

Premedical Course

Biology

Koji Takada, *Professor*

Rie Hiratsuka, *Associate Professor*

General Summary

Our research themes are to understand the mechanism of protein aggregate formation associated with heavy metal cytotoxicity, and the mechanism of generative cell migration in vegetative cell of angiosperm pollen.

Research Activities

Analysis of cadmium-induced cellular protein aggregation

Cadmium is a toxic heavy metal preferentially accumulated in renal cortex of the mammals. One of possible reasons for cadmium cytotoxicity is radical-dependent cellular damage. Ubiquitin-mediated proteolysis has a protective role against the cadmium cytotoxicity. We have found that sublethal cadmium exposure to human kidney HK-2 cells markedly increases amounts of polyubiquitin-containing protein aggregates preceding the cell death. The process of such aggregate formation was analyzed based on the method of stable isotope labeling by amino acids in cell culture (SILAC). Under the condition of SILAC experiments, the sublethal Cd exposures ($\geq 20 \mu\text{M}$ for 24 h) accumulated polyubiquitinated proteins in the fraction containing denatured proteins insoluble with 1% Triton X-100 (Triton insoluble protein fraction). ^{13}C -amino acids were incorporated into both Triton-soluble native proteins and Triton-insoluble denatured proteins during cadmium exposure, and a prolonged exposure brought a relative decrease of the ^{13}C ratios in the Triton-insoluble protein fractions, suggesting a chronic cadmium exposure may damage metastable cellular proteins than nascent proteins.

Ultrastructural analysis of microgametogenesis in rice

In angiosperm pollen, intracellular migration of generative cell into the vegetative cell cytoplasm is one of the important mechanisms to ensure pollen tube fertilization. In this study, three strains of rice mutants (#0113, #0354, #0365) in which migration of the generative cell is blocked were analyzed using electron microscopy. The heterozygotes of these mutants produced approximately equal numbers of normal and abnormal pollen. At the heading stage, many lipid bodies were distributed in all 3 abnormal pollen. The single large vacuole and small sized starch granules were observed within the vegetative cell. On the other hand, specific abnormalities were also observed in each mutant. In abnormal pollen of #0354, the cell wall between generative and vegetative cell was markedly thickened compared to normal pollen and abnormal pollen of other lines. In abnormal pollen of #0365, generative cell membrane was spread in an ameboid shape. Based on the results above, the causative genes of three strains were pollen expressing gene, which was

expected to be different for each strain.

Physics

Tsuyoshi Ueta, *Professor*

Katsumi Kasono, *Assistant Professor*

General Summary

1. We have proposed a disordered air rod photonic crystal as a model of a sponge structure inside a barb and have confirmed that the color of birds, such as the and the red-flanked bluetail, is a structural color owing to the interference of the light within a barb by reproducing the reflection spectrum.
2. We have investigated the effect of optical absorption on the radiation of electromagnetic waves in excited states from an artificially vibrated photonic crystal and have found that it inconceivably even enhances the intensity of higher mode radiation.
3. We are studying an ultrasonic lens with an actively deformable phononic structure constructed with micro-tubes into which liquid metal is injected. In this research, we are attempting to stimulate a cerebral deep part by designing a phononic lens in which a brain and the cranial bones are also taken into account as metamaterials.
4. We have been studying computational methods and algorithms for condensed matter theory. The phenomena interested in are phase transitions and critical phenomena.

Research Activities

1. The concept of topology-optimized carpet cloaks is investigated by using level-set boundary expressions. Specifically, these carpet cloaks are designed with the idea of minimizing the value of an objective functional, which is here defined as the integrated intensity of the difference between the electric field reflected by a flat plane and that controlled by the carpet cloak.
2. We have so far investigated the optical properties within a one-dimensional photonic crystal whose stacked metallic plates are artificially driven by using actuators. In the present study, we compute the wave functions and phase shifts between the transmission and reflection coefficients around the amplifying resonance, and approach and discuss the resonance conditions with the photonic band structures and the Friedel sum rule in one dimension. We have investigated also a disordered photonic crystal case, which is metal plates of random thickness arranged in parallel with equi-intervals.
3. A crystal-growth based model taking into consideration the microscopic process of the proliferation of cancer cells is proposed, and a parameter domain in which the structure of the cancer cell cluster agrees with experimentally observed one has been found out. The shape variation of the cancer cluster has been acquired using the proposed model by changing the nutrient level, the ease of the proliferation and the mobility of cells.
4. We have made Multigrid cluster Monte Carlo simulations to study q-state Potts models

on the square lattices with ferromagnetic phase transitions. We calculated relaxation time of order parameter.

