FACULTY RESEARCH ACTIVITY 2016

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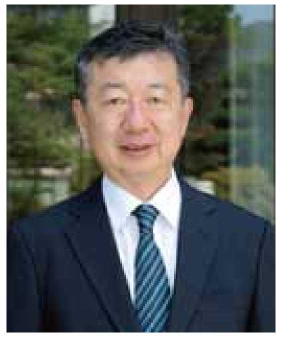
SHINSHU UNIVERSITY | Faculty of Textile Science and Technology

Faculty of Textile Science and Technology
Shinshu University

Introduction of current research activities at FTST



This booklet profiles the research activities conducted by all academic staff at the Faculty of Textile Science and Technology, Shinshu University (FTST) with their promotional messages. FTST is equipped to carry out broad-ranging research in fields such as textiles, chemistry, machinery, robotics, kansei, and biotechnology. FTST is the only faculty to have the name of “textile” among all Japanese universities. We aim at making novel and valuable products related to “textile/fiber”, through collaboration and development across various research fields. High school students can use this information to decide which field they would like to specialize in after completing their basic undergraduate education component. They will have the opportunity to join some these profiled research projects and gain specialized knowledge and techniques at both the undergraduate and graduate levels. Entrepreneurs and company personnel can refer to this booklet to find a professor for consulting or for collaborative research with their business. Please do not hesitate to contact us if you are interested in learning more about the research profiled in this booklet.

Makoto Shimosaka
Dean, Professor at FTST

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Department of Advanced Textile and Kansei Engineering

Advanced Textile Engineering

Using light to measure parameters ranging from the condition of the body to quality without making contact with the object under measurement

With medical treatments of the future, will it really be possible to measure blood sugar without drawing a blood sample? To achieve that goal, I am working to develop a non-invasive optical blood-testing system. The technology also promises to have numerous applications outside the domain of medicine, including 100% inspections of imported products.

Professor
Hiroaki Ishizawa

Professor Ishizawa became an associate professor in 2002 after working at Shimadzu Corporation and took his current position in 2014. His areas of research include measurement engineering and applied optics.

Outlook for research

I also carry out a variety of research in addition to the non-invasive optical blood-testing system. It is possible, for example, to use light to instantaneously quantify the surface roughness of iron (a necessary task in factories that handle iron materials) and to measure mixture ratios in clothing without using chemicals.

Outlook for students after graduation

Graduates are employed not only by manufacturers of measurement devices, medical equipment, and precision devices, but also by electronics manufacturers.

The optical fiber used to measure vital signs is so fine that it's easy to forget that it is in contact with your skin. This approach entails none of the pain normally associated with drawing blood.

It is a simple matter to quantify normal health conditions with optical fiber. Sharing this data with doctors is extremely beneficial for our rapidly aging society.

Department of Advanced Textile and Kansei Engineering

Advanced Textile Engineering

Fabricating high-performance synthetic fibers with laser irradiation

My primary goal is to create high-performance, high-function composite synthetic fibers by irradiating fibers with a carbon dioxide laser to heat them. I expect the resulting fibers to be used in applications such as medicine and optical materials, for example in the form of fiber that is 1/2,000th of the thickness of a human hair or fiber whose shape and composition can be precisely controlled.

Professor
Yutaka Okoshi

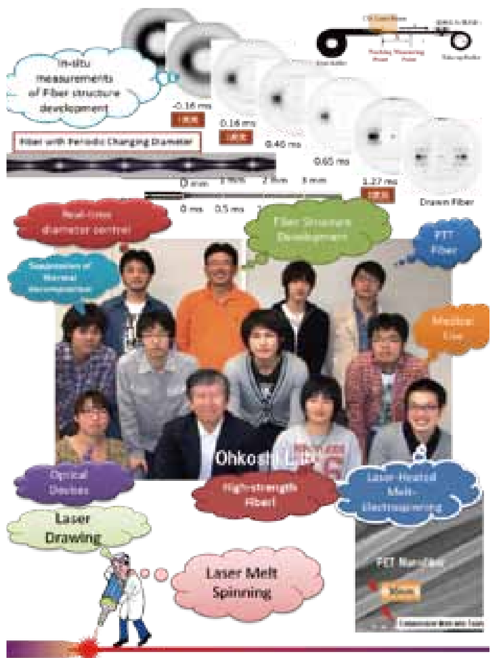
Professor Okoshi joined the Faculty of Textile Science and Technology at Shinshu University in 1986 and took his current position in 2006. He is involved in numerous areas of research, including the formation and processing of high-polymer materials such as fibers and films and the examination of the optical and mechanical properties of fiber.

Outlook for research

High-performance, high-function synthetic fiber is used in aircraft and automobile bodies, artificial organs, optical equipment, and in sports, where it helps reduce environmental impact while improving the comfort of daily life.

Outlook for students after graduation

Graduates work at material manufacturers such as synthetic fiber companies, tire manufacturers, electric machinery manufacturers, and public testing facilities involved in product and material evaluation.



New types of fiber are created by means of laser irradiation.

Department of Advanced Textile and Kansei Engineering

Advanced Textile Engineering

Bringing the wonder of interior textile products to the world

I am involved in research into the performance, safety, and comfort of interior textile products such as curtains and textile floor coverings. My work also includes proposing new testing methods to international standards bodies through research into testing and evaluation methods for accurately determining the properties of those products.

Professor
Hirokazu Kimura

Professor Kimura took his position with the Faculty of Textile Science and Technology at Shinshu University in 2013 after working at the Technology Research Institute of Osaka Prefecture. Principal areas of research include evaluation of the performance safety, and comfort of interior products; evaluation of electrostatic properties of fibers and high-polymer materials; and industrial standardization of textile floor coverings.

Outlook for research

Through the research and development of flooring materials that are elderly-friendly and easy on the feet, I hope to help create safe and comfortable living environments that also contribute to human knowledge by communicating my findings to the world.

Outlook for students after graduation

Graduates strive to participate in research and development work carried out by textile manufacturers and research institutes and official business corporations.

Observation of house dust emissions generated by walking action using visible light

Photographs of cross section of (a) skin-core and (b) triplet spun yarns

Department of Advanced Textile and Kansei Engineering

Advanced Textile Engineering

Science of silkworms, cocoons, and silk: Fashion apparel and textile design

I am pursuing a wide array of research related to silk science, including silkworms, cocoons, raw silk thread, silk fabric, fashion, and market research, and my work draws on such disciplines as management engineering, systems engineering, multivariate analysis, and textile processing technology. I also conduct research related to textile design, for example on topics such as image analysis of fashion apparel.

Professor
Hideaki Morikawa

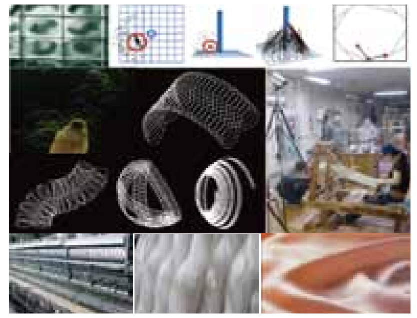
After graduating from Shinshu University Graduate School, Professor Morikawa worked at in the private sector at Kao, at Niigata Women's College, and then as an associate professor in the Faculty of Textile Science and Technology at Shinshu University before taking his current position. His areas of specialization are textile engineering, management engineering, and statistics.

Outlook for researc

While the silk generated by silkworms is an important fiber material in the field of high fashion, applications are expected to extend to biometrics as well as utilization of silk protein as a medical material, and the development of silk science is moving forward through combination with leading-edge technologies.

Outlook for students after graduation

Graduates are likely to work as engineers involved in product development in the fashion, apparel, and textile industries.



Science of silkworms, cocoons, and silk

Image analysis of fashion apparel

Department of Advanced Textile and Kansei Engineering

Advanced Textile Engineering

Quantifying product comfort

I conduct a variety of research into the quantification of product comfort. Specifically, I draw on the science of human comfort to pursue a wide range of research with the goal of quantifying such factors as clothing appearance and comfort and chair comfort and texture.

Professor
Toyonori Nishimatsu

Professor Nishimatsu joined the Faculty of Textile Science and Technology at Shinshu University in 1993 as an associate professor after working at the Mie Prefecture Industrial Research Institute. He took his current position in 2000. His principal areas of research include evaluation of textile products, human comfort engineering, and sportswear design engineering.

Outlook for research

I expect research in this area to expand to encompass all types of products in daily life, including textile products such as car interiors (seat comfort, steering wheel operability, and meter visibility), architectural interiors (ease with which doors can be opened, tactile comfort of floors, and exterior appearance), and household products (detergents and softeners).

Outlook for students after graduation

Graduates are active in new product research in fields such as sportswear, apparel, fabric processing, car seats, car interiors, and architectural interiors.

A student tests freedom of motion while wearing golf apparel. Three-dimensional motion analysis is performed using markers on the arms.

This golf shirt allows a wide range of body motion (sold commercially).

This comfortable suit allows easy motion (sold commercially).

Department of Advanced Textile and Kansei Engineering

Advanced Textile Engineering

Visualizing benefits for products and design through the scientific examination of the five senses

I work to design products that create happiness by fulfilling simple consumer needs, for example the desire to feel like a refined adult by wearing a sharp, eye-opening suit, or to be enveloped in a marshmallow-soft bathrobe after a bath.

Associate Professor
Hiroyuki Kanai

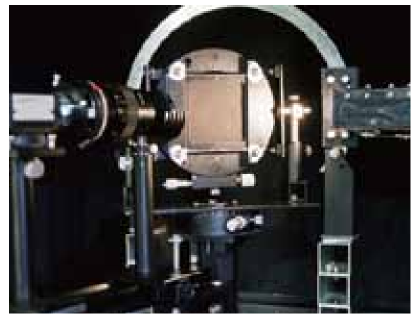
After graduating from the Faculty of Textile Science and Technology at Shinshu University, Associate Professor Kanai took his current position in 2011 after worked at the faculty as an assistant professor and a senior assistant professor. His areas of research include sensory measurement engineering and applied psycho-physiological measurement.

Outlook for research

By utilizing technology to measure and quantify human psychology and physiological responses as a way to explore customer needs, it is possible to assess the emotional stress of people involved in dangerous work, for example astronauts or firemen, or the relaxing effect of a comforting fragrance.

Outlook for students after graduation

The user-friendly technologies that graduates master are needed for an extensive array of consumer products, including cars, interior furnishings, and writing supplies, as well as textiles.



This device measures the distribution of light reflected from fabric to quantify impressions felt by people about characteristics such as depth and brilliance, allowing the beauty of cloth to be quantitatively evaluated.

By measuring (via electromyogram) the muscle activity of a person wearing a suit, it is possible to evaluate how much freedom of movement that suit affords.

Manufacturing high-performance synthetic fiber by controlling fiber structure formation

Spinning and drawing are the most fundamental processes in manufacturing synthetic fiber. In my lab, we produce many types of bicomponent fibers, including sheath/core and sea/island variants, using a bicomponent melt-spinning apparatus and investigate the fiber structure formation process on spinning and drawing lines. This research has broad application in fields such medicine and transportation.

Associate Professor
KyoungHou Kim

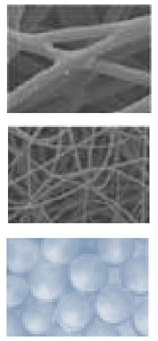
Associate Professor Kim graduated from the Department of Textile Engineering at Pusan National University of South Korea. He currently serves as an assistant professor at the Innovative Cooperation Center in the Faculty of Textile Science and Technology at Shinshu University and as a patent examiner in the Korean Intellectual Patent Office. His fields of research include melt spinning and analysis of the fine structure of fiber, textiles, and films.

Outlook for research

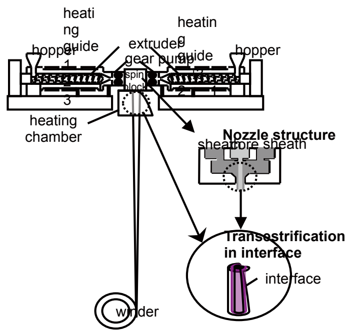
By controlling fiber structure through a detailed on-line analysis of the fiber structure formation process, it is possible to extend fields of application to high-performance tire cord (use as a reinforcement) and high-tenacity hollow fiber (a medical use).

Outlook for students after graduation

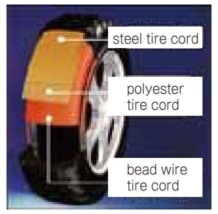
Graduates who understand the fundamentals of the fine structure of fibers and possess knowledge ranging from the fundamentals to applications are able to work in any part of the textile industry.



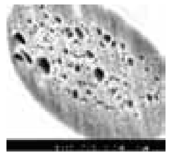
Fibers made of bicomponent spinning



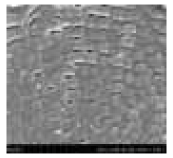
Schematic diagram of a bicomponent spinning machine



High-strength fibers for tire cord



Electron micrograph of multi-hollow polyester fiber



Electron micrograph of sea/island fiber

New applications of cross-discipline integrated textiles

Textiles are predominantly used in the fashion and clothing industries, but their use has recently migrated to less traditional fields. In the lab, I conduct research to develop high-functioning textiles through novel construction design and processing treatments. One example is integrating GPS antennas within clothing's textile fibers for non-invasive patient monitoring. My work also involves development of other sensor fabrics and three-dimensional fabric design.

Tenure-track Assistant Professor
Chunhong Zhu

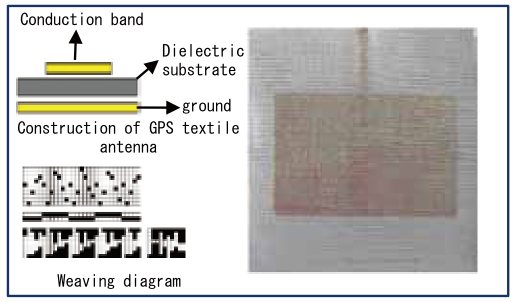
Assistant Professor Zhu received her Ph.D. in Engineering from Shinshu University. She worked in Research and Development at Daio Paper Corporation before starting her current position at Shinshu University in 2015.

Outlook for research

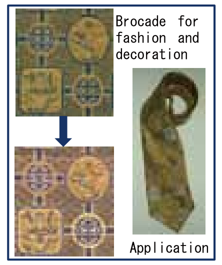
Clothing-integrated antennas involve a mixture of electrical engineering, biology and other fields, and also represent my laboratory's multi-disciplinary approach to textile science. Other novel research areas we pursue include: clothing-integrated sensors and 3D textiles. Our research will help to establish a range of new sub-fields and applications in areas including welfare, architecture, and a variety of other traditional fields.

Outlook for students after graduation

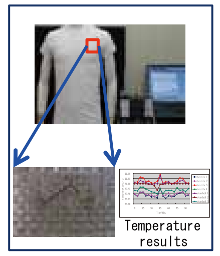
I hope that graduates will not only specialize in textile engineering, including textile materials, technologies,and applications, but also have a global view and communication skills through active learning.



The construction, design and real object of GPS textile antenna



Development of Song Brocade with modern technologies and its application



Thermocouple fabric: a kind of textile sensor

Thinking about the future of *sen'i* (the Japanese word for fibers and textiles) in Japan

I am working on *sen'i* from the standpoint of textile engineering and textile science. In the case of the former, I am investigating textile machines and systems. As for the latter, I my goal is to discover the laws that lie dormant in *sen'i*. Humans have acquired various materials, and *sen'i* have been used for a long time as clothing. Why must clothing be *sen'i*? I believe that this is a mystery worth unraveling.

Assistant Professor
Akio Sakaguchi

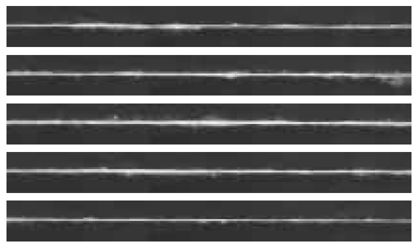
Born in the city of Ueda in Nagano Prefecture, Assistant Professor Sakaguchi graduated from the Faculty of Textile Science and Technology at Shinshu University but left without completing Shinshu University Graduate School's textile engineering program. He worked as a research associate in the Faculty of Textile Science and Technology at Shinshu University before taking his current position. His current area of specialization is textile engineering.

Outlook for research

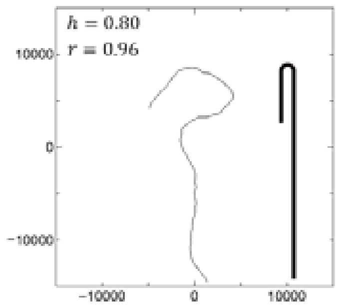
Long ago, there were many large and small printing shops, but computers and printers have completely changed the world of printing. Today, the culture of printing has developed to the point that anyone can print various materials in their own homes. Growth of industry and elevation of culture are not equal. Will similar developments occur in the world of *sen'i*?

Outlook for students after graduation

Even if equipped with engines of the same power, a racecar and bulldozer excel at completely different jobs. What is important is not the question of which is superior, but the fact that they can combine their respective specialties.



There are also rules in spun silk thread hand-crafted from floss silk.



Measuring fiber figures in card webs.

Department of Advanced Textile and Kansei Engineering

Kansei Engineering

Creating easy-to-use, comfortable products that fit user needs

I am working to dramatically improve the efficiency of handmade products by applying information technology to reduce the difficulty of design and prototyping work. I'm focusing on products made from flexible materials such as clothing, an area to which such methods have not conventionally been applied.

Professor
Shigeru Inui

Professor Inui joined the Faculty of Textile Science and Technology at Shinshu University in 2002 after working as the chief scientist at the National Institute of Materials and Chemical Research's Research Institute of Polymers and Textiles and the National Institute of Advanced Industrial Science and Technology. His principal area of research is the application of information technology in the textile domain.

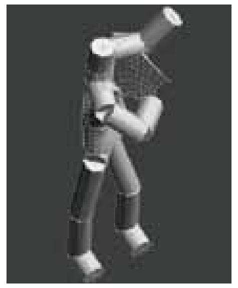
Outlook for research

To create the clothing of the future, I'm working to realize an approach to creating clothing that allows virtual clothing to be designed and prototyped based on simple body measurements taken at home. Users then preview what they would look like wearing those clothes and send the design data to the factory.

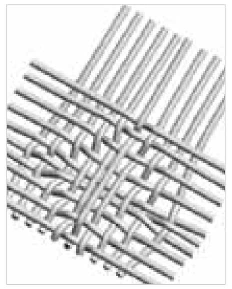
Outlook for students after graduation

Although some graduates have become public officials, most work for manufacturers and IT companies.

The movements of a person wearing clothing are measured using a motion-capture device (a device used to record human motion).



The movements of a person wearing clothing are simulated based on calculations.



A simulation illustrates the cloth that would result from weaving the warp and weave threads.

Department of Advanced Textile and Kansei Engineering

Kansei Engineering

Measuring comfort and stress in the body and mind to create goods with new value (kansei value)

Data describing physiological responses by the brain, heart, and muscles can be obtained from human body. I believe it is possible to create a language to communicate the body's health or state of comfort or stress using this data. The research being carried out by my lab (in kansei measurement), which seeks to create a new system of measurement for communicating comfort by measuring data expressed by the body, is garnering attention in numerous industries.

Professor
Masayoshi Kamijo

Professor Kamijo has earned bachelor's and master's degrees in textile engineering and a doctoral degree in textile engineering from Shinshu University. He worked as an assistant professor at Tokyo University of Science, Suwa, and as an assistant professor and associate professor at Shinshu University before taking his current position. He is engaged in research into kansei measurement (measurement and instrumentation targeting human activity).

Outlook for research

My goal for the future is to develop intelligent clothing (IC). I wish to assess different types of comfort (while wearing clothing, riding in vehicles, sitting, and sleeping) by measuring a person's level of comfort or stress while wearing IC.

Outlook for students after graduation

Kansei measurement is garnering attention in numerous industries, including automobiles, cosmetics, sleeping goods, housing, home appliances, writing supplies, and information. Graduates are active as engineers in research and development and planning and development.

Research seeks to evaluate comfort while driving by measuring the physiological activity of muscles and the heart.

Researchers gauge a person's emotional state based on her facial expressions ("attractive smile," "sleepy face," "fatigued face"). This research seeks to use facial expressions as an indicator of the state of comfort and stress in the body and mind.

Department of Advanced Textile and Kansei Engineering

Kansei Engineering

Adopting a scientific approach to personal sensitivity (kansei) to find reasons for taste in clothing

I am working to identify the values that motivate peoples' emotions by focusing on clothing as the most familiar object in daily life. This effort includes developing new, previously unthinkable methods for evaluating value, for example by searching for factors that determine how people evaluate products and developing new evaluation devices. By taking a scientific approach to personal taste, my research creates opportunities for new products and businesses.

Professor
Masayuki Takatera

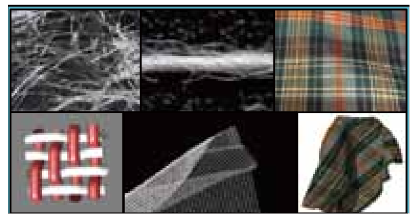
Professor Takatera took his current position in 2006 after serving in the Faculty of Textile Science and Technology at Shinshu University as an assistant professor, senior assistant professor, and associate professor. His principal areas of research include design and evaluation of textiles and apparel and the application of kansei engineering to fashion.

Outlook for research

The automated draping system my lab is developing will make it easy and cheaper to create order-made clothing. I believe that such individually-oriented systems will become common in the future.

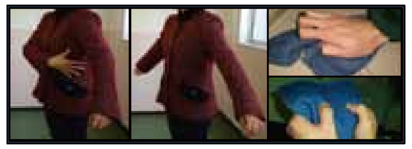
Outlook for students after graduation

In addition to working as engineers in charge of manufacturer product planning or development at educational institutions, product testing organizations, and research centers, graduates work as kansei engineering specialists in the areas of media, electronics, and home-use equipment.



Computers are used to create designs from fiber to thread and from thread to cloth. Shown above is the finished item; below, a simulation.

Clothing design can use three-dimensional measurement, and clothing simulations can take into account clothing patterns and properties.



We are developing methods to evaluate appearance, feel, and texture.

Department of Advanced Textile and Kansei Engineering

Kansei Engineering

More than appearance: Commercializing comfortable socks on the basis of data

Whether the socks that consumers choose for vague reasons end up being comfortable or uncomfortable to wear changes the amount of fatigue that they experience. My work involves quantifying that degree of comfort, and my team has used the results of that research to create an actual product: socks that prevent fatigue by asymmetrically adjusting their elasticity. I am also working with shoe and stocking companies to develop new products.

Professor
Satoshi Hosoya

Associate Professor Hosoya took his current position in 2006 after serving in the Faculty of Textile Science and Technology at Shinshu University as an assistant professor. His principal areas of research include kansei engineering, human engineering, and sports engineering. He conducts joint research with numerous companies and has commercialized many products.

Outlook for research

Kansei engineering brings added value to products. Its techniques are already employed in a vast array of familiar, everyday objects such as the buttons on cell phones as well as in clothing items, and there are still many domains awaiting its application.

Outlook for students after graduation

The paths taken by graduates are diverse. In addition to the apparel industry, many students get jobs with various manufacturers, while others enter the finance and advertising industries.

The socks shown above are a conventional design, while the socks shown below were commercialized by my team to better fit the shape of the foot.

