§ Opening Interview

Complex and Microstructure Machining That Made the Impossible Possible

~ Three-Dimensional Lithography Method, a Fundamental Technology for Society 5.0 ~

Division of Robotics and Intelligent Systems, Graduate School of Science and Technology
Professor Takaaki Suzuki

Professor Takaaki Suzuki is engaged in the design, analysis, and development of ultra-fine processing technology and its systems in units of micrometers and nanometers. The original processing technology he developed is called "Three-dimensional (3D) lithography," announced in 2006. It is an innovative photolithography method (light shaping) where the inclined substrate is rotated during exposure. Previously, there was no technology capable of processing the intermediate size between "small machinery/precision products" found in smartphones and the nanoscale precision of semiconductors, which roughly falls from a few micrometers to sub-millimeters. The 3D lithography method is the method aiming to fill this gap. He has received the Minister of Education, Culture, Sports, Science and Technology Award and obtained patents in Japan and the United States. 3D lithography has evolved into an innovative technology capable of processing three-dimensional microstructures previously unachievable with existing techniques. It is now applied in high-performance biotechnology, optics, and IoT (Internet of Things), advancing innovation in Japan's manufacturing sector.
§ Sprout

Numerical Simulation of Fluid Phenomena

Division of Electronics and Information Sciences, Graduate School of Science and Engineering
Assistant Professor Anna Kuwana

Assistant Professor Anna Kuwana researches "fluid dynamics." Fluids, such as water and air, are representative examples, and their motion can be observed in various everyday situations. For instance, Hydropower, which accounts for approximately 8% of domestic power generation, utilizes the force of flowing water to rotate large turbines and generate electricity. Indoor ventilation, which has gained attention during the COVID-19 pandemic, is one scenario where the management and control of fluid motions are essential. Her specialization lies in the technology of simulating and observing fluid phenomena by solving equations that describe fluid motion using computers. This field of study is known as computational fluid dynamics.
Development of Glycan Molecular Tools for Enzyme Reaction Analysis

Division of Molecular Science, Graduate School of Science and Technology
Assistant Professor Ishii Nozomi

Within our bodies are biomolecules called glycans, consisting of monosaccharides such as glucose linked together in chain-like structures. Glycans are involved in various biological phenomena, including viral and bacterial infections, carcinogenesis, and cell differentiation. Due to their significance in these processes, they are often called the "third chain of life," following nucleic acids and proteins. For example, in genetic information transfer in living organisms, DNA serves as the blueprint, and the information is transmitted from DNA to RNA through transcription and then from RNA to protein through translation. However, there is an additional step in protein synthesis known as "post-translational modification." This process diversifies the properties and functions of proteins and is involved in protein folding (the process of acquiring stable, distinctive, and functional structures), stability, and transport. Approximately 60% of proteins undergo post-translational modification in glycosylation, where glycans are added to them.

Liquid Infiltration into the Gaps between Microstructures

Division of Robotics and Intelligent Systems, Graduate School of Science and Technology
Assistant Professor Ayako Yano

Assistant Professor Ayako Yano has been researching the infiltration of liquids into micro-scale structures with dimensions in the range of micrometers since 2020. This research is aimed at applications in industries that involve liquid-based surface treatment of microfabricated systems, and she is compiling fundamental data on their characteristics. For example, in semiconductor manufacturing processes, wafer surfaces with microscale irregularities are cleaned with water, but a challenge arises in determining whether the cleaning reaches all the gaps. She hopes to apply her research findings to address such issues in this field. Currently, she is conducting
experiments using microstructures made of glass and collecting data. Starting from April 2022, she has been supported by the Grant-in-Aid for Early-Career Scientists Program.

