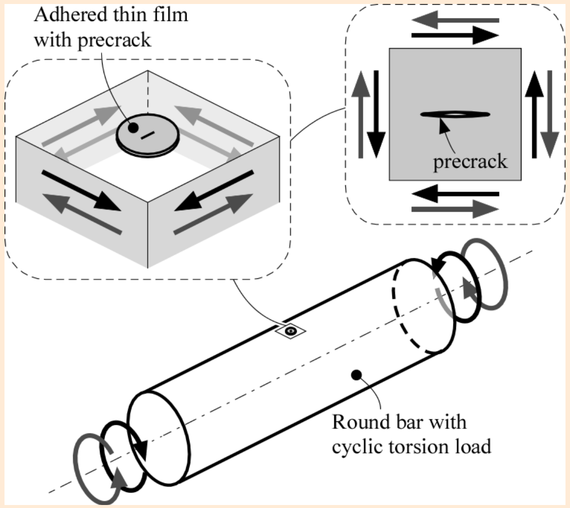
Solid Mechanics Lab.

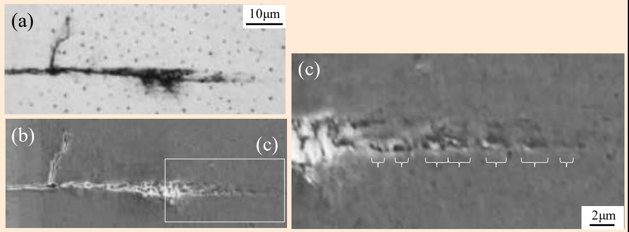
– To seek machine safety and relief by making full use of multi-scale mechanics

Prof. Hiroshi Noguchi, Assoc. Prof. Shigeru Hamada

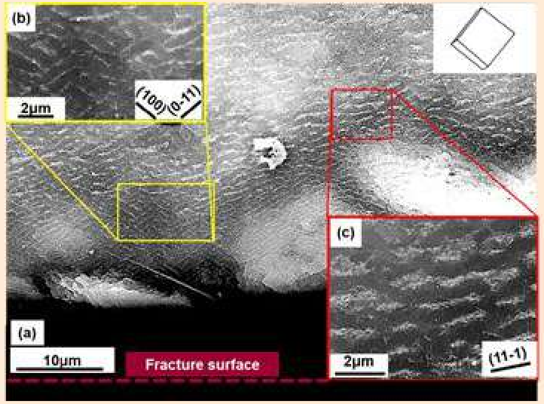
Research topics

- Elucidating and establishing prediction method for Mode II fatigue crack propagation in damage accumulation mode.
- Elucidation of failure mode transition mechanism in metal fatigue and its application to active control design.
- Development of parts strength theory, taking fatigue strength design of a material that has undergone material change due to processing, as an example.
- Development of fatigue crack closure evaluation method for rational fatigue design of new materials.
- Development of rational manufacturing process and safety design method of machine elements fabricated by 3D printer.
- Research on the mechanism of metal fatigue under hydrogen environment.

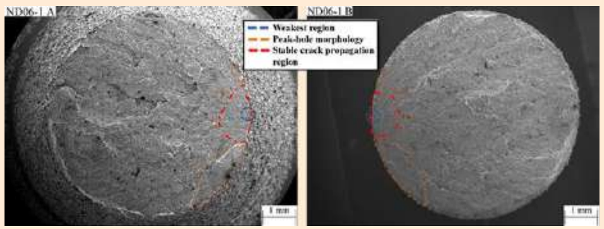




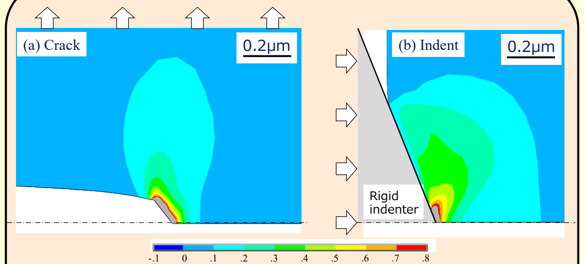
Elucidation of fatigue crack propagation by damage accumulation mode



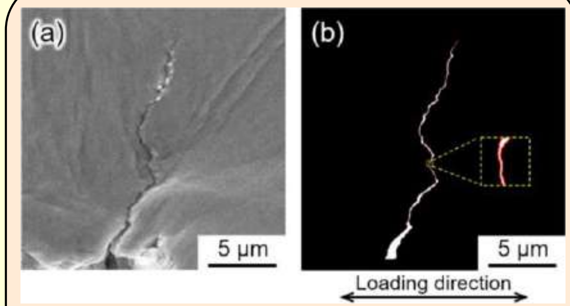
Dislocation substructure analysis using latest equipment



Failure analysis of the machine elements fabricated by 3D printer



Mechanical equivalence simulation of crack and hardness



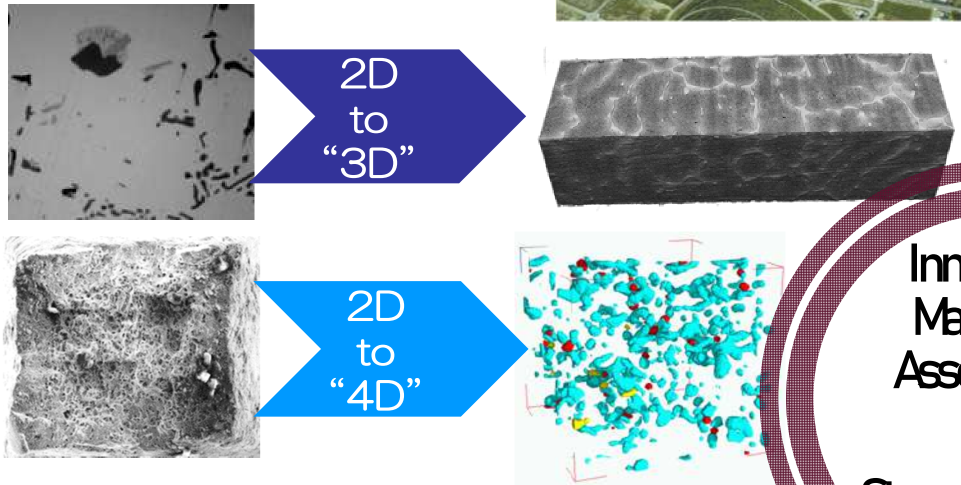
Fatigue crack closure phenomena analysis

Structural Materials Research Lab.

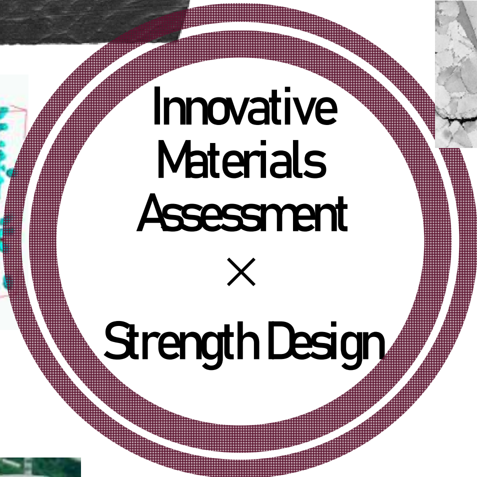
Prof. Toda,
Assoc. Prof. Takakuwa, Assist. Prof. Hirayama

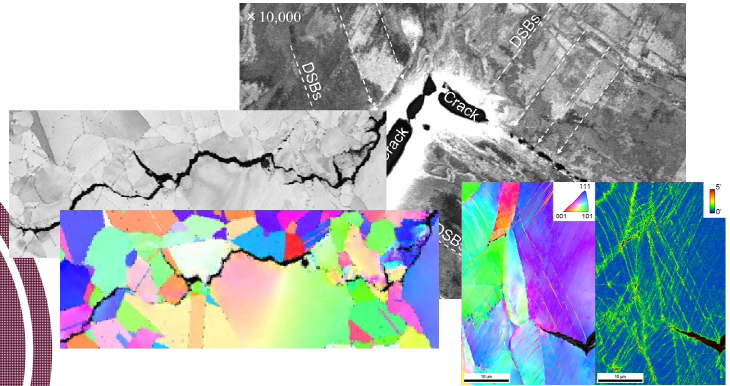
The world's largest synchrotron radiation facility (SPring-8)

Research Center for HYDROGEN Industrial Use and Storage (HYDROGENIUS)



Advanced observation technique using in-situ 3D/4D imaging





Analyses of fracture process under high-pressure H_2 gas

©Boeing

Titanium alloy

©JR-central

Aluminum alloy

FCV

©TOYOTA

Stainless steel

H_2-station

©TATSUNO

Fe-based superalloy

©JAXA

N-based superalloy

Elucidating genuine fracture process by in-situ observation and optimizing the strength design of structures

Flow control systems lab.

Prof. Satoshi Watanabe
Associate Prof. Shin-ichi. Tsuda
Assistant Prof. Yusuke Katayama

Internal flow in fluid machinery and related fluid flow phenomena

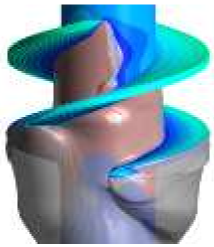
Pumps and flow instability

- R&D of contra-rotating axial flow pump
- Cavitation instabilities of inducer
- Unsteady flow/fluid forces in multi-stage pump

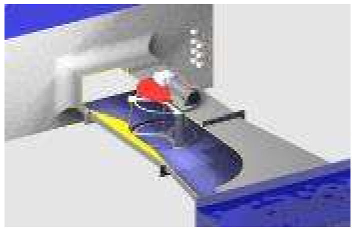
Utilization of natural flow resources

- Darriues-type hydro-turbine for low head flow

Cavitation surge in space rocket inducer



Field experiment of Darriues turbine



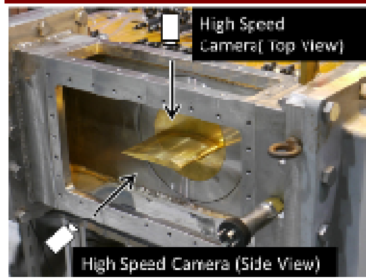
Cavitation

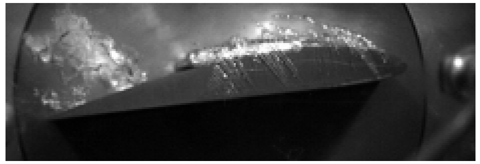
- Unsteady cavitation around hydrofoil/cascade
- Thermal effect of cavitation
- Cavitation in automotive torque converter

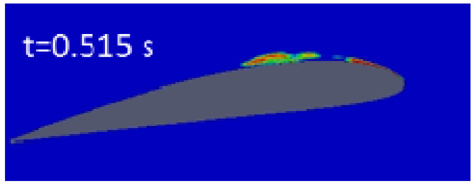
Liquid-vapor interface and bubbles

- Characteristics of evaporation/condensation process
- Bubble formation process in liquid rocket fuel

