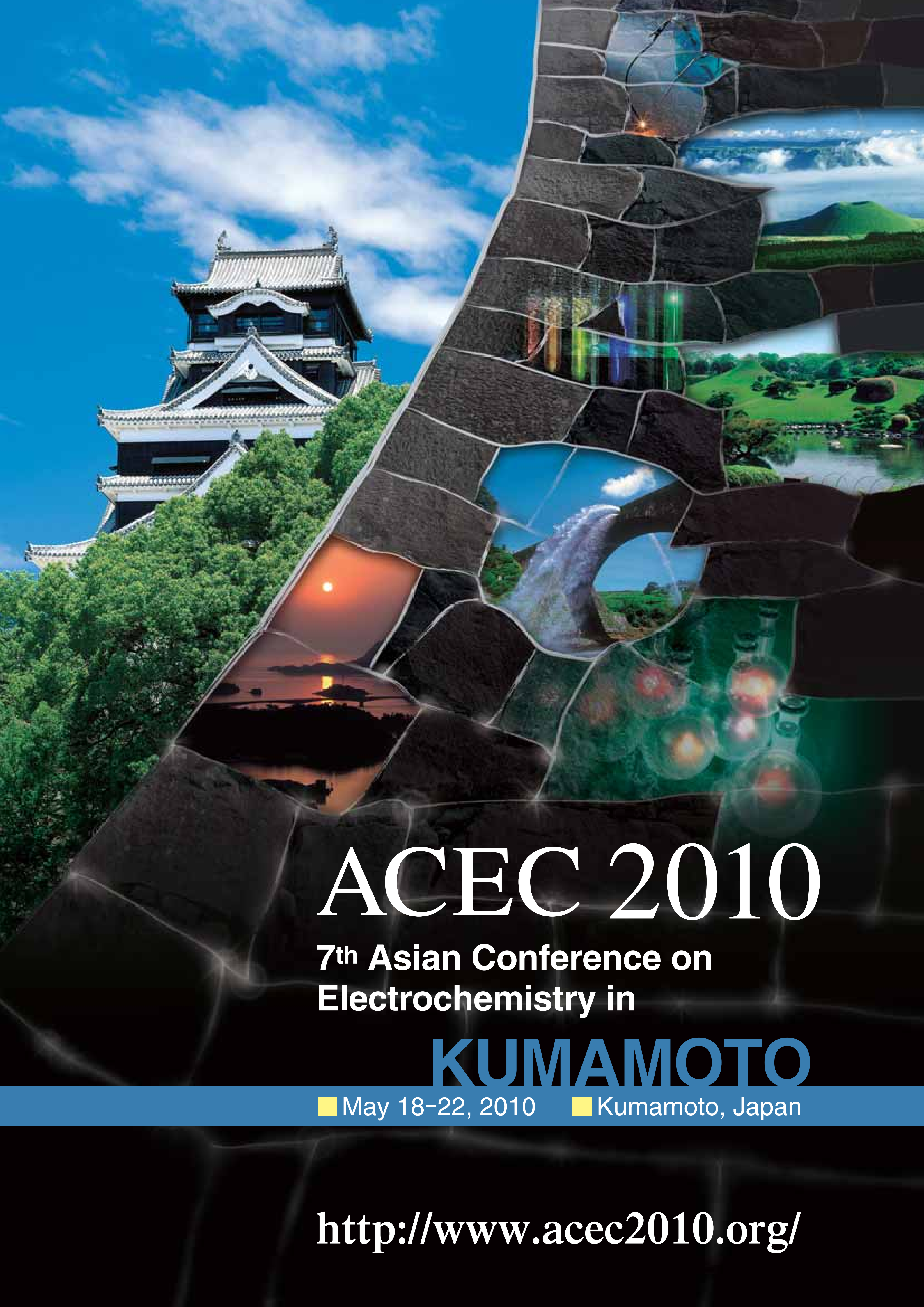

ACEC 2010

7th Asian Conference on Electrochemistry in KUMAMOTO

May 18-22, 2010

Kumamoto, Japan

http://www.acec2010.org/

ACEC2010

The 7th Asian Conference on Electrochemistry

http://www.acec2010.org/

Program Book

Date: May 18 – 22, 2010

Venue: KKR Hotel Kumamoto

Contents

Theme

Electrochemistry in the 21st Century for Sustainable Society

Subject

All aspects in electrochemistry related to electrochemical energy conversion, electrochemical energy storage, environmental issues, sensors, plating and surface technologies of electronic industry, solid-state science, nano-science, bio-electrochemistry etc.

