

# DOCTORAL COURSE INFORMATION

GRADUATE SCHOOL OF SCIENCE AND ENGINEERING

2003 ▶▶ 2004

Materials Engineering

System Engineering

Engineering for Productions

Environmental Science



EHIME UNIVERSITY



# *C O N T E N T S*

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# Materials Engineering

The Materials Engineering Division offers two courses on the Functional Materials Engineering (Functional Materials Science and Engineering, Electronic Materials Engineering, Solid State Chemistry, Physical Metallurgy for Materials, Materials Development Engineering, and Surface and Material Processing Technology), and the Materials Conversion Engineering (Molecular Recognition and Biomolecular Chemistry, Molecular Design and Inorganic Chemistry, Architecture of High-Functional Polymers, and Chemical Engineering).

## Functional Materials Engineering

### Functional Materials Science and Engineering

The key study is "Chemical Sensors". In order to make the sensors with high sensitivity and stability, the method of synthesis and their characterization have been investigated for various types of materials such as polymers, ceramics, solid electrolytes, organic dyes, and their composites. The sensors thus prepared detect relative humidity or the concentration of ppm-level of organic vapors,  $\text{NH}_3$ ,  $\text{NO}_x$ ,  $\text{CO}_2$ ,  $\text{Cl}_2$ ,  $\text{HCl}$ ,  $\text{H}_2\text{S}$ . The laboratory is instrumented with various equipments for characterization of materials, e.g., auger electron spectrometer (AES), X-ray photoelectron spectrometer (XPS), fluorescent X-ray analyzer, thermal analyzer (TG, DTA, DSC), fourier transform infrared spectrophotometer (FT-IR), impedance analyzer, etc.

### Electronic Materials Engineering

The projects are conducted to study the electro-optical properties of compound semiconductors and magnetic properties of inorganic and organic materials: The chalcopyrite semiconductors having super lattice structure are fabricated by molecular beam epitaxy. The electroluminescent phosphor thin films are prepared by radio frequency sputtering. Magnetic properties of permanent magnet magnetic materials, intermetallic compounds, magnetic thin film and organic magnetic materials are studied by magnetizing measurements, neutron diffraction, nuclear resonance, and Kerr effect. The analysis of organic magnetic substance TPV is made by using molecular orbital method. The results obtained from these researches are published in Japanese Journal of Applied Physics, Journal of Society for Information Displays, Physical Review, Computational Physics Communication, etc.

### Solid State Chemistry

Synthesis and characterization of various functional ceramics, electron conducting and ion conducting materials were studied. Apparatus: magnetron sputtering device, vacuum evaporating device, high temperature type furnaces, potentiostats for the preparations of thin and thick films; impedance meter, FFT servo analyzer, differential scanning calorimeter, thermogravimetric analyzer, infrared spectroscopic analyzer, ultraviolet and visible spectrophotometer, gas chromatograph and high precision liquid chromatograph for the analysis and characterization of these materials. The present works are the synthesis of protonic conductor with layered perovskite structure for the hydrogen-oxygen fuel cell, copper or silver ion conductors for the solid battery and the

double-layer capacitor, thin tungsten oxide films for the electrochromic device and thin zinc oxide film by the atomic layer epitaxy method for the super lattice materials, and a development of electrode for the electrochemical-reduction of carbon dioxide.

### Physical Metallurgy for Materials

Mechanisms of phase transformations, lattice defect behaviors and interphase structures have been investigated in terms of crystallography and thermodynamics. The microstructures of metals, alloys, semiconductors, ceramics and composite materials are analyzed in atomic scale mainly by means of high resolution transmission electron microscopy, analytical transmission electron microscopy, X-ray diffraction and image-processing.

The effects of the microstructures on physical properties, and mechanisms for phase transformations and precipitations have been examined based on the atomistic analyses.

### Materials Development Engineering

The researches of preparation and characterization of various functional materials are being made in progress such as composite materials, ceramics, semiconducting compounds and thin film materials. Materials are prepared by plasma-thermal spraying, sintering, molecular beam epitaxy, RF-sputtering and plasma-assisted chemical vapor deposition techniques. Characterization and analysis of the materials are carried out by transmission electron microscopy, X-ray diffraction method, reflected high energy electron diffraction method, electron-probe micro analysis and LASER spectroscopies.

### Surface and Materials Processing Technology

New methods for preparing diamond and diamond-like carbon films are investigated with physical and chemical processes; 1) preparation of diamond-like carbon film using electrostatic hypervelocity-impact and deposition of carbon microparticles (shock synthesis) and its evaluation of structural, electrical and tribological characteristics, 2) high-rate growing of diamond film and particles in high-pressure microwave plasma. Furthermore, a fundamental approach to prepare highly functional surface is made; at present, wettability for carbon- and metal-metal systems is investigated with the first-principle molecular dynamic calculation and by wetting experiment in ultra-high vacuum.



## Materials Conversion Engineering

### Molecular recognition and biomolecular chemistry

Three groups are engaged with the following projects. (1) Elucidation of molecular recognition in a host-guest complex at atomic resolution and design of a new inclusion host molecules aiming to invent methods for optical resolution and enantioselective reaction. (2) Synthesis of phosphoinositides for understanding the mechanism of cellular signal transduction at a molecular level. (3) Study of molecular mechanisms of ribosomes and development of an efficient cell-free protein synthesis system.

Our research resulted in : (1) the invention of reagents for optical resolution ; (2) the synthesis of inositol phosphate ; and (3) discovery of the sarcin/ricin domain in ribosomal RNA.

### Molecular design and inorganic chemistry

The synthesis and investigation of the mechanism of molecular recognition and of new inorganic materials are focused in this field. Mainly three projects are engaged ;

(1) Controls of pore size at nano meter level and microscopic structure of nano to micro pores of ceramics and glasses. (2) Synthesis of inorganic-organic hybrid materials by surface modifications with high-functional organic molecules. (3) The acid-base properties of glass matrix and its surface characteristics. The application of these materials in analyses under a severe condition such as high temperature is an important subject in analytical chemistry.

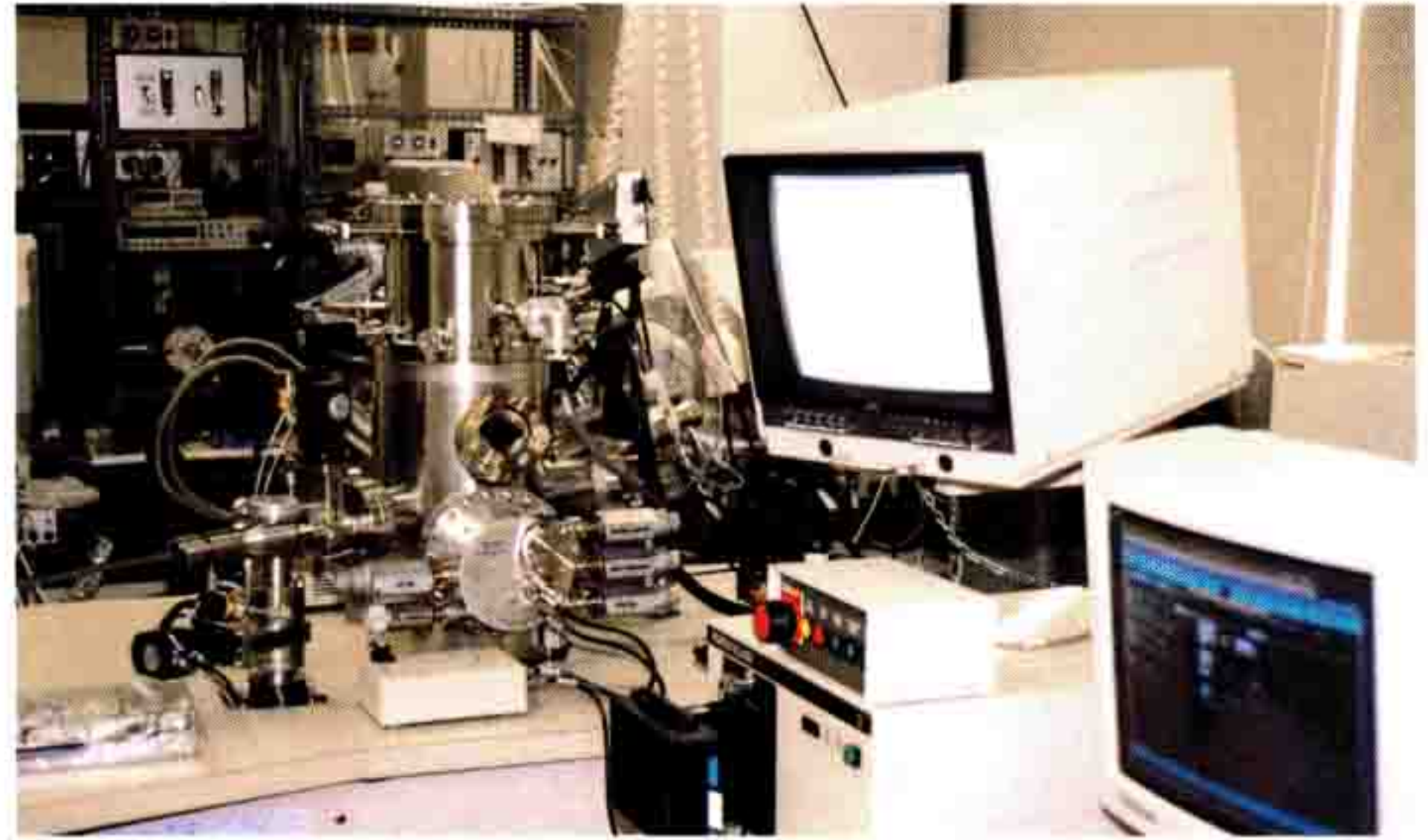
### Architecture of high-functional polymers

The field of architecture of high-functional polymers is related to the metal complexes with long alkyl chain or aromatic rings. the purpose of work is the elucidation of solid and solution structure in molecular level of the complexes. Recently, it was found that the binuclear chromium (III) complex with phenanthroline and d-tartrate was associated into supramolecular assemblies by use of atomic force and transmission electron microscopes.

