

Premedical Course

Biology

Koji Takada, *Professor*

Rie Hiratsuka, *Associate Professor*

General Summary

Our research themes are as follows: (1) mechanism of polyubiquitin-containing protein aggregate formation associated with heavy metal cytotoxicity and its application for toxicity evaluation; (2) microstructural analysis of anther cells in the rice mutant showing abnormal pollen development.

Research Activities

Development of an efficient cytotoxicity evaluation system based on quantitation of insoluble polyubiquitin-containing proteins

Ubiquitin-proteasome system is involved in proteostasis in eukaryotic cells. Sublethal cadmium exposure to HK-2 cells markedly increases amounts of protein aggregates containing polyubiquitin chains preceding the cell death. Thus, cellular polyubiquitin level is a possible indicator of damage induced by toxic heavy metals. However, knowledge of quantitative changes in polyubiquitin levels in other cells is still limited since a series of experiments to determine them is time-consuming and laborious. Therefore, we improved a series of experimental procedures consisting of “(1) cell culture, (2) extraction, centrifugation, sample preparation, (3) polyubiquitin measurement by ELISA”, and developed an efficient experimental evaluation system. That is, in (1), selecting 96-well plates for cell culture vessels, (2) labor saving by using multichannel pipettes and a plate centrifuge in addition to direct cell disruption within each well by an ultrasonic homogenizer. In (3), the method of preparing the secondary antibody was improved, and the reaction in the latter half was accelerated. In addition, we introduced a similar plate platform in parallel experimental system of cell death evaluation and protein quantitation, and simplified the operation of sample transfer by adopting the common sample placement. The constructed method was useful for the efficient quantification of cellular polyubiquitin in the downsizing cell cultures. Sublethal exposures of cadmium or methylmercury induced increases in levels of Triton-insoluble (SDS-soluble) polyubiquitin and decreases in levels of Triton-soluble polyubiquitin in the three epithelial cell lines. Thus, these polyubiquitin levels are contrasting indicators of cellular damages induced by the toxic heavy metals. Further studies are needed to elucidate the relationship between these phenomena and the heavy metal cytotoxicity.

*Observation of rice mutant *isp1* pollen by FE-SEM*

The rice mutant *isp1* was isolated from a library of gene-disrupted strains to which the rice endogenous retrotransposon Tos17 was transferred, and its causative gene encodes an

enzyme involved in protein translation. This mutant shows a gametophytic mutation in which the same number of normal pollen as mutant pollen are produced in the anther. In this study, the prepared section was placed on an osmium-coated slide and its reflected electron image was observed using an ultra-high resolution field emission scanning electron microscope (FE-SEM). As a result, it became clear that pollen development stops at the 2-cell stage for the mutant pollen. Since the mutant pollen lacks an enzyme associated with translation, it can be inferred that the protein necessary for development after the 2-cell stage is newly synthesized in pollen cells. FE-SEM is a highly effective tool for the observation of mutant pollen because it allows easier preparation of sections compared to transmission electron microscopes and observation of a large area even with thick sections.

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 of the red-flanked bluetail, and are attempting to reproduce the structural color of birds by confirming the reflection spectrum.
2. We have found that an incident electro-magnetic wave is amplified resonantly within an artificially vibrating one-dimensional metallic photonic crystal. Now, we are investigating the conditions of the amplification.
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. We have proposed full modeling of the cross-section of blue feather barbs of *Tarsiger cyanurus*, and computed optical properties of the barbs by means of finite element simulations. Computed results agree well with experimental ones in visible wavelength ranges. We have confirmed that nano-sized air pores in keratin have important role for the blue structural color, that is, the high reflectivity in the wavelength range of 380 nm-550 nm.
2. The lattice vibration of a metallic photonic crystal amplifies the incident wave resonantly. In the present study, it has been confirmed that the amplification of an incident electro-magnetic field is caused by resonance with the virtual bound states within the photonic crystal.