About ACEC2010

The purpose of the Asian Conference on Electrochemistry is to provide a forum for presentation and discussion of the recent developments related to electrochemical technologies in academics and industries. The ACEC founder, Professor Fujishima, assigned this conference as a successor of 15 years USSR-Japan Electrochemical Seminar, founded by Professor Matsuda. Since 1995, this conference, which is held every 3 years, has been hosted by several cities in Asia and has provided a discussion forum for Asian manufacturing technologies, entrepreneurs, electrochemists and engineers around the world.

Since the 6th ACEC was held in 2008, in a normal situation, the 7th ACEC will be held in 2011. Since we are going to have ISE meeting at Niigata, Japan in 2011, the date of the conference has been moved forward. The 7th ACEC will be held in 2010 in Kumamoto, Japan.

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Important Information

Registration

The registration will be held on 2 F of KKR hotel, 14:00-18:00 on May 18, 8:00-17:00 on May 19, 20, and 8:00-12:00 on May 21.

Poster Session

The posting time starts from 11:00 on May 19 and 20, and the poster should be removed before 17:00. The poster panel size is 120 (wide) x 180 (height) cm. Tape and sticker are allowed.

Special Notice on Coffee Break

Please note that it is not permitted to bring foods into the lecture. Coffees, soft drinks, and snacks will be served on 2F.

City tour (free)

The city tour will start from16:30 on May 21at the lobby of Hotel KKR. No registration is needed.

Excursion

The bus starts at 9:00 on May 22 and will be back to Hotel KKR around 18:00.

Shuttle Bus

No shuttle service for this conference.

Program list & Conference Schedule

PL = Plenary Lecture
SIL = Specital Invied Lecture

Time/Date	**May 18, 2010**
16:00-18:00	Registration
18:00-20:00	Welcom Party

Time/Date	**May 19, 2010**			
08:00-17:00	Registration			
Time/Location	Room S	Room A	Room B	Room C
08:50-09:00	Opening Remarks			
0900-10:00	PL-1			
10:15-11:00	SIL-1			
11:00-11:45	SIL-2			
11:45-14:00	Lunch and Poster Session			
14:00-15:30		Session 1	Session 2	Session 3
15:30-15:40	Coffee break			
15:40-16:40		Session 4	Session 5	Session 6
16:40-16:50	Coffee break			
16:50-18:10		Session 7	Session 8	Session 9

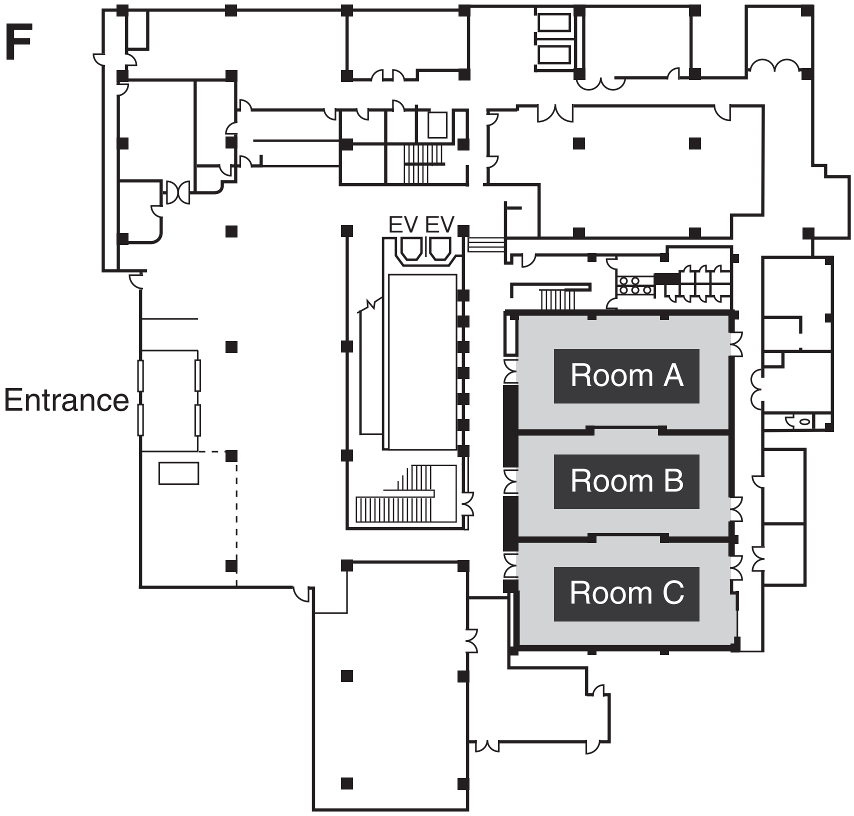
Time/Date	**May 20, 2010**			
08:00-17:00	Registration			
Time/Location	Room S	Room A	Room B	Room C
0900-10:00	PL-2			
10:15-11:00	SIL-3			
11:00-11:45	SIL-4			
11:45-14:00	Lunch and Poster Session			
14:00-15:30		Session 10	Session 11	Session 12
15:30-15:40	Coffee break			
15:40-16:40		Session 13	Session 14	Session 15
16:40-16:50	Coffee break			
16:50-18:10		Session 16	Session 17	Session 18
18:30-20:30	Banquet			

