5th Australia-China Conference on Science, Technology and Education

In conjunction with

5th Australia-China Symposium for Materials Science

21–23 July 2014   Wollongong, Australia
Our research programs include:

- Energy capture, generation, transport and storage
- New materials for bionics and health solutions
- Materials characterisation
- Device development and new fabrication techniques

We also offer the world’s first Masters degree in biofabrication.

Visit aiim.uow.edu.au for more information on our research, facilities and opportunities to collaborate.
Proceedings Publications

Papers presented at this Symposium will be published in Scientific Reports Proceedings. All manuscripts will be subjected to Scientific Reports usual peer review processes. All papers accepted for publication will be published as open-access articles, which will require payment of $1,350.

Submissions are now open and close on 20th August 2014.

Find instructions on how to submit at: isem.uow.edu.au

To connect to wireless, select the UOW_EVENT wireless network from your device, and enter the passkey provided. If you have any problems connection please see one of the conference support staff.
Delegates, distinguished speakers and invited guests, welcome to the 5th Australia-China Conference on Science, Technology and Education and the 5th Australia-China Symposium for Materials Science and welcome to Wollongong.

Over the next three days you will have the opportunity to hear from 90 speakers, including 4 plenary and 22 keynote speakers, from Australia, China and other countries as well as having opportunities to network and exchange ideas.

Australia and China have a long history of friendship. Chinese people are considered to be among the oldest continuous migrant community within Australia and in 2012 our two nations celebrated 40 years of diplomatic relations. Over these 40 years the relationship between our two nations has changed extensively. In 1972 when diplomatic relations were established our bilateral trade was less than $A100 million, in 2010 our bilateral trade reached more than $A100 billion. Similarly our education links that were non-existent in 1972 have transformed with more than 167,000 Chinese students studying in Australia, around 2,800 studying here at the University of Wollongong.

Along with being significant trading partners, the strength of the innovation, teaching and research relationship between Australia and China means that our nations are significant knowledge partners. The collaborations between our nations will help to drive us to find solutions to global problems.

For many of you this will be the first time you have visited both Wollongong and the University of Wollongong. We extend to you a warm welcome and encourage you to take some time to explore one of Australia’s great cities.

This year our institute, the Institute for Superconducting and Electronic Materials (ISEM), celebrates its 20th anniversary at University of Wollongong. It has grown from few of people in 1994 to more than 130 people today and is a well-recognised research establishment.

One of the key factors for its success is strong international collaboration; in particular, the extensive network ISEM has forged with partners in Asian countries. About a third of the eminent participants of this conference are our collaborators in the form of ARC Partner Investigators, joint grant recipients, joint supervisors of exchange students, joint publishers and honorary appointees. It is our strong desire to enhance our existing networks and establish new networks through this conference. I highly value your collaboration and support and look forward to a new era for ISEM in the Asian century.

I also cordially invite you to take the opportunity to tour our world-class laboratories. ISEM has its door open to embrace your expertise and friendship.

Please enjoy the discussion and debate over the coming days. I look forward to speaking with each of you in one of the breaks or at the social events and exploring how we can expand our research collaborations and teaching relationships.

Thank you for attending.

Distinguished Professor Shi Xue Dou, PhD, DSC, FTSE
President, FOCSA
Co-Chair of the Organising Committee
Director, Institute for Superconducting and Electronic Materials
Train Schedule for travelling from Wollongong to Sydney International Airport departing between 2pm and 8pm on 22nd, 23rd, and 24th of July 2014. All travellers are recommended to change trains at Wolli Creek. Proceed to platform 3 when changing trains.

<table>
<thead>
<tr>
<th>Station</th>
<th>Train Departs</th>
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<tbody>
<tr>
<td>Wollongong</td>
<td>14:35 15:35 16:05 16:35 17:35 18:36 19:35</td>
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<tr>
<td>Hurstville</td>
<td>15:42 16:42 17:12 17:42 18:42 19:42 20:42</td>
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<tr>
<td>Wolli Creek / Change Here</td>
<td>16:00 17:00 17:30 18:00 19:00 20:00 21:00</td>
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<td>International Airport</td>
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<td>18:02</td>
<td>19:02</td>
<td>20:02</td>
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<tr>
<td>Domestic Airport</td>
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</tbody>
</table>

![Train map diagram](image-url)
Lab Tours
ISEM lab tours will be available each day between 2pm – 4pm, running every 30 minutes. If you would like to attend please meet the conference support staff at the registration desk in the iC foyer.

Symposium Group Photo
A group photo of all symposium participants will be taken on Tuesday 22nd July at 10.40am. Please congregate in the IC foyer.

Poster Session
The poster session will be held on Tuesday 22nd July at 4.45pm – 6.15pm in the Australian Institute for Innovative Materials (AIIM) building. Presenters must be available during the entire poster session. Winners will be announced at the dinner. Posters must be collected by 5pm Wednesday 23rd July.

Symposium Dinner
The symposium dinner will be held on Tuesday 22nd July, 6.30pm at the Lagoon Seafood Restaurant (Stuart Park, North Wollongong). A bus will be available to take participants to the restaurant departing from iC at 6.15pm. Symposium name badges must be shown upon arrival at the restaurant to the conference organisers.

Illawarra Flame House Tours
Team UOW Australia had taken up the challenge of demonstrating how to retrofit a ‘fibro’ home, to transform it into a sustainable 21st century net-zero energy home. It won the Solar Decathlon China 2013 competition and will be available to tour on Wednesday 23rd July at 4.15pm. Please meet the conference volunteer guide at the iC foyer. If you would like to attend please nominate prior to the tour at the registration desk during breaks on Monday and Tuesday of the symposium.
We are pleased to announce the Poster Awards Competition at the 5th ACCSTE and 5th ACSMS Symposium to be held on 21-23 July 2014 at the Innovation Campus. Awards will be in the form of certificates, cash prize or free one year journal subscription.

**Poster Competition Criteria:**

All accepted poster abstracts are considered for the 5th ACCSTE and 5th ACSMS Symposium poster award, unless the work has already been published or accepted for publication elsewhere. The posters will be judged based on the following criteria:

1. Scientific quality and novelty
2. Organization and visual presentation of poster
3. Ability of presenter to answer questions
4. Clear conclusions

**Sponsors of the poster award:**

- “Applied Physics Letters-Materials”, presented by the Editor in Chief, Prof. Judith Driscoll
- Wiley, "Small", presented by the consulting Editor, Dr Esther Levy
- NPG “Scientific reports” presented by the Editor in Chief, Dr Richard White
- RSC "Frontier Inorganic Chemistry” presented by Prof. Shi Xue Dou on behalf of the Editor in Chief Dr Daping Zhang
- FOCSA poster awards presented by the President of FOCSA Prof. Shi Xue Dou

**Award judgment committee:**

- Prof. Xiaolin Wang, ISEM, program Chair of the Symposium
- Prof. Judith Driscoll, Editor in Chief of APL Materials
- Dr Richard White, Editor in Chief of Scientific Reports
- Dr Esther Levy, former Editor in Chief of Advanced Materials and consulting Editor for Wiley.

**The Symposium will have the following poster awards:**

- One poster award by APL Materials
- Three poster awards by FOCSA
- Two poster awards by Royal Chemistry Society Frontier Inorganic Chemistry
- One poster award by Scientific Reports
- Two poster awards by Small Wiley publisher
The service operates between 7.00am and 10.00pm from Monday to Friday.
Every 10 minutes during peak (7.00am–9.00am & 3.00pm–6.00pm) and every 20 minutes off-peak.
The weekend service will operate every 20 minutes between 8.00am and 6.00pm.

*Operates every 10 minutes during peak (7.00am–9.00am) & every 20 minutes off peak (3.00pm–6.00pm).
ATTRACTIONS IN THE ILLAWARRA

Symbio Wildlife Park
7-11 Lawrence Hargrave Drive, Helensburgh
P. 02 4294 1244   I   F. 02 4294 1734
info@symbiozoo.com.au   I   www.symbiozoo.com.au

Illawarra Fly
182 Knights Hill Road, Knights Hill
P. 1300 362 881   I   F. 02 4885 2366
info@illawarrafly.com   I   www.illawarrafly.com

Nan Tien Temple
Berkeley Road, Berkeley
P. 02 4272 0600   I   F. 02 4272 0601
reception@nantien.org.au

Minnamurra Rainforest
P. 02 4236 0469

Kiama Blowhole
www.kiama.com.au

For more information on places of interest around Wollongong please visit visitwollongong.com.au
The 5th Australia-China Conference on Science, Technology and Education will focus on strategic topics including energy, materials, water, food security, science, technology, education, commerce and trade, Chinese businesses in Australia and international relations.

The 5th Australia-China Symposium for Materials Science will bring together scientists and engineers in materials science and engineering. This multidisciplinary symposium will cover topics including nano-scale, energy, superconducting, electronic, biomedical, magnetic, and environmental materials.

The aims of the joint conference are to:
1. Further the bilateral understanding of important issues concerning Australia and China;
2. Facilitate interdisciplinary and strategic collaboration and communication among science, technology, humanity and social sciences, and education between Australia and China;
3. Provide a forum for the exchange of ideas and networking among representatives from governments, academia, industry and research organisations of the two nations;
4. Support career development of young Chinese scholars in Australia and China; and
5. Disseminate knowledge of the latest developments and progresses in science, technology and education.

Topics
The joint conference will feature presentations in the following areas including:

For 5th Australia-China Symposium for Materials Science:

- Nanomaterials for energy harvesting including solar energy
- Energy storage materials including batteries, capacitors and hydrogen storage
- Thermoelectrics for waste heat recovery
- Piezo-electronics, ferroelectrics and multiferroics
- Superconducting and spintronic materials
- Biomaterials
- Opto-electronics and photonics
- Photocatalysis and water splitting
- Thin film technology
- Structural materials
- Computational design and modelling
- Novel applications of functional materials

For 5th Australia-China Conference on Science, Technology and Education:

- Biotechnology and medical research
- Food Sciences, Agriculture and Natural Resources;
- Civil Engineering, Electrical and Electronic, Mining Engineering;
- Mechanical Engineering and Mechatronics;
- Computer Engineering, Communication Technology and Informatics;
- Environmental Science and Engineering;
- Humanity and Social Sciences;
- Commerce, Business, Finance and Management;
- Politics and International Relations;
- Technology Transfer and Commercialisation.
CONFERENCE COMMITTEES

Advisory Committee
Professor Jing Hai Li, Vice President of Chinese Academy of Science (Chair)
Professor Max Lu, FAA, FTSE, FIChemE, former President of FOCSA, Deputy Vice-Chancellor (Research), University of Queensland
Professor Aibing Yu, FAA, FTSE, Former President of FOCSA, University of NSW
Professor Min Gu, FAA, FTSE, Laureate Fellow, Former President of FOCSA, Swinburne University
Professor Dongke Zhang, FTSE, Former President of FOCSA, University of Western Australia

Organising Committee
Co-Chair: Professor Shi Xue Dou, FTSE, President of FOCSA, University of Wollongong
Co-Chair: Professor Hui Ming Cheng, FCAS, Symposium Chair of 2nd ACSMS, Institute of Metal Research, Chinese Academy of Sciences
Professor Shi Lun Qiu, Vice President of Jilin University, Symposium Chair of 4th ACSMS
Professor Hao Wang, Symposium Chair of 1st ACSMS, University of Southern Queensland
Professor Hui Jun Zhao, Symposium Chair of 3rd ACSMS, Griffith University,
Professor Xiang Dong Yao, Symposium Chair of 3rd ACSMS, Griffith University
Professor Min Zhu, Symposium Chair of 4th ACSMS, South University of Science and Technology

Program Committee
Co-Chair: Professor Wei Zhang, Deputy President of FOCSA, Flinders University
Co-Chair: Professor Xiaolin Wang, Secretary General of FOCSA, University of Wollongong, e-mail: Xiaolin@uow.edu.au
Dr Yi Du, University of Wollongong (Finance), e-mail: ydu@uow.edu.au
Dr. Germanas Peleckis, UoW (Coordinator), e-mail: Peleckis@uow.edu.au
Mrs Crystal Mahfouz, UoW (Secretary), e-mail: clongin@uow.edu.au
# PROGRAM – Day 1, 21st July 2014

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<th>Time</th>
<th>Session</th>
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<tr>
<td>8.00</td>
<td>Conference Registration</td>
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<tr>
<td>8.40</td>
<td>Conference Welcome, Prof. J. Raper, UOW DVCR</td>
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<tr>
<td>8.50</td>
<td>Conference Welcome, Mr. H. X. Li, PR China Consulate General</td>
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<tr>
<td>9.00</td>
<td>ACSMS Plenary / FOCSA Keynotes / Chair – Prof. S. X. Dou</td>
</tr>
<tr>
<td>9.00</td>
<td>PL01, Prof. H. Hosono (page 27)</td>
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<tr>
<td>9.30</td>
<td>PL02, Prof. J. Driscoll (page 27)</td>
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<td>10.00</td>
<td>FO01, Prof. J. H. Li (page 28)</td>
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<td>FO02, Prof. M. Wainwright (page 28)</td>
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<td>10.40</td>
<td>Morning tea</td>
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<tr>
<td>11.00</td>
<td>FOCSA Keynotes / Chair – Prof. H. M. Cheng</td>
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<tr>
<td>11.00</td>
<td>FO03, Prof. A. B. Yu</td>
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<td>11.20</td>
<td>FO04, Prof. Y. W. Mai (page 28)</td>
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<td>11.40</td>
<td>FO05, Prof. D. Y. Zhao (page 28)</td>
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<tr>
<td>12.00</td>
<td>FO06, Prof. Y. B. Cheng (page 29)</td>
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<td>12.20</td>
<td>FO07, Prof. W. Zhang (page 29)</td>
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<td>13.00</td>
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<tr>
<td>14.00</td>
<td>ACSMS Session Talks</td>
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<tr>
<td>14.00</td>
<td>ACSMS Electronic Materials Chair - Prof. P. Murphy</td>
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<tr>
<td>14.00</td>
<td>ACSMS Materials Science Chair - Prof. L. J. Guo</td>
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<tr>
<td>14.00</td>
<td>EM01, Prof. J. Bell (page 30)</td>
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<td>14.15</td>
<td>EM02, Prof. Y. W. Ma (page 30)</td>
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<td>14.30</td>
<td>EM03, Prof. H. Zhang (page 30)</td>
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<td>14.45</td>
<td>EM04, Prof. S. Li (page 30)</td>
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<tr>
<td>15.00</td>
<td>EM05, Prof. K. Wu (page 31)</td>
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<tr>
<td>15.15</td>
<td>EM06, Prof. C. B. Cai (page 31)</td>
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<td>15.30</td>
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<tr>
<td>15.50</td>
<td>ACSMS Energy Materials Chair - Prof. D. Y. Zhao</td>
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<td>15.50</td>
<td>ACSMS Materials Science Chair Prof. - J. Bell</td>
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<tr>
<td>15.50</td>
<td>ENG01, Prof. Y. L. Hou (page 35)</td>
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<tr>
<td>16.05</td>
<td>ENG02, Prof. X. D. Yao (page 35)</td>
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<tr>
<td>16.20</td>
<td>ENG03, Prof. R. Amal (page 36)</td>
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<tr>
<td>16.35</td>
<td>ENG04, Prof. H. G. Yang (page 36)</td>
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<tr>
<td>16.50</td>
<td>ENG05, Prof. W. C. Hao (page 36)</td>
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<td>17.00</td>
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## PROGRAM – Day 2, 22nd July 2014

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<thead>
<tr>
<th>Time</th>
<th>ACSMS Plenary / ACSMS Keynotes / Chair – Prof. H. J. Zhao</th>
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<tbody>
<tr>
<td>9.00</td>
<td>PL03, Prof. Z. L. Wang (page 38)</td>
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<tr>
<td>9.30</td>
<td>PL04, Prof. J. Snyder (page 38)</td>
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<tr>
<td>10.00</td>
<td>ACK01, Prof. C. Jagadish (page 39)</td>
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<tr>
<td>10.20</td>
<td>ACK02, Prof. H. M. Cheng (page 39)</td>
</tr>
<tr>
<td>10.40</td>
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<td>11.00</td>
<td>ACSMS Keynotes / Chair – Prof. C. Jagadish</td>
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<td>11.20</td>
<td>ACK03, Prof. M. S. Fuhrer (page 39)</td>
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<tr>
<td>11.40</td>
<td>ACK04, Prof. M. Gu (page 39)</td>
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<tr>
<td>12.00</td>
<td>ACK05, Prof. S. Smith (page 40)</td>
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<tr>
<td>12.20</td>
<td>ACK06, Prof. J. H. Ye (page 40)</td>
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<tr>
<td>12.40</td>
<td>ACK07, Dr. E. Levy (page 40)</td>
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<tr>
<td>13.00</td>
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<tr>
<td>13.50</td>
<td>Lunch</td>
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## ACSMS Session Talks

### ACSMS Materials Science
**Chair** Prof. K. Ostrikov

<table>
<thead>
<tr>
<th>Time</th>
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<tr>
<td>13.45</td>
<td>MS12, Prof. J. Zou (page 41)</td>
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<tr>
<td>14.00</td>
<td>MS13, Prof. G. X. Wang (page 41)</td>
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<tr>
<td>14.15</td>
<td>MS14, Prof. Y. S. Yang (page 41)</td>
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<tr>
<td>14.30</td>
<td>MS15, Prof. X. C. Jiang (Page 42)</td>
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<tr>
<td>14.45</td>
<td>MS16, Dr. Y. Du (page 42)</td>
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<tr>
<td>15.00</td>
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### ACSMS Energy Materials
**Chair** Prof. S. W. Kim

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<th>Time</th>
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<tbody>
<tr>
<td>13.45</td>
<td>ENG06, Prof. Y. M. Kang (page 42)</td>
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<tr>
<td>14.00</td>
<td>ENG07, Prof. Y. Y. Xia (page 42)</td>
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<td>14.15</td>
<td>ENG08, Dr. H. X. Wang (page 43)</td>
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<td>ENG09, Prof. Y. H. Huang (page 43)</td>
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<td>14.45</td>
<td>ENG10, Prof. H. S. Kim (page 43)</td>
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### ACSMS Materials Science
**Chair** – Prof. W. Zhang

<table>
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<th>Time</th>
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<tr>
<td>15.20</td>
<td>MS17, Prof. S. Z. Qiao (page 44)</td>
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<tr>
<td>15.35</td>
<td>MS18, Prof. K. Ostrikov (page 44)</td>
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<tr>
<td>15.50</td>
<td>MS19, Prof. T. Y. Xiong (page 45)</td>
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<td>16.05</td>
<td>MS20, Prof. L. T. Sun (page 45)</td>
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<td>16.20</td>
<td>MS21, Prof. H. Wang (page 45)</td>
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<tr>
<td>16.45</td>
<td>ACSMS Poster Session and Refreshments</td>
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<tr>
<td>18.30</td>
<td>Conference dinner</td>
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<td>Close of Day 2</td>
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## Program – Day 3, 23rd July 2014

### ACSMS Keynotes / Chair – Prof. W. Price

<table>
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<tr>
<th>Time</th>
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<tr>
<td>9.00</td>
<td>ACK08, Prof. L. Jiang (page 49)</td>
</tr>
<tr>
<td>9.20</td>
<td>ACK09, Prof. X. Y. Zhang (page 49)</td>
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<tr>
<td>9.40</td>
<td>ACK10, Prof. Z. F. Liu (page 49)</td>
</tr>
<tr>
<td>10.00</td>
<td>ACK11, Prof. Y. Xie (page 49)</td>
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</tbody>
</table>

**Morning tea**

### ACSMS Keynotes / Chair – Prof. X. L. Wang

<table>
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<th>Time</th>
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<tr>
<td>10.40</td>
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<td>ACK13, Dr. R. White (page 50)</td>
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<td>ACK14, L. J. Guo (page 50)</td>
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<td>ACK15, Prof. W. Price (page 51)</td>
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**Lunch**

### ACSMS Session Talks

#### ACSMS Electronic Materials
Chair – Prof. I. Gentle

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<tr>
<td>13.00</td>
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<td>EM08, Prof. A. Vinu (page 52)</td>
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<td>EM09, Prof. X. Z. Liao (page 52)</td>
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<td>13.45</td>
<td>EM10, Dr. S. Aminorroaya-Yamini (page 52)</td>
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<tr>
<td>14.00</td>
<td>EM11, Prof. N. Valanoor (page 53)</td>
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<tr>
<td>14.15</td>
<td>EM12, Prof. S. Kennedy (page 53)</td>
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**Afternoon tea**

#### ACSMS Materials Science
Chair – Prof. S. Kennedy

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<td>MS23, Prof. H. Z. Xu (page 57)</td>
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<td>MS24, Prof. J. T. Zhang (page 57)</td>
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<td>MS25, Prof. W. L. Cheng (page 58)</td>
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<td>MS26, Dr. R. M. Tian (page 58)</td>
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#### ACSMS Energy Materials
Chair - Prof. Z. F. Ma

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<td>ENG17, A/Prof. R. Caruso (page 54)</td>
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<td>ENG18, Prof. G. Wei (page 54)</td>
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<td>ENG19, Dr. Z. Q. Sun (page 54)</td>
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<tr>
<td>14.00</td>
<td>ENG20, Prof. Z. X. Wang (page 55)</td>
</tr>
<tr>
<td>14.15</td>
<td>ENG21, Prof. R. M. Wang (page 55)</td>
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**Close of Day 3**
Hideo Hosono

He received his Ph.D at 1982 in Applied Chemistry from Tokyo Metropolitan University, and became a Professor at Materials and Structures Laboratory (MSL), Tokyo Institute of Technology in 1999 via associate professors of Nagoya Institute of Technology and Tokyo Tech. In 2004. He moved to Frontier Research Center, Tokyo Tech, and was appointed to the founding director of Materials Research Center for Element Strategy on August 1, 2012. He is a member of Science Council of Japan.

