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Technology & Engineering

Welcome Message from the Chairperson

It is a great pleasure for me to represent the Kogakuin University of Technology & Engineering, and welcome you at the 2nd symposium for collaborative research on energy science and technology, 2nd SCREST. The SCREST aims to promote an important consortium between the National university of Singapore and Kogakuin University of Technology & Engineering. Fortunately, both universities have many young researchers related intensively to the state-of-the-art energy materials. I wish young researchers including students will have innovative discussions throughout the 2nd SCREST.

I hope you will contribute to this future-oriented symposium as an invaluable resource. It is my great pleasure to invite Prof. Lu Li to this present SCREST. I wish you an enjoyable stay here and have a productive and successful symposium. Finally, I would like to thank the Japan Science and Technology Agency (JST) and organizing committee members, and also express my particular appreciations to the National University of Singapore.

Sincerely Yours,

Mitsunobu Sato

President, Kogakuin University

The 2nd Symposium for Collaborative Research on Energy Science and Technology (SCREST-2nd)

July 4th-6th, 2019, Kogakuin Fujiyoshida Seminar House, Japan

Main theme of SCREST-2nd: Energy Materials and Devices for Innovation

Topics of SCREST-2nd include, but not limited to:

- Energy materials
- Hydrogen energy
- Hydrogen production
- Fuel cells
- Biofuels
- Solar energy
- Alternative energy
- Photocatalysis
- Supercapacitors
- Photovoltaics
- Nanomaterials
- Nanoenergy
- Geothermal Energy

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Kogakuin University

National University of Singapore

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Functional Materials Society

Sponsored by

Japan Science and Technology Agency (JST, SAKURA Exchange Program in Science)

Kogakuin University

INVITATION

Dear Colleagues,

To solve global problems, interdisciplinary collaboration is being required. The innovative energy materials would be created by collaborating among various researchers in the field of physics, chemistry, materials, mechanical, and electrical engineering, because such collaboration can promote effective acquisition of state-of-the-art technology in each field. The SCREST-2nd (The 2nd Symposium for Collaborative Research on Energy Science and Technology) will be held at Kogakuin Fujiyoshida Seminar house from July 4th to 6th, 2019. The International Advisory and Organizing Committees cordially invite you to attend the symposium and participate in its scientific programs. In this symposium, we aim to construct a novel consortium between the two universities, having many young researchers related intensively to energy materials. Presentations will consist only oral presentation. The official language of the symposium will be English.

Important Deadlines

Deadline of Abstract Submission; July 3, 2019

Congress Date; July 4-6, 2019

July 4: Reception

July 5: Presentations/Banquet

July 6: Excursion

Advisory and Committee members

Organizing committee

Chairperson:

Mitsunobu Sato	President of Kogakuin University

Co-chairperson:

Li Lu	National University of Singapore

Committee member

Kaiyang Zeng	National University of Singapore
Jun Min Xue	National University of Singapore
Daniel Chua	National University of Singapore
Hua Chun Zeng	National University of Singapore
Ichiro Takano	Kogakuin University
Toshinori Okura	Kogakuin University
Tetsuo Sakamoto	Kogakuin University
Tohru Honda	Kogakuin University
Hiromitsu Takaba	Kogakuin University

■Language

English will be the official language during the symposium.

■Symposium Venue

The symposium will be held at Kogakuin Fujiyoshida Seminar House.

CORRESPONDENCE

If you have any inquiry, you can contact with the general secretary via e-mails in the URL.

Hiroki Nagai (KU)
Tel: +81-42628-4616
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ORAL PRESENTATIONS:

This symposium has only oral presentation.

Keynote: Speaker has **40 minutes** for their presentation. With approximately 35 minutes given for the presentation followed by 5 minutes for questions and answers.

Oral: Speaker has **10 minutes** for their presentation. With approximately 7 minutes given for the presentation followed by 2 minutes for questions and answers.

Standard facilities for PC presentations will be available at the symposium site.

GUIDELINES:

Abstracts should be prepared according to the abstract template. The abstract should be sent via e-mail (nagai@cc.kogakuin.ac.jp). The deadline for abstract submission would be **July 3, 2019**. The authors are encouraged to submit a camera-ready abstract (A5-size with 25 mm margins on all sides) in Word or PDF format. Use Times New Roman font. In the PDF file case, all fonts should be embedded in the file. The font size should be boldfaced 14 point for the title and 11 point for the remaining. The abstract should be completed within one page without figures and tables.

