Special Committee on Globalization of Education & Research, Faculty of Science & Engineering, Iwate University

KENGURO Quarterly 季刊報 FY2017 Digest

3D Ganchan: Produced by an on-campus company, MMM

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Focus on !! Interviews with international students about their research

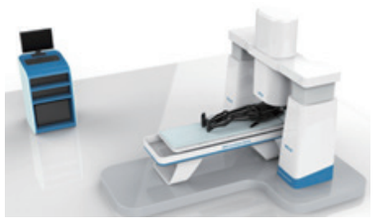
Currently, approximately 110 international undergraduate and graduate students, mainly from Asian countries (China, Korea, Bangladesh, Mongolia etc.), are studying at Faculty of Science and Engineering. This time, we interviewed three international graduate students for their research and living at Iwate. Here are the reports.

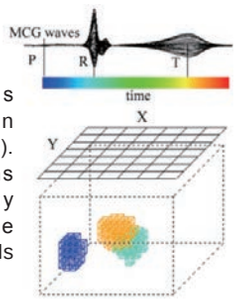
Mr. Wenxu Sun (China) Electrical Engineering and Computer Science D3

【Research theme】:「3-D Visualization of cardiac activity using Magneto-cardiography」

He researched here for 3 years. Next month, he is transferring to National cerebral and Cardiovascular Center Hospital in Osaka to operate clinical testing of Magneto-cardiography. He has two little children. He also mentioned about the kindness of professor and how earnest the students are here.

Electrochemical activity of cardiac muscle cells gives rise to an electromagnetic field. To study the electrical activity of the heart, this field is measured and analyzed: Electrocardiography (ECG) measures differences of electric potential on the body surface, and magneto-cardiography (MCG) measures the magnetic field outside the body. Since the MCG usually has multi-channel and high sensitivity, it is largely expected for clinical applications. However, the biggest challenge for MCG application is 3-D cardiac visualization technic. That is using the measured signals to estimate the current sources. In the past decades, the equivalent current dipole model was usually used for MCG source localization. However, single or several dipoles cannot well explain the measured data. In my research, we developed a spatial filter method to visualize the cardiac electrical activities. And it can also construct a reliable 3-D outline of the cardiac.



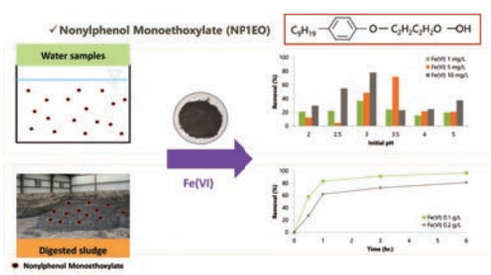


Contactless examination with MCG (top). Active regions of cardiac by analyzing the detected signals (right)

Ms. Limmun Warunee (Thailand) Frontier Matter and Function Engineering D2

【Research theme】:「Removal of NP1EO in water and sludge samples by potassium ferrate」

Sewage sludge has been increasingly recognized as a resource rather than a waste. The sludge can be reused as fertilizer or soil conditioners as an alternative management option to disposal. However, sewage sludge also contains toxic and micropollutants such as nonylphenol monoethoxylate (NP1EO), pharmaceuticals and heavy metals, which might have adverse impacts on human health and ecosystem at very low concentrations. In biological wastewater treatment process, NP1EO are degraded incompletely and tend to remain in sewage sludge. Therefore, it will be necessary to remove NP1EO in sludge before being discharged to the environment. Potassium ferrate (K_2FeO_4, Fe(VI)) is a strong and ecologically friendly oxidant. Consequently, Fe(VI) was used as procedure to mediate NP1EO degradation. The maximum removal efficiency of NP1EO was 78% and 97% in water and sludge samples under conditions examined in this study, respectively. This study demonstrated that Fe(VI) had a potential to degrade NP1EO in water and sludge samples.



Before entering Iwate Univ., she was a teacher of Univ. in Thai. The cold weather in Morioka was really tough for her at first. Someday, she wants to climb up Mt. Iwate. One request to Iwate Univ. is that it will be helpful to those international students if there are English version of the application forms to apply for the Graduate School.

Ms. Tasmin Nishat (Bangladesh) Computer Science and Intelligent Systems M1

In 2017, she entered Hirayama Lab, which her husband was in. She is learning the Japanese language eagerly and tried for the Japanese-Learning Proficiency Test. She also loves to watch Japanese animations, especially "Heidi." She watches those with her two-year-old son together.

