Department of Chemical Engineering

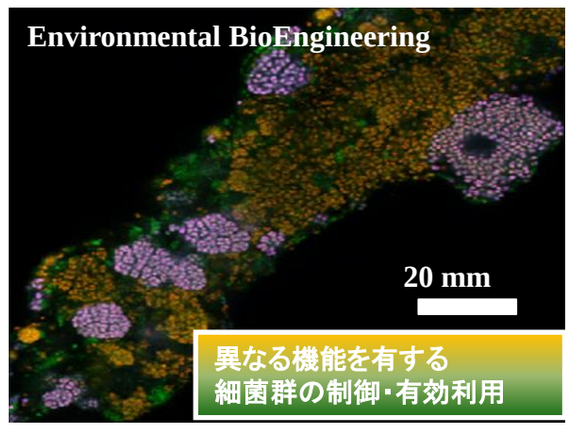
"Chemical Engineering" is a controlling factor to a sustainable society in the 21st century

「**Chemical Engineering**」covers a wide range of fields including chemical analyses, production of chemicals and development of production systems. Our department aims to educate students to develop the ability to understand the nature of an object, to comprehend the technical problems, and to resolve the problems with consideration for economy, safety and social and environmental effects.

◎After Graduation

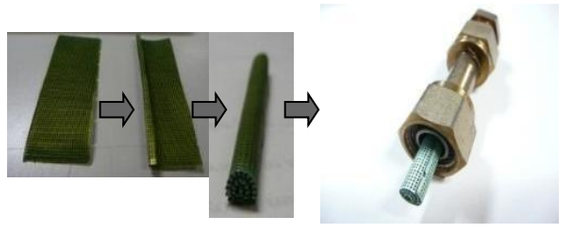
About 80% of students go to master course. Most of students work for companies such as chemical companies, food and pharmaceutical companies, engineering constructors and energy related companies.

Design and Operation of Chemical Plants



Environmentally Benign BioReactor for Water Treatment

Micro Reactor using metal structure

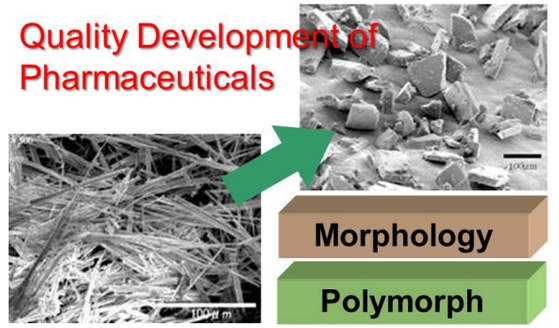


Application of micro reactor to efficient energy conversion

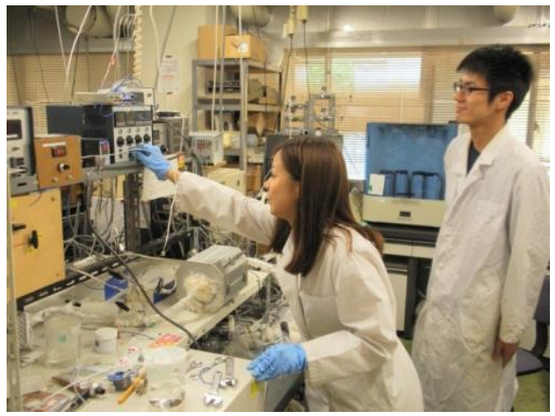
Energy Efficient microreactor

Advanced Energy Conversion Reactor

Quality Development of Pharmaceuticals



Functional Pharmaceuticals



Students during Experiment

What do you study in our department?

東京農工大学

○Chemistry
Physical Chem.
Inorg. Chem.
Org. Chem.
Anal. Chem.
Bio Chem.
Polymer Chem.

○Physics
Dynamics
Electromagnetics
Quantum physics

○Biology

○Mathematics
Calculus
Linear Algebra
Differential Eqs.

○Languages
English
Other foreign language

○Info. Sci.

○Social/Human Science.

○Sports

○Chemical Engineering
Transport Phenomena
Reaction Eng.
Separation Eng.
Process Systems Eng.
Powder Technology
Bio Chemical Eng.