Researchers have attached an electrocardiogram to the subject's body to analyze stress while wearing underwear.

Researchers measure the changes in clothing pressure from socks using a treadmill. Comfort is quantified by measuring changes in pressure by placing pressure sensors on the feet, yielding data for later analysis.

Department of Advanced Textile and Kansei Engineering

Kansei Engineering

Exploring design as a new practical science and pioneering the future with the “theory × sensibility” approach

In the realm of design, both formal knowledge, for example logical knowledge and methods, and informal knowledge, for example judgment and inspiration that are hard to communicate, must be leveraged in development and management. I am deepening understanding of this so-called “theory × sensibility” approach through my development research.

My career in design development began with the world's first Mini-Disc player and has included products used in daily life as well as medical equipment. It culminates in advanced design.

Professor
Isao Wada

Professor Wada took his current position in October 2012 after working at the Pioneer Design Office, the Sony Design Center, and as head of Wada Design. His principal areas of research and development include product design and product planning.

Outlook for research

I see design as a new practical science, and I believe it will be transformed into an opportunity for presenting countless possibilities for the future through experimentation and an opportunity for developing appeal as its potential is realized.

Outlook for students after graduation

My goal is for my students to achieve a level of capability that extends beyond the definitions of planners, engineers, and designers so that they can do their own planning and then produce and carry out projects on their own.

The Yamaha PJP-25UR (Yamaha Corporation) makes it possible for people in remote locations to engage in dialog and participate in meetings by commercializing a completely new approach to “controlling invisible things in a visible way.”

My Tomorrow Project seeks to propose tools, environment, and systems for use by the children of the future.

Department of Advanced Textile and Kansei Engineering

Kansei Engineering

Searching for the future potential of high-polymer materials: The 21st century as the age of soft materials

It is likely that soft materials such as high-polymer materials will continue to increase in importance in manufacturing. High-polymer materials exhibit diverse properties because the shapes of their molecules change in diverse ways. Further, they are not harmful to the body and have significant potential for use in not only industrial, but also biomedical, applications.

Associate Professor
Masato Takahashi

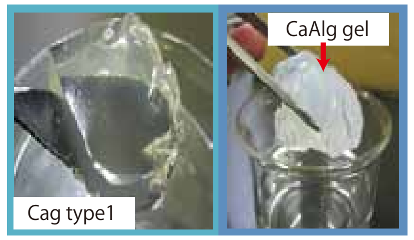
Associate Professor Takahashi took his current position in 1991 after earning his Doctorate of Engineering in 1986 and attending Tokyo Metropolitan University. His principal area of research centers on controlling the structure of high-polymer materials (including forming and controlling the structure of natural polysaccharides, controlling the structure of polymer blends, and forming and controlling the structure of amphiphilic polymers).

Outlook for research

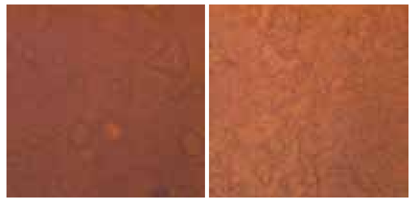
I hope to contribute to the future development of high polymer materials through research into topics such as environmentally friendly polymers like polysaccharides that can be obtained from living things and new polymer-blend materials created by combining other high-polymer materials.

Outlook for students after graduation

Graduates work at chemical-related companies, which have a high level of need for students who have studied high-polymer materials.



Gels such as carrageenan gel (left) and calcium alginate gel (right) may be used as vulnerary covering materials in biomedical science.



It may be possible to create materials with a variety of properties by controlling the polymer-blend structures such as sea-island structures (left) and bicontinuous structures (right).

Department of Advanced Textile and Kansei Engineering

Kansei Engineering

The science of heat and thermal perception: Creating individually preferred thermal environments by adjusting airflow and clothing

Heating, ventilation, air-conditioning, and refrigeration (HVAC&R) systems consume energy. Since the thermal environment is an important factor in determining the productivity of occupants, it is desirable to develop effective HVAC&R systems. I am working to develop numerical simulation methods and experimental devices to analyze the thermophysiological state of the human body and the surrounding thermal environment. Simultaneously, I am developing new personal HVAC&R systems based on various methods and devices.

Senior Assistant Professor
Tomonori Sakoi

Dr. Sakoi came to Shinshu University as an assistant professor after work experience at the University of Tokyo and the National Institute of Advanced Industrial Science and Technology, and he assumed his current position in 2013. He has won nine awards, including three “Best Paper” awards from the Society of Heating, Air-Conditioning and Sanitary Engineers of Japan (2001, 2004, and 2009) and one “Best Paper” award from ASHRAE HVAC&R Research (2014).

Outlook for research

Based on the results of analysis of thermophysiological state and the surrounding environment, I intend to propose reasonable ways to form a comfortable microclimate around the human body, especially by adjusting clothing and airflow. As an example, my lab has developed clothing with adjustable cooling capability that utilizes water evaporation.

Outlook for students after graduation

Graduates work for major homebuilders, insurance companies, part manufacturing companies, and textile development companies.

This human subject experiment is being carried out to validate the cooling clothing that my lab developed. The clothing provided an adequate cooling effect, even in a warm and humid environment, when a convection fan was simultaneously used.

This device is used to determine the heat transfer characteristics of body segments in a non-uniform thermal environment.

Numerical simulation is used to analyze air and body temperature distributions.

Department of Advanced Textile and Kansei Engineering

Kansei Engineering

Developing materials that can be used safely without harming people or the environment

I am working to develop materials that can be used safely without harming people or the environment by using biomass plastics made from renewable resources such as sugars and plant oils as well as biodegradable plastics that are broken down in the environment through the action of microorganisms.

Associate Professor
Toshihisa Tanaka

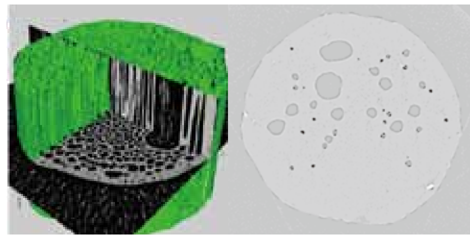
Associate Professor Tanaka took his current position in 2007 after working as a researcher for a project of the Japan Science and Technology Corporation's Core Research for Evolutional Science and Technology and later as a doctoral research fellow at RIKEN.

Outlook for research

My goal is to develop products that are compatible with living organisms (humans), including medical materials (suture materials, cell cultivation sheets, and surgical dressings), health and nursing products (sheets and filters for cosmetics), sheets that transform sea water into fresh water, and even afforestation sheets for use in arid regions.

Outlook for students after graduation

Graduates work not only at material and manufacturing companies involved in materials development, but also in many other industries, particularly textiles.



Composite fiber materials are developed by creating high-tensile fibers from biodegradable polymers with numerous micropores and adding water-soluble polymers.

An electron microscope is used to analyze the fine structure of a water-soluble polymer gel sheet designed to facilitate seed sprouting and growth to assist in afforestation of arid regions.

Kansei Engineering

Kansei education: Teaching lifetime learning skills for knowledge workers

The key to successful learning is management of the following equation: Motivation × Strategy × Time on task = Results. I study how to set up learning environments for new skills such as languages, including English, Japanese, Chinese, and Maori, or hand-eye coordination skills such as kendama and juggling. If inputs are carefully measured, it is possible to monitor progress and aim for optimal results. This is the art of kansei: matching the needs and wants of the user in a meaningful way.

Associate Professor
Michael Honywood

Associate Professor Honywood has studied in Australia, Canada, South Korea, Japan and the United Kingdom. He has worked as an associate professor at Shinshu University since 2003, and his principal area of research is kansei education.

Outlook for research

Students start with a real-life phenomenon, identify a problem, brainstorm potential solutions, and then research one solution to gauge its effectiveness. They gain a wide variety of experience in basic research, education, and presentation skills.

Outlook for students after graduation

Graduates have gone on to a wide variety of jobs. Thanks to proficiency in both Japanese and English, some have found work at multinational corporations, which require good English skills.

Students build teamwork and innovation skills in the "Marshmallow Challenge."

My lab's original interactive multimedia software helps students learn English more effectively.

Department of Advanced Textile and Kansei Engineering

Kansei Engineering

Visualizing flows of people, things, and information by applying network analysis to connections in textile-related industries

I am involved in using network analysis to visualize flows of people, things, and information in textile-related industries. For example, I view transactions between companies as networks and analyze them in order to ascertain which companies exhibit central importance. Based on that data, I am able to extract highly unique transactional relationships between companies.

Associate Professor
Yoshiyuki Matsumura

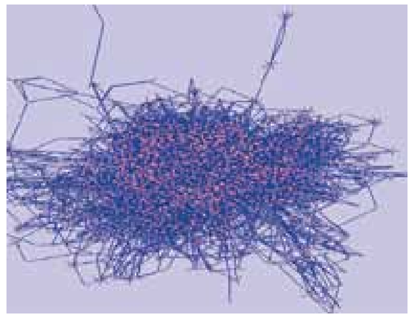
Associate Professor Matsumura took his current position in 2009 after working as a special researcher at the Japan Society for the Promotion of Science, as a visiting researcher at Tokyo University, and at the University of Birmingham in the UK. That same year, he became a visiting professor at Soochow University.

Outlook for research

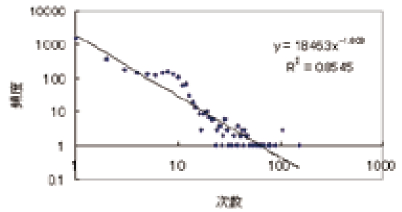
I conduct research in order to support new business strategy planning through network analysis based on industry analysis, to establish new business models, and to achieve process innovation that utilizes information technology.

Outlook for students after graduation

Graduates can choose from a broad range of future paths, serving as upstream process integrators, hotel or company managers, or bureaucrats; working for machinery, electric machinery, information, or systems companies; or continuing their studies in a doctoral program.



Free software is used to display a transactional network linking 3,354 companies in the dye and finishing industry in 1998.



Analysis can be carried out using special network properties based on the results of this graph, which illustrates frequency ordered by the number of companies with which each company trades.

Department of Advanced Textile and Kansei Engineering

Kansei Engineering

Analyzing clothing and textile products through computer simulation

I am engaged in research that uses computer simulation to replicate clothing and the human body and predict and analyze mechanical and thermal phenomena. By allowing visualization of phenomena that would otherwise be difficult to observe, simulation is expected to contribute greatly to the design and evaluation of clothing and textile products.

Associate Professor
Yosuke Horiba

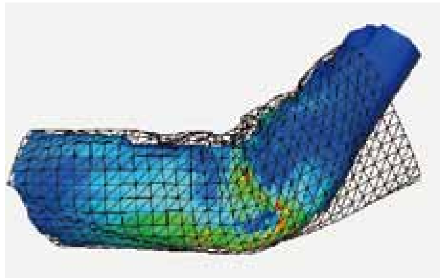
Associate Professor Horiba, who holds a Doctorate of Engineering from the Shinshu University Graduate School of Engineering, took his current position in 2015 after working as an assistant professor in the Faculty of Textile Science and Technology at Shinshu University. He is primarily involved in research in kansei engineering, computational mechanics, and clothing physiology.

Outlook for research

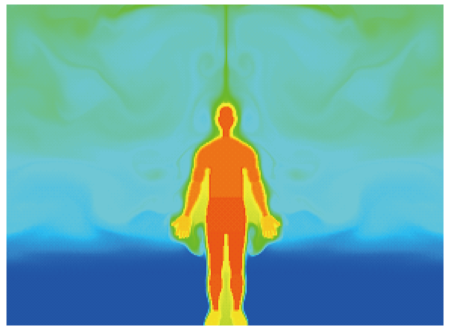
If we can clarify the relationships of the physical phenomena that occur between clothing and the body based on sensation, I believe it will be possible to predict the comfort of clothing.

Outlook for students after graduation

Most graduates leverage their knowledge and experience in textile engineering, computational mechanics, and computer programming to secure employment in the textile and IT industries.



Simulating pressure applied to clothing makes it possible to consider pressure distribution from motion at the design stage.



By combining prediction of the distribution of body temperature and air temperature around the body with such indicators as the predicted mean vote (PMV), it will be possible to predict the thermal comfort of clothing.

Department of Advanced Textile and Kansei Engineering

Kansei Engineering

Visualizing comfort and understanding the underlying science

I make science out of pleasant feel and comfort by visualizing that which is invisible. In addition to measuring physiological activity from brain waves, electrocardiograms, and electromyograms and measuring changes in behavior and feelings, I use computer simulations to understand comfort and sensitivity to make it possible to create things that people will feel are good.

Associate Professor
Hiroaki Yoshida

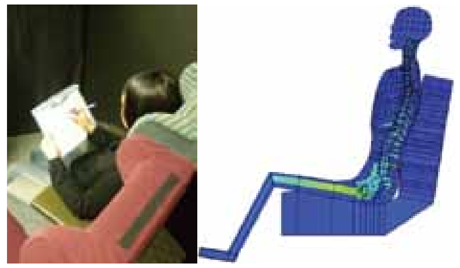
Associate Professor Yoshida took his current position in 2010 after working as a researcher at the Digital Human Research Center and as an assistant professor in the Faculty of Textile Science and Technology at Shinshu University. His areas of research include kansei engineering and biomechanics.

Outlook for research

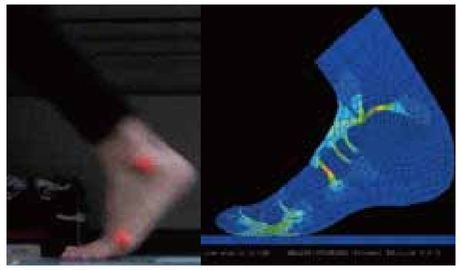
Computer simulation is a method for analyzing the internal state of the body so that we can estimate human senses. I hope to utilize this technology in the future to evaluate various types of comfort, for example while sitting, wearing clothes, sleeping, or touching.

Outlook for students after graduation

Many graduates go on to work in the automotive and railroad industries.



A subject answers survey questions about how her feelings changed when she sat in a chair so that researchers can analyze how internal changes in the body are expressed.



The act of walking is filmed and the resulting motion simulated on a computer in order to explain phenomena within the human body.

Department of Advanced Textile and Kansei Engineering

Kansei Engineering

Searching for beautiful and comfortable clothes based on the relationships of textiles, clothing patterns, and manufacturing technology

I think clothing that provides the function and design that consumers want, and clothing that will also actually lead to purchases, has such kansei values as comfort, beauty, stylishness, elegance, classiness, and cuteness. Such pieces of clothing are also made from clothing materials that are beautiful and that have superior physical properties and function. In the lab, I conduct research to identify methods for designing these kinds of beautiful and comfortable clothes as well as materials to use in such clothes from the points of view of textile engineering, clothing studies, and kansei engineering.

Tenure-track Assistant Professor
KyoungOk Kim

Assistant Professor Kim came to her current position in 2014 after working as a special researcher (DC2/PD) in the Japan Society for the Promotion of Science. Her fields of specialization include clothing engineering, textile engineering, and kansei engineering. Her principal fields of research include clothing materials, clothing design, and evaluation.

Outlook for research

I work to clarify principles of clothing manufacturing that previously have been derived from experience through research that aims to systematize engineering. Ultimately, I would like to propose efficient design methods for clothing that is beautiful and comfortable and thereby contribute to an industrial world that aims to produce clothing that consumers will prefer and purchase.

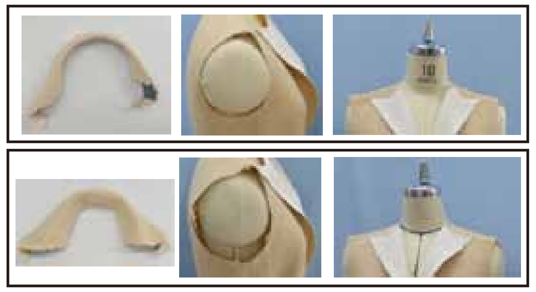
Outlook for students after graduation

My goal in teaching is to train employees of the future who have not only expertise in clothing materials and clothing design, but also a commanding outlook and communication skills along with an ability to accommodate globalization.

External appearance changes depending on whether there is an inner lining (left: without inner lining; right: with inner lining).

The feel of clothing changes depending on whether there is padding (left: without inner lining; right: with inner lining).

Research on the effects of an inner lining when manufacturing clothing



My research also addresses mechanisms for three-dimensional shaping of clothing through sewing and ironing. Shown are differences due to processing of parts of jackets created with the same cloth and pattern (top: with suitable processing; bottom: without suitable processing).

Department of Machinery and Robotics

Functional Machinery and Mechanics

Farewell gasoline: Combining solar cells with fuel cells to create a next-generation solar-powered car

I am working to develop a hybrid system combining solar cells and fuel cells that uses no fossil fuels at all. Members of my lab work together to enter solar car races in Japan and have achieved good results. If this system were commercialized, it would help limit consumption of fossil fuels to make the global environment cleaner than before.

Professor
Hajime Konishi

Professor Konishi joined the Faculty of Textile Science and Technology at Shinshu University in 1989 after working as an assistant professor at the Hokkaido University Applied Electricity Research Institute and as a researcher at the Hokkaido Industrial Technology Center. His principal area of research is electrical engineering, including topics such as superconductivity, micro machines, and new energy.

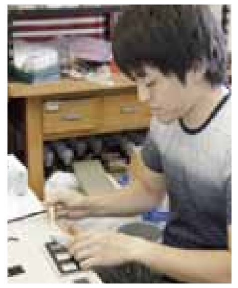
Outlook for research

Achieving a high level of efficiency is very important when using solar and hydrogen energy, and our lab' s findings hold promise for domains other than automobiles. For example, systems have already been commercialized for home power generation.

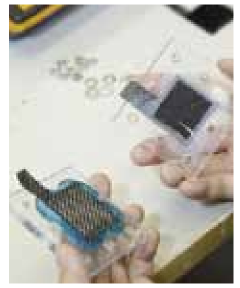
Outlook for students after graduation

Graduates enjoy an increasingly broad choice of career paths in areas such as the automotive industry and energy-related domains.

This solar car was designed and built by students, who have won races.



Students also participate enthusiastically in the development of fuel cells.



My lab is also working on ecological research aimed at operating fuel cells using biomass resources.

Department of Machinery and Robotics

Functional Machinery and Mechanics

New materials: From nano-composite materials to multi-functional materials: Developing and finding applications for lightweight, high-performance, and energy-saving products

I am engaged in research into the optimal design and development of smart materials, nano-composite materials, and composite structures; the evaluation of material properties; and the development of health-monitoring technology. I am also pursuing material development using biomimetics.

Professor
Qing-Qing Ni

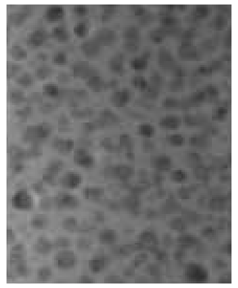
Professor Ni took his current position after working as a senior assistant professor and associate professor at the Kyoto Institute of Technology. His areas of research include composite material engineering, mechanics, and the development and application of multi-functional materials.

Outlook for research

I am also involved in research to develop advanced composite materials and multifunctional materials for aerospace and automotive applications as well as evaluation and measuring technologies for materials and structures. My lab can design practical new materials and structures and achieve intelligent, multifaceted functionality at the nano-scale for energy savings and environmental friendliness.

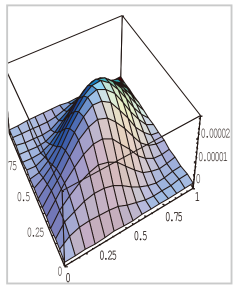
Outlook for students after graduation

Graduates are active in a wide range of domains, ranging from automotive and transportation-related companies to businesses involved in machinery, precision equipment, and electrical equipment.

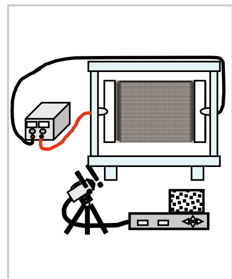


This TEM photograph of a nano-composite material shows silica particles with an approximate diameter of 10 nm.

Detection of buckling damage and acoustic emission signals



Prediction of structural deformation through simulation



Shape recovery and self-repair functionality for shape-memory materials using electrical heating

Functional Machinery and Mechanics

Researching thermo-fluid engineering to support industry and build the future, from energy to the environment

Electrical power plants burn fossil fuels and run steam turbines to generate electrical energy, but 60% of the combustion energy is exhausted to the sea. I am pursuing research to increase the conversion efficiency of such plants and to utilize the exhausted heat. I am also engaged in research into cleaning pollutant gases, which are a significant environmental problem.

Professor
Nobuhiro Himeno

Professor Himeno joined the Faculty of Textile Science and Technology at Shinshu University in 1989 after completing a master's program at the Tokyo Institute of Technology and working as an assistant professor at the Tokyo Institute of Technology School of Engineering. His areas of research include thermo-fluid engineering, energy conversion and component technologies, heat storage technology, measurement of thermophysical properties, and environmental cleaning technology.

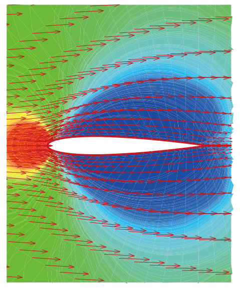
Outlook for research

My lab works to develop important fundamental technologies for industry and society, including high-efficiency heat storage systems, and to conduct research into heat pump systems, methods for measuring the thermophysical properties of newly designed materials, and highly efficient insulation materials.

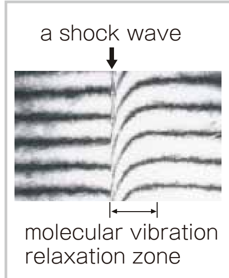
Outlook for students after graduation

Graduates are active as thermo-fluid engineers working to design and build energy-related equipment and engines in the power, heavy industry, and automotive industries, as well as a wide array of other fields.

My lab is working to develop a high-performance cleaning system that instantly removes dust, contaminant gases, and foul-smelling components from the emissions of factories and garbage collection facilities.



Numerical analysis of the flow around blades is important in analyzing turbine performance.



Heat transfer analysis in the areas behind shock waves is important in the design of turbines and spacecraft reentering the atmosphere.

Functional Machinery and Mechanics

Engineering composite material structures that are stronger, lighter, and easier to recycle

As the only facility of its kind dedicated to applied fiber mechanics research in Japan, my lab is currently engaged in research and development of optimal high-relative-strength and multi-function fiber structures as well as fiber-reinforced plastics and fiber-reinforced thermoplastics (FRPs and FRTPs). We have been successfully in developing fiber-reinforced plastics that exhibit high relative strength and strong erosion resistance, as well as low-cost FRP recycling methods characterized by a high recovery rate.

Professor
Limin Bao

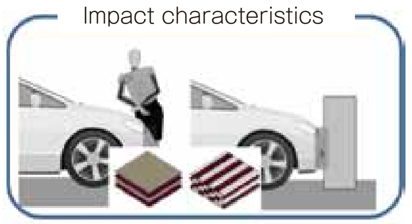
Professor Bao took his current position in 2013 after serving in the Faculty of Textile Science and Technology at Shinshu University as an assistant professor, senior assistant professor, and associate professor. His areas of research are applied fiber mechanics and composite material engineering, including development of FRP using carbon and super-fibers.