Time/Date	**May 21, 2010**			
08:00-13:00	Registration			
Time/Location	Room S	Room A	Room B	Room C
0900-10:00	PL-3			
10:15-11:00	SIL-5			
11:00-11:45	SIL-6			
11:45-13:00	Lunch			
13:00-14:30		Session 19	Session 20	Session 21
14:30-14:50	Coffee break			
14:50-16:30		Session 22	Session 23	Session 24
16:30-16:35	Closing Remarks			
16:35-18:00	**City tour**			

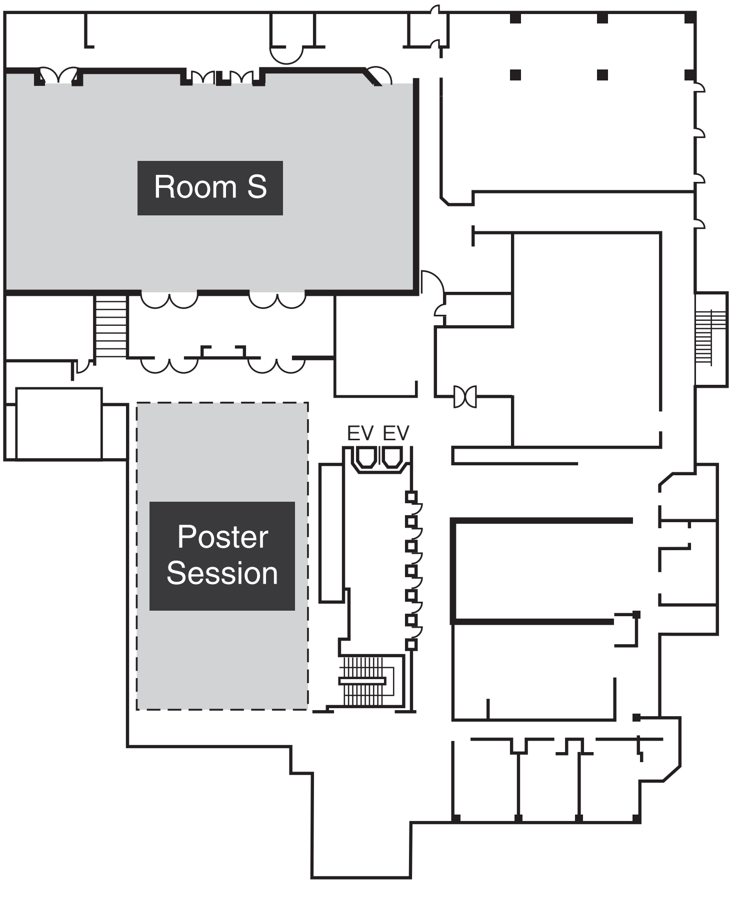
Time/Date	**May 22, 2010**
09:00-18:00	**Excursion**

KKR Hotel Kumamoto

1 F



2 F



Plenary Lectures

Wednesday, May 19th

Chairperson: Prof. F. Mizutani

09:00-10:00 **PL-1** Bioelectrochemistry Fundamentals and Applications

Tomokazu Matsue

Tohoku University

Thursday, May 20th

Chairperson: Prof. S. Yau

09:00-10:00 **PL-2** Functional Molecular Organization on Solid Surface: Electrochemical Strategy for Nanotechnology

Prof. Li-Jun Wan

Chinese Academy of Sciences

Friday, May 21st

Chairperson:A. Prof. K. Nishiyama

09:00-10:00 **PL-3** New Trends for Green Energy Devices with Nano-composite Materials; Super Capacitor Applications & System

Prof. Soo-Gil Park

Chungbu Nat'l Univ.