○Engineering Courses
Environmental Eng.
Material Science
Project Study
Academic Paper Reading
Engineering Drawing
etc.

○ Experiments, Seminars, Practice

Faculty, Dept. of Chemical Engineering (2014)

東京農工大学

Member		Research Area
Prof.	Hideo Kameyama	Energy Chemical Engineering, Catalyst Reaction Engineering, MOT
Prof.	Masaaki Hosomi	Purification of Water and Soil, Improvement of Environment
Prof.	Hiroshi Takiyama	Crystallization Engineering, Separation Engineering, Solid-Liquid Equilibrium
Prof.	Yoshiyuki Yamashita	Process Systems Engineering, Computer Aided Process Engineering
Prof.	Yoko Sato	Chemical Information Communication
Prof.	Hidehiro Kamiya	Powder Technology, Nano Particle Design
Prof.	Eika Qian	Catalyst, Biomass Utilization
Assoc. Prof	Wuled Lenggoro	Particulate Materials Processing and Aerosol Technology
Assoc. Prof	Makoto Sakurai	Chemical Energy Engineering, Micro Chemical Process
Assoc. Prof	Hideaki Tokuyama	Functional Polymer Material, Gel
Assoc. Prof	Yuichiro Nagatsu	Liquid Phase Reactive Flow
Assoc. Prof	Chihiro Fushimi	Energy Conversion Engineering, Fluidization Technology
Assoc. Prof	Akihiko Terada	Advanced Microbial Engineering, BioReactor System
Assoc. Prof	Susumu Inasawa	Reaction Engineering of Silicon Material, Thin Film Formation by Drying
Visit. Prof.	Kenichi Yoshie	Non-equilibrium Processes
Visit. Prof.	Naoki Dohi	Process Control
Visit. Prof.	Haruo Asatani	Process Development, Separation Engineering, Powder Technology

Study of Chemical Engineering to solve the Problems of Food, Medical Care, Environmental Cleanup and Energy by Use of Air ,Water and Sun

Prof. Hideo Kameyama

We develop the technology to produce ozone water to create the nano-sized bubbles of ozone in the water from the air in the plasma reaction using electrical energy from the sun in order to sterilize the virus, such as salmonella and foot-and-mouth disease. In addition, we have developed the technology to produce ammonia from air, water and sun instead of using the fossil fuel.

Hybrid Thermochemical Ammonia Production Cycle

(1)Plasma Reaction

$1.5CO_2 \Rightarrow 1.5CO + 0.75O_2$

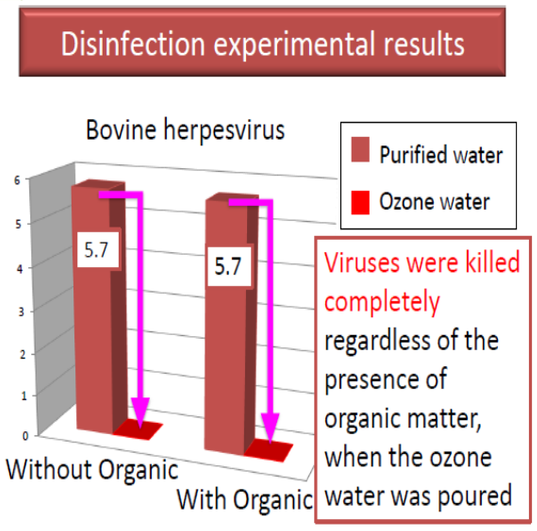
(2)Thermochemical Catalytic Reaction

$0.5N_2 + 1.5CO + 1.5H_2O \Rightarrow NH_3 + 2.5CO_2$

In total (1)+(2)