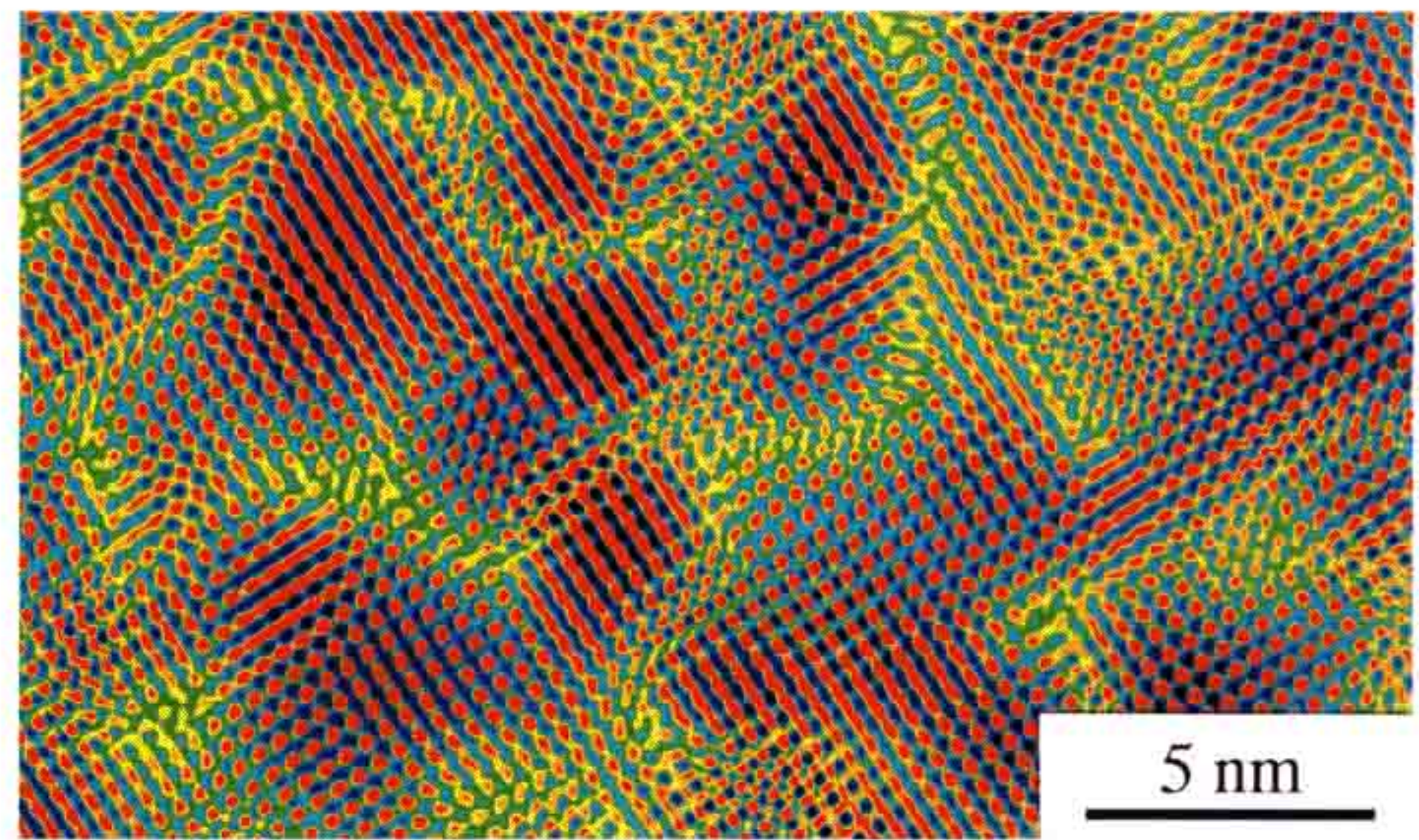
### Chemical engineering

In the field of chemical engineering, the following investigations on a biochemical engineering have been carried out :

1) applications of lipid vesicles, of which surfaces are modified with various species of bioactive agents, for the techniques such as enzyme immobilization, column chromatography and DDS ; 2) application of a foam separation to such a selective protein-separation of high degree and wastewater treatment. On the other hand, the following subjects are studied to protect the water environment : the waste water treatment by up-flow and down-flow aerated biofilters, the aerobic digestion and freezing-thawing treatment of excess activated sludge, the solid-liquid separation by membrane, the freezing concentration and separation of impurities. Also, the absorption refrigerating machine, which does not use chlorofluorocarbons and electric power, is experimented.



Auger electron spectrometer (AES) for surface analysis



High resolution electron micrograph showing atomic arrangements in Al-Li base alloy. Red or yellow circle corresponds to an atomic column normal to the print. The color of the circle depends on the location of atoms in the column.



Cell-free protein synthesis system



# System Engineering

Electronics and computer technologies as well as communication systems have made remarkable progress and had significant influence on a wide variety of industries and our society. Hence, it is strongly required to train scientists and engineers in the fields of computer systems, information technologies and their applications. With this in mind, education and research in the System Engineering are directed to the following subjects : differential equations, numerical analysis ; computer simulations, remote sensing ; optimal location of urban facilities, transport network analysis ; computer algebra systems, test and diagnosis of VLSI ; knowledge based software engineering, coding, image processing, neural networks ; digital communication systems ; digital information storage systems ; optical devices and systems.

## Information System Engineering

### Applied Mathematics

Mathematics is the base of science and engineering. It is especially important in the field of system and computer science. The major subjects of our research area contain the following :

1. Computational mathematics
2. Differential equations
3. Numerical analysis
4. Non-linear dynamics
5. Mathematical programming

### Simulation Engineering

Computer simulation has been one of the most significant fields of computer applications. In particular, in the field of science, it is known as 'Computational Science', which is now recognized to be an indispensable tool in studying nonlinear properties. Here, our main concern is directed to applications to space physics. In this respect, we exploit the numerical code, visualization of numerical data (graphics system), and so forth. In connection with satellite observations, we study complicated nonlinear problems in space that could never be resolved without advanced computer systems and techniques.

### Urban and Transport Systems Planning

Professor Masuo Kashiwadani studies analytical methods and planning methods in urban areas based on regional science and urban economics. Professor Yasuo Asakura studies transport network planning and travel demand analysis.

Research topics are categorized into the following subjects. Congestion management in metropolitan areas. Optimum location of urban facilities both for elder people and in less populated areas. Evaluation of Intelligent Transport Systems using microscopic network simulation. Analysis of drivers' travel choice behaviour, travel demand and performability in road network systems.

### Computer Architecture and Data Processing

Active research programs of this area are test pattern generation, fault simulation, fault diagnosis (Doctor's supervisor : Prof. Yuzo Takamatu), computer algebra system and its algorithms, software systems (Doctor' s supervisor : Prof. Matu-Tarow Noda), information systems, distributed system and parallel processing. Above topics are one of the most important research area of computer sciences.

### Intelligent Information Processing Division

The principal aims of this division are to develop a fundamental theory of intelligence and to develop practical applications in areas such as information theory and digital communications, digital watermarking, image processing (image restoration, enhancement and coding), pattern classification and recognition, clustering theory, machine learning, neural networks, artificial intelligence, knowledge based systems, representation of knowledge, common sense reasoning, knowledge based software engineering, computer supported collaboration works, and multimedia communications.

## Electronics, Information and Communication Engineering

### Information and Communication Systems

Information and Communication Systems section research field has two major education and research fields, i.e.

"Information Media Study" and  
"Communication Systems Study."

Information Media Study covers several fields concerning

digital media processing, such as image and signal processing algorithms, neural networks applications to image and signal processing, and multi-dimensional nearest neighbor search algorithms.

Communication Systems Study covers several fields concerning digital communication systems such as coding theory, channel error control, digital modulation and demodulation, transmission codes, and protocols for multiple access.



## Information Storage System

The advent of multi-media society brings an enormous demand for the storage of digital data along with the demands for processing and transmission of such data. Signal processing technologies play an important role in achieving high storage density on digital information storage systems such as magnetic disk drives, optical disk drives and digital VTR's.

Information Storage System Research Field is responsible for signal processing for high-density recording based on coding theory, communication theory and artificial neural network technologies.



Character shape coding using Euclid distance skeleton.