Outlook for research

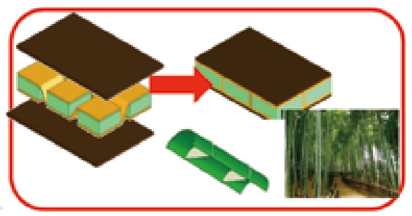
Composite materials are being used in an increasingly broad range of applications. CFRPs comprise nearly 90% of the fuselage and wings of the recently developed Boeing 787 aircraft. Use of FRPs is also accelerating in products such as cars and windmills.

Outlook for students after graduation

Graduates are primarily employed by aircraft and automobile manufacturers in Japan and internationally.



My lab is working to develop a hybrid super-fiber and carbon-fiber FRP structure that exhibits excellent buffering properties and impact strength.



We are also conducting research and development into a highly rigid and super-light FRP that has a strengthened web structure inspired by bamboo fibers.

Functional Machinery and Mechanics

Researching robots based on mechanisms and bringing the skills of humans and living things to robots

I am pursuing research into mechatronics robots based on mechanical engineering. The key word in this endeavor is "skills." My lab focuses on observing the skills of living things nurtured through evolution and in daily life and analyzing them from an engineering standpoint to understand their nature and significance for building systems.

Associate Professor
Takashi Kawamura

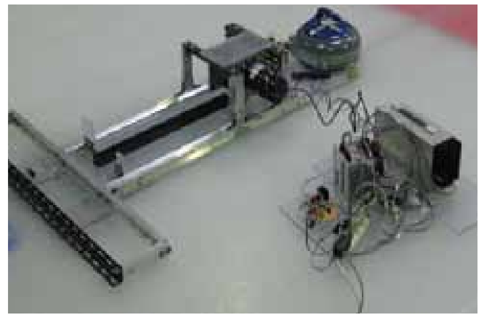
Associate Professor Kawamura first came to the Faculty of Textile Science and Technology at Shinshu University as an assistant professor. After subsequently working as a senior assistant professor, he took his current position in 2003. In 1996, he served as a visiting researcher at the University of Illinois. His interests include mechatronics, intelligent control, robots capable of learning the skills of living things, kansei (sensitivity) robotics, and human dynamics.

Outlook for research

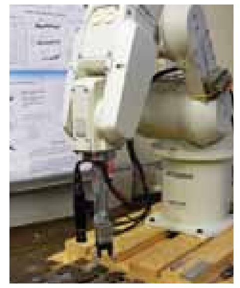
To develop mechatronics robots, it is necessary to design systems based on a wide range of engineering knowledge along with observation, understanding, and evaluation of motion. I aim to design easy-to-use, highly functional mechatronics systems.

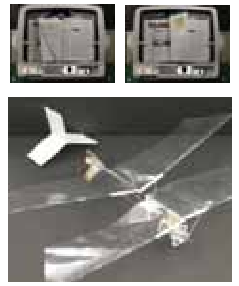
Outlook for students after graduation

Mechatronics is a comprehensive technology combining machines, electronics, and information control. Graduates can be expected to find jobs as mechatronics engineers, which are in high demand in the world today.



I am working to develop robots capable of competing with human teams in the sport of curling. These robots sense minute changes in the surface of the ice and prepare strategies to play.





Robotic mechanisms handle metal sheets (left), turn pages based on the same principles as the human hand (upper right), and flap wings based on a dragonfly (lower right).

Functional Machinery and Mechanics

Pushing the envelope in fiber thinness and bringing abundance to the world with nanofiber

Nanofiber is fiber with a diameter of several dozen to several hundred nanometers, and it has qualities that are completely different from existing fibers. Benefits that can be expected from minimizing the thinness of the fiber include filtering or purification of foreign objects in ways not previously possible, improving the performance of fuel cells by improving the efficiency of electrical response, and improving efficiency in medical areas such as high-speed cell cultivation.

Associate Professor
Ick Soo Kim

Associate Professor Kim took his current position in 2005 after working as a researcher at the Oak Ridge National Laboratory in the U.S. and as a research professor at Chonbuk National University. His principal areas of research are nanofiber and material design. He was the first researcher to achieve mass-production of nanofiber, and he was a leading performer in the nanofiber industry in 2011.

Outlook for research

I have succeeded in developing numerous nano-scale products such as high-performance filters, moisture-permeable waterproof jackets, nano-wipers for clean rooms, separators, and masks, as well as in developing a mass-production plant. In the near future, nanofibers will likely play a role in many familiar products.

Outlook for students after graduation

Graduates are active not only in the fiber industry, but also in the electronics, medicine, semiconductors, and machinery industries. Some students even hope to start their own business.

This moisture-permeable, waterproof jacket offers excellent breathability and waterproofing.

Nano-wipers for clean rooms catch even the most minuscule pieces of dirt.

The world's first successful device for mass-producing nanofiber (left)
A nanofiber separator (upper right) and a high-performance mask capable of filtering out PM 2.5 particles (lower right)

Department of Machinery and Robotics

Functional Machinery and Mechanics

Moving, thinking, and working autonomously: Implementing an autonomous robot

I am engaged in research from the standpoint of control engineering and robotics with the goal of implementing an autonomous robot that can think, move, and work on its own. My lab has developed numerous small aerial and terrestrial robots as well as motion control systems, external environment sensing systems, and robot cooperative behavior control systems.

Tenure-track Assistant Professor
Satoshi Suzuki

After completing the second-semester doctoral course at Chiba University, Satoshi Suzuki worked as a researcher at the university before taking his current position in 2009. He is currently working on autonomous robots such as an autonomous, unmanned helicopter. His principal areas of research include control engineering, robotics, and control applications.

Outlook for research

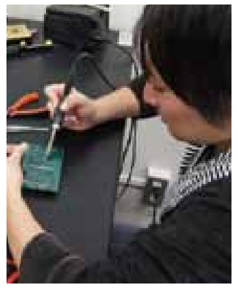
My goal is to create robots that can replace human work in dangerous areas and extreme environments such as disaster response and rescue activities and to develop robot systems that can work under all terrain and environmental conditions through the collaboration of multiple types of robots.

Outlook for students after graduation

Graduates are able to go to work immediately in many fields since they not only study mechanical engineering, but also master many other skills, including electricity and electronic circuits, control engineering, and programming.

This autonomous, small-scale unmanned helicopter, one of our aerial robots, can fly without human operation using autonomous control technology.

My first goal is to achieve collaboration between aerial and terrestrial robots.



The devices used to control the robots are developed entirely from scratch.

Department of Machinery and Robotics

Functional Machinery and Mechanics

Scientific Research on Fire and its Application to Firefighter Safety

Our lab conducts scientific research on (1) understanding fire dynamics and firefighters' working environment, (2) heat transfer process in firefighters' personal protection equipment (PPE), (3) development and revision on standard fire tests and thermal performance requirement of material and PPE and (4) development of new firefighter PPE. Finally, research on fire protection for materials and people is one of our objectives, but our essential goal is to educate firefighters (emergency responders) about better understanding of fundamental of fire risk and physics within PPE for their safe operation.

Associate Professor
Kaoru Wakatsuki

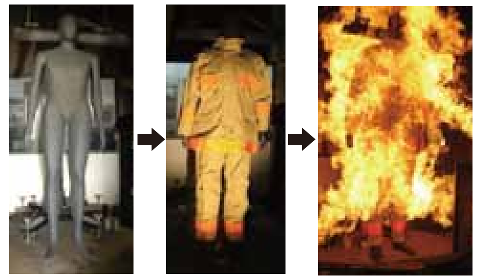
After completion of Ph.D. at Univ. of Maryland in the U.S., he had worked for Nat' l Res. Inst. of Fire and Disaster as a research scientist and a federal fire investigator before joining Shinshu Univ. in 2015. His expertise is thermal and fire protection engineering and its application of personal protection.

Outlook for research

Principle of natural phenomena shall be understood by using various sciences and engineering. Throughout the research in our lab, understanding of scale gap between ideal and fact will be recognized. This will be good experience and basic knowledge to contribute to research and development for new technology.

Outlook for students after graduation

Due to energy conservation and fuel efficiency, many kinds of polymer materials and its application have been developed. Safety shall be the first priority even if main objective is new material development. Our graduates will always have safety consciousness in any new technology development.



Evaluation of firefighter clothing by flash fire manikin. Fundamental research on test method against heat and flame will be contributed to international standard (ISO) development.

Development of testing method against heat and flame for firefighting gloves. Design of fabric layering in firefighting gloves will be developed by fabric and by whole glove test.

Department of Machinery and Robotics

Functional Machinery and Mechanics

An extraordinary new material: Carbon nanotubes Creating and analyzing high-functionality nano-composite materials

I am working to explain the mechanical properties of carbon nanotubes (CNT), for example elasticity, vibration, and buckling, and to use CNT to develop high-functionality composite materials. My lab leverages the unique properties of CNT, which cannot be achieved with other materials, to create lightweight and highly functional CNT-strengthened composite materials and to utilize them in numerous ways.

Associate Professor
Toshiaki Natsuki

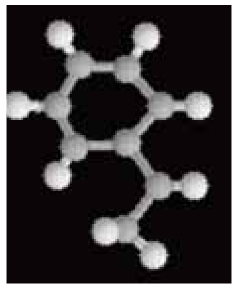
Associate Professor Natsuki took his current position in 2006 after working as a researcher at Hitachi Chemical's Tsukuba Research and Development Center, the National Institute of Advanced Industrial Science and Technology, and the New Energy and Industrial Technology Development Organization. His principal areas of research include the creation of composite materials, composite material engineering, and computational science for the analysis and evaluation of their properties.

Outlook for research

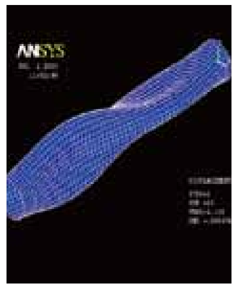
Nano-composite materials made using CNT can be made suitable for use in aerospace and sports equipment applications by increasing their mechanical properties of attenuation and vibration control. Further research and development can be expected to lead to expanded use of CNT properties for numerous purposes.

Outlook for students after graduation

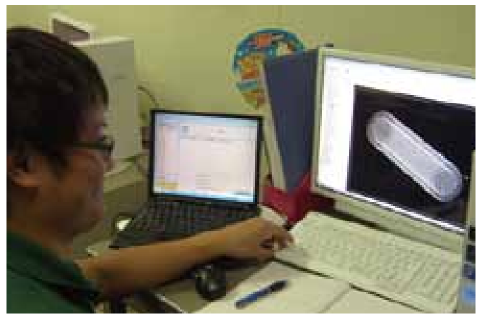
Graduates are active in a wide array of domains, including at software companies and government agencies in addition to textile, appliance and electrical equipment, and automotive part manufacturers.



A model of molecular structure is used to analyze the mechanical properties of carbon nanotubes.



The vibrational properties of carbon nanotubes are analyzed using the finite element method.



Since experimental measurement is difficult, computers are used for logical analysis and evaluation of the mechanical properties of carbon nanotubes.

Department of Machinery and Robotics

Bioengineering

Exploring the biomimetics of aquatic life and medical engineering using biofluid mechanics

I am studying the swimming behavior of various forms of aquatic life in order to create a new robot based on the adroit swimming ability of living creatures. I am also studying blood flow in order to examine mechanical vulnerability to atherosclerotic plaque through model experiments using artificial diseased arteries and numerical computations.

Professor
Shunichi Kobayashi

Professor Kobayashi took his current position in 2009 after serving in the Faculty of Textile Science and Technology at Shinshu University as a senior assistant professor and associate professor. He began his research on blood flow in 1996 and 1997 while working as a visiting scholar at the Georgia Institute of Technology. He currently continues to carry out international joint research.

Outlook for research

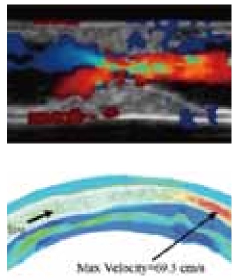
I believe that it is possible to implement a robot capable of working in mud or in ocean settings where there is a great deal of seaweed or detritus. In the area of blood flow research, my goal is to create a diagnostic system that can instantly assess the risk of atherosclerotic plaque based on patient-specific medical imaging, for example by means of MRI.

Outlook for students after graduation

Graduates have gone on to work in such fields as medical devices, precision machinery, automobiles, electronics, and information and communications. Some have even pursued careers as public officials or researchers in educational research organizations.

The stiffness of this fin, whose design is based on the flexible movement of the tails of fish, is altered in real time in an attempt to increase propulsive performance.

This robot, which can swim in all directions, was developed by studying the swimming motion of the ragworm.



A model experiment and numerical computation of atherosclerosis

Department of Machinery and Robotics

Bioengineering

Striving to achieve flexibility and subtlety while working to recreate the movement of the human hand, which is challenging for robots

I am attempting to recreate the flexible movement of the human hand using machines. My lab is pursuing research to develop a robot that can approach the adroit and subtle behavior of the human hand by coordinating countless artificial muscles that contract using air pressure. Through this research, we believe it will be possible to develop artificial arms that more closely imitate the capabilities of the human hand and use them as robots in nursing applications.

Professor
Atsushi Nishikawa

Professor Nishikawa took his current position in 2010 after working as an assistant professor at the Osaka University School of Engineering Science and as an associate professor at the Osaka University Graduate School of Engineering Science. His interests include the unified areas of biology, medicine, mechanical engineering, and robotics, for example as applied to the development of musculoskeletal robots.

Outlook for research

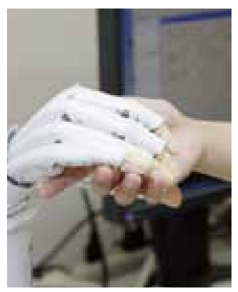
This research will enable future applications previously thought difficult, for example the use of robots to operate endoscopes in support of medical operations or treatment of patients in their homes by doctors in remote locations. My theme is the question of how closely mechanical devices can approximate human movement.

Outlook for students after graduation

Graduates have numerous paths available to them, including employment by manufacturers involved in product design and production or IT-related companies involved in programming.

Computer analysis of sensor data allows finger motion to be recreated accurately on a computer.

Artificial muscles that move in the same way as human beings are one basic technology for robotic hands.



This approach makes it possible to implement difficult movements such as gripping something gently.

Department of Machinery and Robotics

Bioengineering

Transitioning from robots that learn from life to robots that combine with life

I am working to implement technology for making products that are easy on humans by combining robots with life at numerous levels. Specifically, I am pursuing projects involving the development of a wearable robotic suit that learns from the systems responsible for rhythmic movement in living organisms, a communications robot that provides comfort by reading people's emotions, and artificial muscles using polymer gels and cell cultivation technology.

Professor
Minoru Hashimoto

Professor Hashimoto took his current position in 1999 after working as an assistant professor at the University of Electro-Communications and as an associate professor at Kagoshima University. His principal area of research is biorobotics. A cohort of unique students keeps every day is fun and exciting.

Outlook for research

I believe that it will be possible to realize a society in which everyone, from children to the elderly, can live happily by using robotic technology, which will assist the elderly as their bodily functions decline and they experience an emotional sense of loneliness.

Outlook for students after graduation

I help train researchers and engineers so that they will be able to pursue active careers in a wide range of fields, from medicine and welfare to automobiles, machinery, and electricity.

This wearable robotic suit learns from the rhythmic movement of living things.

This communications robot provides comfort by reading people's emotions.

My lab is working to create artificial muscles using polymer gels and cell cultivation technology.

Department of Machinery and Robotics

Bioengineering

Human information networks and noninvasive biosensing

Our laboratory has been exploring a new research field: biological measurement by analyzing salivary samples with "human", "noninvasive", and "biosensor" as research key words. Noninvasive biological measurement, using a variety of information obtained painlessly from the human body, is a technology to maintain human health and is used for medical diagnosis and treatment. Furthermore, our lab is also researching other technologies that can physically control wettability of material surfaces as a biomimetic technology.

Professor
Masaki Yamaguchi

Professor Yamaguchi took his current position in 2015 after working as an assistant professor at Tokyo University of Agriculture and technology, an associate professor at Toyama University, and a professor at Iwate University.

Outlook for research

By applying engineering solutions to the medical field, I have been investigating a measurement system to obtain biological information that is useful for diagnosis and to assist daily lives. Focusing on a salivary protein, which can be an effective index of sympathetic nerves activity, a quick, easy-to-use analytical method as a portable device was proposed.

Outlook for students after graduation

Graduates work at manufactures such as pharmaceuticals, biotechnology, automobile and other industries. The human science and assistive technology might contribute to an aging society.

Portable biosensor of human stress levels by using salivary biomarker.

Lotus leaf and superhydrophobicity expressed by nano-periodic structure on a solid surface.

Department of Machinery and Robotics

Bioengineering

Creating new bio-hybrid technologies for applications ranging from micro-robots to regenerative medicine

By incorporating living organisms into man-made systems such as machine parts, I am working to develop new technologies that differ from existing machine systems. For example, I am currently attempting to create bio-hybrid robots with self-assembly and self-repair functions that do not require electricity or fossil fuels by incorporating muscles into systems instead of motors. At the same time, I am also developing technologies for operating cells via magnetic fields and systems for fabricating biological tissue that can be transplanted from cells.

Associate Professor
Yoshitake Akiyama

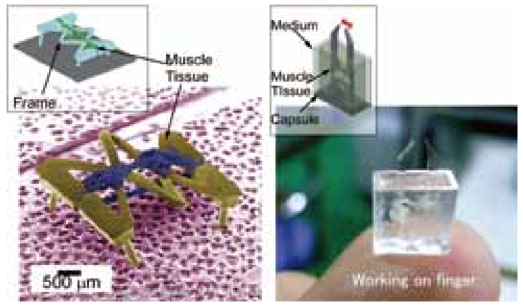
After completing a graduate program at Tokyo University of Agriculture and Technology, Associate Professor Akiyama worked at JEOL Ltd., at Tokyo University of Agriculture and Technology as a specially appointed assistant professor, and at Osaka University as a senior assistant professor before coming to his current position in 2014. His fields of specialization include biotechnology, micromachining, regenerative medicine, and the integration of the same.

Outlook for research

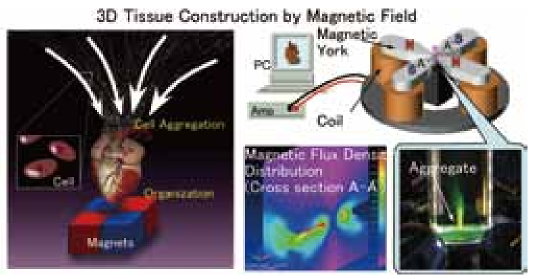
Modern society is dependent on fossil fuels, but experts only expect those resources to last for about 150 more years. If muscles could be used to power robots, our energy problems could be resolved. Additionally, the ability to grow three-dimensional tissue that can be transplanted from iPS cells, which are able to differentiate into all cell types, would contribute greatly to the development of regenerative medicine.

Outlook for students after graduation

I have not mentored any graduates yet in my current position, but graduates whom I mentored in my previous position have been employed by medical equipment and precision equipment manufacturers.



A micro-robot walks autonomously (left) while a micro pin set moves through its environment (right), both using muscle tissue.



An illustration (left) and overview (right) of how tissue could be fabricated from cells via magnetic fields

Department of Machinery and Robotics

Bioengineering

Utilizing dynamic loading in applications ranging from elephant developmental health assessment to biometric identification

My lab is developing techniques for statistically analyzing complex patterns of dynamic loading, especially with regard to gait and posture applications. Through a variety of research collaborations we are applying these techniques to real-world problems. Current research collaborations include: in-shoe and wearable sensor development (Nike Inc., USA), elephant and other large-animal developmental assessments (Royal Veterinary College, London), and biometric identification via dynamic foot loading patterns (University of Münster, Germany).

Associate Professor
Todd Pataky

After earning his Ph.D. in kinesiology and mechanical engineering from Pennsylvania State University, Associate Professor Pataky pursued postdoctoral opportunities at ATR International (Kyoto, Japan) and the University of Liverpool before coming to Shinshu University in 2009. His fields of specialization include biomechanics and statistics.

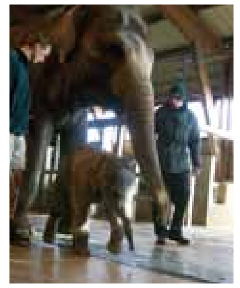
Outlook for research

Since we interact constantly with the physical world, a deeper understanding of dynamic human body loading will lead to improvements in designs of shoes, clothing, wheelchairs, and prosthetics. Through dynamic loading research I hope to create more comfortable, reduced-risk environments for all.

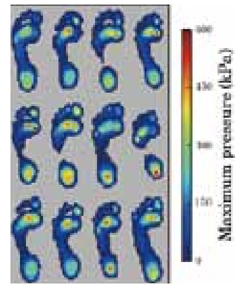
Outlook for students after graduation

Graduates can pursue opportunities in a wide range of applications, including sports and rehabilitation science, biofeedback, and shoe development and design.

We use a pressure board—a pressure measurement sensor array with a resolution of 5 mm and 200 Hz—to investigate mechanical characteristics of walking behavior of humans and animals.



Foot problems cause over 50% of all deaths among elephants living in zoos.



The pattern of pressure on people's feet is unique and can be used for individual identification.

Department of Machinery and Robotics

Bioengineering

Proposing reliable medical techniques through computational biomechanical simulations

Surgical operations are sometimes required to fix severe bone fractures or muscle injuries. Here, if we can estimate mechanical conditions of our body parts and/or surgical instruments prior to the operation, the information will be greatly helpful to avoid surgical errors or further surgeries. Our laboratory examines patient-specific biomechanical simulation methods. That is, we fabricate a computational model with the exact shape of the patient based on clinical X-ray CT images, and perform analyses to estimate mechanical states of bones or artificial instruments in our body. Collaboration with medical doctors leads us to propose novel medical techniques.

Associate Professor
Michihiko Koseki

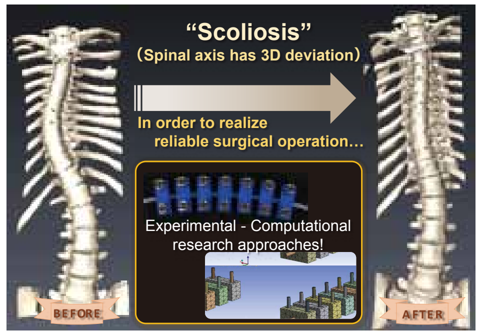
Associate Professor Koseki took his current position in 2009 after working as an engineer at Fujitsu Limited and an assistant professor at Tokyo Institute of Technology. His research interests include computational biomechanics, medical imaging techniques and bio-inspired robotics.

Outlook for research

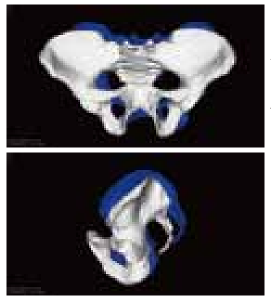
Our research solutions will powerfully support medical doctors on both diagnoses and treatments for illnesses or injuries in orthopedic fields. Patients can also obtain great benefits including personalized and information-rich informed consent for their own treatments. We aim to realize a world which is sensitive to the needs and desires of doctors, patients, and everyone.

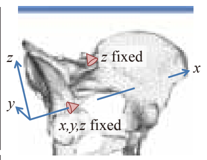
Outlook for students after graduation

We regard living organs of "humans" from the perspectives of "mechanical engineering" and "information engineering." A diverse range of knowledge makes our students enjoy a variety of career paths after graduation.