The abstract should be completed within one pages.

Papers in the form of electronic file should be submitted by **e-mail** to the following address: nagai@cc.kogakuin.ac.jp

Chair: Prof. Tohru Honda

10:30-10:40	Opening	Prof. Tetsuo Sakamoto
10:40-11:20	Keynote 1	Prof. Li Lu Principle of Design of Solid Ionic Conductor
11:20-12:00	Keynote 2	Prof. Tetsuo Sakamoto Development of High Spatial Resolution TOF-SIMS for Nano-Scale Mass Imaging of Industrial, Biological, Environmental Samples
12:00-13:00	Lunch	

Chairman: Dr. Hsiang-Jung Wu

13:00-13:10	Oral 1	Mr. Jin An Sam Oh TOF-SIMS Characterization of NASICON electrolyte
13:10-13:20	Oral 2	Mr. Takashi Kusachi Deep Learning to Identify Original Molecule from Mass Spectrometry
13:20-13:30	Oral 3	Ms. Xinyu Dong Electronic structure of Nickel-rich cathodes materials $LiNi_{0.8}Mn_{0.1}Co_{0.1}O_2$ of lithium-ion batteries based on first-principles density functional theory
13:30-13:40	Oral 4	Mr. Sota Nanbu Preparation of $Na_5YSi_4O_{12}$ thin film by sol-gel method
13:40-13:50	Oral 5	Ms. Qiaomei Sun LAGP/PEO Based Polymer Electrolytes Towards Li-metal Solid Batteries
13:50-14:00	Oral 6	Ms. Naamo Suzuki New type polyether/$Li_{1.5}Al_{0.5}Ge_{1.5}(PO_4)_3$ hybrid Li-conductive solid electrolyte
14:00-14:10	Oral 7	Ms. Jingjing Wang Preparation and photosensitivity of CNT/WO_3 composite thin films
14:10-14:30	Tea Break	

Chairman: Dr. Shiro Seki

14:30-14:40	Oral 8	Mr. Kazuya Tamura Analysis of water-containing biological sample by TOF-SIMS
14:40-14:50	Oral 9	Ms. Serene Wen Ling Ng Fabrication and photosensitivity of CNT/TiO_2 composite thin films on quartz glass substrate prepared by MPM

14:50-15:00	Oral 10	Mr. Nao Wakabayashi Growth and Structural Characterization of Cu_3N by Mist CVD
15:00-15:10	Oral 11	Mr. Zhongkai Hao Fabrication of TiO_2 and LCO films on FTO by doctor-blading for Energy storage
15:10-15:20	Oral 12	Mr. Yutaka Suwazono Fabrication of Li_2MnO_3 thin film for photovoltaic charge/discharge thin film device using molecular precursor method
15:20-15:30	Oral 13	Mr. Jiaxin Yan ・Growth of p-type NiO on C-Sapphire through Mist CVD Method ・Synthesis of Ag Nanowire Doped Ga_2O_3 Thin Film through Solution Mixing, Casting and Heat Treatment
15:30-15:40	Oral 14	Mr. Gen Nakayama Fabrication of photovoltaic lithium-ion-battery using Li^+-involved nickel oxide as a cathodic active material
15:40-16:00	Tea Break	
Chairman: Dr, Hiroki Nagai		
16:00-16:10	Oral 15	Ms. Ting Xiong Optimizing Electrolyte Physiochemical Properties toward Stable Aqueous Zinc Ion Battery
16:10-16:20	Oral 16	Mr. Kenta Watarai Development of freeze-fracture system for wet samples and devices
16:20-16:30	Oral 17	Ms. Wenqian Zhang Glass-Ceramics based electrolyte for all solid state sodium ion batteries
16:30-16:40	Oral 18	Mr. Koji Hiraoka Polymer/inorganic composite electrolyte for all-solid-state Na battery
16:40-16:50	Oral 19	Ms. Lei Zhang Electrochemical Measurement of Single-Particle Li-ion Battery Materials using Microprobe
16:50-17:00	Oral 20	Mr. Hiroki Hirukawa XRD-RSM Measurements of GaInN Films Grown on GaN/sapphire templates at Different Temperatures by RF-MBE
17:00-17:15	Closing	Prof. Mitsunobu Sato (President, KUTE)
17:30-19:30	Banquet	