## Optical System

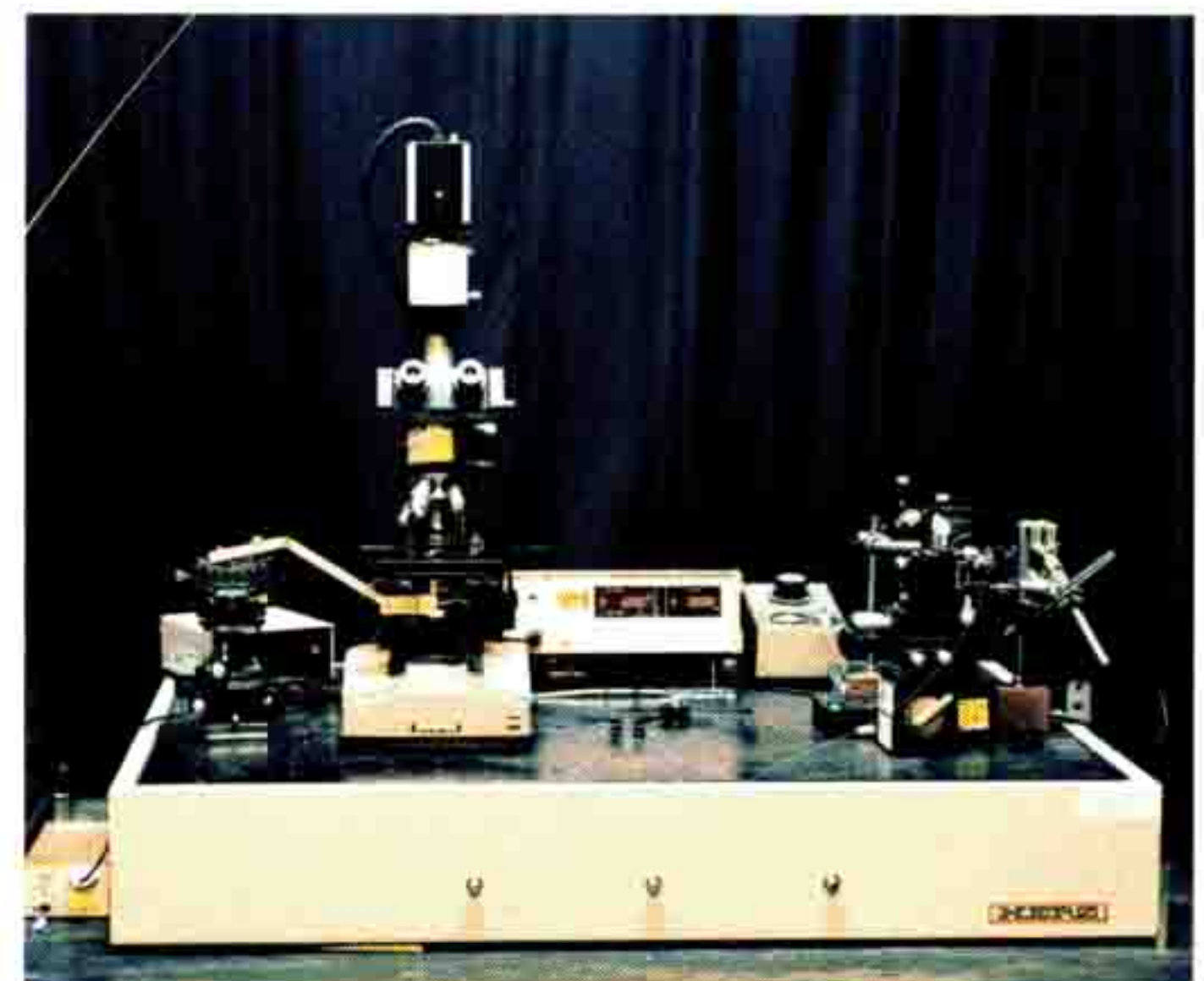
Lasers have revolutionized the world of information and communication technology. We are responsible for design, fabrication and analysis of communication and storage systems which use lasers. Our main effort at the moment is numerical analysis of electromagnetic fields of optical devices using finite-difference time-domain method and beam propagation method. Investigating fundamental properties of waveguides and fibers for sensors and diffraction gratings for novel optical elements are examples. Our traditional advantage lies in branching waveguides and connection of two displaced waveguides. Also, we are working on fabrication of single-mode waveguide devices using thermal diffusion technique.



Animation Production for computer simulations on auroral flare and plasmoid propagation.



Simulation system for high-density digital magnetic recording.



Measurement system of optical waveguide parameters.



# Engineering for Productions

## Mechanical and Structural Synthesis

Buildings and structures are becoming bigger and bigger, and machinery also larger and more complicated. This trend is supported by basic researches on materials and strength of structures, and development of design, machining, construction techniques and control. The course of Mechanical and Structural Synthesis consists of five research fields.

Education and researches are being conducted on the following comprehensive subjects :

### Materials Strength

Strength, fatigue and fracture of materials, and micromechanics

### Design Engineering for Structures

Optimal design, engineering decision making and nonlinear analysis of structural systems

### Mechanics and Control

Dynamics and control of mechanical systems



Photo 1. 1.4kW CO<sub>2</sub> laser processor.

### Hybrid Materials Processing

Design and processing of materials and their surface

### Construction Machinery

Construction techniques, terramechanics and design of construction machinery

#### Facilities and Apparatuses

- (1) 1.4kW CO<sub>2</sub> laser processor (Photo 1)
- (2) Plasma spraying apparatus
- (3) Tensile testing machine with atmosphere control chamber
- (4) Scanning electron microscope
- (5) Impact cutting test machine for rock materials (Photo 2)
- (6) Fatigue testing machine
- (7) Workstation with image processing unit
- (8) Impact testing system
- (9) Two-dimensional shaking table



Photo 2. Impact cutting test machine for rock materials.

## Engineering for Environments and Developments

### Environmental Geomechanics

Mechanical characteristics of soils, prediction and protection methods for geo-disasters, methods of development of soft ground, inclined ground earthquake engineering for disaster prevention and seismic responses of structure in the aspect of structural/geotechnical earthquake engineering are educated and studied.

Research topics are categorized as follows; Nonlinear dynamic soil-structure interaction, Liquefaction effects on pile foundations, Analysis and modeling of strong ground motion,

Earthquake damage investigation, and their applications for disaster prevention.

### Underground Space Engineering

Strength, deformation characteristics and thermal properties of rock mass, design and construction of underground space, analysis for mechanical behavior and degradation mechanism of rocks and construction materials related to construction of underground space are educated and studied. (Photo 3)



## Engineering for Water Environment and Development

Numerical modeling of ocean winds, waves, storm surges, nearshore currents and beach changes, development and defense of coastal sea area, theory of water and sediment movement in river channel, planning and design of rivers and urban sewer systems for flood control, water resources development and improvement of environment are educated and studied. (Photo 4)

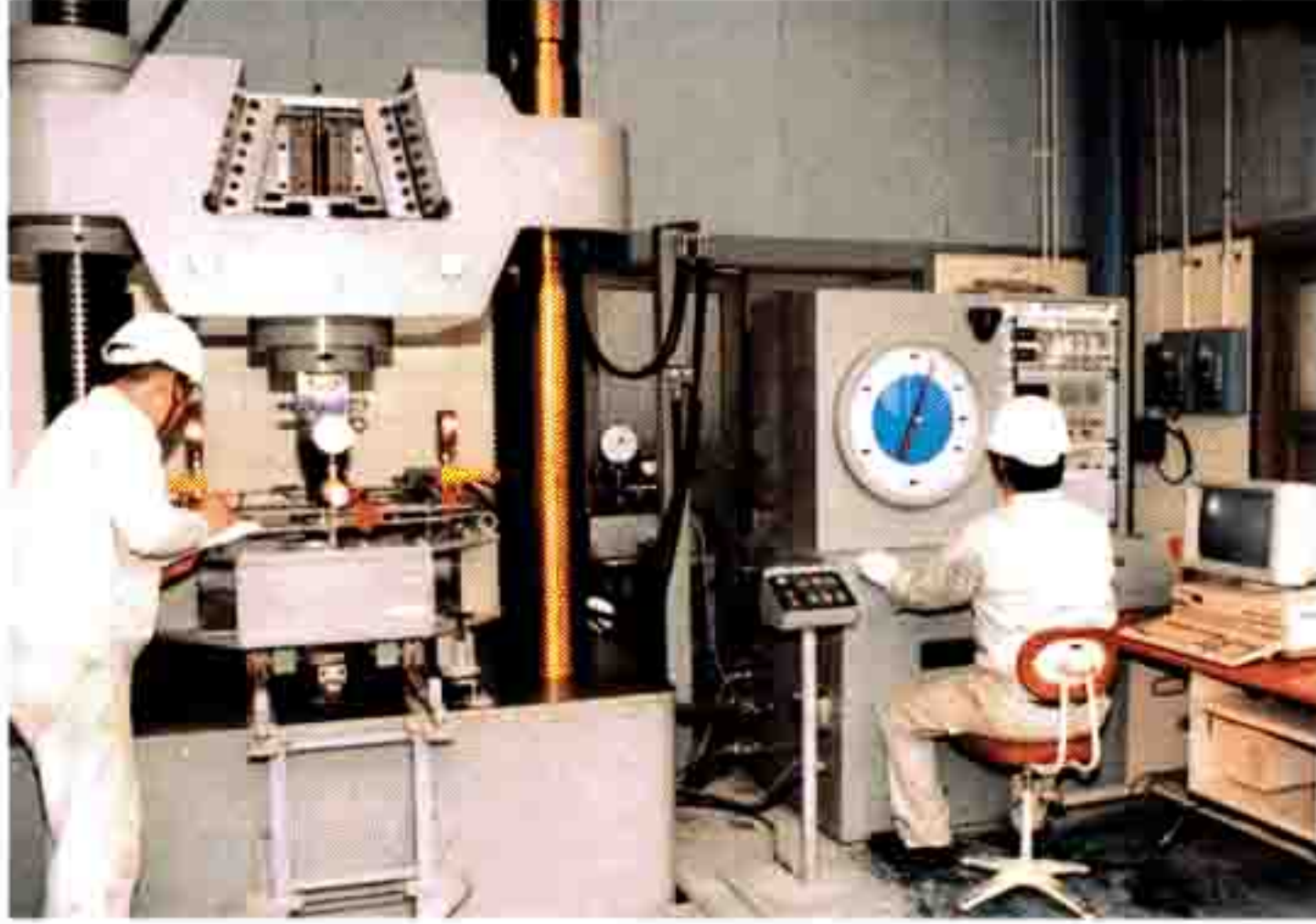


Photo 3. True triaxial compression test machine for rocks.

## Marine Environmental Sciences

Education and research on the theories of ocean dynamics, ocean variabilities, material transport processes and ground water dynamics in coastal aquifers and on the measurements and preservations of marine and landwater environments.



Photo 4. Experimental flume for water flow and sediment transport.

## Power Engineering

Future development of industrial production will be impossible without stable supply of energy, progress in researches on effective uses of energy and new energy resources, and precaution against the environmental disruption. The course of Power Engineering consists of two research fields. Educational and research activities in the course are concerned, in a wide sense, with the above problems. The comprehensive subjects are as follows :

### Electrical Power Engineering

Electrical insulation  
Discharge, plasma and laser applications  
Plasma physics and lighting applications

### Thermal and Fluids Engineering

Fluids engineering and multiphase flow



Photo 5. Optical system for Kerr effect.

Heat transfer with or without phase change.

### Facilities and Apparatuses

- (1) 150kV power transformer
- (2) 50kV voltage pulse generator
- (3) High voltage pulse generator with 100 nanoseconds duration
- (4) Optical system for Kerr effect (Photo 5)
- (5) Optical system for measurements of very faint light
- (6) Excimer laser, Ruby laser, He-Ne laser
- (7) Detection system of void discharge in insulators
- (8) Measuring system of surface potential of insulators
- (9) Purifying equipment for liquid dielectrics
- (10) Three-dimensional laser-Doppler velocimeter (Photo 6)
- (11) Wind tunnel
- (12) Graphics workstation
- (13) Experimental system for boiling inception
- (14) Experimental apparatus for condensation in rotating cylinder.
- (15) VUV measurement systems



Photo 6. Three-dimensional laser-Doppler velocimeter.