Examination of surgical operation methods in scoliosis in collaboration with Shinshu University's Medical School.





Although there are many physical training methods for weight reduction, some of them don't reveal their effects from the viewpoint of mechanical engineers. Our simulation method demonstrates mechanical conditions in our body and the results may lead to more efficient training methods for our beautiful life!

Department of Machinery and Robotics

Bioengineering

Assistive Technology for Activities of Daily Living in our new lifestyle

In our country with a super-ageing society, the locomotive syndrome is a social issue that decreases the independence of the patients with paralyzed lower limbs and increasing the need of nursing-care. In order to resolve these problems, we have been working in research and development on an assistive technology for activity of daily living (ADL). In particular, we aim to create human assistive robots/devices for the patients which are intuitively easy to use.

Assistant Professor
Atsushi Tsukahara

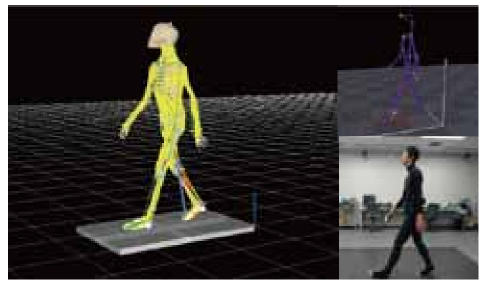
After receiving the PhD degrees in engineering from University of Tsukuba, he was a PhD researcher at the university, and an Associate Program Manager of ImPACT program at JST. He is currently an Assistant Professor at Shinshu University.

Outlook for research

The goal of our assistive technology is to decrease the risk of injuries to nursing-care of elderly people and patients, and to improve their ADL and QOL. Consequently, the findings of our study are expected to lead to the practical improvements in fields of daily life.

Outlook for students after graduation

In order to develop innovative technology, we have to collaborate closely across multiple specialized fields. Therefore, the goal of education in this lab is to cultivate the pioneering human resources that can empower students to know what to do and how to behave for the benefit of all human beings in our society.



Gait analysis calculates the joint angles, muscular tension, and joint torque based on the data measured by motion capture system.

System configuration of Robotic Wear curara®

Walking and standing-up motion assist using curara®

Department of Machinery and Robotics

Bioengineering

Equating biology with engineering through animal experimentation

I am attempting to rewrite the supposedly intuitive blueprint that claims instincts are adaptive while excess is maladaptive by observing and experimentally examining the instinctive behavior of animals. My goal in doing so is to create a blueprint that equates biology with engineering and to offer behind-the-scenes support for bioengineering.

Assistant Professor
Toru Moriyama

Key words: Pill bug, giant isopod, Mictyris brevidactylus, the heart of animals, the heart of things, autonomy, emergence, self, comparative cognitive science, animal psychology, ethology

Outlook for research

I am investigating the psychology of the giant isopod, which lives at depths of several hundred meters in the ocean, as well as the social shaping of Mictyris brevidactylus, a crab that lives on the island of Iriomote-jima, with robots. These efforts encompass not only ethology, but also cognitive science and robotics.

Outlook for students after graduation

One graduate went on to take over the local family furniture shop after starting his own lab. Another became the principle author of a publication in an international academic journal before going on to become an actor and forming an event production company. A third traveled the length and breadth of Japan on a cheap bicycle before launching a project in which he interviews people about their graduate research. A fourth traveled alone to the typhoon-swept island of Iriomote-jima after producing a wedding event, while a fifth joined a leading educational company.

Research on the pill bug
Publications: Moriyama, Tooru. "Does the Pill Bug Have a Heart?" PHP Interface, 2011.

Research on the giant isopod
Research paper: Matsui T, Moriyama T, Kato R, Zoological Science, accepted.

Department of Chemistry and Materials

Fiber Materials Engineering

Design of photocatalytic reaction system with nm – μm scale architecture

Our research targets are design and fabrication of photocatalytic reaction system with nm – μm scale architecture for degradation of pollutant and photochemical organic synthesis using uv-light bulb and sunlight. Photocatalytic reaction starts by absorption of a photon to produce a pair of hole and electron, which can serve as oxidation and reduction with organic compounds, respectively. We have designed a microporous glass reactor which serves as an efficient waveguide network, wide inner surface to deposit photocatalyst and a micro-channel network for efficient mass transport of substrate and products.

Professor
Hisanao Usami

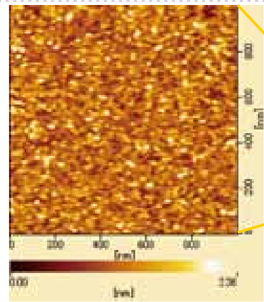
joined Shinshu University as a research associate in 1992 and was promoted to full professor in 2012. His research topics are photocatalyst and photochemical reaction systems.

Outlook for research

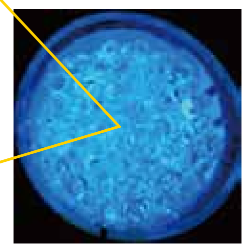
Designing microporous glass reactors based on the science of photocatalysts derives intrinsic properties of each photocatalysts. The photocatalytic systems will be applied to photochemical synthesis of chemical resorces from CO_2 using sunlight, which are expected to become important technologies for a sustainable society.

Outlook for students after graduation

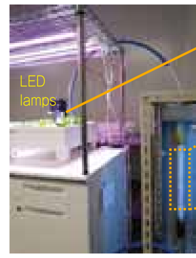
Graduate research in our laboratory supports our students to learn and utilize their knowledge of chemistry to solve scientific and technological challenges. Alumni are working in the fields of chemistry, electronics and machinery.



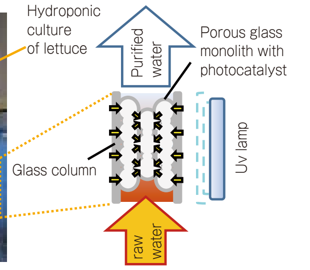
TiO_2 nano-tile with 3 nm thickness and 50 nm width, which can be controlled by adjusting pH, temperature and pressure.



Cross sectional view of a porous glass reactor. Channel size can be controlled by selecting the size of component glass beads.



Application of porous glass reactor to purification of solution for hydroponic culture



Photochemical reactor with porous glass monolith through which excitation light is delivered to each reaction site

Department of Chemistry and Materials

Fiber Materials Engineering

Discovering new functional materials through nanotech and realizing new functionality by imitating the structure of living things

I am pursuing research into high-efficiency conversion of the energy and chemicals found within living things by artificially imitating the detailed structures found in them. Specifically, my research includes the breaking down of hazardous substances found in the environment, chemical sensors that can detect trace amounts of substances, and solar panels made without silicon.

Professor
Mutsumi Kimura

Professor Kimura graduated from Tsukuba University in 1990 and from that university's master's program in environmental science in 1992. He completed the Shinshu University Graduate School of Engineering's doctoral research program in 1995. His area of specialization is functional material chemistry.

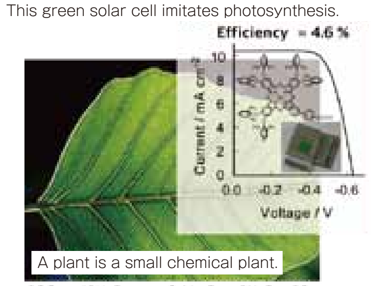
Outlook for research

I carry out research into environmental purification catalysts on the nano-scale, highly sensitive sensors that can detect trace amounts of chemical substances, and functional materials that allow the production of colorful solar panels. These materials are the keys to developing a society capable of sustainable growth.

Outlook for students after graduation

Graduates go on to work primarily at chemical and material manufacturers, but some also work at electrical and machinery manufacturers.

This green solar cell imitates photosynthesis.



$6CO_2 + 12H_2O \longrightarrow C_6H_{12}O_6 + 6H_2O + 6O_2$

By using materials at the nano-scale, it becomes possible to detect extremely low concentrations of gas (as part of the effort to develop artificial olfactory sensors).

Department of Chemistry and Materials

Fiber Materials Engineering

Small is BIG: Developing state-of-the-art nano-materials for use in fuel cells and supercapacitors

Clean and efficient electrochemical energy conversion and storage: The fight against environmental and energy issues. Our research is focused on using nano-materials (NANOSHEETS in particular) for supercapacitors and fuel cells, which are important devices for realizing a sustainable society. The electrode materials we synthesize have a tremendously large surface area and high activity, thus providing a technological basis for clean and efficient energy utilization.
An energy device that can fully charge in 3 minutes and implanted in your body? Yes, this may be possible with your ideas! Join our team in realizing such a dream.

Professor
Wataru Sugimoto

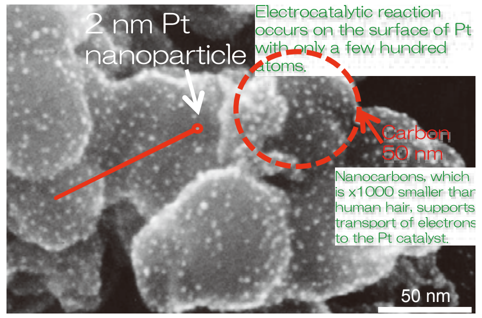
Dr. Eng. (1999, Waseda Univ.); Assistant Professor (1999 Shinshu Univ.);Associate Professor (2007, Shinshu Univ.); Professor(2013, Shinshu Univ.)

Outlook for research

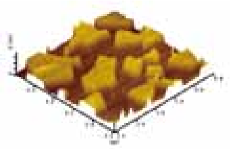
Our core technology is based on innovative nano-materials and advanced methods of synthesis. Our specialty is NANOSHEETS, which are materials that have a thickness of only 1 nm. Conducting state-of-the-art research in fundamental science and practical applications allows students to acquire not only skills in materials and chemical engineering, but also additional expertise so that they will be able to serve as researchers with a global mind.

Outlook for students after graduation

Graduates have pursued careers in a vast variety of fields, including automotive, materials and chemical industries.



A fuel-cell catalyst with Pt nanoparticles supported on carbon. Fuel cells are the key energy devices for the H_2 economy since they generate clean energy.


A nanosheet is the ultimate nanocrystal, just a few nanometers in thickness. Conducting nanosheets are used to create ultrafast charge storage.



Top: Electrochemistry equipment
Bottom: English seminar held every morning at 8:30

Department of Chemistry and Materials

Fiber Materials Engineering

Fiber as the key to preventing global warming: Working not only to reduce CO_2, but also to lower costs

I am researching a new technology for separating and collecting CO_2 from exhaust fumes. Specifically, by applying an absorbing liquid that reacts with CO_2 to the inside of a cylindrical hollow fiber membrane, I hope to absorb only the CO_2 from the exhaust gas on the outside. If this technology can be developed, I expect it to lower the cost of separation and collection.

Professor
Nobuhide Takahashi

After obtaining his doctorate at Tokyo University, Professor Takahashi worked as an assistant professor and associate professor in the Faculty of Textile Science and Technology at Shinshu University before taking his current position in 2014. His areas of specialization are chemical engineering and environmental engineering, and he bases his research on the concept that CO_2 + water + soil + sunlight + knowledge + technology = happiness.

Outlook for research

In addition to CO_2 separation and collection technology, my research has ramifications for tree-planting in dry areas as well as efficient conversion of wood biomass to solid fuel—all areas that suggest it has immediate application to solving environmental and energy problems and contributing to the prevention of global warming.

Outlook for students after graduation

Graduates pursue diverse paths in addition to employment at chemical plant manufacturers and water treatment technology companies.


A student analyzes the process of absorbing CO_2 using a hollow fiber membrane to compare its effectiveness. Students designed the absorption and diffusion device themselves and carry out their own experiments.


Students are examining the effects of membrane pore size and surface shape on CO_2 absorption.


Research and development on a new absorbent material based on biomass

Department of Chemistry and Materials

Fiber Materials Engineering

Breaking new ground in materials, processes, and systems with the ultimate goal of energy self-sufficiency

The optical materials and inorganic nanofiber materials that my lab has developed are unique in the world, and they are actually being used. My current focus is energy self-sufficiency. If biomass could be dried without applying too much energy, it would be possible to utilize marine resources as well, and if electricity could be generated efficiently from heat, we would be able to convert the long wavelength range of sunlight into electricity.

Professor
Yasushi Murakami

Professor Murakami joined the Faculty of Textile Science and Technology at Shinshu University in 1993 and took his current position in 2007. He spent five years working as the lead researcher for the knowledge cluster creation project starting in 2007, during which time he spearheaded advanced collaboration between industry and academia. His area of research is material chemistry.

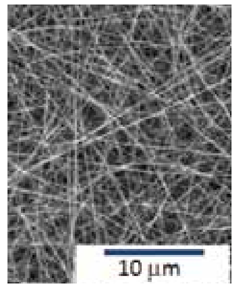
Outlook for research

A project develops into major research when a new and unprecedented vision is proposed. My hope for my students is that they will grow into researchers who can propose such visions.

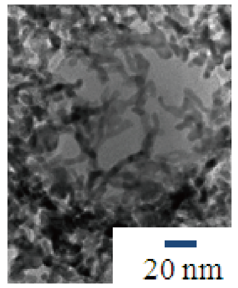
Outlook for students after graduation

In the development of new materials, failure is more common than success. My goal is to foster the development of tough and resilient researchers.


We select only research that is truly necessary to solve society's problems and strive to break new ground with our work.



Titanium oxide nanofiber used as a photo catalyst



A highly active and long-life platinum/silica fuel cell catalyst

Department of Chemistry and Materials

Fiber Materials Engineering

Production of Functional Materials from Biomass by Using Only Water

We are studying biomass conversion in high-temperature water (HTW) and supercritical water (SCW). HTW refers to water in its liquid state below its critical temperature and pressure (374ºC, 22.1 MPa). It becomes a highly compressible fluid called SCW above this point. We are also using a water jet machine for wet pulverization treatment of biomass, as water is the most environmentally benign solvent. The target biomass are wood (lignin), fish scale (protein), squid pen (chitin). For example, we are trying to produce a chitin nanofiber from a squid pen by using a water jet machine.

Associate Professor
Mitsumasa Osada

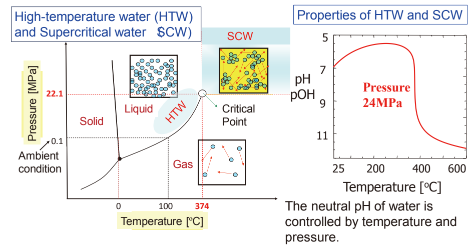
Ph. D. Tohoku Univ. Japan. 2005. Assoc. Prof. Ichinoseki National Coll. of Tech. 2006-2014. Visiting Scholar, Univ. of Michigan, USA. 2007-2008. Assoc. Prof. Shinshu Univ. 2014-.

Outlook for research

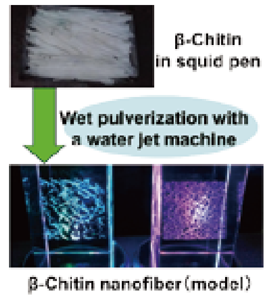
An advantage of biomass conversion in HTW and SCW is that hot water can serve as a solvent, a reactant, and a catalyst. While many biomass (e.g., protein and chitin) are not water-soluble at ambient conditions, most are readily solubilized in HTW or SCW. In addition, H+ and OH- concentrations of HTW are higher than those of ambient water. The acid or base catalyzed reactions also proceed without adding catalysts.

Outlook for students after graduation

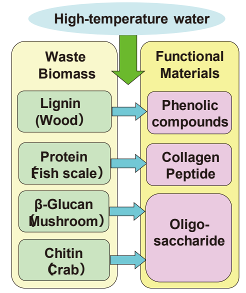
Graduates work at chemical, food, and pharmaceutical companies as an engineer and a researcher. I hope that the graduates will make a big impact in the field of new environmental benign chemical engineering.



Investigation of HTW and SCW as a new chemical reaction environment



Nanofiber production from agricultural resources



Functional Materials from waste biomass

Department of Chemistry and Materials

Fiber Materials Engineering

Interdisciplinary Chemical Physics exploring the microscopic mechanisms of life phenomena

We are working on a wide range of soft condensed matters involving pure liquids, solutions, colloids, polymers, gels, and bio-macromolecules. Our special interests are in water and biomolecules because almost all life phenomena occur in an aqueous environment. With the help of spectroscopic and scattering techniques, we are seeking to understand the microscopic mechanisms supporting life phenomena. We also aim to contribute to the developments of pharmaceuticals, cosmetics, and detergents.

Associate Professor
Takaaki Sato

Associate Professor Sato graduated from Waseda University. He worked at Waseda University as a JSPS young research fellow (DC2 and PD) and as a senior assistant professor and then at Shinshu University as a tenure-track assistant professor before taking his current position in 2012.

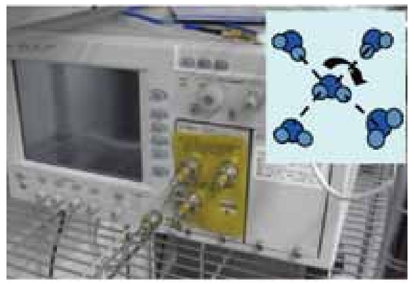
Outlook for research

A recent social situation may emphasize the importance of practical research that can be instantly applied in society. Even so, we pursue fundamental research on soft condensed matters to gain deeper insights into structure and dynamics of diverse aqueous systems.

Outlook for students after graduation

Our research topics and techniques produce students useful to a wide range of industries, such as cosmetic, detergent, and food. More importantly, our target is to develop human resources having a high level of problem-solving abilities, penetrating insights, and international communication skills.

High-resolution small-angle X-ray scattering reveals the microscopic behavior of proteins to help us understand their biological functions.



Dielectric spectroscopy clarifies the cooperative rearrangement dynamics of H-bond liquids. My lab is focusing on microscopic frictional forces acting on the reorientational motion of water molecules.

Department of Chemistry and Materials

Fiber Materials Engineering

Making fuel cells a more familiar energy system

I am developing two types of fuel cells that do not use platinum, which is expensive, as a catalyst. One is a solid oxide fuel cell (SOFC) that operates at high temperatures. The other is polymer electrolyte fuel cell (PEFC) that uses a non-platinum catalyst, specifically silk-derived activated carbon. Reaction activity and transport phenomena for gas, ions, and electrons in the electrodes are important in both cases, and I am working to develop new materials and to optimize the electrode structure.

Associate Professor
Hiroshi Fukunaga

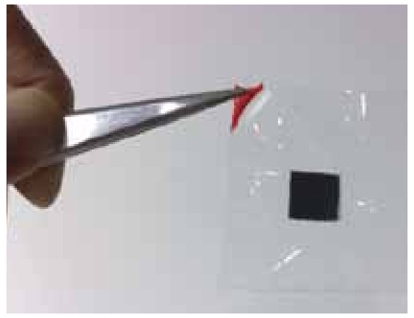
Associate Professor Fukunaga took his current position in 2009 after serving in the Faculty of Textile Science and Technology at Shinshu University as an assistant professor. His principal areas of research include chemical engineering and electrochemistry as regards solid oxide and polymer electrolyte fuel cells.

Outlook for research

Fuel cells are a dream technology that can extract energy efficiently. A growing array of applications use fuel cells in large-scale power plants, in residential and automotive power systems, and as a power source for portable devices and artificial organs.

Outlook for students after graduation

Chemical engineering can be put to use in a wide range of domains, including chemicals, electricity and electronics, automobiles, and energy.



An electrode for a solid polymer fuel cell that my lab created

A power-generating device that uses a solid oxide fuel cell

Department of Chemistry and Materials

Fiber Materials Engineering

Mixing familiar materials to make coatings for high-efficiency solar cells

Many universities and companies throughout the world are pursuing research and development programs with the goal of increasing the efficiency of solar cells that can be created by coating surfaces with a mixture of titanium oxide (used in sunblock creams), iodine (used as a disinfectant), and pigments (such as from blueberries). I am working to develop highly efficient solar cells and explain the mechanism of electron transfer.

Associate Professor
Shogo Mori

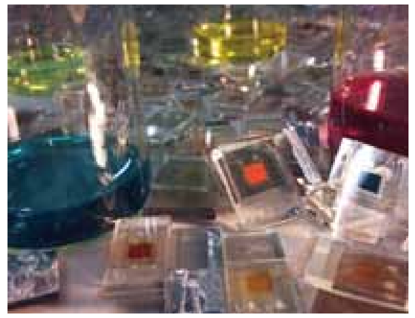
Associate Professor Mori took his current position in 2009 after working at Nokia Japan and as an assistant professor in the Faculty of Textile Science and Technology at Shinshu University. His areas of research include dye-sensitized and organic film solar cells and semiconductor and surface electron transfer.

Outlook for research

Dye-sensitized solar cells and organic-film solar cells are expected to serve as low-cost, next-generation solar cells. Further, by explaining the mechanism of electron transfer, I believe it will be possible to design high-performance devices using low-cost materials.

Outlook for students after graduation

Graduates are employed by material, device, and electrical manufacturers.



A selection of pigment solutions and dye-sensitized solar cells made from them These solutions make it possible to design effective solar cells.

It is possible to make solar cells without complex equipment.

Department of Chemistry and Materials

Fiber Materials Engineering

Aiming to realize a sustainable society through the effective utilization of biomass resources

I am working to explain detailed response mechanisms and propose new high-activity catalysts from both an experimental and model calculation approach with the goal of producing biomass fuels, which can be expected to serve as a carbon-neutral energy source, and using those fuels for highly efficient energy conversion.

Tenure-track Assistant Professor
Iori Shimada

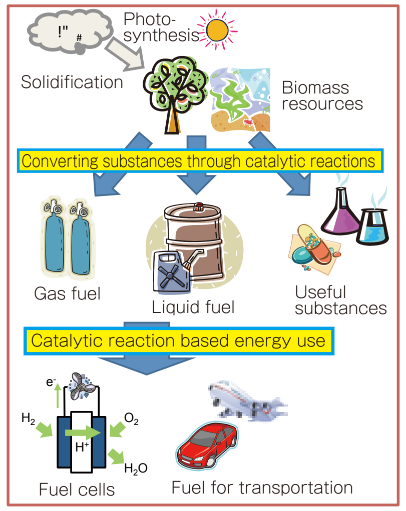
Iori Shimada graduated from the University of Tokyo Graduate School of Frontier Sciences and obtained his doctorate in environmental studies. He took his current position in April 2013 after working as a special researcher (DC2) at the Japan Society for the Promotion of Science. His specialty is reaction engineering.

Outlook for research

My goal is to help develop a society powered by clean and sustainable energy that does not rely on exhaustible resources such as fossil fuels. Further, I hope to develop methods for synthesizing useful substances using biomass to replace the many chemical products that are currently synthesized from oil resources.

Outlook for students after graduation

It is my hope that graduates will gain the ability to think from a variety of angles and pursue productive careers in a diverse array of fields.



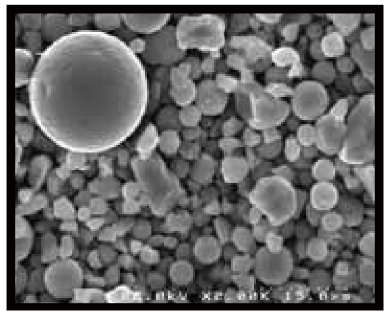
Uses of energy from biomass resources. Numerous types of catalytic reactions are used. Optimizing those reactions is the key to practical application.

