



**2013 Spring Meeting**

**Congress Center - Strasbourg, France**

May 27<sup>th</sup> - 31<sup>st</sup>, 2013

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**Resume :** Silicon as an anode material for lithium thin film battery has high capacity (approximately 9000 mAh/cm<sup>3</sup>). In spite of this high capacity, these materials are still deprived of its use as commercial purpose due to two major deficiencies, such as serious volume expansion during charge-discharge (up to 312%) and the low electronic conductivity ( $6.7 \times 10^{-4} \text{ Scm}^{-1}$ ) because of the present of oxide layer on the Si surface. On the other hand, carbon as an anode material has low capacity (approximately 850mAh/cm<sup>3</sup>) but its stability is much higher than Si. We have investigated a combination of this two as anode material to overcome their individual deficiencies to use in commercial thin film battery. It is solved by carbon as a buffering structure. The amorphous Si/C composite (a:Si/C) was deposited by radio-frequency (RF) co-sputtering with silicon and carbon target under Ar gas atmosphere at different input power. The properties of the a:Si/C were observed by field emission scanning electron microscopy, energy dispersive spectrometer. Their electrochemical performances evaluated with charge and discharge test with differential capacity. The differential capacity plots for electrochemical processes transform plateaus in discharge/charge curves. In these results, capacity and cycle life of the a:Si/C was analyzed and found to be higher stable than Si material. It is expected that a:Si/C overcomes the volume expansion problem due to carbon acts as buffering the layer.

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14:00

#### **Oxygen reduction activity of iron/carbon and iron-nickel/carbon nanoparticles synthesized by solution plasma process**

**Authors :** Dae-wook Kim<sup>1</sup>, Panuphong Pootawang<sup>2</sup>, Nagahiro Saito<sup>1,2,3</sup>

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**Resume :** Among the non-noble materials, transition metals have been widely researched as non-noble catalysts. In particular, iron and nickel are the examples of non noble catalyst showing activity towards the oxygen reduction reaction in polymer electrolyte membrane fuel cells (PEMFC). In the present study, we studied both the effect of iron/carbon and iron-nickel/carbon nanoparticles synthesized using various carbon sources on the ORR catalytic activity and the possibility of iron/carbon and iron-nickel/carbon catalyses instead of commercially Pt-based catalysts. Carbons with iron and iron-nickel particles were obtained after discharge of the carbon precursors, benzene/dodecane, thiophene/dodecane, and pyrrole/dodecane, containing iron phthalocyanine solution. The iron rod electrode was selected when synthesizing iron/carbon catalyst. Nickel and iron rods were the utilized electrodes for synthesizing iron-nickel/carbon catalyst. The obtained suspension was filtered and dried in a vacuum oven at 80 °C. Then it was heat-treated at 850 °C under nitrogen atmosphere. The electrochemical properties of the iron/carbon and iron-nickel/carbon catalysts were evaluated by cycle voltammetry using a three-electrode cell in 0.1 M KOH electrolyte and O<sub>2</sub> gas was purged in the solution during measurement. X-ray diffraction (XRD) pattern, X-ray Photoelectron Spectroscopy (XPS) and Brunauer-Emmett-Teller (BET) were conducted to examine the crystal structure, chemical bonding structure and specific surface area, respectively. The relations among electrochemical property, crystal structure, chemical bonding structure and specific surface area have been considered.

F.P2  
79

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14:00

#### **Electrodeposition from molybdate aqueous solutions: a preliminary study.**

**Authors :** Tiziana Spanò, Rosalinda Inguanta, Roberto Luigi Oliveri, Salvatore Piazza, Carmelo Sunseri

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**Resume :** The electrochemistry of molybdenum (Mo) and its oxides is very important for several applications in electrocatalysis, batteries, sensors and in particular for CIGS-based solar cells, where metal Mo is used as back contact. Properties and the fabrication method of Mo films are of fundamental importance, because they could induce significant changes in

F.P2  
80

solar cell performances. The most important issues in the electrochemical behaviour of Mo are the nature and stability of its surface oxides, which are strongly dependent on deposition bath pH. Ivanova et al. (2006) reported that it is possible to accomplish the cathodic reduction of molybdate ions to metallic Mo from electrolytes containing HF. The addition of this acid selectively prevents the polymerization of MoO<sub>4</sub><sup>2-</sup> anions, therefore its concentration plays a fundamental role. A hard drawback connected to deposition in acid media is the strong hydrogen evolution, since H<sup>+</sup> reduction is the reaction thermodynamically favoured, therefore it is necessary to apply a very high current density for appreciably depositing Mo. In this work, we report some preliminary results dealing with the electrodeposition process from molybdate aqueous solutions to grow thin films on different substrates and nanowires inside the channels of polycarbonate membranes; electrolyte pH was varied in order to evidence its role on the nature of the deposits, which were characterized by EDS, SEM, RAMAN and XRD analyses.