【Research theme】:「Machine Learning Algorithm Implementation in FPGA」

There are various machine learning algorithms in the field of Artificial Intelligence (AI) which provides systems the ability to learn and improve from experience automatically. Now the question is "What is AI?" AI is the development of computer systems which is one kind of intelligence demonstrated by machines. In contrast, the natural intelligence is displayed by human and other animals. AI has applications in the internet of things (IoT), deep learning, machine learning, robotics, etc. Let's discuss simple examples of the machine learning algorithms which we are using every day such as Facebook, Google Maps, Google Search, etc. Consider Facebook. When Facebook prompts you to tag your friends, it uses some kind of impressive technology to recognize familiar faces from your contact list. For this, Facebook uses a machine learning algorithm. I want to develop a computer program for the machine learning algorithm that can run in Field Programmable Gate Arrays (FPGAs), where an FPGA is one type of chip which can be programmed after manufacture. We will use this algorithm in numerous applications such as the mechanical control, the sensor monitoring, and the opponent of a game who needs reflexes like fighting games.

Focus on !!

Introducing research work by young faculty members at the Faculty of Science and Engineering !!

Kenguro Quarterly regularly introduces young faculty members to spread outstanding research achievements to the rest of the university and society at large. The following faculty members will introduce their research themes relating to this: Assistant Professor, Toshihiko Mandai from the Chemistry Course of the Department of Chemistry and Biological Sciences, Associate Professor, Taku Ozaki from the Biological Sciences Course of the Department of Chemistry and Biological Sciences, Assistant Professor, Haruka Taniguchi from the Mathematical Science and Physics Course of the Department of Physical Science and Materials Engineering, and Assistant Professor, Takami Abe from the Electrical, Electronic, and Communication Engineering Course of the Department of Systems Innovation Engineering.

★ Assis. Prof. Toshihiko Mandai: Development of electrolyte materials for innovative batteries

Lithium ion secondary batteries are widely spread and used for various electronic devices from small ones like mobile phones and laptop PC to large including electric vehicles. Different large-scale energy storage technologies are however strongly required to realize an energy and materials sustainable society (Figure 1). Our lab engages in research and development of so-called innovative batteries. Innovative batteries, especially multivalent metal batteries based on magnesium, zinc, and aluminum, are one of the most promising technologies to respond the growing demands for electric power owing to many advantageous properties of these multivalent metals than those of lithium, i.e. large volumetric capacity, large natural abundance, and low cost. Moreover, development of the multivalent metal batteries would offer improved safety. One of the major obstacle for materialization of such batteries is the very stable passivation film on these multivalent metal surface, which make the metals inactive electrochemically. Many researchers have focused on the electrolytes with high reactivity (thus unstable in the air) that could remove this passive film. We here designed novel electrolytes not “destroy the passive film” but rather “prevent passivation of metal” (Figure 2). I believe that the development of electrolyte materials from diversified standpoints – electrochemistry, structural chemistry, and organic chemistry – will bring practical innovative batteries.

Figure 1: Future society realized by innovative batteries

Figure 2: Structure of newly synthesized magnesium salt

Assis. Prof. Mandai examines molecular design

★ Assoc. Prof. Taku Ozaki: Focusing on the physiological function of mitochondrial protease !

Calpain is one of the intracellular proteases and controls various vital phenomenon including generation, cell differentiation, and cell death. People had thought calpain only existed in cytoplasm until 2005 and we discovered that there are two types of calpains in the mitochondria, an organelle. We found that these calpains play roles for cell death and energy generation. We are currently studying a novel mitochondrial calpain and its functions.(Figure 1)

We also focused on the fact that many proteins related to cell death are combined with other partner proteins including molecular chaperone and scaffolding protein. And we discovered a way to control the function of the proteins by introducing peptide to competitively inhibit their interaction. We are now developing new peptide drugs for neurodegenerative diseases of the brain and retina.(Figure 2)

Assoc. Prof. Taku Ozaki

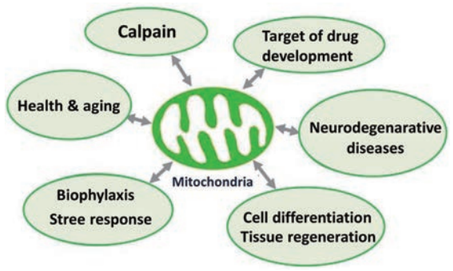


Figure 1: Studying life phenomena centered around mitochondria

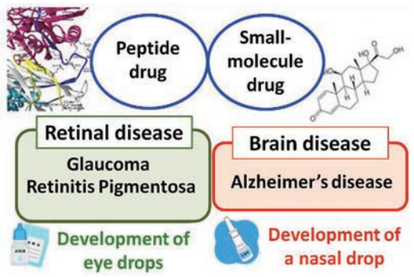


Figure 2: Drug development against neurodegenerative diseases

★ Assis. Prof. Haruka Taniguchi: In search of new multiferroics!!