Special Invited Lectures

Wednesday, May 19th

Chairperson: Prof. T. Itoh

10:15-11:00 **PIL-1** Surface-enhanced Raman Spectroscopy for Electrochemical Interfaces

Prof. Bin Ren
Xiamen University

Chairperson: Prof. S. Park

11:00-11:45 **PIL-2** Interfacial Reactions between Lithium Metal and Concentrated Electrolyte Solutions

Prof. Soon-Ki Jeong
Soonchunghwang University

Thursday, May 20th

Chairperson: Prof. K. Itaya

10:15-11:00 **PIL-3** Chemical modification of indium-tin-oxide (ITO) electrode surfaces for photo-electric conversion devices

Prof. Masamichi Fujihira
Tokyou Insititute of Technology

Chairperson: Prof. M. Kunitake

11:00-11:45 **PIL-4** In situ STM studying the adsorption and electropolymerization of *o*-, *m*-, and *p*-ethylaniline molecules on Au(111) electrode

Prof. Shuehlin Yau
National Central University

Friday, May 21st

Chairperson:Prof. H. Nishihara

10:15-11:00 **PIL-5** Boron-doped diamond electrodes for electrochemical analysis

Prof. Yasuaki Einaga
Keio University

Chairperson:Prof. S. Mho

11:00-11:45 **PIL-6** Nanostructured Electrode Materials with High-Rate Charging-Discharging Capability

Prof. Isamu Moriguchi
Nagasaki University

Oral Session

Wednesday, May 19th

Room A

Session 01 Nanoelectrochemistry/Electrochemical Material Science

Chairperson: Prof. L. Wan

14:00-14:30 Key note **1A01** **Direct Observation of Monatomic Steps in Electrolyte Solutions by A New Optical Microscope**

Kingo Itaya

WPI Advanced Institute for Materials Research Department of Applied Chemistry Tohoku University

14:30-14:50 **1A02** **Observation of Chemical Reactions at Interface Between Liquid and Solid by Fast Scanning Probe Microscopy Technique**

Shin-ichiro Kobayashi[1], Ken Ezura[1], Rui Wen[2] and Kingo Itaya[1,2]

[1]Department of Applied Chemistry, School of Engineering, Tohoku University, [2]WPI Research Center, Advanced Institute for Materials Research, Tohoku University

14:50-15:10 **1A03** **Construction of Flatly Adsorbed Porphyrin Self-Assembled Monolayers on Au Single Crystal Surfaces**

Toshihiro Kondo, *Kaori Sato, Kayo Hasegawa, Shoko Sano, and Mizuki Kageyama

Graduate School of Humanities and Sciences, Ochanomizu University

15:10-15:30 **1A04** **Electrochemical Self-Assembly of ZnO/ Rhodamine B Hybrid Thin Films**

Lina Sun, Tomohiro Sekiya, Keigo Ichinose, Shigeo Hori, and Tsukasa Yoshida*

Graduate School of Engineering, Gifu University

Coffee Break 15:30-15:40

Sesson 04 Nanoelectrochemistry/Electrochemical Material Science

Chairperson:Prof. W. Sugimoto

15:40-16:00 **1A05** **Enhancement of the Activity for Oxygen Reduction Reaction on Pd(*hkl*) and Pt/Pd(*hkl*) Electrodes**

Nagahiro Hoshi,* Masashi Nakamura, Keita Naito, and Shinpei Kondo

Graduate School of Engineering, Chiba University

16:00-16:20 **1A06** **Epitaxial Electrodeposition of Zinc Oxide on Gallium Nitride Bulk Single Crystals**

Keigo Ichinose and Tsukasa Yoshida*

Center of Innovative Photovoltaic Systems (CIPS), Environmental and Renewable Energy Systems (ERES) Division, Graduate School of Engineering, Gifu University

16:20-16:40 **1A07** Efficient Electrochemical Decomposition of Perfluorocarboxylic Acids by Using Boron-Doped Diamond Electrode

Tsuyoshi Ochiai,*[1] Kazuya Nakata,[1] Taketoshi Murakami,[1] and Akira Fujishima[1,2]

[1]Kanagawa Academy of Science and Technology, [2]Tokyo University of Science

Coffee Break 16:40-16:50

Sesson 07 Electrochemical Material Science/Semiconductor Device

Chairperson:A.Prof. S. Ida

16:50-17:10 **1A08** Comparison of Oxygen Sorption/Desorption Behavior Between $BaFeO_{3-\delta}$ and $SrFeO_{3-\delta}$

Takamitsu Masunaga[1], Jun Izumi[2], Norio Miura[3]

[1]Interdisciplinary Graduate School of Engineering Sciences, Kyushu University, [2]Adsorption Technological Industry, [3]Art, Science and Technology Center for Cooperative Research, Kyushu University

17:10-17:30 **1A09** Electrodeposition of Layered Manganese Oxide Film Intercalated with Cationic Surfactants and the Film-Mediated Oxidation of Phenol