$0.5N_2 + 1.5\,H_2O \Rightarrow NH_3 + \ 0.75O_2$

Ammonia can be produced from nitrogen and water

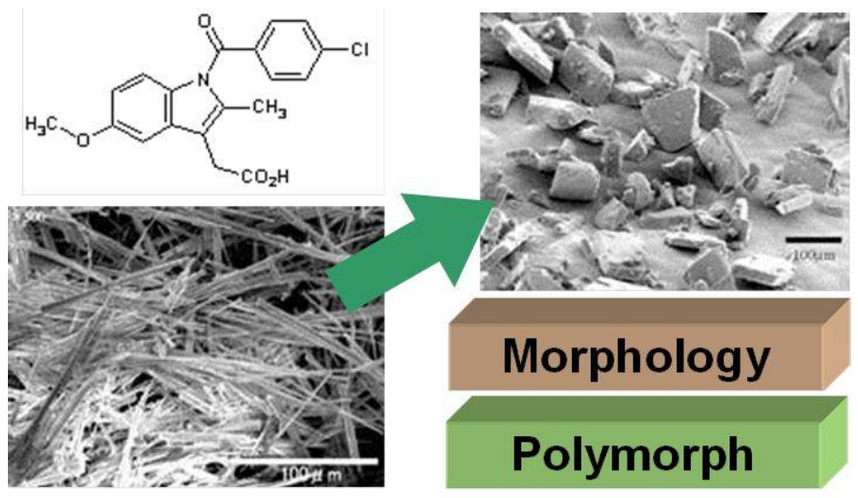


Why not create a technology that produces dreams! Let's together the study of chemical-free sterilization by ozone and production of fertilizer and necessary energy for life from those obtained easily from the natural world.

Crystallization Operation and Crystal Engineering for Pharmaceutical and Food

Prof. Hiroshi Takiyama

The industrial operation using crystal phenomena is called “Crystallization”. In the chemical engineering field, the crystallization is one of the separation unit operation and is widely used in the pharmaceutical and food industry. The crystalline particle qualities, such as crystal morphology and polymorphism, are developed.



Quality development in pharmaceuticals by using “Crystallization”

Let’s try to develop the crystallization operation and to produce the new functional crystalline particles in my crystallization laboratory!

Environmental Bio-Engineering and Chemical Engineering for a sustainable world

Prof. Masaaki Hosomi

Co-benefit approach research targeting preservation of water environment and control/mitigation of global warming: Dry thermophilic anaerobic digestion process of livestock waste and forage rice straw

DryThermophilic Anaerobic Digestion

Anaerobic digestion under the condition of solid content 15-40% and 55℃

Liquid form

Digested residue

Clayey form

Wet Anaerobic Digestion (traditional)

Dry Anaerobic Digestion (our study)

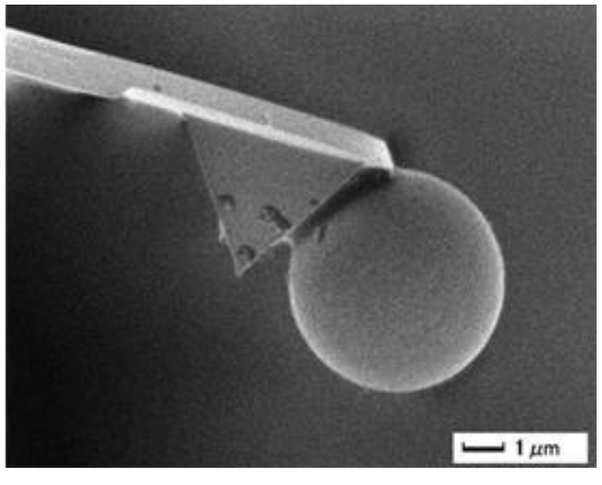
Over 20 students with strong sense of mission engage different themes from energy-efficient wastewater treatment technologies incorporating new microbe to bio-technology that can control nitrous oxide, in addition to non-combustion technologies of PCB and Dioxin.

Fine Powder Technology – For application of Materials, Energy and Environmental

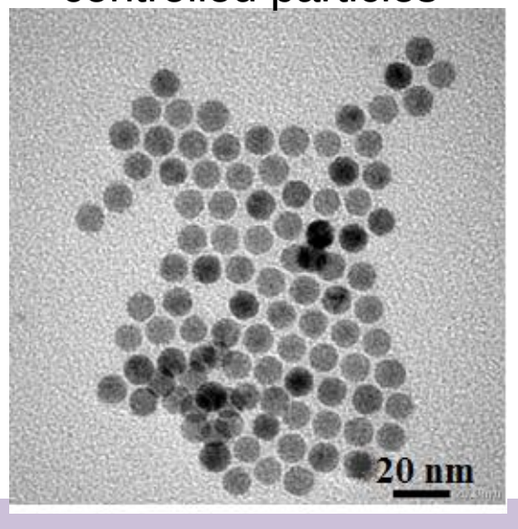
Prof. Hidehiro Kamiya

Based on the fundamental research in the field of colloid and aerosol science, fine and nano particles technologies are applying for various field, such as ceramics and inorganic/ polymer composite materials, environmental (PM2.5 and particulate emission from stationary sources) and energy (Li ion battery and ash behavior control in coal, biomass and solid waste combustion and gasification), drug, cosmetics, pigment industries.