Dr.Hosono is known as the invention of IGZO (InGaZnOx)-thin film transistors which have been applied to new iPad, smart phones, and large sized OLED-TV as the backplane to drive them and the discovery of Iron-pnictide superconductors which was chosen as a breakthrough of the year 2008 by the Science Magazine. He is a Thomson Reuters Citation Laureate in Physics (2013).

Judith Driscoll

Judith Driscoll’s research is in the area of thin film functional oxide materials. Judith received her Ph.D. from the University of Cambridge in 1991. She was an IBM Post-doctoral Fellow at Stanford University and IBM Almaden from 1991-1995. She was a Reader at Imperial College from 1995 until 2003. She has been a Long Term visiting staff member at Los Alamos National Lab since 2003. She joined the University of Cambridge where she is a Professor of Materials Science in 2003 and she became a Fellow of Trinity College in 2004. She is also Fellow of the Institute of Physics and the American Physical Society. She has published over 300 papers and is Founding Editor of a new all open-access journal from the American Institute of Physics, called APL Materials. A number of her patents have been licensed and inventions taken up by industries worldwide.
Zhong Lin Wang
Dr. Zhong Lin (ZL) Wang received his PhD from Arizona State University in 1987. He now is the Hightower Chair in Materials Science and Engineering and Regents’ Professor at Georgia Tech. Dr. Wang has made original and innovative contributions to the synthesis, discovery, characterization and understanding of fundamental physical properties of oxide nanobelts and nanowires, as well as applications of nanowires in energy sciences, electronics, optoelectronics and biological science. His discovery and breakthroughs in developing nanogenerators establish the principle and technological road map for harvesting mechanical energy from environment and biological systems for powering a personal electronics. His research on self-powered nanosystems has inspired the worldwide effort in academia and industry for studying energy for micro-nano-systems, which is now a distinct disciplinary in energy research and future sensor networks. He coined and pioneered the field of piezotronics and piezo-phototronics by introducing piezoelectric potential gated charge transport process in fabricating new electronic and optoelectronic devices. This breakthrough by redesign CMOS transistor has important applications in smart MEMS/NEMS, nanorobotics, human-electronics interface and sensors. Dr. Wang’s publications have been cited for over 65,000 times. The H-index of his citations is 124. Dr. Wang was elected as a foreign member of the Chinese Academy of Sciences in 2009, member of European Academy of Sciences in 2002, fellow of American Physical Society in 2005, fellow of AAAS in 2006, fellow of Materials Research Society in 2008, fellow of Microscopy Society of America in 2010, and fellow of the World Innovation Foundation in 2002. He received 2014 the James C. McGroddy Prize for New Materials from American Physical Society, 2013 ACS Nano Lectureship award, 2012 Edward Orton Memorial Lecture Award and 2009 Purdy Award from American Ceramic Society, 2011 MRS Medal from the Materials Research Society, 1999 Burton Medal from Microscopy Society of America. Details can be found at: www.nanoscience.gatech.edu

G. Jeffrey Snyder
G. Jeffrey Snyder obtained his B.S. degree in physics, chemistry and mathematics at Cornell University (1991) focusing on solid state chemistry which he continued during a two year stay at the Max Planck Institut FKF (Festkörperferrfororschung) in Stuttgart, Germany. He received his Ph.D. in applied physics from Stanford University (1997) where he studied magnetic and magneto-electrical transport properties of metallic perovskites as a Hertz Fellow. He was a Senior Member of the Technical Staff in the thermoelectrics group at NASA’s Jet Propulsion Laboratory for 9 years (1997-2006) where he focused on thermoelectric materials and devices. He is currently a Faculty Associate in materials science at the California Institute of Technology (Caltech). His interests include the discovery of new Zintl phase thermoelectric materials and nanostructured thermoelectric composites using bulk processing, band structure engineering and thermoelectric performance optimization. Dr. Snyder has published over 200 articles, book chapters and patents. He serves as treasurer of the international thermoelectric society.
KEYNOTE SPEAKERS

J. H. Li
J. H. Li is the Vice-President and a Fellow of the Chinese Academy of Sciences, and a Professor at the Processing Institute of the Chinese Academy of Sciences.

M. Wainwright
Emeritus Professor Mark S Wainwright AM FTSE is an Honorary Visiting Fellow in the School of Chemical Engineering at the University of New South Wales. He has continued his strong activities in Asia since retiring as Vice-Chancellor and President of UNSW in 2006. From 2006 to 2011 he was Chair of the Australia-China Council and in 2011 he became Foundation Chair of the Foundation for Australian Studies in China.

A. B. Yu
A. B. Yu is a Professor in the School of Chemical Engineering at Monash University, where he is a PVC as well. He is the President of Monash University Suzhou Campus. He is the former President of FOCSA and the Director of joint MMM centre. He is a Fellow of the Australian Academy of Science and a Fellow of the Australian Academy of Technological Sciences and Engineering.

Y. W. Mai
Professor Yiu-Wing Mai holds a University Chair at the University of Sydney. His major research interests are on fracture mechanics and advanced composites.

D. Y. Zhao
Dongyuan Zhao was born in Northeastern of China, he received B.S. (1984), M.S. (1987) and PhD (1990) from Jilin University. He was a post-doctoral fellow in the Weizmann Institute of Science (1993–94), University of Houston (1995–96), University of California at Santa Barbara (1996–98). Now he is a Professor (Cheung Kong and HaoQing Professorship) in the Department of Chemistry at Fudan University. He was a member of Chinese Academy of Sciences and The World Academy of Science (TWAS), Council Member of IZA, Vice President of International Mesostructured Materials Association (IMMA). He has received many prizes from China and international awards such as CRN Rao Award from India Chemical Research Society (2013); Mueterties Memory Award (2012); The Ho Leung Ho Lee Award (2009), TWAS Prize (2008); IMMS Award (2008); DuPond Award (2005). He is now appointed as Editor-in-Chief of Journal of Materials Chemistry, and co-editor of Journal of Colloid and Interface Science. He published more than 550 peer-review papers, 40 patents and is listed as one of highly cited researchers in ISI (Total citation ~ 45,000, h index 95). His research interests mainly include designed synthesis, assembly, structure and application of ordered mesoporous materials.

Y. B. Cheng
Y. B. Cheng is a Professor in the School of Materials Science at Monash University. He is a Fellow of Australian Academy for Technological Sciences and Engineering.

W. Zhang
Professor Wei Zhang, a Biochemical Engineer since 1989, has a broad research interest in bioprocess engineering, marine bioproducts engineering, and industrial and pharmaceutical biotechnology. He obtained his PhD from Dalian Institute of Chemical Physics, CAS in 1994, and is a Professor and Director at Flinders Centre for Marine Bioproducts Development since 1997. In 2008 he won the “South Australia Young Tall Poppy Science Award”, the founding co-chair of Australia-New Zealand Marine Biotechnology Network.
C. Jagadish
C. Jagadish is a Professor at School of Physics at the Australian National University. He is a Fellow of the Australian Academy of Sciences, a Fellow of the Australian Academy of Technological Sciences and Engineering, and ARC Laureate Fellow. His research interests are in fabrication and applications of nanostructured semiconductors.

H. M. Cheng
Prof. Cheng is working at Institute of Metal Research, Chinese Academy of Sciences on carbon nanotubes, graphene, and new energy materials. He published >400 papers, gave >70 lenary/keynote/invited talks, and received several national and international awards. He is Editor of Carbon, and co-chaired the World Conference on Carbon in 2002 and 2011.

M. Fuhrer
Michael S. Fuhrer is Professor of Physics and ARC Laureate Fellow at Monash University. He studies the electronic properties of two-dimensional materials such as graphene, topological insulator surfaces, and atomically-thin semiconductors.

M. Gu
M. Gu is a ARC Laureate Fellow, Professor and PVC at Swinburne University of Technology. He is a Fellow of the Australian Academy of Sciences and a Fellow of the Australian Academy of Technological Sciences and Engineering. His research interest is in the field of quantum optics of nano-materials and solar cells.

S. Smith
Sean Smith became Professor and centre Director at UQ in 2002. In 2011, he became Director of the DOE-funded Center for Nanophase Materials Sciences at Oak Ridge National Laboratory. He has moved in 2014 as Professor to The University of New South Wales. His specific research involves computational studies in nano- and nano-bio science.

J. H. Ye
J. H. Ye is a Unit Director within the Environment and Energy Materials Division at national Institute for Materials Science and a Full Professor at Tianjin University. Her research concentrates on photo-catalysts and water splitting.

E. Levy
Esther Levy is Consulting Editor for Wiley’s leading materials science journals Advanced Materials, Advanced Functional Materials, and Small. After completing her Ph.D. at Cambridge University (UK) in 1997 she joined the Advanced Materials editorial team (Wiley-VCH, Germany) where she was promoted to Editor-in-Chief in 2002. She has been in her current role based in Sydney, Australia since January 2007.

L. Jiang
L. Jiang is a Professor and Dean of Faculty of Chemical Science at Beihang University. He is a Fellow of the Chinese Academy of Sciences. His research interests are in surface and interface chemistry.

Z. F. Liu
Is a full professor at Penking University and has research interests in VD growth of nanocarbons and 2D atomic crystals including carbon nanotubes, graphene, h-BN, MoS2 and their hybrids, Carbon-based electronics and photoelectric conversion, and graphene chemistry.
Y. Xie
Y. Xie is a Professor at Chemistry Department of the Chinese University of Science and Technology. She is a Fellow of the Chinese Academy of Sciences. Her research interests include nanomaterials, their chemistry and applications.

Y. Yamauchi
Y. Yamauchi is a Group leader at World Premier International Research Center for Materials and Nanoarchitectonics at National Institute for Materials Science. He is also a Visiting Professor at Tianjin University. He is the Associate Editor of APL Materials. His research concentrates on nanomaterials for photocatalysts.

R. White
A chemist by training, Richard is now Editorial Manager of Scientific Reports and was previously a Senior Editor at Nature Communications.

L. J. Guo
L. J. Guo is a Professor at Xi’an Jiaotong University. His current research concentrates on multiphase flow and heat and mass transfer, high efficient clean energy-power system and thermal power conversion process.

W. E. Price
William Price is Executive Director of AIIM and Professor of Chemistry. He has held previous positions as Dean of the Faculty of Science and Head of Chemistry at University of Wollongong. He is a physical chemist by background and has current interests in environmental engineering, and physical properties of polymers and foods.
Qingdao, A City of Vitality, Romance And Happiness!

Qingdao is a major city in eastern Shandong Province, Eastern China. It is located on the south facing coast of the Shandong Peninsula, with a population of over 8.86 million. Its built up area, made of 6 urban districts and 4 county-level cities. The city’s total jurisdiction area occupies 11,282 square kilometers on the land as well as 1,2000 square kilometers costal waters.

After foundation over one hundred years, Qingdao has become a vibrant, young and beautiful city, has formed unique characteristics and advantages. By 2013, the city’s GDP has reached 800.66 billion RMB, the public finance budget income of 78.87 billion RMB, the social investment in fixed assets of 503.04 billion RMB, 290.56 billion RMB of total retail sales of social consumer goods. Qingdao has won the title of “National Civilized City”, “the Most Economic Vitality City in China”, “China’s Top Ten Livable Cities”, “The Most Fortunate Cities of China” and other honorary titles.

Qingdao is not only a beautiful and dynamic city, but also a city advocates in innovation, entrepreneurship and respect for talent. In recent years, the city’s government vigorously carries on the strategy of talent city, has started the implementation of special plan to speed up the recruitment of overseas high-level entrepreneurial talent, introducing high-level personnel plan, “Qingdao 211 Talents Program”, accelerating the “Millions of Talents Converging Program”, implementing "talent zone" construction, introducing projects of up to 50 million RMB capital support. By now, Qingdao has successively built 79 post-doctoral scientific research workstations, seven students venture park, three high-level personnel centers for entrepreneurship and a large number of science and technology innovation incubation bases. Chinese Academy of Sciences has seven institutes located in Qingdao, talent platforms and developing environment are well optimized.

By 2013, Qingdao has 52 academicians, 44 Qingdao New Century Millions Engineering candidates, 61 National Recruitment Program members, 184 Shandong province Outstanding Contribution Experts, 152 Taishan Scholars and distinguished overseas experts. They offered a great talent strength and promotion to the development of Qingdao’s economy while drawing their gorgeous life pictures and chieving their live's value in the city.

Qingdao sincerely welcomes talented people, innovation and entrepreneurial companies from all over the world. We will provide the most intimate policies, enthusiastic services and comfortable environment, to make sure your dreams come true. Let's work together to make Qingdao become a fertile land of creation and glories, construct the advantage of scientific development, lead the cross step to the Blue Economic fulfillment and promote the city’s internationalization.
INVITED SPEAKERS

Z. Y. Tang
Zhi Yong Tang is a full professor at the National Centre for Nanoscience and Technology. His research interests are controllable synthesis, self-assembly, and property manipulation of inorganic nanomaterials.

D. Wang
Dan Wang is a full professor at Institute of Process Engineering, Chinese Academy of Sciences. His research interest is in synthesis of mesostructured functional inorganic materials and their applications in solar energy conversion and storage. He sits on the Advisory Board of Energy & Environmental Science and Advanced Materials Interface.

H. B. Sun
Prof. Hong-Bo Sun from Jilin University, China is currently interested in ultrafast laser interactions with materials, for deep insight into optoelectronic physics of materials and functional micronanodevice fabrication. Over 200 papers he has published so far have been cited for over 6000 times according to SCI report.

C. Z. Yu
Professor Chengzhong (Michael) Yu is a group leader at the Australian Institute for Bioengineering and Nanotechnology, The University of Queensland. He is working on functional materials and their applications in health, energy and environmental protection.

D. Li
Prof. Dan Li is currently a professor of Materials Engineering at Monash University. His current research interests are centred on synthesis and properties of graphene-based soft materials and their applications in energy storage and conversion, nanofluidics, bionics and environmental protection. He received the ARC Queen Elizabeth II Fellowship in 2006, the Scopus Young Researcher of the Year Award (Engineering and Technology) in 2010, ARC Future Fellowship in 2011, Dean’s Award for Excellence in Research in 2012 and Thomson Reuters’ Highly Cited Researchers in 2014.

J. Zhang
Dr. Jin Zhang comes from Center for Nanochemistry, College of Chemistry and Molecular Engineering, Peking University. He is a Changjiang professor and his research focuses on the controlled synthesis and spectroscopic characterization of carbon nanomaterials. Dr. Zhang has published over 160 peer-reviewed journal articles. And now he is the editor of Carbon.

J. Z. Zhao
Jiu Zhou Zhao is a full professor at the Institute of Metal Research, Chinese Academy of Sciences. Prof. Zhao’s research interests include solidification and thermal processing of alloys; Modelling and simulation of the microstructure evolution during solidifications of alloys; Rapid solidification and metallic glass composite; Aging of alloys and process control.

Y. S. Yang
Professor Yuansheng Yang work at the Institute of Metal Research, Chinese Academy of Sciences. His research interests include magnesium alloys, superalloys, solidification and preparation of advanced materials.
M. S. A. Hossain
Dr. Hossain was awarded the PhD from the Institute for Superconducting and Electronic Materials (ISEM) in 2008. After his graduation, he was employed as a Research Fellow at University of Geneva (Switzerland) and after the conclusion of his post-doc position in Switzerland he returned to ISEM in 2011 and employed as a Research Fellow under a successful ARC Linkage Project. Just after a year, he was awarded the highly prestigious ARC DECRA grant and currently, he is working on this project until end of 2016.

Y. Du
Dr. Yi Du is a research fellow at the Institute for Superconducting and Electronic Materials (ISEM), the Australian Institute for Innovative Materials (AIIM) at the University of Wollongong (UOW). His research interests include multiferroic materials, two-dimensional (2D) materials, and surface physics and chemistry by using scanning probe microscopy techniques.

K. Ostrikov
Kostya (Ken) Ostrikov is an Office of Chief Executive Science Leader and Chief Research Scientist at CSIRO’s Future Manufacturing Flagship, Professor with Queensland University of Technology, and Honorary/Visiting Professor of University of Wollongong and 6 more universities nationally and internationally. His research interests are in advanced plasma treatments and nanomaterials for diverse energy, environment, electronics, optoelectronics and biomedical applications.

T. Y. Xiong
Work for institute of Metal Research (IMR), Chinese Academy of Sciences since 1991. The current research interests include high-temperature protective coatings, bio-active coatings, photocatalytic coatings, and so on which be made by cold spraying or thermal spraying.

L. T. Sun
Dr. Litao Sun is distinguished professor and vice dean of School of Electronic Science and Engineering, Southeast University, China, and visiting professor at Australian Institute of Innovative Materials, University of Wollongong, Australia. His main research areas focus on in-situ experimentations, carbon-related materials and their applications in environment and renewable energy.

L. Z. Wang
Lianzhou Wang is a Professor in School of Chemical Engineering and Research Director of Nanomaterials Centre, the University of Queensland. His research focuses on the design and development of functional semiconductor metal oxides for energy conversion applications including photocatalysis and low cost solar cells.