Masaharu Nakayama,[1],* Mitsuhiro Shamoto,[1] and Akio Kamimura[2]

[1]Graduate School of Science and Engineering, Yamaguchi University, [2]Graduate School of Medicine, Yamaguchi University

17:30-17:50 **1A10** Thermoelectric Material $Ca_3Co_4O_9$ as a Cathode Electrode for IT-SOFCs

Kensaku Nagasawa[a]*, Hiroshi Nakatsugawa[b], Olivier Mentre[c], and Mami Yamada[a]

[a]Department of Applied Chemistry, Tokyo University of Agriculture and Technology (TAT), [b]Graduate School of Engineering, Yokohama National University, [c]UCCS - Unite de Catalyse et de Chimie du Solide

17:50-18:10 **1A11** Preparation of Nanosheet of N-doped Layered oxides by Solution Reaction

Michio Koinuma*[1,2], Kunihiko Miyazaki[1], Yoshifumi Iwanaga[1], and Yasumichi Matsumoto[1,2]

[1] Graduate School of Science and Tecnology, Kumamoto University, [2] JST, CREST

Room B

Session 02 Electrochemical Sensor/Analytical Electrochemistry

Chairperson: Prof. H. Xue

14:00-14:30 Key note **1B01** Implications of Ultraslow Relaxation of Ionic Liquids at the Electrochemical Interface in Electrochemistry of Ionic Liquids

Takashi Kakiuchi* Yukinori Yasui, Yuki Kitazumi, Toshiyuki Motokawa,
Shinpei Makino, and Naoya Nishi

Graduate School of Engineering, Department of Energy and Hydrocarbon Chemistry, Kyoto University

14:30-14:50 **1B02** In Situ SEM Observation of Ag and Li Electrodeposition/Stripping in Room-Temperature Ionic Liquid

Tetsuya Tsuda[a], Yoshitomo Nishimura[a], Taro Uematsu[a], Hajime Matsumoto[b], and Susumu Kuwabata[a,c]

[a]Department of Applied Chemistry, Osaka University, [b]Research Institute for Ubiquitous Energy Devices, AIST, [c]CREST-JST

Abstract

Bioelectrochemistry
Fundamentals and Applications

Tomokazu Matsue
Graduate School of Environmental Studies, Tohoku University,
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Electrochemistry in biological filed has a long history because it is closely related in various processes in every living system1). In this presentation, I would like to introduce some recent trends in bioelectrochemistry in terms of fundamental and application aspects.

Biomembranes: Biomembranes have various important functions in which electrochemical processes are major driving forces. The membranes contain various proteins to communicate with biomolecules in surrounding environments to generate biological energy through electron-transport processes and to perform signal transduction through ion/biomolecule transport. Since biomembrane has complicated structures, a bilayer lipid membrane (BLM) has been frequently used for disclosing the functions of biomenbranes. We investigated electron-transfer of several redox species at a BLM with tetracyanoquinodimetane and found that the heterogeneous electron transfer rate was greatly influenced by the surface nature of the BLM. Also, permeability of some redox species through BLM with ion channels was investigated using microelectrochemical techniques.2) Functions of ion channels have been traditionally investigated by so-called patch-clump and whole-cell recording methods which require special skills and times. Recently, high throughput technology for characterization of ion-channel proteins has been developed and used for protein screening.

Redox biomolecues and proteins: Redox reactions of small molecules and proteins play also important roles in living materials. NADH is one of the most important small redox-active molecules. Various attempts have been made to reduce the large overpotential required for direct oxidation of NADH at a conventional electrode. We used diaphorase, a flavin enzyme, to reduce the overpotential at a carbon electrode3). Fundamental studies of protein electrochemistry increased in 1960s and, later, the studies have applied to biosensors and bioreactors. The most important development both in fundamentals and applications is in mediated electron-transfer of glucose oxidase (GOD). The electrocatalytic oxidation of glucose in the presence GOD and various redox mediators has been investigated in detail and the reaction has been applied to commercially-available blood-glucose sensors. Redox enzymes have been applied to label materials for electrochemical detection of DNA and antigens. The mediated enzyme reaction has also been used for enzyme-based biofuel cells. Since most of redox sites of proteins are covered with insulating peptide backbones, direct communication between redox proteins and electrodes are usually difficult. Direct electron-transfer was first found for cytochrome c (cyt c). Purified cyt c showed quasi-reversible voltammetric behavior on ITO and edge-plane graphite electrodes. More importantly, self-assembled monolayer of thiols facilitates the direct electron-transfer of cyt c. Other redox proteins have also been found to show direct communication with various types of electrodes.