Principle of Design of Solid Ionic Conductor (SCREST-2nd)

Li Lu

Department of Mechanical Engineering

National University of Singapore

Abstract

Solid ionic conductor is one of important functional materials that facilitates transportation of particular ions. Therefore it has been used in the devices of sensors and energy storages. One of most important parameters that judges quality of the solid ionic conductor is its ionic conductivity which is controlled by its crystallographic structure, and density of moving ions and vacancies. This talk will provide fundamental understanding of inorganic solid electrolyte and principle of ion transportation is the solids, and its applications.

Keywords: Solid electrolyte; Ionic conductivity; Structure

Development of High Spatial Resolution TOF-SIMS for Nano-Scale Mass Imaging of Industrial, Biological, Environmental Samples

Tetsuo SAKAMOTO

Department of Applied Physics, School of Advanced Engineering, Kogakuin University

Abstract

Recent years, small samples are needed to be analyzed. Conventional analysis methods have not been met these demand satisfactory. Mass spectrometry is a universal method to analyze elements, compounds and organics, including isotopes. I have developed a “Mass Imaging Apparatus”, where mass spectrum is acquired pixel-by-pixel. As a result, mass-separated images can be obtained. Furthermore, design and construction of finely focused ion beam (FIB) enabled us to get spatial resolution down to 40 nm. History of the development and some applications will be presented in the lecture.

Keywords: LIB, Cell, PM2.5, Yellow-Sand, Focused Ion Beam, Secondary Ion Mass Spectrometry

TOF-SIMS Characterization of NASICON electrolyte (SCREST-2nd)

Jin An Sam Oh[1,2], Masato Morita[3], Yue Zhao[4], Tetsuo Sakamoto[3], Li Lu[1*]

*[1]Department of Mechanical Engineering, National University of Singapore, Singapore 117575, [2]Singapore Institute of Manufacturing Technology, A*STAR (Agency for Science, Technology and Research), 2 Fusionopolis Way, Innovis, Singapore 138634, [3]Department of Applied Physics, Kogakuin University, 2665-1 Nakano, Hachioji, Tokyo, 192-0015 Japan, [4]Collaborative Open Research Center, Kogakuin University, 2665-1 Nakano, Hachioji, Tokyo, 192-0015 Japan.*

Abstract

NASICON solid-state electrolyte is one of the most promising candidates to be utilized in all-solid-state sodium-ion battery. However, being a polycrystalline material, the total ionic conductivity is mainly limited by the grain boundary conductivity at room, which includes grain boundary chemistry, secondary phase, and microstructure. In this study, FIB-TOF-SIMS is utilized to differentiate the main phase ($Na_3Zr_2Si_2PO_{12}$) and the secondary phase in the NASICON electrolyte by comparing the contrast of the secondary ion distribution. This characterization method provides an alternative insight of the chemical composition of the solid-state electrolyte at 1-5 nm depth resolution.

Keywords: NASICON; Solid-state electrolyte; Sodium-ion battery

Deep Learning to Identify Original Molecule from Mass Spectrometry

Takashi Kusachi, Hiromitsu Takaba*

Dept. of Environmental Chemistry and Chemical Engineering, Kogakuin University

Abstract

Mass spectrometry is widely used to identify an original molecular structure of organic compounds and proteins. The identification of molecular structure is usually based on the assignment of spectrum peaks and their mass-ion for a known molecule. This will be done using a database of spectrum data, and there were many attempt to develop a computer-based analysis method. This method was called as an expert system in 1980's, and it was said to be an analysis using artificial intelligence (AI) for the first time. After 40 years, AI is drastically improved by developing a deep learning method, although it is not widely used in the research filed of chemistry. In this study we report that the investigation of the deep learning for identification of known/un-known molecule from database of mass spectrometry.