Department of Chemistry and Materials

Fiber Materials Engineering

Microwave chemistry

I am interested in creating and elucidating the physical properties of new materials using microwave irradiation. Microwave irradiation exploits "electric waves" in many everyday communications applications including terrestrial radio and TV, satellite broadcasting, cell-phones and Wi-Fi wireless LAN. These electric waves have also proven useful for a variety of other purposes, including most commonly cooking with household microwave ovens. My research goes one step further: by recognizing that electric waves, when used in cooking, ultimately change food's chemical properties, I am able to harness that power over a wide realm of chemistry applications.



An image of natural allophane made using a scanning electron microscope. This material is found in great quantities in soil formed from volcanic ash and can break down endocrine disruptors at room temperature, under normal pressure conditions, and in the absence of light.

Assistant Professor
Tokihiro Takizawa

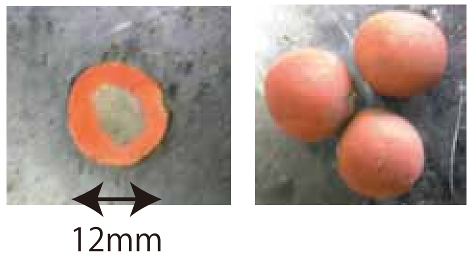
Assistant Professor Takizawa graduated from the Functional Polymer Science Course in the Faculty of Textile Science and Technology at Shinshu University. He took his current position after working in the Faculty as a research associate and assistant professor. His area of interest is general material properties.

Outlook for research

I carry out research based on the principle of thinking for oneself. By leveraging the research lab as a place for training, I empower graduates to respond appropriately to the demands that will be made of them in the real world.

Outlook for students after graduation

Graduates develop into personnel who can proactively and specifically propose processes (methods of making things) and systems (ways of using things).



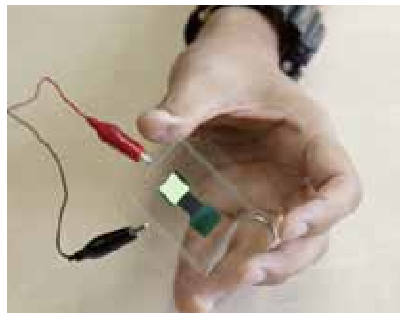
A cutaway view of an allophane ball consisting of an allophane core surrounded by clay (left) and after sintering using microwaves (right).

Department of Chemistry and Materials

Functional Polymer Science

Tapping organic EL to bring us future products such as televisions that can be rolled up and carried and ceilings with built-in lighting

I am carrying out research into organic EL (organic LED), an area that is the focus of increasing expectations concerning potential applications in next-generation displays and lighting. Multinational corporations from outside Japan are also showing interest, and my lab is cooperating with them. If successful, it will become possible to make entire ceilings and walls into lighting and to make televisions and computer monitors that can be rolled up and carried around. Currently, our major challenge is to reduce power consumption.



An organic EL. Unlike LEDs, the principal characteristic of an organic EL, a conductive polymer, is that it emits light from a form like a thin membrane.

Professor
Musubu Ichikawa

Professor Ichikawa took his current position in 2013 after working at the Ube Industries Polymer Research Center and as an assistant professor and associate professor in the Faculty of Textile Science and Technology at Shinshu University. His areas of research are functional materials and devices and physical chemistry, including organic semiconductor devices and organic photoelectric materials.

Outlook for research

In addition to research into organic EL, research is also being actively conducted into organic semiconductors and organic solar cells, and these products are expected to contribute to the realization of an abundant and sustainable society.

Outlook for students after graduation

Graduates are employed by material, chemical, and electrical equipment manufacturers, while some students are employed by major printing companies that are involved in organic EL development.

An organic semiconductor material developed in the research lab is melted and applied to a circuit board to create a transistor. We are carrying out research to create example uses that leverage its properties.

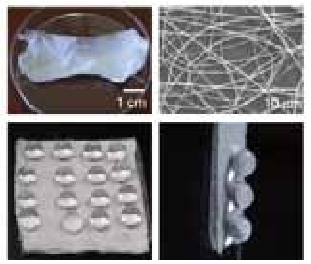
Department of Chemistry and Materials

Fiber Materials Engineering

Creation of safe/secure materials from natural compounds for bio/environmental applications

Safety and security are very important properties for medical and environmental materials. However, most materials used in biomedical situations are synthesized from oils, so developing truly safe and secure materials from bio-derived components is imperative.

We are creating novel functional materials for use in biomedical and environmental applications by chemically-modifying natural compounds with good safety and security properties and then engineering and processing them appropriately.



Superhydrophobic nonwovens prepared from only amino acids
The challenge is to reproduce the superhydrophobicity of lotus leaves without fluorine, using just biocomponents.

Assistant Professor
Hiroaki Yoshida

After completion of PhD work at Osaka University (2011), Prof. Yoshida worked as a researcher at the Georgia Institute of Technology and Osaka University before taking his current position (2014). Professional interests: Polymer Chemistry and Materials, Biomaterials.

Outlook for research

Developing novel functional materials, such as biomaterials for serious diseases and adsorption/separation materials for environmental pollution is essential to solve general problems in society today. As well, finding new materials is definitely linked to finding a new usage, and to design and develop materials to meet future challenges.

Outlook for students after graduation

I believe students can choose a variety of career paths after graduation because of their wide knowledge and experience in various fields such as chemistry, biology and material science & engineering.

Materials dissolve when cooled
Generally, materials dissolve by heating and/or adding solvents. HOWEVER, these material dissolve by cooling. Fibers and particles can be easily prepared.

3D engineered tissue composed of cells and proteins
By arranging cells (20-50 mm in diameter), various 3D tissues can be constructed. A new way to "Tissue Engineering".

Department of Chemistry and Materials

Functional Polymer Science

Developing environmentally friendly organic materials that can be easily broken down and recycled after use

Cleavable materials, which can be converted into non-toxic substances under mild conditions after use, have been receiving a great deal of attention. If materials can be broken down and recycled when needed, they are not only environmentally friendly, but also functional. I am pursuing research to add chemical degradability to commonly used organic materials such as surfactants and plastics.

Immediately after adding a small amount of a weak alkali to an aqueous surfactant (detergent) solution, bubbles disappear and solids (hydrolyzed product) precipitate.

Professor
Yoshihiro Itoh

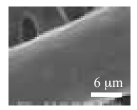
Professor Itoh took his current position in 2009 after serving in the Faculty of Textile Science and Technology at Shinshu University as an assistant professor and associate professor. His areas of research include synthetic polymer chemistry, photochemistry, and organic material chemistry.

Outlook for research

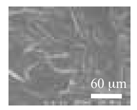
My lab is developing organic materials that can be quickly broken down and recycled after use through simple exposure to light or addition of weak acids or alkalis. The addition of such chemical degradability to commercial products will transform them into high-performance, eco-friendly materials that are available for use in numerous industrial fields and in everyday life.

Outlook for students after graduation

Many graduates are employed by chemical companies in the manufacture of paints, adhesives, films, plastics, and other products.



Micrograph of a latex paint-coated fiber surface



Micrograph of a latex paint-coated paper surface

Photograph of carbon-black latex ink-coated paper

Hydrolyzable surfactant-containing polymer particles (latex) are utilized as quick-drying water-based paints and pigment inks.

Exploring the future of biochemical research

I am carrying out bioscience and biochemical research into fibers made by organisms that live in water. My research primarily covers the phyla Mollusca and Arthropoda. Bivalve clams that live in the ocean create a type of fiber called byssus.

Professor
Kousaku Ohkawa

After graduating from the Functional Polymer Science Course at the Faculty of Textile Science and Technology (FTST) and completing the first semester of a doctoral program at the Graduate School of Engineering, Professor Ohkawa participated in a graduate course offered by the University of Tokyo's Graduate School of Biological Science. He subsequently returned to the Institute of High Polymer Research (IHPR) run by the FTST at Shinshu University in 1996 as an assistant professor and later submitted his doctoral thesis to the University of Tokyo (Doctorate of Science, 1998). He was promoted to associate professor at the IHPR in 2003. His has served as a professor in the Division of Biological and Medical Fibers at the Institute for Fiber Engineering (IFES) at Shinshu University since 2014.

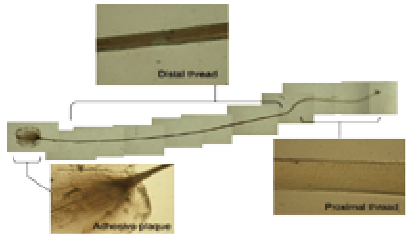
Outlook for research

Living organisms leverage their acquired knowledge to create exceptional fibers in the water. There is a great deal that researchers can learn from fiber materials created by living organisms. This knowledge will lead to the fiber material engineering of the future.

Outlook for students after graduation

Graduates are employed as R&D engineers by manufacturers involved in the following businesses: spinning; fiber production; non-woven material production; food ingredient production; sports product production; plastic processing; processing, manufacture, and sale of natural polysaccharides; and chemical product manufacturing.

The Asian green mussel creates this strange byssus fiber underwater.



Byssus fibers are generated by the adhesive disk at the end (left: the sticky part), the distal section (center: a hard, strong fiber), and the proximal section (right: a tough, strong fiber).

Department of Chemistry and Materials
Functional Polymer Science

Exploring applications of discotic liquid crystalline organic semiconductors in solar cells

Recently, liquid crystals are being used in flat-panel televisions, a product that is very familiar to most consumers. Liquid crystals (LCs) normally have a rod-like molecular shape, so that they are known as rod-like LCs. However, some LCs are not only rod-like, but also disk-like, and these are known as discotic LCs. Although discotic LCs are not used in ordinary applications, they are expected to find application in other fields (for example, solar cells) that differ entirely from those of rod-like LCs. Consequently, discotic LCs are considered to have enormous future potential. In my lab, we study novel discotic LC semiconductors that are suitable for use in organic solar cells.

Professor
Kazuchika Ohta

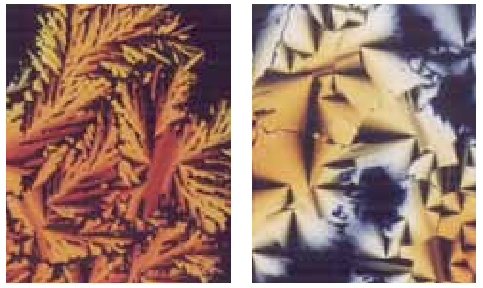
After obtaining his Ph.D from Osaka University in March 1981, Professor Ohta worked for Toshiba Corporation from April 1981 to December 1982. He has been at Shinshu University's Ueda Campus since December 1982 and currently serves as a professor. His research interests include supramolecular chemistry, physical chemistry of liquid crystals, organic materials for electronics, organic transition metal complexes, and microwave chemistry.

Outlook for research

Today's solar cells use silicon, which is rigid and heavy. By contrast, if they could be replaced by organic thin film solar cells, they would become flexible and light. Were discotic LCs utilized in solar cells, their cost could be greatly reduced in mass production. Such solar cells would become a much more familiar product in the future.

Outlook for students after graduation

In my lab, students acquire extensive knowledge of both organic synthesis and the physical properties of functional materials. After their completion of a bachelor's, master's or doctoral course, they will be able to work in both the chemical materials and electronic materials industries.



Photomicrographs of discotic liquid crystals. We enjoy working with their beautiful textures.

A student observes the texture of her synthesized discotic liquid crystalline semiconductor with a temperature-variable hot stage and a polarizing microscope.

Department of Chemistry and Materials
Functional Polymer Science

Creating gels from numerous liquids throughout the world and investigating a wide array of applications for supramolecular gels

I am carrying out research into the development and application of low-molecular-weight gelling agents for gelling such liquids as oils, organic solutions, and water solutions. There is high demand for low-molecular-weight gelling agents in many fields, including oil-processing agents, cosmetics, medical and pharmaceutical applications, foods, writing supplies, paints and inks, electronic devices, and LCDs.

Professor
Masahiro Suzuki

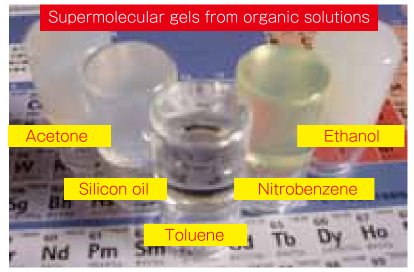
Professor Suzuki took his current position in 2015 after working as an assistant professor and associate professor at the Shinshu University Interdisciplinary Graduate School of Science and Technology. His principal areas of research include low-molecular-weight gelling agents, functional polymer materials, and artificial photosynthesis.

Outlook for research

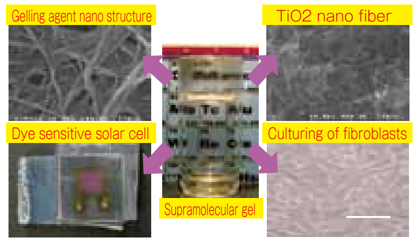
Much research into applications for these materials focuses on low-molecular-weight gelling agents because they form nanofibers within supramolecular gels. It is expected that low-molecular-weight gelling agents will permeate daily life in much the same way that polymers have.

Outlook for students after graduation

Graduates are primarily employed by chemical manufacturers. Their skills as chemical researchers enable them to find work in a wide variety of fields.



Supermolecular gels formed from organic solutions using an L-amino acid-based low-molecular-weight gelling agent. We have created solid gels that do not fall out, even when held upside-down.



A nano-structure formed in a supramolecular gel by a low-molecular-weight gelling agent, the gel electrolyte of a dye-sensitive solar cell, TiO_2 cast production, and application as a cell-culture substrate

Department of Chemistry and Materials
Functional Polymer Science

Developing gelling agents that can create solids simply by their addition and thickeners for creating viscous substances through molecular design

I am working to develop low-molecular-weight compounds that form gels or bring about viscosity simply through addition to organic solutions or water and to research potential applications of these substances. My lab is categorizing components that comprise compounds that act as gelling agents and thickeners and examining the forces and structures that form gels and viscous substances. We are also researching potential applications in cosmetics.

Professor
Kenji Hanabusa

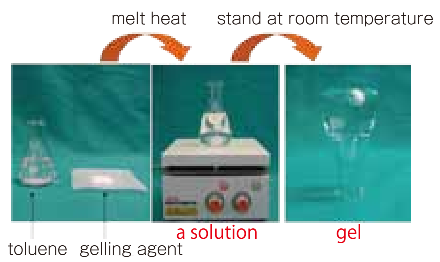
After graduating from Osaka University as an undergraduate and later completing the school's graduate course, Professor Hanabusa worked at Shinshu University as a research associate, assistant professor, and associate professor before taking his current position in 1999.
In 2002, he received an award from the Society of Fiber Science and Technology in Japan. In 2011, he received the Mitsubishi Chemical Award from the Society of Polymer Science, Japan, as well as the Chemical Society of Japan's Technology Award.

Outlook for research

This research has major potential for industrial applications (including cosmetics, gel electrolytes, coating materials, display devices, liquid crystal gels, inkjet inks, paper for printing, formulations for external skin use, and sol-gel polymerization casts).

Outlook for students after graduation

Graduates are employed by chemical, electrical, and cosmetic companies and as public officials. They are valued by companies in numerous fields.



The gel formation process using a gelling agent: The gelling agent is mixed in a solution (left) and melted using heat (center). When cooled, it becomes a gel (right).

A new eye shadow prototype made using a polysiloxane gelling agent

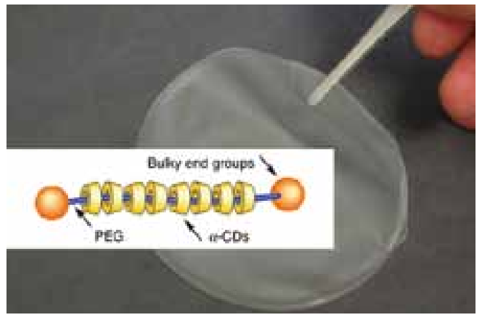
We plan to commercialize this lipstick, which uses a low-molecular-weight gelling agent.

Department of Chemistry and Materials

Functional Polymer Science

Necklace-shaped supramolecules and cellulose/chitin nano-whiskers

I am pursuing two principal areas of research. The first involves utilization of necklace-shaped supramolecules called polyrotaxanes in order to develop functional materials such as gels, fibers, and films through chemical modification. The second involves applications of nano-whiskers, that is, rod-like microcrystal particles of cellulose obtained primarily from trees and plants and those of chitin from crab and shrimp shells for use as reinforced nanocomposites.



A certain polyrotaxane derivative, that is, a nano-sized necklace molecule with a width of 1 nanometer, can be used to form a flexible film that has been utilized to paint cell phones.

Associate Professor
Jun Araki

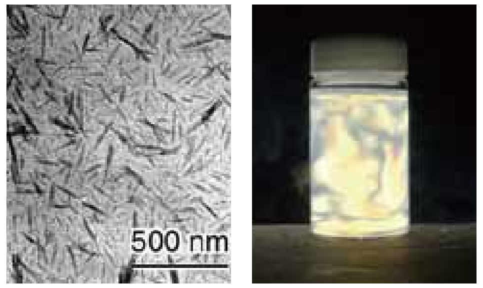
Associate Professor Araki took his current position in 2012 after working as a JST-CREST postdoc researcher, a technical advisor to Advanced Softmaterials Inc., and an assistant professor under the Shinshu University Young Researchers Empowerment Project. His areas of specialization include supramolecular chemistry and polysaccharide chemistry.

Outlook for research

Polyrotaxane and cellulose/chitin nano-whiskers are both materials with diverse future potential. These carbohydrate-based, eco-friendly, and biodegradable components will find wide application in society.

Outlook for students after graduation

Graduates are employed primarily by chemical and material manufacturers.



Cellulose nano-whiskers from plants (left). These nano-sized fibers have an elastic modulus higher than that of steel. They can form a liquid crystal that shows vivid birefringence between crossed polarizers (right).

Department of Chemistry and Materials

Functional Polymer Science

Creating high-function fibers to facilitate safer and more comfortable lifestyles

Fiber is a material that is essential in our daily lives, and I am pursuing research to make fiber even more useful. Currently, my lab is focusing on research to make fiber stronger (high performance) and to add conductive or antibacterial properties (high functionality) by combining numerous types of different materials.

Associate Professor
Yasuo Gotoh

Associate Professor Gotoh took his current position in 2007 after serving in the Faculty of Textile Science and Technology at Shinshu University as an assistant professor. His area of research is fiber and polymer material science, and he is currently focuses on research into the properties of compound materials and high-polymer solids that combine organic and inorganic materials.

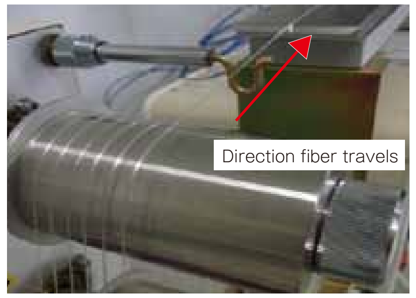
Outlook for research

When used in the bodies of moving vehicles such as aircraft and cars, these fibers can reduce weight, improving fuel efficiency and leading to energy savings. Improving the performance and functionality of fiber is an area of research that contributes to the future of humanity.

Outlook for students after graduation

Many graduates are employed by chemical and material companies. They also find employment at non-fiber-related companies when those companies handle fibers.


Polymers are melted in a solution to prepare the spinning solution that serves as the raw material for fiber.



Here, fiber is being stretched on a heating plate. This process increases the strength of the fiber by a factor of 10.

Department of Chemistry and Materials

Functional Polymer Science

Utilizing biological materials in engineering to create biosensors and new materials

I am working to develop a biosensor capable of easily identifying the appropriate amount of medicine to administer by affixing CYP, which plays a central role in the liver, to an electrode. Diatoms, a type of phytoplankton, use a protein called silaffin to form their silica shells. My lab has succeeded in using a polymer that imitates that structure to create new silica materials in numerous forms.

Associate Professor
Yoshiro Ogoma

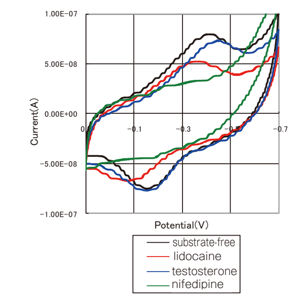
Associate Professor Ogoma received his Doctorate of Science at Tohoku University after completing the textile research course at Shinshu University Graduate School. He took his current position in 1999. From 2001 to 2002, he studied at the University of Cologne in Germany as an exchange student. His specialty is biopolymer engineering.

Outlook for research

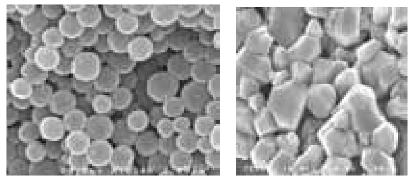
By recombining countless biological molecules to apply biological materials to engineering, it becomes possible to develop new materials based on new principles.

Outlook for students after graduation

Although many graduates are employed in the areas of chemical materials and medical equipment, I strive to give them an education that can be applied to companies in all fields.



A CYP immobilized electrode that demonstrates a different electrical current and voltage response depending on the type of chemical (an example use as a biosensor)


Formation of silica in numerous shapes by adding polymers (an example use in new materials)

Department of Chemistry and Materials

Functional Polymer Science

Developing thin, lightweight wearable fuel cells to supply power to robots and power suits

I am pursuing research into functional polymer membranes and nanofiber materials such as vaporization membranes for micro fuel cells that use neat methanol as fuel, self-humidification layers for H_2/O_2 fuel cells, carbon nano-paper as nano-porous gas diffusion electrodes, and nickel nano-paper for alkaline fuel cells using thin electrolyte membranes.

Associate Professor
Toshiki Koyama

Associate Professor Koyama took his current position in 1998 after serving in the Faculty of Textile Science and Technology at Shinshu University as an assistant professor and senior assistant professor. His area of research is physical chemistry related to the development of functional polymer materials and devices inspired by the movement of electrons and ions in living organisms.

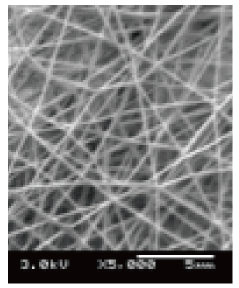
Outlook for research

My lab is working to develop materials that will make possible more compact fuel cells that are both thinner and lighter. Wearer fuel cells would have numerous applications, including as power supplies for robots and power suits.

Outlook for students after graduation

Many graduates go on to complete master's programs, after which they usually find employment at companies involved with chemical materials, organic electronic materials, and electronic devices.


This flexible fuel cell with a thickness of 4 mm was formed from an array of six cells.


We developed this carbon nanoweb (CNW) electrode with a diameter of 150 nm.


A student uses an evaluation device to check the power-generating properties of fuel cells built with materials developed in the lab.

Functional Polymer Science

Development of Functional Polymeric Materials for Bio-Applications

The body identifies artificial materials as foreign objects and attempts to eliminate them from the body and neutralize any harmful effects. Consequently, thinking of, and developing, new polymer materials that are more compatible with living organisms are extremely important steps in the treatment of numerous diseases.