W. L. Cheng
Wenlong Cheng is an associate professor in the Department of Chemical Engineering at Monash University, Australia and a senior Tech Fellow at Melbourne Centre for Nanofabrication. His research interest includes plasmonic nanoparticles, DNA nanotechnology, nanoparticle anticancer theranostics and electronic skins.

H. G. Yang
Hua Gui Yang completed his Ph.D. in 2005 at the National University of Singapore. He joined East China University of Science and Technology as a full professor in 2008. Currently he has interests in design and synthesis of metallic and semiconducting functional materials for clean energy and environmental protection applications.
H. X. Wang
Dr. Hongxia Wang is ARC Future Fellow at Queensland University of Technology. Currently, her research group is mainly focus on development of new routes for low cost solar cells - work that includes dye/quantum dots sensitized solar cells and thin film solar cells using earth abundant materials.

M. S. Park
Min-Sik Park is a managerial researcher of Korea Electronic Technology Institute (KETI). His Ph.D at University of Wollongong was on the nanostructured materials for lithium rechargeable batteries. Before he joined to KETI, he was a research staff at Samsung Advanced Institute of Technology (SAIT). His current research focuses on developing various materials for energy storage systems such as lithium ion batteries, lithium ion capacitors and post-lithium systems.

S. Q. Zhang
A/Prof. Shanqing Zhang obtained his PhD degree in electrochemistry in 2001 at Griffith University, Australia. Dr. Zhang has developed a series of patented and commercialized nanotechnologies for environmental monitoring. He was awarded Australia Research Council Future Fellow for 2009-2013. Currently, he is leading his group conducting research on sensing, energy conversion and energy storage devices.

S. W. Kim
Professor Sang-Woo Kim at School of MSE and SKKU Advanced Institute of Nanotechnology at Sungkyunkwan University (SKKU) pioneered the realization of large-scale transparent flexible piezoelectric nanogenerators for harvesting mechanical energy for self-powered electronics. His recent research interest is focused on piezoelectric/triboelectric nanogenerators, piezophototronics, and 2D materials. He has served as an Associate Editor of Nano Energy.

Q. H. Yang
Dr. Quan-Hong Yang is a professor of Tianjin University, China. Now he is also a “Pengcheng Scholar” Professor (short-term) of Graduate School at Shenzhen, Tsinghua University. His research has been totally related to carbon materials from bulk carbons to nanocarbons mainly for energy storage. His present interests are mainly on self-assembly of graphene oxide at interface and its use as a potential approach for rational construction of functionalized carbon solids.

J. W. Lee
Dr. Jong-Won Lee is a Senior Research Scientist at Korea Institute of Energy Research (KIER). His research interests cover the design, synthesis, and characterization of electrochemically active materials for next-generation energy storage/conversion devices. He focuses on both fundamental and applied aspects: understanding the interfacial and transport phenomena and building advanced batteries and fuel cells.

S. L. Chou
His research interest is in the field of materials engineering for electrochemical energy storage systems. He has published more than 60 papers in top journals such as Adv. Mater., Nano Letters, and Chem. Mater with more than 1800 citations and an H-index factor of 23.
G. Wei
Professor Wei received his Ph.D degree in chemistry from the University of Newcastle, followed by postdoctoral work at the University of Sydney after which he joined CSIRO in 2002. Professor Wei has developed extensive research collaboration links between CSIRO and national and international universities and research institutes, particularly with those in China. He is a Fellow of the Royal Australian Chemical Institute (FRACI); Honorary Professor at the University of Queensland, Honorary Associate at the University of Sydney; Director of the Yunnan Normal University Board and Expert of the Expert Advisory Panel, Shanghai Nanotechnology and Promotion Centre (SNPC). Professor Wei's current research interests are in the field of synthesis and characterization of novel nanoscale compounds and materials, molecular electronics and sensors.

Z. Q. Sun
Dr. Ziqi Sun received his PhD degree at Institute of Metal Research, Chinese Academy of Sciences in 2009 and joined Institute for Superconducting and Electronic Materials as APD fellow and followed VC research fellow in 2010. His research interest is nanomaterials design and characterization for sustainable energy harvesting, conversion, and storage.

X. C. Jiang
A/Prof. Dr. Xuchuan Jiang, at the University of New South Wales (Australia), has fully devoted to the study on synthesis, self-assembly and functional applications of nanoparticles since the award of his PhD in 2001. Dr. Jiang has been working in various academic research environments, including the University of Washington (USA) and the University of Paris (France). He has published over 90 papers with SCI citations over 3500 times, leading him to H-index 28. He has been awarded ARC future fellow and QEII fellow in 2009. He has also been nominated as an OZreader for assessing Australia Research Council (ARC) projects/grants, and as a reviewer for a number of highly-ranked journals.

A. Vinu
Prof. Vinu has been working as a full professor and ARC Future Fellow at the University of Queensland, Brisbane, Australia since September 2011. Previously he worked as a senior researcher at NIMS, Tsukuba, Japan and Technical University of Kaiserslautern (TUK), Germany. Prof. Vinu has made a tremendous contribution in the field of nanoporous materials and their application in sensing, energy storage, fuel cells, adsorption and separation, and catalysis.

S. Kennedy
Shane Kennedy (Technical Director of the Bragg Institute) specialises in the application of neutron scattering techniques to studies of magnetism, superconductivity, renewable energy systems, novel materials and process engineering. His technical expertise spans construction of neutron beam instrumentation, neutron optics and transport, diffraction methods, polarization analysis and small angle scattering.

R. Amal
Rose Amal is a Scientia Professor at UNSW. She has been working in the area of photocatalysis for over 15 years. Her research addresses the core issues of energy and water, two highly critical resources in Australia as well as worldwide.
The Federation of Chinese Scholars in Australia (FOCSA) is a non-politic, non-religious and not-for-profit organisation for Chinese Australian scholars and professionals. It is established in 2004 as a federation to represent Chinese scholars in Australia. FOCSA currently consists of 13 Chinese professional associations across Australia. The objectives of FOCSA are to promote scientific and technological advances, and promote self-development of Chinese Australian scholars across all disciplines; foster exchanges and cooperation in science, technology and education among Chinese Australian scholars, among Chinese professional associations in Australia; encourage Chinese Australians or their affiliated professional associations to make contributions toward the progress in science and technology, and the economic development both in Australia and China and coordinate among the group members to organise events at the federal level and/or represent Chinese Australian scholars to participate in events at the international level.

The current executive committee is based at the University of Wollongong (UOW). The President is Professor Shi-Xue Dou (UOW), the Vice President is Professor Wei Zhang (Flinders University), and the Secretary-General is Professor Xiao-Lin Wang (UOW).

Website: focsa.org.au
PLENARY PRESENTATIONS

PL01 Hideo Hosono “Recent progress in iron-based superconductors”
More than 6 years have passed since the publication of our report on LaFeAsO$_1$-$x$F$_x$ with Tc=26K in early 2008. More than 10,000 papers have been published on this subject during this period but the scientific excitement is going on until today. In this talk I will review the recent progress of iron-based superconductors from both materials and applications points of view. In the science of materials, a whole Tc-x dome in the 1111-type was revealed by successful heavy electron-doping using H- ion in place of F-, i.e., REFeAsO$_{1-x}$H$_x$. The Tc dome is largely extended to the higher electron-doped concentration unlike the previous data and two-dome structure appears when RE=La. Very recently, the existence of a new antiferromagnetic phase has been found around x=0.5. This phase may be regarded as the second parent phase of superconductor. As for applications, the improvement of superconducting critical current (Jc) is remarkable both in taped and pit-wires. 122-type superconductors have favorable properties for wire applications, i.e. less anisotropic nature, high Hc, and advantageous grain boundary nature. The maximum Jc in the pit-wires has reached 10^5A/cm^2 at 4K under 10T, which is commercially available performance.

PL02 Judith Driscoll “Unprecedented physical properties in nanocomposite functional oxides”
There is much interest in interface coupling the properties of two individual materials systems to create improved or novel physical properties. Normally, planar artificial heterostructures are created for this purpose, but here I present results on self-assembled heteroepitaxial nanocomposite thin films. I include aspects such as how to design different nanostructures, how to select materials to give desired coupling effects, the new physical phenomena which are realized in these composite structures, and the fascinating properties which emerge from them, such as practical magnetoelectric effects, strongly enhanced ferroelectricity, and unprecedented flux pinning in superconductors. Finally, I argue that for complex oxide materials, a holistic approach is required to go beyond the basic physical understanding to move to the next level of practical systems for applications.
FO01 Jinhai Li “Current challenges in chemical engineering: three bottlenecks and two gaps:
This presentation will review the evolution track of chemical engineering science and prospect its future development. It is indicated that evolution of the discipline features the increasing generality of its knowledge base from common “operation”, common “phenomena” and through to common scientific principles, and will likely focus on three mesoscales at different levels. It is believed that three mesoscales at material, reactor and system levels (i.e. three bottlenecks) and their cross-correlations (i.e. two gaps) will be the challenges and research focuses in future development of chemical engineering.

FO02 Mark Wainwright “Australia’s growing research collaborations with China”
As with trade, China is rapidly becoming the world leader in research output and research collaborations between Australia and China are increasing rapidly. Co-authorships of research papers between Australia and China for the period 2010-2012 were 5,631 and they are also rising. Australia’s international research collaborations only tripled with the rest of the world and the USA between 1995 and 2010 whereas there was an 11 fold increase between Australia and China over the same period. China’s research publications output grew from 21,130 (16.4% of the Asia and Oceania region) in 2001 to 80,804 (38%) in 2011 whereas in the case of Japan, they dropped from 56,082 (43.6%) in 2001 to 47,106 (20.1%) in 2011. This paper examines the rise in Australia’s research collaborations with China, along with the roles of science and research in diplomacy between our two countries.

FO04 Yiu Wing Mai “Toughening laminated composites: approaches from micro to nano”
Interlaminar delamination is a failure mode that is critical to the integrity and reliability of laminated fibre composite structures. With increasing usage of fibre composites, there have been substantial efforts by many researchers to develop new techniques to enhance the interlaminar toughness to suppress delamination. These techniques can be conveniently grouped into two main approaches: (a) toughening of matrices by incorporation of micro- or nano-sized fillers, and (b) placement of through-thickness-reinforcement, stitching or z-pinning, across the laminates. Herein, we review our research results on the interlaminar toughening of fibre composites with micro-sized rubber and nano-sized filler toughened matrices, stitching and z-pinning, and recent studies using hierarchical carbon nanotubes (CNTs) grown on carbon fibres (CF). Their efficiency, advantages and disadvantages will be addressed.

FO05 Dongyuan Zhao “Hydrothermal synthesis of ordered mesoporous materials for application”
Here, we demonstrate a surfactant-templating approach to synthesize ordered mesoporous materials with high surface area, uniform large pore size and high pore volume for the application in catalysis. Especially, we will show the facile organic-organic assembly approaches to synthesize ordered mesoporous polymers and carbon frameworks. The mesoporous carbons have a large uniform mesopore (2 – 20 nm), high surface areas (800 – 2400 m²/g) and large pore volume (0.8 – 2.4 cm³/g). The mesostructures can be easily tuned from hexagonal to cubic. It is interesting that using this hydrothermal method, single crystals, nanospheres, hemispheres, vesicles, monoliths and single nanosheets can be easily synthesized. A layer-by-layer growth mechanism for monomicellar sub-units is proposed. For example, mesoporous carbon nanospheres with uniform diameter of 20 – 140 nm are fabricated through a low-concentration route. All the mesopores are open and accessible. We also show large-scale synthesis approach based on the hydrothermal cooperative assembly. Kilogrammes of ordered mesoporous carbons are easily obtained for applications in catalysis.
FO06 Yi Bing Cheng “Printing of hybrid solar cells”

Hybrid solar cells are constructed with organic and inorganic semiconductor materials. Typical hybrid solar cells include bulk heterojunction solar cells (BHJ), dye sensitized solar cells (DSSC) and the recently emerged perovskite solar cells (PSC). These devices consist of functional layers of several hundred nanometers to a few micrometers in thickness and can be made via solution chemistry coating processes. The flat multi-layer structure, the wet chemistry process and the large volume of market demand make hybrid solar cells idea to be manufactured by continuous printing technologies. The Victorian Organic Solar Cell Consortium (VICOSC), Australia was established in 2007, consisting of research teams from the University of Melbourne, Monash University and Commonwealth Scientific and Industrial Research Organization (CSIRO), and supported by a number of industrial companies. A purpose of the VICOSC is to demonstrate printing technologies can be applied and scaled up for industrial manufacturing of hybrid solar cells. This presentation will introduce the R&D activities of the VICOSC in the last seven years, including the two large scale printing lines that can continuously print both BHJ and DSSC modules up to 30x30 cm in size. The potential for printing of perovskite solar cells will also be discussed.

FO07 Wei Zhang “Marine biotechnology: An ocean of opportunities for Australian and Chinese blue bio-economy partnership”

Australia enjoys a reputation as the world’s fifth most ‘megadiverse’ country, with a huge proportion of endemic biota, especially in marine waters. Australia has over 16.1 million km² of oceanic jurisdiction, 70 thousand kilometres of continental coastline and 8.6 million km² of continental marine territory. Ocean-based blue economy has been designated as one of the seven Chinese national development strategies, and all the coastal provinces have developed their comprehensive policies and measures in supporting the emerging blue economy for the next 5-10 years. However, China’s blue economy development can be significantly handicapped by the facts that it has limited marine resource per capita; and the coastal lines have been heavily utilised for aquaculture, shipping and manufacturing industries of heavy pollutions. This presentation will focus on a high level overview of the marine biotechnology industry development in Australia; identification of issues and opportunities for future industry developments; and discussion on the opportunities for national and international collaborations to benefit not only Australian, but the global economy and society. The focus will be on the development of Australia-China Partnership on Blue Bioeconomy Strategy.
**SESSION PRESENTATIONS**

**EM01 John Bell “Intriguing thermal properties of graphene-based materials”**

The discovery of graphene has stimulated enormous exploration in the heat transport in strictly 2D materials. To facilitate diverse applications of graphene in the thermal management, it is crucial to modulate its thermal transport properties. Towards this aim, we investigated the influences from structures and different patterns of dopants/heteroatoms on the thermal transport properties of graphene nano-ribbons by large-scale molecular dynamics simulations. The thermal conductivity of graphyne (GY)-like geometries is observed to decrease monotonously with increasing number of acetylenic linkages between adjacent hexagons. Strikingly, by incorporating those GY or GY-like structures, the thermal performance of graphene can be effectively engineered. The resulting hetero-junctions possess a sharp local temperature jump at the interface, and show a much lower effective thermal conductivity due to the enhanced phonon-phonon scattering. Such phenomena are also observed for the graphene nano-ribbon with patterned carbon isotope doping and h-BN doping. Specifically, a much higher interfacial thermal resistance is found for the hetero-junction with h-BN stripes than the cases with carbon isotopes. This study provides a heuristic guideline to manipulate the thermal properties of 2D carbon networks, ideal for application in thermoelectric devices with strongly suppressed thermal conductivity.

**EM02 Yanwei Ma “Development of superconducting and electrode materials at IEECAS”**

Recently, the research at IEECAS is focused on developing high performance Iron-based superconducting wires and graphene-based electrode materials for supercapacitors. In this talk, I will first describe our group’s work on improving in-field $J_c$ performance of iron-based wires and tapes by solving the weak linked problem and densifying superconducting core. Our latest achievement in the developing Sr$_{0.8}$K$_{0.4}$Fe$_2$As$_2$ tapes with transport $J_c$ up to 0.1 MA/cm$^2$ at 10 T and 4.2 K. This value is by far the highest ever recorded for iron based superconducting wires and has surpassed the threshold for practical application. Finally very recent work on fabrication of graphene-based electrode materials for high performance supercapacitors will be presented. We developed a novel method to synthesize mesoporous graphene on a large scale via the direct reaction of CO$_2$ with Mg metal. Such graphene-based symmetrical supercapacitor exhibits a high capacitance, good cycling stability, and a high energy density value of 80 Wh/kg.

**EM03 Hua Zhang “Synthesis and applications of novel two-dimensional nanomaterials”**

In this talk, I will summarize the recent research on synthesis, characterization and applications of two-dimensional nanomaterials in my group. I will introduce the synthesis and characterization of novel low-dimensional nanomaterials, such as graphene-based composites including the first-time synthesized hexagonal-close packed (hcp) Au nanostructures on graphene oxide, and the epitaxial growth of Pd, Pt and Ag nanostructures on solution-processable MoS$_2$ nanosheets at ambient conditions, single- or few-layer metal dichalcogenide and hybrid nanosheets, and large-amount, uniform, ultrathin metal sulfide and selenide nanocrystals. Then I will demonstrate the applications of these novel nanomaterials in chemical and biosensors, solar cells, water splitting, hydrogen evolution reaction, electric devices, memory devices, and conductive electrodes.

**EM04 Sean Li “High performance of nanoelectronic devices”**

Nanocapacitors are the key component in resistive random access memory (RRAM) for next generation nanometre scaled electronic devices. It is believed that bottom up approach is a cost effective technique compared with the other nanotechnologies. In this work, we report a novel procedure for fabricating high
performance nanocapacitors by using oxide nanocubes as colloidal building blocks. The nanocubes of CeO₂, which was synthesised with hydrothermal methodology, were used to build the monolayer and multilayer nanocapacitors through the capillary force assisted self-assembly approach. Such a synthesis results in a large area of high quality ordered structure with several square millimetres due to the narrow size and shape distributions of nanocubes in non-polar organic solvents. The as-fabricated nanocapacitors exhibited excellent resistive switching properties with very large ON/OFF ratios, good reliability and stability. These demonstrate the developed technique is a promising approach for the fabrication of next generation RRAM devices.

**EM05 Kehui Wu “Persistent Dirac electron state on bulk-like Si(111)”**

Recently, silicene, a single sheet of Si atoms arranged in honeycomb lattice with sp² bonding, has been proposed and successfully fabricated on Ag(111) and other substrates in ultrahigh vacuum. The existence of Dirac fermion in silicene on Ag(111) surface with (√3×√3)R30° superstructure has been proven by the observation of linear energy-momentum dispersion and quasiparticle chirality by scanning tunneling microscopy (STM) and spectroscopy (STS). In this talk we will present our new results on multilayer silicene film. We found that the “multilayer silicene” is indeed a bulk Si(111) film. Such Si film on Ag(111) always exhibits a (√3×√3)R30° honeycomb superstructure on surface. Delocalized surface state as well as linear energy-momentum dispersion was revealed by quasiparticle interference patterns (QPI) on the surface, which proves the existence of Dirac fermions state. Our results indicate that bulk silicon with diamond structure can also host Dirac fermions, which makes the system even more attractive for further applications compared with monolayer silicene.

**EM06 Chuanbing Cai “Progress of secondary-generation high-Τc superconducting tapes and power application in China”**

Based on epitaxially-growth and biaxially-textured technologies, the secondary-generation (2G) high-Tc superconducting tapes have been the focus of practical high-Tc superconducting, showing the scalable production abilities and growing market requirements in recent 5 years. In the present talk, it is introduced that in China both central and local government’s efforts and projects on the superconducting project regarding 2G superconducting tapes and power applications such as cable, induction coil, and transformer etc.