# Environmental Science

This division offers the research instruction and opportunity for the advanced graduate work in basic and applied sciences of organisms, natural environments and artificial materials. It consists of three Major Courses ; Molecular and Organismal Environmental Science, Fundamental Environmental Science, and Materials Science and Environment. Each Major Course is composed of three subcourses which provide work in the specific research projects as shown below.

## Molecular and Organismal Environmental Science

### Organismal Environmental Science

Molecular mechanism of environmental adaptation, correlation for organismal environment, adaptation of microorganisms for environmental change, and mechanism of cell division and organismal formation.

### Organic Environmental Chemistry

Organic syntheses of functional substances directed toward harmony with environment, and functional appearance and correlation between structure and function in organic molecules and macromolecules.

### Molecular Environmental Chemistry

interaction between organic molecules (biomolecules) and environments such as heat, light, and magnetic field, molecular conversion utilizing catalyst without environmental pollution, interaction between functionalized molecules and environment, and reactions of metal complexes related to environmental studies.

The research laboratories related to the Course are equipped with specialized equipment required for modern research, and other analytical instruments are facilitated in the Advanced INCS.

## Fundamental Environmental Sciences

### Fundamental Dynamics

nonlinear acoustics, nearfield theory and acoustic radiation pressure in Theoretical and Applied Physics, nonlinear analysis for nonlinear equations, verification of solution numerical iterative analysis, characterization and application of hyper space in Mathematics, and high pressure mineral physics and its application to earths interior in High pressure Geophysics

### Earth Material Science and Crustal Dynamics

Physical properties of minerals in the earths interior, thermodynamics of rock forming minerals, crust and mantle interactions and dynamics during the evolution of the earth, geology, structure and crustal evolution of island arcs and continents,

active tectonics of island arcs and other fields in Earth Sciences

### Ecosystem

Behavioural ecology, and genetics of environmental adaptation in Ecology and Biology, and conservation and control of coastal and marine environment in Civil Engineering.

The research laboratories related to the Major Course are equipped with most of the specialized equipment required for modern research including ultra high pressure apparatus, EPMA, XRF, SEM and work stations, and other analytical instruments facilitated in the Advanced INCS.

## Materials Science and Environment

### Environmental Sensor System

This field is focused on the education and research of the basic and applied aspects of environmental sensors relating to the surface ionization property, solid and liquid state materials of ionics, the combustion reaction, the analysis of reduction systems for the environmental pollutant, and the fundamental mathematic theory on global environment.

### Environmental Materials Science

The macro and micro properties of magnetic materials and amorphous under the special environment, physical characteristics of mesoscopic system, and the basic theory and the development of new materials to make the environment most suitable are educated and researched.





## Energy and Environment

The universal property of nuclear matters relating to the

energy and environment, the nonlinear analysis to control and built up an agreeable environment, and the fusion research and the creation of the new energy system with environment impact are educated and studied.



Water-cooled magnet (applied field  $H < 1.5T$ ) and equipment measuring Magnetic properties. (ac-susceptibility, magnetstriction etc.)



Shock tube apparatus contribution to combustion chemistry : combustion science has taken on added significance, owing to increased public awareness of the finite supply of fossil fuels and injurious effects of some combustion products on the environment and human health. The combustion reaction mechanism of the fuels is very important in the combustion science. The shock tube is responsible for major contribution to the combustion reaction mechanism.



Multianvil apparatus (ORange-2000 and ORange-1000) at the Ultra-High Pressure Laboratory. These apparatus can produce pressures to 40 GPa and temperatures exceeding 2000°C, and are used to explore the constitution and composition of the Earth's deep interior.



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- **TEACHING AREAS**

Chemistry of Functional Materials Part I

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Preparation of Nanosized Perovskite-type Oxide Powders Using the Therm Decomposition of Heteronuclear Complexes
- ② Optical Gas Sensors using Organic dyes
- ③ Gas Sensors Using Inorganic Materials
- ④ Study of Environmental Monitoring System Using Plural Sensors
- ⑤ Studies of Solid Electrolytes for Gas Sensors and Fuel Cells

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- **TEACHING AREAS**

Advanced Materials Engineering

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Magnetic and transport properties of conducting ceramics
- ② Development of advanced ceramics for electric, magnetic and mechanical application
- ③ Ceramic process using micro-wave heating
- ④ Phase transformation of ceramics and metals
- ⑤ Ceramic Superconductor

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- **TEACHING AREAS**

Applied Physical Chemistry

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Development of humidity sensors usable in various harsh conditions
- ② Development of portable gas sensors for an environmental monitoring
- ③ Investigation of gas sorption mechanism in polymers
- ④ Development of novel polyelectrolytes and its application

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- **TEACHING AREAS**

Chemistry of Functional Materials Part II

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Inorganic materials for chemical sensors
- ② (1) Preparation of Nanosized Perovskite-type Oxide Powders Using the Therm Decomposition of Heteronuclear Complexes  
(2) Gas Sensors Using Inorganic Materials  
(3) Studies of Solid Electrolytes for Gas Sensors and Batteries

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- **TEACHING AREAS**

Electronic Devices

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Preparation and characterization of phosphors
- ② Thin film electroluminescent devices
- ③ Powder electroluminescent devices



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- **TEACHING AREAS**

Magnetism and Magnetic Materials

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Magnetism of Metals and Intermetallic Compounds
- ② Neutron Diffraction
- ③ Organic Magnetic Materials
- ④ Proton Irradiation of Semiconductor
- ⑤ Spin Transistor

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- **TEACHING AREAS**

Quantum Mechanical Approach to Materials Science

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Analysis of organic magnetic substances
- ② Simulation of quantum phenomena
- ③ Numerical analysis

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- **TEACHING AREAS**

Advanced Magnetic Materials

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① NMR and Magnetic Studies of Crystalline-Amorphous Transformation in Mechanically Alloyed  $\text{Co}_{75}\text{Ti}_{25}$
- ② NMR Studies of Valence Phase Transformation in  $\text{YbInCu}_4$
- ③ Physical Properties of Heavy Electron System in  $\text{YbMCu}_4$  (M=Mg, Cd, Sn)
- ④ Magnetic Studies of Mn mono-pnictides

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- **TEACHING AREAS**

Properties of Materials

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Developments of fuel cell
- ② Developments of electronic device

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- **TEACHING AREAS**

Chemistry of inorganic Materials

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Development of environmental catalysts
- ② Preparation and characterization of semiconductor particles in porous materials
- ③ ESR study on the paramagnetic molecules in zeolites
- ④ Synthesis and characterization of mesoporous materials
- ⑤ Preparation of proton-conductor for applying to fuel cell



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● **TEACHING AREAS**

Lattice Defects and Crystallography

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Phase transformations in Al-, Mg-, and Ti-based alloys
- ② Mechanism of grain refinement in weld heat-affected zone of steels
- ③ Effects of atomic arrangement at artificial interfaces on deformation behavior in composite materials
- ④ Development of human-bone materials and nano-structural magnetic materials
- ⑤ Crystallographic analysis of nano-structures and lattice defects by high-resolution transmission electron microscopy

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● **TEACHING AREAS**

Advanced Functional Materials

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Characterizations and optical communication device application of GaInAs and GaInNAs narrow-gap alloy semiconductors
- ② Luminescence of semiconductors doped with transition-metal and rare-earth impurities
- ③ Epitaxial growth of wide-gap semiconductors : GaN, ZnO and ternary chalcopyrite semiconductors
- ④ Spectroscopic studies of semiconductors by modulation spectroscopy, photoluminescence, cathodoluminescence, photoacoustic spectroscopy and Raman spectroscopy
- ⑤ Preparation and characterization of CuInSe<sub>2</sub> and ZnO polycrystalline thin films for photovoltaic applications

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● **TEACHING AREAS**

Advanced Surface Processings

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① A New Fabrication of Diamond-Like-Carbon (DLC) Film Using Electrostatic Acceleration of Carbon-Microparticles
- ② Characterization of Boundary-Lubrication of the DLC, and its Evaluation with Atomic Force Measurement
- ③ Development of Ultra-fine Particle Beam Processing for New Materials
- ④ Synthesis of Diamond with Microwave Plasma under High Pressure
- ⑤ Evaluation of the Atomic Diffusibility and Wettability of Metal on Carbon Using Ab Initio Molecular Orbital Calculation

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● **TEACHING AREAS**

Advanced Particulate Engineering

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Synthesis of material by plasma CVD method
- ② Powder technology
- ③ Sintering
- ④ Design and manufacturing system



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• **TEACHING AREAS**

Molecular Biotechnology

• **RESEARCH AND SCHOLARSHIP AREAS**

- ① Development of the cell-free protein synthesis system.
- ② Development of the robot, "Protein Synthesizer".
- ③ Materialization of a genetic information into protein.
- ④ Establishment of a new field, "Cell-free Sciences" and "Cell-free Technology".
- ⑤ Structure and function of translation apparatus.

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• **TEACHING AREAS**

Synthetic Chemistry of Biologically Active Substances

• **RESEARCH AND SCHOLARSHIP AREAS**

- ① Synthetic organic chemistry, Bioorganic chemistry, Organic reaction chemistry
- ② (1) Total synthesis of inositol phospholipids  
(2) Preparation of inositol phospholipid analogs as biological probes  
(3) Development of new synthetic methodologies  
(4) Characterization of new reactions in heteroatom chemistry including phosphorus and tellurium  
(5) Development of new materials with useful functions based on supramolecular chemistry

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• **TEACHING AREAS**

Synthetic Organic Chemistry

• **RESEARCH AND SCHOLARSHIP AREAS**

- ① Optical resolution and enantioselective reaction in the inclusion crystals with optically active host compounds.
- ② Development of environmentally friendly organic synthesis under solvent-free conditions.
- ③ Novel organic photochromism in the crystalline state.