Associate Professor
Akira Teramoto

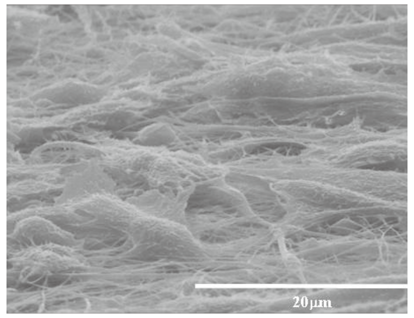
Associate Professor Teramoto took his current position in 2008 after working as a researcher at a private dairy company and as a research associate and assistant professor in the Faculty of Textile Science and Technology at Shinshu University. His areas of research include the development of substrates for cell culturing and the functional evaluation of cultured cells.

Outlook for research

My lab is working to develop artificial extracellular matrices (ECM) that use natural materials such as proteins and polysaccharides as raw materials. Clinical applications for these materials are expected to include uses in regenerative medicine.

Outlook for students after graduation

Graduates are primarily employed by material and chemical manufacturers, although some work at companies involved in medical equipment or pursue clinical applications such as regenerative medicine.



Osteoblasts from mice cultured on a non-woven material made from cellulose nanofibers

Tissue cells are cultured over a long period of time using a petri dish whose bottom is coated with the material we created, and then they are kept in a device that maintains sanitary conditions so that we can examine their functionality.

Department of Chemistry and Materials

Functional Polymer Science

Fabrication of functional fiber materials based on microstructural development

An “entanglement” is a typical characteristic of polymer, which has a long molecular chain. The control of the entangled state, i.e., entanglement or disentanglement, is important for the preparation of fiber materials with high performance and high functionality.
The fiber structure formation of functional materials (e.g., ceramics) takes advantage of this new and enhanced functionality.
Our laboratory focuses on the fabrication of functional fiber materials based on the microstructural development.

Assistant Professor
Masaki Kakiage

Dr. Eng. (2008, Gunma University) Postdoctoral Research Fellow (2009, Tokyo Institute of Technology); Assistant Professor (2009, Saitama University); Assistant Professor (2015, Shinshu University)

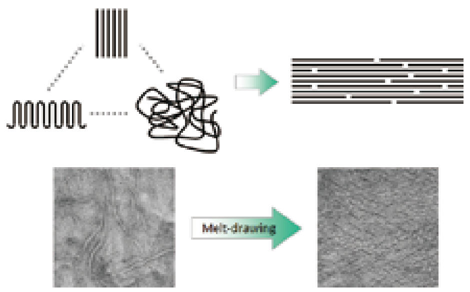
Outlook for research

・Structural development for preparation of fiber materials with high performance and high function induced by spinning techniques

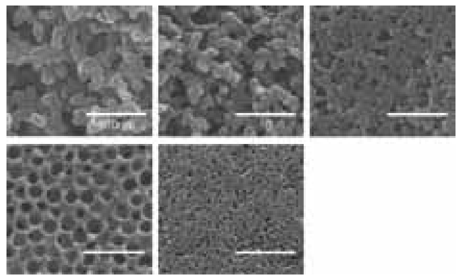
・Fabrication of functional ceramic fibers using organic precursors

Outlook for students after graduation

Graduates acquire diverse knowledge of fiber materials. Students cultivate initiative, logical thinking, problem-solving skills, and problem-finding skills through research activities in our laboratory.



(top) Chain disentanglement and orientation by drawing
(bottom) TEM images of UHMW-PE before and after melt-drawing



Morphological changes in porous materials prepared by using structure-forming ability of polymer

Department of Chemistry and Materials

Functional Polymer Science

The beginning of a New Polymer Synthesis: Materials by Molecular and Reaction Design

Fibers, plastics, rubbers… common materials are composed of macromolecules (polymers) built up from hundreds and thousands of small molecules. Our research focuses on creating new polymer materials by designing functional molecules and their reactions. For example, we aim the development of a facile method to synthesize a polymer from a higher fatty acid made from plants materials in order to create a new rubber from biomass. Depending on how we design the molecules to be used in the synthesis, we can create new materials that we could not be previously imagined. We are busy working hard making experiments every day.

Assistant Professor
Yasuhiro Kohsaka

Dr. Kohsaka received his Ph. D. in Engineering from The Tokyo Institute of Technology. He worked as a JSPS Research Fellowship for Young Scientists (DC-1) and then as an assistant professor in Osaka University, before starting his current position at Shinshu University in 2015.

Outlook for research

In general, polymeric materials is a product of the petroleum industry. However, we also design polymers from natural products, aiming to develop a sustainable system by developing new synthetic technologies. Synthetic chemistry is very interesting, as it can be used to create many materials, such as the advanced materials used in medicine and solar cells, and everyday products made from fibers and rubber.

Outlook for students after graduation

You can learn the logic that is needed in science, the English language, the way to make presentations, and the knowledge that future researches need. As this laboratory was only established in 2015, no students have graduated yet. However, this type of knowledge is indispensable in our society.

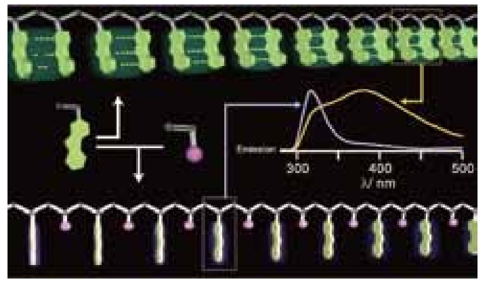


Fig. 1. Synthetic research on fluorescent polymers. Polymers composed of a single monomer and those of two different monomers in alternating sequence showed different fluorescent emission colors.

Fig. 2. A polymer prepared from a β-amino acid derivative was a solution under acidic conditions and a low temperature, but become insoluble at higher temperatures.

Department of Chemistry and Materials
Applied Molecular Chemistry

Metal and metal oxide nanomaterials for our daily life

In our laboratory, we are studying materials science that contributes to energy and environmental matters. One of the central issues in nanotechnology research is the fabrication of metal oxide nanomaterials whose shape and size is controlled. This is important as the chemical and physical properties of the nanomaterials are highly dependent on their structures. Furthermore, we are preparing many types of nanoporous metals to be used as efficient heterogeneous catalysts for various kinds of material transformations.

Professor
Naoki Asao

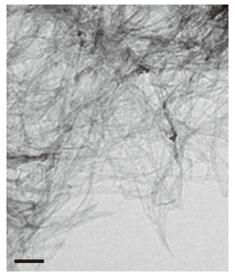
Professor Asao joined the Faculty of Textile Science and Technology at Shinshu University in 2016 after working at Tohoku University. His principal area of research is materials science, based organic chemistry, catalytic science, and metallurgy.

Outlook for research

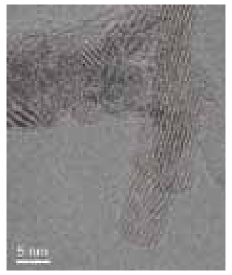
Recently, we have developed a new method to fabricate ultrafine metal oxide nanomaterials that is based on a dealloying method. The nanomaterials exhibit remarkable chemical properties that can be used in a variety of research fields.

Outlook for students after graduation

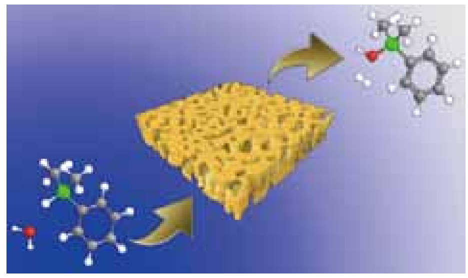
Many graduates go on to graduate school and get positions in a broad range of research areas in chemical companies.



A transmission electron micrograph of titanate nanowires



A high-resolution transmission electron micrograph of cerium oxide nanorods



Nanoporous gold as a heterogeneous catalyst for molecular transformations

Department of Chemistry and Materials
Applied Molecular Chemistry

Investigating how chemical reactions emit light and searching for possible applications

I carry out research into the foundations and applications of organic photochemistry, with a focus on organic chemistry research into chemiluminescence, the phenomenon of light emitted by chemical reactions. My goals include pursuing the functionalization of chemiluminescence while carrying out a quantitative and qualitative analysis of special metallic ions and chemicals.

Professor
Jiro Motoyoshiya

Professor Motoyoshiya took his current position after working in the Faculty of Textile Science and Technology at Shinshu University as an assistant professor and associate professor. His principal area of research is photochemistry based on organic chemistry, particularly chemiluminescence.

Outlook for research

In addition to basic research, I hope to put chemiluminescence to use in applications such as the detection of minute quantities of substances and the prevention of disease by leveraging the knowledge obtained from basic research.

Outlook for students after graduation

Many graduates go on to the master's program. Many find employment in the chemical industry, where they are involved in research and development or manufacturing at chemical manufacturers.

Chemiluminescence causes the emission of light in numerous colors due to fluorescing agents. The mechanism of light emission is extremely complex, but my lab is working to get to the heart of it.

Researchers are developing new fluorescing agents based on organic synthesis.

Department of Chemistry and Materials
Applied Molecular Chemistry

Fabricating novel functional materials by utilizing the diversity of carbon materials

I am working to tap the diversity of carbon materials and create new materials that are useful for human society. Lithium-ion secondary batteries (LIBs) are useful power sources for mobile phones and laptop computers, and there is an intensive effort underway to develop them for use in plug-in hybrid electric vehicles and electric vehicles. In addition to a diverse range of roles in LIBs, carbon materials can play a key role in composite materials such as carbon fiber reinforced plastic (CFRP), which is used in aircraft structural components.

Professor
Fujio Okino

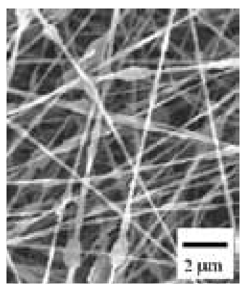
Professor Okino took his current position after working as a senior assistant professor and associate professor at Shinshu University. His principal areas of research include structures, properties, and applications of carbon materials such as graphite, carbon fiber, nanodiamonds, carbon nanotubes, fullerenes, and graphene.

Outlook for research

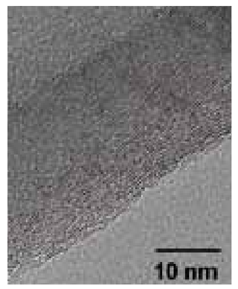
Submicron carbon fibers are prepared using the electrospinning method and used as a host material in the anodes and/or as a conductive material in anodes and/or cathodes of LIBs to enhance capacity as well as cycle and high-rate performance. Nano-carbons such as nanodiamonds and carbon nanotubes are used as fillers in metal or plastic hosts to enhance mechanical strength and thermal and electrical conductivity.

Outlook for students after graduation

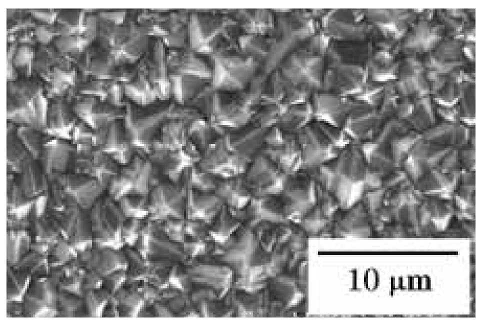
Graduates can pursue careers at chemical, electrical, material, and textile companies.



A scanning electron micrograph of submicron carbon fibers



A transmission electron micrograph of a multi-layer carbon nanotube



A scanning electron micrograph of a diamond film grown by chemical vapor deposition using nanodiamonds as seed crystals

Department of Chemistry and Materials
Applied Molecular Chemistry

Printing microchemical chips

I am engaged in developing technology to enable printing of microchemical chips. My lab is working to develop technology that will allow end-users to design their own microchemical chips and then print them using an inkjet printer.

Associate Professor
Masashi Watanabe

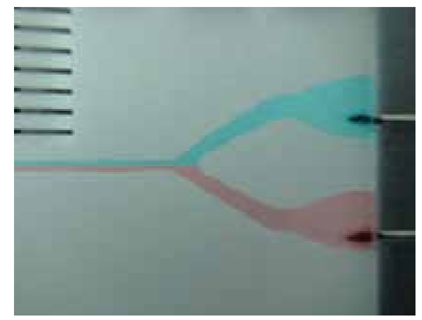
Associate Professor Watanabe conducted research into organic synthetic chemistry for his graduate research in the department and in a graduate school course. Following some twists and turns in his career, he now specializes in polymer chemistry and chemical engineering.

Outlook for research

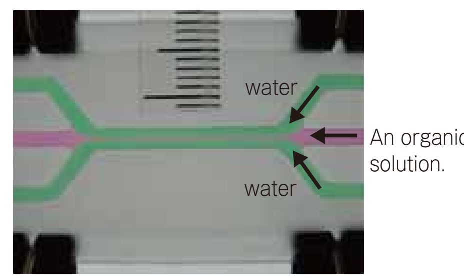
Technology for printing microchemical chips with an inkjet printer is still in the early stages, and we do not yet know whether it will prove to be viable in the future.

Outlook for students after graduation

In light of the large number of interesting domains, my hope is that graduates will choose their jobs freely, irrespective of their graduate research.



Two types of liquid are mixed in a microchemical chip.



A microchemical chip is used for extraction via the oil/water interface.

Department of Chemistry and Materials

Applied Molecular Chemistry

Developing cutting-edge polymer particles and pursuing science in the mysterious world of the micro-scale

I am working to develop functional polymer particles, a type of material that is both old and new and that promises applications in paints and inks and in components for cutting-edge materials. In my research, I first design functional particles, propose new synthesis methods, properly evaluate the resulting particles, and, finally, consider the possible applications in which they can be expected to play a useful role.

Associate Professor

Daisuke Suzuki

After obtaining his doctorate (in engineering) at Keio University, Associate Professor Suzuki worked as a researcher at the Georgia Institute of Technology and at the University of Tokyo, and as an assistant professor under the Shinshu University Young Researchers Empowerment Project before taking his current position 2013. He specializes in polymer chemistry, colloid chemistry, and material chemistry.

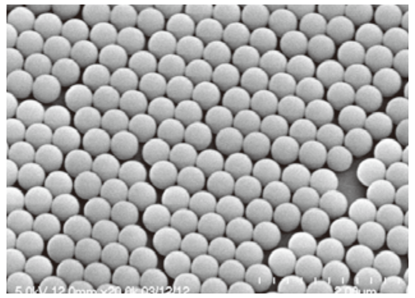
Outlook for research

I hope to consult with scientists throughout the world to understand the nano-space, which is invisible to the naked eye, and to create materials that will enrich our daily lives.

Outlook for students after graduation

My goal is for students to experience the joy of creating things during their school years to give them an interest in science.

While this liquid looks at a glance like milk, here we are dispersing polymer particles in normal water.



The particles, which are invisible to the naked eye, look like this when viewed through an electron microscope. Each particle has a diameter of 400 nm.

Department of Chemistry and Materials

Applied Molecular Chemistry

Utilizing organic chemistry to solve biological phenomena: Searching for biologically active substances and developing new reactions and medicines

I use organic chemistry as a surgeon's knife to delve into life and biological phenomena. For instance, my lab successfully synthesized a natural substance with antiviral and blood platelet coagulation-inhibiting properties (that is, we synthesized a substance that is identical to a natural substance in a flask). We have also synthesized biologically active substances such as antibacterial and bactericidal substances and pheromones.

Associate Professor

Yoshinori Nishii

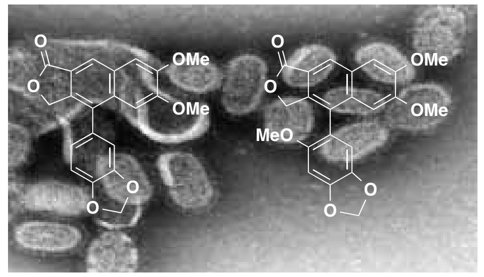
Associate Professor Nishii took his current position in 2007 after serving as a doctoral researcher at the University of Pittsburgh and participating in the Special Postdoctorate Research Program at RIKEN. His principal areas of research include organic chemistry for natural substances, organic synthetic chemistry, and organic reactions.

Outlook for research

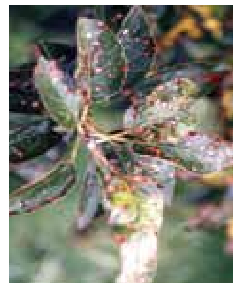
Exciting potential applications made possible by examination at the molecular level include development of medications that learn from natural substances, development of medicinal treatments for previously untreatable diseases, treatments for crop diseases, capture of harmful organisms using pheromones, and control of valuable organisms through the use of pheromones.

Outlook for students after graduation

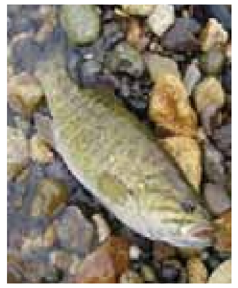
Most graduates are employed by pharmaceutical and chemical manufacturers. They are active in a wide range of research domains throughout society.



My lab has been successful in synthesizing several natural substances with antiviral and anti-HIV properties as well as blood platelet coagulation-inhibiting properties.



We are conducting R&D work to create a bactericidal substance to help farmers deal with a disease that affects the trunks of pear and apple trees.



We are also involved in research to uncover fish pheromones and explain their molecular structure and the relationship between structure and activity.

Department of Chemistry and Materials

Applied Molecular Chemistry

Lining up sub-micron minute particles in an orderly manner to create photonic crystals

I synthesize minute particles at the sub-micron scale with identical diameters and line them up properly using electrophoretic deposition (colloid crystals). The particles have a strong electrostatic resistance and normally resist alignment. The members of my lab enjoy the challenge of researching numerous ways to overcome this issue.

Associate Professor

Tetsuya Tanigami

Associate Professor Tanigami joined the Faculty of Textile Science and Technology at Shinshu University in 1982. During his student years, he used X-rays to carry out research on the solid structure and characteristics of polymers. Currently, he is researching colloid crystals using visible light. A phenomenon common to both pursuits is Bragg reflection.

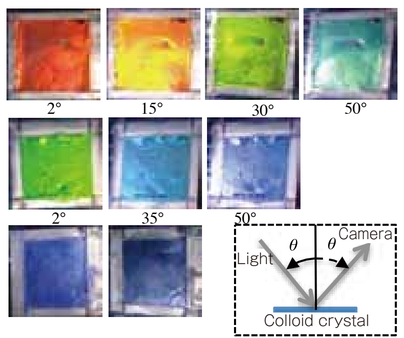
Outlook for research

There is now a need for quantum computers. In order to fulfill that need, it is necessary for components to allow only light of a certain wavelength to pass and to bend light at a right angle. One method for pursuing associated research is the use of colloid crystals.

Outlook for students after graduation

Many graduates are employed by chemical manufacturers involved in polymers and fibers.

In this research, from the right, minute particles of inorganic silica, organic polystyrene, and hydrogel are being formed into colloid crystals.



An example of a material in which the color of light changes depending on the angle (polystyrene)

Department of Chemistry and Materials

Applied Molecular Chemistry

Using a computer to examine the properties of substances in a "dry lab," thereby performing chemistry without experimentation

I am examining numerous properties, including optical properties, without actually carrying out experiments by performing molecular computation based on quantum chemistry. This approach makes it possible to understand the true nature of those properties and to discover the roots of the properties of the substances one wishes to investigate. Currently, my lab is focusing its research primarily on carbon substances such as fullerenes.

Associate Professor

Yasushi Nomura

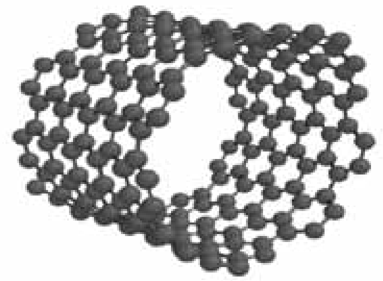
Associate Professor Nomura took his current position in 2005 after working in the Faculty of Textile Science and Technology at Shinshu University as an assistant professor. His area of focus is theoretical chemistry based on quantum chemistry. Recently, he has been researching the electronic properties of carbon materials such as fullerenes, the glow of certain organic molecules, and their quenching process.

Outlook for research

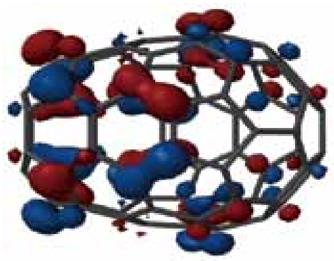
Currently, organic synthesis using molecular computation to predict reaction pathways has been addressed in the scientific literature. In this way, researchers expect that by calculating an efficient reaction in advance, it will be possible to carry out experiments without wasting test reagents or time.

Outlook for students after graduation

While graduates pursue numerous career paths, many aim to become system engineers, teachers, or public officials.



One subject my lab is investigating is carbon nanotubes.



There are abundant electrons in the large red and blue areas of this molecular orbital model related to electron distribution for a certain fullerene.

Department of Chemistry and Materials

Applied Molecular Chemistry

Developing new luminescent materials and energy-storing materials using nanocarbon

I am carrying out research to synthesize fluorescent nanocarbon and to use nanocarbon (carbon nanotubes, graphene, carbon nano-horns, etc.) in energy-storage devices (primary and secondary lithium batteries and super capacitors). My research covers a wide range of topics, from fundamentals to applications.

Associate Professor
Yoshiyuki Hattori

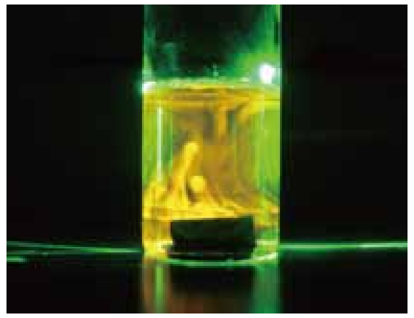
Associate Professor Hattori took his current position after working as a researcher involved in collaboration among industry, academia, and government in the Chiba University Faculty of Science and as a senior assistant professor in the Faculty of Textile Science and Technology at Shinshu University. He is currently engaged in basic research in carbon science and inorganic fluorine chemistry, including research on the applications of nanocarbon as an electrode material and as an adsorption material.

Outlook for research

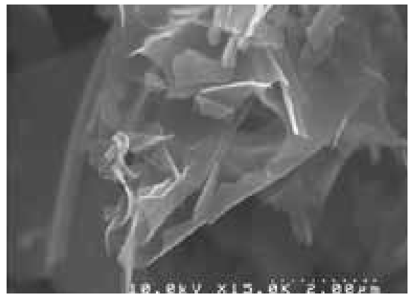
Potential applications for this research are growing in number and include drive power sources for electric vehicles, next-generation bio-imaging materials, and cleaning gases for semiconductors that are environmentally friendly and energy-efficient.

Outlook for students after graduation

Graduates seek employment at chemical companies, particularly companies involved in carbon materials, electrochemicals, and fluorine chemistry, or as teachers or public officials.



My lab succeeded in synthesizing fluorescent nanocarbon, whose applications include use in imaging materials.



We also succeeded in synthesizing porous carbon nano-sheets, whose potential uses include capacitors and electrodes in high-output secondary lithium batteries.

Department of Chemistry and Materials

Applied Molecular Chemistry

Developing novel organocatalysts for highly stereoselective synthesis of organic molecules

Organic molecules sometimes come in a chiral form with an enantiotopic relationship. I am carrying out research focused primarily on the development of an asymmetrical catalyst to selectively synthesize one side of a chiral molecule. My goal in doing so is to create new catalysts that are highly selective and highly activated, that do not use rare metals, and that can be synthesized simply.