3. Shape of vesicle containing colloidal particles transforms into a pearl-necklace shape when the number of these particles and the excess area of the vesicular membrane becomes large. In order to explain the experimental phenomena, we constructed two vesicle models with soft-core particles in: (i) rigid spherical shell and (ii) closed triangulated lattice. We investigated influence of contained particles to the membrane by using the two models, and found that Dumbbell shape similar to one of pearl-necklace shape is caused by the network of long-range repulsion among particles.

4. We have made Multigrid cluster Monte Carlo simulations of q-state ferromagnetic Potts models on the square lattices. We calculated relaxation time of energy and order parameter.

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 organic/organometallic compounds for highly emissive fluorescent and phosphorescent materials in solid state and kinetic probe for dynamic behavior in solution state.

Research Activities

Extension of aromaticity to the cross-conjugated cyclic system

Aromaticity of conjugated cyclic compounds is a fundamental feature of organic chemistry. Double helical structure of DNA is stabilized by the π - π stacking interaction of aromatic DNA bases. However, DNA bases form cross-conjugated system except for adenine, and they have not been considered as aromatics. The resonance energies of the cyclic cross-conjugated system were assessed by Hückel method. As the results, although the resonance energies of cyclic cross-conjugated radialene structures are between aromatics and non-aromatics, 1,3-benzenedimethylidene dianion and 5,7-dimethylenindenetriide trianion, which are the isoelectronic structure of thymine and guanine, have obviously large stability based on the aromaticity.

Fluorescent crystals of zwitterionic imidazolium pyridinolates: A rational molecular design for intense solid-state emission based on the twisting control of proemissive N-aryl imidazolium platforms

Novel zwitterionic imidazolium pyridinolates were synthesized, and of which solid-state emission properties were investigated. N-Alkylimidazolium 2-pyridin-3-olate (**1**) exhibits intense blue emission at ambient temperature ($\Phi_{298\text{ K}} = 0.44$, $\lambda_{\text{max}} = 424\text{ nm}$) in the crys-

talline state, while phenolate (**2**), another pyridinolate analogue bearing the nitrogen atom at a different position on the pyridine ring, and *N*-phenylimidazolium ring are less emissive ($\Phi_{298\text{ K}} < 0.05$) under the same measurement conditions. Temperature-dependent emission spectra indicate that crystal **1** exhibits high heat-resistance properties towards emission decay and red shifting thermochromism upon increasing temperature, both of which are in contrast with the heat quenching and blue shift properties of phenolate analogue crystal **2** under the same measurement conditions. XRD analysis and DFT calculations revealed that the effect of the 2-pyridinolate functionality on the specific efficiency and thermochromism in the crystalline-state fluorescence of imidazolium arenolates arises from specific restriction of molecular rotation and the resultant molecular constraints in the crystals.

Publications

Komiya N, Yoshida A¹, Zhang D¹, Inoue R¹, Kawamorita S¹, Naota T¹ (¹Osaka Univ). Fluorescent crystals of zwitterionic imidazolium pyridinolates: A rational molecular design for intense solid-state emission based on the twisting control of premissive *N*-aryl imidazolium platforms. *Eur J Org Chem.* 2017; 5044-54.

Yoshida A¹, Ikeshita M¹, Komiya N, Naota T¹ (¹Osaka Univ). Solid-state fluorescence of zwitterionic imidazolium pyridinolates bearing long alkyl

chains: control of emission properties based on variation of lamellar alignment. *Tetrahedron.* 2017; **73**: 6000-7.

Anzai K¹, Kawamorita S¹, Komiya N, Naota T¹ (¹Osaka Univ). Convenient spectroscopic method for quantitative analysis of trace hydrochloric acid in chlorinated organic solvents using 2-(1-adamantylimino)methyl-1*H*-pyrrole as a robust indicator. *Chem Lett.* 2017; **46**: 672-5.