Electrons that decide the nature of solid substances have the charge degree of freedom and the spin degree of freedom (the direction of the small magnet which each electron has). For normal substances, an electric field affects the electrical charge and a magnetic field affects the spin. However, interestingly, their interactions crisscross in “multiferroics” that have both spontaneous electric polarization (macro-deviation of electrical charge) and magnetic order (periodic structure of the spin). The electric field affects the magnetic nature and the magnetic field affects the electric nature (magnetoelectric effect), and this effect can be applied to energy-efficient memory devices. Our lab synthesizes various polycrystalline manganese oxides and investigates the dielectric and magnetic properties in an attempt to discover new multiferroics. Some substances exhibited a dielectric constant anomaly and magnetoelectric effect. Now, we engage in collaborative research to grow single crystals and are studying how electric and magnetic characteristics will change when directions of electric field or magnetic field are changed. By identifying the conditions for the reinforcement of multiferroic characteristics, we will elucidate the mechanism of the magnetoelectric effect in each group of substances and further discover more highly-functional new substances.

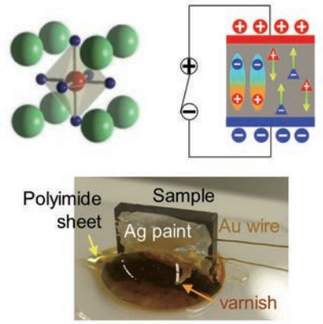


Figure 1: Crystal structure of manganese oxide (top left), conceptual illustration of measuring the dielectric constant (top right), and sample prepared for the dielectric measurement (bottom)

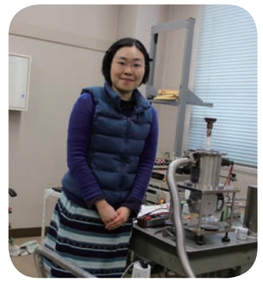


Figure 2: In front of a GM freezer that can cool down to -268 ℃. Low temperature experiments have an advantage in controlling the effect of heat fluctuation to extract the essence of substances.

Figure 3: Staff and students of Matsukawa Lab that Taniguchi is affiliated with (at the lab’s welcome party)

★ Assis. Prof. Takami Abe: Research on optical devices using a ZnO single crystal substrate!!

Zinc oxide (ZnO) is a chemical compound made of oxygen and zinc and widely used in familiar products including face powders, sunscreen, and a wide range of medical products such as ointments. ZnO is a wide-bandgap semiconductor with a bandgap of 3.37 eV at room temperature and expected to become a material for high efficiency UV-LED and UV sensors.

We have so far developed a homojunction UV-LED using the ZnO single crystal substrate to confirm the exciton emission and successfully improved the luminous efficiency by developing the ZnO/MgZnO heterojunction UV-LED. We also engage in research on photoconductive UV sensors using the ZnO single crystal substrate and already confirmed that weak UV leaking from fluorescent light can be detected with high sensitivity. These sensors have very a simple structure and their traits include compact size and durability as well as high photosensitivity (Figure 1). We are also working to develop a radiation detector by applying this UV sensor to combine with UV scintillator (YAP:Ce) and confirmed that it worked as the radiation detector by using X-ray as a sources of radiation. In addition, we started growing a ZnO single crystal as a basis of this research work (Figure 2) and are looking to further accelerate the research on ZnO devices.

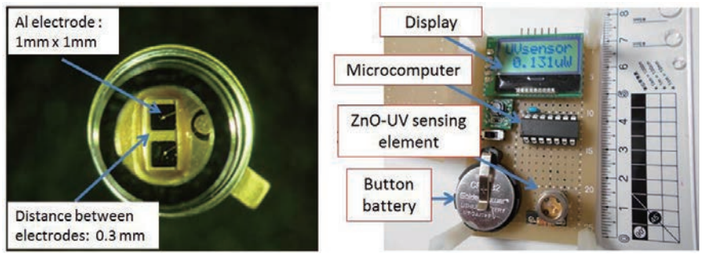


Figure 1: Prototype of ZnO-UV sensing element and canned package (top left) and exterior of the UV sensor equipment (top right)

Assis. Prof. Takami Abe

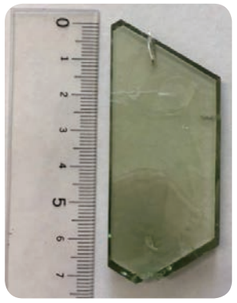


Figure 2: ZnO bulk single crystals were actually grown.

★ 26 guests from King Mongkut's Institute of Technology, Thailand

A group of 26 guests from the King Mongkut's Institute of Technology Ladkrabang (KMITL) in Thailand visited for three days from June 15 to 17, 2017. This group, including faculty members, technical staff and students, visited Iwate Univ. to participate in the first Joint International Symposium. Faculty members from both universities gave keynote speeches. This was followed by two sessions in which participants split into two groups to introduce their research in the physics/mathematics field and the chemistry/biochemistry field respectively. A total of 39 participants, 16 from KMITL and 23 from our Faculty participated in this two-day symposium. Students and technical staff also got to know each other through the poster session and other activities.