**MS01 Ying Chen “Nanomaterials and their applications in energy storage”**

Energy storage becomes a critical issue to the current energy economy because of the urgent applications from several major energy areas including the harvest of renewable energy sources, the huge range of mobile electronic devices, the emergence of commercial hybrid and electric vehicles as well as the efficient usage of electrical energy from the grids. However, most current batteries cannot meet the need of these applications at industrial scale because of technical challenges such as a low storage capability, long charging time, short cycling life and poor safety issues. Overcoming these limitations by using new technologies and materials is the current focus of energy research and technology development. Nanotechnology and nanomaterials are believed to be able to improve battery’s energy density and performance. This presentation covers two main research areas: (1) boron nitride nanotubes and nanosheets and their biological and environmental applications, including Eu-doped BN nanotubes for special light emission, BN nanoribbons and porous BN nanosheets; (2) nanostructured electrodes made of nanosheet/nanorod composites for improving the capacities and cycling stability of Li-ion batteries and supercapacitors and a better charging behavior attributed by conductivity improvement.

**MS02 Lin Guo “Morphological control and properties of nickel nanomaterials”**

Ni nanomaterials fabricated by a mild wet chemical method in an open system. By adjusting the reaction conditions, we succeed in controlling the size, the shape, the dimension and the component of the products. The as-prepared samples including ball particles, flower-like particles, chain-like structures, hollow chains
and core-shell structures, Ni(OH)$_2$ polyhedrons, nanobowls. Systematic magnetic measurements on the pure chains in different particle sizes, the Ni/Ni$_3$C core-shell chains and the Ni/Ni$_3$S$_2$ peapod chains reveal the different magnetic properties of 1D structure changed by the size, the structure and the component. And the two core-shell structures provide ideal materials for studying the special properties. Also, the alignment mode of liquid crystal molecules depends on the morphologies of the doped nickel nanomaterials were studied.

**MS03 George Zhao “Colloidal photonic crystals and functional structures”**

Photonic crystals are materials that possess spatial periodicity in their dielectric constant on the order of the wavelength of light. If the material has an appropriate geometry with a sufficiently high dielectric contrast, it may exhibit a photonic bandgap, through which photons with energies comparable to the bandgap are prohibited to propagate. With this property, photonic crystals can be used as all-optical and optoelectronic devices. Photonic crystals are classified by the dimensionality of their structural periodicity. In order to rigorously prevent the propagation of photonic bandgap frequencies in all directions, a three-dimensional photonic crystal with an omnidirectional or complete photonic bandgap is required. This presentation discusses our experimental and computational studies on photonic crystals and devices from self-assembly and photolithography approaches.

**MS04 Zhiyong Tang “Inorganic nanoparticle-metal organic framework core-shell nanostructures: A novel multifunctional platform”**

Inorganic nanoparticles possess unique optical, electrical, magnetic, mechanical and catalytic properties owing to high specific surface area and strong quantum confinement effect, which offer broad research and application prospects in many fields such as physics, biology, chemistry and materials science. However, it is well known that free inorganic nanoparticles have high surface energies and tend to aggregate and fuse, and thus the intriguing properties registered in the nanoparticles are degraded or even disappeared, leading to difficulty in long-term storage, processing and applications. Recently, we demonstrate that the metal-organic frameworks could be selected as a coating layer to stabilize inorganic nanoparticles. Inorganic nanoparticle@metal-organic framework core-shell nanostructures, in which a single inorganic nanoparticle core is coated with a uniform metal-organic framework shell, have been fabricated through self-assembly method. Furthermore, the functionality of the core-shell nanostructures has been regulated by adjusting the size, morphology, structure, composition, etc. of the inorganic nanoparticle core and the metal-organic framework shell. The corresponding applications of these novel composite nanomaterials in the fields of sensing, catalysis, bioimaging and drug delivery have been explored.

**MS05 Dan Wang “Multi-shelled metal oxides hollow microspheres: controllable synthesis and applications”**

Multi-shelled Co$_3$O$_4$-Fe$_2$O$_3$-TiO$_2$ hollow microspheres are prepared and tested as anode materials for LIBs. By controlling the size and diffusion rate of the hydrated metal cations, and the ion absorption capability of carbonaceous sphere templates, we can accurately control the number of shells and the interior structures of multi-shelled Co$_3$O$_4$ hollow microspheres with a high yield and purity. When tested as the anode materials for LIBs, these multi-shelled Co$_3$O$_4$ hollow microspheres exhibit excellent rate capacity, good cycling performance and ultrahigh specific capacity (1615.8 mAh g$^{-1}$ at the thirtieth cycle for triple-shelled Co$_3$O$_4$). When tested as the anode materials for LIBs, thin, porous, triple-shelled α-Fe$_2$O$_3$ hollow microspheres showed the best cycling performance, demonstrating excellent stability and reversible capacities up to 1702 mAh g$^{-1}$ at current density of 50 mA g$^{-1}$. Because the charge storage mechanism of TiO$_2$ is insertion instead of conversion like Co$_3$O$_4$ and Fe$_2$O$_3$, the volume change of TiO$_2$ is less than 4%, leading to superb cycling stability. And multi-shelled TiO$_2$ hollow microspheres exhibit excellent rate capacity, good cycling performance and high specific capacity (237 mAh g$^{-1}$ after 100 cycles at a current rate of 1 C).
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- Functional seafood co-products

**Industry services**
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**Australia-New Zealand Marine Biotechnology Network**
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MS06 Hong Bo Sun “Using femtosecond laser to push the frontiers of material research”
Femtosecond laser is becoming a powerful tool for materials study and frontier applications. As a micro-nanofabrication tool, it features intrinsic three-dimensional (3D) fabrication capability, arbitrary shape designability, and high fabricating accuracy up to tens of nanometers, far beyond the optical diffraction limit. Thus complicated structures and devices are being made from materials ranging from hard-processing materials like sapphire and proteins, to two-dimensional graphene. On the other hand, the ultrashort laser pulse width enables deep insight into photo-electronic and electron-photonic conversion dynamics by means of transient spectroscopic means, which are critical for solar cells and light emitting devices. Here, we report our recent research following the above lines: (i) application of the delicate femtosecond laser direct writing (FsLDW) technology on microelectronics, micromechanics, microoptics, microfluidics and microbiomimetics [1-10]; (2) Ultrafast spectroscopic studies on nanostructures like nano carbons.

MS07 Chengzhong Yu “Novel hollow particles and their applications”
Hollow structures are promising candidates in many applications such as drug delivery, catalysis and electrode materials. Fine control over compositions and structures through fundamental understanding in structure-property relationship are important to prepare unprecedented materials with improved performance. In this presentation we will summarise our recent progresses in the strategic design of novel hollow particles. We demonstrate that hollow silica spheres with mesopores in the wall and rough outer surface have unusual hydrophobic properties compared to their smooth counterparts with the same composition. This unusual property is explained by the stabilisation of Cassie-Baxter state with reduced wettability and thus less hydrophilicity, providing a new approach to deliver hydrophobic molecules into cells without conventional surface modifications. In a second example, we show that novel carbon nanospheres with large pores inside the walls can be prepared. Due to the hydrophobic nature and excellent dispersity as well as colloidal stability, they have shown excellent performance as nano-carriers for drug delivery, gene therapy and lithium sulfur/ selenium battery applications. Our successes in other hollow structures will also be briefly communicated in the last part.

MS08 Dan Li “Graphene-based supramolecular gels”
From a chemistry/materials point of view, graphene is a giant conductive polymer. Chemically modified graphene can be prepared in large quantity by chemical conversion of natural graphite. As with many traditional polymers, chemically converted graphene (CCG) can self-gel under certain conditions to form hydrogels. By taking advantage of the unique chemical molecular structure of CCG and supramolecular interactions, we have successfully synthesized two types of unusual supramolecular gel materials: the densest yet highly porous carbon gel film and the ultralight yet superelastic conductive aerogel. In this talk, I will demonstrate how these unprecedented graphene gels lead to record-high-energy density supercapacitors and enable the successful synthesis of mechanically robust, stimuli-responsive and electroconductive polymer hydrogels that are unattainable with the traditional techniques.

MS09 Jin Zhang „CVD growth of single-walled carbon nanotubes with controlled structures for nanodevice applications”
Single-walled carbon nanotubes (SWNTs) directly synthesized on surfaces are promising building blocks for nanoelectronics. The structures and the arrangement of the SWNTs on surfaces determine the quality and density of the fabricated nanoelectronics, implying the importance of structure controlled growth of SWNTs on surfaces. This talk covers the progress of our lab in controlling the orientation, density, length, density, diameter, metallicity, and chirality of SWNTs directly synthesized on surfaces by chemical vapor deposition, together with a session presenting the characterization method of the chirality of SWNTs.
Collaborations between academia and industry are often challenging, as the outcomes desired by the partners can be significantly opposed. This is most commonly due to the different metrics by which successful outcomes are measured within the respective partner organisations. In the case of industry, successful outcomes are usually measured in the form of commercial products, improved manufacturing processes or patents. Within academia, research success is usually measured by way of refereed journal publications, conference presentations and additional grant funding. Such opposing outcomes frequently result in less than ideal collaborations with tensions between the partners. This presentation will give an overview of how SMR Automotive, in partnership with UniSA, is transforming its automotive manufacturing capability in the high value-add, advanced manufacturing space. The project has developed a world first plastic automotive rear view mirror, using innovative materials science in the area of thin film coating technology. The patented product is now in full commercial production. The successful ingredients of this collaboration and the way in which the needs of all parties have been met will be presented as an exemplar of academic/industry interaction.

Solidification behaviors of immiscible alloys under the effect of electric current pulses (ECPs) are investigated. It is demonstrated that ECPs mainly affect the microstructure formation through changing the nucleation behaviors of the precipitated phase droplets (PPDs). When the PPDs have a higher electrical conductivity compared to the matrix, ECPs enhance the nucleation rate and promote the formation of a well dispersed microstructure. Otherwise, ECPs cause a decrease in the nucleation rate and promote the formation of a phase segregated microstructure.

Carefully designed nanostructures of materials have become an important methodology for the LIBs to achieve higher capacities, better rate capabilities and improved cyclic performances. The amazingly fast progress of research about graphene and its modification methods to make its hybrids with other materials revolutionize its possible applications. These hybrid structures exhibit excellent material characteristics including high charge carrier mobility and long term stability because of excellent electrical conductivity, mechanical flexibility and electrochemical behavior of graphene. Here, we synthesized different types of graphene and their composites with different types of metal alloys and sulfides like SnS$_2$-rGO, Co$_3$S$_4$-G, Ni$_3$S$_4$-NG, NiS$_{1033}$-NG, Co$_2$SnO$_4$-NG and Co$_3$Sn$_2$@Co-NG for their application as anode electrode in LIBs. To overcome the problem of electrode pulverization, two different strategies were utilized. One is the encapsulation of NPs in elastically strong graphene matrix and the second one is sealing out the NPs in the shell of inactive metal and then wrapped by graphene. Because of its high surface area, graphene can provide large contact area between the electrolyte and electrode for better performance. In addition, because of the high conductivity and ions transfer mobility, graphene maintains the fast electrical flow of the composites. It is worth noting that Ni$_3$S$_4$-NG and Co$_3$Sn$_2$@Co-NG composites displayed 98.87% and 102% capacity retention with a discharge capacity of 1323.2 and 1615 mAh/g after 100th cycle, respectively.

Energy, environment and water are the urgent and critical issues that human being is facing currently. Hydrogen economy presented in the past decade is supposed to completely solve the aforementioned problems. Hydrogen energy related materials are widely regarded to play a key role to realise the so-called hydrogen economy, but
require significant innovations – from new materials to new methodology. In our group, we recently develop a series of nano-confined systems, using different porous materials (mesoporous and nanoporous) as templates, to address some critical issues for practical applications in hydrogen storage and utilization. In this talk, I will report some of our recent progress in this direction, especially on hydrogen storage.

ENG03 Rose Amal “Photocatalysis – from material design to system engineering”
Water, environment and energy are three of the most important issues facing mankind in the coming 50 years. The demand for clean drinking water, fresh air, sustainable energy, becomes more challenging in view of the ever-growing population. The needs to develop ecologically clean solar-induced chemical processes, such as photocatalysis, are at presence limited by low quantum efficiencies. The presentation illustrates the past and ongoing research in the development of a highly efficient photocatalyst system for water and air purifications as well as H2 generations through (i) Design hybrid/composite materials that can absorb a wider range of the solar spectrum and possess higher quantum efficiencies (ii) Understanding relationships between photoelectrical-properties of photocatalysts and mechanisms for degrading organics (iii) Develop an improved “light penetration” reactor system.

ENG04 Huagui Yang “Atomically engineered materials for solar-driven water splitting”
Solar energy as one of the best sources of renewable energy has attracted significant attention as a promising way to solve these problems. Herein, we studied various atomically engineered catalytic materials to enhance the solar-driven water splitting. First of all, using polymer ligands to control the size and valence state of platinum monoxide clusters, we found that Pt in a higher oxidation has remarkable hydrogen oxidation reaction suppression ability, while its H2 evolution capacity is still comparable to that of the benchmark of conventional Pt cocatalyst. Moreover, we explored the active sites of Pt/TiO2 photocatalyst on atomic level by a collaborative analysis from both experimental and theoretical work. In addition, we designed and synthesized a surface H-bonding network decorated g-C3N4 photocatalyst with high efficiency of visible-light-driven H2 production. Furthermore, we anchored isolated Pt atoms on TiO2 and this photocatalyst exhibits a high solar-driven hydrogen evolution performance compared with Pt nanoparticles or clusters. The configurations of the isolated Pt atoms and their catalytic hydrogen evolution activity were calculated by large-scale periodic DFT analysis. These results would open a door for rethinking of the detailed principles of photocatalysis, and may also stimulate novel ideas for the design and optimization of heterogeneous photocatalysts.

ENG05 Weichang Hao “Exploring photocatalysis based on sp hybridization”
Recently, it was found that the incorporation of p-block elements into compounds with d0 or d10 electronic configurations can narrow the band gap greatly, leading to high visible-light photocatalytic activities. Three variations occur in band structures when a p-block element is incorporated: (1) the top of the VB is up-shifted by incorporating an extra p state in the VB or by hybridization of d/s states with O 2p; (2) sp hybridization leads to a dispersive CB and lowers the bottom of the CB; (3) some solid solutions are good examples of band tuning via combination of the cases: as a result, the VB is up-shifted, and the CB is down-shifted simultaneously. p orbital plays an important role in the states of charge carriers for the above-mentioned high performance photocatalysis. Since the CB constructed with d orbital is flat in contrast to the sp hybridization states, we propose a new strategy to explore high-performance visible-light photocatalysis using only p-block elements, based on the following conceptual design. In this talk, we report visible-light photocatalysis BiOX(X=Cl|Br|I), γ-Bi2O3 and Bi24O39Br10 with the CB and VB formed only by sp and p states, since Bi, O and Br are all p-block elements. We observed high redox activity and found that high photocatalytic activity was caused by the charge transfer between p and sp states.
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PLENARY PRESENTATIONS

PL03 Zhong Lin Wang “Nanogenerators as new energy technology and piezotronics for functional systems”
Developing wireless nanodevices and nanosystems is of critical importance for sensing, medical science, environmental/infrastructure monitoring, defense technology and even personal electronics. Nanogenerators (NGs) have been developed based on piezoelectric, triboelectric and pyroelectric effects, aiming at building self-sufficient power sources for micro/nano-systems. The output of the nanogenerators now is high enough to drive a wireless sensor system and charge a battery for a cell phone, and they are becoming a vital technology for sustainable, independent and maintenance free operation of micro/nano-systems and mobile/portable electronics. This talk will focus on the fundamentals and novel applications of NGs based on wurtzite and zinc blend structures.

PL04 Jeffrey Snyder “Materials engineering of complex thermoelectric materials”
The widespread use of thermoelectric generators has been limited by the low material efficiency of the thermoelectric material. A number of strategies for Complex Thermoelectric Materials with higher Thermoelectric figure of merit, \( zT \), are being actively studied at Caltech. Complex electronic band structures provide mechanisms to achieve high \( zT \) in thermoelectric materials through band structure engineering. The shift to focus on high mobility and band degeneracy has helped reveal the high \( zT \sim 2 \) in the lead chalcogenides and potential for new materials at room temperature such as Ag\(_2\)Se.

Complementary to grain and interface engineering that targets low frequency phonons, complex crystal structures and selective alloying target the high frequency phonons as well. Here the chemistry of Zintl compounds help select and optimize appropriate materials moving from the realm of elemental or binary semiconductors to ionic-covalent Zintl compounds such as SrZn\(_2\)Sb\(_2\), Ca\(_2\)Al\(_2\)Sb\(_2\), Yb\(_2\)Co\(_2\)Sb\(_4\), and Yb\(_4\)AlSb\(_6\). Finally, fast diffusing or ‘liquid-like’ elements in the complex materials Zn\(_4\)Sb\(_3\) and Cu\(_2\)Se provide additional mechanisms to scatter phonons and enhance thermoelectric conversion.
ACSMS KEYNOTE PRESENTATIONS

ACK01 Chennupati Jagadish “Semiconductor nanowires for optoelectronics and energy applications”
Semiconductors have played an important role in the development of information and communications technology, solar cells, solid state lighting. Nanowires are considered as building blocks for the next generation electronics and optoelectronics. In this talk, I will introduce the importance of nanowires and their potential applications and discuss about how these nanowires can be synthesized and how the shape, size and composition of the nanowires influence their structural and optical properties. I will present results on axial and radial heterostructures and how one can engineer the optical properties to obtain high performance optoelectronic devices such as lasers, solar cells. Future prospects of the semiconductor nanowires will be discussed.

ACK02 Hui Ming Cheng “Novel approaches for efficient energy storage”
The development of high-performance energy storage devices needs continuing efforts. To increase the energy/power density and flexibility of energy storage devices, we have proposed several approaches: (1) A hierarchical pore structure was proposed, in which different pores have different functions in supercapacitors (SCs). Then hierarchical porous carbon with facilitated ion transport and good electrical conductivity was developed for SCs; (2) a common problem in SCs is that the specific capacity of electrode materials and the voltage window of electrolytes cannot be fully used. Benefiting from electrochemical charge injection, the energy density of SCs has significantly improved; (3) a template-directed CVD was used to synthesize a 3D interconnected graphene framework (GF) that is flexible and has outstanding electrical and mechanical properties. By using the GF as a current collector on which Li$_4$Ti$_5$O$_12$ and LiFePO$_4$ were loaded as anode and cathode, a lightweight and flexible full lithium ion battery was fabricated; (4) by using a commercially-available graphene material with high electrical conductivity developed by our group, a simple graphene membrane-sulfur structure was used as cathode for Li-S batteries that show excellent performance.

ACK03 Michael Fuhrer “Graphene: A novel material for electronics and optoelectronics”
Graphene, an atom-thick plane of carbon, is of interest for its unique electronic structure: electrons in graphene obey the Dirac equation for massless (gapless) particles, complete with a two-component spin or degree of freedom that mimics the spin of a relativistic particle. I will give an introduction to graphene’s unique electronic structure, then follow with two recent examples from my research group which illustrate graphene’s potential for novel applications. First, gapless graphene allows photoabsorption across a wide spectral range, which we exploit to realize an extremely broadband detector. We accomplish ultrafast, sensitive detection via the hot electron photothermoelectric effect at room temperature. We demonstrate room-temperature detection of THz radiation with sensitivity >700 V/W and noise equivalent power of <20 pW/Hz$^{1/2}$, competitive with the best commercial room temperature THz detectors. However our device is orders of magnitude faster, with characteristic timescales <100 ps. Second, we measure the electrical conductivity and optical transmission spectra of ultrathin graphite during lithium intercalation. The high doping upon lithium intercalation increases the conductivity to near the phonon-limited value at room-temperature, and also increases the transmission in the visible range, due to Pauli blocking of optical transitions. Transmission as high as 91.7% for sheet resistance of 3.0 Ω is achieved for 19 layer LiC$_6$, better performance than any other continuous-film electrode.