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 *Tokyo Jikeikai Ika Daigaku Kyoiku Kenkyu Nenpo 2017*.

Human Science

Takao Fukuyama, *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 role-taking of others'. The goal of this development is the subject that can think from the universal point of 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 the association among gender, communication and patient satisfaction in Japanese primary care visits.

Research Activities

We conducted a research to investigate the association among physician-patient gender

combination, communication behavior and patient satisfaction in the Japanese primary care visits, and reported the following results: 1) Female concordant visits showed higher levels of patient-centeredness than all other gender combinations. 2) Female physicians substantially modified their communication based on patient gender while male physicians did not. 3) Gender concordance was associated with higher female, but lower male patient satisfaction relative to gender discordant visits.

Publications

Noro I, Roter DL¹, Kurosawa S², Miura Y, Ishizaki M³ (¹*Johns Hopkins Univ*, ²*Tohoku Univ*, ³*Univ Tokyo*). The impact of gender on

medical visit communication and patient satisfaction within the Japanese primary care context. *Pat Educ Couns*. 2018; **101**: 227-32.

Mathematics

Katsuya Yokoi, *Professor*

Yasuko Hasegawa, *Assistant Professor*

General Summary

- I. Dimension theory and topological dynamics.
- II. Some applications of automorphic forms to number theory.

Research Activities

- I. We studied a homotopical invariant of isolated invariant sets and gave its application to topological dynamics.
- II. We clarified some analytic properties of Dirichlet series associated with the function to appear as limit formula of Siegel-Eisenstein series.

English

Osamu Ohara, *Professor*

Tetsuro Fujii, *Professor*

General Summary

English audio-visual education and digital medieval English study (Ohara)

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

Ohara continued his study of graphology and morphology in the letters of the the Pastons in the fifteenth century. Ohara also continued an investigation concerning how to make useful digital images and XML files of fifteenth century manuscripts, especially of the

Paston Letters. The results of this investigation were discussed in the papers read at an international conference.

Ohara received a grant-in-Aid for Scientific Research (C) with 8 other professors in different colleges and continue the study concerning the evaluation of students joining the English SNS community making use of the TED materials.

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

Ohara presented a paper at a session in the International Medieval Congress held at Leeds University in England in July.

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 II*, was officially approved by the Ministry and published in February 2018.

Fujii has been developing English teaching methods to beginning level learners and gave teacher training sessions to English instructors at Firstwellness English Academy in Sebu, Philippines in March 2018.

Reviews and Books

Mochizuki M¹, Aizawa K², Allum P³, Sasabe N⁴, Hayashi Y⁵, Fujii T, Miura S⁶ (¹Reitaku Univ, ²Toyo Denki Univ, ³Rikkyo Univ, ⁴Toritsu Aoyama High Sch, ⁵Koshigaya High Sch, ⁶Tsurubunka Univ). *World Trek English Communication II*. Tokyo: Kirihara Shoten; 2018.

Mochizuki M¹, Aizawa K², Allum P³, Sasabe N⁴,

Hayashi Y⁵, Fujii T, Miura S⁶ (¹Reitaku Univ, ²Toyo Denki Univ, ³Rikkyo Univ, ⁴Toritsu Aoyama High Sch, ⁵Koshigaya High Sch, ⁶Tsurubunka Univ). *World Trek English Communication II Teacher's Book*. Tokyo: Kirihara Shoten; 2018.

First Foreign Languages

Katsumi Suzuki, *Professor*

General Summary

German contemporary literature.

Research Activities

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

I am working now with novels of Sherko Fatah. His father is Kurdish Iraqi and his mother is German from Poland. In fact, he is a native writer with the background as an immigrant. His heroines are always playing their part not only in Germany, but also in the Middle East, mainly in Iraq. What is offered to him in the creative work as subjects, is the fatherland of his father. And he writes it in the mother tongue. I am now researching the relationship between the fatherland and mother tongue in his novels.