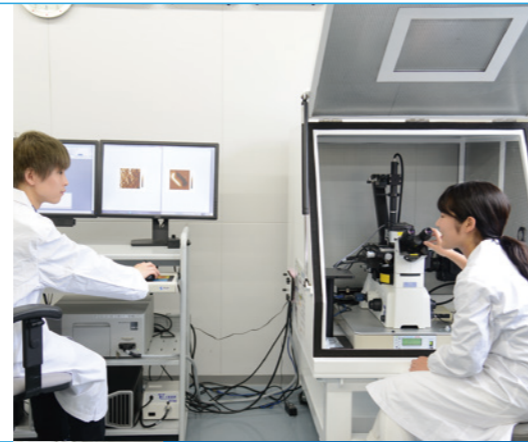


## 1 Particle Science and Technology Group

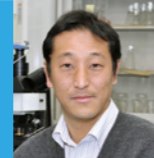
Creation of innovative environmental biotechnology that is useful for society

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



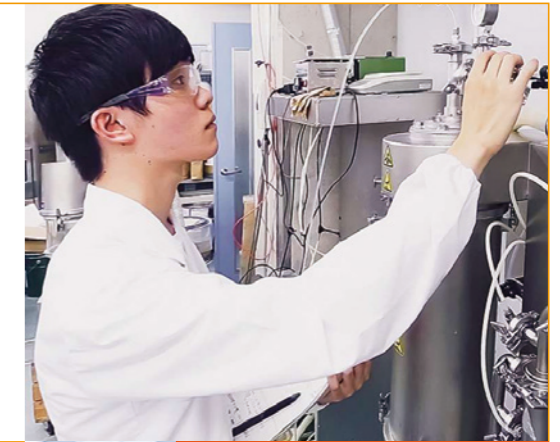
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## 3 Process Systems Engineering Group

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.)
- Computational modeling of powder handling processes
- Analysis and control of nanoparticle translocation across cell membrane
- Synthesis of functional particles of metal-organic framework



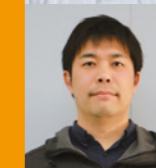
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## 4 Chemical Reaction Engineering Group

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 Separation Science and Engineering Group

Fundamental research of separation process and development of practical separation technology

Creation smart material, device and process for separation process and energy storage



### Our research topics

- Fundamental research of synthesis and separation technology for micro chemical process
- Understanding of mass transfer in a porous material; pore structure and pore surface effect
- Development of device and process of practical compact chemical processes
- Application of smart carbon material to electric double layer capacitor (EDLC) and lithium ion capacitor and battery



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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 NOx and SOx 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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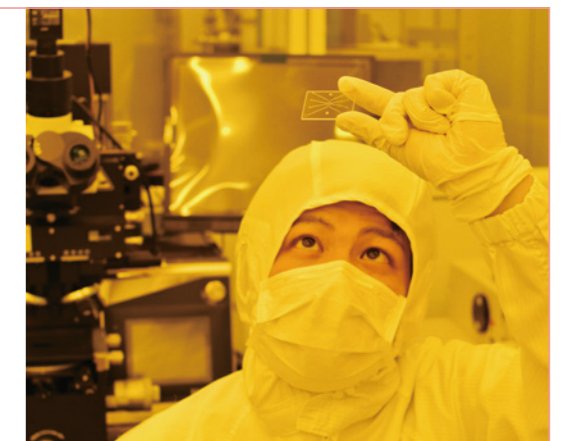
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## 8 Nano Chemical Systems Engineering Group

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 infection 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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