The 1st students' associated seminar

Amezawa / Nakamura Lab.

Kawada / Hashimoto / Yashiro Lab.

Kawamura / Kuwata Lab.

Takamura / Kamegawa Lab.

Laforet Zao, conference room

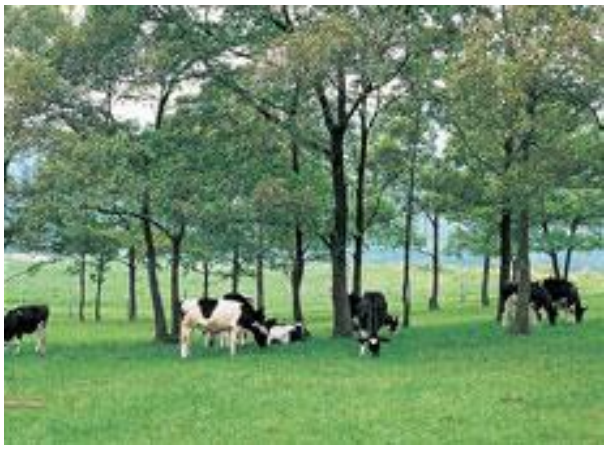
August 5-6. 2013

Introduction

First of all, I sincerely appreciate all the members' cooperation to organize this seminar. The primary objective of the associated seminar is to provide a chance for students to discuss the topics and results of their studies, share their own thought and discussions concerned with the "Properties and applications for next generation energy materials". Additionally, build-up of goodrelationship among the participating professors, researchers and students is another important objective of the seminar. I hope all of participants will have a great fruitful time and will share new idea. Also, it will be my pleasure if this seminar will play a role as a bridge between the laboratories.

Organizer
Ryo Oike (Amezawa Lab.)

About Laforet Zao



LAFORET
HOTELS & RESORTS

ラフォーレ蔵王

TEL：0224-35-3111

宮城県刈田郡蔵王町

遠刈田温泉七日原 2-1

Time schedule

The 1st day (August 5th)

11:30	Bus departure time (Sakura hall in Katahira)
13:00	Arrival
13:15	Opening address
13:30	Laboratory introduction
14:30	Short presentation for poster session 1
15:30	Poster session 1
18:00	Break, Check in
18:30	Dinner
19:30	Nomikai party

Bus departure place (片平さくらホール)

The 2nd day (August 6th)

8:00	Breakfast (Restaurant is available from 7:30)
8:50	Check out
9:00	Short presentation for poster session 2
10:00	Poster session 2
12:30	Move to Zao Hart Land
13:00	Barbecue party
17:00	Bus departure time
18:30	Arrival

Budget

Accommodation fee (+2meals)	¥ 8,900
Bus fee (Round trip)	¥ 400
Barbecue	¥ 1,800
Others	¥ 1,400

(Nomikai, Meeting room fee, Hot spring fee, etc.)

Total	¥ 12,500

Thank you for your cooperation.

Presentation schedule

Lab. introduction (1st day, 13:30-)

13:00- Amezawa Lab.

13:15- Kawada Lab.

13:30- Kawamura Lab.

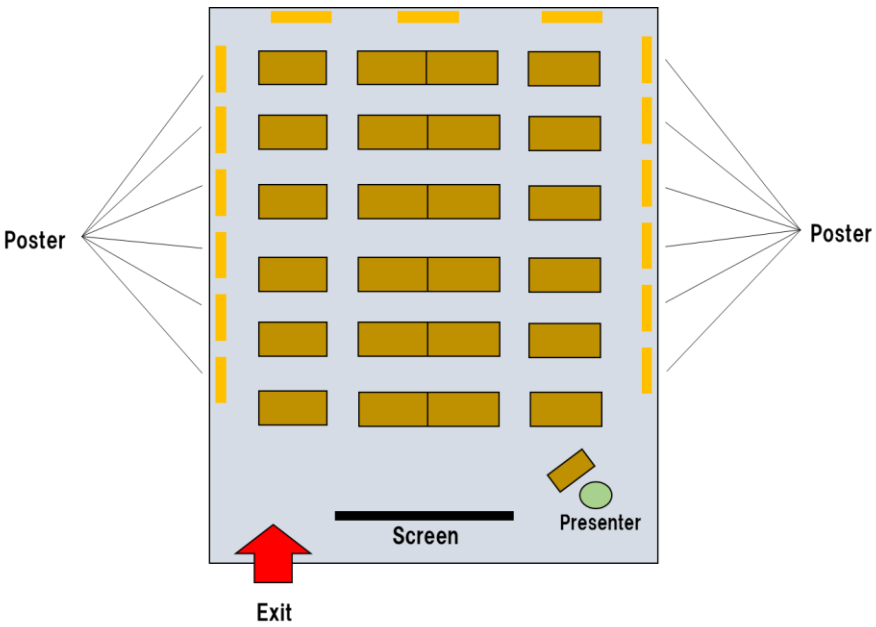
13:45- Takamura Lab.