Publications

Fujii G, Ueta T. Topology-optimized carpet cloaks based on a level-set boundary expression. *Phys*

Rev E. 2016; **94**: 043301.

Chemistry

Takashi Okano, *Professor*

Naruyoshi Komiya, *Associate Professor*

General Summary

The research of this laboratory is focused on synthesis-oriented organic chemistry, including the synthesis of bioactive compounds and fluorine-containing materials, and the development of novel functional organometallic compounds, including the highly emissive phosphorescent materials in solid state and kinetic probe for dynamic behavior in solution state.

Research Activities

Preparation of Fluorine-containing organic compounds via NHC Catalysis

NHC (N-heterocyclic carbene) is a highly stable carbanion stabilized by the aromatic azolium system including vitamin B₁. NHC is now attracting interests as an environmentally compatible organic catalyst for the various reactions using aldehydes as acyl anion equivalents. However, the NHC reaction of trifluoroacetaldehyde (TFA) is not expected to be simply applied as aliphatic aldehydes because of the anomalous character of fluorine. As a preliminary study, the NHC reaction of TFA was examined theoretically. The calculation predicted successfully the NHC reaction of TFA is possible even though the dehydration from the TFA hydrate, usual state of TFA, is necessary.

*Kinetic Studies of the Chirality Inversion of Salicylaldiminato-Ruthenium Using Racemic η^6 -*p*-Cymene Complexes as a Mechanistic Probe*

Kinetic studies of the chirality inversion of a series of mono- and bimetallic (*p*-cymene) (salicylaldiminato)Ru(II) complexes with halo ligands in solution have been performed by means of the line-shape method, using ¹H NMR spectroscopy to evaluate the signal exchange rates between diastereotopic protons in the *p*-cymene ligand. The activation parameters (ΔH^\ddagger and ΔS^\ddagger) associated with the flipping molecular mobility were determined from variable-temperature NMR analyses, and it was found that the neutral halo complexes exhibit much lower enthalpies and entropies than the corresponding cationic pyridine analogues.

Publications

Komiya N, Nakajima T¹, Hotta M¹, Maeda T¹, Matsuoka T¹, Kawamorita S¹, Naota T¹ (Osaka Univ). Kinetic studies of the chirality inversion of salicylaldehyde ruthenium using racemic η^6 -*p*-cymene complexes as a mechanistic probe. *Eur J Inorg Chem.* 2016; 3148-56.

Naito M¹, Komiya N, Naota T¹ (Osaka Univ). Homochiral association behavior of binuclear *trans*-bis(β -iminoaryloxy)palladium(II) complexes doubly linked with *m*-xylylene spacers: Drastic

linker-dependence of the association chirality of chiral clothespin-shaped molecules. *Org Chem Front.* 2016; **3**: 3148-56.

Hashimoto T¹, Fukumoto K¹, Ngoc Ha-Thu Le¹, Matsuoka T¹, Kawamorita S¹, Komiya N, Naota T¹ (Osaka Univ). Dynamic neighbouring participation of nitrogen lone pairs on the chromogenic behaviour of *trans*-bis(salicylaldehyde)Pt(II) coordination platforms. *Dalton Trans.* 2016; **45**: 19257-68.

Social Science (Law)

Ryuichi Ozawa, *professor*

General Summary

Problems of Constitutional Law in present-day Japan.

Research Activities

OZAWA published Articles and Books cited in Japanese Research Activities 2016.

Human Science

Kazushi Masaki, *Professor*

General Summary

The Study of Western philosophy and ethics.

Research Activities

Origin of the ego; The intersubjective approach to the subject

Descartes' "cogito", the ego as subject of thought, is still a popular and paradigmatic image for the human subject: to be a mature human means that one can think independently and autonomously and one can act according to the belief of his own.