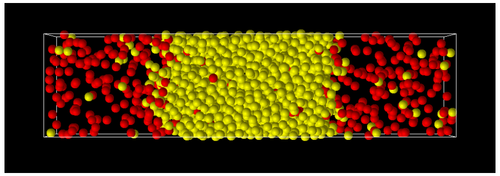
Cavitating hydrofoil

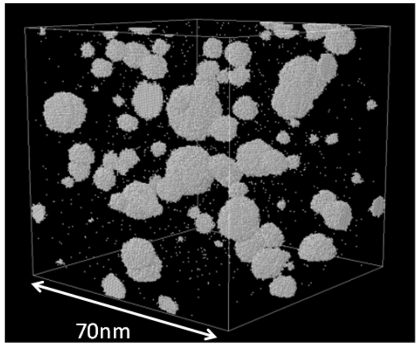




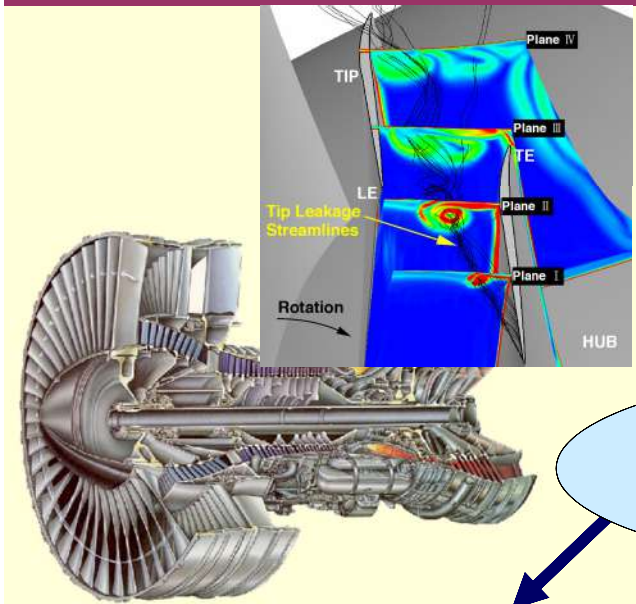


Molecular simulations on interface and bubbles



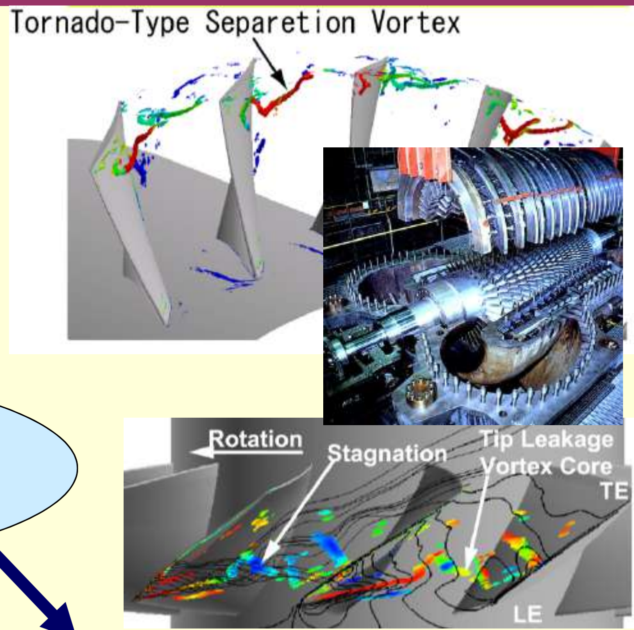


Fluids Engineering Science Lab.



CFD analysis of complex internal flows

- Unsteady 3-D vortex flows
- Rotating stall inception
- EFD/CFD hybrid analysis



Analysis of gas flows in turbomachinery

Development of wind-lens wind turbine

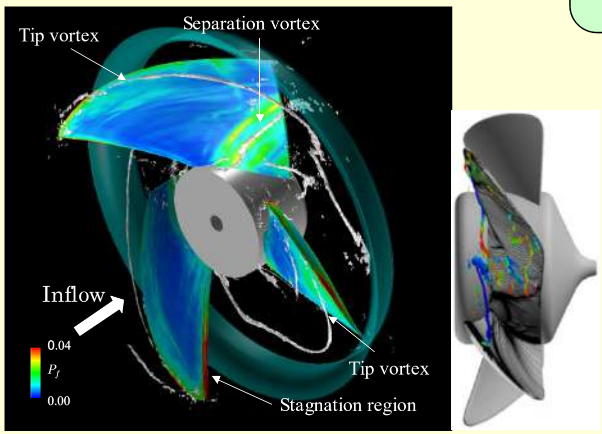
- 3-D aerodynamic design
- Matching of wind-lens body and turbine blades

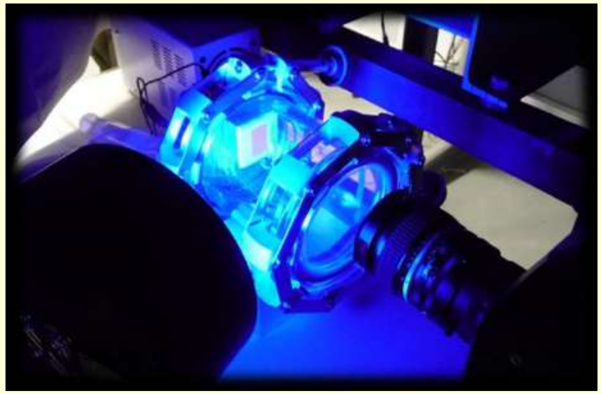
Mechanism of aerodynamic noise

- Noise reduction of fans

Development of imaging measurement technique

- Pressure Sensitive Paint (PSP)
- Particle Image Velocimetry (PIV)





Thermal Energy Conversion Lab.

– To convert or utilize thermal energy with high efficiency

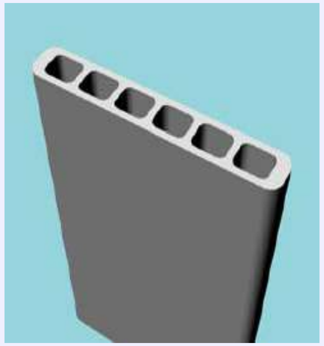
Research topics

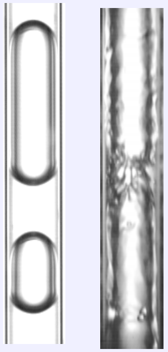
Prof. Shoji MORI, Assoc. Prof. Yoshinori HAMAMOTO

- CHF enhancement of a large heated surface using Honeycomb Porous Plate
- Development of high-temperature heat pump systems using supercritical pressure fluids
- Evaluation of heat transfer and flow resistance of flow boiling in mini-channels to develop high performance heat pump systems
- Study on heat and mass transfer of adsorption/desorption desiccant materials used for air conditioning, refrigeration and heat pump systems operating with low-grade waste heat

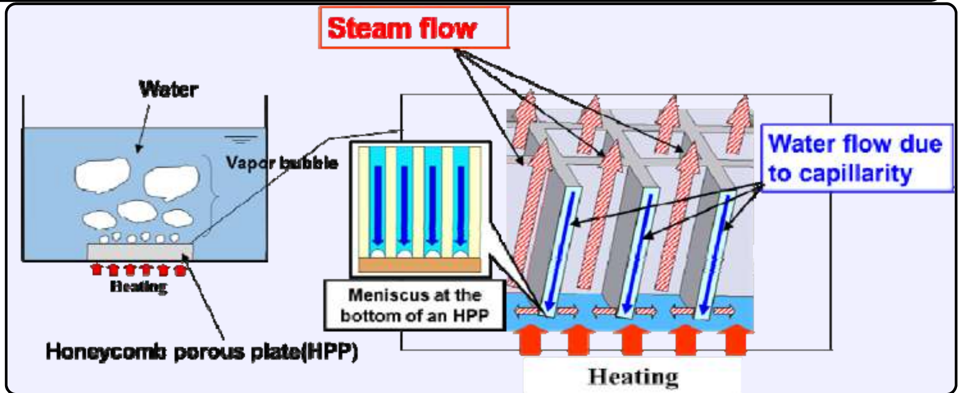
Experiments and simulation analyses on heat transfer and pressure drop of flow boiling inside mini-channels for a heat exchanger of next generation air conditioning

Multiport mini-channel tube



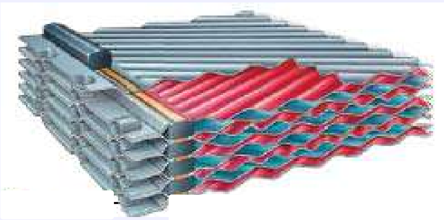


Flow visualization



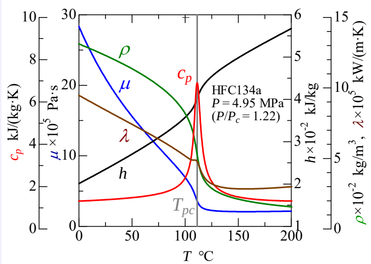
CHF enhancement of a large heated surface using a Honeycomb Porous Plate

Supercritical pressure fluid



Ref. Catalogue from Alfa Laval

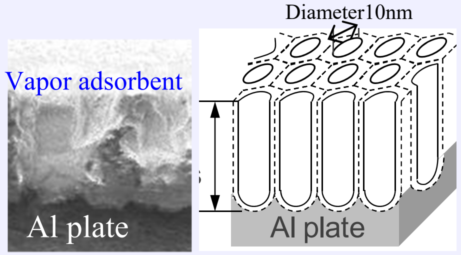
Plate heat exchanger



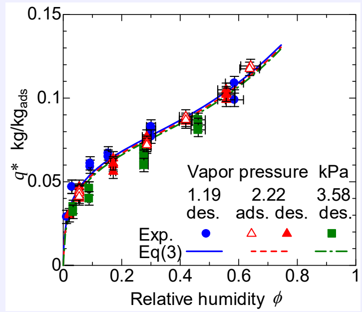
Huge change of thermo physical properties of supercritical pressure fluids

Experiments and simulation analyses on thermal-hydraulics of supercritical pressure fluids for high-temperature heat pumps

Nano-scale porous adsorbent



SEM of a cross section (Left), Schematic image (Right)



Equilibrium amount of adsorbed water

Meas. devices

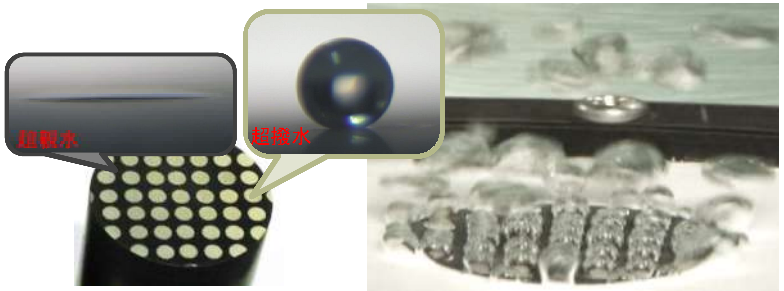
Measurements of static and dynamic vapor adsorption phenomena in adsorbent materials