Short presentation for poster session 1 (1st day, 14:30-)

No.	Presentation title	Presenter	Year	Lab.
1	Electronic structures of SOFC oxide cathodes studied by in-situ soft X-ray absorption spectroscopy	Ryo Oike	M1	Amezawa
2	Mechanical-energy influences to electrochemical properties and lattice states of cathodes in all solid lithium ion secondary battery	Keita Funayama	M1	Amezawa
3	Evaluation of the reaction distribution in Li-ion battery(LIB) composite cathodes by magnetic resonance imaging(MRI)	Genki Imai	B4	Amezawa
4	Study on self-assembled monolayer confined at the solid-solid interface by sum frequency generation spectroscopy	Ryosuke Shimizu	M2	Kawamura
5	In situ study of anodes in Li ion battery by acoustic emission	Takehiro Fukushima	M1	Kawamura
6	Hydride-ion transference number of fluorite-type Ca_4ZrH_{10} under high pressure	Akira Hatakeyama	D2	Takamura
7	Cathode properties of Bi-Sr-Fe-based perovskite-type oxides	Doohyun Baek	D2	Takamura
8	Efficiency analysis of hydrogen production by solid oxide electrolysis cell	Takuro Matsuoka	M2	Takamura
9	Li-ion conduction of Ca-doped $LiBH_4$ under high pressure	Takeya mezaki	M2	Takamura
10	High-pressure synthesis of novel perovskite-type oxides with mixed conductivity	Takashi Osawa	M1	Takamura
11	Young's modulus and ferroelasticity of $La_{0.6}Sr_{0.4}Co_{1-y}Fe_yO_{3-\delta}$at high temperatures	Yuta Kimura	D2	Kawada
12	Electrochemical Performance and Reaction Mechanism of $LaNi_{0.6}Fe_{0.4}O_{3-\delta}$ – $Ce_{0.9}Gd_{0.1}O_{1.95}$ Composite Electrode for Solid Oxide Fuel Cell	Riyan Achmad Budiman	D1	Kawada
13	Oxygen nonstoichiometry and electrochemical properties in a thin film of Nickel substituted lanthanum cobaltite for SOFCs	Yuya Uzumaki	M2	Kawada
14	The Effect of Coexisting Oxides upon Carbon Formation on Ni Surface	Taiki Shindo	M1	Kawada
15	Hetero-Interface Effect of Composite Oxide Electrodes for SOFC cathodes	Hiroki Sato	M1	Kawada

Short presentation for poster session 2 (2nd day, 9:00-)

No.	Presentation title	Presenter	Year	Lab.
1	The effect of cation substitution on chemical stability of Ba0.5Sr0.5Co0.8Fe0.2O3-δ-based mixed conductors	Wang Fang	D3	Amezawa
2	Destruction mechanism of Ni-cermets due to carbon deposition when feeding hydrocarbon fuels	Nobuaki Ohmura	M1	Amezawa
3	Separation of Electronic and Ionic Conductivity in LiCoO2 Cathode by AC Impedance Analysis	Erika Oki	M2	Kawamura
4	Ion Dynamics of Lithium Ion Battery observed by MRI	Masato Ohzu	M1	Kawamura
5	Thin-film lithium-ion battery with oxide amorphous Anode fabricated by pulsed laser deposition	Taku Yoshida	B4	Kawamura
6	Defects and local enviroment in perovskite-type protonic conductors	Itaru Oikawa	D3	Takamura
7	Preparation of cathode materials for co-sintering with electrolyte at high tempertures	Toshiki Kon	M2	Takamura
8	High-pressure synthesis of new compounds in RE-TM systems and their magnetic properties (RE :Rare Earth, TM: Fe, Co, Ni)	Takafumi Ono	M1	Takamura
9	Effect of hydration on Li-ion conductivity of $LiBH_4$	Akira Takano	M1	Takamura
10	Effects of surface modification on oxygen permeability of $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$	Yoshiaki Hayamizu	M1	Takamura
11	Defect chemistry and conduction properties of Sc doped-$CaTiO_3$	Hyun-Jin Hong	D2	Kawada
12	Cathodic reaction of perovskite oxide electrodes on a proton conducting electrolyte	Kota Suzuki	M2	Kawada
13	Simulation of Oxygen Diffusion Process on Electrical Conductivity Relaxation	Honami Kudo	M2	Kawada
14	Evaluation of the reaction distribution in LiCoO2 composite cathode by in-situ two dimension X-ray absorption spectroscopy	Toshiki Watanabe	M1	Kawada
15	Effect of mechanical stress on properties of transition metal oxides	Yuki Gonoi	M1	Kawada