As part of the visit, they took a tour around research labs and technical staff from both universities exchanged their knowledge. Iwate Univ. technical staff showed them experiments done by the students of the Department of Chemistry and Biological Sciences, the Advanced Manufacturing and Prototyping Center, and the Center for Hiraizumi Studies. All the Thai participants received name plates made with a combined machine tool called the machining center in the Advanced Manufacturing and Prototyping Center as a gift. They enjoyed visiting Geibikei Gorge in Ichinoseki and Hiraizumi on the last day and all participants greatly enjoyed spending time together.

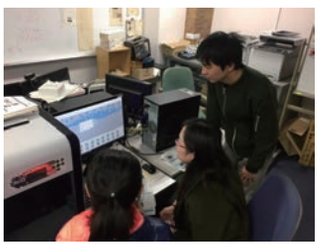
Poster session by technical staff and students (left). A total of 24 presentations including 6 from Thailand and 18 from Iwate Univ. were given.

Boat ride at Geibikei Gorge (right). Participants had a great time listening to the folk songs sung by the boatman and singing Thai songs.

★ Ten students were invited from China and Mongolia

With the support of the Japan-Asia Youth Exchange Program in Science (Sakura Science) by the Japan Science and Technology Agency, ten students were invited from China and Mongolia from November 10 (Fri) to 17 (Fri), 2017. The program was hosted under the theme, "Experience the Cutting-edge Digital Contents and Media Technologies!"

On the second and third day of the program, students went to Morioka to participate in a research gathering on computer graphics and multimedia called NICOGRAPH. The guest students were from software backgrounds and listened to sessions on the latest virtual reality and augmented reality with great interest. On the fourth and fifth day, they worked on the research assignments prepared in each lab. On the sixth day, they reported the results in four presentations: "3D modeling by photo measurement and subsequent model making with a 3D printer," "lecture on product designing and observation of actual products," "lecture on biological sensing technologies, making electrocardiograms using electronic circuits, and measurement of the electrocardiogram," and "lecture on the application of the random graph theory and non-linear time series model to media technologies and simulation experience." Students later took a campus and labs tour led by Iwate Univ. students and went to Tokyo by Shinkansen. They visited the National Museum of Emerging Science and Innovation and went back home the following day in high spirits but with a lingering farewell.



Lab practice. Students engage in computer processing for 3D modeling.

Party on the fourth night. Many of the Iwate Univ. international students attended and had a great time talking about Iwate Univ. and their home countries.

Participants' voice

Mr. G. Bilguun, Mongolian Univ. of Science and Technology M2 :It's a pleasure to visit to Japan even it's a very short term, during the program amazed by students' learning environment and technical resources. Professors are very kind, easy to communicate and their latest research works are very interesting. In the end i'm observing possibilities to studying in Japan

Ms. Caiyan Xing, Northwest A&F Univ. M3 (China) : I was able to learn about Japanese culture and lifestyle and feel the passion and kindness of the instructors through this program. Japanese students introduced their specialized knowledge and related software at the lab and we were able to meet and talk about our future plans and the current state of our research. I hope this exchange will continue in the future.

★ Student exchange with Hanbat National University, Korea

We organize mutual student exchange every year with Hanbat National University in Korea. This year marks the fourth year and the programs were held from September 4-7 and November 7-11 in 2017. There were joint PBL-based programs both at Hanbat National University and Iwate University.

● 9/4 ~ 9/7 at Hanbat National University

After the self-introduction by 11 Iwate University students and 11 Hanbat National University students, Iwate University students gave presentations on the five PBL themes: (1) "Safety in society, especially for children and elderly", (2) "Creating sustainable energy technology for space colonization," (3) "Sustainable social infrastructure," (4) "Water resource management," and (5) "Future transportation." Students were divided into five groups and each group, with Korean and Japanese students, engaged in the joint PBL. Participants then moved to Jeonju, which is famous for good bibimbap. After learning about the historical culture of Korea at the National Intangible Heritage Center, students split into groups to explore the streets of Jeonju freely. They tried colorful chima jeogori and took many pictures, enjoying the town to its full extent.

Group photo after the joint PBL

● 11/7 ~ 11/11 at Iwate University

Students heard mid-term reports of the joint PBL on the first day. Based on the harsh feedback from Korean and Japanese faculty members, students continued discussions and summarized them in the slides. The afternoon of the second day was spent on the PBL debriefing session. Each team, whether individual members or as a team, introduced various ideas. Teams with outstanding presentations were awarded. Students moved to Hiraizumi on the third day and took a tour around Chusonji Temple and Motsuji Temple. They were in time for perfect autumn colors and took many pictures.

In front of the Pure Land Jodo Garden at the Motsuji Temple

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