Thermofluid Physics Lab

Professor Y. TAKATA
Assoc Prof N. SAKODA
Assist Prof Y. KITA

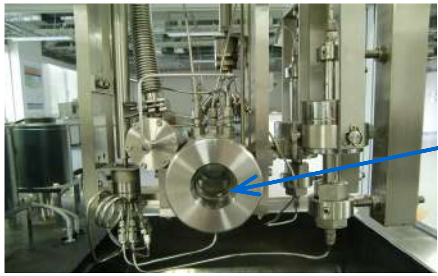
Reveal **fundamental thermofluid phenomena** at vapor-liquid-solid interfaces
Establish **thermophysical property databases** for new generation refrigerants

Heat transfer enhancement by wettability modification

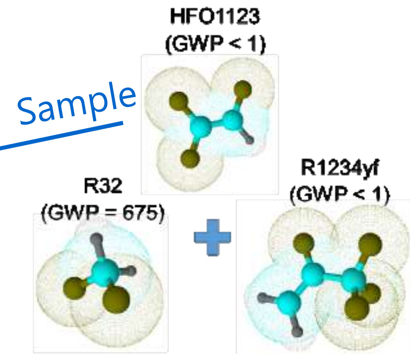


Pool boiling on a wettability-patterned surface

Thermophysical properties of new refrigerants

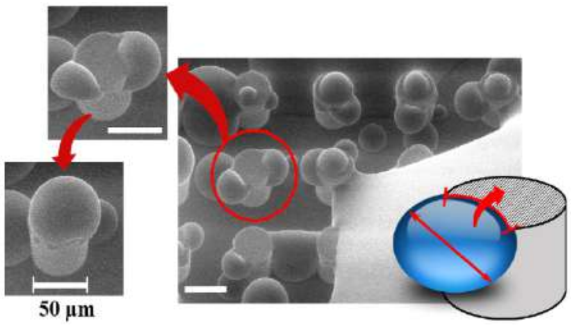


Vapor-liquid Equilibrium Measurement Apparatus



Multiscale observations of phase change phenomena

Environmental SEM

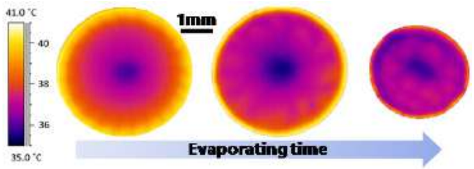


Orejon *et al.*, *RSC Advances* **6**, 2016

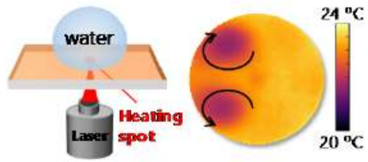
Condensation on wettability-patterned micropillars

Droplet evaporation and flows

Droplet impact on a hot surface



Thermograph of a drying ethanol drop



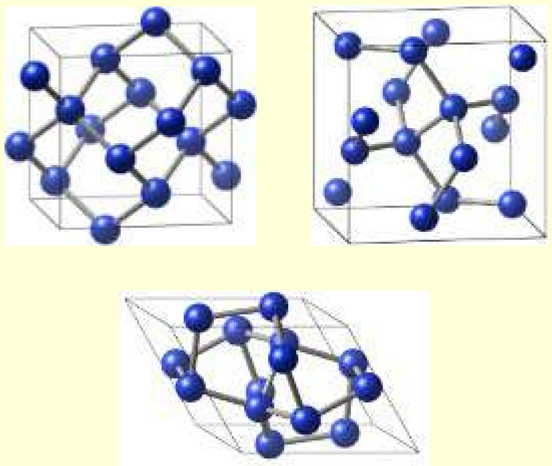
Controlling internal flows in a drop

Thermal Physics & Engineering

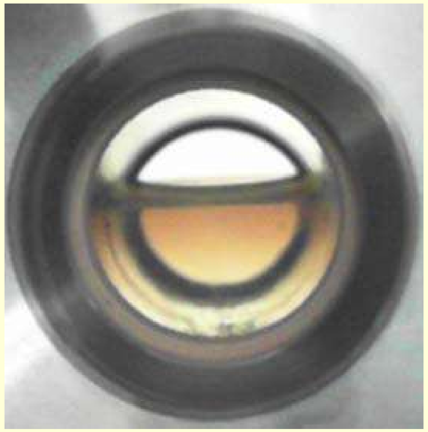
Professor
Masamichi KOHNO

Research Topics

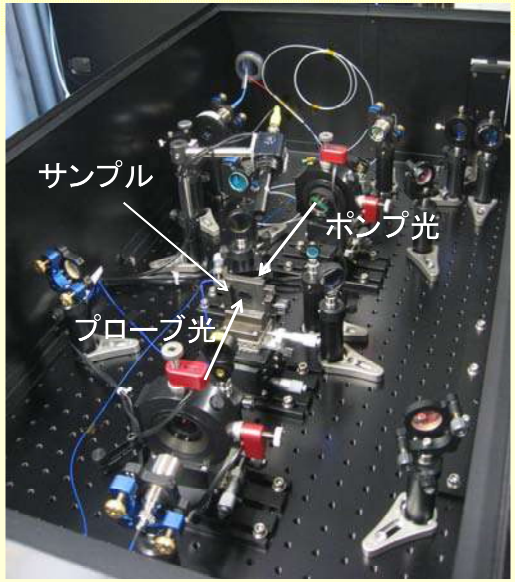
- Effect of high pressure torsion on material thermal transport properties
- Measurement of thermophysical properties of nano materials by laser flash Raman spectroscopy
- Nanoscale solid-liquid-vapor interfacial phenomena
- Behavior and heat transfer of micro droplets impinging on high temperature solid surfaces



Development of Si thermoelectric



Coloring with critical protein light.
Near the critical point of CO_2 (31.0 ºC, 7.4 MPa)



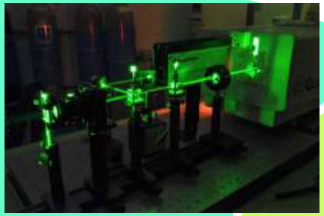
Laser system for thermophysical property measurement

Reactive Gas Dynamics Lab.

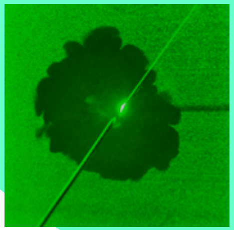
Prof. T. Kitagawa

- Pursuit of principle and technologies in combustion

Our Goals	✧ Thermal efficiency (Energy saving) ✧ Environmental feasibility (Low carbonization, Low hazardous substances emission) ✧ Fuel diversification (Cost reduction, Energy security)
Our Targets	✧ Propulsive devices (Automobile engines, Supersonic aircraft engines, etc.) ✧ Energy devices (Industrial gas turbines, etc.) ✧ Gas combustion, Liquid fuel (spray) combustion, Supersonic combustion, etc.
Our Themes	✧ Experiment and simulation for understanding physics, developing new concept, etc. Engine combustion, Direct injection combustion, Engine knock, Hydrogen combustion, PM(soot) formation, Syngas combustion , Supersonic combustion, etc.

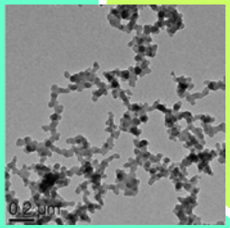



Experimental study using advanced laser diagnostics



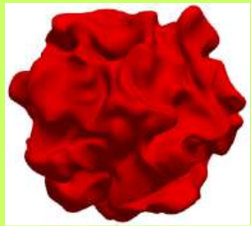
Laser visualization of flame

Exp of hydrogen combustion



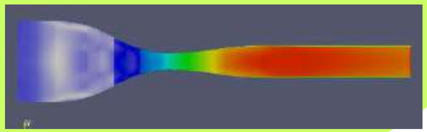
EXP of PM formation

Simulation study using massive parallel computer



CFD on turbulent flame

CFD on engine



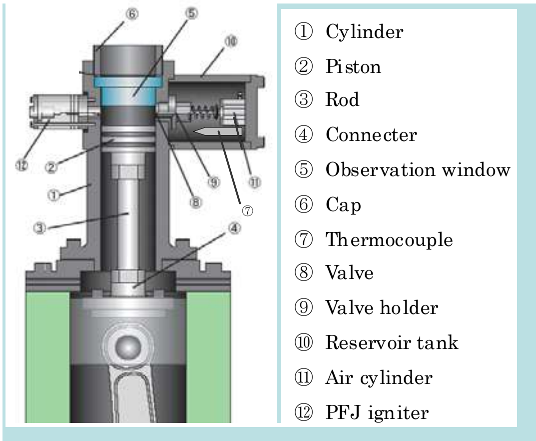
CFD on supersonic combustion

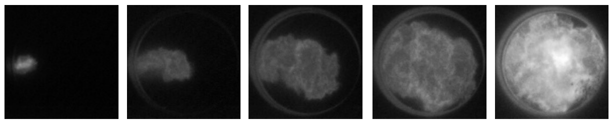
Engine Systems Lab.

Professor : Osamu MORIUE
Assistant Professor : Shion ANDO

Research topics

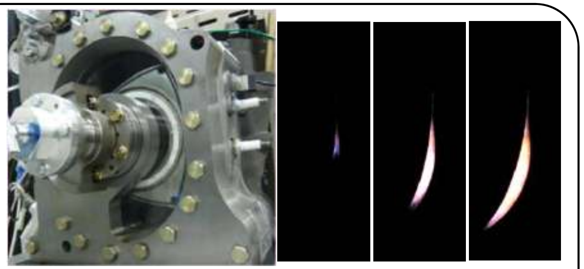
- Enhancement of ignition and burning rate of lean mixtures by Pulsed Flame Jet
- Ignition timing control of Homogeneous Charge Compression Ignition Combustion by Pulsed Flame Jet
- Study on combustion phenomena in engines with visualized rotary engine
- Study on vaporization, spontaneous ignition and combustion of fuel sprays
- Improvement of spark ignition of lean mixtures in a fast gas flow
- Numerical simulation of spray combustion





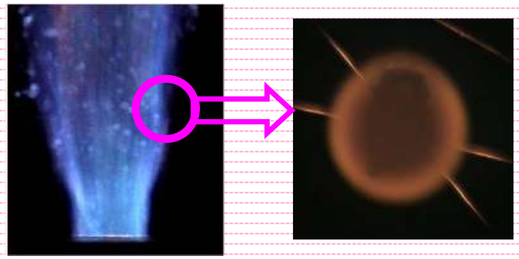
Ignition timing control of HCCI combustion by Pulsed Flame Jet

New concept of internal combustion engines



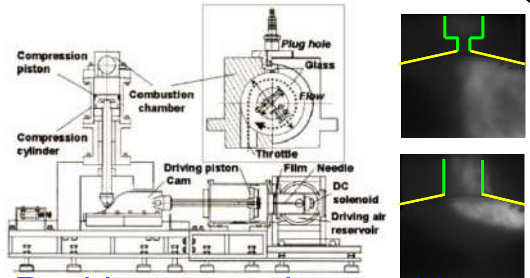
Visualized rotary engine

Gasoline engines



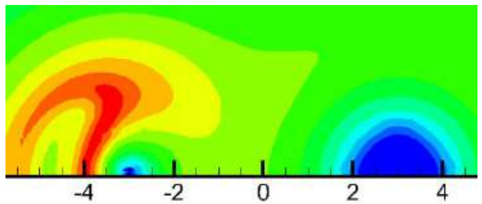
Spray combustion

Diesel engines
Gas turbine engines



Rapid compression machine

Improvement of spark ignition



Numerical simulation

Detailed mechanism of combustion phenomena

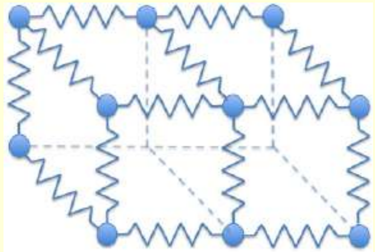
Vibration and Acoustics Lab.