Self-introduction and Short abstract

Name	:	Fang Wang
Laboratory	:	Amezawa Lab.
Course	:	Mechanical engineering, D3
Hometown	:	Jilin, China
Hobby	:	Cooking

Presentation title (Poster)

The effect of cation substitution on chemical stability of $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$-based mixed conductors

Short abstract (100 words)

In this study, cubic perovskite $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.1}R_{0.1}O_{3-\delta}$ (R=Fe, Nb, Mo, Sb) was synthesized, and the chemical stability under high oxygen partial pressure ($p(O_2)$) was studied by using HT-XRD in the temperature range of 773-1373 K. It was found that $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.1}Sb_{0.1}O_{3-\delta}$ was remarkably stable than $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$ and $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.1}Mo_{0.1}O_{3-\delta}$ in high $p(O_2)$ condition. The effect of B-site substitution on the CO_2-tolerance of $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.1}R_{0.1}O_{3-\delta}$ was also investigated by TG-DTA analysis at 300-1373 K. It was demonstrated that the chemical stability of $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$ against CO_2 could be significantly improved when Fe were partially substituted by Nb or Sb ions.

Name	:	Ryo Oike
Laboratory	:	Amezawa Lab.
Course	:	Mechanical engineering, M1
Hometown	:	Shizuoka, Japan
Hobby	:	Nomikai

Presentation title (Poster)

Electronic structures of SOFC oxide cathodes studied by *in situ* soft X-ray absorption spectroscopy

Short abstract (100 words)

In this study, *in situ* soft X-ray absorption spectroscopy (soft XAS) technique, which enables us to analyze electronic structures of oxides at elevated temperatures while controlling atmospheric conditions, was developed. The technique was applied to investigate the electronic structures of $La_{0.6}Sr_{0.4}CoO_{3-\delta}$. X-ray absorption spectra at the Co *L*-edges and the O *K*-edge were measured in the temperature range from room temperature to 873 K and the $p(O_2)$ range from 10^{-4} to 10^{-2} bar. The developed *in situ* soft XAS technique is found to be effective for evaluating electronic structures of oxides under controlled temperature and $p(O_2)$.

Name	:	Keita Funayama
Laboratory	:	Amezawa Lab.
Course	:	Mechanical engineering, M1
Hometown	:	Miyagi, Japan
Hobby	:	Soccer

Presentation title (Poster)

Mechanical-energy influences to electrochemical properties
and lattice states of cathodes in all solid lithium ion secondary battery

Short abstract (100 words)

All solid lithium ion secondary battery, which has advantages of incombustibility and high energy density, is investigated for purpose of practical application. However there are some things which we haven't known very well. One of them is the influence given by solid interface. It is considered that electrode materials' volume changes due to intercalation/deintercalation of lithium. According to this phenomenon, battery's electrochemical property change too. To investigate mechanism of this phenomenon, I carried out electrochemical analysis during binding test and XRD to obtain lattice state of $LiCoO_2$.

Name	:	Nobuaki Ohmura
Laboratory	:	Amezawa Lab.
Course	:	Mechanical engineering, M1
Hometown	:	Shizuoka, Japan
Hobby	:	Cycling, Bouldering, Swimming

Presentation title (Poster)

Destruction mechanism of Ni-cermets due to carbon deposition
when feeding hydrocarbon fuels

Short abstract (100 words)

A major advantage of Solid Oxide Fuel Cells is inertial reforming of hydrocarbon fuels, such as Natural gas, owing to its high operating temperature. However, the reforming of hydrocarbon often be followed by carbon deposition, which not only inactivate the reaction area but lead to permanent deformation and even break-down of the anode itself. In order to improve cell durability and reliability, it is required to evaluate carbon deposition condition and clarify the following destruction mechanism of the anode. Here Ni-YSZ cermet is examined as the model electrode and discussed macroscopic expansion and change in microscopic structure.

Name	:	Genki Imai
Laboratory	:	Amezawa Lab.
Course	:	Mechanical engineering, B4
Hometown	:	Tochigi, Japan
Hobby	:	Soccer

Presentation title (Poster)

Evaluation of the reaction distribution in Li-ion battery(LIB) composite cathodes by magnetic resonance imaging(MRI)

Short abstract (100 words)

Recently, Li ion batteries (LIB) are being used widely as a power source of mobile electronic devices. In the near future, high rate characteristics will be important for the strong demand on high power output and rapid charging for electronic vehicle. To achieve high rate charging/discharging, it is important to understand the factor which makes reaction distribution formed in cathode during high rate charging/discharging. In this study, observation of reaction distribution in $LiMn_2O_4$ was tried by *in-situ* MRI technique. However, since the study is still in a preliminary stage, the author need to brush up the study.