Live cells: Living cells, prokaryotic to eukaryotic cells, carry out a variety of electrochemical processes in their cell bodies. Recently, various types of recombinant cells have been fabricated and used as sensing elements for biosensors. Among them, the reporter protein will be most promising system for development of future biosensing methodologies. We have used reporter proteins, β-galactosidase (βGAL) and secreted alkaline phosphatase (SEAP), for electrochemical detection of specific biomolecules4). For example, the in situ cellular signal transduction was carried out by using the recombinant cells with SEAP. Cellular SEAP expression triggered by the exposure to TNFα □was monitored on a cellular chip to realize a high-throughput screening system for cellular gene expression. The electrochemical detection of gene expression was also done on an addressable cellular array.

Micro/nano bioelectrochemistry: Incorporation of micro- and nanotechnology into bioelectrochemistry is current stream in the field of applied bioelectrochemistry. Various types of integrated devices and systems using MEMS/NEMS technology have been fabricated. In this presentation, I will report recent progresses of micro/nano bioelectrochemical devices and systems in my laboratory, including scanning electrochemical microscope (SECM) and related systems and integrated electrochemical devices for selective and comprehensive analysis5).

References

1) “Bioelectrochemistry”, ed. by P. N. Bartlett, Wiley **(2008)**
2) H. Yamada et al., *J. Phys. Chem.*, **97, 9574 (1993)**; T. Matsue et al., *J. Phys. Chem.*, **98, 11001 (1994)**.
3) T. Matsue et al., *Tetrahedron Lett.*, **29, 1551 (1988)**; *Biochim. Biophys. Acta*, **1038, 29 (1990)**.
4) T. Kaya et al., *Chem. Commun.,* **248 (2004)**; Y. Torisawa et al., *Anal. Chem.*, **87, 7652 (2006)**
5) Y. Takahashi et al., *Anal. Chem.*, **81, 9674 (2009)**; Z. Lin et al., *Angew. Chem. Int. Ed.*, **48, 2044 (2009)**.

Functional Molecular Organization on Solid Surface: Electrochemical Strategy for Nanotechnology

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Electrochemistry is playing an important role in nanoscience and nanotechnology.1) By electrochemical technique, atomically flat surface, functional nanomaterial and various nanodevice such as sensor and molecular machine could be prepared. To make a nanodevice, fabricating functional molecular patterns on solid surface is an essential issue and a prerequisite. Therefore, it is significant for scientists to study molecular adsorption, structural transition, and surface pattern formation.

In this presentation, we will report our recent results on electrochemical application in nanotechnology. Functional molecules were employed to fabricate patterns on solid surface. The so-prepared patterns were investigated by electrochemical scanning tunneling microscopy (STM). The results include: (1) Adsorption and pattern formation; (2) Potential induced molecular orientation; (3) In situ controllable patterns by potential and photochemical reaction; (4) Nanomaterials prepared by electrodeposition and (5) Possible application of surface molecular assembly and nanomaterials.3,4)

For example,5) C_{60} clusters are introduced into AAO template under a dc electric field and aggregated in the pores. The diameter and length of the nanowires are easily controllable by tailoring the pore size and the thickness of the template, respectively. With this method, various arrays of fullerene derivatives and endohedral fullerenes could be fabricated in nanowires and nanotubes. It opens a new avenue to assemble the fullerenes for applications in chemical sensors, light energy conversion devices and nanoscale electronic and optoelectronic devices.

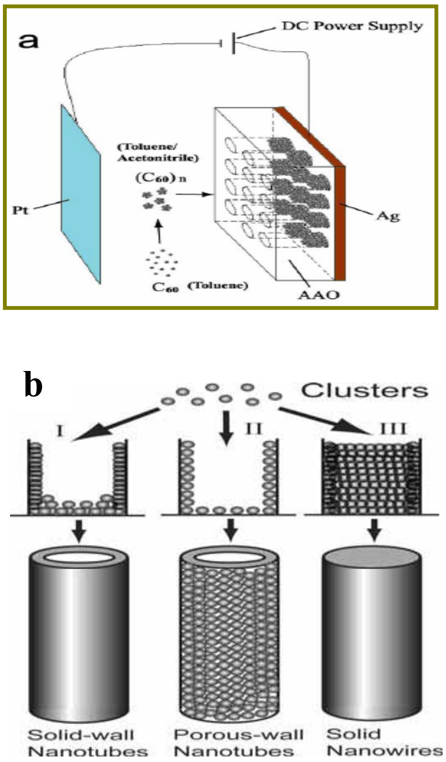

Fig. 1. Schematic illustration of fullerene nanowires fabricated by electrodeposition in AAO template.