Prof. KIJIMOTO, Shinya
Assoc. Prof. ISHIKAWA, Satoshi

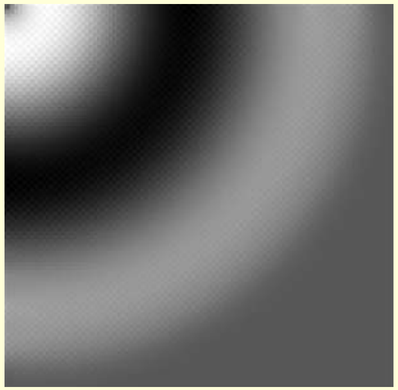
Research topics

- Active noise control in 3-dimentional sound field.
- Large scale acoustic analysis using lumped mass model.
- Vibration damping.
- Evaluating and detecting softness of human body.

Experiment of Active Noise Control in anechoic chamber

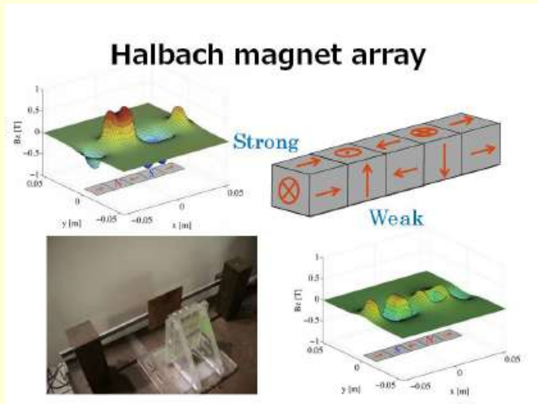


3-D lumped mass model



Sound pressure distribution (example of calculation result)

Softness sensor for human body



Magnetic damper

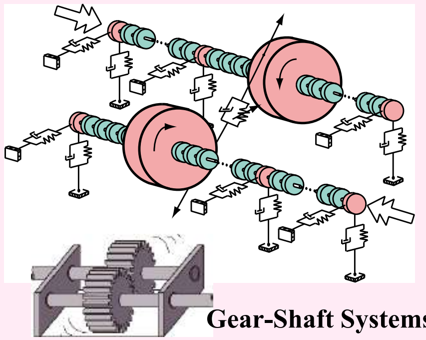
Mechanical Vibration Lab.

Prof. KONDOU, Takahiro
Assoc. Prof. MORI, Hiroki
Assist. Prof. SOWA, Nobuyuki

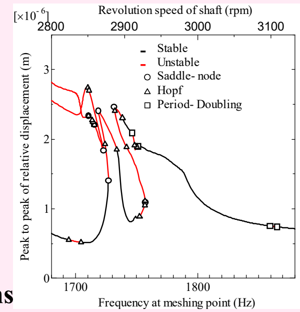
Research topics

- A High-Performance Method of Vibration Analysis for Large-Scale Nonlinear Systems.
- Prevention Method for Self-Excited Vibration.
- Development of Mechanical Systems Using Self-Synchronized Phenomena.
- Vibration Control by Elimination of Natural Frequency Component.
- Low Frequency Vibration of a Vibroimpact System

Vibration Analysis for Nonlinear Systems

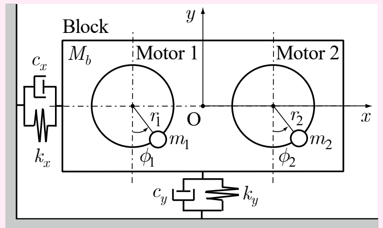


Gear-Shaft Systems

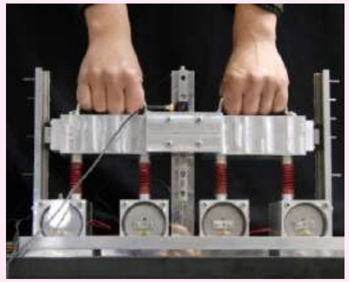


Self-Synchronized Phenomena

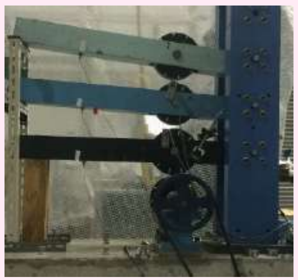
Clarification of Mechanism and Characteristics

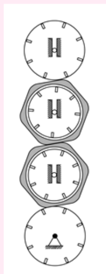


Tamping Rammer Using Self-Synchronization



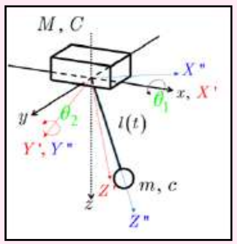
Self-Excited Vibration

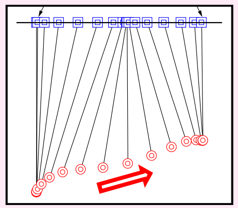




Pattern Formation Phenomena in Contact Rotating Systems

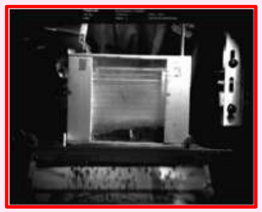
Elimination Method of Natural Frequency





Vibration Control of Overhead Traveling Crane

Vibroimpact System



Vibration Screen

2 DOF Experimental Rig

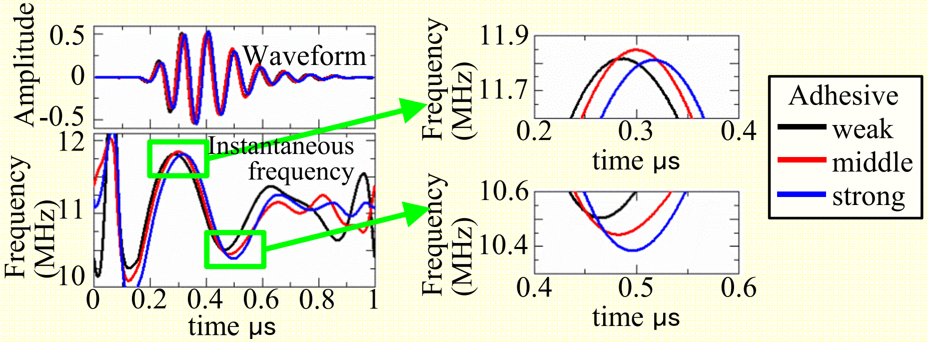
Low Frequency Vibration of a Vibrating Filter

Structural Dynamics Lab.

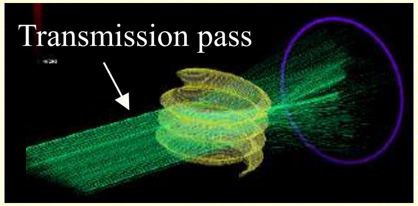
Prof. INOUE Takumi
A.P. KADOWAKI Ren

New diagnostic technique using ultrasound wave

Diagnostics technique with instantaneous frequency of ultrasound pulse

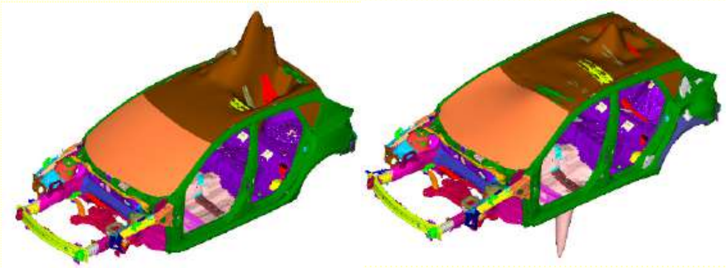


Evaluation of adhesive strength of heat seal with instantaneous frequency of ultrasound pulse

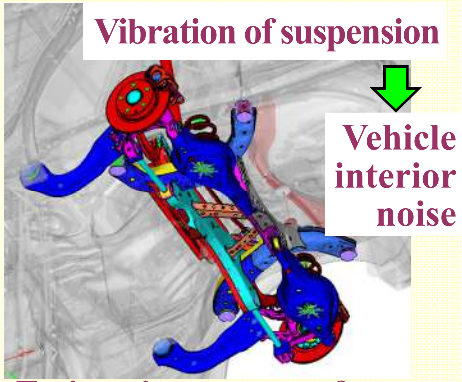


Evaluation of slackness using ultrasound pulse wave (simulation and basic experiment)

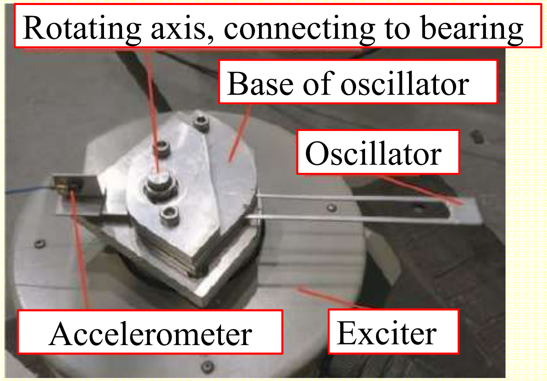
Vibration analysis of complicated structure



Study for efficient vibration analysis of automobile body structure



Estimation on transfer characteristics of vibration



Novel mechanism for automatic tuning to resonance

Mechanism for automatic tuning, signal processing etc.,

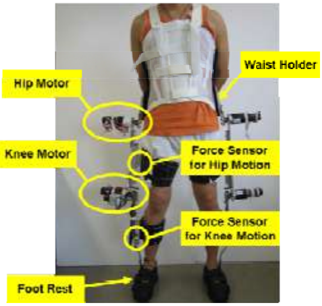
System Engineering Laboratory

http://system.mech.kyushu-u.ac.jp/

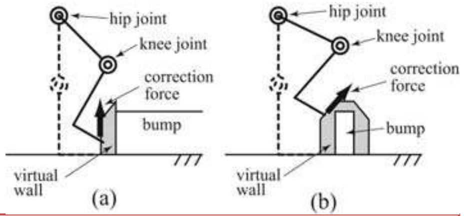
Prof. Kazuo Kiguchi ・ Assist. Prof. Yasutaka Tsuji

Studies on robotic systems and intelligent machines are carried out. Especially, robotics technologies for medical and human assist systems are studied. For details, power-assist robots, perception-assist, human assist systems, rehabilitation systems, human motion simulation, human motion change using vibration stimulation, robotic prosthetic systems such as robotic artificial arms, surgery assist robots, human body characteristics, machine learning are studied to prepare for an aged society.