Keywords: Mass Spectrometry; Machine Learning; Molecular structure

Title: Electronic structure of Nickel-rich cathodes materials $LiNi_{0.8}Mn_{0.1}Co_{0.1}O_2$ of lithium-ion batteries based on first-principles density functional theory (SCREST-2nd)

Dong Xinyu[1], Fumiya Hirosawa[2], Lu Li[1,*], Hiromitsu Takaba[2,*]

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[2]Dept. of Env.Chem.&Chem.Eng., Kogakuin University. E-mail: takaba@cc.kogakuin.ac.jp

Abstract

First-principles density functional theory (DFT) and ultra-soft pseudo potential plane-wave method are the foundation of calculating electronic structures such as Fermi levels, band structure, density of status and lithium intercalation energy of cathodes. The research started with microscopic atoms and combines theoretical calculation with experiments. While the CASTEP and DMol3 method was used to carry out preliminary theoretical calculations on materials such as $LiNi_{0.8}Mn_{0.1}Co_{0.1}O_2$ and other cathodes then compared them. A series of data was obtained that matched the experimental results.

Keywords: LiNi0.8Mn0.1Co0.1O2; First-principles density functional theory (DFT); Li-ion battery

Preparation of $Na_5YSi_4O_{12}$ thin film by sol-gel method

S. Nambu, N. Yoshida, K. Yamashita, T. Okura*

Department of Applied Chemistry and Chemical Engineering, Graduate School of Engineering, Kogakuin University

Abstract

Our group has developed glass-ceramics of $Na_5RSi_4O_{12}$ (R=Rare earth) as Na^+-superionic conductors. We tried preparation of the $Na_5YSi_4O_{12}$ Na^+-superionic conducting thin films by sol-gel method. Thin films were prepared from $Na_5YSi_4O_{12}$ precursor solutions on a glass substrate by spin-coating method. After spin-coating, the samples were calcined at 500°C. An amorphous film was obtained from $NaNO_3$ as the sodium source with 2-$C_2H_5OC_2H_4OH$ or PVA. A slightly crystallized film was obtained from $NaPF_6$ as the sodium source. It can be expected that the $Na_5YSi_4O_{12}$ phase can be obtained by examining the calcination conditions.

Keywords: Solid electrolyte; Ionic conduction; Thin film; Sol-gel method

LAGP/PEO Based Polymer Electrolytes Towards Li-metal Solid Batteries

Qiaomei Sun,[1] Masaki Kato,[2] Shrio Seki, [2, *] Kaiyang Zeng[1, *]

[1] Department of Mechanical Engineering, National University of Singapore

[2]Department of Environmental Chemistry and Chemical Engineering, School of Advanced Engineering, Kogakuin University

Abstract

The use of metallic lithium anodes enables higher energy density and higher specific capacity Li-based batteries. However, Li-ion-conducting ceramics can mechanically suppress dendritic growth but are too fragile and suffer from poor interfacial contact with the electrodes. Herein, flexible Li-ion-conducting composite membranes composed of $Li_{1.5}Al_{0.5}Ge_{1.5}(PO_4)_3$ (LAGP) particles embedded in a poly(ethylene oxide) (PEO) based polymer matrix have been fabricated. The ionic conductivity of the electrolyte with 100 wt% LAGP can reach1.12e-4 S/cm at 60 °C, but the resistance increases with the decreasing temperature. After that, all-solid-state batteries using $LiCoO_2$ as cathode and Li metal as anode have been assembled. The first charging capacity of the cell exhibit a high capacity of 107.4 mAh g^{-1}.

Keywords: All-solid-state battery; polymer solid electrolyte; LAGP; PEO polymer.

New type polyether/$Li_{1.5}Al_{0.5}Ge_{1.5}(PO_4)_3$ hybrid Li-conductive solid electrolyte

Naamo Suzuki, Masaki Kato, Koji Hiraoka, Shiro Seki *

Graduate School of Applied Chemistry and Chemical Engineering, Kogakuin University

Abstract

Recently, all-solid-state Li battery attracts attention as a new type battery. All-solid-state battery uses solid electrolytes instead of volatile liquid electrolytes. It has high safety and high energy density owing to their formability of thin-film layer. In general, solid electrolytes can be categorized into two types. One is polymer electrolyte and the another one is inorganic electrolyte. Purpose of this study is investigation of compatibility for both advantages. We propose inorganic, $Li_{1.5}Al_{0.5}Ge_{1.5}(PO_4)_3$, and polyether hybrid electrolytes having flexibility, high conductivity and no grain boundaries. Ionic conductivity and glass transition temperature of these electrolytes were investigated. Obtained results suggest the possibility of reduction of grain boundary influences.