Surface interaction measured by colloid probe AFM

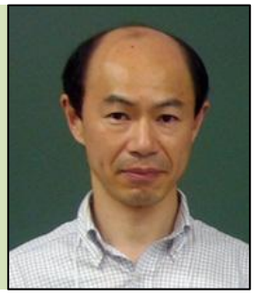


Uniform size and shape controlled particles



In our laboratory, all students are developing and enjoying excellent research and discussion with industrial members and international collaborations.

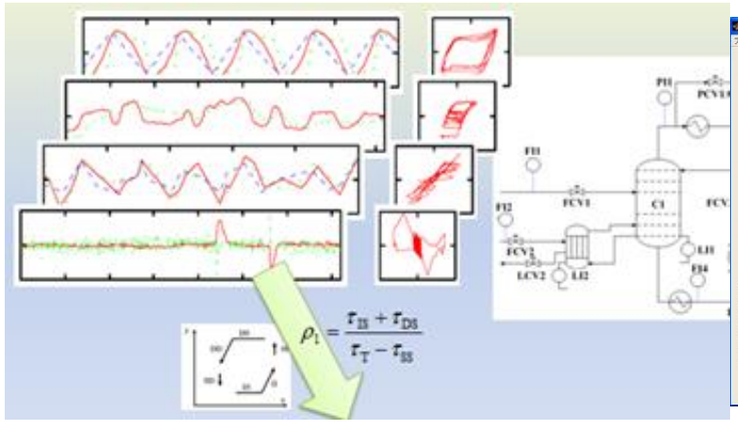
Process Systems Engineering for safe & sustainable societies



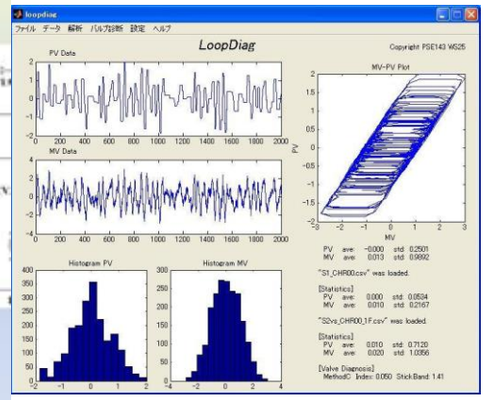
Prof. Yoshiyuki Yamashita

An advanced operation and control system is the key technology of safe, highly efficient, and high quality production.

To realize the future smart plant, we are investigating process monitoring, process control, soft-sensors, simulation engineering and optimization.