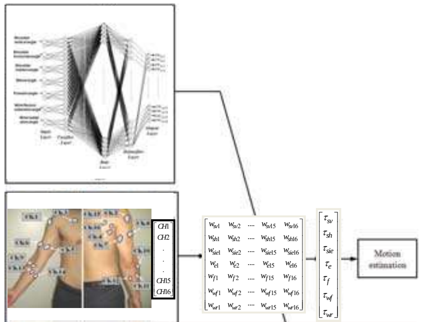
Robotics technologies for medical and human assist systems, adaptation of systems to human , robotic limbs, and robotic human simulators.



Lower-limb power-assist using EMG signals



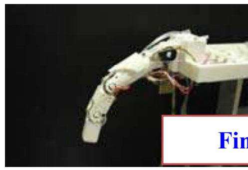
Perception-assist with power-assist



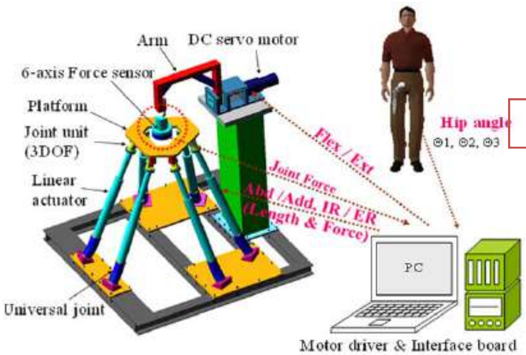
Machine learning

Upper-limb power-assist using EEG signals

Laparoscopic surgery simulator



Finger robot

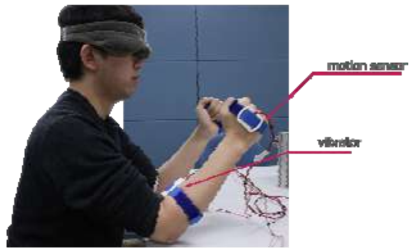


Analysis of artificial joint dislocation with a hip joint simulator

Robotic artificial arm

Motion estimation

Tremor compensation

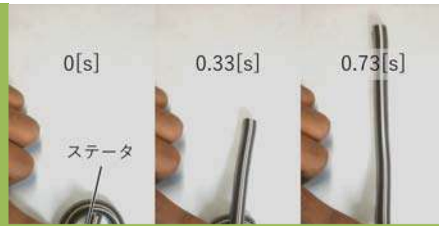


Motion change with vibration stimulation

Control Engineering Laboratory

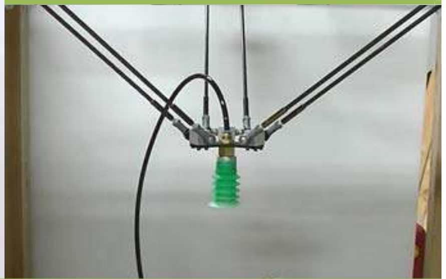
Motoji Yamamoto, Prof.
Yasutaka Nakashima, Assoc. Prof.
Ayato Kanada, Koki Honda, Assist. Prof.

SOFT ROBOTICS



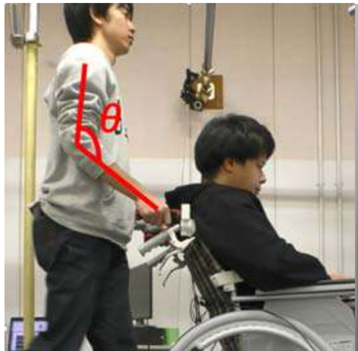
Flexible Linear Motor

Stable grasping by passively deformable soft finger

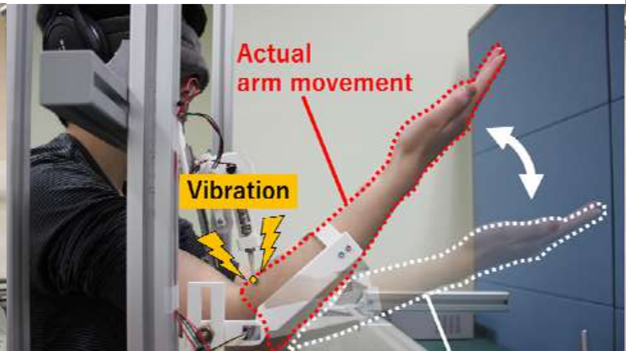


Flexible object grasping by ultra-high speed parallel link

HEALTHCARE ROBOT



Analysis of wheelchair's caregiver



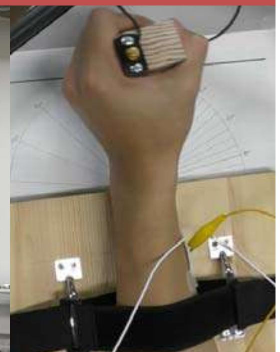
Motion control using human illusions and reflexes

Pointing devices for endoscopic procedures

HUMAN's CONTROLLED PERFORMANCES

Evaluation of fall slipping

Evaluation of standing stability



Precise control by FES

Human Centered Robotics Lab.

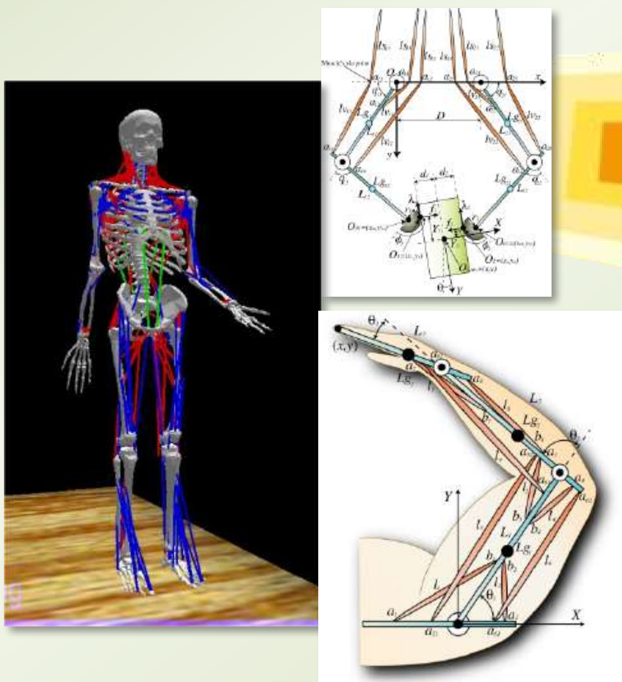
Professor: Kenji TAHARA

- **From human to robotics**

  To realize the advanced motor intelligence of human's movements in robotics

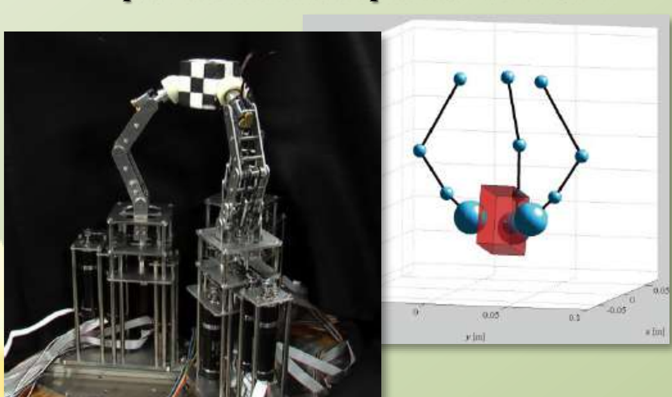
- **From robotics to human**

  To realize flexible and dexterous robots that can support human's daily life



Numerical simulation for the musculoskeletal system

High-backdrivable parallel-link manipulator with CVT



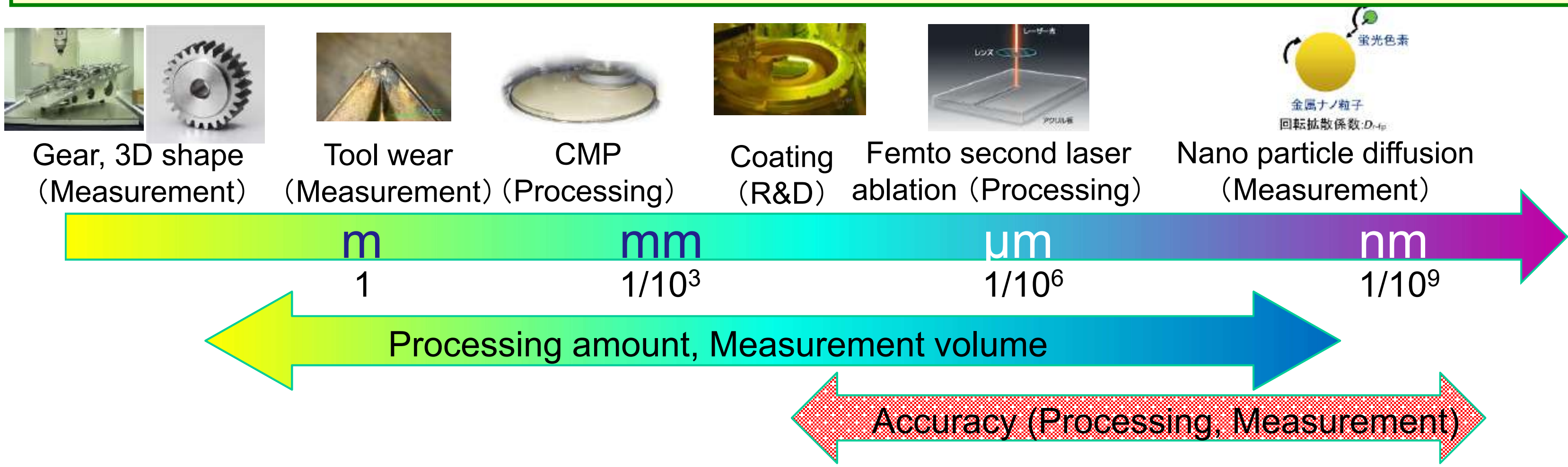
Multi-fingered robotic hand

Manufacturing Process

Precision Machining Lab.

Professor Syuhei Kurokawa
Assoc. Prof. Terutake Hayashi
Assist. Prof Takao Sajima

Development of the state-of-the-art manufacturing processes and measuring techniques for the green devices and machine elements



Giga range processing and evaluation

I. Ultra-Precision Manufacturing Technology

(1) CMP(Chemical Mechanical Polishing) for energy saving device materials
(SiC, Sapphire, Diamond, Silicon, GaN, Atmosphere controlled CMP machine, Slurry, Polishing pad, Recycling, etc.)