Name	:	Yuta Kimura
Laboratory	:	Kawada Lab.
Course	:	Environmental Studies, D2
Hometown	:	Niigata, Japan
Hobby	:	Nomikai

Presentation title (Poster)

Young's modulus and ferroelasticity of $La_{0.6}Sr_{0.4}Co_{1-y}Fe_yO_{3-\delta}$ at high temperatures

Short abstract (100 words)

The mechanical properties of components of solid oxide fuel cells (SOFCs) under operating conditions should be comprehensively understood to suppress mechanical failures. For above background, our group investigated the Young's modulus of $La_{0.6}Sr_{0.4}Co_{1-y}Fe_yO_{3-\delta}$(LSCF) at high temperatures by the resonance measurement. It was found that the Young's modulus of LSCF significantly decreased with increasing temperature at low temperatures. On the other hand, LSCF is known to be ferroelastic at low temperatures. Such an inelastic property may affect the Young's modulus of LSCF. In this study, the effect of the ferroelasticity on the Young's modulus of LSCF was evaluated by the resonance measurements and uniaxial compression tests.

Name	:	Hyun-Jin Hong
Laboratory	:	Kawada&Yashiro Lab.
Course	:	Environmental Science, D2
Hometown	:	Incheon, Korea
Hobby	:	Cooking

Presentation title (Poster)

Defect chemistry and conduction properties of Sc doped-$CaTiO_3$

Short abstract (100 words)

Calcium titanate ($CaTiO_3$) is one of typical perovskite structure materials and known for high conduction and easy-character modification material. But relatively narrow ion conduction range and low structural stability are limit their wide application for solid oxide fuels (SOFCs) system.

In this study, Scandium (SC) -doped $CaTiO_3$ ($CaTi_{1-x}Sc_xO_{3-\delta}$, x=0.05, 0.1) was selected as a dopant and fabricated using solid state reaction into $CaTiO_3$ to extend their narrow ion conduction range by distortion of lattice. The effect of Sc addition on material properties was evaluated using conductivity analysis assisted by 4-terminal method in a defect chemistry point of view.

Name	:	Riyan Achmad Budiman
Laboratory	:	Kawada Lab.
Course	:	Environmental Studies, D1
Hometown	:	Indonesia
Hobby	:	Sleeping

Presentation title (Poster)

Electrochemical Performance and Reaction Mechanism of $LaNi_{0.6}Fe_{0.4}O_{3-\delta}$ – $Ce_{0.9}Gd_{0.1}O_{1.95}$ Composite Electrode for Solid Oxide Fuel Cell

Short abstract (100 words)

Mixed conducting $LaNi_{0.6}Fe_{0.4}O_{3-\delta}$ electrode was combined with an ionically conducting oxide $Ce_{0.9}Gd_{0.1}O_{1.95}$ resulting high area specific conductivity (ASC). The enhancement of ASC did not only depend on their volume ratio but depended on sintering temperatures as well. Besides the extension of triple phase boundary, the catalytic activity itself could also be enhanced at the junction of the two oxides. This was proven with a $LaNi_{0.6}Fe_{0.4}O_{3-\delta}$ film electrode coated with $Ce_{0.9}Gd_{0.1}O_{1.95}$ porous layer on the top. It showed higher ASC compared to the bare $LaNi_{0.6}Fe_{0.4}O_{3-\delta}$ film electrode.

Name	:	Kota Suzuki
Laboratory	:	Kawada Lab.
Course	:	Environmental studies, M2
Hometown	:	Shizuoka, Japan
Hobby	:	Protonic Party!!!

Presentation title (Poster)

Cathodic reaction of perovskite oxide electrodes on a proton conducting electrolyte

Short abstract (100 words)

Cathodic reaction of protonic ceramic fuel cells (PCFCs) using $SrZrO_3$ based proton conducting electrolyte with perovskite oxide cathode is studied. A dense $La_{0.6}Sr_{0.4}CoO_3$ (LSC) film is fabricated on 10mol% Y-doped $SrZrO_3$ (SZY) electrolyte as a cathode. Cathodic performance of the dense LSC electrode is evaluated using AC impedance measurement and Secondary Ion Mass Spectroscopy (SIMS) analysis. Impedance spectra suggest that LSC dense film play a role as proton blocking electrode. SIMS analysis reveals that proton concentration in LSC dense film is higher than bulk of LSC, and there is no concentration gradient in LSC and SZY.