Detection & diagnosis of control valves
（Yamashita Method）



An example of the diagnosis screen

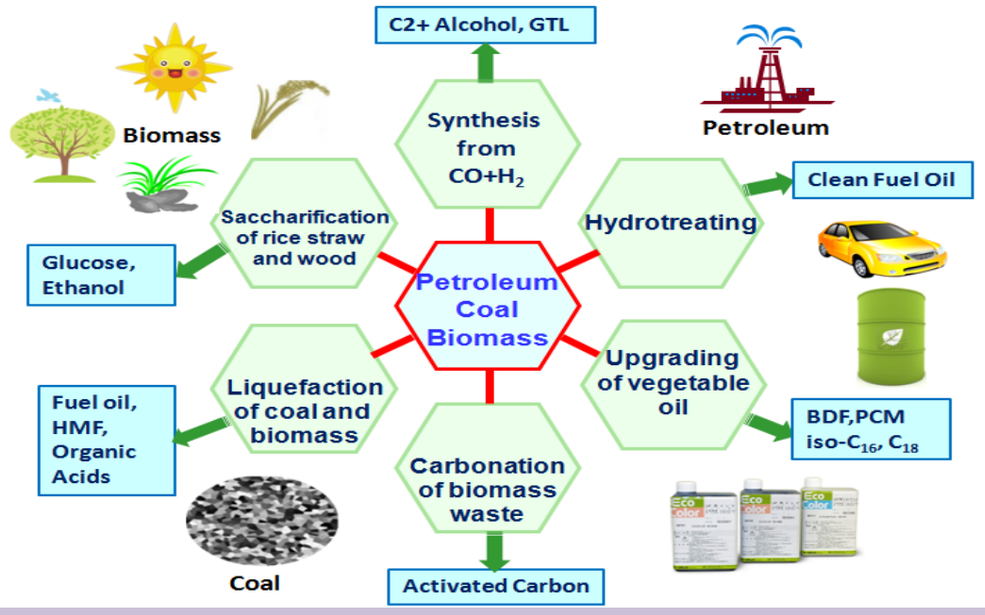
Designing the future process systems: with both data science and chemical engineering!

PSE Lab

Environmentally-friendly Technology to Manufacture Clean Energy and Materials

Prof. Eika Qian

Build on Catalytic Science and Chemical Engineering, we study how to develop novel catalysts and processes to efficiently manufacture clean fuel oil and materials in an eco-friendly way from fossil fuel, and biomass. The research field includes hydrotreating, liquefaction, stream reforming, saccharification, higher alcohol synthesis, carbonization etc.

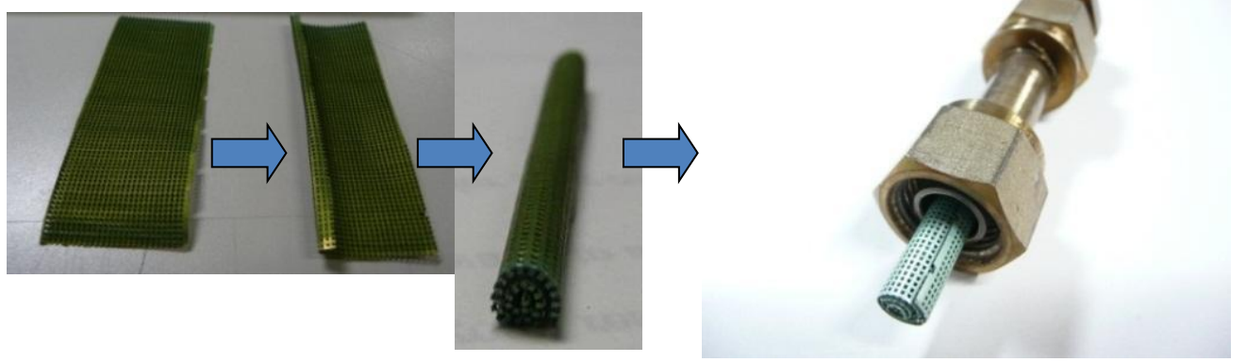


Challenging green catalytic processes: Let's develop high selective, eco-friendly, sustainable systems for production of energy and materials!

Micro Process Engineering for Energy Utilization Process

Assoc. Prof. Makoto Sakurai

The micro reactor has channels with a thickness of micrometer range and its large surface-to-volume ratio leads to excellent chemical reaction control. We are developing various type of structured catalytic micro reactors using metal as basic materials in order to apply to effective energy utilization and energy conversion process.



Catalytic micro reactor with structured catalyst using aluminum.

Let’s try to develop novel micro reactors together and to contribute to resolve the energy problems!

Environmentally-conscious Materials Processing and Aerosol Technology

Assoc. Prof. Wuled Lenggoro

We are advancing research at the intersection of Chemical Engineering and Particle Technology (Particulate System) to address the issues on materials resources, energy use, agriculture and health-care fields. Our work involves the collaborations with other researchers of other groups of surface chemistry, electronic engineering, and plant sciences.