References

1) Li-Jun Wan, *Acc. Chem. Res.*, **39**, 334(2006).
2) D. Wang and Li-Jun Wan, *J. Phys. Chem. C,* **111**, 16109(2007), Feature Article.
3) Shan-Shan Li, Brian H. Northrop, Qun-Hui Yuan, Li-Jun Wan, Peter J. Stang, *Acc. Chem. Res.*, **42**, 249 (2009).
4) R. Wen, G.B. Pan and Li-Jun Wan, *J. Am. Chem. Soc.,* **130**, 12123(2008).
5) Y.G. Guo, C.J. Li, Li-Jun Wan et al., *Adv. Fun. Mater.*, **13**, 626 (2003).

New Trends for Green Energy Devices with Nano-composite Materials; Super Capacitor Applications & System

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Electrochemical capacitor as called supercapacitor is an electrochemical energy storage device utilizing the electric charges accumulated at the interface between the electrode and the electrolyte to form the electric double layer.1, 2) It has been increasingly getting attention not only for the established applications as backup power to electronic equipments and mobile devices,3) but also for high power applications in pulsed lasers and electric vehicles.4) Advancement in energy-storage technologies can benefit of moving from conventional to nanostructured electrodes. For supercapacitors, recent attention has focused on nanostructured carbon, transition metal oxide, nanotemplate and conducting polymer.

More than 20 years after its discovery, carbon nanotubes5) continue to be one of the hottest research areas in all of science and engineering. The interest is driven by the possibility of several commercial applications, including: Field emission-based flat panel displays, transistors, quantum dots, hydrogen storage devices, structural reinforcement agents, chemical and electromechanical sensors, nanoscale manipulators, probes, and tweezers. Carbon nano-materials like carbon nanotubes and carbon nanofibers, are called a novel material in next generation and have excellent mechanical, electrically selectivity, high efficient hydrogen storage properties etc. so its can be applied in many field such as aerospace science, bio-engineering, environmental energy, materials industry, medical and medicine science, electronic computer, security and safety. Various carbon materials have been considered for energy storage electrodes and a great attention was also focused on conducting polymers. Because the problem with energy storage material was that the internal resistance of electrode was too high. So, this internal resistance could be reduced and then the amount of electric current would increase and the scope of applications would also significantly grow. The modification of carbon nanotube by another material is now a feasible way to enhance capacitance.6)

Pseudocapacitor, in which using electroactive materials with several redox states or structures, such as hydrous metal oxide, transition metal oxide and conducting polymer, show a similar charge storage mechanism of secondly batteries but they have extremely high reversibility of the superficial redox couples of certain electroactive materials. Especially ruthenium oxides are an excellent material with a remarkable high specific capacitance value, great wide potential range over reversible redox reaction. But the high coating of ruthenium metal has retarded its commercial acceptance as electrochemical capacitor. Other cheap metal oxide with equivalent capacitive characteristics is needed to be developed.

And conducting polymer are an attractive class of electrode materials to be used in supercapacitor due to their advantageous properties including low cost effectiveness compared to noble metal oxide, high charge densities compared to high surface carbon, easy synthesis through chemical and electrochemical processing. Especially polypyrrole has been the most widely studied conducting material for electrochemical capacitor. Because of their porous particles, high surface roughness, play a crucial role in high capacitance. However polypyrrole's dynamic properties are poor, particularly the long-term stability during cycling is a major demand for an industrial application. Conducting polymer suffer volumetric change on insertion/deinsertion of ions through cycling cause their degradation. Thus, the mechanical stress in the polymer relates directly with the cycle life of polymer based capacitor. So many researchers always try hard to solve this problem. In recent day, it's most popular way that the electrode fabrication process based on nano-material with a conducting polymer.

In summary, both nano material and its composite material are promising materials for fabricating the energy storage device of battery and capacitor systems due to their unique attributes. Today, nano-composite material holds a promise to revolutionize the energy storage materials in the coming years. But to realize this promise, it needs active participation of researchers in the world.

References

1) B. E. Conway, *Kluwer Academic, New York*, 29-31 (1999).
2) R. Koetz, M. Carlen, *Electrochim. Acta*, **45**, 2483 (2000).
3) J M. Morita, M. Goto, Y. Matsuda, J. *Appl. Electrochem.*, **22**, 901 (1992).
4) A. Rudge, I. Raistrick, S. Gottesfeld, J. P. Ferraris, *Electrochim. Acta*., **39**, 273 (1994).
5) S. Iijima, *Nature*, **354**, 56 (1991).
6) E. Frackowiak, V. Khomenko, K. Jurewicz, K. Lota, F. Beguin, *J. of Power Sources*, **153**, 413 (2006).