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• **TEACHING AREAS**

Organic Photochemistry

• **RESEARCH AND SCHOLARSHIP AREAS**

- ① Preparation of two-component crystals and development of solid state bimolecular photoreactions.
- ② Design of absolute asymmetric synthesis by solid state reaction.
- ③ Development of optical materials such as nonlinear optical crystals.
- ④ Measurement of optical activity of chiral crystals and correlation between chirality and light.
- ⑤ Solvent-free organic synthesis, especially under microwave irradiation.



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● **TEACHING AREAS**

Biochemistry

● **RESEARCH AND SCHOLARSHIP AREAS**

RNA modification enzyme, Redox protein, Enzymology, Translation, Structure analysis of protein and nucleic acid

- ① X-ray crystal structure analysis of tRNA methyltransferase and its substrate bound form.  
Reaction mechanism study of RNA modification enzyme.
- ② Molecular evolution of RNA modification enzyme.
- ③ Molecular folding of flavo-redox protein.

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● **TEACHING AREAS**

Inorganic Chemistry

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Industrial Analytical Chemistry                      Industrial Inorganic Chemistry  
Glass and Ceramics                                      High Temperature Melts
- ② (1) NMR studies of multicomponent oxide glasses-microstructure around network forming element  
(2) Electrochemical studies of high temperature glass melts-“Fining” in glass  
(3) Industry-Synthesis and characterization of microporous spherical TiO<sub>2</sub> particles by sol-gel method  
(4) Acid-base and Redox properties of glasses and their melts

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● **TEACHING AREAS**

Advanced Inorganic-Organic Chemistry

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Research field    Physical Chemistry  
Solid State Chemistry                                      Surface Science  
Catalysis and Catalysts
- ② Research projects    Inorganic-organic materials  
Layered materials    Intercalation compounds  
Electrical conducting materials                                      Methane coupling catalysts

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● **TEACHING AREAS**

Chemistry of Noncrystalline Materials

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Synthesis and characterization of inorganic porous materials
- ② Structural analysis of inorganic material by solid NMR
- ③ Redox study of oxide glass melts
- ④ Separation study of metal ion



### KOINE Norio, Assoc. Prof.(DSc)

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- **TEACHING AREAS**

Biopolymer Chemistry

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Application to the optical resolution of the metal complexes with bifunctional ligands.
- ② Elucidation of chiral discrimination mechanism of metal complexes.
- ③ Preparation and structure of metal complexes forming self-organized supramolecular assemblies in aqueous solution.
- ④ Chromatographic separation of rare earth metals by a chelating resin having edta groups.

### IHARA Eiji, Assoc. Prof.(Dr. Eng.)

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- **TEACHING AREAS**

Chemistry of Polymerization Catalysts

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Development of New Method for Polymer Synthesis using Transition Metal Reagents
- ② Synthesis of New Polymers

### MATSUDA Akira, Prof.(Dr. Eng.)

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- **TEACHING AREAS**

Biochemical Engineering

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Wastewater Treatment by Upflow and Downflow Aerated Biofilters
- ② Submerged Membrane Separation Activated Sludge Process
- ③ Freezing and Thawing Treatment of Excess Activated Sludge
- ④ Freeze Concentration with Supersonic Radiation
- ⑤ Absorber and Generator of Absorption Refrigerator

### KATO Keiichi, Assoc. Prof.(Dr. Eng.)

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- **TEACHING AREAS**

Separation Chemistry

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Preparation method of a lipid vesicle having a targeting function to a cancer cell And the function in DDS for cancer therapy
- ② Gene-transfection using a lipid vesicle as a gene-vector
- ③ A study of a preparation method of a lipid vesicle immobilized membrane enzyme and the function of the vesicle
- ④ Characteristics of the bound water to a excess sludge in a water treatment



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- **TEACHING AREAS**  
Mathematical Analysis
- **RESEARCH AND SCHOLARSHIP AREAS**
  - ① Partial differential equations
  - ② Cauchy problems
  - ③ Propagation of singularities
  - ④ Analytic continuation

## AMANO Kaname, Prof.(Dr. Eng.)

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- **TEACHING AREAS**  
Computational Mathematics
- **RESEARCH AND SCHOLARSHIP AREAS**
  - ① Numerical methods for computational science
  - ② Applied and computational complex analysis
  - ③ Mathematical software
  - ④ Theory and experiment on pattern cognition

## TSUDA Kôichi, Prof.(DSc)

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- **TEACHING AREAS**  
Mathematical Foundations
- **RESEARCH AND SCHOLARSHIP AREAS**
  - ① Fractional invariant
  - ② Dimension functions
  - ③ Universal spaces
  - ④ ANR spaces

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- **TEACHING AREAS**  
Differential Equations
- **RESEARCH AND SCHOLARSHIP AREAS**
  - ① Mathematical physics
  - ② Spectral theory for differential operator
  - ③ Scattering theory for quantum mechanics

## INOUE Tomoki, Assoc. Prof.(DSc)

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- **TEACHING AREAS**  
Nonlinear Dynamics
- **RESEARCH AND SCHOLARSHIP AREAS**
  - ① Ergodic properties on discrete dynamical systems with chaos
  - ② Limit theorems on dynamical systems with intermittent chaos
  - ③ Mathematical foundations towards applications of chaos and fractals



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- **TEACHING AREAS**  
Theory of Computer Simulation
- **RESEARCH AND SCHOLARSHIP AREAS**
  - ① Computational science and visualization
  - ② Modeling and supercomputing
  - ③ Space plasma simulations
  - ④ MHD simulations on flare phenomena

**KASHIWADANI Masuo, Prof.(Dr. Eng.)**

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- **TEACHING AREAS**  
Urban and Regional Systems
- **RESEARCH AND SCHOLARSHIP AREAS**
  - ① Transportation network and public facility location
  - ② Transportation planning in rural areas
  - ③ Travel behavior analysis of residents in remote areas

**HATO Eiji, Assoc. Prof.(Dr. Eng.)**

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- **TEACHING AREAS**  
Traffic Engineering
- **RESEARCH AND SCHOLARSHIP AREAS**
  - ① Management of Dynamic Network Flow
  - ② Spatial Marketing
  - ③ Decision under Uncertainty

**TAKAMATSU Yuzo, Prof.(Dr. Eng.)**

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- **TEACHING AREAS**  
Theory of Switching Circuits
- **RESEARCH AND SCHOLARSHIP AREAS**

① Digital systems-design and test	④ Fault diagnosis
② Testable design	⑤ Fault tolerant computing
③ Test generation	

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- **TEACHING AREAS**  
Theory of Computing
- **RESEARCH AND SCHOLARSHIP AREAS**
  - ① Computer algebra system and algorithms
  - ② Software systems
  - ③ Web computing

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- **TEACHING AREAS**  
Parallel and Distributed Computations
- **RESEARCH AND SCHOLARSHIP AREAS**
  - ① Computer science
  - ② Parallel processing, distributed system and autonomous processing



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● **TEACHING AREAS**

Theory of Logic Design

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Logic and fault simulation for advance fault model
- ② Combinational circuit test generation and fault diagnosis
- ③ Sequential circuit test generation and fault diagnosis
- ④ Design for testability
- ⑤ Digital systems design with hardware description language

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● **TEACHING AREAS**

Information Processing Systems

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Image processing
- ② Neural networks

**OHUE Kenji, Prof.(Dr. Eng.)**

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● **TEACHING AREAS**

Communication Theory

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Image processing
- ② Digital watermarking
- ③ Communication theory
- ④ Coding theory

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● **TEACHING AREAS**

Knowledge Based Software Engineering

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Intelligent support environment for software development
- ② Computer supported colabored works
- ③ Multimedia communication

**IZUMIDA Masanori, Assoc. Prof.(Dr. Eng.)**

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● **TEACHING AREAS**

Artificial Intelligence

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Learning methods of multi layer neural networks
- ② Solving optimization problems by neural networks
- ③ Self organization of neural networks
- ④ Clustering methods by the Fuzzy C-Means method



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- **TEACHING AREAS**

Theory of Information Media

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Image and signal processing algorithms
- ② Motion analysis and estimation algorithms for image sequence
- ③ Neural networks applications to image and signal processing
- ④ Multi-dimensional nearest neighbour search algorithms

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- **TEACHING AREAS**

Communication Systems

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Spread spectrum communication
- ② Power line communication
- ③ Video streaming over IP networks

## OSAWA Hisashi, Prof.(Dr. Eng.)

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- **TEACHING AREAS**

Signal Processing Systems

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Partial response maximum likelihood (PRML) system for perpendicular magnetic recording
- ② Noise predictive maximum likelihood (NPML) system for perpendicular magnetic recording
- ③ Neuro NPML system for perpendicular magnetic recording
- ④ Neural network equalization for PR channel with nonlinear distortion
- ⑤ Iterative decoding for perpendicular magnetic recording

## OKAMOTO Yoshihiro, Assoc. Prof.(Dr. Eng.)

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- **TEACHING AREAS**

Information Storage Systems

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① PRML system for perpendicular magnetic recording
- ② Iterative decoding for information storage system
- ③ Modeling of PR channel in perpendicular magnetic recording
- ④ PRML system with noise cancellation
- ⑤ Post processing for PRML system



## ONO Kazuo, Prof.(Dr. Eng.)

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- **TEACHING AREAS**

Guided-wave Optoelectronics

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Numerical techniques for electromagnetic waves
- ② Design theory for guided-wave devices
- ③ Numerical analysis of groundwave propagation
- ④ Design theory and fabrication techniques for optical sensors
- ⑤ Numerical analysis of photonic crystal waveguides

## ICHIKAWA Hiroyuki, Assoc. Prof.(Ph. D.)

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- **TEACHING AREAS**

Optical Engineering

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Electromagnetic analysis of diffractive and holographic optical elements
- ② Designing and characterising optical systems consisting of micro structure
- ③ Theoretical analysis of fabrication of nanostructure by optical lithography
- ④ Application of FDTD method to various electromagnetic wave propagation problems
- ⑤ Utilisation of optics in information technology

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- **TEACHING AREAS**

System Reliability Analysis

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Graph theory
- ② System reliability
- ③ VLSI design
- ④ Computerisable algorithms
- ⑤ Network analysis