Associate Professor
Tetsuya Fujimoto

Associate Professor Fujimoto first completed a Shinshu University Graduate School of Engineering research course specializing in the study of functional polymers. His area of research is organic synthetic chemistry, and his work focuses on new methods for organic synthesis and the development of new catalysts.

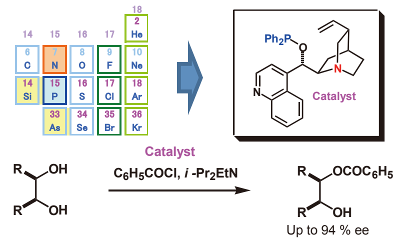
Outlook for research

Expected applications include the functionalization of glycerin, a type of biomass, using the asymmetric esterification reaction and the easy supply of optically active alcohol and amine, in addition to the carbon-carbon bond-forming reaction that is important for organic synthesis.

Outlook for students after graduation

Graduates have gone on to work for manufacturers of low- and high-polymer products and pharmaceuticals.

A view of the lab. Numerous reagents, solvents, and glass containers are used to synthesize the target organic compounds, yielding substances whose structure can be confirmed using NMR.



An asymmetric esterification solution designed based on atomic principles, and associated reactions. Esterification proceeds by differentiating between the two symmetrical hydroxyls in the diol.

Department of Chemistry and Materials

Applied Molecular Chemistry

Examining the mystery of polymer membranes and using tiny holes in PET bottles

Synthetic resin polymer membranes, of which PET bottles are a leading example, have extremely tiny pores that allow gases to pass through them but not liquids. I am working to develop a barrier material for electronic materials that will make them 1 million times less permeable to gases. This area of research is currently garnering attention.

Associate Professor
Yuichi Hirata

Associate Professor Hirata took his current position in 2010 after working as a senior assistant professor at the Meiji University School of Science and Technology, as a doctoral researcher at the French National Institute for Agricultural Research, and as an assistant professor in the Faculty of Textile Science and Technology at Shinshu University. His principal areas of research include barrier films, separation membranes, and dye chemistry.

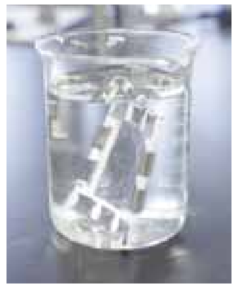
Outlook for research

I am also researching polymers that will only allow specified substances to pass through them. This property could be leveraged to make it possible to extract only oxygen from the air, or pure water from the ocean. Medical applications are also possible, such as for dialysis.

Outlook for students after graduation

In addition to working for chemical manufacturers, graduates are active in a wide range of research domains that extends beyond any single industry.

Salt water can be seen on the left and pure water on the right. A salinometer is being used to measure how much salt passes through the film to the pure water side.



Cellulose acetate is boiled in ammonia to examine polymer changes.

Students are also engaged in the creation of membranes using surfactants.

Department of Chemistry and Materials

Applied Molecular Chemistry

Applying colloid and interface chemistry to nano-technological and biological systems

In my laboratory, we use colloid and interfacial science to study nano-technological and biological systems.

Nano-technological applications: We are using interfacial forces to produce a monolayer of nanoparticles at an air-water interface with a controlled packing. Such a monolayer can be used to produce magnetic or semiconductor materials. Our goal is to determine how to create high-quality devices at low cost by determining (1) the effects of the particle material, size, and shape on the physical properties of the monolayer and (2) the forces and factors controlling the structuring and interactions of the particles at the interface.

Biological applications: We are researching (1) the physical properties of polysaccharides in order to produce materials that can act as lubricant films in joints and (2) how to control the interactions of lipids in cell membranes with other molecules so as to inhibit their aggregation, which can cause health problems such as metabolic syndrome.

Associate Professor
Cathy McNamee

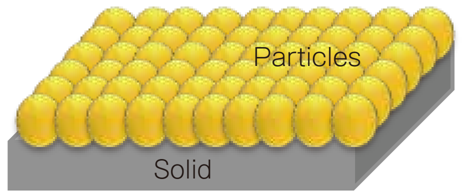
Education:
B.Sc. (hons), B.A.: University of Queensland, Australia
D.Sc.: Kyoto University, Japan
International collaborations:
Max Planck Institute for Polymer Science, Germany
Research Field:
Colloid and Interface Science

Outlook for research

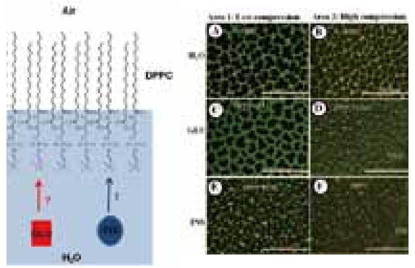
I am studying nano-technological and biological systems by using colloid and interfacial physical chemical techniques. My focus is on determining the fundamental properties of these systems and how they can be controlled.

Outlook for students after graduation

In our society, people have to think and make decisions on new and unknown topics everyday. In my lab, we are learning how to think and make decisions though our research on new and unknown science.



A particulate monolayer that has been transferred to a solid substrate



The interaction of glucose or insulin with a model biological membrane is determined by using a Langmuir trough and fluorescence imaging techniques.

Department of Applied Biology

Pursuing plant genome engineering and bio-refineries, from the cultivation of biomass to its utilization

Research and development are proceeding throughout the world to explore the cultivation and utilization of renewable biomass resources. When working in the private sector, I was involved in a range of technical development projects covering everything from the development of recombinant technology for the cultivation of biomass to experiments in using biofuels at coal-burning thermal power plants. Currently, I am engaged in predicting the future of bio-refineries focusing on fiber and conducting research on plant genome engineering, which forms the basis for biomass improvement.

Professor
Hiroyasu Ebinuma

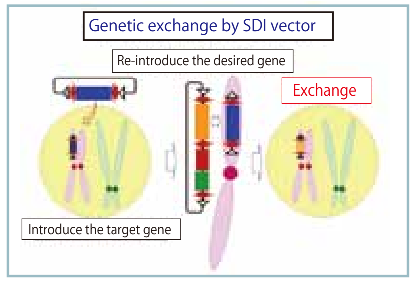
Professor Ebinuma took his current position on April 1, 2013, after working as the deputy general manager of the Energy Business Department at Nippon Paper Group, Inc. His areas of research include plant genome engineering for freely altering plant genomes and the development of a next-generation bio-refinery for the biomass industry.

Outlook for research

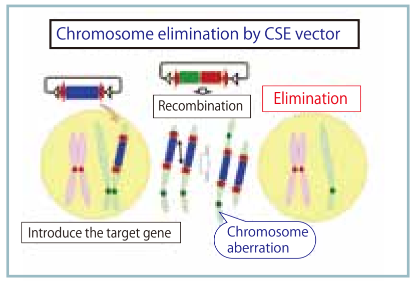
Using SDI and CSE vectors that I developed, I am developing plant genome engineering technology that will enable the free alteration of the genome through gene swapping and chromosome removal. I hope to make this technology a worldwide standard.

Outlook for students after graduation

I train my students to tackle research and development projects that meet corporate needs based on my own research experience in the private sector.



SDI vector technology allows insertion of a gene at a precisely targeted spot on a chromosome. It enables highly reproducible DNA analysis, and I am working to improve this technology and promote it as a world standard.



CSE vector technology makes it possible to freely remove plant chromosomes. Swift realization of practical applications is expected as the resulting modified genome has great value as a breeding material.

Department of Applied Biology

Biopolymers: Gaining an understanding of the function and structure of DNA and enzymes in order to explain their interactions and apply them to biotechnology

I examine the nature and structure of nucleic acids, which form DNA, and carcinogens and active oxygen, which damages DNA. My lab is also researching DNA repair enzymes that repair damaged DNA from a completely new perspective with the goal of clarifying how repair enzymes find damaged parts of the DNA and applying this knowledge to research into anti-carcinogenic drugs.

Professor
Toshio Shida

Professor Shida joined the Faculty of Textile Science and Technology at Shinshu University in 1986 as a senior assistant professor after working as a research associate at the Nagoya University Chemical Instrument Center and as a doctoral researcher at Johns Hopkins University. He took his current position in 2009 after becoming an associate professor. His areas of specialization include nucleic acid chemistry, protein engineering, the science of biopolymer properties, and applied microorganism engineering.

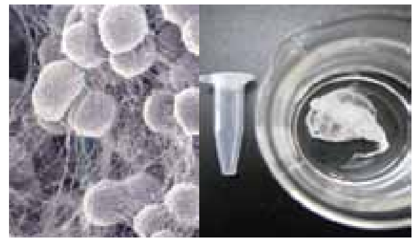
Outlook for research

If we could clarify the functional structure of DNA and enzymes, we believe that knowledge could be applied in the medical domain and effectively used in the industrial production of biological materials.

Outlook for students after graduation

Graduates are active in research centers at public research institutions and companies as well as at food product companies and fermented food companies, in the medical domain, and at scientific publishing companies.

An explanation of the substrate recognition mechanism of very-early-stage enzymes before the formation of the enzyme-substrate complex, something that had not previously been considered for enzyme substrate recognition structure. Far left: The enzyme has not yet found the damaged DNA. Center: The amino acid on the surface of the enzyme has found the damage to the DNA (in the form of a hole). Far right: The enzyme is attempting to repair the damaged DNA.



Left: An electron microscope image of ***Kokuria rosea***, a microorganism that lives in the ocean at a depth of 6,000 m (showing the fibrous substance around the cell body). Right: Fibrous protein obtained from a cultured cell

Department of Applied Biology

Developing the genetic resources of domestic and wild silkworms to make a brand of silk

I am carrying out research into genetic breeding, ecdysis and metamorphosis, and the genetic relationship of the silkworm to its relative, the giant silkworm (natural silkworm). My lab cultivates excellent strains of natural silkworms in order to reinvigorate Japan's silk industry. This is done by supporting the raising of natural silkworms in silk-producing regions.

Professor
Zenta Kajiura

Professor Kajiura's academic credentials are in agriculture, and his areas of specialization include agriculture and applied entomology, molecular genetics.
Keywords:
D N A, bio-resources, breeding

Outlook for research

My goal is to train new talent that can carry on the tradition of cultivating and producing natural silk. This will create a future, where the production of silk and other agricultural products is reinvigorated through a collaboration between agriculture, business, and industry.

Outlook for students after graduation

Graduates go on to graduate school or work at textile and food companies, JA, or local companies. Some serve as middle school teachers and public officials in agricultural studies.

Cocoons and silk from natural silkworms. The cocoons take on a beautiful green color that is unique to Japanese cocoons.

I succeeded in breeding the large wild silkworm. Standard wild silkworm are shown in the top row. The large wild silkworm is shown in the bottom row. I usually need more than 3000 cocoons of the standard wild silkworm to get 1 kg raw silk. However, I only need approximately 2000 cocoons if I use the large size wild silkworm.

Department of Applied Biology

Harnessing the amazing powers of tiny microorganisms in our daily lives

I am carrying out research to discover useful microorganisms from among the countless number that exist in nature and put them to use solving problems involving food, the environment, and energy. For instance, my lab is working on microbial chitin-degrading enzymes to effectively utilize chitin, an abundant biomass resource, and on molecular breeding of mushrooms to allow efficient use of their enzymes and metabolites.

Professor
Makoto Shimosaka

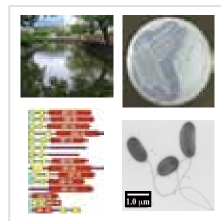
Professor Shimosaka took his current position in 2004 after working as an assistant professor in the Faculty of Textile Science and Technology at Shinshu University starting in 1985. His area of specialization is applied microbiology. He has handled numerous types of microorganisms since beginning his graduate research in college, including bacteria, yeasts, molds, and mushrooms.

Outlook for research

Many mysteries continue to surround tiny microorganisms. In fact, only about 1% of all microorganisms that exist in nature have been cultivated and given scientific names. The natural world is a treasure trove of unknown and valuable microorganisms.

Outlook for students after graduation

Graduates are employed by companies that handle foods, alcoholic beverages, and chemical products. Typically, they enter industries that make use of biological systems.



We discovered a novel bacterium that degrades chitin in moat water from Ueda Castle.

A student examines the DNA of microorganisms using electrophoresis.

We use numerous microorganisms in experiments, and there are over 1,000 species of microorganisms stored in the lab' s freezers.

Department of Applied Biology

Opening up new domains for the utilization of silk materials, especially aim to use in medical area including as material for regenerative medicine

I am carrying out research focused on the development of new utilization technology for silk proteins material beyond the use as fabric in apparel. My lab is studying to understand the characteristic natures of silk proteins materials for utilization as medical materials (biomaterials) by cell culture technique, biochemical measurements, and physicochemical analysis of materials, and aim to create new functional silk materials by development of new fabrication technology, chemically and genetically modification technology.

Professor
Yasushi Tamada

After graduating from Kyoto University Graduate School, Professor Tamada worked as a researcher at the Japan Synthetic Rubber Co., Ltd., (now JSR) and at the National Institute of Sericultural and Entomological Sciences (now the National Institute of Agrobiological Sciences), during which time he focused on research on the use of silk. He took his current position in 2013, and his area of specialization is biomaterials.

Outlook for research

The development of materials in support of regenerative medicine is also an important challenge. I expect silk to contribute to treatment as one such material, and I believe that our research will lead to the happiness of many patients.

Outlook for students after graduation

I train students to solve variety kinds of tasks required in society beyond industry boundaries by multi points of view getting through the study in interdisciplinary fields such as engineering, agriculture, and medical sciences.

A domestic silkworm (left) and cocoon (right). The silkworm is a protein factory that efficiently produces high-purity silk proteins with low environmental impact.

Sponge material made from 100% silk protein (fibroin). We are currently carrying out research on materials for cartilage regeneration, spinal cord regeneration, and surgical dressings for difficult-to-treat injuries.

Department of Applied Biology

Factory production of safe and reliable vegetables with high photosynthetic efficiency

Plant growth is limited by light-driven photosynthesis, but photosynthetic energy conversion efficiency is not very high. The goal of our project is to establish an energy-saving plant production system with maximum photosynthetic efficiency for factory use.

Professor
Masayuki Nozue

After completing a research course at the Nagoya University, Graduate School of Agricultural Sciences, Professor Nozue worked in the Faculty of Science, Shinshu University, then moved internally to the Faculty of Textile Science and Technology. His area of specialization is Plant Cell Physiology.

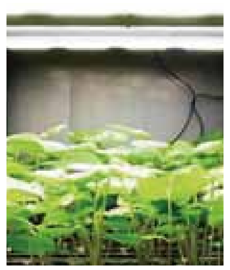
Outlook for research

Risks to the stable supply of agricultural products posed by global warming and natural disasters increase the importance of novel food production systems. The challenge is to establish an energy-saving plant growing system.

Outlook for students after graduation

Graduates are employed in a wide range of jobs, ranging from plant nurseries, food-processing companies, paper, drug pharmaceutical and food distribution industries to education and public service.

Research Center for Advanced Plant Factory (SU-PLAF)



Wasabi nursery plant production with white LED light

Romaine lettuce production with LED light

Department of Applied Biology

Creating new plants through green innovation

What would it be like if vegetables could cure allergies, rice could survive global warming, and fruit could grow easily inside a spacecraft? I am carrying out research on selective breeding using the genetic resources of plants to control their shape and form, for example regarding the nutrition of plant fiber, and to make them grow readily without contracting diseases.

Professor
Nobuaki Hayashida

After graduating from the Nagoya University Graduate School, Professor Hayashida worked at RIKEN and then moved to Shinshu University to establish the Gene Research Center before taking his current position in 2009. His area of research is plant molecular Breeding.

Outlook for research

In the future, it will be theoretically possible to create weeds that collect poisons that have spread through the environment or roadside trees that glow without using electricity, or to make different fruits like bananas or apples that taste like chocolate or vanilla all on a single tree, as one might expect to see in a comic book.

Outlook for students after graduation

Graduates work at food and pharmaceutical manufacturers and companies in the biotech industry in jobs related to research and development, quality control, and logistics control.

The greatest ability of plants is photosynthesis, but the white areas have lost that ability. Understanding why this is will lead to an understanding of photosynthesis itself.

Even though Chinese cabbage and turnips do not look alike, they are in fact a single species that can cross-pollinate. If we can understand why the forms are so different, we may be able to change the shapes of other crops in similar ways.

Department of Applied Biology

Researching human health and protection of the freshwater environment and analyzing water environment changes using aquatic insects as indicators

We are researching the relationship between the benthonic fauna of the freshwater environment (i.e., rivers, lakes, and marshes) and water qualities (trophic status). We use changes in the composition, densities and biomass of various species, and their role in the aquatic ecosystem to learn and monitor of the changes to the freshwater environment. We capture the signals given by aquatic organisms to learn about the current water environment and predict future trends.

Professor
Kimio Hirabayashi

Professor Hirabayashi took his current position in 2007 after working as an associate professor at the Yamanashi Women's Junior College, and as an associate professor on the Faculty of Textile Science and Technology, Shinshu University. He has served on the academic staff at the University College of London in the UK and at the University of Melbourne in Australia. Research keywords include Applied Ecology, Freshwater Biology, Sanitary Zoology, and Environmental Hygiene.

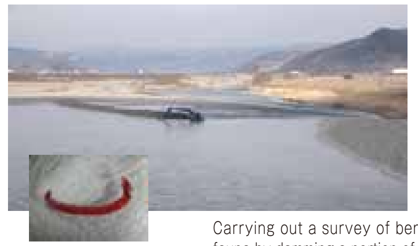
Outlook for research

Coexisting with nature is a great challenge. We believe it is important to find ways to do this by becoming highly knowledgeable about nature and living things. Why not become an environmental biologist?

Outlook for students after graduation

Our graduates are active as researchers at research facilities for pharmaceutical companies, local public organizations, pest control companies, and water quality inspection companies, etc.

Carrying out a survey of aquatic insects in the Azusa River, the Kamikochi Special Protected Zone, with permission from the Ministry of the Environment. (Background: Mt. Yakedake)



Chironomid larvae, *Propsolocerus akamusi*, used as an indicator of aquatic environments.

Carrying out a survey of benthonic fauna by damming a portion of a river, as part of a joint project with the Public Works Research Institute of the Ministry of Land, Infrastructure, Transport and Tourism.

Department of Applied Biology

“Self-recycling” and its application in hair science

Self-recycling is said to refer to the use of the tissues and biological substances in your body as raw materials and their transformation into useful processed goods. In my lab, we use hair and nail clippings that are generated as waste in daily life as a first step. We are currently pursuing development projects in the area of hair care, and several companies have started to make use of our findings.

Professor
Toshihiro Fujii

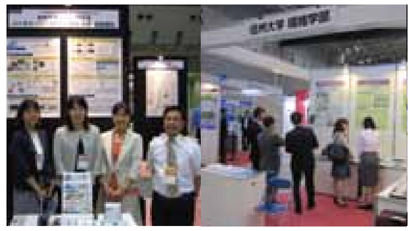
Professor Fujii's areas of research include self-recycling, the development of biomaterials, protein engineering, and biopolymers. He is a member of the Japanese Cosmetic Science Society, the Society of Fiber Science and Technology Japan, the Japanese Biochemical Society, the Society of Polymer Science Japan, and the Pharmaceutical Society of Japan. His areas of expertise include biochemistry, neuroscience, protein science, and history.

Outlook for research

This is an imagined conversation between students 50 years in the future.
Student A: Fifty years ago, when you had your hair cut at a salon or barber shop, they threw the cut hair away!
Student B: No, really? What a waste! It is such a valuable resource. In the past, they didn't have the technology to process and reuse it.

Outlook for students after graduation

Graduates are employed by such organizations as Shiseido, LION, Menicon, Asahi Kasei, Unicharm, Otsuka Pharmaceutical, Hisamitsu, Toray Industries, Toyobo, Seiko Epson, Murata Manufacturing, Dokkyo Medical University, Shinshu University, and Nagano Prefecture.



We announced and promoted keratin film at Cosmetics Japan, an international cosmetics trade show held at Tokyo Big Sight.

A study group aims to achieve a score of 700 on the TOEIC test.

Department of Applied Biology

Learning from the environment through environmental analysis and developing new environmental purification methods using materials creating by living organisms

I am carrying out research in a wide range of domains related to environmental contamination, from environmental analysis and toxicological testing to the development of environmental purification methods. This effort includes numerous activities, for example analyzing litter and searching in caves for microorganisms that might be useful in environmental purification. In recent years, my lab has been focusing on the development of environmental purification methods that use materials produced by living things.

Professor
Hiroshi Moriwaki

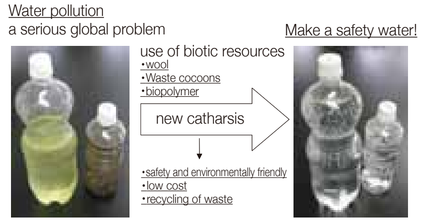
Professor Moriwaki took his current position in 2015 after working as a researcher at the Osaka City Institute of Public Health and Environmental Sciences and as an associate professor at Faculty of Textile Science and Technology at Shinshu University.His areas of research include environmental chemistry and analytical chemistry with a focus on the development of environmental purification and analysis methods as well as environmental monitoring.

Outlook for research

I believe that understanding the state of environmental contamination while developing purification methods is essential for the future of humanity. Through environmental analysis and research on purification, I hope to obtain results that prove useful in addressing numerous environmental problems.

Outlook for students after graduation

I carry out education and research to train students to become leaders in the next generation of environmental research and measures. Graduates are employed as public officials and by companies engaged in environmental analysis and inspection.



Throughout the world, countless children contract communicable diseases because they do not have access to safe water. In this way, purification is an extremely important research topic.

We analyzed mud from the moat of Osaka Castle to recreate 350 years in the history of the atmospheric environment. The aerial bombing during the war caused the greatest damage to the environment.

Department of Applied Biology

Using micromanipulation to study the mechanism of fertilization and preserve, regenerate, and utilize genetic resources

My lab studies physiological aspects of early events during fertilization in mammals as well as technical innovations involving the preservation and utilization of genetic resources. My students and I have published more than 100 research papers so far describing our research into haploid gametes (spermatozoa and oocytes) and diploid embryos from various mammalian species, including mice, rats, rabbits, cats, horses, buffalo, cattle, whales, and humans.

Professor
Shinichi Hochi

Professor Hochi took his current position in 2008 after working as a researcher (1986 to 1992) at Snow Brand Milk Products Co. Ltd., as a visiting assistant professor (1992 to 1995) and visiting associate professor (1995 to 1996) at Obihiro University of Agriculture and Veterinary Medicine, and as an assistant professor (1996 to 1999) and associate professor (1999 to 2008) in the Faculty of Textile Science and Technology at Shinshu University. He is engaged in research on reproductive physiology, cryobiology, and developmental engineering in small experimental rodents, large domestic animals, and humans.

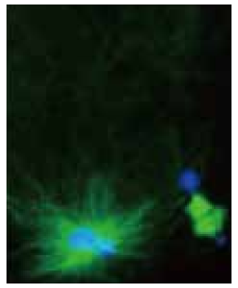
Outlook for research

Advanced reproductive technologies such as intracytoplasmic sperm injection and somatic cell nuclear transplantation made it possible to bring the mammoth back to life. Furthermore, we have recently established pluripotent stem cell lines in laboratory rats. If these ES or iPS cells could be differentiated into functional gametes, the process would be the ultimate treatment for infertility.