Keywords: Polyether electrolyte, Li ion battery, grain boundary

Preparation and photosensitivity of CNT/WO_3 composite thin films

Wang_jingjing[1], Gen Nakayama[2], Hiroki Nagai[2], Zeng Hua Chun[1,*], Mitsunobu Sato[2,*]

[1]Department of Chemical and Biomolecular Engineering, Faculty of Engineering, National University of Singapore, 10 Kent Ridge Crescent, Singapore 119260, [2]School of Advanced Engineering, Department of Applied Physics, Kogakuin University, 2665-1Nakano, Hachioji, Tokyo 192-0015.

Abstract

A WO_3/carbon nano-tube (CNT) composite thin film was synthesized on the quartz substrate via a spray method by using the mixture solution of WO_3 and CNT as precursor. The WO_3 was synthesized from a molecular precursor. Compared with the pure WO_3 film, the mixed WO_3/CNT thin film shows an enhanced conductivity. As a proof-of-concept application, the WO_3/CNT thin film can be used as a photo detector, exhibiting an enhanced photo-sensitivity compared with its pure WO_3 counterpart, which can be attributed to its enhanced carrier transportation.

Keywords: Tungsten oxide; Multiwall carbon nanotube; Conductivity; Photocurrent.

Analysis of water-containing biological sample by TOF-SIMS

Kazuya Tamura,[1] Takurou Hasegawa,[1] Masato Morita,[2] Tetsuo Sakamoto[1,2,*]

1.Graduate School of Electric Engineering and Electronics, Kogakuin University

2.Department of Applied physics, School of Advanced Engineering, Kogakuin University

Abstract

We have developed a high resolution imaging method by using Ga Focused Ion Beam Time-of-Flight Secondary Ion Mass Spectrometry (FIB-TOF-SIMS). TOF-SIMS analysis requires introduction of a sample into a high vacuum chamber. As a result, water and volatile components in the sample evaporate rapidly, and the shape changes. As a countermeasure of these problems, we have developed a mechanism to freeze the sample and introduce it into the vacuum chamber without contamination from ambient. Hereby the imaging of hydrated samples with TOF-SIMS has been realized. In this study, we have examined analysis technique

Keywords: SIMS, biological sample,

Fabrication and photosensitivity of CNT/TiO_2 composite thin films on quartz glass substrate prepared by MPM

Serene Wen Ling Ng[1], Yuuki Fukuda[2], Hiroki Nagai[2], Ghim Wei Ho[1*], Mitsunobu Sato[2*]

[1]*Department of Electrical and Computer Engineering, National University of Singapore, 4 Engineering Drive 3, 117583, Singapore,*

[2]*Department of Applied Physics, School of Advanced Engineering, Kogakuin University of Technology and Engineering, 2665-1 Nakano, Hachioji, Tokyo 192-0015*

Abstract

Increasing the conductivity of TiO_2 is important for enhancement of the photocatalytic activity. In this work, three samples (TiO_2, TiO_2/single-wall carbon nano-tube (SWCNT) and TiO_2/multi-wall carbon nano-tube (MWCNT)) were fabricated on quartz glass substrate prepared by the molecular precursor method (MPM), and the photocatalytic activities were tested. As CNT is conductive, addition of both SWCNT and MWCNT aid in reducing the resistivity of the nanocomposite, which is favorable for the electron transfer process from TiO_2 to the CNT. Since TiO_2/MWCNT has the lowest resistivity of 0.38 Ω cm, it demonstrated MB discoloration of up to 20 % compared to TiO_2 (13 %).

Growth and Structural Characterization of Cu_3N by Mist CVD

Nao Wakabayashi[1], Mikio Takahashi[1], Tomohiro Yamaguchi[1], Hiroki Nagai[1], Mitsunobu Sato[1], Takeyoshi Onuma[1], Tohru Honda[*1].