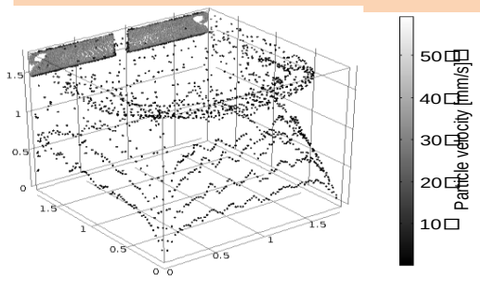


Fig. 1: Flow simulation of aerosols

A multi-year project with School of Agriculture, to study the influence of particles on the plants: (i) Fabrication of air pollutant model particles and (ii) Designing a plant chamber with particle delivery system (Fig.1-2)

Fig. 2 : A plant-growth chamber

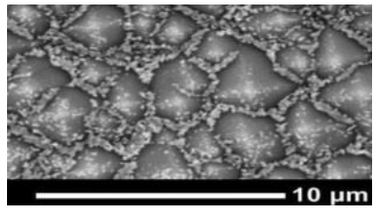


Fig. 3: Surfaces of the sensor

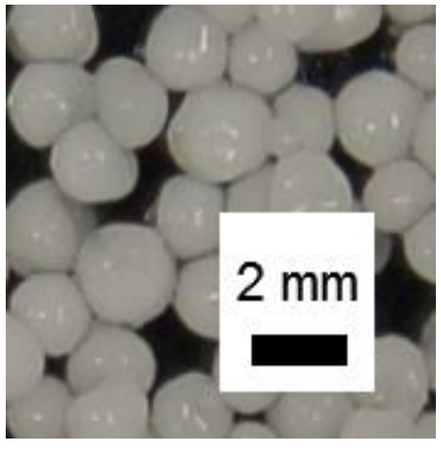
Development of a chemical sensor system for detecting pesticide residues (Fig.3)

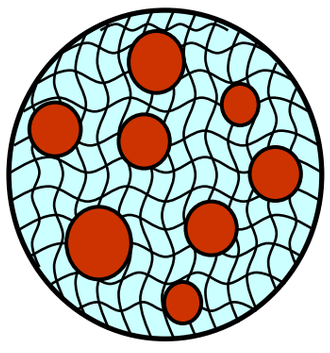
Research includes aerosol technology & powder synthesis for their advanced use as "engineered" & "unwanted" materials.

Development of functional polymers/gels and process to produce and apply their materials

Assoc. Prof. Hideaki Tokuyama

Our research target is to develop novel functional polymeric materials (polymers, gels, etc). In addition to the development of novel materials, we are also carrying out the effort to realize environmentally-friendly processes to produce the materials and to apply the materials in industrial, environmental, medical, and pharmaceutical fields using chemical engineering methods. Our research includes the control of the morphology of polymeric materials such as nano- and micro-particles, porous gels, and composites, and designs and operations of separation, reaction, adsorption, and diffusion processes.





Emulsion gel beads: Hydrogels containing randomly distributed oil microdroplets. Potential use as adsorbents, carriers for DDSs, and supports for enzymes.

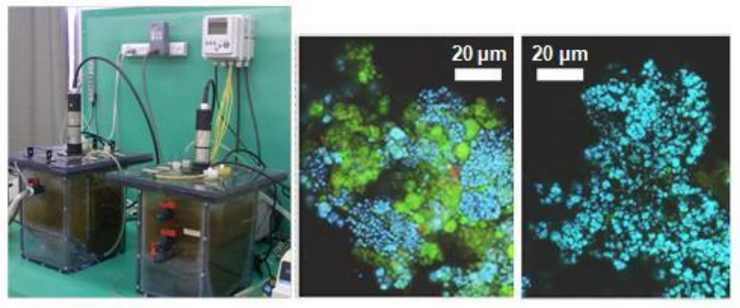
Our goal is to solve the recent serious environmental and resource problems, to help people to live safe, secure and healthy lives, etc.