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14:00

### **Nano-Structured Ni/YSZ Model Anodes for SOFC**

**Authors :** Andreas Häffelin<sup>1</sup>, Konstantin Ilin<sup>2</sup>, André Weber<sup>1</sup>, Michael Siegel<sup>2</sup> and Ellen Ivers-Tiffée<sup>1</sup>

**Affiliations :** 1 Institut für Werkstoffe der Elektrotechnik (IWE), Karlsruher Institut für Technologie (KIT), Adenauerring 20b, D-76131 Karlsruhe / Germany 2 Institut für Mikro- und Nanoelektronische Systeme (IMS), Karlsruher Institut für Technologie (KIT), Hertzstrasse 16, 76187 Karlsruhe / Germany

**Resume :** In order to decrease the operating temperatures of solid oxide fuel cells (SOFC) to 450 °C, the development of high performance nanostructured fuel electrodes (anode) are of great interest. The electrooxidation reaction takes place at the triple-phase boundary (TPB), where the ionic-conducting electrolyte (YSZ), the solid electrode (nickel) and the gas-phase meet. Technical anodes with porous multiphase microstructures usually have an unknown TPB length with inhomogeneous volumetric density distributions. In contrast to this, model anodes with well-defined geometries allow a detailed investigation of the TPB processes, which is required for an optimized design of technical anodes. Though fundamental work with μm-scaled patterned anodes focused on determining the kinetics of the electrochemical reactions, there is still no consensus on the elementary reaction mechanisms and the spatial extension of the electrochemically active region. In this work the fabrication and characterization of nanoscaled model anodes is presented. While patterned structures with nickel on the nanoscale fail because of the tendency of nickel to agglomerate, the nickel layers was stabilized with a protection layer of Al<sub>2</sub>O<sub>3</sub>. By means of long-term measurements and post-test REM analysis, special care was taken to ensure structural stability, reproducibility and significance of the experimental results. Experimental data was used to develop a 3D model for the simulation of the reaction kinetics and can be used to predict the performance of simplified model-geometries as well as technical relevant nanoporous anodes.

F.P2  
81

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14:00

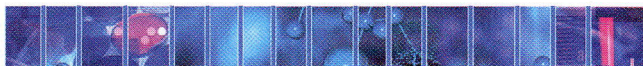
### **Synthesis of laminated semiconductor nano-composites AIIIBVI and study of optical and photoelectric properties of them for solar energy conversion**

**Authors :** Iuliana Caraman<sup>1</sup>, Igor Evtodiev<sup>2</sup>, Liliana Dimitroglu<sup>2</sup>, Marius Stamate<sup>1</sup>, Valentin Nedeff<sup>1</sup>

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**Resume :** The mono-crystals of GaSe are composed of plane packages of Se-Ga-Ga-Se type with ion-covalent bonds inside packaging and polarized bonds between packs. The valence bonds on the surface of packaging are closed. These structural properties of the compounds AIIIBVI favor the introduction of atoms and molecules between the elementary packing. The lamellar nano-composites of pGaSe-nCdSe and pGaSe-nCdSe were obtained by heating the samples in CdSe and Cd vapors at temperatures lower than the dissociation temperature of GaSe (t < 600 °C). The composition of the obtained layers was studied by XRD, FTIR and AFM measurements. Samples' composition can vary in large limits from GaSe to CdSe depending on the technological process applied (temperature and duration of heat treatment, the concentration of the insertion element in Cd and CdSe container, quality of GaSe lamellas and doping level of GaSe). Photoluminescence and cathodoluminescence spectra at the temperature from 78 °K to 300 °K