*[1]*Department of Applied Physics, School of Advanced Engineering, Graduate school of Engineering, Kogakuin University, Tokyo 192-0015, Japan. E-mail: cm19053@ns.kogakuin.ac.jp.*

Abstract

Using mist chemical vapor deposition (mist CVD) method, single-crystalline oxide films can be grown in atmospheric pressure[1)]. In mist CVD, the metal ingredient, such as acetylacetonate, is first dissolved in the water. The solution is atomized and transformed to a reactor. An oxide film is then grown on a substrate in the reactor. Recently, we have successfully grown non-oxide film of Cu_3N by mist CVD using NH3 *aq.* solution instead of water. In this presentation, we introduce on the growth of Cu_3N by mist CVD. The structural characterization of Cu_3N film by X-ray diffraction (XRD) is also presented.

1)T. Kawaharamura *et al.*, J. Appl. Phys. Lett. **47**, 4669 (2008).

Keywords: Mist CVD growth; Cu_3N; XRD.

Title: Fabrication of TiO_2 and LCO films on FTO by doctor-blading for Energy storage

Zhongkai Hao[1], Yutaka Suwazono[2], Hiroki Nagai[2] , Mitsunobu Sato[2,*], Guoqin Xu[1,*]

[1] *Department of Chemistry, National University of Singapore, Singapore 117543, Singapore.*

[2] *Department of Applied Physics, School of Advanced Engineering, Kogakuin University, 2665-1 Nakano, Hachioji, Tokyo, Japan.*

Abstract

Titanium dioxide (TiO_2) is one representative transition metal oxide, which is relatively stable, abundant, eco-friendly, and safe, has attracted tremendous interest as the potential anodes in Li-ion batteries for energy storage. Here we report a facile one-step synthesis method to produce oxygen vacancy-doped TiO_2 nanoparticles and oxygen vacancy-doped amorphous TiO_2 nanoparticles. These novel anode materials are investigated for lithium ion and photovoltaic-lithium ion storage activity, where they exhibit interesting electrochemical activities in comparison with P25-based control anode.

Keywords: TiO_2; Oxygen vacancy; Amorphous structure; PV-Li ion batteries.

Fabrication of Li_2MnO_3 thin film for photovoltaic charge/discharge thin film device using molecular precursor method

Yutaka Suwazono[1], Hiroki Nagai[2], Mitsunobu Sato[2*]

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Abstract

Recently, we reported a photovoltaic lithium-ion battery (PV-LIB) with TiO_2 and $LiCoO_2$ (LCO) thin films fabricated on an FTO glass substrate, for the anode and the cathode active materials respectively by the molecular precursor method (MPM). In the present study, a Li_2MnO_3 (LMO) thin film instead of LCO was fabricated by the MPM. The charging voltages, 1.5 and 3.1 V, of the device assembled with TiO_2, LMO, and electrolytic solution involving $LiPF_6$ was recorded using 1-sun irradiation and constant current of 0.05 mA, respectively. Both charging voltages of this device under light irradiation and constant current was 0.5 V higher than the corresponding PV-LIB assembled with LCO as a cathode.

Keywords: Li_2MnO_3 thin film; photovoltaic device; molecular precursor method

Synthesis of Ag Nanowire Doped Ga_2O_3 Thin Film through Solution Mixing, Casting and Heat Treatment

Yan Jiaxin[1], Hideto Ichinose[2], Daniel Chua[1*], Hiroki Nagai[2*], Tohru Honda[2*], Mitsunobu Sato[2*]

[1]National University of Singapore, [2]Kogakuin University of Technology and Science, [*]supervisors

Abstract

Silver Nanowire (Ag NW) doped gallium oxide (Ga_2O_3) thin film was fabricated. Fabrication precursor is prepared by mixing ethanol-Ga_2O_3-EDTA (Ethylenediaminetetraacetic acid) solution with various amount of ethanol-suspended Ag NW to attain an overall Ag NW/Ga_2O_3 molar ratio of 40, 50 and 60 percent. The precursor was casted through spin coating or doctor blade method on quartz substrate, and then heated treated at 600 ^oC or 800 ^oC under argon or air environment. It is found that more suitable casting method, such as spray coating, might be necessary to attain films with both thinness and silver retention. In addition, ramping up temperature in argon environment till 800 ^oC and then swap to purified air could be the best route to prevent silver oxidation as well as eliminating carbon residue.