Name	:	Yuya Uzumaki
Laboratory	:	Kawada/Hashimoto/Yashiro Lab.
Course	:	Environmental Studies, M2
Hometown	:	Tokyo, Japan
Hobby	:	Baseball, Handball, and Karaoke

Presentation title (Poster)

Oxygen nonstoichiometry and electrochemical properties in a thin film of Nickel substituted lanthanum cobaltite for SOFCs

Short abstract (100 words)

Oxygen nonstoichiometry of $LaNi_{0.6}Co_{0.4}O_{3-\delta}$ (LNC64) was measured by thermogravimetry. Electrochemical properties of thin film electrode were evaluated by AC impedance measurement. The oxygen nonstoichiometry was almost independent of $p(O_2)$ and absolute value in pure O_2 was close to zero. From the comparison between chemical capacitance estimated from the oxygen nonstoichiometry and AC impedance measurement, it was suggested that the rate determining-step was surface reaction or bulk diffusion. From the apparent activation energy of area specific interfacial conductivity, it was suggested that the micro structure difference between film and porous electrode probably cause the change in electrode reaction process.

Name	:	Honami Kudo
Laboratory	:	Kawada Lab.
Course	:	Environmental Studies, M2
Hometown	:	Miyagi, Japan
Hobby	:	Nameko

Presentation title (Poster)

Simulation of Oxygen Diffusion Process on Electrical Conductivity Relaxation

Short abstract (100 words)

In our past study, oxygen vacancy diffusion coefficient, D_V, of $La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_{3-\delta}$ measured by isotope exchange and depth profile measurement showed little dependence on δ. It is contradictory to the preceding works where the D_V values obtained by electrical conductivity relaxation (ECR) technique drastically decreased with increasing δ. To clarify the reason of the discrepancy, oxygen diffusion pathway in samples for ECR measurements were simulated using the finite element method. The results suggested catalytic effects of the platinum electrodes for conductivity measurement gives a non-uniform oxygen exchange profile. It can be the cause of apparent δ-dependence of D_V.

Name	:	Yuki Gonoi
Laboratory	:	Kawada Lab.
Course	:	Environmental studies, M1
Hometown	:	Fukushima, Japan
Hobby	:	Nomikai

Presentation title (Poster)

Effect of mechanical stress on properties of transition metal oxides

Short abstract (100 words)

It is known that transition metal oxides show oxygen nonstoichiometry as functions of temperature and oxygen partial pressure. Oxygen nonstoichiometry affects on thermo-mechanical properties of the oxides such as thermal expansibility, Young's modulus and so on. In our previous study, it is found out that mechanical stress can also affect oxygen nonstoichiometry reversely. In this study, the relations between mechanical stress and oxygen nonstoichiometry in $La_{0.6}Sr_{0.4}CoO_{3-\delta}$ (LSC) and $La_{0.6}Sr_{0.4}FeO_{3-\delta}$ (LSF) are evaluated by electromotive force measurement using a YSZ ball. In addition, the relations between mechanical stress and electrochemical properties are evaluated by electrode measurement.

Name	:	Taiki Shindo
Laboratory	:	Kawada・Hashimoto / Yashiro Lab.
Course	:	Environmental Studies, M1
Hometown	:	Akita, Japan
Hobby	:	Nomikai, Volleyball

Presentation title (Poster)

The Effect of Coexisting Oxides upon Carbon Formation on Ni Surface

Short abstract (100 words)

Carbon deposition on Ni anode support causes degradation of cell performance. Using an additive is one of possible solutions to suppress carbon deposition on Ni. In this study, the substrate effect for carbon formation was investigated at 1073 K under CH_4/H_2O/ Ar (S/C = 0.087) using Ni particles dispersed on substrate oxides (8YSZ, $SrZr_{0.95}Y_{0.05}O_{3-\delta}$, $Ce_{0.9}Gd_{0.1}O_{1.95-\delta}$, Y_2O_3, TiO_2, CeO_2). The Ni surfaces after carbon deposition were observed with FE-SEM. As the results of Ni surface texture observation, the order of suppressive effect for carbon deposition can be estimated qualitatively as follows, CeO_2, TiO_2 > $SrZr_{0.95}Y_{0.05}O_{3-\delta}$, $Ce_{0.9}Gd_{0.1}O_{1.95-\delta}$ > 8YSZ, Y_2O_3.