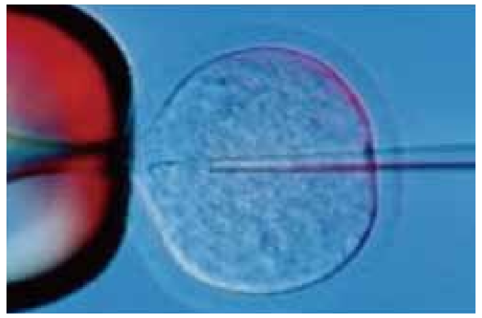
Outlook for students after graduation

Graduates are employed by pharmaceutical and food-related companies as well as national and local organizations (as public officials). In what has become a recent trend, some skilled graduates work at human infertility clinics as potential embryologists.

Micromanipulation enables us to handle not only oocytes with diameters of 100 to 120 μm, but also much smaller sperm cells.



A microtubule network can be assembled from a centrosome of spermatozoon immediately after fertilization.



Intracytoplasmic injection of fishhook-shaped rat sperm heads was difficult to achieve, but several clues helped us expand its application to freeze-dried spermatozoa.

Department of Applied Biology

Using insects' high-performance sensors to develop methods for extermination

I am carrying out research on the sensors carried by insects to monitor the arrival of the seasons via sensor proteins that respond to temperature and day length. My findings can be applied to the extermination of pests and invasive species through such techniques as causing eggs to hatch in winter and making adult insects without wings grow them. This approach is garnering attention as a pest extermination method that does not harm nature or humans.

Associate Professor
Kunihiro Shiomi

Associate Professor Shiomi took his current position in 2007 after serving in the Faculty of Textile Science and Technology at Shinshu University as an assistant professor. His areas of research include environmental molecular entomology and applied entomology with a focus on the dormancy, metamorphosis, and seasonal morphology of insects.

Outlook for research

The ability to control the dormant stage of insects is useful not only for exterminating pests, but also for protecting ecosystems. Further, I believe that explaining the ecology of insects can contribute solutions for global environmental, food-related, and medical problems.

Outlook for students after graduation

Graduates can find employment at food and pharmaceutical companies, environmental companies working with nature, companies engaged in genetic analysis, and even trade-related inspection companies.

A student observes cultured cells into which insect sensor genes have been inserted.

Useful genes are cloned from insects of the order Lepidoptera.

Hestina assimilis larva. There are many insects like this. Typically, students who gather in my lab are lovers of insects who see the appeal of their mysteries.

Department of Applied Biology

Studying the capabilities and survival strategies of insects and leveraging them in daily life

Insects are the most prosperous animals on earth. They employ artful survival strategies to adapt to the environment, and each species has developed unique features. I investigate attractive and useful capabilities of insects in order to leverage them to benefit our daily lives in the future. Insects are not completely different from us, a fact that is clear even if we only consider their morphology. Research into the special features of insects provides us with important clues to understanding ourselves as humans.

Associate Professor
Koji Shirai

Associate Professor Shirai took his current position after working as a COE special researcher at the National Institute of Sericultural and Entomological Science of the Ministry of Agriculture, Forestry, and Fisheries and as an assistant professor at Shinshu University. His areas of specialization are biological chemistry and molecular cell biology for utilizing insects and insect cells.

Outlook for research

The picture to the right shows a green larva. In this larva, dye-binding proteins are stored in granules in epidermal cells. My lab is researching the mechanism by which these granules are formed. By discovering how that occurs, we hope to also discover a mechanism by which secretory proteins can be maintained within cells.

Outlook for students after graduation

Graduates are active as researchers at food and pharmaceutical manufacturers and as public officials.

The green larva of the sweet potato hornworm, *Agrius convolvuli*, a large lepidopteran insect found throughout Japan.

A dye-binding protein extracted from the dermal cell of an insect. The protein contains clues about protein secretion control.

Department of Applied Biology

Exploring the undiscovered abilities of plants to tap their power to enrich our lives

I am carrying out research into the numerous functions of plants. For instance, plants have the ability to attach sugars such as glucose to substances they produce, store them in cells, and then remove the sugar later when it is required. My lab is examining whether this function can be put to use in medicine through application to the processing of substances.

Associate Professor
Goro Taguchi

Associate Professor Taguchi took his current position after working as an assistant professor in the Faculty of Textile Science and Technology at Shinshu University and at the University's DNA research facility. His area of research is applied biochemistry, specifically enzyme reactions and DNA analysis related to the production of useful plant materials and their practical application.

Outlook for research

The plants we are researching have the ability to neutralize hazardous substances to protect themselves, and this ability can be utilized for environmental cleanup. By researching and explaining the power of plants, we can discover numerous capabilities that can be applied in our daily lives.

Outlook for students after graduation

Graduates are employed by food companies and companies involved in analysis or pharmaceutical products. Many are also employed by agricultural companies.

The leaves of the mulberry tree contain a substance that is effective in lowering blood sugar. We are studying the mechanism by which that substance is created.

DNA is extracted from the familiar green horseradish leaf, which contains antioxidants.

A student analyzes the base sequence of DNA extracted from a plant.

Department of Applied Biology

Utilizing *Agrobacterium tumefaciens*, which carries out genetic engineering on its own

I am carrying out research on how to use *A. tumefaciens*, which has the ability to insert its own DNA into the chromosomes of plants, to develop DNA insertion methods for numerous crops; research to infect plants with *A. tumefaciens* to create useful substances; and research to alter *A. tumefaciens* through genetic engineering to give the bacterium new capabilities.

Associate Professor
Masahiro Nogawa

Associate Professor Nogawa took his current position after working as an assistant professor at the Nagaoka University of Technology and as an assistant professor in the Faculty of Textile Science and Technology at Shinshu University. His principal areas of research are genetic engineering and applied microbiology focusing on plants and microorganisms.

Outlook for research

In addition to creating plants that do not need pesticides, we can create raw materials for industry and pharmaceuticals. Through the use of genetically modified plants, these substances will be created using only solar energy and CO_2.

Outlook for students after graduation

While many graduates are employed by food companies, others work at computer and chemical companies and as public officials, for example as plant protection officers.

A.tumefaciens is injected into a turnip.

DNA from *A. tumefaciens* has caused this turnip to turn green.

Untransformant Transformant

Branching in this mulberry tree has been increased from a state of apical dominance through the increase in expression of cytokinin due to genetic modification.

Department of Applied Biology

Creating new plants based on knowledge of basic plant science in order to contribute to the development of a sustainable society

I investigate the molecular mechanisms by means of which plants protect themselves from salinity stress (high-salt environments) using the experimental methods of molecular biology, molecular genetics, and plant physiology. I hope to develop innovative technology to generate salt-resistant crops in order to increase agricultural yields in salt-affected areas.

Associate Professor
Tomoaki Horie

Associate Professor Horie took his current position in 2010 after working as a researcher at the University of California, San Diego, and as an assistant professor on special contract with the Institute of Plant Science and Resources at Okayama University. His research centers on the basic molecular physiology of plants and plant genetic and cellular engineering based on it.

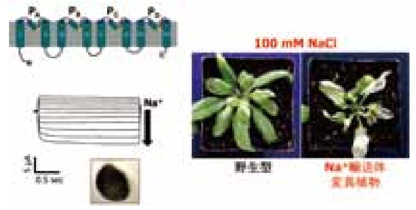
Outlook for research

I expect that my lab's research could become an important element in avoiding food and energy shortages that are expected in the near future if we can apply knowledge obtained from basic plant science to breed salt-tolerant plants.

Outlook for students after graduation

Many of the students in my lab choose to pursue careers with companies whose work involves plants. Graduates also tend to be interested in working for companies that develop distinctive environmental technologies or in becoming teachers.

My lab focuses on rice and plants in the genius Arabidopsis for molecular physiological studies using wild-type and Na^+ transporter-mutant plants. The picture shows an example of a hydroponic culture of rice plants.



We analyze the target Na^+ transporter that is essential for plant salt tolerance in the oocyte expression system of *Xenopus laevis*. We are attempting to produce mutagenized Na^+ transporters, which we expect to increase the salt tolerance of the host plants.

Department of Applied Biology

Making effective use of microorganism resources: Discovering and applying the potential capabilities of *Bacillus subtilis*

In order to discover the novel functions and networks of the 4,100 genes that make up the ***Bacillus subtilis*** genome, my lab is cooperating with domestic and international research labs to carry out more detailed research. We believe that ***B. subtilis*** is an important microorganism resource, and we are working to develop a deeper understanding of its potential so that we can utilize it.

Associate Professor
Hiroki Yamamoto

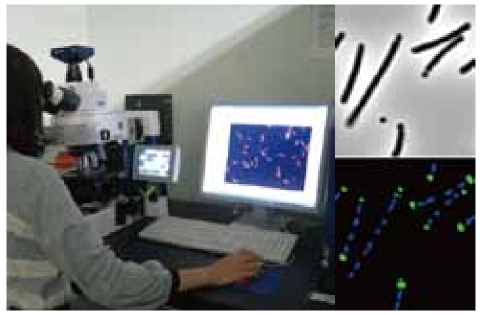
Associate Professor Yamamoto took his current position in 2007 after serving in the Faculty of Textile Science and Technology at Shinshu University as an assistant professor. His areas of research include microbiology to examine the properties of molecules functioning in the cells of microorganisms and applied microbiology to make use of the latent capabilities of microbes.

Outlook for research

In the future, my goal is to establish a rare metal recovery system using ***B. subtilis*** strains with altered cell wall polymers, to make effective use of the genetic resources of its closest relatives, and to apply associated technology to the development of antibacterial agents for pathogenic bacteria.

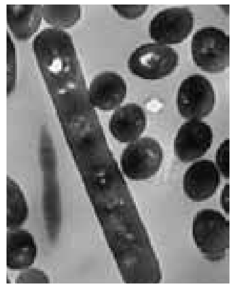
Outlook for students after graduation

Graduates are typically employed by food and pharmaceutical companies. Some choose to continue their research at domestic and overseas research organizations.



A student uses a fluorescence microscope to assess the effect on the cell when cell wall polymers are modified.

A student searches for bacterial substances that will activate the immune system of animal cells.



We also make observations using an electron microscope so we do not miss slight changes.

Department of Applied Biology

Understanding the nature of stem cells and controlling their fate

Regenerative medicine using iPS cells is expected to serve as a novel approach for curing disease. My lab is focusing on germline stem (GS) cells, tissue-specific stem cells in testis. Although GS cells have already committed to germ cell lineage, they also have pluripotency potential and often de-differentiate into multipotent GS (mGS) cells that possess pluripotency like iPS cells. The goal of our research is to understand the unique nature of GS/mGS cells and control their fate.

Tenure-track Assistant Professor
Seiji Takashima

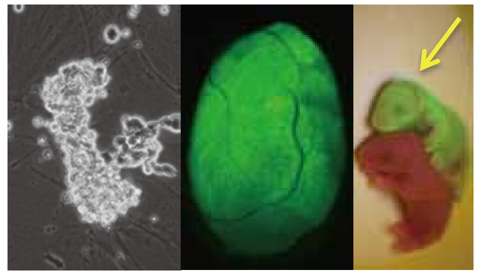
After receiving a doctorate (in engineering) from the Tokyo Institute of Technology, Assistant Professor Takashima worked as a research fellow at the University of Tokyo before coming Kyoto University as an assistant professor. His areas of research are regenerative medicine and stem cell biology.

Outlook for research

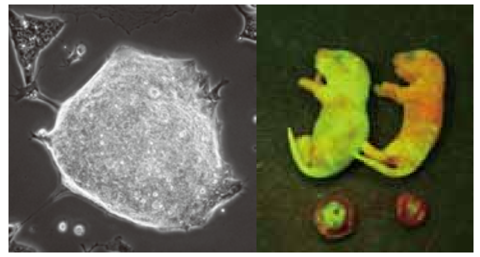
The spermatogenic potential of GS cells is expected to find application not only in treating male infertility, but also in producing superior livestock. In addition, mGS cells are expected to serve as another source of pluripotent stem cells such as iPS cells. In this context, GS cells might be called multipotent stem cells with the potential to contribute to a wide range of fields.

Outlook for students after graduation

The value of the market associated with regenerative medicine is expected to grow to 1 trillion yen in 2020 (according to statistics from the Ministry of Economy, Trade and Industry). It is my hope that our future colleagues will be able to play a remarkable role in growth industries, including in regenerative medicine.



GS cells. Left: Mouse GS cells growing in vitro. Center: Spermatogenesis in the testis transplanted with GS cells expressing green fluorescent protein (GFP). Right: Mouse offspring produced from sperm derived from GS cells expressing GFP. The offspring also exhibited green fluorescence under UV light (highlighted with).



The pluripotency potential of GS cells. Left: mGS cells de-differentiated (rejuvenated) from GS cells. mGS cells possess pluripotency like iPS cells. Right: mGS can contribute to the formation of "chimera mice." mGS-derived tissue in the chimaera mice exhibited GFP expression.

Department of Applied Biology

Designing and applying useful proteins by studying the structure and function of proteins

I am carrying out research to gain a deep understanding of the structure and function of proteins and to design, develop, and apply useful modified and artificial proteins. Based on my goal of achieving results that will prove useful in addressing biological resource issues and environmental problems, my lab uses cutting edge chemistry to see, examine, create, and apply proteins.

Associate Professor
Ryoichi Arai

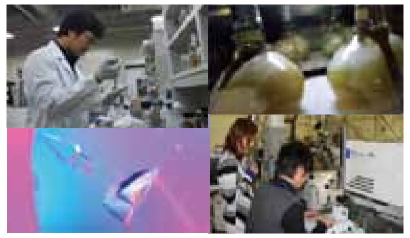
Associate Professor Arai took his current position in December 2007 after working as a researcher at RIKEN and Princeton University in the U.S. His areas of research are structural biology, which he uses to examine the three-dimensional structure and function of proteins, and protein engineering, which he uses to find applications for proteins through their modification and design.

Outlook for research

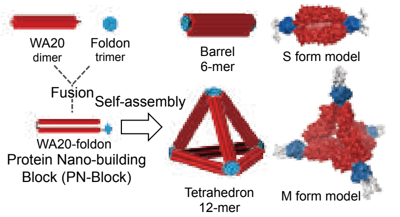
My goal is to apply proteins in new fields, for example in pharmaceutical development and biotechnology, in order to create eco-friendly high-function nano-materials, clean chemistry catalysts, and high-sensitivity biosensors. In this way, I hope to contribute the achievement of a sustainable and abundant society.

Outlook for students after graduation

Graduates are employed in numerous fields, including at pharmaceutical, enzyme, and chemical companies.



An experiment in the research lab (upper left), production of useful proteins with microorganisms (upper right), a protein crystal that shines like a precious stone (lower left), and an x-ray diffraction experiment at a synchrotron radiation facility (lower right)



Self-assembling nano-architectures are created from a protein nano building block by fusing a dimeric de novo protein WA20 and a trimeric foldon domain from T4 phage. (Kobayashi, N., et al., J. Am. Chem. Soc., 137, 11285-11293, 2015)

Department of Applied Biology

To investigate the characteristics of the biological material, to develop a new medical device

Decellularized tissues are prepared from biological tissues, and are clinically used in Europe and U.S. The decellularized materials show biocompatibilities at implanted sites. It is possible to transplant animal tissues to humans by decellularization treatments. The object of our research is an application and an investigation of these decellularized tissue properties for use in medical devices. The vacuum pressure impregnation technique is able to easily rehydrate materials. Our research aims to fabricate a new medical material using this technique.

Assistant Professor
Jun Negishi

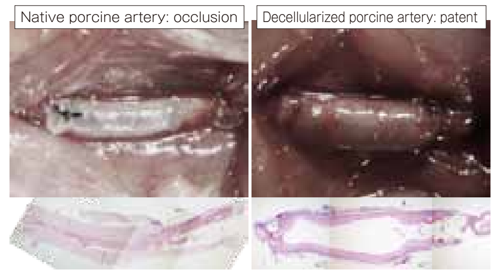
After receiving a doctorate in Tokyo Medical and Dental University, Assistant Professor Negisih worked as a JSPS post doctor at Sapporo Medical University before coming ADEKA as a research worker. His areas of research are biological materials.

Outlook for research

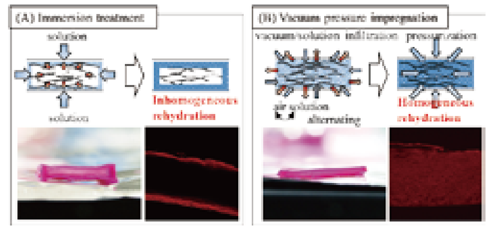
Biological materials such as a decellularized material are able to mimic complex structures of animal tissues and can be used as a remodeling material by patients' own cells. It would be possible to fabricate tissues and organ in vitro by combining these materials and stem cells. Using other filed techniques may lead a novel medical device fabrication.

Outlook for students after graduation

Students learn to think by themselves and take initiative in this research lab, and this prepares them to work by well in groups or by themselves. They are equipped to pursue careers across a variety of scientific fields.



(Left) A native porcine artery after 3 days in rat carotid transplantation. (Right) A decellularizzed porcine artery after 2 weeks in rat carotid transplantation.



(A) A freeze-dried aorta after 10 min immersion into PEG. (B) A freeze-dried aorta after PEG hydration by vacuum pressure impregnation (VPI). The VPI treated aorta showed homogeneous rehydration.

Department of Applied Biology

Moving from understanding of functional biomolecules to their application, utilizing unused protein resources, and developing production technologies

I am carrying out research on proteins, a principle type of functional biomolecule. My lab uses molecular biology and genetic engineering technology to identify and improve useful proteins such as enzymes and to develop protein-manufacturing technologies.

Assistant Professor
Takaomi Nomura

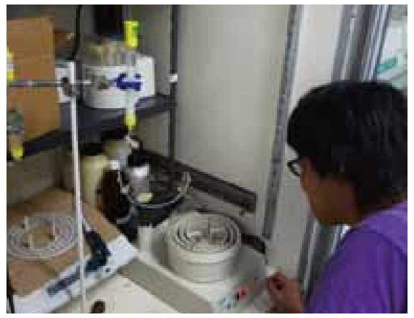
Assistant Professor Nomura took his current position in 2008 after working at the Lion Corporation Research Center and as a research associate and assistant professor in the Faculty of Textile Science and Technology at Shinshu University. His principal area of research is the analysis of functional biomolecules using molecular biology and genetic engineering technology.

Outlook for research

The identification of new enzymes and their improvement through genetic engineering are expected to contribute to many domains, including food, medicine, and chemical synthesis. We are also attempting to develop technology for making the production of useful proteins possible through alteration of ribosomes and related factors at the molecular level.

Outlook for students after graduation

Many graduates are employed as researchers in a variety of fields, including by food and pharmaceutical companies and chemical manufacturers that handle various materials.



A student conducts an experiment to refine protein. A target protein is being extracted from among the immense number of proteins that exist within living organisms.

We are attempting to apply more advanced functionality to proteins by modifying them through genetic engineering.

Division of Gene Research

Elucidating genome functions for food production

I use DNA sequencing technology that has shown significant technical advancement in recent years to carry out research that contributes to the selective breeding of crops. My lab has used plant materials ranging from rice and mulberries to tropical crops obtained in collaboration with Okinawa Prefecture to carry out research into the efficient breeding of new varieties.

Associate Professor
Hideo Matsumura

Associate Professor Matsumura took his current position in January 2010 after working as a senior researcher at the Iwate Biotechnology Research Center. His areas of research include functional genomics for large-scale analysis of gene expression and plant breeding.

Outlook for research

I hope to utilize genomic information to improve breeding systems so that we can achieve stable food production.

Outlook for students after graduation

I hope that graduates will pursue careers in research or food-related businesses.

A DNA sequencer can be used to sequence isolated genes.

We collaborate with Okinawa Prefecture to understand the papaya' s sex determination mechanism.

Division of Gene Research

Understanding the development of biofilms to explore the survival strategies of bacteria based on genomic information

In the natural environment, many bacteria form biofilms and communicate with each other. I am carrying out research to culture bacteria attached to solid surfaces to understand which genes work in which ways as they develop into biofilms. I believe my lab's research will play a useful role in future development of medicines targeting problem-causing bacteria in the industrial and medical domains.

Assistant Professor
Hiroshi Ogasawara

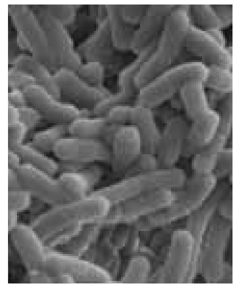
Assistant Professor Ogasawara took his current position in 2011 after working as a researcher at the Hosei University Research Center for Micro-nano Technology and in Shinshu University' s Faculty of Bioscience and Applied Chemistry. His research explores gene expression networks related to the formation of biofilm in bacteria.

Outlook for research

Bacteria, which can adapt to numerous environments, do not always express all of the genes present in their genomes. By studying the mechanism by which bacteria express certain genes depending on conditions, it will become possible to utilize the capabilities of each bacterium to maximum effect.

Outlook for students after graduation

While many graduates are employed by food and textile manufacturers, they can also pursue careers at pharmaceutical and other biotech companies.



An electron micrograph of *Bacillus subtilis*. Many bacteria form biofilms.

We conduct detailed analyses of genes involved in the biofilm formation of bacteria based on genomic information.

A student examines the culture conditions that activate gene expression. Bacteria have the ability to quickly adjust the functioning of their genes in response to external environmental changes.

Textile Education

Using fiber and machine fabrication technology to actually make things

Textile Education

Our undergraduate and graduate students experiment with textile fabrication technology using spinning machinery, which makes thread from raw fiber materials, and other equipment while carrying out research and experiments in an effort to develop new materials. Further, in the adjacent Textile Prototype Development Center, an extensive array of testing equipment is available for tasks such as evaluating the properties of threads and fabrics.

Machine Fabrication Education

Students of the Functional Machinery and Mechanics Course and Bioengineering Course use machining and measurement rooms for experimentation and practice in the area of machine fabrication. Technicians also create and fabricate experimental equipment upon request from other departments and courses. Most importantly, these facilities enable students to experience the process of creating things by actually fabricating, creating, and measuring their own experimental devices.

Textile machinery

Machine tools

Experimental Farm

Fostering creativity through education in textile materials

At the Experimental Farm, we train highly inquisitive and creative students with distinctive personalities through the technical application of academic theory to textile raw materials and ingredients and through research education relating to field science with the goal of contributing to the development of the community.

The entrance to the Experimental Farm Laboratory on the on-campus Experimental Farm is surrounded by cherry blossoms.

Outlook for research

In practical field science, farming activities that are also popular outside the department include the study of cotton cultivation, sheep shearing, silk cultivation, and natural silkworm cocoon and egg collection as well as sweet potato planting and harvesting, potato harvesting, and buckwheat cultivation.

Inquiries

Campus Farm: 3-15-1 Tokida, Ueda, Nagano Prefecture
Omuro Farm: 6788 Kano, Tomi, Nagano Prefecture

Fifth instar domestic silkworm larvae just before the pupa stage (left) and fifth instar wild (natural) silkworm larvae (right)

Cotton balls that have burst open during cotton cultivation (left) and collected silkworm cocoons (right)