

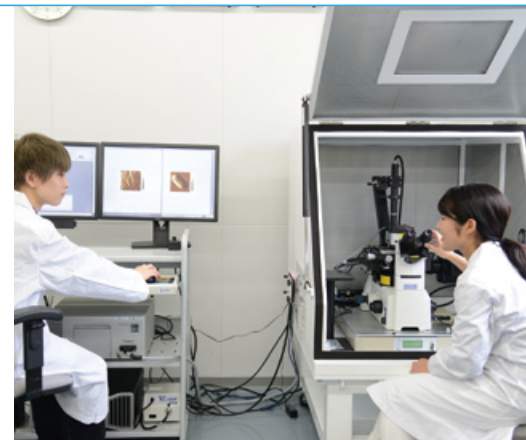
1 Particle Science and Technology Group

Creation of innovative environmental biotechnology that is useful for society

Research on microorganisms (bacteria, yeasts) as "living fine particles" for utilization to new environmental technologies

Our research topics

- Development of attractive and ecofriendly technologies capable of separating and recovering rare and precious metals indispensable for manufacturing industries such as electronics and automobiles from urban mines by new biotechnology
- Collaboration with industrial sectors for developing new biotechnology that can recycle rare and precious metals
- Development of new technology to prepare platinum type industrial catalysts using microorganisms
- Elucidation of adhesion phenomenon of microorganisms and development of engineering technology using the microbial function
- Evaluation on the effect of nanoparticles on living body
- Synthesis of carrier particles suitable for drug delivery



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2 Resource Engineering Group

Effective utilization of underused resources using nanotechnologies

Research on new energy-efficient technologies for synthesizing valuable nanomaterials from abundant resources

Our research topics

- Development of environmentally friendly processes for synthesizing high-functional nanomaterials with high performances using wastes as starting raw materials
- Synthesis of advanced materials for environmental restoration by adsorption removal of toxic ions and organic compounds in water environments
- Synthesis of magnetic nanoparticles for cancer therapy using hyperthermia treatments and nanocatalysts with high catalytic activity under moderate conditions
- Development of organic-inorganic hybrid materials as fillers in plastics and electrode materials in batteries
- Design and optimization of chemical processes for effective utilization of resources based on data science



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3 Process Systems Engineering Group

Innovation in Powder Handling

Production of smart particulate products with high functionality and development of novel powder handling processes

Our research topics

- Synthesis of smart particulate products with high functionality
- Application to pharmaceutical, cosmetics, next-generation batteries, etc.
- Development of innovative powder handling processes (granulation, coating, mixing, drying, etc.)
- Synthesis of functional particles of metal-organic framework



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4 Chemical Reaction Engineering Group

Advanced Biotechnology and Bioengineering

Development of high performance biocatalysts and environment-friendly bioprocesses

Our research topics

- Development of organic solvent-tolerant enzymes by genetic, protein, and molecular-evolutional engineering
- Development of high functional microbial cells by cell, metabolic, and genomic engineering
- Molecular design of high active and stable biocatalysts synthesizing fine chemicals such as pharmaceuticals, functional food materials, and cosmetic materials
- Production of renewable clean energy and bioproducts
- Molecular simulation and modeling for understanding life phenomena
- Development of advanced green chemical processes and innovative bioprocesses based on chemical reaction and biochemical engineering



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5 Computational Chemical Engineering Group

Transforming manufacturing process with digital technology

Contributing to sustainable manufacturing by using computer simulation to predict phenomena exhibited by complex assemblies

Our research topics

- Development of theory and computational technologies for predicting complex phenomena exhibited by powder and solid particles
- Computer simulation of complex phenomena exhibited by molecular assemblies such as cell membranes and vesicles
- Development of new computational techniques utilizing AI and machine learning
- Experimental measurement of complex phenomena exhibited by molecular and particle assemblies
- Collaborative research with various industrial sectors (e.g., automotive, battery, iron making, mining, pharmaceuticals)



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7 Environment and Energy Process Engineering Group

Effective utilization of valuable resources and energy

Development of conversion technique of resources and energy and construction of environmentally harmonious process

Our research topics

- Clarification of absorption mechanism of NO_x and SO_x in water
- Effective utilization of monomers and energy in suspension polymerization process
- Development of exhaust gas purification technology aimed at recycling nitrogen oxides, development of concentration and purification technology of useful components
- Establishment of separation and purification technology of carbon dioxide gas and effective utilization technology
- Construction of environmentally harmonious reaction process and processing technology
- Resource recycling of unused valuables and waste



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6 Materials Process Engineering Group

Synthesis of innovative materials for state-of-the-art electronic devices

Studying various elementary processes involving functional materials thin films and nanoparticles preparation

Our research topics

- Preparation of the novel and reliable electrode materials for rare-metal free next generation (Na, Mg, multivalent etc.) ion secondary batteries
- Development of electrochemical technique to realize large area synthesis of next generation high efficiency solar cell materials over silicon through nanostructure control
- Development of fast and low cost chemical vapor deposition process to form hard materials such as diamond, carbide, nitride, boride and their compound
- Theoretical optimization of functional materials for energy conservation and energy creation and establishment of fabrication processes
- Findings of novel device functions through innovative integration of functional materials
- Process analysis of molecules, ions, and colloids formation steps during functional materials preparation in chemical reactors to control and improve material synthesis



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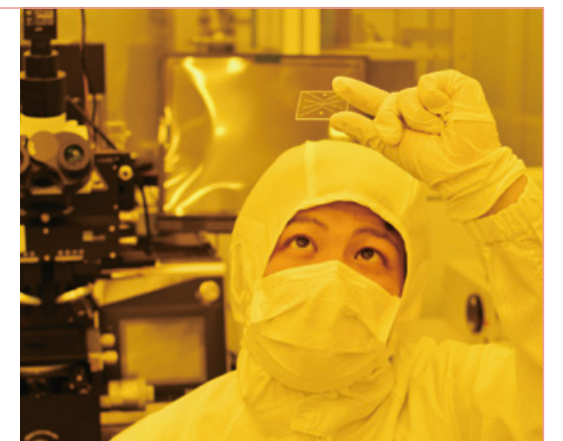
8 Nano Chemical Systems Engineering Group

Pioneering new chemical engineering on tiny nanofluidic devices

Development of nano chemical systems to realize a healthy longevity society and to solve challenging issues in environmental and energy fields

Our research topics

- Research in our group is directed toward the integration of "Nano", "Bio", and "Chem" at femtoliter (10^{-15} liter), attoliter (10^{-18} liter), and single molecule scales through nanofluidics.
- We continue to involve the study and development of novel nanofluidic methods and devices for single cell omics, single molecule chemistry, biomaterials, nanomedicine, energy, and process engineering.
- Our developed nanofluidic devices and methods are contributing to the fields as diverse as single molecule dynamics, ultimate chemical synthesis/materials fabrication, ultra-early diagnosis of cancers and infectious diseases, super-precision high-throughput drug discovery, personal medicine, precision medicine, smart implantable sensors/actuators, nano energy devices, and information sciences.



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