ACK04 Min Gu “Australian-China collaborative partnership in solar cell research”
Solar cells and solar-cell-based devices are playing a pivotal role in green economies. Because of the limited
thickness of the conventional photon-conversion materials used in those devices, there is a limit of the electricity generation efficiency determined by the physical and chemical properties of the materials. The recent development of nanotechnology has facilitated the modification of the materials at a nanoscale, which is generally called the nano-structured materials. One of the effective ways to generate the nano-structured materials is the doping of metallic nanoparticles into photon-conversion materials. The plasmatic effects of the metallic nanoparticles can result in a significant enhancement of the photon-conversion processes. It has been therefore demonstrated that the solar cells based on the nanoplasmatic effects exhibit the efficiency higher than the limit of the current solar cell technologies. In this talk, we will present the progress on Australia-China nanoplasmonic solar cell collaborative initiative including academics and industries.

ACK05 Sean Smith “Materials epigenetics: Accelerating the discovery of new functional materials”
In the coming decade, theory and modelling that harness massive advances in high performance computing to rapidly predict materials properties and functionality will enable an unprecedented acceleration in discovery, development and innovation in the materials sciences, powering new technologies in the energy, environment and health sectors. In recognition of this, computationally accelerated materials discovery - the Materials Genome Initiative - is one of the two major research thrust areas in the US that are slated for large scale support in the next 5-10 years. Similar initiatives are underway in Europe and Asia. In this talk I provide an overview of research involving my group and collaborating friends in Australia and the US that evince the concept of an integrated theoretical and experimental approach to accelerating the discovery of new material functionalities and new functional materials. Topics covered include new hybrid 2-dimensional materials, carbon capture, and the development of novel synthetic and catalytic techniques.

ACK06 Jinhua Ye “Design and construction of solar energy harvesting materials for chemical conversion and environmental remediation”
This talk will introduce the latest research activities in our group, focusing on our challenges on the scientific and technological possibilities of nano-photocatalytic materials for solar fuel conversion as well as the environmental remediation offered by nanoarchitectonics of metal/semiconductor materials. Efforts to explore suitable materials and to optimize their energy band configurations for specific applications, and the design and fabrication of advanced photocatalytic materials in the framework of nanotechnology will be introduced, taking examples of recent research progress on Ag₃PO₄ and other newly developed materials. Many of the most recent advances in photocatalysis have been realized by selective control of the morphology of nanomaterials or by utilizing the collective properties of nano-assembly systems. The current theoretical understanding of key aspects of photocatalytic materials, as well as the crucial issues that should be addressed in future research activities will also be introduced and discussed.

ACK07 Esther Levy “Materials science publishing and how to maximise your success”
A highly competitive research environment with increasingly limited research funding has created a “Publish or Perish” attitude among scientists who are judged on the quantity rather than quality of their research articles. This presentation provides insight into the peer review process from the perspective of the Advanced Materials editorial office. A brief overview is given of editorial workflows, best practice for authors and reviewers, the reasoning behind peer review, and ethical considerations. Tips are presented on how to select an appropriate journal for your paper, which aspects of preparation and presentation to focus on from an editor’s and referee’s perspective, and how to increase the discoverability of your paper after publication.
SESSION PRESENTATIONS

MS12 Jin Zou “Impact of catalysts in the epitaxial growth of III-V nanowires”
Epitaxial III-V semiconductor nanowires have shown great potential in a wide range of potential applications in optoelectronics and nanoelectronics due to their unique structural characteristics. In general, epitaxial III-V nanowires are grown by the molecular beam epitaxy (MBE) or metal-organic vapour phase epitaxy (MOCVD) growth technologies, in which metallic catalysts are often used to induce the nanowire growth. The fact that the growth of epitaxial III-V nanowires is mediated by the catalysts indicates that the epitaxial nanowire growth can be much complex than anticipated. In this study, Au and Pd catalysts, prepared by annealing their corresponding thin films, were used to explore the role of catalysts in the growth of epitaxial InAs nanowires. In this study, the role of metallic catalysts (e.g. Au and Pd) in the growth of epitaxial III-V semiconductor nanowires is summarized.

MS13 Guoxiu Wang “Development of novel electrode materials for lithium-air batteries and sodium-ion batteries”
Firstly, we will report on the synthesis of an effective cathode catalyst of ruthenium nanocrystals. The as-prepared ruthenium nanocrystals exhibited an excellent catalytic activity as cathodes in Li-O₂ batteries with a high reversible capacity of about 9,800 mAh g⁻¹, a low charge-discharge over-potential (about 0.37 V), and an outstanding cycle performance up to 150 cycles (with a curtaining capacity of 1,000 mAh g⁻¹). The electrochemical testing showed that ruthenium nanocrystals can significantly reduce the charge potential comparing to carbon black catalysts indicating their potential for application as effective cathode catalysts for high performance Li-O₂ batteries. Secondly, we report the synthesis of β-MnO₂ nanorods with exposed tunnel structures by a hydrothermal method. The as-prepared β-MnO₂ nanorods have exposed {111} crystal planes with a high density of (1 × 1) tunnels, which leads to facile sodium ion insertion and extraction. β-MnO₂ nanorods exhibited good electrochemical performance with a high initial Na-ion storage capacity of 350 mA h g⁻¹. β-MnO₂ nanorods also demonstrated a satisfactory high-rate capability as cathode materials for sodium-ion batteries. Thirdly, we show an in-situ synthesis approach to fabricate WS₂@graphene nanocomposites. The WS₂@graphene nanocomposite exhibited a high reversible sodium storage capacity of about 590 mA h g⁻¹, good cyclability and a satisfactory high rate performance.

MS14 Yuansheng Yang “Dispersion of carbon nanotubes in CNTs/Mg composite fabricated with ultrasonic”
The dispersion of carbon nanotubes (CNTs) has a significant influence on the mechanical properties of CNTs/Mg composite. However, the large ratio of length to diameter makes CNTs easily to form clusters which are the weakness of CNTs/Mg composite. In order to disperse nano-reinforcements into matrix materials, ultrasonic processing is induced into the fabrication of CNTs/Mg composite. The effects of ultrasonic acoustic streaming were investigated by numerical calculation and simulation and well as experimental methods. The calculation results showed that the sound pressure amplitude decreased with the increase of axis distance. A verification experiment using glycerin as solution showed that CNTs were well dispersed under the action of ultrasonic acoustic streaming on the macro level. For the microcosmic separation, each CNTs cluster was regarded as a bubble with an equal volume. Calculations showed that when the sound pressure amplitude was below the cavitation threshold, both bubbles with small and big initial radius could exist; when sound pressure amplitude was over the cavitation threshold, those bubbles with big initial radius would exist several cycles but finally lead to strong collapses while those small ones could exist a long time. The experimental results agreed well with the simulation data.
MS15 Xuchuan Jiang “Engineering nanoparticles for energy and environmental applications”

Energy and environment have emerged as the most critical challenges to the sustainable global development in the 21st century. Nanomaterials have attracted much more attention because of their unique functional properties and broad applications in energy and environment. This presentation is going to talk about the efforts our group has made on the development of advanced synthesis strategies for the preparation of metal oxide nanoparticles, fundamental understandings and functions. In particularly, I’d like to talk about how to engineer nanoparticles for energy and environmental applications, focusing on gas sensors, smart window coatings and self-cleaning films.

MS16 Yi Du “STM and Raman studies on silicene and silicene oxides”

Silicene, a new allotropy of silicon in a two-dimensional honeycomb structure, recently attracts a great interest. Despite the rapidly increasing experimental works on silicene, the identification of silicene layers in different structures is still a major hurdle, especially for monolayer silicene. In practice, it is only possible to distinguish phases by scanning tunneling microscopy in an ultra-high vacuum environment. This limitation hinders large-scale identification of silicene and is a drawback for the widespread utilization of this material. Raman spectroscopy plays an important role in the structural characterization of materials, and has become a unique tool for understanding the behaviour of the electrons and phonons in two-dimensional materials. In this work, we present Raman spectra of epitaxial silicene layers in different structures grown on Ag(111) surface. The fingerprint Raman peaks have been identified. √3×√3 silicene shows obvious phonon softening in contrast to theoretical calculated phonon modes. It is attributed to that electrons transfer from the substrate to the epitaxial layer, and partially due to mechanical strain induced by mismatch between silicene layers and the substrate. Raman spectra of oxidized silicene samples indicate that √3×√3 silicene layers possesses very low chemical reactivity to oxygen compared to √13×√13 and 4×4 silicene layers.

ENG06 Yong Mook Kang “Fundamental design principles of cathode catalysts and the tailoring methods for their optimized structure and composition for Li-O2 batteries”

Lithium-air batteries have significantly high theoretical specific energy coming up to 11,140 Wh/kg because lithium–air batteries are based on discharge reaction between Li and oxygen to yield Li2O2. However, regardless of its high energy density, low cycling capability remains an important hurdle for its commercialization. A major drawback of lithium-air batteries is its low round trip efficiency coming from very large potential difference between ORR and OER (Oxygen evolution reaction). Various types of materials have been adopted for the catalysts to reduce potential hysteresis and thus attain high round-trip efficiency. In particular, α-MnO2 has received great attention as an oxide catalyst for lithium-air batteries due to its superior catalytic activity. In this presentation we report on the [112]-oriented α-MnO2 nanowires having thermodynamically metastable surface with significant instability and more open-structured surface frame ascribed to its cross-sectionally ordered 2x2 channel resultantly enabling more homogeneous nucleation of Li2O2 without toroidal growth and more effective Li2O2 accommodation compared to the [002]-oriented α-MnO2 nanotubes. The dependence of catalytic activity on the growth direction has been predicted based on the state-of-the-art first principles calculation on low miller index planes as main sidewall surface planes. To experimentally confirm the calculation results, very facile route based on hydrothermal reaction is also introduced.

ENG07 Yongyao Xia “Lithium storage in the graphite intercalation compounds (GICs)”

In the present talk, we will introduce that the GICs with lithium-ion storage intercalates (for example, metal oxides, metal chlorides, etc.), in which a lithium active gust material was sandwiched in atomic or molecular
between graphite interlayer spaces, can be used as a new type of promising anode material for LIB, which shows much better cycling stability than the other reported alternative materials. The mechanism responsible for the lithium storage in GICs was extensively investigated by means of charge-discharge test, XRD, XAFS, and TEM observation. The new material has a reversible capacity as large as 500 mAh/g with 100% capacity retention after 400 cycles. The large capacity has three origins: lithium-ion intercalation/deintercalation in the graphite interlayer; Li-ion adsorption/desorption on the surface of the graphene sheet; and formation/decomposition of LiCl. The unique structure of GICs appears to effectively solve the bottleneck problem of preventing capacity loss due to large volume change. Most importantly, being different from the conventional nanosized metal oxides, metal chlorides of large surface area usually show poor cycling stability at elevated temperature, but the GIC, typically of microsize, is very stable. We also extend this approach to prepare the other metal oxide composites making GIC format promising for upscaling.

ENG08 Hongxia Wang “Influence of stacking layer of Cu-ZnS-SnS precursors on the performance of Cu$_2$ZnSnS$_4$ thin film solar cells”

Solar cells using earth-abundant materials such as copper, zinc and tin as well as sulphide/selenide (CZTSSe) have pave a way towards fabrication of PVS with low cost and low environmental impact in the future. It is well-known that the quality of the light absorber thin film is the core of high performance solar cells. In my talk, I will present our recent study on CZTS thin films which were deposited by sputtering copper, zinc sulfide and tin sulphide precursors on molybdenum substrate followed by selenization. It has been found that the stacking sequence of the precursors has significant impact on the properties of the resultant CZTSSe films as well as the adhesion strength between the light absorber film and the molybdenum substrate. CZTSSe thin film solar cells with better performance were achieved with copper as the top layer and ZnS as the bottom layer in the precursor films. The effect of the stacking sequence of precursors on the formation mechanism of CZTSSe compound will be discussed.

ENG09 Yunhui Huang “How to get high energy density in lithium-ion batteries”

Although lithium-ion batteries (LIBs) have been extensively used, their applications are usually limited by energy density especially for high-quality electronic devices and electric vehicles. How to get high energy density is extremely important and urgent for development of next-generation rechargeable batteries for energy storage. Both cathode and anode materials are crucial for the LIBs to achieve high energy density. In this presentation, we compare several electrode materials and analyze how to get high energy density in LIBs: (1) cathode materials - lithium-rich Mn-based layered oxides with formula xLi$_2$MnO$_3$×(1-x)LiMO$_2$ (M=Co, Ni, Mn) show high specific capacity. With optimization, it can deliver a capacity as high as 290 mAh g$^{-1}$ and capacity retention of 92.3% after 100 cycles. Promoted by surface modification with Al$_2$O$_3$, better cycling performance is attained 94.5% capacity is retained after 150 cycles for the Al$_2$O$_3$-modified electrode; (2) anode materials - silicon and metal oxides exhibit very high specific capacity, but serious volume expansion during charge/discharge process leads to pulverization of electrode and, hence, the capacity decay. N-doped porous carbon with a unique interconnected 3D nanofiber framework exhibit superhigh capacity, excellent rate capability and stable cyclability as the anode material for LIBs. The specific capacity is as high as 943 mAh g$^{-1}$ even at 2 A g$^{-1}$ after 600 cycles.

ENG10 Hansu Kim “Electrochemical performances of nanostructured Si-SiO$_x$ materials as high capacity anode material for lithium-ion battery”

Si has recently aroused great attention as a promising anode material for next generation lithium ion batteries. With recent achievements in the research and development of Si, there have been considerable innovations exploiting its full potential as an anode for Li$^+$ storage. Thus far, the important concerns associated with the
practical implementation of Si anode are to find feasible ways to effectively suppress huge volume expansion (~300%) and to develop scalable process for mass production of Si anode. Non-stoichiometric SiO$_x$ has gained much attention as a one of the feasible matrix to circumvent the limitations of Si based anode materials. The presence of SiO$_x$ matrix is expected to act as a buffer against volume expansion, which facilitates strain relaxation without significant structural degradation. However, the complexity and limited number of available synthetic routes for the preparation of SiO$_x$ based anode materials should be resolved. The presentation will focus on our recent works involving the development of various nanostructured Si-SiO$_x$ materials as high capacity lithium storage material prepared by sol-gel reaction based scalable process. In this presentation, I will present results on carbon coated Si nanocrystals embedded SiO$_x$ nanosphere, carbon coated mesoporous SiO$_x$ particles and SiO$_x$ nanosheets that show excellent cycling stability with good dimensional stability even after prolonged cycles.

**MS17 Shi Zhang Qiao “Carbon-based materials for electrochemical energy conversion”**

Graphene and porous carbon based catalysts embedded with guest atoms can be considered as potential substitutes for the currently used noble catalysts in fuel cells or metal-air batteries. We report a boron and nitrogen dual-doped graphene (B,N-graphene), a sulfur and nitrogen dual-doped porous graphene (S,N-graphene), and a phosphorus and nitrogen dual-doped graphene (P,N-graphene) with a synergistic effect between heteroatoms. Their electrocatalytic activity and efficiency are comparable with those obtained on the precious metal catalysts, and significantly higher than those for the solely doped graphene. The new catalyst also shows excellent long-term stability. On the basis of first-principle calculations, we further designed and synthesized mesoporous g-C$_3$N$_4$@CMK-3 and 3-dimensionally ordered macroporous g-C$_3$N$_4$/C as metal-free ORR electrocatalysts, with high electrocatalytic activity and efficiency. These novel catalysts possessed prominent ORR catalytic activity in both reaction current density and onset potential. It also showed much better fuel crossover resistance and long-term durability than the commercial Pt/C in alkaline medium. The excellent ORR performance and reliable stability of g-C$_3$N$_4$@Carbon indicate that new catalysts are promising candidates for the next generation of highly efficient ORR electrocatalysts particularly for methanol alkaline fuel cells. We will also introduce our work on carbon-based materials synthesis and their applications in electrocatalytic energy conversion such as OER and HER.

**MS18 Kostya Ostrikov “Graphenes from plasmas: fabrication, properties and applications”**

Plasma-enabled graphene-based materials, their unique properties, and applications are introduced and critically discussed. In particular, non-equilibrium conditions of low-temperature plasmas that determine the formation and shape structural and morphological features of various graphenes and other related nanocarbon materials are discussed. Several examples of the vertical, horizontal, and hybrid embodiments of graphene-like structures such as vertical graphene nanosheets (also commonly known as carbon nanowalls), single- and few-layer horizontal, substrate-supported graphenes, and hybrid, microwell-like structures are presented and their properties and applications are explained. Specific examples focus on cases when low-temperature plasma-specific effects are particularly important, e.g., they enable low-temperature growth, specific structural or morphological features, or make it possible to materialize some specific utility in targeted applications. For example, growth of vertical graphenes on silicon substrates is only possible in a plasma while other similar processes fail or are inefficient. It is also possible to grow horizontal, single- and few-layer graphenes on metal (e.g., copper) substrates at very low temperatures when non-thermal plasma activation plays a pivotal role. We also discuss production, functionalization, and doping of graphenes using purified (e.g., methane) or natural biomass (e.g., fats, sugars, starches, etc.) precursors. The potential applications of graphene-based nanomaterials, in particular in energy, biomedical, electronic, magnetic, and environmental devices are introduced and analyzed.
MS19 Tianying Xiong “The Study of photocatalytic coating by cold spraying"
Cold spray (CS) is a solid state coating process that uses a high-speed gas jet to accelerate powder particles toward a substrate whereby metal particles plastically deform and consolidate upon impact. The term “cold spray” refers to the relatively low process temperature involved in the process, which is typically much lower than the melting point of the spray material. As a consequence, the deleterious effects of high-temperature oxidation, crystallization, phase transformation, residual stress, and other common problems for traditionally thermal spraying are minimized or eliminated. In the past, CS process is usually applied to metallic coatings, such as Cu, Ag, Zn, Al and so on. In recent decade, brittle materials (including oxides and ceramic, etc.) deserve special attention. Well-crystallized titania (TiO₂) and phosphorous, nitrogen, and molybdenum tri-doped TiO₂ (P, N, Mo)-TiO₂ coating were prepared respectively through Cold Spraying with compressed air as processing gas in this study. The photodegradation of rhodamine B (RB), assisted by such deposited TiO₂ coatings was studied. The RB decayed directly to colorless end products of water and mineral acids. Mechanism on photodegradation of RB by (P, N, Mo)-TiO₂ coatings under visible light and on deposition of cold spraying coating was also proposed.

MS20 Litao Sun “Setting up a Nanolab in a TEM for nanomaterials research"
With the continuous improvement of in situ techniques inside transmission electron microscope (TEM), the capabilities of TEM extend beyond structural characterization to high-precision nanofabrication and property measurement. Based on the idea of “setting up a nanolab inside a TEM”, we present our recent progress in nanomaterials research including in-situ growth, nanofabrication with atomic resolution, in-situ property characterization, nanodevice construction and possible applications. Examples such as in-situ nanofabrication of suspended molybdenum sulfide sub-nanometer ribbons with uniform width of 0.35 nm from monolayer MoS₂ by electron beam irradiation will be shown. The mechanism of electron-beam induced high-resolution nanofabrication is also discussed.