Name	:	Hiroki Sato
Laboratory	:	Kawada・Hashimoto / Yashiro Lab.
Course	:	Environmental Studies, M1
Hometown	:	Miyagi, Japan
Hobby	:	Futsal, Comics

Presentation title (Poster)

Hetero-Interface Effect of Composite Oxide Electrodes for SOFC cathodes

Short abstract (100 words)

Hetero-interface effect is studied to improve performance of electrodes for SOFC cathodes. In this study, hetero-interface electrodes were made from perovskite oxides (ABO_3) and layer perovskite-like oxides (A_2BO_4). They were fabricated on $Ce_{0.9}Gd_{0.1}O_2$ base electrolyte by PLD method. The resistance of electrode reaction was measured by impedance measurement and compared with those of electrodes made of perovskite oxides only and perovskite-like oxides only. The resistance of the hetero-interface electrode was smaller than that of both single electrodes for some combination of the oxides ($La_{0.6}Sr_{0.4}CoO_3$ and $La_{1.5}Sr_{0.5}CoO_4$, $La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_3$ and $La_{1.0}Sr_{1.0}CoO_4$, and so on) and it can be caused by hetero-interface effect.

Name	:	Toshiki Watanabe
Laboratory	:	Kawada Lab.
Course	:	Environmental Studies, M1
Hometown	:	Iwate, Japan
Hobby	:	World soccer winning eleven

Presentation title (Poster)

Evaluation of the reaction distribution in $LiCoO_2$ composite cathode
by in-situ two dimension X-ray absorption spectroscopy

Short abstract (100 words)

Reaction distribution in composite electrode of $LiCoO_2$ was tried to be evaluated by using in-situ two dimensions X-ray absorption spectroscopy. In this work, in order to simplify the factors that make reaction distribution during charging, composite electrode laminated by aluminum foil and polyimide film was applied, and the valence states of Co during the charge was evaluated as a function of the distance from electrode edge. As a result clear absorption edge shift was observed in $LiCoO_2$ cathodes. Because of these results, it is suggested that mass transport thorough liquid electrolyte should be one of the rate-controlling factor during charging and discharging.

Name	:	Erika Oki
Laboratory	:	Kawamura Lab.
Course	:	Physics, M2
Hometown	:	Aichi, Japan
Hobby	:	Travel

Presentation title (Poster)

Separation of Electronic and Ionic Conductivity in $LiCoO_2$ Cathode by AC Impedance Analysis

Short abstract (100 words)

In this study, a new technique is developed for the separation of the lithium ionic and the electronic conductivity of thin film $LiCoO_2$ cathode, where an electrochemical impedance method is used with blocking electrodes to ions and electrons. Two different compositions of thin film cathodes, $LiCoO_2$ and $Li_{0.8}CoO_2$ are prepared by a Pulsed Laser Deposition (PLD) technique and are used for the measurements. $Li_{0.8}CoO_2$ was prepared by chemical extraction method using the oxidizer NO_2BF_4 in acetonitrile. The ionic and the electronic conductivity of $Li_{0.8}CoO_2$ were higher than $LiCoO_2$. Due to the hole creation by Li extraction, it becomes easier for Li ion to move in the CoO_6 octahedron layer.

Name	:	Ryosuke Shimizu
Laboratory	:	Kawamura Lab.
Course	:	Physics, Surface Chemistry, M2
Hometown	:	Saitama, Japan
Hobby	:	Travel

Presentation title (Poster)

Study on self-assembled monolayer confined at the solid-solid interface by sum frequency generation spectroscopy

Short abstract (100 words)

Sum frequency generation spectroscopy (SFS) is one of the ways to investigate molecular conformation and dynamics at an interface by using sum frequency generation, which occurs only when two beams overlap at the interface both spatially and temporally. SFS measurement has been conducted to investigate silica surface coated with the alkylsilane monolayer under pressure. When the alkylsilane monolayer was pressed by soft material, the increasing load normal force decreases the SF intensity. This pressure-dependent change was mainly due to the inhomogeneity at the soft-silica interface, where the “air gaps” exists and the soft elastomer could not achieve perfect contact.

Name	:	Masato Ohzu
Laboratory	:	Kawamura Lab.
Course	:	Physics, M1
Hometown	:	Niigata, Japan
Hobby	:	Darts

Presentation title (Poster)

Ion Dynamics of Lithium Ion Battery observed by MRI

Short abstract (100 words)

Nuclear magnetic resonance imaging (MRI) is a method to create pictures of nuclear spin density with static and gradient magnetic field. In general, the spin density is obtained from detected signals of transverse magnetization through Fourier transformation. The signal intensity changes due to artifacts caused by the presence of magnetic materials in a sample. In our study, we used $LiMn_2O_4$ as a cathode and conducted in-situ measurement of lithium ion battery. The changes of the MRI pictures were observed during charge-discharge process.

