College of Engineering, Graduate School of Engineering

Department of Chemical Engineering
Osaka Prefecture University

Sakai, Osaka, Japan

OSAKA PREFECTURE UNIVERSITY

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OSAKA PREFECTURE UNIVERSITY

Introduction to "Chemical Engineering"

"'Chemical Engineering' is what we need for mono-zukuri (making of material objects)."

Knowledge of chemical engineering is essential to produce things that are essential to modern society. Chemical engineering, which supports mono-zukuri around the world, contributes to the development of a wide variety of fields beyond the framework of chemical, including global environment, resources, energy, medicine, and biotechnology.

"For those with a driving interest in learning about chemical engineering"

Chemical engineering is a discipline that systematizes the methodology for learning the basics not only of chemistry but also physics and biology to create new science and technology based on chemistry, and promote mono-zukuri to produce things that are useful in our daily life and society.

Chemical engineering is a discipline that is necessary in order to develop an entire manufacturing system to manufacture products from materials on an industrial scale by considering a process that is safe, environmentally-friendly and efficient, and by comprehensively taking into account the impact of products and wastes on the environment, how to secure resources and energy, and the establishment of a recycling-oriented society. Because of this nature of the discipline, chemical engineering has become important not only in the chemical industry but also in other industries, such as food, pharmaceutical, electronics, metals and automobiles, as well as energy industries, such as petroleum refining, electricity and gas. More recently, chemical engineering has been contributing to society, such as in developing new materials and ingredients, addressing challenging issues of life science, developing new resources and energies, and solving global environmental issues.

Researchers and engineers in chemical engineering deal with all processes and systems associated with chemical reactions with emphasis on the balance between substances and energies. They are engaged in the development of advanced chemical synthesizing technology, synthesizing systems for new substances and new materials using nanotechnology and biotechnology and their production systems, environmentally-friendly new energy systems, and innovative resource circulation systems for a recycling-oriented society.

Education and research in our department focus on training specialists who have not only expertise in a specific field but also all-round competence to be able to overview the entire targeted chemical system and rationally design and assess it from a global perspective. Alumni of our department are playing an important role in a wide range of industrial fields.

Education

Courses

Undergraduate

Introduction to Materials, Chemistry and Chemical Engineering
Introduction to Physical Chemistry
Laboratory: Chemical Engineering I
Laboratory: Chemical Engineering II
Undergraduate Project in Chemical Engineering
Chemical Engineering Practice
Chemical Engineering Stoichiometry
Transport Phenomena I
Transport Phenomena II
Transport Phenomena III
Chemical Engineering Thermodynamics
Diffusional Separation Engineering I
Diffusional Separation Engineering II
Chemical Reaction Engineering I
Chemical Reaction Engineering II
Biochemical Engineering
Powder Technology I
Powder Technology II
Process Control Engineering
Process Systems Engineering
Process Equipment Design
Process Design
Special Topics: Chemical Engineering I
Special Topics: Chemical Engineering II
Mathematics for Chemical Engineering
Exercises: Chemical Engineering I
Exercises: Chemical Engineering II
English Reading for Chemical Engineers
Analytical Chemistry B
Physical Chemistry IIB
Introduction to Inorganic Chemistry
Organic Chemistry IB

Graduate

Advanced Seminar in Materials Science and Engineering
Special Project in Materials Science and Engineering
Advanced Particle Science and Technology
Advanced Chemical Reaction Engineering
Advanced Chemical Engineering Fluid Mechanics
Advanced Process System Engineering
Advanced Separation Science and Engineering
Advanced Materials Process Engineering
Advanced Chemical Engineering
Advanced Science and Engineering of Material Cycling
Advanced Science and Engineering of Energy Cycling
Advanced Resource Engineering
Advanced Internship in Chemical Engineering
Advanced Chemical Engineering and Process Technology
Advanced Studies on International Envionmental Issues
Advanced Envionmental Communication
Field Work on International Envionmental Activities
Technology-based-Entrepreneurship Course
Nanoscience and Nanotechnology

Carrier of Alumni

Graduate course; National government; Local government; Academia

[Chemical] Bridgestone; Chiyoda Corporation; Daicel; Daikin; DIC; Dupont; Kaneka; Kuraray; Mitsubishi Chemical; Mitsui Chemicals; Nippon Shokubai; Sumitomo Chemical; Toray; Tosoh; TOYOBO; UBE Industries

[Pharmaceutical] Astellas Pharma; Chugai Pharmceutical; Kobayashi Pharmaceutical; Kyowa Hakko Kirin; Otsuka Pharmaceutical; Sawai; Shionogi Pharmaceutical; Takeda Pharmaceutical

[Energy and Plant engineering] JGC; Hitachi Zosen; Kajima; Kawasaki Heavy Industries; Kobelco Eco-Solutions; Nippon Steel & Sumikin Engineering; Osaka Gas

[Food] Ajinomoto; Kagome; Morinaga Milk; Nichirei; Nisshin Flour Milling; Meiji; Suntory

[Consumer products] Kao; Lion; Shiseido; Sunstar

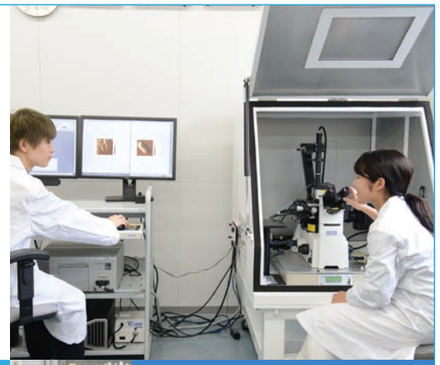
[Electronics] Kyocera; Panasonic; ROHM

[Automobile] Nissan; Toyota

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

Experts on low-cost mechanical unit operations: solid-liquid separation and mechanochemical synthesis

Research on new energy efficient technologies for extracting or synthesizing valuable materials from resources

Our research topics

- Study on energy saving mechanical unit operations to extract target substance from mineral and biological resources or to synthesize new functional materials
- Development of energy efficient solid-liquid separation processes
- Development of a new flocculant that quickly separates difficult-to-separate solid-liquid mixture
- Development of new centrifugal separation technology for difficult-to-filter suspensions
- Development of a new process using mechanochemical and/or hydrothermal treatments for synthesizing functional materials
- Analysis of separation and materials fabrication processes by computational fluid dynamics and discrete element method

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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 and related microscale-phenomena
- Analysis of nanoparticle permeation phenomena across cell membrane and its control
- 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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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

- Electrodeposition of the novel electrode materials for rare-metal free sodium ion or multivalent 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 prepration in chemical reactors to contol and improve material synthesis

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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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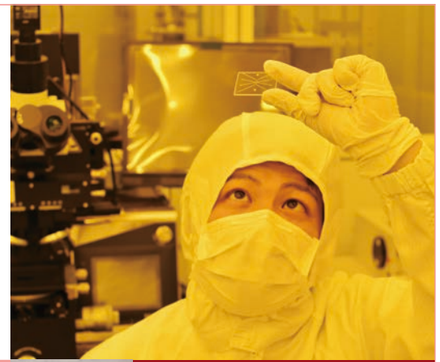
8 Nano Chemical Systems Engineering Group

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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