Keywords: Ag Nanowire doping, Ga_2O_3 thin film, precursor mixing, casting, heat treatment

Growth of p-type NiO on C-Sapphire through Mist CVD Method

Yan Jiaxin[1], Nao Wakabayashi[2], Daniel Chua[1*], Tomohiro Yamaguchi[2*], Hiroki Nagai[2*], Mitsunobu Sato[2*]

[1]National University of Singapore, [2]Kogakuin University of Technology and Engineering, [*]supervisors

Abstract

NiO (films/particles) was successfully grown on C-Sapphire substrate through novel mist chemical vapor deposition technique (Mist CVD). Correlation between growth parameters (gas type, gas flow rate, furnace temperature, and precursor concentration) and the characteristics of the final product was established through tuning of said parameters. The samples were examined with X-Ray diffraction (XRD), scanning electron microscopy (SEM) and Hall Effect measurement. It is found that only with certain parameters, NiO with film/layer morphology as well as p-type conduction can be grown. The as-grown films open up possibilities for applications such as p-n junction devices, electrochromic display and UV-absorbing transparent photovoltaic cells.

Keywords: Mist CVD, NiO, p-type conducting film

Fabrication of photovoltaic lithium-ion-battery using Li^+-involved nickel oxide as a cathodic active material

Gen Nakayama[1], Hiroki Nagai[2], and Mitsunobu Sato[2*]

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Abstract

The photovoltaic lithium-ion-battery (PV-LIB), whose anodic and cathodic active materials are TiO_2 and $LiCoO_2$ thin films on FTO glass substrate respectively, has been reported by our group. A $LiNiO_2$ molecular precursor solution $\mathbf{S_{LNO}}$ was newly prepared and used to fabricate a cathodic thin film. The precursor film on FTO glass substrate spin-coated with $\mathbf{S_{LNO}}$ was preheated and heat treated at 500ºC for 30 min in air. An XRD pattern indicated that $Li_{0.301}Ni_{1.699}O_2$ was formed in the resultant LNO thin film. The device assembled using TiO_2 and LNO thin films with an electrolytic solution generates 0.66 V as average voltage under 1-sun light irradiation, indicating a capability of PV-LIB.

Keywords: photovoltaic lithium ion battery; molecular precursor solution; $Li_{0.301}Ni_{1.699}O_2$

Optimizing Electrolyte Physiochemical Properties toward Stable Aqueous Zinc Ion Battery (SCREST-2nd)

Ting Xiong [1], Hayato Higuchi[2], Hiromitsu Takaba[2], Jun Min Xue[1]

[1] Department of Materials Science and Engineering, National University of Singapore, Singapore 117573, [2] Department of Environmental Chemistry and Chemical Engineering, School of Advanced Engineering, Kogakuin University, 2665-1 Nakano, Hachioji, Tokyo 192-0015, Japan.

Abstract

Zinc ion battery (ZIB) has recently gained significant research attention. However, ZIB still suffers from instability issues caused by water consumption and irreversible by-products. In this work, we performed molecular-scale modelling of electrolytes composed of $Zn(TFSI)_2$ and $ZnSO_4$, and results show that the anions interact with Zn^{2+} to form ion pairs $(Zn–TFSI)^+$ and $(Zn–SO_4)^+$ that suppress the presence of $(Zn–(H_2O)_6)^{2+}$.The weak interaction between Zn^{2+}, $TFSI^+$, SO_4^{2-} and H_2O benefits the Zn^{2+} to desolvate and deposit, and the suppression of Zn hydroxides generated from water decomposition. Thus, such kind of electrolyte system is expected to develop stable aqueous zinc ion battery.

Keywords: Aqueous zinc ion battery; ion pairs; suppression; excellent stability.