F.P2  
82



## 2013 Spring Meeting – Strasbourg, France – May 27<sup>th</sup> - 31<sup>st</sup>

- SMITH Anderson, I.15-7  
 SMITS Edsger, V.PIII-38  
**SNAITH Henry, D.X.-1**  
**SNYDER Jeff, C.XI-1**  
 SO Keun-Soo, N.P1-34  
 SOARES DE MELO Luísa, V.P1-48  
 SOBČZAK Janusz, J.P.II.-18  
 SOCOL Gabriel, O.P1-25, R.P1-22, V.P1-16, V.P1-34  
 SODANO Henry, F.10-2  
 SOLA Daniel, V.PIII-11  
 SOLDOVIERI Francesco, Y.P-21  
 SOLÓRZANO Guillermo, N.P2-49  
 SOLTANI Sonia, J.P.II.-42  
 SONES Collin, V.III-3  
 SONG Jae Yong, C.VIII-4  
 SONG Jie, I.15-3  
 SONG Myoung Hoon, B.PII-21  
 SONG Zhenlun, SP.II.-39  
 SOPPE Wim, D.XIV.-2  
 SOPRONYI Mihai, V.PII-23  
 SOUILAH Marc, E.V-18  
 SOUSA Marta, D.PII.-72  
 SOUSSI Jordane, U.4-3  
 SOWINSKA Malgorzata, H.III.-6  
 SPANÓ Tiziana, D.PII.-49  
 SPANÓ Tiziana, F.P2-80  
 SPEGHINI Adolfo, U.14-5  
 SPIGA Sabina, H.III.-2  
 SPIROS Kassavetis, B.PII-43, SP.I.-33  
 SPITZ Stefanie, S.V-7  
 SPREITZER Matjaz, H.P1-1  
 SRINIVASAN Nagendra Babu, N.P1-27, N.IX-3  
 STADLER Philipp, B.P1-42  
 STAMATIN Ioan, D.P1.-26, F.P1-41, F.P2-52, F.P2-54, F.P2-60, Q.P1-29, SP.II.-1  
 STAN George, OP.III-33, OP.III-34  
 STANCULESCU Anca Ioana, V.PII-24  
 STANKOVA Nadya, V.PIII-53  
 STATHOKOSTOPOULOS Dimitrios, C.P1-9, SP.I.-13  
 STATHOPOULOS Spyridon, K.P9-12  
 STAVARACHE Ionel, JXVII-6  
 STEFAN Nicolaie, V.PII-9  
 ŠTEFANCIKOVÁ Lenka, U.13-4  
 STEFANIA Sandoval, TP-11  
 STEFIK Morgan, F.13-7  
**STELLACCI Francesco, U.13-1**  
 STEPIKHOVA Margarita, JXVII-8  
 STERGIPOULOS Thomas, B.P1-8, B.XII-2, B.PII-37  
 STESMANS Andre, I.4-4  
 STEYER Philippe, S.VI-2, SP.II.-52  
 STIEVENARD Didier, F.P1-7, OP.II.-1, OP.III-1  
 STEOFFLER Daniel, H.P1.-14  
 STOKKER CHEREGI Flavian, V.PIII-28  
**STOLARCZYK Jacek, F.3-1**  
 STOLNIK Snow, U.3-4  
 STOLOJAN Vlad, I.11-27  
 STOOP Ralph, P.VII.-8  
 STRANAK Vitezslav, S.II-2  
 STRANKS Samuel, JI-4  
 STRATAKIS Emmanuel, B.P1-22, R.2-4, V.IV-1, V.PII-15  
 STREECK Cornelia, D.PII.-69  
 STRELCHUK Viktor, LP2-18  
 STRULLER Carolin, OP.III-17  
 STRULLER Carolin, SP.II.-31  
 SU Chen-Yi, H.I.-9, I.5-3, LP2-27  
 SU Yin-Hsien, D.XVII.-2, K.P9-17  
 SUEKAMP Tobias, K.3-5  
 SUGIMOTO Hiroshi, D.VIII.-2, Q.P1-14  
**SUGIYAMA Masakazu, D.XVI.-1**  
 SUGUIHIRO Natasha, N.P2-49  
 SUHAK Yuriy, D.PII.-42  
 SULEIMANOV Nail, F.P2-48  
 SUMATHI Rajappan Radhakrishnan, G5-2  
 SUMMONTE Caterina, D.P1.-54  
 SUN Jianwu, GP-5  
 SUNGEUN Heo, F.P2-68  
 SUPRYADKINA Irina, LP1-20  
 SURACE Yuri, F.P1-73  
 SUZUKI Akio, P.PII.-6  
 SUZUKI Atsushi, T6.2  
 SVEC Martin, SP.II.-54  
 SVIRSKAS Sarunas, P.P1.-28  
 SVOUKIS Efthymios, V.P1-43, V.XV-2  
 SYNOOKA Olesia, B.III-5  
 SZÁSZ Julian Tibor, F.P1-74  
 SZIRAKI Laura, SP.II.-21  