MS21 Hao Wang “Geopolymer: green cement from waste materials and no calcination"
Geopolymer has emerged as a green alternative to ordinary Portland cement (OPC) to provide the solution for its high CO₂ emission, high energy consumption and scarcity of raw materials. Geopolymer, also known as alkali activated cement, is an inorganic polymer produced by alkali activation of aluminosilicate-bearing raw materials, such as the industrial wastes coal fly ash and metallurgical slags, at or slightly above room temperature. The alkali activation produces a three dimensional polymeric network as the binding mechanism, which differs from the calcium silicate hydrate (C-S-H) gel system in ordinary Portland cement, but offers equivalent or even superior mechanical and chemical properties to OPC. The room temperature synthesis completely bypasses the high temperature process of calcination of limestone, and reduces CO₂ emission up to 80%. In OPC sometime fly ash is added as a supplementary cementitious material but does not contribute much to the early-age strength of the binder, while in geopolymers fly ash is used as the source of the aluminosilicates for the binders and is thus the critical component for strength development. The absence of a method to effectively evaluate the raw material fly ash and its variables has become the biggest barrier for geopolymer being fully adopted by industries, especially in civil and construction industries where predictable and reliable performance is critical. We have developed a fly ash reactivity index and match it with activation capacity, which can result in an efficient geopolymer reaction and predictable material performance.

ENG11 Min Sik Park “A Novel lithium-doping approach for advanced lithium ion capacitors"
A lithium ion capacitor (LIC) has been considered as a fashionable energy storage system in terms of specific energy (Wh/kg) and power density (W/L) because it can store more electrochemical energy than that of conventional electrochemical double-layer capacitor (EDLC). To be more specific, the LIC has an asymmetric
configuration composed of activated carbon (positive electrode; PE) and Li\(^+\) intercalating materials (negative electrode; NE) such as graphite, soft carbon and hard carbon, currently used as anode materials for lithium ion batteries. One of the most important concerns is developing a key technology for lithium pre-doping to the NE. Currently used methods for development of NEs pose serious safety hazards, thus, there is a strong need to explore alternative lithium sources and develop efficient Li\(^+\) pre-doping processes. In this regard, we propose a new lithium pre-doping method using various transition metal oxides featuring a high irreversibility as alternative lithium sources. This versatile approach can yield sufficient doping efficiency over 90% and secure safety by removing metallic lithium from the cell. The advantages and drawbacks associated with the use of highly irreversible transition metal oxides as alternative lithium sources in the LIC will be discussed.

**ENG12 Shanqing Zhang “Visible light photoelectrochemical sensors for determination of organic compounds”**

A series of nanostructured TiO\(_2\) sensors and photoelectrochemical cells have been developed in our group for photoelectrochemical determination of organic compounds, leading to a series of commercialized patents and commercial products. This sensing mechanism is based on photoelectrocatalytic oxidation of organic compounds in waters under UV radiation. Recently, a hydrogenated nanostructured TiO\(_2\) photoanode was prepared by hydrogenating TiO\(_2\) nanorod arrays (H-TNRs) electrode. Hydrogenation is an efficient and effective means to extend light absorption to visible light region and improve electron conductivity of TiO\(_2\) via introduction of oxygen vacancy and mid-gap levels in TiO\(_2\) lattice. The H-TNRs photoanode was used as a sensor for organic compound detections under visible light illumination for the first time. Preliminary experiments demonstrate that the H-TNR electrode is able to sensitively determine various organic compounds in water with satisfactory stability. This suggests that the hydrogenation nanostructured TiO\(_2\) electrodes are promising in sensing organic compounds in waters and further to be further developed into commercial products.

**ENG13 Sang Woo Kim “Transparent flexible nanogenerators based on piezoelectric and triboelectric nanomaterials”**

Energy harvesting systems based on piezoelectric and triboelectric nanomaterials are in great demand, as they can provide routes for the development of self-powered devices which are highly flexible, stretchable, mechanically durable, and can be used in a wide range of applications. Our recent research interest mainly focuses on the fabrication of nanogenerators (NGs) based on 1D/2D nanomaterials such as zinc oxide nanowire/nanosheets and graphene. In this talk, I will address the first demonstration of DC power generation using piezoelectric 2D ZnO nanostructure and an anionic layer. The combined effect of buckling the ZnO nanosheets, anionic layer, and coupled semiconducting and piezoelectric properties of ZnO nanosheets are the main causes of the efficient DC power generation. Further I will present the growth of lead-free single-crystalline ferroelectric V-doped 2D ZnO nanosheets and the realization of a high-performance flexible DC power output NG based on V-doped 2D ZnO nanosheet networks for the first time. Furthermore, this talk will introduce the importance of nanogenerators as well as the recent advances in power generation through piezoelectric/triboelectric nanogenerators with the power generation mechanism. I will discuss recent research and design efforts that enhanced the power generation to commercialize the nanogenerators to power portable and wearable devices.

**ENG14 Quan Hong Yang “Effective energy storage from the surface of graphene”**

Graphene has been estimated as excellent platform for energy storage with fascinating performance and bright future. The surface of graphene witnesses all the energy storage behavior for a variety of devices. In this talk, based on the unique surface chemistry of graphene and the rational self-assembly of graphene oxide, we will present how we utilize the surface of graphene to store energy, including the supercapacitors based
on the EDLC on the surface of low-temperature exfoliate graphene and the 3D graphene monolith with high volumetric energy density, the lithium ion batteries based on the “plane to point” conductive model of graphene, the long cycle life lithium sulfur batteries based on the self-assembled graphene membrane. And specifically, a high performance lithium sulfur battery based on the surface reaction between graphene oxide and H$_2$S will be introduced to illustrate how the surface of graphene can store energy and hybridize other components to realize the storage of energy.

**ENG15 Jong Won Lee “Carbon- and binder-free oxide cathodes for reversible lithium–oxygen batteries”**

The major hurdle for widespread commercialization of electric vehicles (EVs) is low energy storage capability of rechargeable batteries that limit the vehicle’s driving range. In recent years, therefore, an increasing need for long-range EVs led to considerable research and development activity on lithium–oxygen (Li–O$_2$) batteries. There are many challenges facing development of Li–O$_2$ batteries. In particular, main constituents comprising a cathode, such as carbon and binders, are known to suffer from irreversible decomposition, leading to performance degradation. Here, carbon- and binder-free cathodes based on non-precious metal oxides are designed and applied as cathodes for Li–O$_2$ batteries. A cathode architecture with a high porosity and a large surface area is proposed that consists of numerous one-dimensional nanoneedle arrays decorated with thin nanoflakes. The oxide-only cathodes show high specific capacities and remarkably reduced charge potentials as well as excellent cyclability. This is attributed to the following design features: 1) the carbon- and binder-free cathode reduces the parasitic reaction with Li$_2$O$_2$ and thus promotes reversible formation and decomposition of Li$_2$O$_2$; 2) micro- and macro-pores among 1-D nanoneedles offer a large amount of open spaces for Li$_2$O$_2$ accumulation, while reducing mass transport limitations; and 3) the nanoflakes deposited on nanoneedles provide a large number of active reaction sites.
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ACK08 Lei Jiang “Bio-inspired interfacial materials with super-wettability”
Learning from nature and based on lotus leaves and fish scale, we developed super-wettability system: superhydrophobic, superoleophobic, superhydrophilic, superoleophilic surfaces in air and superoleophobic, superareophobic, superoleophilic, superareophilic surfaces under water. Further, we revealed smart switchable super-wettability. The smart super-wettability system has great applications in various fields, such as self-cleaning glasses, water/oil separation, anti-biofouling interfaces, and water collection system. The smart property was further extended into 1D system. Energy conversion systems that based on artificial ion channels have been fabricated. Also, we discovered the spider silk’s and cactus’s amazing water collection and transportation capability, and based on these nature systems, artificial water collection fibers and oil/water separation system have been designed successfully.

ACK09 Xinyi Zhang “Advanced engineering materials and membranes for energy conversion & storage”
There is now an increasing demand for energy conversion & storage technologies due to the depletion of our fossil fuel reserves and fossil fuel combustion caused problems. The design and fabrication of new functional engineering materials is critical in tackling these scientific challenges. In this talk, the recent development in our group in the fabrication of functional materials, including ionic liquids, plastic crystals, porous materials, nanomaterials and membranes will be introduced. A range of applications of these materials and membranes including batteries, water splitting, CO₂ conversion, solar cells, and fuel cells will be presented.

ACK10 Zhongfan Liu “Graphene and its 2D hybrids: attraction, reality and future”
Graphene, the atomic thin carbon film with honeycomb lattice, holds great promise in a wide range of applications, arising from its unique band structure and excellent electronic and mechanical properties. The research of this star material is being stimulated by the development of various emerging preparation techniques, among which chemical vapor deposition (CVD) has received the fastest advances in the last few years. This talk focuses on recent progresses towards the controlled surface growth of graphene and its 2D hybrids via CVD process engineering. The general strategy is to design and control the elementary steps of catalytic CVD process for achieving a precise control of layer thickness, stacking order, domain size, doping and energy band structure. A particular emphasis is laid on the design of growth catalysts, including bimetal alloys and groups IVB-VIB transition metal carbides. We are also working with a photochemical approach for graphene chemistry, where the chemical scissors are the highly reactive radicals generated from photochemical processes. A number of examples are given, including photochlorination, photomethylation, photocatalytic oxidation and Janus chemistry.

ACK11 Yi Xie “Semiconductor ultrathin nanosheets with atomic thickness: chemistry, challenge and opportunities”
Atomically-thin semiconductor nanosheets can provide promising opportunities to satisfy people’s requirement of next-generation flexible and transparent nanodevices. This study reviews our group’s recent advances in the large-scale synthesis, fine structure/defect characterization, electronic structure investigation, device assembly, and photoelectric, catalysis and thermoelectric properties of ultrathin nanosheets with atomic thickness. In other words, this study mainly focuses on recent advances in synthetic strategies of atomically-thin nanosheets with layered/non-layered structure as well as the quasi-layered structure, their fine structure characterization by X-ray absorption fine structure spectroscopy, defect structure characterization
by positron annihilation spectrum and electron spin resonance, and electronic structure investigation by density-functional calculations. Effective strategies have been developed to fabricate film devices of the single or few-layered inorganic semiconductor two-dimensional nanosheets and their hybrid structure with graphene, and their ordered assembly mechanisms have been investigated. This study also summarizes the well-defined correlation between atomic, defect, electronic structure variations and the optical, electrical, magnetic properties of atomically-thin 2D nanosheets. Our work may be only the tip of the iceberg on the study of atomically-thin inorganic two-dimensional nanosheets, while their other innovative properties are urgently waiting to be explored.

ACK12 Yusuke Yamauchi “Chemical design of functional nanoporous materials”

Nanoporous materials now include a variety of inorganic-based materials, e.g., transition-metal oxides, carbons, inorganic-organic hybrid materials, polymers, and even metals. Among many types of nanoporous materials, metal-based nanoporous materials hold promise for a wide range of potential applications, such as electronic devices, magnetic recording media, and metal catalysts, owing to their metallic frameworks. There are two synthetic pathways for nanoporous metals; soft-templating and hard-templating. Nanoporous metals show high specific surface areas, which are quite effective for enhancement of chemical reactions on the metal surface as electrocatalysts. Recently, we developed a new facile approach ‘electrochemical micelle assembly’ for preparation of nanoporous metals with uniformly-sized pores. We prepared multilayer nanoporous bimetallic (Pt/Pd) alternating films by layer-by-layer (LbL) electrochemical deposition. Other core-shell and hollow nanoporous metal particles have been also prepared by chemical reduction methods. Because of the high surface area and hetero-metallic interfacial atomic contacts, enhanced electrocatalytic activity for methanol oxidation reaction is realized. Here I will show our recent advances on functional nanoporous materials.

ACK13 Richard White “Demystifying the editorial process at Nature and its sister journals”

Richard will discuss the relationships of the different journals in Nature Publishing Group and explain their editorial processes. He will consider issues including: preparing for submission, cover letters, dealing with reviewers, and Open Access publication.

ACK14 Liejin Guo “Solar hydrogen: On material design and pilot-scale demonstration”

Solar hydrogen conversion via water splitting is an important technology for energy and environment sustainability. Since the pioneering work of Fujisima and Honda in 1972, tremendous research on semiconductor-based photocatalytic and photoelectrochemical water splitting has yielded better understanding of the processes involved in solar hydrogen production, as well as encouraging development of high efficiency photocatalysts/photoelectrodes for solar hydrogen generation. In the past 15 years, aiming at applicable solar hydrogen conversion in the near future, we have been focusing on the design of low cost and high efficiency semiconductors, which are completely composed of earth-abundant elements, as well as pilot-scale demonstration for large scale solar hydrogen production. In this article, we give a brief overview of recently developed all oxide-based photoanodes and cheap photocatalytic materials without any noble metals for solar water splitting, and also the principles and examples of pilot-scale demonstration for large scale solar hydrogen production.
ACK15 William Price “The Australian Institute for Innovative Materials: AllMing to make a material impact – an overview”

The Australian Institute for Innovative Materials is a flagship research enterprise at University of Wollongong (UOW). It opened in 2008 and houses UOW’s two premier research groups in Materials: the Institute for Superconducting and Electronic Materials (ISEM), Research Director, Prof. Shi-Xue Dou, and the Intelligent Polymer Research institute (IPRI), whose director is Prof Gordon Wallace. The research groups within AIIM look at a broad range of new materials and composites, from metals and semiconductors to conducting polymers and carbon based materials such as graphene. More than 250 staff and students undertake ground breaking research across several major themes including energy applications such as generation, storage and for transportation and biomaterials. AIIM’s facilities are world class and range from fundamental research through to prototype and device development. It also has state of the art equipment for materials science synthesis, characterisation and testing including an excellent electron microscopy centre. One of AIIM’s primary goals is to bridge the gap between research and development to strongly engage with industry and bring new ideas and products to the market place. This talk will overview AIIM’s facilities and research programs.
EM07 John Zhu “Novel cathode materials for intermediate temperature solid oxide fuel cells”
SOFCs are an electrochemical device that can effectively convert the chemical energy of fuels into electricity. They typically operate at high temperature (800-1000 °C) resulting in high costs and materials compatibility challenges. Developing SOFCs that can work at intermediate temperature (600-750 °C) has thus been attracting considerable attentions. However, the performance of the cathode is the largest hurdle to the full realization of low temperature solid oxide fuel cells. In this talk, we will introduce two novel 3D heterostructured electrodes for highly efficient oxygen reduction.

EM08 Ajayan Vinu “Nanoporous carbon nitride: A Unique material with multiple functions”
A Nanoporous non-siliceous materials such as carbons have attracted much attention in the recent years due to their enormous applications in the fields of adsorption, catalysis, and fuel cells. However, the incorporation of hetero atoms such as boron and nitrogen in the non-siliceous materials can significantly change their electronic and semi-conducting properties. In this talk, I will present some results about the discovery of the nanoporous carbon and nitride materials, and the basics and the mechanism behind the synthesis of various nanoporous nitride materials with different pore structure and textural parameters. Then, the preparation, characterization and the applications of one and three dimensional nanoporous carbon nitrides materials synthesized using various inorganic templates with the different pore structures (MCN-1 and MCN-2) through a simple polymerization reaction between ethylenediamine (EDA) and carbon tetrachloride (CTC) will be presented. Moreover, the methods to control the textural parameters and the nitrogen content of the nanoporous carbon nitride materials, which have been solely developed in my group, will also be discussed. I will also present a simple approach for constructing highly ordered macro-nanoporous carbon nitride films with controlled thickness and pore size and their applications as sensors for detecting various molecules including amine based compounds.

EM09 Xiaozhou Liao “The structural evolution of nanocrystalline materials processed by severe plastic deformation”
Severe plastic deformation (SPD) has been widely used to refine coarse-grained crystalline materials for superior mechanical properties. In fact, SPD not only refines coarse grains, it also leads to the growth of small grains. The final grain size of materials processed by SPD is determined by the dynamic balance of SPD-induced grain refinement and grain growth. While the mechanisms of SPD-induced grain refinement have been widely reported, SPD-induced grain growth was less investigated. In this presentation, I will discuss our recent investigations on the structural evolution of nanocrystalline materials processed by SPD. Results to be presented include (1) the mechanism of SPD-induced grain growth, (2) grain size effect on deformation twinning and de-twinning, and (3) various types of interactions between dislocations and twin boundaries in nanocrystalline materials. I will also briefly discuss the relationship between the structural evolution and mechanical behaviour.

EM10 Sima Aminorroaya “Thermoelectric performance of p-type quaternary (PbTe)_{1-x-y} (PbSe)_{x} (PbS)_{y} compounds”
Lead chalcogenides (PbQ, Q = Te, Se, S) have proved to possess high thermoelectric efficiency for both n-type and p-type compounds. Recently a significant improvement in thermoelectric performance of p-type ternary
PbTe-PbSe and PbTe-PbS systems has been realized through alternating the electronic band structure and introducing nano-scale precipitates to bulk materials respectively. However, the quaternary system of PbTe-PbSe-PbS has received less attention. We have studied the thermoelectric efficiency of single phase and nanostructured $p$-type quaternary PbTe-PbSe-PbS and shown that single phase quaternary chalcogenides is superior to ternary PbTe-PbSe and PbTe-PbS at similar carrier concentrations and the binary PbTe, PbSe and PbS alloys. A large Seebeck coefficient, indicative of a wider band gap and valence bands energy offset and heavier carriers effective mass was achieved with surprisingly low thermal conductivity, as low as the thermal conductivity of nanostructured compounds. However, the thermoelectric efficiency of nanostructured $p$-type quaternary lead chalcogenides were found to be lower than that of single phase alloys due to larger electrical resistivity.

**EM11 Nagarajan Valanoor “Combinatorial studies of multilayer periodicity modulation on Ferroelectric behaviour of Sm-BiFeO$_3$ multilayers”**

Rare-earth substituted Bismuth Ferrite (RE-BFO) thin-films have been a subject of recent interest due to their high ferroelectric polarization and enhanced piezoresponse, attributed to the presence of a (morphotropic) phase boundary between rhombohedral ferroelectric (FE) and orthorhombic paraelectric (PE) phases. Firstly, we will present structure-electromechanical property correlations in rare-earth (RE)-substituted (001) BiFeO$_3$ (BFO) epitaxial thin films revealed by quantitative piezoelectric coefficient ($d_{33}$) and dielectric constant ($e_{33}$) measurements in conjunction with selected area electron diffractions. Secondly, artificial superlattices are discussed. [Bi$_{1-x}$Sm$_x$FeO$_3$/BiFeO$_3$]$_n$/SrRuO$_3$/SrTiO$_3$ (x=0-0.3) heterostructures of varying periodicities (6,10,20 and 50nm per layer, to a total thickness of 200nm) are presented. Motivated by recent studies involving the growth of artificial superlattices we sought a framework to tune the functional electronic properties in ferroelectric materials without compromising either the epitaxial nature or the leakage of the thin-films. Crystallographic evidence of the phase coupling between the Bi$_{1-x}$Sm$_x$FeO$_3$ and BiFeO$_3$ layers is presented using reciprocal space mapping and 2-dimensional X-Ray Diffraction. Functional characterization using Piezoresponse Force Microscopy, Polarization Hysteresis measurements and Capacitance-Voltage measurements further explore the behaviour of the phase coupled material, and provide an intriguing experimental outlook coupling mechanisms (>10u.c) in dielectric multilayers.