Surface-enhanced Raman Spectroscopy for Electrochemical Interfaces

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Surface-enhanced Raman spectroscopy (SERS) can provide fingerprint of molecules with a single molecule sensitivity and has found wide applications in chemistry, physics, material science, bio- and medical sciences. It has been long considered a non-destructive method due to the use of laser from visible to the near-infrared region for excitation. However, recently the laser-induced deterioration of the sample has been reported even under a mild laser illumination.

Here we will demonstrate how a laser used in SERS for excitation can significantly change the surface species and even induce a surface reaction and how to get a reliable SERS result under a strict control of the experimental condition. Para-aminothiophenol (PATP) molecules was found chemically transformed to azo species on a roughened Ag surface during the SERS measurement with a laser power considered to be low in conventional SERS measurements. Surface mass spectroscopy measurement clearly shows the presence of the fragment of DMAB, an oxidation product of PATP, on the surface. The electrochemical SERS of the synthesized DMAB confirms that the "b_2 mode" bands, an evidence of the photon-driven charge transfer (PDCT) process in the literature, actually originate from the vibration modes of DMAB. However, by controlling the laser power density to a very low value using a defocusing method as in this study, we can effectively avoid the surface reaction and to ensure the signal obtained is right from the molecule we are really interested in. This study clearly demonstrates the importance to strictly control the experimental conditions during the characterization or identification process to avoid a strong disturbance to the system we are going to probe.

We found that another molecules, adenine, shows metal to molecule charge transfer on Pd surface, using the UV laser as the excitation line in addition to the two visible lasers, which provide a wide frequency region for reliable detection of the shift of the potential for maximum SERS intensity with the laser excitation energy.

We systematical investigated the co-adsorption of four DNA bases: adenine, guanine, cytosine and thymine with ClO_4^- was studied. Factors like adsorption ability, applied potentials and coexisting anions were examined to illustrate how they affect co-adsorption. We found that the four DNA bases in their protonated forms can co-adsorb with ClO_4^-. Among them, thymine with the weakest adsorption ability on Au showed the weakest co-adsorption ability with ClO_4^-. In addition, repulsion from both negative potentials and reduced SERS enhancements of Au substrates at relatively positive potentials led to a decrease in the SERS intensity of ClO_4^-. It provides a way to optimize the SERS detection sensitivity of weakly adsorbed ions or molecules via the co-adsorption method.

We further used SERS for detecting the electrocatalytic reactions on the Pt group metals for understanding the reaction mechanism, by designing a temperature controlled flow cell. Detailed result will be presented at the conference.

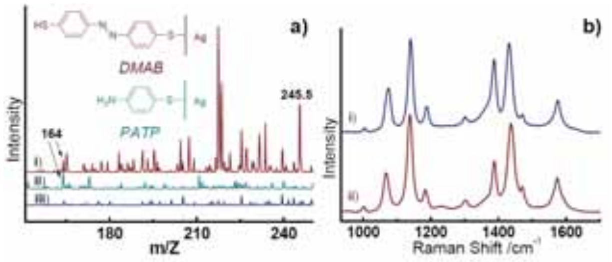

Figure 1 (a) The DESI-MS spectra of PATP adsorbed roughened Ag electrodes illuminated with laser (i) and without any irradiation (ii) and a roughened Ag free of PATP (iii). (b) The Raman spectrum of PATP (i) and DMAB (ii) on the roughened Ag electrode excited by a laser at a power density of ca. 1×10^8 mW/cm^2.

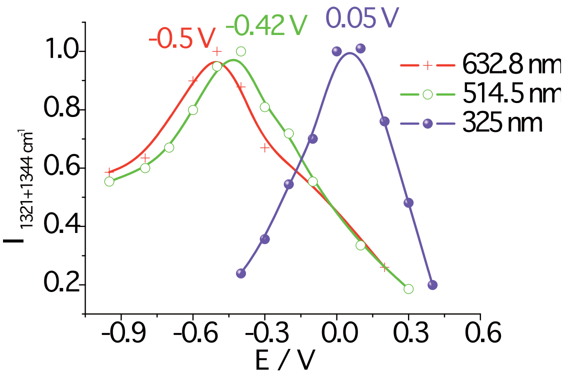

Figure 2 (Potential dependent integrated intensity of bands at 1321cm^{-1} and 1340 cm^{-1} for 632.8, 514.5 and 325 nm excitations on Rh surface. The intensities are normalized with the maximum values for each excitation.

References:
(1) D. Y. Wu, J. F. Li, B. Ren, Z. Q. Tian, Chem. Soc. Rev., 2008, 37, 1025.


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