Environmental biotechnology towards environmental preservation

Assoc. Prof. Akihiko Terada

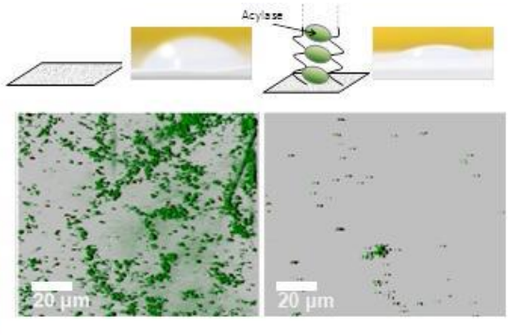
Natural environment holds numerous amount of unknown and unexplored microorganisms. Such microorganisms may have potentials to degrade contaminants and greenhouse gases, harmful for humans and environment. Our mission is to elucidate roles and interactions of these microorganisms and to harness them to develop novel environmental preservation systems and materials. Main topics are development of a novel wastewater treatment system with low cost and greenhouse gas emission, and fabrication of a biointerface for mitigation of biofilm formation causing clogging in industries and nosocomial infectious diseases.

◆Energy-efficient and low environment-burden wastewater treatment system by control of



Enrichment of highly active bacteria(cells in cyan) in a bioreactor system (Left)

◆Development of an anti- bacteria and biofilm polymer sheet



Modified surface (Right) mitigates biofilm formation (in green)

Better understanding and control of unexplored microorganisms lead to a breakthrough of environmental technologies for better environment. Why don’t you join our activities?

Energy Conversion Engineering and Fluidization Technology

Assoc. Prof. Chihiro Fushimi

Considering resource depletion and possible global warming, very efficient utilization of fossil fuels and significant increase in utilization of renewable energy are strongly required. In our laboratory, we conduct research on the following themes:

1. Efficient Utilization of Coal by Gasification

2. System Analyses for Large-Scale Utilization of Renewable Energy

3. Energy Efficient Drying System using Self-Heat Recuperation Technology

4. Novel Energy Materials Production using a Fine-Powder Fluidized Bed

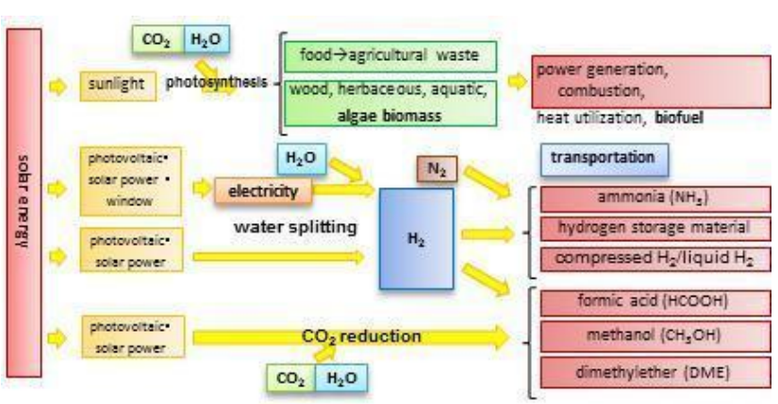


Fig. 1 : Process flow of solar energy conversion and utilization

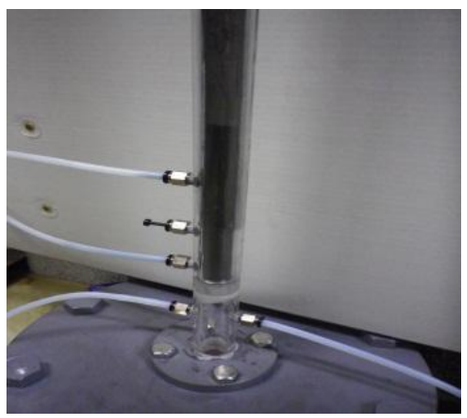


Fig. 2 : Fine Powder Fluidized Bed

Let's study to create solutions for energy and environmental problems using engineering and chemistry together!

Fundamental study on reacting hydrodynamics and application study on reacting hydrodynamics in environmental and energy fields

Assoc. Prof. Yuichiro Nagatsu

Reacting fluid dynamics treat chemical reactions between fluids with physical processes such as flow and mixing of fluids and transport phenomena of heat and mass. Reacting fluid dynamics in liquids (reacting hydrodynamics) is a new academic discipline since the first international workshop was held in 2009. Our laboratory is devoted to fundamental study on reacting hydrodynamics and application study on reacting hydrodynamics in environmental and energy fields.