(2) Ultra-precision manufacturing and performance evaluation (Ultra-high-speed hobbing, Coated tools, etc.)

II. Ultra-Precision Measuring Technology

(1) Optical measurement & evaluation (Nano particle sizing using fluorescent probe, Ultra-precision defect detection by femtosecond laser, Ultra-high-precision measurement of transmission error, etc.)

(2) R&D of 3D measurement and testing method (Test and evaluation of high-speed CMM, Gear accuracy evaluation by whole circumference scanning measurement, etc.)

III. R&D of Creative Manufacturing Technique and Machines

Film formation of organic LED, Conformal coating and Electro spray application for MEMS, Development of high throughput CO_2 capturing system at low temperature, Low power laser processing with surface excitation

Material Processing Laboratory

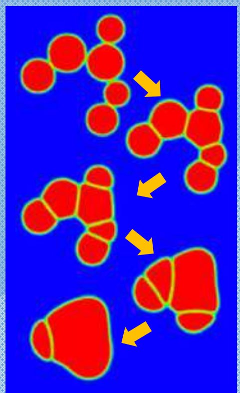
Prof. K. Shinagawa, Assoc. Prof. F. Tsumori, and Asst. Prof. K. Kudo

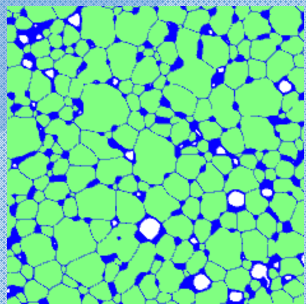
Variable approaches to “Manufacturing”

In our laboratory, we develop and analyze new material processing techniques using powders as structure materials, with an aim to revolutionize the process of “Manufacturing” . We process ceramic or metal powders. The outcome of our research is expanded to a wide variety of applications.

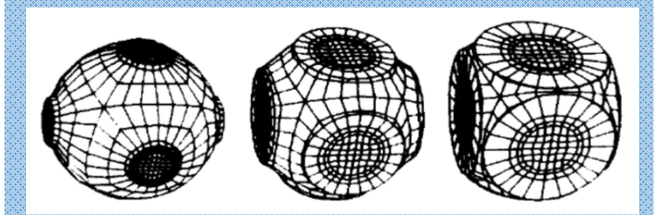
Analysis

Numerical analysis of the powder metallurgy process in order to improve precision and functionality of industrial parts.





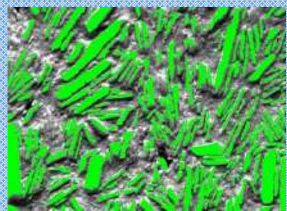
Examples of time evolution of structures during sintering, applying the Phase Field Method.



Particle deformation analysis during sintering using FEM. Analysis of transitions in bonding behaviors of particles in order to estimate the deformation of sintered products.

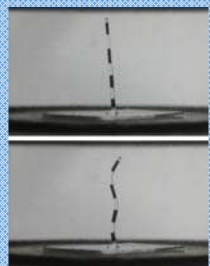
Development

“Manufacturing” is carried out by the process development itself. Constant inventions of processes from a new point of view.



Development of high performance piezoelectric materials by the powder rolling process.

Applying nanoimprinting lithography for powder processing.

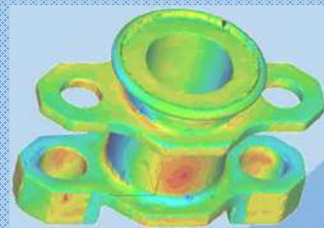


Flexible micro actuators fabricated by the soft MEMS process.

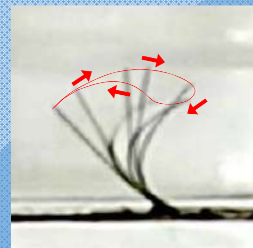
MIM apparatus, which enables mass-production of complex metal products.

Application

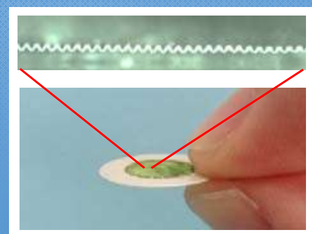
The outcome of our research is expanded to a wide variety of applications.



Application of the MIM Process to large size parts. Analytic technology and optimization of process parameters are carried out in order to suppress deformation.



Artificial cilia for the use of micro pumps, which replicates naturally optimized asymmetrical movement or metachronal waves.

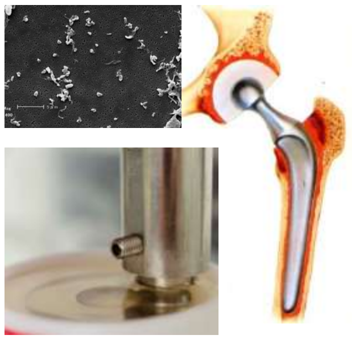


An application example of the nanoimprinting process to ceramic materials. Fuel cell electrolyte is processed into a wavy shape in order to improve cell performance.

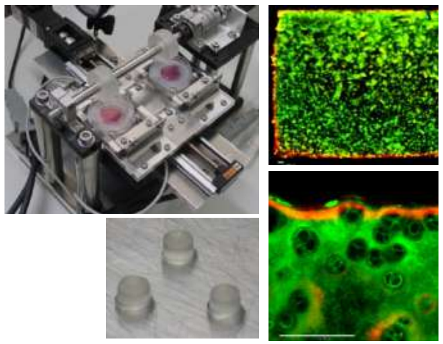
Machine Elements and Design Engineering Laboratory

- Yoshinori SAWAE, Professor
- Takehiro MORITA, Assistant Professor
- Tetsuo Yamaguchi, Associate Professor

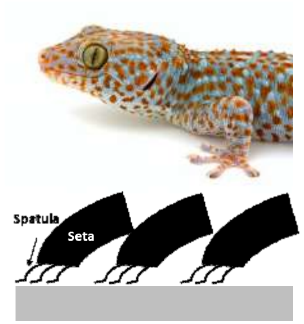
- Basic studies for establishing design guideline of machine elements used in various applications, from medical devices to machine components in hydrogen energy systems.
- Tribology in biomedical engineering field is one of the main research target.



Wear of prosthetic joint materials



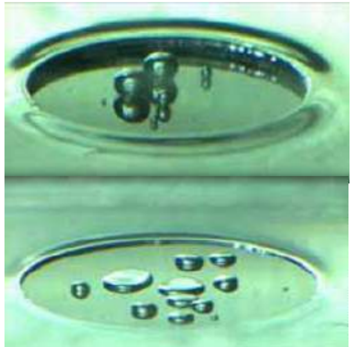
Biotribology for functional cartilage tissue engineering



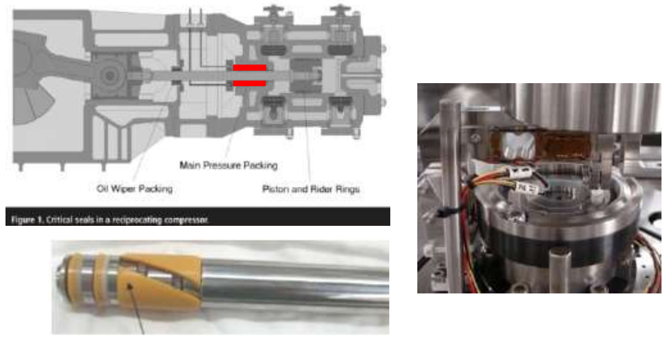
Biomimetic design based on microstructure of gecko finger

Mathematical model for crack propagation and fatigue fracture in gels

Structural optimization for dental implant



Interfacial fracture and non-linear rheology of adhesive



Wear of polymer seals in high pressure hydrogen

Tribology Laboratory (Prof. J. Sugimura, Dr. K. Yagi & Mr. H. Tanaka)

Machine Design for Energy, Environment and Safety

Structural design
Strength of materials
Fluid Engineering
Dynamics, Vibration
Thermal Engineering
Machine Elements
Manufacturing
etc.

Interior design
Fluid Engineering
Thermal Engineering
Machine Elements
Human Engineering
etc.

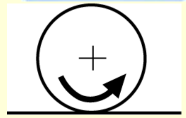
Engine design
Combustion, Thermal Engineering
Fuel Cell, Chemistry, Strength
Dynamics, Vibration, Control,
Fluid Engineering, Manufacturing
Electronics, Machine Elements
etc.

Wheel design
Strength of materials
Dynamics, Vibration
Machine Elements
Manufacturing
Materials
etc.

Importance of Machine elements

Machine life depends on machine elements!!

Bearings, shafts, springs, gears, crews, joints, belts, seals, brakes, their materials, etc.



Tribology

Science and technology of friction, wear and lubrication

- for future interfacial technology

Research Topics

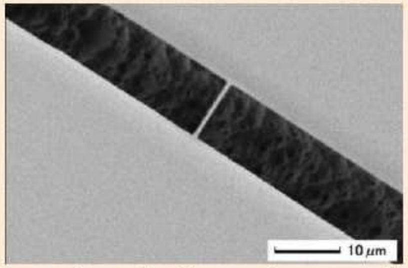
- Surface engineering
- Novel lubrication concept
- Soft materials for elements
- Extreme environment

Heat & Mass Transfer Lab.

Prof. Hiroshi Takamatsu
Assoc. Prof. Kosaku Kurata
Assoc. Prof. James Cannon
Assist. Prof. Yoko Tomo

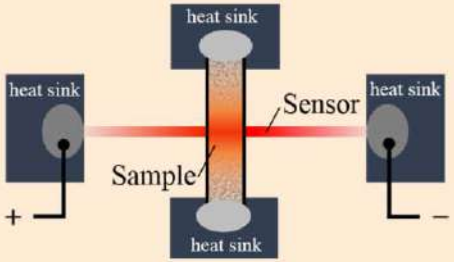
Interdisciplinary topics between thermal engineering and bioengineering

Measurement of fluid thermal conductivity with small samples using a MEMS sensor



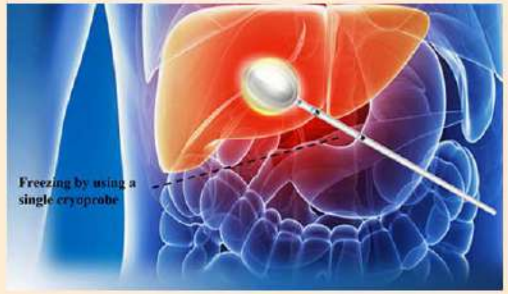
Scanning electron micrograph of a MEMS sensor

Measurement of thermal conductivity of biopolymers



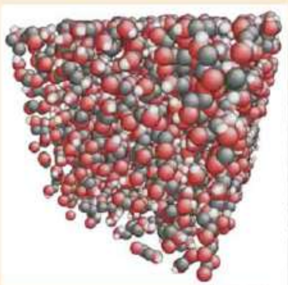
New method for measuring thermal conductivity

Experiments and simulation of freezing during cryosurgery



Cryosurgery of liver cancer (image)