## OGIYAMA Hiroyuki, Prof. (Dr. Eng.)

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- **TEACHING AREAS**

Advanced Strength and Fracture of Materials

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Strength and fracture of structural materials
- ② Effect of microstructures on fatigue behaviors of duplex stainless steel
- ③ Fatigue behaviors of superplastically deformed duplex stainless steel
- ④ Diffusion bonding of microduplex stainless steel

## ARIMITSU Yutaka, Assoc. Prof. (Dr. Eng.)

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- **TEACHING AREAS**

Advanced Theory of Micromechanics

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Micromechanics in solids
- ② Modeling for inhomogeneous materials
- ③ Molecular dynamic simulation of fracture
- ④ Simulation of fabric shaping process

## TAKAHASHI Manabu, Assoc. Prof. (Dr. Eng.)

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- **TEACHING AREAS**

Fracture Control Engineering for Materials

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Study on strength estimation of ceramic-metal joints
- ② Study on contact strength estimation of ceramics
- ③ Development of stabilizer for high-rate tensile test
- ④ Study on ceramic surface modification with CO<sub>2</sub> gas laser
- ⑤ Study on excision technology of liver cancer

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- **TEACHING AREAS**

Advanced Structural Analysis

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Linear and nonlinear structural analysis
- ② Strength of thin-walled members
- ③ Vibration properties of thin-walled members
- ④ Structural analysis and design of shell structures

## SHIMIZU Akira, Prof. (Dr. Eng.)

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- **TEACHING AREAS**

Control of Mechanical Systems

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Pneumatic servo systems
- ② Intelligent Robot
- ③ Fluid control
- ④ Numerical fluid dynamics
- ⑤ Control of mechanical systems by fuzzy and neural network



### SOGABE Yuji, Prof.(Dr. Eng.)

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- **TEACHING AREAS**

Dynamics of Materials

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Viscoelastic properties of materials subjected to impact loads
- ② Propagation of stress waves
- ③ Experimental method for determining dynamic properties of materials
- ④ Shape and structural optimization problems

### SHIBATA Satoru, Assoc. Prof. (Dr. Eng.)

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- **TEACHING AREAS**

Man-Machine Systems

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Robot-human interface Ergonomics
- ② Pneumatic servo system Assistive technology
- ③ Medical engineering

### ARAKI Takao, Prof.(Dr. Eng.)

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- **TEACHING AREAS**

Advanced Joining Technique and Design Concept of Composite

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Materials design and processing for compositionally gradient materials
- ② High performance thin films and thermal barrier coatings by laser irradiation
- ③ Formation of BaTiO<sub>3</sub> thin films using pulsed laser deposition for multi layer ceramics capacitor (MLCC)
- ④ Laser reactive spraying method for tailored coatings of intermetallic compounds
- ⑤ Development of emission-free recycling process for printed circuit boards of spent personal computers

### NISHIDA Minoru, Assoc. Prof.(Dr. Eng.)

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- **TEACHING AREAS**

Strength and Fracture of Composite Materials

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① The development of the novel MLCC using Pulsed Laser Deposition
- ② Production of intermetallic compounds using laser reactive spraying method
- ③ Cycling of printed circuit boards
- ④ Production of TiN coating

### MURO Tatsuro, Prof.(Dr. Eng.)

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- **TEACHING AREAS**

Advanced Theory of Construction Machinery

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Effect of vibro-compaction
- ② Excavation property for T. B. M.
- ③ Vibro-excavation of rock material
- ④ Land locomotion of OR tyre and tracked vehicle
- ⑤ Robotized construction





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- **TEACHING AREAS**

Geo-Engineering

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Soil Mechanics
- ② Geo Environment
- ③ Land slide



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- **TEACHING AREAS**

Dynamic Soil-Structure Interaction and Seismic Design of Foundations

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Earthquake response of pile-founded structure
- ② Dynamic behavior of liquefying ground
- ③ Liquefaction characteristics and modeling of soil
- ④ Estimation of geological structure using microtremors
- ⑤ Seismic ground motion



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- **TEACHING AREAS**

Advanced Underground Space Engineering

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① High and low temperature materials storage in rock caverns
- ② Development of hydraulic rock fracture machine
- ③ New type adiabatical materials
- ④ Effective utilization of industrial waste for construction materials



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- **TEACHING AREAS**

Construction Material Engineering

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Permeability of concrete, Durability of concrete
- ② Long-term behaviors of reinforced concrete
- ③ Development of new construction materials



## YAMAGUCHI Masataka, Prof.(Dr. Eng.)

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- **TEACHING AREAS**

Ocean Wave Engineering

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Stochastic modeling of typhoon and low pressure system
- ② Extremes of winds, waves and storm surges
- ③ Wave climate, Extremal analysis system
- ④ Wave prediction



## SUZUKI Koichi, Prof.(Dr. Eng.)

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- **TEACHING AREAS**  
Hydraulic Engineering
- **RESEARCH AND SCHOLARSHIP AREAS**
  - ① Sediment transport of sand-gravl mixture
  - ② Numerical simulation of river bed variation
  - ③ Local scour around river works, Soil erosion
  - ④ water resources development

## WATANABE Masahiro, Prof.(Dr. Eng.)

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- **TEACHING AREAS**  
Engineering Aspects of Urban Water
- **RESEARCH AND SCHOLARSHIP AREAS**
  - ① Urban stormwater runoff analysis
  - ② Urban runoff water quality analysis
  - ③ Countermeasures against inundation in urbanized area
  - ④ Countermeasures against combined sewer overflows (COS's)

## IFUKU Makoto, Assoc. Prof. (Dr. Eng.)

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- **TEACHING AREAS**  
Coastal Engineering with Disaster Prevention
- **RESEARCH AND SCHOLARSHIP AREAS**
  - ① Wave transformation in shallow water
  - ② Coastal sediment process due to wave and wave-current coexisting system
  - ③ Mixing process and circulation in tidal estuary
  - ④ Dynamic of fine suspended matter in tidal estuary

## KISHI Yosuke, Prof.(DSc)

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- **TEACHING AREAS**  
Hydrological Environment
- **RESEARCH AND SCHOLARSHIP AREAS**
  - ① Studies on the fine powder formation by applying solvent extraction method
  - ② Analysis of fine powder formation mechanism based on the thermodynamical consideration of chemical equilibria

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- **TEACHING AREAS**  
Environmental Oceanography
- **RESEARCH AND SCHOLARSHIP AREAS**
  - ① Currents and material transport processes in coastal seas
  - ② Mechanisms of biological production in the Seto Inland Sea
  - ③ Influences of global warming on coastal seas
  - ④ Environmental preservation of marine culture farms
  - ⑤ Generation processes of red tides and anoxic water masses



### KITANI Isamu, Prof.(Dr. Eng.)

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- **TEACHING AREAS**

Electrical Insulation Engineering II

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Breakdown phenomena in liquid and solid dielectrics
- ② Space charge distribution measurement in dielectrics
- ③ Potential distribution measurement on dielectrics surface
- ④ Ultrasonic sound detection of tree in polymers

### MIZUKAMI Koichi, Prof.(Dr. Eng.)

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- **TEACHING AREAS**

Heat Transfer with Phase Change

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Effect of wetting in boiling inception
- ② Effect of noncondensable gas in boiling inception
- ③ Condensation in rotating cylinder
- ④ Unsteady spray cooling

### OCHI Junji, Prof.(Dr. Eng.)

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- **TEACHING AREAS**

Multiphase Flow

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Multiphase flow, Critical two-phase flow through converging nozzle
- ② Two-phase flow with phase change
- ③ Multicomponent gaseous flow, Reactive fluids flow
- ④ Flow through packed bed

### MURAKAMI Koichi, Prof.(Dr. Eng.)

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- **TEACHING AREAS**

Multiphase Flows with Clear Interfaces

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Multiphase flow
- ② Behavior of gas liquid interface moving in channel
- ③ Behavior of liquid drop exposed to gas flow on wall
- ④ Boiling phenomena in narrow horizontal or inclined channel
- ⑤ Flow and heat transfer in complex channel





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● **TEACHING AREAS**

Turbulent Heat Transfer

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Convection heat transfer with secondary flow
- ② Numerical analysis by engineering turbulence models
- ③ Heat transfer enhancement for internal flow



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● **TEACHING AREAS**

Fluid Acoustics

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Effective Utilization of Acoustic Energy
- ② Heat Transfer and Fluid Flow in Ultrasonic Field
- ③ Study on Acoustic Cavitation
- ④ Hyperthermia using Magnetite Materials
- ⑤ Soft Freezing Method for Liver Surgical Procedures



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● **TEACHING AREAS**

Mechanics of Jets

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Interaction between jet and boundary surface
- ② Flow structure in various pipe-flows
- ③ Diffusion and control of jet
- ④ Turbulent flow
- ⑤ Flow induced vibration



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- **TEACHING AREAS**

Analytical Chemistry of Biomolecules

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① High-performance analysis of complex protein systems, Development of electrophoretic techniques for protein separation.
- ② Construction of a human plasma protein-database using non-denaturing and denaturing two-dimensional gel electrophoresis.
- ③ Development of electrophoretic techniques for separation and analysis of proteins.
- ④ Structural analysis of proteins in complex systems using mass spectrometry.
- ⑤ Applications of electrophoresis for the diagnostic analyses of human plasma proteins.

## HAYASHI Hidenori, Prof.(Ph.D.)

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- **TEACHING AREAS**

Chemical Mechanisms of Stress Response

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Acclimation of plants to environmental stress, Salt tolerance in plant, Heat shock proteins, Gene manipulation, Photosynthesis
- ② Studies on mechanism of high temperature tolerance in cyanobacteria
- ③ Cloning and functional analysis of heat shock proteins in plants and bacteria
- ④ Molecular engineering of heavy-metal binding proteins of cyanobacteria
- ⑤ Genetic engineering of salt tolerance in higher plants

## JOHO Masanori, Prof.(DSc)

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- **TEACHING AREAS**

Environmental Physiology

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Accomodation of fungi to environmental stress.
- ② Adaptation of yeast to heavy metal ions.

## SATO Seiichi, Prof.(DSc)

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- **TEACHING AREAS**

Structural Biology

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Structure and function of plant nucleoli.
- ② Studies on morphogenesis of plant cells.
- ③ Gravitropism of plant roots.