In the modern philosophy this image of the ego has been attacked from various positions. One of those, an intersubjective approach criticizes Descartes' cogito as isolated subject and maintains that an ego can be a subject only in the intersubjective relations. Through the recognition of the other one can become and can be a subject. Studies by Donald Winnicott show how important the relationship of the baby with his mother is at the first stage

of the ego. George Herbert Mead considers the development of the ego as a process of 'ideal roll-taking of others'. The goal of this development is the subject that can think from the universal point of the view, as Descartes imagined.

Learn from the experience in Auschwitz

From another respect the 'inhuman' situations in the concentration camp Auschwitz show various elements needed to be 'human'. From the experience written by Frankl in Auschwitz we can learn the 'human conditions' that in ordinary life remain unconscious but essential.

Japanese

Ikuko Noro, *Professor*

General Summary

A study on elderly patients' comprehension of information during Informed Consent

I investigated how the comprehensibility of the physician's verbal explanation as well as his attitude during informed consent affected the comprehension of the information and decision-making in elderly patients.

Research Activities

I presented the results at the symposium of 31st International Congress of Psychology 2016.

Mathematics

Katsuya Yokoi, *Professor*

Yasuko Hasegawa, *Assistant Professor*

General Summary

1. To study dimension theory and topological dynamics
2. To study construction of automorphic forms in several variables

Research Activities

1. We studied omega-limit sets, (strong) chain recurrent sets on topological dynamics, Conley index theory, and LS-category.
2. The Fourier expansion of Eisenstein series is important research in the theory of num-

bers. We gave an explicit formula of a spherical function on $GL(3, \mathbb{R})$ which is a part of the research.

English

Osamu Ohara, *Professor*

Tetsuro Fujii, *Associate Professor*

General Summary

English Language communication and education: material analysis and development (Fujii)

Fujii joined a project team to compile English textbooks for high school English classes: *English Communication I, II, and III*. Along with compiling the textbooks, Fujii has been writing their exercise materials and teacher's manuals. In addition, Fujii has been studying how teaching materials influence learner motivation and language development.

Research Activities

Fujii analyzed and collected authentic English materials to meet the level and the needs of high-school textbooks based on current teaching methods, theories, and research findings on learning English as a foreign language. These materials were used to compile textbooks following the revised teaching guidelines set out by the Ministry of Education, Culture, Sports, Science and Technology. New edition of the textbook, *World Trek English Communication I*, was officially approved by the Ministry and published in February 2017.

Fujii presented about the effects of English class materials that were created to improve learner's reading speed and knowledge of words in "Practical application of teaching materials that integrate fast-reading comprehension and vocabulary acquisition" at Japan Association of College English Teachers (JACET) Joint Forum of Reading Study Group and English Dictionary Research Group in Waseda University, Tokyo in March 2017.

Reviews and Books

Mochizuki M¹, Aizawa K², Allum P³, Sasabe N⁴, Hayashi Y⁵, Fujii T, Miura S⁶ (¹*Reitaku Univ*, ²*Toyo Denki Univ*, ³*Rikkyo Univ*, ⁴*Toritsu Aoyama High*, ⁵*Soka High*, ⁶*Tsurubunka Univ*). *World Trek: English Communication I*. Tokyo: Kirihara Shoten; 2017.

Mochizuki M¹, Aizawa K², Allum P³, Sasabe N⁴, Hayashi Y⁵, Fujii T, Miura S⁶ (¹*Reitaku Univ*, ²*Toyo Denki Univ*, ³*Rikkyo Univ*, ⁴*Toritsu Aoyama High*, ⁵*Soka High*, ⁶*Tsurubunka Univ*). *World Trek: English Communication I. Teacher's Book*. Tokyo: Kirihara Shoten; 2017.

First Foreign Languages

Katsumi Suzuki, *Associate Professor*

General Summary

German contemporary literature.

Research Activities

The research topic: “the modern German literature of nonnative writers in German-speaking areas”.

At a symposium, where I participated as a panelist and gave a presentation about Rafik Schami who is a famous German writer, coming from Syria, and his latest novel “Sophia, I got to know the name of the writer who has background as migrants, Sherko Fatah. His father is Kurdish Iraqi and his mother is Polish German. I am working now with his novels and translated a great novel “ein weißes Land (a white country)” into Japanese.