 SZOT Michal, C.IV-4  
**T**  
**TABACCHI Gloria, N. VIII-1**  
 TABBAL Malek, LP1-36  
 TAHINI Hassan, I.11-22  
**TAKABATAKE Toshiro, C.I-1**  
 TAKAHASHI Akira, N.P1-39  
 TAKAOKA Gikan, W.3-5, WP1-4  
 TAKEDA Masatoshi, C.XI-3  
 TAKEDA Yasuhiko, D.II.-3  
 TAKEYA Hiroyuki, P.IX.-2  
 TALAGRAND Clément, O.P1-33  
 TALALAEV Vadim, J.P.II.-30, N.P1-19  
 TALLARIDA Massimo, A.III-2, A.VIII-6, A.VII-3, N.P1-25  
 TAMARA Potlog, D.PII.-8  
 TAMION Alexandre, U.2-6  
 TAMM Aile, N.VI-1  
 TAMULEVICIUS Sigita, OP.III-26  
 TAMULEVICIUS Tomas, WP1-7  
 TANDIA Adama, D.P1.-32  
 TANG Zheng, B.III-2, B.P1-19  
 TAO Andrea, Q.V-2  
 TAO Lili, V.P1-1  
 TAPASZTO Levente, I.10-2  
 TARASENKA Natalie, V.PII-7  
 TATA Sonia, X.P-10  
 TAVARES Luciana, JI-2  
 TAYAGAKI Takeshi, D.P1.-7  
**TAYLOR Robin, E. III-1**  
 TCHERNYCHEVA Maria, P.VII.-3  
 TEA Eric, D.PII.-52  
 TEAGUE Melissa, E.II-10  
 TEASDALE Ian, U.P1-32  
 TEGHIL Roberto, V.P1-8, V.PII-8  
 TELLO Pablo, F.9-8  
 TEMMEL Sandra, V.P1-4  
 TEMPEZ Agnes, X.P-19  
 TEMST Kristiaan, W.6-4  
 TENGSTRAND Olof, S.V-6  
 TEODORESCU Valentin, V.PIII-31  
 TEPLOV Pavel, E.III-12  
**TESSIER Franck, T1.4, TP-2**  
 TESSIER Mickael, JV-6  
**TESSLER Nir, B.XI-2**  
 TEWARI Girish C, C.IX-4  
 TEX David, D.I-3  
 THAI Thibaut, N.XII-3  
 THANH TOAN Pham, F.P2-21  
 THAYUMANANDARAM Savitha, F.P1-42  
 THISSANDIER Fleur, F.P1-16, F.6-4  
 THOMAS Jacob, Y.4-3  
 THOMAS Maxime, P.PII.-26  
 THOMAS Pam, H.II.-4  
 THOMASSON Alexandre, O.VI-7  
**THOMASKE Bruno, E.III-10**  
 TIMOFEEV Vyacheslav, J.P.I.-32  
 TING Heng-Wen, N.XII-1  
 TINO Angela, U.PII-29  
 TISCHER Ingo, LP1-21  
 TITE Teddy, I.10-7, V.X-3  
 TKACHOV Grigory, JVI-3  
 TOBAIL Osama, D.P1.-61  
 TOCINO Florent, E.I-3  
 TOFFANIN Stefano, Q.P1-37  
 TOKAROVA Viola, U.7-2  
 TOKUDA Yutaka, LP1-12  
 TOKUMITSU Eisuke, H.P1.-34  
 TOMCZAK Yoann, N.IV-4  
 TOMINA Veronika, U.P1-18  
 TOMINAGA Aki, N.P2-44, N.P2-46  
 TOMIOKA Katsuhiko, P.I-5  
 TOMUT Marilena, M.9-6  
 TOMYLKO Irina, RP.2-25  
 TONAZZINI Ilaria, R.2-2  
 TONKIKH Alexander, J.P.II.-30  
 TORINO Enza, RP.1-6  
**TORIUMI Akira, I.4-1, I.15-2**  
 TORRENT Franck, S.IV-4, V.PIII-6  
 TORTIGLIONE Claudia, Q.III-5  
 TOULEMONDE Marcel, M.9-2  
 TOURY Bérangère, SP.1.-16  
 TRAN Ngoc, Q.P1.-28  
 TRAN Van De, SP.1.-59  
 TRANCHANT Julien, H.V.-1, T5.8  
 TRIANTIS Dimos, X.P-36, F.P2-77  
 TROCELLIER Patrick, M.3-3  
**TROLIER-MCKINSTRY Susan, H.VII.-1**  
 TROMPOUKIS Christos, D.V.-2, D.XIV.-4  
 TSAI Hsu-Sheng, I.8-8  
 TSAI Hung-Wei, C.VII-4  
 TSAI Meng-Yu, U.P1-8  
 TSANG Ming Kiu, Q.II-11  
 TSIBIZOV Alexander, K.P9-15  
 TSIPAS Polychronis, I.12-3  
 TSUJIMOTO Yoshihiro, T1.2  
 TUDISCO Cristina, U.PII-13  
 TUPALA Jere, F.P2-41