## TAMURA Minoru, Assoc. Prof.(DSc)

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- **TEACHING AREAS**

Host Defense System

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Superoxide ( $O_2^-$ ) generation and signal transduction
- ② Regulation mechanism and subunit structure of neutrophil NADPH oxidase
- ③ Stabilization of multi-component enzymes by fusion technique
- ④ Development of a stable  $O_2^-$ -generating device for cell biology
- ⑤ Study on protein-protein interactions



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- **TEACHING AREAS**  
Plant Molecular Physiology
- **RESEARCH AND SCHOLARSHIP AREAS**
  - ① Plant Growth & Molecular Physiology
  - ② Hormones and cell wall metabolisms
  - ③ Plant responses to cadmium and other metals
  - ④ Sugar utilization by plants
  - ⑤ Plant tissue culture

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- **TEACHING AREAS**  
Functional Organic Synthesis
- **RESEARCH AND SCHOLARSHIP AREAS**
  - ① Synthesis of conductive organic materials, biologically active compounds and porphyrins, New synthetic methods based on properties of hetero atoms
    - (1) Synthesis of New  $\pi$ -Conjugated Molecules and Their Applications to Opt-Electronic Materials
    - (2) Control of Properties of Functional Dyes and Pigments
    - (3) Chemistry of Porphyrins and Related Compounds
    - (4) Organic Synthesis Using Nitro Compounds
    - (5) Synthesis of Biologically Active Compounds

## INOUE Kenzo, Prof.(Dr. Eng.)

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- **TEACHING AREAS**  
Functional Polymers
- **RESEARCH AND SCHOLARSHIP AREAS**
  - ① Synthesis and functionalities of star polymers.
  - ② Ionically conductive polymers.

## UNO Hidemitsu, Prof.(DSc)

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- **TEACHING AREAS**  
Synthetic Organic Chemistry
- **RESEARCH AND SCHOLARSHIP AREAS**
  - ① Synthesis of Bioactive Compounds, Synthesis of Heterocyclic and Heteroatomic Compounds
  - ② Synthesis of neuronal-cell-protecting substances
  - ③ Biomimetic synthesis of quinonoid compounds
  - ④ Synthesis and structural elucidation of highly conjugated heteroaromatic compounds and their application for dyestuffs, pigments, and sensors



**MUKAI Kazuo, Prof.(DSc)**

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● **TEACHING AREAS**

Molecular Functional Chemistry

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Molecular magnetism, Organic ferromagnet, Ferromagnetic superconductor, Natural Antioxidants, Active oxygen · free radical, Lipid peroxidation
  - (1) Development of Molecular Superconducting Ferromagnet and Antiferromagnet
  - (2) Development of Molecular Ferromagnet with High Curie Temperature
  - (3) Natural Antioxidants : Their Activities and Action Mechanism
  - (4) Mechanism of Coexistence of Antiferromagnetic Order and Spin-Peierls State in the Doped Organic Spin-Peierls System
  - (5) Study of Radical Alloy

**YAMAGUCHI Tsutomu, Prof.(DSc)**

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● **TEACHING AREAS**

Molecular Assembly Chemistry

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Solid Acid and Base Catalysts
- ② Acid-Base Bifunctional Catalysis
- ③ Catalytic Conversion of Organosilanes
- ④ Catalytic Conversion of Light Alkanes
- ⑤ Environmentally Benign Catalysts

**AZUMA Nagao, Prof.(DSc)**

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● **TEACHING AREAS**

Chemistry of Paramagnetic Molecules

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Molecular and electronic structure of paramagnetic metal complexes
- ② Redox reaction of nitridochromium (V) complexes
- ③ X-Ray crystal structure analysis
- ④ Magnetism of organic radical crystals

**KITAMURA Yoichi, Assoc. Prof.(DSc)**

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● **TEACHING AREAS**

Chemistry of Metal Complex

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Coordination chemistry  
Kinetic study for the hydrolysis reactions of a carbonatocobalt (III) and of a hexafluoro-2, 4-pentanedionatocobalt(III)

**NAGAOKA Shin-ichi, Assoc. Prof.(DSc)**

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[http : //www.sci.ehime-u.ac.jp/~struct1/int\\_naga.htm](http://www.sci.ehime-u.ac.jp/~struct1/int_naga.htm)



● **TEACHING AREAS**

Molecular Photonics

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Photochemistry, Excited state, Core level, Synchrotron radiation, Antioxidant reaction
- ② (1) Site-specific fragmentation caused by core-level excitation,  
(2) Excited-state intramolecular-proton-transfer  
(3) Tunneling effect in antioxidant reaction of vitamin E





HASEGAWA Takahi, Prof. (Dr. Eng.)

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● **TEACHING AREAS**

Ultrasonic Engineering

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Ultrasonic Physics, Fluid Mechanics, Mathematical Physics, Study on acoustic radiation pressure, acoustic nearfield, and ultrasonic scattering. Study on solitons, chaos, and fractals.



IRIFUNE Tetsuo, Prof. (DSc)

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● **TEACHING AREAS**

High-pressure Mineral Physics

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Development of ultra-high pressure technology  
 ② Phase transformations of the earth's materials  
 ③ Application of synchrotron radiation to high pressure mineral physics  
 ④ Material synthesis at high pressure  
 ⑤ Constitution of the Earth's deep interior



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● **TEACHING AREAS**

Geographical Analysis

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Continuous selection, Convergent properties



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<http://at.yorku.ca/z/a/a/a/10.htm>

● **TEACHING AREAS**

Topological Algebra

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Topological algebra (topological groups, vector spaces and fields)  
 ② Set-theoretic topology  
 ③ Applications of topology in other areas of mathematics



SASAKI Hiroki, Prof. (DSc)

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● **TEACHING AREAS**

Homological Algebra

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Cohomology theory and representation theory of finite groups





FUCHIZAKI Kazuhiro, Prof. (Dr. Eng.)

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● **TEACHING AREAS**

Statistical Physics

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Theory of phase transitions, critical phenomena and pattern formation kinetics



INOUE Toru, Assoc. Prof. (DSc)

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● **TEACHING AREAS**

Evolution of the Solid Earth

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Evolution of the Earth's interior
- ② High pressure melting of the Earth's mantle materials
- ③ Effect of H<sub>2</sub>O and CO<sub>2</sub> on the Earth's mantle materials
- ④ Thermoelastic properties of minerals
- ⑤ Hydrous phases in the Earth's mantle



TSUCHIYA Takuya, Assoc. Prof. (Ph. D.)

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● **TEACHING AREAS**

Numerical Analysis

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Mathematical foundations of finite element methods
- ② elliptic boundary value problems



OHNO Ichiro, Prof. (DSc)

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● **TEACHING AREAS**

Physical Properties of the Earth's Interior

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Mineral physics under high temperature and high pressure
- ② Elastic properties of solids
- ③ Geologic and crustal structures by means of gravity anomaly



KAWASAKI Toshisuke, Prof. (DSc)

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● **TEACHING AREAS**

Petro-thermodynamics

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Element partitioning among rock-forming minerals
- ② Geothermometry and geobarometry
- ③ Thermodynamic properties of minerals
- ④ High-pressure and high-temperature phase relations of granulites and eclogites
- ⑤ Petrology of the Archean ultra-high temperature granulites from Antarctica





## INOUCHI Yoshio, Prof.(DSc)

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- **TEACHING AREAS**

Local and Global Environmental Geology

- **RESEARCH AND SCHOLARSHIP AREAS**

① Local and Global environmental geohistory, Studies on environmental designing



## ZHAO Dapeng, Prof. (DSc)

zhao@sci.ehime-u.ac.jp

- **TEACHING AREAS**

Earth's Interior Structure

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Seismic tomography methods
- ② Earth's deep structure and dynamics
- ③ Earthquake mechanism and dynamics
- ④ Structure and dynamics of subduction zones
- ⑤ Stress field of lithosphere



## MORI Hiroshi, Assoc. Prof. (DSc)

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- **TEACHING AREAS**

Meteoritics

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Mineralogy and petrology of achondrites
- ② Shock metamorphism of chondrites



## SAKAKIBARA Masayuki, Assoc. Prof. (DSc)

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- **TEACHING AREAS**

Material Transfer in the Crust

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Material transfer in accretionary prisms
- ② Petrogenesis of green rocks in accretionary prisms
- ③ Heat and material transfer in the crust by fluid
- ④ Partial melting process of metamorphic rocks
- ⑤ Transfer of metal by hydrothermal alteration





**YANAGISAWA Yasunobu, Prof.(DSc)**

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● **TEACHING AREAS**

Behavioural Ecology

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Behavioural ecology of marine and freshwater fishes
- ② Mating systems and parental care of fishes
- ③ Symbiotic relationship between marine animals
- ④ Adaptive radiation of Tanganyikan cichlid fishes



**TOHOYAMA Hiroshi, Prof.(DSc)**

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● **TEACHING AREAS**

Genetics of Environmental Adaptation

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Mutation of yeast for environmental adaptation
- ② Resistant mechanisms for metals in yeast



**NAKAMURA Takayuki, Assoc. Prof.(Dr. Eng.)**

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● **TEACHING AREAS**

Conservation and Control of Coastal and Marine Environment

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Vortex flow analysis around coastal and harbor structures and its contributions to the water exchange in coastal and harbor regions.
- ② Hydraulic functions and developments of effective structures of breakwater system.
- ③ Mechanics of wave induced forces on coastal and offshore structures.
- ④ Estimation of 3-D wave transformations in a harbor with depth variations.
- ⑤ Estimation of floating body dynamics in waves.



**UEDA Hiroshi, Assoc. Prof.(Dr. Agr.)**

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● **TEACHING AREAS**

Study of Aquatic Indicator Organisms

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Plankton ecology, Taxonomy of marine and freshwater Copepoda(Crustacea)



**OMORI Koji, Assoc. Prof.(DSc)**

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● **TEACHING AREAS**

Ecosystem Analysis

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Energy Balance, Population Dynamics, Ecosystem Ecology, Marine Ecology.





**INOUE Naoki, Prof. (Dr. Eng.)**  
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● **TEACHING AREAS**

Solid State Ionics

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Solid State Ionics based on the phenomena of fast ion transport, electronic structure and phase transition.



