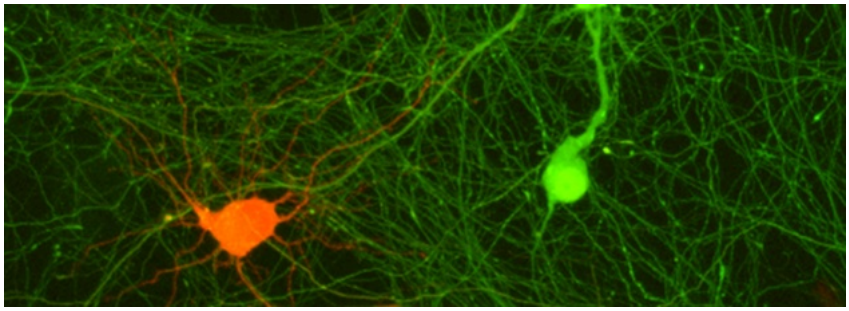


Prof. Toshiaki TANIIKE
https://www.jaist.ac.jp/ms/labs/taniike/en/

The data-driven approach applied in the field of catalysis, called catalyst informatics, is a potential game changer in R&D, though its implementation is bottlenecked by the scarce availability of sized data. Our group is practicing large-scale yet efficient catalyst R&D by generating sized and qualified data and screening numerous hypotheses with our own technologies for high-throughput experimentation and machine learning.

Key words: *catalysis, high-throughput experimentation, informatics, machine learning*

Molecular tools for neuronal signal detection

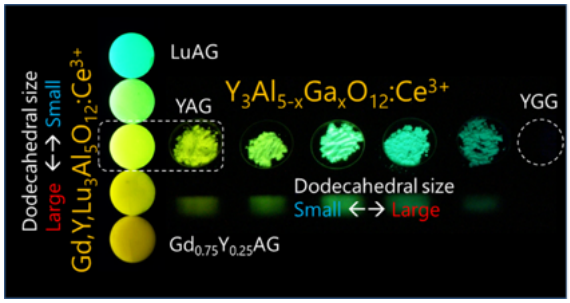


Assoc. Prof. Hidekazu TSUTSUI
https://www.jaist.ac.jp/ms/labs//tsutsui/

Technological advances in the measurements of neuron electrical activities are essential to explore the mystery behind neuronal circuit operations. By combining molecular biology and microfabrication techniques, we seek to develop next-generation molecular tools for the detailed detection of neuronal electrical activities.

Key words: *neuron, synapse, DNA, protein, microfabrication, electrophysiology, bio-imaging*

Development of Optically Functionalized Materials

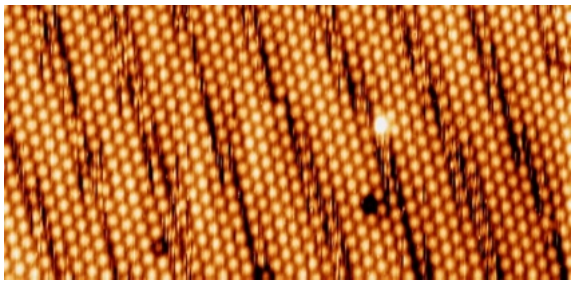


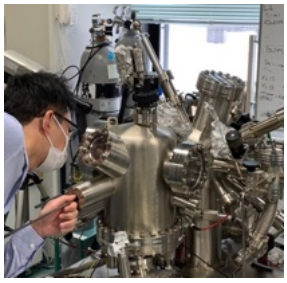
Assoc. Prof. Jumpei UEDA
https://uedalab.com/

Inorganic luminescent materials have been widely used in various applications. The optical properties of the luminescent materials vary greatly depending on the type of luminescence center, its geometrical and chemical coordination environment, and the electronic structure of the host material. By controlling the these factors, novel white LED phoshphors, persistent pshophors, luminescent themomters are developed.

Key words: *lanthanide ions, transition mental ions, phosphors, persistent phosphors, storage phosphors, transparent ceramics*

Towards the atomistic understanding of surfaces and interfaces



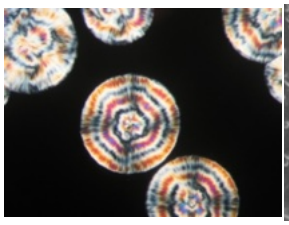


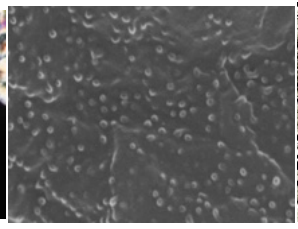
Prof. Yukiko YAMADA-TAKAMURA
https://www.jaist.ac.jp/ms/labs/yukikoyt/

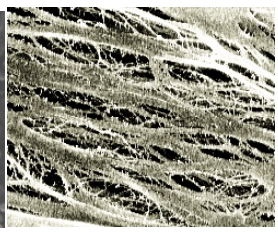
Modern industry is founded on thin film materials technologies, ranging from protective coatings to electronic devices. To improve their performance, film-substrate interface is critical. The surfaces and interfaces become even more important in the growth of nanomaterials and their properties. Our aim is to develop new nanomaterials based on the understanding of surfaces and interfaces through advanced microscopies.

Key words: *nanomaterials, 2D materials, thin films, surface structure, SPM, STM*

Rheology for Soft-Material Design







Prof. Masayuki YAMAGUCHI
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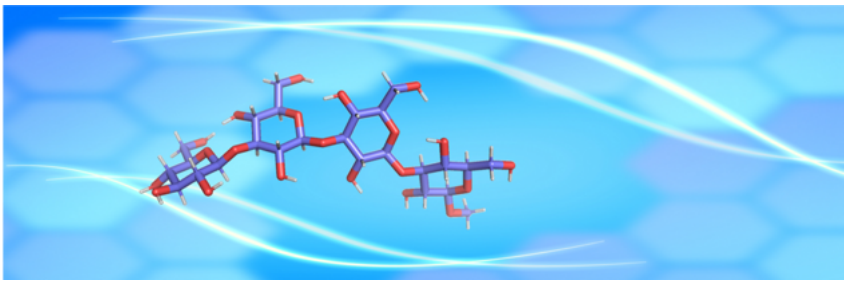
Rheology - the new science of deformation and flow for a material showing complicated mechanical responses - is inevitable to develop advanced soft materials including polymers. Our lab. is carrying out material design of functional and high performance polymers based on the rheological approaches.

Key words: *polymer rheology, polymer processing, polymer blends*

Sweet Science of Bio-functional Sugar Molecules



Assoc. Prof. Takumi YAMAGUCHI
https://www.jaist.ac.jp/ms/labs/t-yamaguchi/

Carbohydrates play crucial roles in a variety of biological events such as cell-cell communications. Our research seeks the underlying molecular basis for the function of carbohydrates, providing knowledge for the rational design of drugs and biomolecular engineering that contribute towards a detailed understanding of living systems.

Key words: *glycoscience, protein science, biochemistry, bioinformatics, molecular simulation*

Surface-Enhanced Raman Spectroscopy Advances Physical Chemistry Frontiers

Assoc. Prof. Yuko S. YAMAMOTO
https://www.researchgate.net/profile/Yuko-Yamamoto-2

Yamamoto Laboratory focuses on surface-enhanced Raman spectroscopy (SERS) as both an ultra-sensitive analytical technique and a pioneering probe that opens new frontiers in physical chemistry. Plasmon resonance -the oscillation of conduction electrons in metals- is key to our SERS research.

Key words: *Surface-enhanced Raman scattering (SERS), Ultra-sensitive Raman spectroscopy, Plasmon resonance*