**EM12 Shane Kennedy “Applications of neutron beam methods in materials science”**

Neutron scattering techniques have evolved over more than ½ a century into a powerful set of tools for determination of atomic and molecular structures. Modern neutron beam facilities have the capability to determine complex structures over length scales from < 0.1 nm to > 500 nm. They also provide unique insights into magnetic interactions, into atomic and molecular dynamics, and on the location and behaviour of light elements (such as hydrogen) in a variety of materials. As a consequence, neutron beam research applications are many and varied; those in the hard matter sciences include studies of magnetic and superconducting materials, hydrogen storage and transport, ferroelectrics, ceramics, minerals and glasses; while applications in the soft matter sciences including polymers, micelles, surfactants and biological systems. The OPAL nuclear research reactor, at Lucas Heights, is a modern 20 MW pool type reactor. OPAL is used for scientific research using neutron beams, radioisotope production (particularly for radiopharmaceuticals) and industrial irradiation services. OPAL now has ten first rate neutron spectrometers in operation, including one radiography/tomography instrument, with three more under commissioning. The presentation will include an introduction to the OPAL neutron beam facility, including some discussion of our strategic objectives. It will also provide scientific highlights from our research selected to illustrate the potential for applications in materials science.
ENG16 Shulei Chou “Alloy-based anode materials for sodium ion battery”
There are mainly three types of anode materials for sodium-ion batteries including carbon materials, alloy-based materials such as Sn, Sb, and P and insertion type sodium metal oxide materials. Alloy-based anode materials such as Sn, Sb, and P show high theoretical capacity of 847 (Na_{15}Sn_{4}), 660 (Na_{3}Sb), 2,596 (Na_{3}P) mAh g\(^{-1}\) towards sodium, but with more than 300% volume expansion. The expansion ratio for sodium based anode materials is more serious than lithium based anode materials due to the bigger size of Na\(^+\) ions leading to poor cycle life. This massive volume expansion can lead to poor cycle life. Capacity fade can be caused by pulverization of the active particles or degradation of the electrode coating. The capacity fade of alloy-based negative electrodes is also very sensitive to the choice of binder. A good binder must ideally maintain adhesion of the electrode to the current collector, maintain ionic contact, and facilitate the formation of a stable interface with the electrolyte. Here, we will present our work on anode materials for sodium ion battery. The materials include carbon based materials, Sn-based materials and red phosphorous based composites with high specific capacity and excellent capacity retention.

ENG17 Rachel Caruso “Morphological control of materials for environmental applications”
Obtaining a sufficient supply of clean water for a growing population is seen as a major challenge that needs to be addressed. Hence significant effort has gone into researching materials that can remove pollutants from water. This can be achieved through adsorption of the pollutant onto a support that can be separated from the water, or destruction of the contaminant through degradation processes. The effectiveness of the material to adsorb or degrade pollutants is dependent on the materials properties, which are determined by characteristics of the material. Careful manipulation of the synthesis process of materials allows control over such characteristics - the crystal size and phase, pore size and structure, outer morphology and surface functionality. In this presentation examples of the synthesis and characterisation of materials with application in the removal of pollutants from water will be discussed.

ENG18 Gang Wei “Science and technology innovation and collaboration, Australia – China”
The talk will focus on a snapshot of Australia’s Commonwealth Scientific and Industrial Research Organisation (CSIRO) – including our purpose, where we are, some facts on our revenue, staff, publications, our achievements, and the areas of impact of our research. It will also describe how we work towards becoming a research enterprise with global reach – through talent, impact and networks. The talk will focus on CSIRO’s potential collaboration with China particularly in the area of green car / rail research, advance materials, biomaterials and technologies, followed by some thoughts on future opportunities.

ENG19 Ziqi Sun “Metal oxide nanostructure engineering for advanced photovoltaic devices”
Metal oxides are known to possess unique functionalities that are absent or inferior in other solid materials. Their nanostructures have emerged as an important class of materials with a rich collection of properties and general potential for device applications. In this presentation, we will show our recent results on the rational design of the diverse morphologies of the typical metal oxides, like TiO\(_2\), ZnO, WO\(_3\), etc, with 1D, 2D, and 3D architectures, based on the precise controlling of the starting solutions, to meet the materials requirements for high-performance photovoltaic devices. Particularly, a generalized and fundamental approach to molecular self-assembly synthesis of ultrathin 2D nanosheets of transition metal oxides is developed by rationally employing lamellar reverse micelles. These metal oxide nanostructured materials offer huge surface to
volume ratios, favourable transport properties, altered physical properties, and confined quantum size effects, and thus boost the performance of the photovoltaic devices.

**ENG20 Zhaoxiang Wang “Feasibility of constructing Mo-based Li-rich cathode materials for lithium ion batteries”**

In this presentation, the feasibility of constructing novel Li-rich cathode materials by substitution of Mo for Mn$^{4+}$ in Li$_2$MnO$_3$ and replacement of Li$_2$MoO$_3$ for Li$_2$MnO$_3$ in the composite was studied by first-principles calculation and X-ray absorption spectroscopy. First-principles calculations show that Mo doping is beneficial for improving both the kinetic and thermodynamic properties of Li$_2$MnO$_3$, by reducing the band gap and increasing the number of states near the Fermi level, promoting the Li-ion diffusion between the lithium layer and the transition-metal layer and the charge transference from Mo to O. Aliovalent substitution of electrochemically active Mo$^{5+}$ ions for inactive Mn$^{4+}$ improves the charge compensation and the stability of O$^{2-}$ in the lattice of Li$_2$MnO$_3$, suppresses the oxygen release and enhances the structural stability of Li$_2$MnO$_3$. Investigation of the crystalline and electronic structure of Li$_2$MoO$_3$ in the initial lithium extraction/insertion between 2.0 and 4.8 V shows that both the O$^{2-}$ on the surface of Li$_2$MoO$_3$ and its Mo$^{4+}$/Mo$^{6+}$ redox couple can reversibly compensate for the charge loss/gain upon Li extraction and insertion. In addition, the partially reversible Mo-ion migration to/from the Li vacancies leads to reversible phase transition. These reveal the feasibility to replace Li$_2$MnO$_3$ for constructing Li$_2$MoO$_3$-based novel Li-rich cathode materials.

**ENG21 Rongming Wang “Controllable synthesis, atomic structure and properties of magnetic and optical nanomaterials”**

Noble-metal bimetallic nanostructures have aroused increasing attention in the past few years for their superior catalytic and magnetic properties. Their innovative applications based on the synergy of two distinct metals require an atomistic understanding and control of key structural factors like combination types, interface structures, and surface oxidation states, since these factors can influence the relaxation/mixing of elements and the binding energy of surface atoms, thus determine the properties. In situ high resolution transmission microscopy (HRTEM) and scanning transmission electron microscopy (STEM) can give atomic structure of the nanoparticles dynamically. The structural stability of FePt nanoparticles was investigated by dynamic HRTEM. The structure of the FePt nanoparticle, a Pt enriched shell around an Fe/Pt magnetic core, is believed to be responsible for its dynamic behaviour under different beam conditions. The structure evolution behaviors of NiAu nanospindles in oxidizing/vacuum conditions were studied by in situ STEM, providing a practical insight into the structural stability of NiAu bimetallic catalysts through a thermal processes. In situ STEM imaging and 3D reconstruction were performed to evidence the migration of Pt atoms decorated on the NiPt hollow spheres during catalysis of CO oxidation, providing a practical insight into the structural stability of bimetallic catalysts.

**ENG22 Zi Feng Ma “Graphene-based electrode material preparation for rechargeable sodium ion battery application”**

Sodium ion battery technology is considered as an attractive alternative to lithium ion batteries for the large scale energy storage systems. The key issue for developing practical sodium ion batteries (SIB) is to develop high performance electrode materials. P2-type Na$_{2/3}$[Ni$_{1/3}$Mn$_{2/3}$]O$_2$ cathode material has been synthesized via spray drying method and a two-step solid state process and their electrochemical behaviour was investigated in different charge-discharge voltage ranges. The cycling performance of the P2- Na$_{2/3}$[Ni$_{1/3}$Mn$_{2/3}$]O$_2$ cathode is greatly dependant on the voltage window. The material shows excellent reversibility between 2.0 V and 4.0 V with capacity of 86 mAh/g (0.1 C) and 77 mAh/g (1 C). Recently, a novel, flexible and binder-free graphene/Na$_{2/3}$[Ni$_{1/3}$Mn$_{2/3}$]O$_2$ composite electrode (GNNM) was fabricated. Graphene sheets cover Na$_{2/3}$[Ni$_{1/3}$Mn$_{2/3}$]O$_2$
particles very well and establish stable electric conductive structures due to their strong p-p bonds. During 2.0V to 4.0V, GNNM electrode delivers reversible specific capacity of 83 mAh/g at 1C rate and is close to the theoretical capacity of Na$_{2/3}$[Ni$_{1/3}$Mn$_{2/3}$]O$_2$. In this talk, we will present the results mentioned above and prospect the graphene-based electrode material application in the design of electrochemical energy storage device. The authors are grateful for the financial support of this work by the Natural Science Foundation of China (21336003) and the 973 Program of China (2014CB239700).

**ENG23 Ian Gentle “Carbon materials for electrocatalysis”**

The oxygen reduction reaction is an essential component of the functioning of fuel cells and metal-air batteries. Because of the sluggish kinetics at the cathode, the energy efficiency of these processes is limited, so that a major effort has gone into developing an effective, low-cost and robust electrocatalyst material to overcome this limitation. A good electrocatalyst is one that leads to low overpotential and high current density, which are the consequences of a number of factors including poor activity, limited electronic conductivity, slow mass transfer of reactants and products and low electrocatalytic surface area. Our group has recently developed new carbon-based materials for electrocatalysis using a variety of techniques. These include chemically modifying graphene nanosheets with using chitosan as a binder, resulting in a gas diffusion electrode that combines the high surface area and good conductivity of graphene with a stable, low cost binder material. In another approach we have developed a composite material, which uses the favorable properties of graphene nanoribbons, metal oxides and carbon nanotubes in a ternary composite to produce excellent performance when compared to platinum.

**ENG24 Md Shahriar Al Hossain “The Roles of CHPD: superior critical current density and n-value obtained in in-situ MgB$_2$ wires and cables”**

During the past few years, the superconducting properties of monofilament and multifilament MgB$_2$ wires and tapes have been improved considerably. Not much work has yet been done on cabling procedures, although these are well recognized in classical low temperature superconductors. In this work, a binary magnesium diboride (MgB$_2$) cable has been assembled by braiding six Nb/Monel sheathed monofilament strands with a central copper stabilizer for improving the operational environment. The total critical current of the braided cable are obtained by multiplying the critical current of six single wires, without any dissipation. In this work, various mechanical deformations, i.e., swaging, two-axial rolling, groove rolling and cold high pressure densification (CHPD) at 1.8 GPa have been applied to the 6-stranded cable to obtain additional densification. The highest critical current density at both 4.2 and 20 K has been achieved in this work through the CHPD treated cable due to higher filament mass density. The present results are promising in view of the cable particularly in power and fusion applications that exist at industrial lengths that pave the way to seek an optimal protocol to meet a practical functionality.

**ENG25 Zhi Gang Chen “Design of band engineered and nanostructure engineered metal chalcogenide thermoelectrics”**

Novel band-engineered metal chalcogenide nanomaterials has been developed for improving energy conversion efficiency using low cost wet chemistry synthesis, structural modification, and band engineering strategies. Several binary or ternary metal chalcogenides with tuneable structural characteristics and dopants to form desired n- and p- type semiconductors have been manipulated and show improved thermoelectric performance and unique magnetic properties.
ENG26 Ai Shui Yu “Free-standing electrodes used in lithium-oxygen batteries”

The rechargeable lithium–oxygen batteries (Li-O₂) have recently attracted worldwide attention due to their highest energy density among the state-of-the-art batteries. However, the practical applications of lithium-oxygen batteries still face substantial challenges, including large polarization, low round-trip efficiency, and poor cyclability. Particularly, the polyvinylidene difluoride binder (PVDF) used to fabricate the porous electrode is not stable in the presence of superoxide as well as Li₂O₂. A binder-free nickel foam supported nitrogen-doped carbon nanotubes (N-CNTs@Ni) was synthesized by a floating catalyst chemical vapor deposition (FCCVD). Without any additional treatment, it could be employed as the air electrode in the lithium-oxygen batteries and delivers 1814 mAh g⁻¹ at the current density of 0.05 mA cm⁻². This 3-dimensional network structure facilitates the O₂ diffusion in the inner electrode and provides enough void volume for the products deposition during discharge process. A carbon-free, three-dimensional network structured material composed of (Co, Mn)₃O₄ nanowires and Ni foam was synthesized and employed in the lithium-oxygen batteries, a specific capacity of 3605 mA h g⁻¹ electrode is obtained at a current density of 0.05 mA cm⁻². By restricting the capacity with a cut-off of 500 mAh g⁻¹ electrode the (Co, Mn)₃O₄@Ni electrode exhibits good reversibility for 50 cycles.

MS22 Lianzhou Wang “Semiconductor layered materials for photoelectrochemical energy conversion”

Global concerns on the climate change and exhausting fossil fuels have seen great effort being directed towards the development of new energy generation/conversion systems. Innovative materials for energy conversion hold the key for renewable energy production. The ability to design these nanomaterials with tailored structures and functionalised properties is an important challenge that researchers strive to meet. Aimed at developing new nanostructures for efficient photocatalytic and photo-electrochemical solar energy conversion, we have been focusing on the structural design and band-gap modification of several types of semiconducting metal oxides including layered titanate, tantalates and niobate-perovskites. The resultant innovative material systems exhibited efficient visible light active photocatalytic performance, which underpin a number of important solar-energy conversion applications including water/air purification, solar fuel production, and low cost solar cells.

MS23 Huaizhe Xu “The microstructure and magnetic coupling mechanism in Mn-doped ZnO nanocrystals”

Zn₁₋ₓMnxO nanocrystals were synthesized by a wet chemical method and post processed with dodecanethiol, octylamine and H₂/Ar. The coordination environment and magnetic properties were characterized by XRD, XPS, Raman, PL, XAFS, and PPMS. It is found that the solubility of substitutional Mn in ZnO lattice is very low (<0.4%). When x ≤0.001, Mn ions are initially dissolved into the substituional sites in ZnO lattice forming Mn²⁺O₄ tetrahedral coordination, and it then enter into the interstitial sites, forming Mn³⁺O₆ octahedral coordination when x ≥ 0.005. After being processed with dodecanethiol, octylamine and H₂/Ar, the solubility of Mn increased due to the orbital hybridization between Mn and S (N or H), and some interstitial Mn ions would dissolve into the ZnO lattice and substitute for Zn. The samples exhibited both ferromagnetic and antiferromagnetic behaviour, the relationship between the magnetic coupling and Mn coordination environment are analyzed and discussed.

MS24 Jiatao Zhang “Hybrid metal/semiconductor nanostructures: controlled synthesis and their optoelectronic properties research”

Growth of single-crystal semiconductor based metal/semiconductor hybrid nanostructures with modulated composition, morphology and interface strain are the prerequisite for exploring their plasmon-exciton coupling, efficient electron/hole separation, and enhanced photocatalysis properties. By controlling soft acid-
base coordination reactions between molecular complexes and colloidal nanostructures, we showed that chemical thermodynamics could drive nanoscale monocrystalline growth of the semiconductor shell on metal nano-substrates. The compositions of semiconductor shell were also easily realized. We found resonantly enhanced light–matter-spin interactions in these judiciously engineered nanostructures. Existence of lattice strain between metal and semiconductor can be applied to control fine structural configuration in their hybrid colloidal nanostructures. We have demonstrated evolution of relative position of Au and CdX in Au-CdX from symmetric to asymmetric configuration, which can further lead to fine tuning of plasmon-exciton coupling and different hydrogen photocatalytic performance. Our results provide new insight on plasmon enhanced photocatalytic mechanism and can provide new potential catalysts of photo-reduction reactions.

**MS25 Wenlong Cheng “From soft meta-atoms to wearable electronic skin sensors”**

‘Hard’ microelectronics and “soft” biology play with different materials by different rules but they meet at the nanoscale. Interfacing of nanoscale ‘hard’ inorganic building blocks (such as metallic nanoparticles) with nanoscale ‘soft’ organic building blocks (DNA, RNA, polymer, etc), provides an ideal platform to develop powerful nanobionic materials that possess both ‘nano’ and ‘bio’ functions for novel applications in optoelectronics and biology. My research group is interested in interfacing hard metallic nanoparticles with soft ligands, particularly on organically-capped metal nanoparticles using DNA, polymer and alkyl molecules as capping ligands. We have successfully applied such soft ‘meta-atoms’ to three major directions: (1) assembling soft plasmonic nanoparticle superlattice sheets; (2) fabricating wearable electronic skin sensors; (2) DNA aptamer-targeted and light-controlled drug delivery. In this talk, I will firstly describe synthesis of soft ‘meta-atoms’ using nanospheres, nanorods, nanocages, nanocubes, and nanowires) and briefly discuss how we manipulate the notoriously-difficult-to-manipulate ‘meta-atoms’ to form free-standing thinnest possible superlattice nanosheets. Then I will focus on describing our recent success in fabricating wearable e-Skin sensors using ultrathin gold nanowires. Time permitting, I will briefly describe our newest development in DNA aptamer-functionalised gold nanorods and caged gold nanorods for targeted and light-controlled drug delivery.

**MS26 Ruoming Tian “Development of high-performance thermoelectric material calcium cobaltates via advanced neutron/synchrotron diffraction techniques”**

Oxide-based thermoelectric materials are being considered for applications in both solid-state refrigerators and power regeneration. Among them, calcium cobaltate has demonstrated to be one of the most promising high-temperature (above 700K) thermoelectric candidates, due to its exotic thermoelectric properties and excellent thermal stability. The crystal structure of this material consists of two subsystems: a distorted rock-salt-type [Ca2CoO3] layer sandwiched between two hexagonal CdI 2 type [CoO 2] layers stacked along the c-axis. Such layered structure permits high electrical resistivity to coexist with low thermal conductivity, as the electron and phonon can transport in separate pathways. In present work, the influence of cation doping on the thermoelectric properties was investigated by the evolution of crystal structure using synchrotron X-ray diffraction and X-ray absorption spectroscopy. In addition, the doping dependence of lattice dynamics was studied by means of inelastic neutron scattering, which unambiguously demonstrated an Einstein-like rattling mode at around 10 emV with Bi doping. This is the first time to show that the role of Bi that remarkably suppress the thermal conductivity of this compound is due to the fact that Bi acts as the rattler, leading to significant influence on the phonon vibration. These studies provide insights into the future development of high-performance calcium cobaltates-based thermoelectric materials.
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POSTER ABSTRACTS:

PSENG01 Xianjiu Guan “One-pot synthesis of graphene-modified Cr-SrTiO₃ with enhanced photocatalytic H₂ evolution under visible-light irradiation”

SrTiO₃ has been widely studied as a stable photocatalyst for water splitting. Nevertheless, application was restrained by its wide band gap and inefficient charge separation. Herein, we report on fabrication of graphene-modified Cr doped SrTiO₃ via a facile one-pot hydrothermal process, which enables both growth of Cr-SrTiO₃ and reduction of graphene oxide simultaneously. FESEM images showed that the as-synthesized Cr-SrTiO₃/Graphene composites were formed by assembled Cr-SrTiO₃ coated by flexible graphene sheets. UV-vis spectra indicated remarkable enhanced absorption throughout the visible light region. Furthermore, activities of visible-light-driven H₂ evolution demonstrated that the graphene-modefied Cr-SrTiO₃ exhibit significant enhancement of photocatalytic performance. 2.5-fold of H₂ production compared to bare Cr-SrTiO₃ was accomplished by introducing 2 wt% graphene, which serve as electron acceptor for efficiently separation of photo-generated charge carriers. Both inhibited charge carrier recombination and better visible-light utilization account for the improvement of H₂ production.