Title: Development of freeze-fracture system for wet samples and devices (SCREST-2nd)

K. Watarai[1], M. Morita[2], T. Sakamoto[1,2,*]

[1]Graduate School of Electric Engineering and Electronics, Kogakuin University, [2]Department of Applied physics, School of advanced Engineering, Kogakuin University 2665-1 Nakano-machi, Hachioji, Tokyo 192-0015 Japan, *ct13087@ns.kogakuin.ac.jp

Abstract

Micro/nano scale analysis is one of the most attractive subject in recent years. And it is considered that the behavior of the active materials in wet samples and devices should be clarified to moreover application and deeply understood. Since Time-of-flight secondary ion mass spectrometry (TOF-SIMS), which constructed by our grope, can be cooled to –140°C by circulation of liquid nitrogen, wet samples can be analyzed after it was frozen. In this study, a new freeze-fracture system for wet samples and devices was developed.

Keywords: TOF-SIMS; rapid freezing; sample preparaion system.

Glass-Ceramics based electrolyte for all solid state sodium ion batteries

Zhang Wenqian[1], Koji Kawada[2], Naoya Yoshida[2], Toshinori Okura[2], Lu Li[1*]

[1]Faculty of Engineering, National University of Singpore,

[2]Department of Applied Chemistry, School of Advanced Engineering, Kogakuin University

Abstract

Glass-ceramics of the phosphorus-containing $Na_5YSi_4O_{12}$-type Na^+-superionic conductors were perpared by crystallization of glasses with the composition $Na_{3+3x-y}Y_{1-x}P_ySi_{3-y}O_9$(x=0.4,y=0.2). The crystallization kinetics of the glasses was examined by DTA, and the ionic conductivity properties under different temperatures of glasses and glass-ceramics were discussed. The activation energy of glass-ceramics decreases and the ionic conductivity of glass-ceramics has a significant increase compared with glasses.

Keywords: Crystallized glass, Electrolyte, Solid state, Sodium ion battery, $Na_5YSi_4O_{12}$-type

Polymer/inorganic composite electrolyte for all-solid-state Na battery

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The all-solid-state Na battery are attracted attention by high resource abundance and safety as alternative of Li-ion battery. Although inorganic electrolyte shows high ionic conductivity (σ), this material has low interfacial stability with electrodes due to their fragility. The polymer/inorganic composite electrolytes are proposed in order to be appeared high interfacial stability, σ and flexibility. Herein, we investigated properties of composite electrolytes to clarify effects of composition ratio between polymer and inorganic electrolyte.

The composite electrolyte were prepared by polymerization of casted solution containing polyether-based macromonomer, Na salt, photo-initiator, and $Na_3Zr_2Si_2PO_{12}$ (NZSP) as an inorganic electrolyte.

The composite electrolyte showed high σ and flexibility at 30wt% NZSP sample in comparison with 0wt% NZSP. In the contrast, interfacial resistance exhibited lowest value at 200wt% NZSP sample.

Keywords: all-solid-state battery, Na secondary battery, composite electrolyte, polymer

Electrochemical Measurement of Single-Particle Li-ion Battery Materials using Microprobe

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Abstract

Conventional electrochemical measurements of battery materials rely on measuring the bulk performance of devices. The intrinsic properties of the active materials cannot be studied in isolation due to the incorporation of binders and conductive additives when making the battery device. Herein, we employ the microprobe technique to measure the electrochemical properties of Li-ion battery materials at the single particle scale (particle size ~20μm). This novel technique allows the isolation of the contribution of a single-particle active material and the study of its intrinsic properties.

Keywords: Single-particle electrochemical measurement; Microprobe; Li-ion batteries.

XRD-RSM Measurements of GaInN Films Grown on GaN/sapphire templates at Different Temperatures by RF-MBE

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Abstract

GaInN alloys are candidate materials for photovoltaic receiver in blue-light optical wireless power transmission (OWPT) system. The GaInN films have typically been grown on GaN/sapphire templates because of unavailability of bulk GaInN substrates. Plenty of crystal defects, such as dislocations and point defects, are generated due to large lattice mismatch between GaInN and GaN, though appropriate thickness is necessary to absorb the blue-lights.

In this study, 400-nm-thick GaInN films were grown on GaN/sapphire templates at different temperatures between 520 and 720°C by RF-MBE. The films were comprehensively investigated by the XRD-RSM measurements in terms of In composition, relaxation ratio, and dislocation density.

Keywords: GaInN ; RF-MBE ; XRD-RSM.