§ Research Activities Opening Up New Frontiers

Dementia Rehabilitation Enhances Quality of Life

Department of Rehabilitation Sciences, Graduate School of Health Sciences
Associate Professor Tetsuya Yamagami

Associate Professor Tetsuya Yamagami is researching methods for preventing the onset and progression of dementia, as well as preventive care and community rehabilitation. He has been consistently engaged in research on dementia rehabilitation since his undergraduate study at the university. This research aims to delay the progression of dementia and enable individuals to maintain a high quality of life according to the severity of their symptoms, fostering a sense of purpose. Over the past five years, he has been conducting collaborative research with a company on the relationship between the daily walking speed of older adults and cognitive function. He intends to apply this research to the secondary prevention (early detection) of individuals at high risk of dementia.

Development of Ideal Antibodies that Simultaneously Attack Cancer cells and Improve Immune Function

Global Initiative for Advanced Research
Associate Professor Takehiko Yokobori

Associate Professor Takehiko Yokobori is working on two challenging themes related to cancer. One is the development of ideal antibodies that attack cancer cells and enhance immune function. The other is the creation of "cancer markers" that can detect the presence and progression of various types of cancer. He is a surgeon, and he started researching "cancer markers"
during the latter stages of his graduate program, but after completing his studies, he
transitioned to the clinical field. After that, however, he shifted his focus towards
research. He felt a growing desire that if patients' diseases could be diagnosed earlier, he
could help more cancer patients. Therefore, he is actively engaged in research to deliver
his findings to patients suffering from cancer and make a difference in their lives.

§ Close-Up

Aiming for a "Mentally Healthy Society" Cooperating with Society

~ Build a Model for Information Distribution to
the Youth Generation ~

Department of Neuroscience and Psychiatry, Graduate School
of Medicine
Professor Masato Fukuda

Professor Masato Fukuda leads education and research in the
Department of Neuroscience and Psychiatry of the Graduate
School of Medicine. He also provides clinical care to patients
visiting the psychiatric neurology department at the Gunma
University Hospital. Mental disorders are one of the five national
diseases defined by medical regulations. Amidst the increase in individuals, particularly
young people, facing concerns and anxieties during the COVID-19 pandemic, Professor
Fukuda, as a psychiatrist and researcher at the university, has gained attention from
educators and individuals that support young people. His work has been highly praised
based on his achievements in education, research, and clinical work and his longstanding
efforts in collaborating with society (such as distributing information to young people and
promoting societal understanding of mental illnesses). His achievement is a model of
collaboration between universities and society regarding young people's mental health.
As part of Gunma University's recent community contribution project, three booklets on
collaboration with society have been created and published. One of the booklets,
published this spring, was in response to the revival of mental disorder education in high
school health and physical education after a 40-year hiatus, and it received significant
attention, including coverage in national newspapers. Alongside the practical application
of optical topography examinations in diagnosing mental disorders through brain imaging
research, these efforts aim to achieve a "mentally healthy society."
§ Prism

Hosting Ukrainian Students and Researchers

Gunma University, in collaboration with the Ukrainian Embassy, has been accommodating Ukrainian students and researchers who were deprived of learning opportunities due to the armed invasion by Russia in February of this year. The university has provided them with accommodations and waived their tuition fees. Additionally, they have received support for travel and living expenses from the Japan Foundation and economic and material assistance from Gunma Prefecture, Maebashi City, Takasaki City, Maebashi Rotary Club, and the general public. As a result, one researcher and four students can pursue their studies and research with peace of mind.

In September, three of them gave a lecture at Ota High School about the current situation in Ukraine. They used photographs to depict the devastating conditions of the war-torn cities and expressed their desire for peace, urging the audience to understand the truth. Students responded with comments such as, "We were once again reminded of how terrible it is for everyday life to be destroyed by one person's decision. We want to think about what we can do for the evacuees from Ukraine. We want to discern the facts from misinformation."

They stated, "Our mission, as those who have found refuge here in Japan, is to convey the truth of what is happening in Ukraine to as many people as possible in Japan."

Ukrainian students and researchers
At Global Exchange Seminar

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