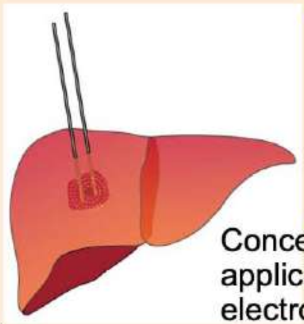
Understanding thermal transport through simulation and statistics

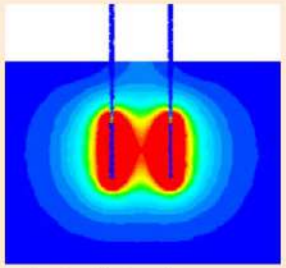


Molecular simulation of liquid

Kyushu University's supercomputer

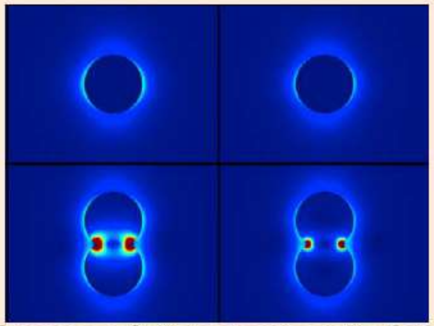
Non-thermal irreversible electroporation to treat tumors





Concept of clinical application of irreversible electroporation

Inhibition of tumor cell division using a weak electric field



Difference of dielectrophoretic force distribution depending on cell shape

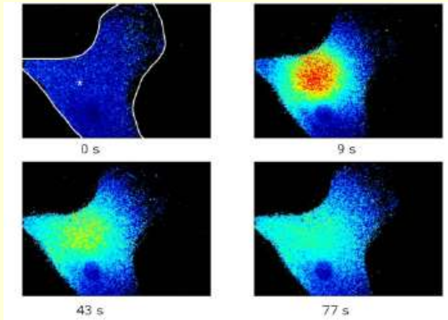
Biofunctional Engineering

Prof. Susumu KUDO
Assoc. Prof. Toshihiro SERA
Assist. Prof. Saori SASAKI

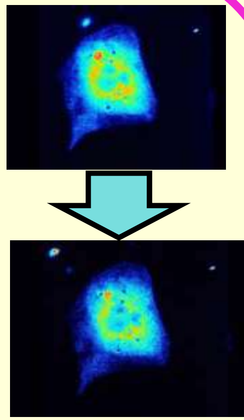
Abstract

We are elucidating the mechanisms by which the functions of cells and tissues adapt to mechanical environments on the basis of biomechanics. We are also trying to clarify the mechanism and micro- and nanoscopic biotransport. Macroscopic biotransport can be often be analyzed by using a differential equation to model physical phenomena. However, biotransport at much smaller scales (the micro-and nano-scales) is more difficult to model in physical detail. Clarification of the mechanisms of such micro- and nanoscale biotransport will be useful not only in improving our understanding of the mechanisms of disease and the maintenance of stable biological functions, but also for the development of clinical applications such as tissue engineering.

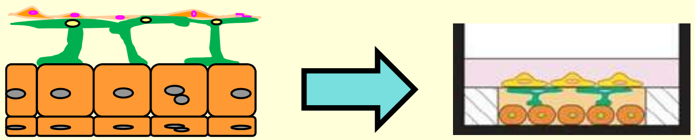
Results



Intracellular diffusion



Response to a mechanical stimulus



Artificial construction of a liver tissue

Artificial knee joint

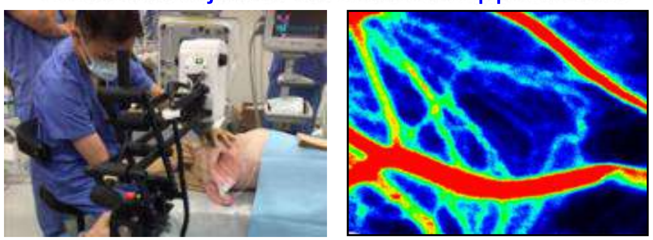
Biomedical Microfluidics Lab.

Profs. Yoko Yamanishi, Shinya Sakuma, Naotomo Tottori

Biomedical Applications

Researches on Minimally invasive cell therapy

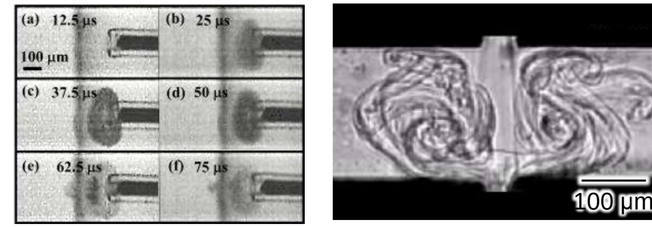
Needless injector for medical applications



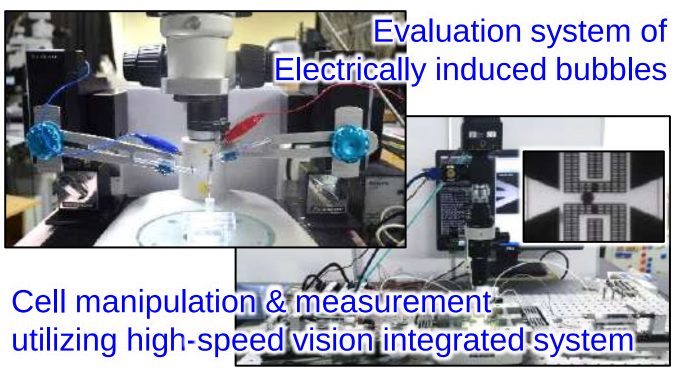
"Seamless researches"
Fundamentals to Applications

Spatiotemporal microfluidics

Investigation of ultra-fast microfluids



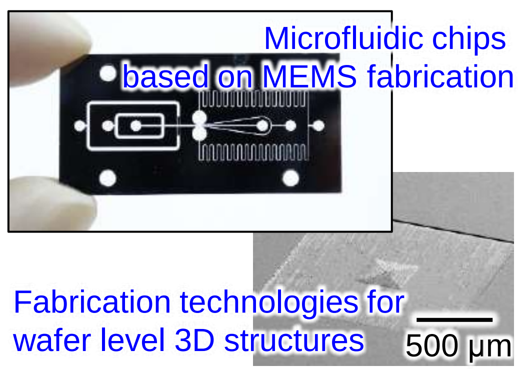
Novel medical devices & applications



Evaluation system of Electrically induced bubbles

Cell manipulation & measurement utilizing high-speed vision integrated system

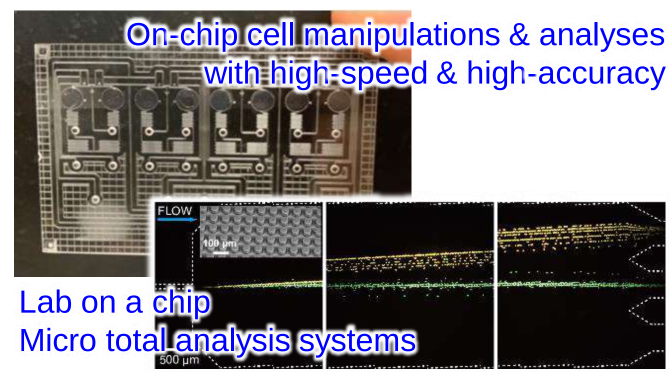
Micro/Nano-mechatoronics



Microfluidic chips based on MEMS fabrication

Fabrication technologies for wafer level 3D structures

Microfabrication/MEMS



On-chip cell manipulations & analyses with high-speed & high-accuracy

Lab on a chip
Micro total analysis systems

Fundamental micro/nano fluidics

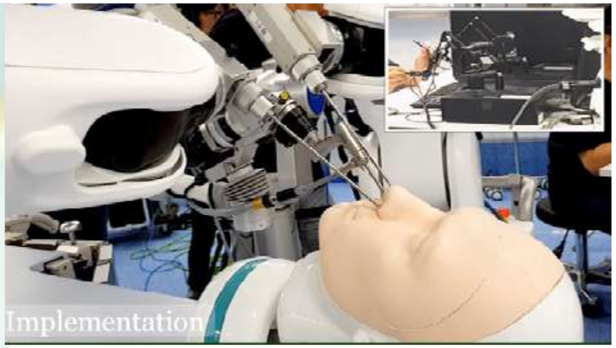
Interdisciplinary researches on "Bio" "Medical" "Microfluidics (Mech. Eng.)"

Advanced Medical Devices Lab.

Prof. Jumpei Arata
Assistant Prof. Hirofumi Nogami

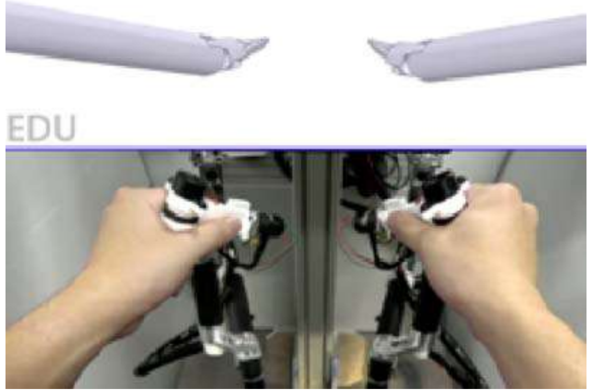
Research on new Medical Devices based on Robotics

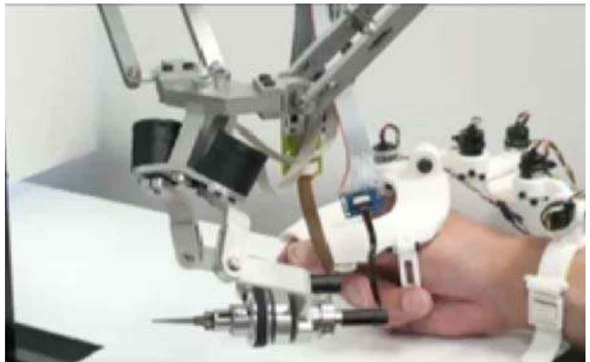
Our research aims at new medical applications based on Robotic technology. Robotic technology includes many elements – mechanism, sensor, control, system integration and etc. We study about these elements to realize further effective medical applications. Find more on http://amd.mech.kyushu-u.ac.jp/

World smallest 2mm robotic surgical manipulator


Hand rehabilitation robot currently tested in clinics



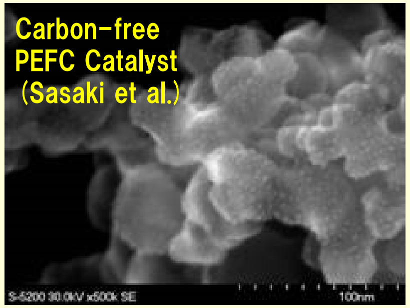


Tele-manipulation system for the orbital space station

Hydrogen Utilization Processes Laboratory

Prof. K. Sasaki, Associate Prof. Y. Shiratori, Assistant Prof. Y. Tachikawa et al.