**MORIMOTO Hiroaki, Prof. (DSc)**  
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● **TEACHING AREAS**

Stochastic Systems Theory and Control

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Study on optimal control of stochastic differential systems



**HIDAKA Yoshiaki, Prof. (DSc)**  
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● **TEACHING AREAS**

High Temperature Reaction in Gas Phase

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① High temperature pyrolysis and combustion mechanism in gas phase, Study of production and consumption of air pollutant.  
② (1) Shock-tube and modeling study of hydrocarbon pyrolysis and oxidation.  
(2) Shock-tube and modeling study of ether pyrolysis and oxidation.  
(3) Study of NO<sub>x</sub> production mechanism in hydrocarbon combustion.



**YOKOTA Toshiaki, Prof. (DSc)**  
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● **TEACHING AREAS**

Fine Particle Plasmas Physics

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Physics of fine particle plasmas and laboratory experiments, Spectroscopic study of laboratory and space plasmas, Applied Spectroscopy.



**FUJII Masaharu, Assoc. Prof. (Ph.D.)**  
mfujii@en2.ehime-u.ac.jp

● **TEACHING AREAS**

Electronics Materials Science

● **RESEARCH AND SCHOLARSHIP AREAS**

- ① Development of neuron-type conducting polymer device  
② Development of network conducting polymer device  
③ Fractal analysis of conducting polymers using wavelet transform  
④ Analysis of electrical trees in insulators with local fractal dimension  
⑤ Detection of location of PD source in transformer



## ASADA Hiromu, Assoc. Prof.(DSc)

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- **TEACHING AREAS**

Physical Chemistry of Surface and Interface Phases

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Effect of gas adsorption on the electric conductivity of semiconducting sulfides
- ② Cluster variation theory on the phase behavior of a single or multiple layer of atoms/molecules adsorbed on a crystalline surface
- ③ Cluster variation theory on kinetic processes, e.g., diffusion, desorption and chemical reactions, taking place in the adsorbed layers on a crystalline surface

## ISHIKAWA Yasushi, Assoc. Prof.(DSc)

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- **TEACHING AREAS**

Stochastic Analysis

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Stochastic calculus of variations of jump type
- ② Its applications to mathematical finance

## OKABE Nagatoshi, Prof.(Dr.Eng.)

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- **TEACHING AREAS**

Environmental Deterioration and Damage of Materials

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Probabilistic Reliability Analysis
- ② Damage & Failure Analysis of Materials,
- ③ Critical Evaluation of High Speed Collision Failure
- ④ Estimation of Environmental Degradation of Materials
- ⑤ Characteristic Analysis for Shape Memory Alloys

## SHIRAIISHI Tetsuro, Prof.(Dr.Eng.)

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- **TEACHING AREAS**

Environmental Fracture of Materials

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Fatigue strength and life in engineering plastics
- ② Fatigue crack initiation and propagation in plastics
- ③ Environmental damage and fracture in plastics
- ④ Strength and damage in FRP
- ⑤ Fatigue behavior in FRP

## KAMIMORI Tatsuo, Assoc. Prof.(DSc)

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- **TEACHING AREAS**

Magnetic Properties of Metals

- **RESEARCH AND SCHOLARSHIP AREAS**

- ① Material science. Study on magnetic properties of compounds and alloys.  
Transition metal-rare earth intermetallic compounds, Mossbauer spectroscopy, neutron diffraction.





**NAITO Manabu, Prof.(DSc)**

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● **TEACHING AREAS**

Nonlinear Analysis

● **RESEARCH AND SCHOLARSHIP AREAS**

① Qualitative properties of solutions of nonlinear differential equations



**SUGAYA Reiji, Prof.(DSc)**

sugaya@phys.sci.ehime-u.ac.jp

● **TEACHING AREAS**

High Energy Plasmas

● **RESEARCH AND SCHOLARSHIP AREAS**

① Plasma Physics, Nuclear Fusion, Nonlinear wave phenomena, High-energy particle acceleration and transport



**SUGAWA Masao, Prof.(DSc)**

sugawa@phys.sci.ehime-u.ac.jp

● **TEACHING AREAS**

Physics on Plasma Processing

● **RESEARCH AND SCHOLARSHIP AREAS**

① Discharge process of plasma by electron beam, Space plasma experiment, Nonlinear Interaction of ion beam and plasma.



**YOSHII Hisashi, Prof.(DSc)**

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● **TEACHING AREAS**

Physics of Cosmic Energy

● **RESEARCH AND SCHOLARSHIP AREAS**

① Energy spectrum and chemical composition of primary cosmic rays, Nature of cosmic ray origins and propagation mechanisms of primary cosmic rays in the Galaxy.



**EZAWA Yasuo, Prof.(DSc)**

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● **TEACHING AREAS**

Physics on Fundamental Matter

● **RESEARCH AND SCHOLARSHIP AREAS**

① Higher-dimensional cosmology, non-linear gravity, approximate solutions





**SAKAGUCHI Shigeru, Prof.(DSc)**

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● **TEACHING AREAS**

Qualitative Applied Analysis

● **RESEARCH AND SCHOLARSHIP AREAS**

① Partial differential equations



**KASHIWA Taro, Prof.(DSc)**

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● **TEACHING AREAS**

Theory of Quantum Energy

● **RESEARCH AND SCHOLARSHIP AREAS**

① Elementary Particle Theory, Gauge Field Theories, Path Integral Method in Quantum Mechanics and Quantum Field Theories, Fundamental Quantum Mechanics



**AWAKI Hisamitsu, Assoc. Prof.(Ph. D.)**

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● **TEACHING AREAS**


High Energy Astrophysics

● **RESEARCH AND SCHOLARSHIP AREAS**

① structure and evolution of the universe

② instrument development for space astronomy



 **Director : Hidemitsu Uno, B. Sc., M. Sc., Ph.D.**

Located close to the Faculty of Science, this division promotes research and the development of university faculty as well as private companies by supplying high-quality chemical analysis with a high resolution mass spectrometer, 270 MHz and 400 MHz multinuclear magnetic resonance spectrometers, a 300 MHz magnetic resonance spectrometer for solids, rapid X-ray crystallographic analysis systems, a complete rapid scan electron spin resonance spectrometer, an elemental microanalyzer, an analytic electron microscope, a thermogravimetric analyzer, a differential calorimetric scanning analyzer, UV and fluorescence spectrometers, an ICP mass spectrometer, an ICP atomic emission spectrometer, a spectropolarimeter, and analytic and preparative liquid chromatographs.



**SOLID STATE HIGH RESOLUTION NUCLEAR MAGNETIC RESONANCE SPECTROMETER**

This solid state nuclear magnetic resonance spectrometer supplies the various spectral data for solid state substances nondestructively.

 **Director : Renkichi Takata, B. Arts, M. Sc., Ph. D.**

The Division is a joint facility shared by all the university faculties for the promotion of research and education in the fields of gene technology. The laboratory includes P 2 and P 3 rooms for recombinant DNA experiments together with radioisotope units for facilitating varied research projects under university control.



 **Director : Matu-Tarow Noda, B. Sc., M. Sc., Ph. D.**

The Center for Information Technology, Ehime university (CITE) is located in Johoku Campus. CITE offers a wide range of support services for computer users in Ehime university. More precisely, tasks of CITE are to accelerate the effective exploitation of university information technology, to offer the fulfilling information literacy education to undergraduate students, to give the useful computing environment support to academic researchers in the university, and to contribute the effort of realization of information-intensive society in Ehime university and regional. CITE has a lot of computers which are connected via Campus Network (EUNET). CITE has seven faculty members and four staff members.





## Center for Cooperative Research and Development



**Director : Akira Shimizu Prof, Dr. Eng.**

The center serves the university and the public by means of coordinating cooperative research between them, technology transfer and consulting, continuous education for skill up, in support of the university's mission to encourage innovation and disseminate knowledge.



## Center for Marine Environmental Studies (CMES)



**Director : Hidetaka Takeoka, B. Sc.,  
M. Sc., Ph. D.**

Established in 1999 the Center for Marine Environmental Studies (CMES) is the biggest research department at Ehime University consisting four units (1) Coastal Oceanography, (2) Environmental Chemistry and Ecotoxicology, (3) Aquatic Biology and Ecology and (4) Marine Geology with a total staff strength of 13. The Center's recently built laboratories consist most modern analytical facilities for the measurement of various physical, chemical and biological oceanographic processes. The Center has very good International connections through its myriad number of collaborative studies with many Asian, European and North American countries. The field station of CMES, Nakajima Marine Biological Station has all the facilities needed by marine scientists, such as seawater circulation, laboratory and culture facilities apart from a 11t research boat "Tobi-uwo" equipped with necessary survey and sampling devices and basic equipments for field observations. CMES has been designated in the year 2002 by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), Government of Japan as "The 21<sup>st</sup> Century Center of Excellence (21<sup>st</sup> COE)" for Coastal Marine Environmental Research and adopted for financial support a period of five years.



## Geodynamics Research Center (GRC)



**Director : Tetsuo Irifune, B. Sc., M. Sc.,  
D. Sc.**

GRC is a new research center founded in April 2001, which consists of three laboratories (High Pressure Laboratory, Seismological Laboratory, and Physical Measurements Laboratory) and a Foreign Guest Professor Division. The staff members of GRC work for the advancement of basic sciences and technologies related to Earth sciences, and for the promotion of cooperative and interdisciplinary researches, in addition to their own studies on structure, constitution, dynamics, and evolution of the solid Earth.







**Director : Yaeta Endo, B. Med.,  
M. Med., Ph. D.**

With the completion of sequencing of the genomes of various species, attention has turned to the structure, properties, and functional activities of proteins. Ehime University has recently been succeeded in establishing the efficient cell-free protein synthesis system. Based on these successful achievements, the CSTC has been established in Ehime University in April, 2003. It consists of four divisions ; Cell-Free Sciences, Proteomedical Sciences, Biomolecular Engineering and Plant Molecular Biotechnology. The CSTC is not only exploring basic sciences like biology, biochemistry, molecular biology, physiology, but also applied sciences focusing on medical, environment, material, energy, food, ocean and even space sciences.







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