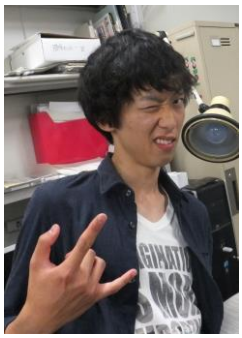
Name	:	Takehiro Fukushima
Laboratory	:	Kawamura Lab.
Course	:	Physics, M1
Hometown	:	Chiba, Japan
Hobby	:	Futsal, Karaoke

Presentation title (Poster)

In situ study of anodes in Li ion battery by acoustic emission

Short abstract (100 words)

Acoustic emission (AE) measurement is used to investigate a structural/chemical evolution of Li ion battery during charge/discharge process by detecting sounds whose frequency range is higher than 20 kHz. AE comes from cracks of electrodes, decomposition of electrolyte (gas evolution and solid electrolyte interface (SEI) formation) and electrode detachment from substrate. The results of AE measurement using Sn, SnO and Si thin film electrodes are introduced in this report. Each electrode has specific AE patterns and different AE origins. If patterns of AE origins in many kinds of batteries will be identified, AE measurement will be a good technique to evaluate the performance of batteries.



Name	:	Taku Yoshida
Laboratory	:	Kawamura Lab.
Course	:	Physics ,B4
Hometown	:	Gunma, Japan
Hobby	:	conversation with inner-muscle

Presentation title (Poster)

Thin-film lithium-ion battery with oxide amorphous Anode fabricated by pulsed laser deposition

Short abstract (100 words)

In general, All solid Thin Film Battery (TFB) has Lithium as an anode. Hence, it is unable to be used in air. Batteries which work easily in air are produced by using oxide amorphous Anode. In this study, oxide amorphous anode was fabricated as thin film by pulsed laser deposition (PLD) and was measured electrochemical characterization. We produced TFB which has Oxide amorphous anode, $LiCoO_2$ as a cathode and $Li_{3.4}V_{0.6}Si_{0.4}O_6$ as an electrolyte and value it.

Name	:	Itaru Oikawa
Laboratory	:	Takamura Lab.
Course	:	Materials Science, D3
Hometown	:	Okayama, Japan
Hobby	:	Tennis

Presentation title (Poster)

Defects and local environment in perovskite-type protonic conductors

Short abstract

Understanding of defects in perovskite-type protonic conductors, *i.e.* oxygen vacancies and protonic defects, is important to further improve their ionic conductivity. Recently, by using a nuclear magnetic resonance (NMR) spectroscopy, we have revealed change in local environment around an acceptor and defects in perovskite-type protonic conductors; isotropy of coordination environment around an acceptor with an oxygen vacancy varies with host cations in the perovskite-type oxides, which may affects stability of defects around the acceptor dopant.

Name	:	Akira Hatakeyama
Laboratory	:	Takamura Lab.
Course	:	Materials Science, D2
Hometown	:	Iwate, Japan
Hobby	:	Reading, Drinking

Presentation title

Hydride-ion transference number of fluorite-type Ca_4ZrH_{10} under high pressure

Short abstract

Recently metal hydrides as an ionic conductor have been attracting much attention. Our group has been focusing on the electrical conductivity of fluorite-type Ca_4ZrH_{10} prepared under high pressure. On the basis of structural similarity to CeO_2 and YSZ known as typical oxide-ion conductors, anion conduction originating from hydride ion (H^-) occupied on tetrahedron-site can be expected for the metal hydride. In order to clarify the presence of H^-, the transference number (t_{H-}) needs to be measured. In this study, we report t_{H-} for fluorite-type Ca_4ZrH_{10} derived from EMF and conductivity measurements including AC impedance and DC polarization under high pressure.

Name	:	Doohyun Baek
Laboratory	:	Takamura Lab.
Course	:	Materials Science, D2
Hometown	:	Ansan, Korea
Hobby	:	Sports

Presentation title

Cathode properties of Bi-Sr-Fe-based perovskite-type oxides

Short abstract

Recently, mixed ionic and electronic conducting oxides (MIECs) have been energetically focused as strong candidates for IT-SOFC cathode because of their outstanding electrochemical performances. Among them, Bi-Sr-Fe-Based perovskite-type oxides have been reported to show high oxygen nonstoichiometry and surface exchange kinetics. Here, we focus on the cathode properties of $Bi_{0.5}Sr_{0.5}FeO_{3-\delta}$ (BSF55) and its composite cathode with $PrBaCo_2O_{5+\delta}$ (PBCO) with respect to their electronic transport characteristics. Furthermore, nano PBCO dispersed BSF55 cathode was prepared and its electrode properties was also compared.