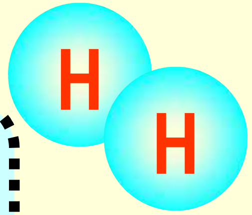
Research topics

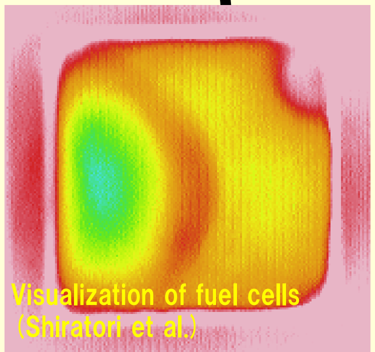

Carbon-free PEFC Catalyst (Sasaki et al.)

Studies on High-Temperature Fuel Cells (SOFCs)

(High electric efficiency & fuel flexibility)

- Fundamental studies to realize longer durability.
- Evaluation of electrodes.
- Studies on materials / system design principles.

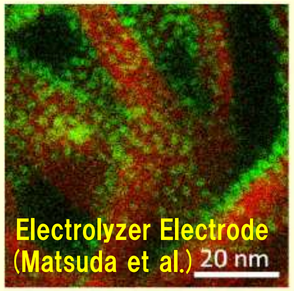


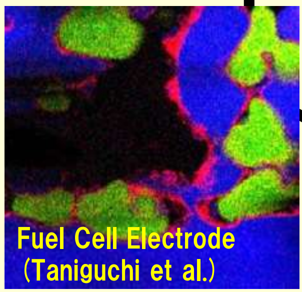

Visualization of fuel cells (Shiratori et al.)

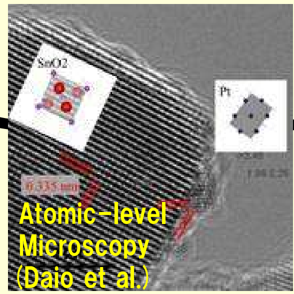
Studies on Low-Temperature Fuel Cells (PEFCs)

(Electric power units for automotive and portable applications)

- Novel electrocatalysts and alternative materials.
- Cell performance evaluation & simulation studies.


Electrolyzer Electrode (Matsuda et al.) 20 nm


Fuel Cell Electrode (Taniguchi et al.)


Atomic-level Microscopy (Daio et al.)

Fundamental Studies on Hydrogen Energy Related Technologies

- Study on hydrogen sensors.
- Fuel cell operation with bio-fuels.

You can learn research and development skills for fuel cells and related technologies!

"Fabrication of materials and cells ⇒ Measurement of cell performance and durability ⇒ Microscopic characterization and various electrochemical / materials analysis"

Fuel Cell System Lab.

Prof. Ito, Associate Prof. Kitahara
and Assistant Prof. Nakajima

Fuel cell (FC) is a direct electricity generator from chemical energy of fuel, with high efficiency and low environmental impact. This merit motivates FCs to be used as a main generator in hydrogen energy age. FCs are expected as mobile, vehicle, residential and dispersed power source. Although a part of FCs has been utilized practically, cost, durability and efficiency are still large concern.

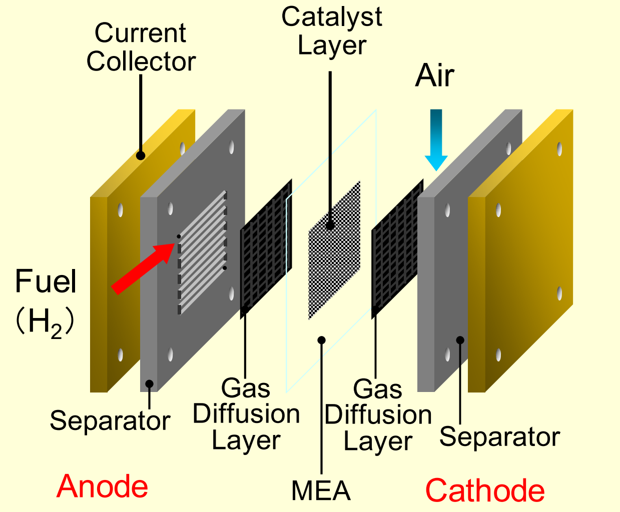
Against this backdrop, our laboratory advances globally competitive research and development on FC through mechanical engineering approach with the following keywords:

□Elucidation of mass, heat and charge transfer phenomena
- Flooding ・Drying ・Temperature ・Thermal analysis
- Hydrogen solubility in electrolyte membrane

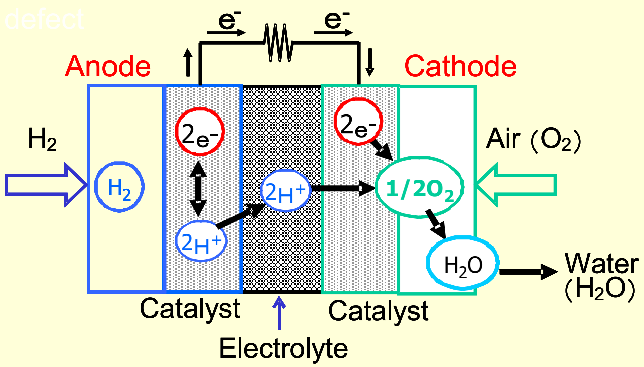
□Development of new proving technique for the elucidation.
- Measurement of temperature distribution with micro TCs.
- Tracer method ・Concentration and current distribution
- FC diagnostic with impedance measurement

□New proposal based on understanding the phenomena in cell.
- Repellency optimization of porous layers
- Advanced channel pattern
- Feedback control for water management
- Hydrogen pump

Contact us! kohei@mech.kyushu-u.ac.jp
http://www.mech.kyushu-u.ac.jp/lab/ki07/index.html



Structure of Polymer Electrolyte FC



Anode: $H_2=2H^++2e^-$
Cathode: $1/2O_2+2H^++2e^-=H_2O$

$H_2+1/2O_2=H_2O$ + Electrical Energy

Principle of fuel cell

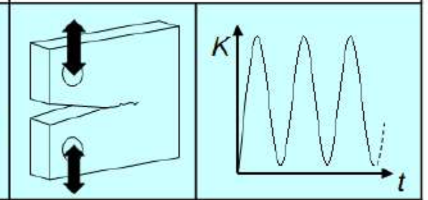
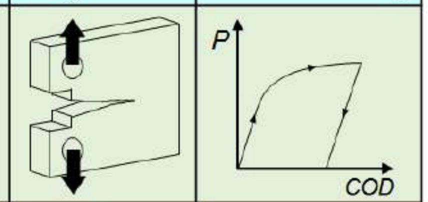
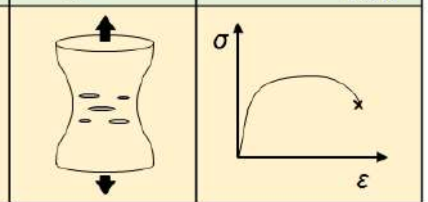
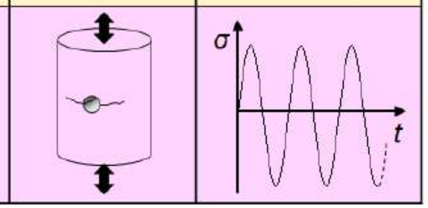
Hydrogen Storage Systems Laboratory

Prof. Hisao Matsunaga
Assistant Prof. Yuhei Ogawa

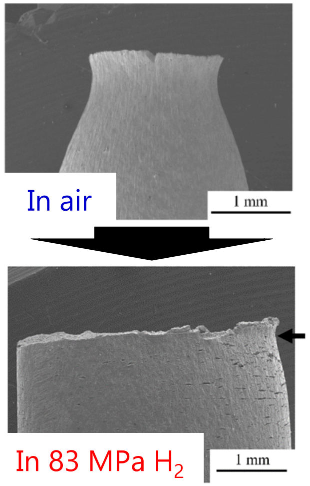
Aims and scope

- Elucidate the **fundamental principles** of hydrogen embrittlement.
- Contribute to revisions of **domestic-** and **international-** regulations on material selection and strength design (e.g., design by rule and design by analysis) for components used in high-pressure gaseous hydrogen.
- Find and develop **new structural materials** having higher resistance to hydrogen with lower cost.

Strength properties which is necessary for the strength design of high-pressure hydrogen components

Properties	Loading types
Fatigue crack growth	
Fracture toughness	
Tensile fracture	
Fatigue life	

Material testing in high-pressure H_2 gas up to 140 MPa



Ductility loss of type 304 stainless steel in hydrogen gas

Contribution for safer and more economic hydrogen society

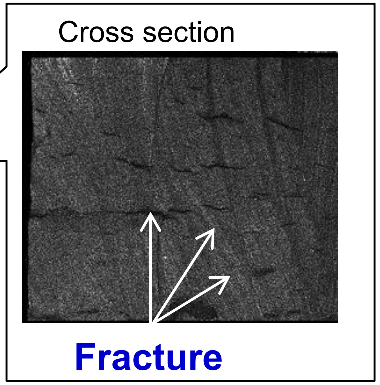
Keywords:
Hydrogen Storage, Hydrogen Embrittlement, Fatigue and Fracture, Strength Design, Regulation Review

Advanced Hydrogen Materials Lab.

Research topics

- Influence of fillers on hydrogen penetration properties and blister fracture of rubber composites for O-ring exposed to high-pressure hydrogen gas.
- Evaluation of sealing behavior of rubber O-ring in high pressure hydrogen gas.
- Development of rubber materials for diaphragm pump.
- Analyses of polymer materials after high-pressure hydrogen exposure.

Seal breaks after 100MPa, 30° C ×25 cycles



Analyses of mechanism of blister fracture of rubber materials during high-pressure hydrogen exposure

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High durability rubber materials for O-ring of high-pressure hydrogen gas vessels

Evaluation of sealing behavior of rubber O-ring in high pressure hydrogen gas

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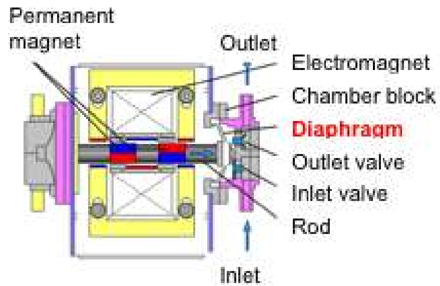
High reliability high-pressure hydrogen gas seal design



Development of high frequency fatigue-resistant rubber materials

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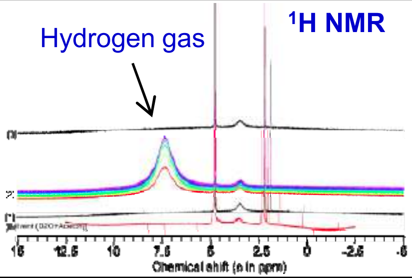
Long-life diaphragm pump for hydrogen gas



Analyses of polymer materials by NMR, IR, Raman spectroscopy and measurement of physical properties after high-pressure hydrogen exposure

→

Molecular design guidelines for polymer materials for hydrogen energy system