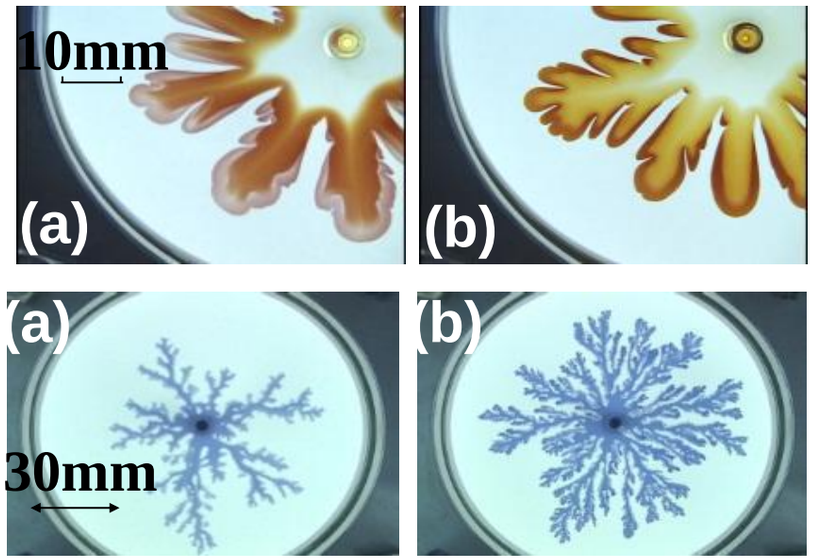


Fig.1 Reacting hydrodynamics involving the product distribution significantly depending on initial reactant concentrations

Fig.2 Flow control by a chemical reaction involving viscosity changes

In our laboratory, most of master course students have made presentation in English in international conference. Let's study together on the world stage.

Reaction Engineering of silicon materials,

Kinetics of the formation of thin films by coating and drying

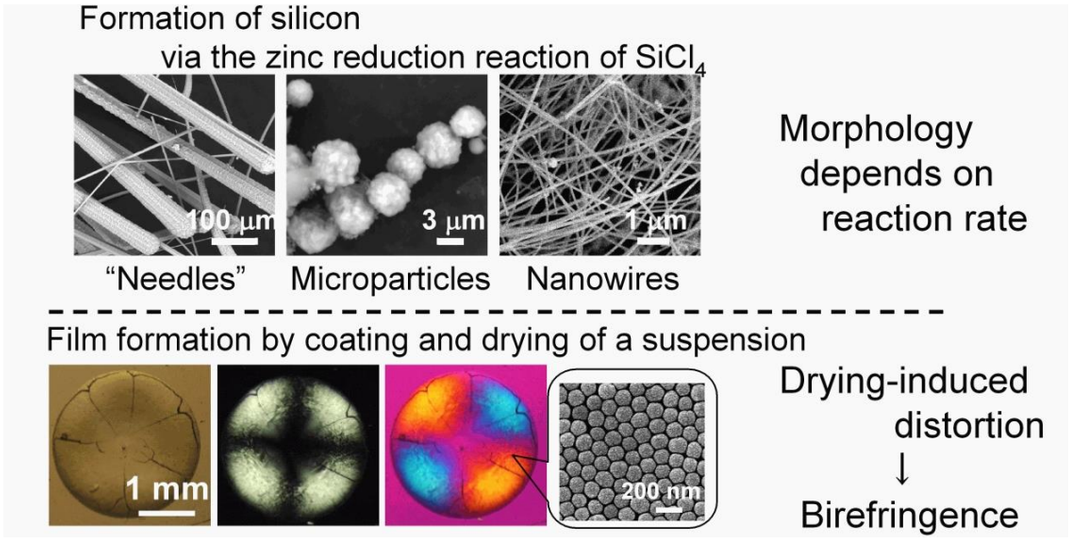
Assoc. Prof. Susumu Inasawa

We are studying two main topics:

One is production of various silicon solids (solar-grade silicon and silicon nanowires, etc.) via the zinc reduction reaction of SiCl4.

The other is the formation of solids by coating and drying of a suspension.

In both cases, "kinetics" is quite important. Understanding of these kinetics is essential to mass production and scale-up problem.



Chemical engineering is very practical.

Learning chemical engineering at TUAT

is surely fruitful to you !