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Presentation title

Preparation of cathode materials for co-sintering with electrolyte at high temperatures

Short abstract

As one of cost-effective fabrication techniques for SOFC, co-sintering has been attracted much attention. I focus on a cathode material for co-sintering with electrolyte. In this work, Y-Sr-Mn oxides were prepared as a candidate material. Sinterability and thermal expansion coefficient (TEC) deceased compared with La-Sr-Mn oxides, and the TECs were close to GDC electrolyte. Meanwhile, electrical conductivity was lower than that of typical cathode materials. Requirements for co-sintering is to have compatibility with low sinterability, high electrical conductivity, close TEC to an electrolyte material. The compatibility can be improved by optimizing sample composition and preparation conditions.

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Presentation title

Efficiency analysis of hydrogen production by solid oxide electrolysis cell

Short abstract

Solid oxide electrolysis cell (SOEC) has been attracting much attention as an effective way of hydrogen production. Steam electrolysis is endothermic reaction, so thermal energy is utilized for electrolysis. In this study, the efficiency including thermal energy is analyzed by means of exergy diagram. In general, Ni-YSZ cermet is used for SOEC cathode; meanwhile, Ni-SDC is used in this study. Applying MIEC cathodes is expected to show higher efficiency.

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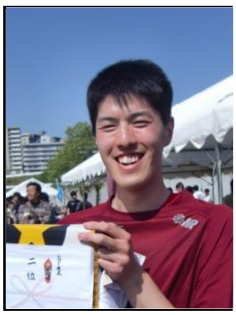
Presentation title

Li-ion conduction of Ca-doped $LiBH_4$ under high pressure

Short abstract

$CaCl_2$-doping effect on high-pressure phase of $LiBH_4$ (phase V) has been investigated. The phase V has NaCl-type structure, in which 3-dimensional ion-conducting path can be formed; so, electrode reaction is expected to occur more effectively when used as a solid electrolyte. Moreover, our group has reported that, by adding $CaCl_2$ into $LiBH_4$, electrical conductivity of phase V was enhanced by approximately 2 orders of magnitude; however, mobile ionic species and electrochemical stability of the $CaCl_2$-doped phase V remain unclear. In this study, Li-ion transport number and electrochemical window of undoped and $CaCl_2$-doped samples are clarified.



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Presentation title

High-pressure synthesis of novel perovskite-type oxides with mixed conductivity

Short abstract

Free volume is important factor for mixed ionic and electronic conducting perovskite-type oxides (ABO_3). Cubic perovskite-type oxide, $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$(BSCF5582) has high oxygen permeability and large free volume because large ionic radii of Ba^{2+} increase A-O and B-O bond distance. In order to obtain larger free volume, the synthesis of perovskite-type oxide having alkali metal on A-site is conducted by using a cubic multi-anvil high-pressure apparatus.

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Presentation title

High-pressure synthesis of new compounds in RE-TM systems
and their magnetic properties (RE: Rare Earth, TM: Fe, Co, Ni)

Short abstract

Recently, the development of strong permanent magnets has been highly demanded. The essential requirements for such the strong magnets are high saturation magnetization and high magnetocrystalline anisotropy yielding coercivity. We have focused on high-pressure synthesis of new compounds containing 3d-transition metals (TMs) and rare earth (RE) elements. High-pressure synthesis is one of the effective means to obtain new compounds, and used in a variety of research fields such as High-T_c superconductors. The purpose of this study is to explore new compounds in RE-TM systems by using the high-pressure synthesis and investigate their magnetic properties.

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Presentation title

Effect of hydration on Li-ion conductivity of $LiBH_4$

Short abstract

Lithium borohydride ($LiBH_4$) has attracted attention as solid electrolyte for lithium secondary battery. It shows high Li-ion conductive phase above 115°C; however, the temperature is high for practical applications. There have been reported that LiI and RbI stabilize high conductive phase of $LiBH_4$ at room temperature. Meanwhile, it is known that $LiBH_4$ itself and the dopants easily react with water; the hydrated water may affect electrochemical properties of $LiBH_4$. The purpose of this study is to clarify the effect of water on Li-ion conductivity in $LiBH_4$ system.

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Presentation title

Effects of surface modification on oxygen permeability of $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$

Short abstract

It has been reported that oxygen permeation rate of thin oxygen permeable membrane is limited by surface exchange reaction at lower temperature. In this study, oxygen permeation rate of tape cast $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$, (BSCF) membrane is improved by surface modification. Applying porous BSCF layer of 6.5 μm by screen printing, the permeation rate at 700°C was improved by a factor of 3.6, however, it was suggested that the effective thickness is only 2.0 μm. In order to further improve oxygen permeation property, research on new effective surface modification is underway.