

Premedical Course

Biology

Koji Takada, *Professor*

Rie Hiratsuka, *Associate Professor*

General Summary

Our research themes are the mechanisms of cellular protein aggregation associated with heavy metal toxicity and the mechanism by which the generative cell of angiosperm is taken into a pollen tube cell.

Research Activities

Cadmium-induced cellular protein aggregation: analyses with stable isotope

Cadmium is a toxic heavy metal preferentially accumulated in the renal cortex of mammals. A possible reason for cadmium cytotoxicity is radical-dependent cellular damage. Ubiquitin-mediated proteolysis has a protective role against cadmium cytotoxicity. We have found that sublethal cadmium exposure induces protein damage to form polyubiquitin-containing aggregates. In the present study, the process of such aggregate formation was analyzed with the method of stable isotope labeling by amino acids in cell culture (SILAC). Sublethal cadmium exposure to a human kidney cell line, HK-2, markedly increases the amounts of polyubiquitin-containing protein aggregates preceding cell death. Cadmium-induced polyubiquitin-containing protein aggregates were similarly formed under the condition of the SILAC experiments. However, content ratios of ^{13}C amino acids in both aggregated and nonaggregated protein fractions were changed in the course of cadmium exposure, indicating qualitative alteration of the main component of the aggregates. In addition, cadmium cytotoxicity was enhanced under the condition of SILAC in which a dialyzed fetal bovine serum was employed, suggesting the presence of a factor or factors suppressing cadmium toxicity in the serum.

Ultrastructural analysis of pollen development in a rice cap1 mutant

Collapsed abnormal pollen 1 (CAP1), a novel arabinokinase-like protein, is critical in pollen developments. In mutants, pollen grains lack almost all cytoplasm and collapse. In this study, we used electron microscopy in an attempt to clarify the process of pollen grain degradation. The generative cell wall formed by microspore division presented morphological abnormality, and the nucleus of the cell was condensed and deformed. After that, shrunken protoplast and degenerated intine were observed in the vegetative cell. These results suggest that with a mutant of the CAP1 gene (*cap1*), the cell wall dysplasia of generative cells and the collapse of pollen grains might have been caused by the toxic accumulation of arabinose or by the inhibition of cell wall metabolisms due arabinokinase lacking function.

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 a 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 excited modes of the ground state have been confirmed to be generated by introducing artificial lattice vibration to a 1-dimensional metallic photonic crystal in which an electromagnetic field between metallic plates is in the ground state. In this study, the effect of optical absorption of metallic material on the radiation of higher excited modes was systematically investigated. We found that the optical absorption inconceivably even enhances the intensity of higher mode radiation and that its optimal values, which maximize the value of peaks in the spectra, exist.
2. Photon-phonon interaction is considered in 1-dimensional disordered metal photonic crystals, which are metal plates of different thicknesses arranged in parallel with an equi-interval. Each metal plate is assumed to be artificially driven. A simple model is numerically analyzed, and the following novel phenomena are discovered. The incident wave with frequencies near the plasma frequency is resonantly amplified. Resonant peaks change with the frequency and the phase of lattice vibration.
3. Topology optimized designs of multiple-disk resonators are newly presented using level-set expression that incorporates surface effects. Effects from total internal reflection at the surfaces of the dielectric disks are precisely simulated by modeling clearly defined dielectric boundaries during topology optimization. The electric field intensity in optimal resonators increases to more than 5 times the initial intensity in a resonant state, whereas in some cases the Q factor increases by a factor of 4 over that for the initial state. Wavelength-scale link structures between neighboring disks improve the performance of the multiple-disk resonators.

4. We have made Monte Carlo simulations to study systems with the ferromagnetic phase transition. Multigrad cluster Monte Carlo method is used to study $q=4$ Potts models on the square lattices. We calculated relaxation time of order parameters.

Publications

Fujii G¹, Ueta T, Mizuno M¹, Nakamura M²
(¹*Shinshu Univ.*, ²*Akita Pref Univ.*). Topology optimized multiple-disk resonators obtained using

level set expression incorporating surface effects. *Optics Express*. 2015; **23**: 11312-26.

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 the solid state and kinetic probes for dynamic behavior in the solution state.

Research Activities

Synthesis of ¹³C-labeled materials for metabolic and diagnostic research

¹³C-Labeled biologically active compounds are useful as probes for metabolic and diagnostic research because they can be directly applied to mass spectrometry or infrared spectroscopy without separation or purification. We are now engaged in the synthesis of ¹³C-labeled retinol derivatives and ¹³C-labeled biological polyamines. As the new synthetic tools, an automatic liquid-phase synthesizer and an automatic preparative liquid chromatograph were fully utilized.

Exploitation of emissive platinum complexes, exhibiting linkage-length and substitution-position dependence in emission wavelength

A series of methoxy-substituted trans-bis(salicylaldehyde)platinum(II) complexes incorporating octa-, nona-, deca-, undeca-, dodeca-, and tridecamethylene bridges has been synthesized, and their unique structure-dependencies in the solution-state emission were discovered. Methoxy-substitution on the aromatic rings was found to improve the emission quantum efficiency in the glassy state in 2-methyltetrahydrofuran at 77 kelvin. Chromogenic control over a range of 70 nm was demonstrated, with the 3-, 4-, 5- and 6-methoxy substitutions giving yellow, green, orange, and yellow-green emissions, respectively. These complexes exhibited obvious linker-dependent emission chromism under the same conditions, such that a regular hypsochromic shift from yellow to green

was observed when the linker length was increased.

Publications

Komiya N, Okada M¹, Inoue R¹, Kawamorita S¹, Naota T¹ (Osaka Univ). Variations in the emission of polymethylene-vaulted *trans*-bis(salicylaldiminato)platinum(II) complexes incorporating methoxy functionalities with linkage length and substitution position. *Polyhedron*. 2015; **98**: 75-83.

Naito M¹, Inoue R¹, Iida M¹, Kuwajima Y¹, Kawamorita S¹, Komiya N, Naota T¹ (Osaka

Univ). Control of metal array based on heterometallic masquerade in heterochiral aggregation of chiral clothespin-shaped complexes. *Chemistry*. 2015; **21**: 12927-39.

Naito M¹, Komiya N, Naota T¹ (Osaka Univ). Synthesis, structure and crystal packing of a clothespin-shaped binuclear *trans*-Bis(2-amino-2-propano) palladium(II) complex bearing *m*-Xylylene linkers. *J Mol Struct*. 2015; **1102**: 230-4.

Social Science (Law)

Ryuichi Ozawa, *Professor*

General Summary

Problems of constitutional law in present-day Japan.

Research Activities

OZAWA published 2 Articles and Books from Research Activities 2015 in Japanese.

Human Science

Kazushi Misaki, *Professor*

General Summary

The study of Western philosophy and ethics

Research Activities

Origin of the ego: The intersubjective approach to the subject

René Descartes' "cogito ergo sum," the ego as a 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 one's own beliefs.

In modern philosophy this image of the ego has been attacked from various positions. One such position, an intersubjective approach, criticizes Descartes' "cogito" as an isolated subject and maintains that an ego can be a subject in only intersubjective relations. Through the recognition of others, one can become and can be a subject. Studies by Don-

ald Winnicott show how important the relationship of the baby with its 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 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 about by Viktor Frankl in Auschwitz we can learn the “human conditions” that in ordinary life remain unconscious but essential.

Japanese

Ikuko Noro, *Professor*

General Summary

- 1) A study of the structure of the interview by an experienced psychiatric nurse of patients with mental disease
- 2) A study of the association among gender, communication, and patient satisfaction

Research Activities

- 1) We explored the structure of conversation of a well-trained counselor in psychiatric nursing by examining the relations among intention, skill, and function of the statement of the counselor’s dialogue with a patient who has schizophrenia and patients with a depression.
- 2) We held a workshop on gender and communication having Debra Roter, DrPH, of Johns Hopkins University, who is a pioneer in this field, as a keynote speaker, and discussed the associations among gender, communication, and patient satisfaction.

Mathematics

Katsuya Yokoi, *Professor*

Yasuko Hasegawa, *Assistant Professor*

General Summary

1. To study dimension theory and topological dynamics
2. To study real analytic automorphic forms and their applications in number theory

Research Activities

1. We studied omega-limit sets, (strong) chain recurrent sets on topological dynamics, and Conley index theory.
2. The construction of automorphic forms has been an important topic in the theory of automorphic forms. We proved the limit formula of the Siegel–Eisenstein series and contributed to it.

Publications

Yokoi K. On strong chain recurrence for maps. *Annales Polonici Mathematici*. 2015; **114**: 165–77.

English

Osamu Ohara, *Professor*

Tetsuro Fujii, *Associate 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 Stonors 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 *Stonor 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 began a study concerning the evaluation of students joining the English social networking service community making use of materials from the TED (Technology, Entertainment, Design) Conference.

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 50th International Congress on Medieval Studies held at Western Michigan University in Kalamazoo, MI, USA, in May and also presented the results of his study concerning the graphology of the English medieval letters at Winchester University in November 2015.

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. The revised textbook, *World Trek - English Communication I*, was officially approved by the Ministry in March 2016.

Fujii presented about the effects of teaching materials, exercises, and examinations on students' attitudes toward leaning in "The first year English teaching program that improves learner motivation" at the 79th Faculty Development Meeting held by The Jikei University in Tokyo in November 2015.

First Foreign Languages

Katsumi Suzuki, *Associate Professor*

General Summary

German contemporary literature

Research Activities

I am working on the topic of "the modern German literature of nonnative writers in German-speaking areas," especially the works of Ilija Trojanow, who was born in Bulgaria and now lives in Vienna. His novel *The Collector of Worlds* deals with the 3 different worlds of India, Arabia, and Africa. At the academic workshop of the Cross-Lingual Network, I gave a presentation on the topic of "border crossing," which can be found in this novel.

With respect to my working field, at a public lecture organized by the Middle East contemporary literature Study Group, I gave the keynote speech about the trends of the writers in Germany, who had come from Turkey, and the writers of the second and third generation.

Under the concept "What can a literature researcher do in the face of hard facts in Syria," the symposium was organized by the Middle East contemporary literature Study Group and Kyoto University Graduate School of Human and Environmental Studies. I participated as a panelist in it and gave a presentation about Rafik Schami and his latest novel *Sophia oder Der Anfang aller Geschichten*. He is a famous German writer who was born in Syria.