PSENG02 Chandrasekar Subramaniyam “High rate performing spinel-layered based Li-rich compounds as cathode materials for next generation lithium-ion batteries applications”

A quest to hunt for reliable, cost-effective and high rate performing materials constitute the hot topic in applications for lithium-ion batteries (LiBs) in hybrid/plug-in electric vehicles. In order to foresee these objectives, herein, we have attempted to synthesis spinel-layered Li-rich Li-Mn-M-O based compound as cathode material for lithium-ion batteries applications via simple, low temperature - solvothermal method. Both as-obtained and annealed samples were characterized for their phase, morphology using x-ray diffraction (XRD) and field emission scanning electron microscopy (FESEM), respectively. When electrochemically tested against Li⁺/Li⁰ between 2.0 – 4.6V, the annealed Li-rich spinel-layered exhibited excellent specific capacity and rate capability even at high current density, making it as a probable next generation cathode material for LiBs application.

PSENG03 Yankuan Wei “Shape driven charge carrier separation: a Co-Pi capped pyramidal BiVO₄ nanorod arrays with enhanced solar water oxidation”

Solar-driven electrochemical splitting of water to produce hydrogen and oxygen is a high energy density method for the storage of solar energy. This process comprises of the four electron, four proton oxidation of water to oxygen and the reduction of the produced protons to hydrogen. Of these two half-reactions, the oxygen evolution reaction (OER) is particularly demanding. The continued development of effective OER catalysts and elucidation of their mechanisms stand as central scientific and technological challenges in energy conversion. In our study, a cobalt-phosphate (Co-Pi) based oxygen evolution catalyst was photochemically deposited on the tip of the pyramidal-shaped BiVO₄ nanowire arrays. The comparison of the photocurrent-voltage characteristics of the BiVO₄ electrodes with and without the presence of Co-based catalyst demonstrated that the catalyst generally enhanced the anodic photocurrent of the BiVO₄ electrode. A stable photocurrent density of 1.5mA/cm² at 1.3V vs. Ag/AgCl was achieved under standard AM 1.5 back illumination using Na₂SO₄ aqueous solution. To the best of our knowledge, no Co-Pi capped nanowire structures have previously been reported. These results demonstrate that the cobalt-based catalyst can efficiently use the photogenerated holes in BiVO₄ and enhance solar O₂ evolution. This study provides important new understanding of the enhancement and limitations of the Co-Pi catalyst coupled with semiconductor electrodes for water-splitting applications.
PSENG04 Yuqing Liu “Highly flexible rGO-PEDOT/PSS films as electrode materials on rolling-up energy storage devices”

In recent years, portable electronic devices have become much more multifunctional, small, thin, lightweight and flexible. However, high-performance rolling-up batteries or supercapacitors, as an industry-standard to manufacture commercial ones on the macroscale, are still being restricted because of the limited types of highly flexible and self-wound electrode materials. In this work, we mainly focus on the fabrication of highly flexible and self-wound films based on Reduced Graphene Oxide (rGO) and a commercial conducting polymer, poly (3,4-ethylenedioxythiophene) poly(styrene sulfonate) (PEDOT/PSS), as electrode materials for rolling-up supercapacitor devices. The physical properties of these films can be characterized by Scanning electron microscopy, X-ray Diffraction, Raman spectroscopy and Fourier transform infrared spectroscopy. Cyclic voltammetry and Electrochemical impedance spectroscopy will be employed to compare the electrochemical properties of films with varying composition of rGO and PEDOT/PSS and the performance of the assembled devices will be tested by galvanostatic charge/discharge technique.

PSENG05 Shulei Chou “High-electrochemical performance LiNi0.5Mn1.5O4 cathode material controlled by solid state electrolyte - LiNbO3 bifunctional additive”

Spinel LiNi0.5Mn1.5O4(LNMO) has received particularly attention as a potential cathode material for large-scale energy storage and electric vehicles (EV), due to its high-voltage plateau (~ 4.7 V vs. Li/Li) offering high energy density. In addition, LNMO show several advantages, such as low cost, environmental friendly, good rate capability and cycling stability due to its fast Li+ diffusion within the three-dimensional spinel structure. The electrochemical performances of LNMO, however, are very sensitive to temperature and interrelated physicochemical parameters, including Mn3+ ions, doping/substitution, degree of disorder, impurities. Herein, we mix solid state electrolyte-LiNbO3 and LiNi0.5Mn1.5O4 hollow structures cathode material using a simple solid-state reaction method. Solid state electrolyte-LiNbO3 decreases the internal charge transfer resistance and localizes the the disproportionation reaction (2Mn3+(solid) →Mn4+(solid)+ Mn2+(solution)). The electrode of LiNi0.5Mn1.5O4-LiNbO3 show higher rate capability and better high-temperature cycling performance.

PSENG06 Min Ling “Functionalization of natural polymer as conductive polymer binder for lithium ion batteries”

Conductive binders can improve the specific rate capacity of the LIBs by eliminating the need of electric conductive additives. Water soluble and low cost sodium alginate can be an effective alternative to conventional synthetic binders, however, it lacks required conductivity. It is well-established that the conductivity of polymer can be improved by grafting conductive functional groups onto the polymer framework. In this work, we successfully graft conjugated functional groups (hydroxylated ProDOT) onto the alginate framework using esterification in microemulsion, which can be governed in neutral pH environment at room temperature. It is a green synthesis process and most importantly its production yield can reach 100%. Microemulsion can commonly be achieved by addition of desired concentration of dodecylbenzenesulfonic acid (DBSA) in cyclohexane. In the DBSA microemulsion systems, esterification takes place at interface area and water produced by esterification enters the water micro-domain, which shifts esterification equilibrium towards the product. The polar heads of DBSA surfactant that has certain acidity will congregate because of the formation of microemulsion thus leading to relatively high acidity in the interfacial area. The resultant polymer was used to fabricate lithium ion battery with typical cathode material LiFePO4. The electrochemical performance of the functionalized alginate based LiFePO4 cathode was tested in terms of galvanostatic discharge-charge cycling, which suggests that the resultant conducting functionalized alginate can act as a conducting binder for LIBs.
PSENG07 Shaohua Shen “Engineered doping to metal oxide nanorod arrays for improved photoelectrochemical water splitting”
In the past decades, numerous semiconducting materials, especially oxide semiconductors, have been investigated as potential photoelectrodes in photoelectrochemical (PEC) system with a view to efficient light-induced water splitting for solar-hydrogen conversion. Compared to other metal oxide semiconductors, a-Fe$_2$O$_3$ (hematite) has the advantage such as the small band gap energy of ~2.0 eV, which enables it to absorb most of the photons of solar spectrum. Unfortunately, the ultrafast recombination of the photogenerated carriers and the poor minority charge carrier mobility lead to a short hole diffusion length in a-Fe$_2$O$_3$, severely limiting the overall photocurrents produced by solar light. ZnO has many attractive material properties, including non-toxicity, low cost, large excitation binding energy, and high electronic conductivity. However, either ZnO particles or nanostructured ZnO films have a wide band gap of ~3.2 eV, suggesting that only ultraviolet (UV) light could be utilized. Effective and controlled doping with metal or non-metal ions is a very common method to modify the electronic and optical properties for metal oxides semiconductors. It was demonstrated that engineered doping with metal or nonmetal ions displayed positive effects on the efficiency of a-Fe$_2$O$_3$ and ZnO nanorod photoanodes. In this presentation, some successful examples of engineered doping will be introduced, and related mechanisms for enhanced PEC water splitting will be discussed in detail.

PSENG08 Yunxiao Wang “High-performance sodium-ion batteries and sodium-ion pseudocapacitors based on MoS$_2$/graphene composites”
Sodium-ion energy storage, including sodium-ion batteries (NIBs) and electrochemical capacitive storage (NICs), is considered as a promising alternative of lithium-ion energy storage. It is an intriguing prospect, especially for large-scale applications, due to its low cost and abundance. Molybdenum disulfide (MoS$_2$) sodiation/ desodiation with Na ions is based on the conversion reaction, which is not only able to deliver higher capacity than intercalation reaction, but is also supposed to be applied in capacitive storage due to its typically sloping charge/discharge curves. Here, we construct NIBs and NICs based on expanded MoS$_2$/graphene composite (MoS$_2$/G). The enlarged d-spacing, participant of graphene matrix, and the unique properties of the MoS$_2$/G substantially optimize Na storage behaviours, accommodating large volume changes and facilitating fast ion diffusion as well. MoS$_2$/G can exhibit a stable capacity of ~350 mAh g$^{-1}$ over 200 cycles at 0.25 C in half cells, and Na-doped MoS$_2$/G (Na$_x$MoS$_2$) is capable of delivering a capacitance of 50 F g$^{-1}$ over 2000 cycles at 1.5 C in pseudocapacitors with a wide voltage window of 0.1-2.5 V.

PSENG09 Dawei Su “Mesoporous Co$_3$O$_4$ nanoplates for high performance Li-ion batteries”
Mesoporous Co$_3$O$_4$ nanoplates were successfully prepared by the conversion of hexagonal β-Co(OH)$_2$ nanoplates. TEM, HRTEM and N$_2$ sorption analysis confirmed the facet crystal structure and inner mesoporous architecture. When applied as anode materials for lithium storage in lithium ion batteries, mesoporous facet Co$_3$O$_4$ nanocrystals delivered a high specific capacity and an outstanding high rate performance. At 10 C current rate, as-prepared mesoporous Co$_3$O$_4$ nanoplates delivered a specific capacity of 1203 mAh/g. From ex-situ TEM, SAED and FESEM observation, it was found that mesoporous Co$_3$O$_4$ nanocrystals were reduced to Li$_2$O and Co during the discharge process and re-oxidised to Co$_3$O$_4$ crystals without losing the crystallity and mesoporous structure. Even after 100 cycles, mesoporous Co$_3$O$_4$ crystals still preserved their pristine hexagonal shape and mesoporous nanostructure.
PSEN10 Emily Wang “Fabrication of visible light induced Ag-TiO$_2$@rGO nanospherical composite photocatalyst and application for environmental purification”

A new Ag-TiO$_2$@rGO composite nanomaterial with superior photocatalytic activity under visible light irradiation has been tailored stepwise by wrapping a thin layer of rGO on silver-deposited TiO$_2$ particles. The material and its performance were studied using a series of characterization methods including field-emission scanning electron microscopy (FESEM), high resolution transmission electron microscopy (HRTEM), selected area electron diffraction (SAED), diffuse reflectance spectroscopy (DRS), X-ray photoelectron spectroscopy (XPS) and UV-vis spectroscopy. The light absorption range of the new material was red-shifted via the decoration of silver nanoparticles, which was further reinforced by rGO sheet due to its excellent electron conductivity. The photocatalyst showed good performance in photodegradation of Orange II. The results may offer new insights to the development of high performance visible light induced photocatalysts.

PSEN11 Jie Chen “Facile one-pot synthesized metal oxide modified g-C$_3$N$_4$ for efficient photocatalytic hydrogen production”

The novel metal-free polymer semiconductor, graphitic carbon nitride (g-C$_3$N$_4$) with band gap of about 2.7 eV has showed promising performance for hydrogen production under visible light irradiation. However, the photocatalytic efficiency of pure g-C$_3$N$_4$ was relatively low mainly due to the fast recombination of photogenerated electron-hole pairs. The constructing of Type II band alignment heterojunction was a widely recognized approach to improve the charge carriers separation efficiency in semiconductors and thus inhibit the recombination of electron-hole pairs. In this contribution, metal oxide, namely, nitrogen doped CeO$_x$ (N-CeO$_x$) and Cu$_2$O nanoparticles (NPs) were successfully decorated on g-C$_3$N$_4$ via a facile one-pot method using abundant Ce(NO$_3$)$_3$, Cu(NO$_3$)$_2$ and melamine as precursors. The physical and photophysical properties of Cu$_2$O, N-CeO$_x$ NPs modified g-C$_3$N$_4$ photocatalysts were characterized to investigate the effects of these NPs on the photocatalytic activities of g-C$_3$N$_4$. Close contact was formed between the metal oxide NPs and g-C$_3$N$_4$ and the NPs were well dispersed on g-C$_3$N$_4$. The visible light photocatalytic hydrogen production activity over g-C$_3$N$_4$ was enhanced by more than 70% and 220% with Cu$_2$O and N-CeO$_x$ NPs modification, respectively. It is revealed that the efficient visible light absorption and Type II band alignment induced charge separation by the metal oxide NPs modification should be the key factors for the improved photocatalytic performance.

PSEN12 “Katja Kertschmer “Simple and environmental friendly preparation of LiFePO$_4$/C for lithium ion batteries with effective industrial scale-up potential”

Carbon-coated LiFePO$_4$ cathode material is prepared in a sequence of simple and easily up scalable steps via ball milling and solid-state reaction using Starch as carbon source. The generated morphology appears to be very uniform and the particles are well dispersed. This uniformity can be attributed to the initiated particle growth during decomposition and subsequently growth restriction achieved by effective carbon wrapping (see top SEM images). The secondary particle size is located between 50-200nm, which is very favourable for Li$^+$ transport as well as for tap density of the obtained LiFePO$_4$/C composite. XRD analysis and electrochemical testing indicate the significant impact of the applied amount of Starch for the final product, which so far implies that 10wt% Starch added to the Li/FePO$_4$ precursor is the maximum content to avoid impurities, such as Fe$_2$P and realise competitive reversible capacity (see bottom galvanostatic charge/discharge curve and XRD patterns). The initial capacity can be increased by ~13% achieving a low final carbon content of 4.43%.
PSENG13 Shuangqiang Chen “Mesoporous hollow carbon nanocubes encapsulated Sn nanoparticles for sodium ion batteries”

LIBs have demonstrated indisputable commercial success in the last two decades. However, the increasing cost of raw material has sparked the shift of commercial interests to sodium ion batteries representing lower cost but similar electrochemical behaviour. Herein, we synthesized mesoporous hollow carbon nanocubes with a high surface area of 599 m²/g encapsulated Sn nanoparticles via template-assisted chemical vapour deposition and accurate controlled hydrolysis method. The scanning electron microscopy illustrates that Sn nanoparticles are homogenously encapsulated into individual and interconnected hollow carbon nanocubes. The transmission electron microscopy exactly reflects that separated Sn nanoparticles, approximate 40 nm in diameter, are locked into individual hollow carbon nanocubes. That is further demonstrated by its corresponding elemental mapping. The crystalline feature of Sn nanoparticles is revealed by high resolution TEM image. When the mesoporous hollow carbon nanocube-Sn (MHCC-Sn) composite is employed as anode electrode for Na-ion batteries, it delivered a high reversible specific capacity of 638 mAh/g at a current density of 50 mA/g. After cycling for 100 cycles, the as-prepared material still maintained 392 mAh/g showing high capacity retention of 61.4%. Moreover, the MHCC-Sn electrode also showed superior rate capabilities and excellent cyclability, which is ascribed to the unique architectures of mesoporous hollow carbon nanocubes and effective synergistic effect between MHCC and Sn nanoparticles.

PSENG14 Tengfei Zhou “Enhanced sodium ion battery performance by structural phase transition from two-dimensional hexagonal SnS₂ to orthorhombic SnS”

Structural phase transitions can be used to alter the properties of a material without adding any additional atoms and are therefore of significant technological value. It was found that the hexagonal-SnS₂ phase can be transformed into orthorhombic-SnS phase after an annealing step in an argon atmosphere, and the transited SnS shows enhanced sodium ion storage performance than the SnS₂. Here, we provide the first report on SnS@graphene architecture for application as sodium ion battery anodes, built from two-dimensional (2D) SnS and graphene nanosheets as complementary building blocks. The as-prepared SnS@graphene hybrid nanostructured composite delivers excellent specific capacities of 940 mAh g⁻¹ and impressive rate capability of 492 and 308 mAh g⁻¹ after 250 cycles at the current densities of 810 and 7290 mA g⁻¹, respectively. The performance was found to be much better than those of most reported anode materials for Na ion batteries. Comprehensive investigations showed that SnS experienced a two structural phase transformation mechanism (orthorhombic-SnS to cubic-Sn to orthorhombic-Na₃Sn) while the SnS₂ experienced a three structural phase transformation mechanism (hexagonal-SnS₂ to tetragonal-Sn to orthorhombic-Na₃Sn) during the sodiation process. The less structural changes of SnS during the conversion, expected a good structural stability and excellent cycling stability for the performance on the sodium ion battery.

PSENG15 Sujith Kalluri “Nanostructured design of Li₁⁺ₓ(Ni₁/₃Mn₁/₃Fe₁/₃)O₂ as a dual cathode material for lithium-ion and sodium-ion batteries”

Efficacy of the cathode material is a key aspect for upgrading lithium-ion battery technology for next generation applications such as advanced electric vehicles (EV/HEV). However, the present technology has limitations in electrochemical performance, storage efficiency, safety and cost; which are current global research challenges. One of the potential ways to address such issues is by developing nanostructured design of cathodes such as one-dimensional (1D) nanostructures by simple and advanced process. Consequently in the present study, Li₁⁺ₓ(Ni₁/₃Mn₁/₃Fe₁/₃)O₂ electrospun nanofibers are fabricated with superior electrochemical performance when compared to nanoparticles. On the other hand, feasibility of this low-cost and eco-friendly material in sodium-ion batteries is also tested.
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Sujith Kalluri “Influence of hierarchical one-dimensional nanostructure on the electrochemistry of ‘Mn’ doped P2-type Na$_x$FeO$_2$ in sodium-ion batteries”

Sodium-ion batteries are one of the best alternatives to lithium-ion batteries, owing to similar electrochemistry, elemental abundance, non-toxicity, and the low-cost of sodium. However, structurally and electrochemically stabilised cathode materials are still in need for commercial hit of sodium-ion batteries. Global research focussed on various materials from polyanions to layered metal oxides. Layered metal oxides are prominent for their feasibility and high capacity values. Likely, P2-type Na$_x$FeO$_2$ is considered to be better option in terms of low-cost and eco-friendliness. Due to the stabilization issues of Fe$^{4+}$ in the oxide-ion frameworks, ‘Mn’ was partially doped for Fe to give P2-type Na$_{2/3}$(Fe$_{1/2}$Mn$_{1/2}$)O$_2$. Not only the doping aspects but also nanostructured design of the cathode materials plays a key role in enhanced electrochemical properties. One-dimensional nanostructures could have better effective contact areas with the electrolyte and offer improved electrochemistry and cycle life. Accordingly, the present study reports the first example of the preparation of Na$_{2/3}$(Fe$_{1/2}$Mn$_{1/2}$)O$_2$ hierarchical nanofibers by feasible and low-cost electrospinning technique. The nanofibers with aggregated nanocrystallites along the fiber direction have been characterized structurally and electrochemically; resulted in enhanced cyclability with initial discharge capacity of ~195 mAh g$^{-1}$, when compared to nanoparticles. This is attributed to the well-interconnections among the fibers with well-guided charge transfers and better electrolyte contacts.

Yufei Zhao “Conducting porous Mo$_2$C as catalyst with superior performance for hydrogen evolution”

The molybdenum carbide (Mo$_2$C) preparation is carried out via facial chemical vapor deposition (CVD) method and it shows superior active and stable behavior as hydrogen evolution reaction (HER) catalyst in alkaline solution. Electrochemical experiments demonstrate that Mo$_2$C presents low onset potential of 94 mV and a Tafel slope of 58 mV/dec under pH 14 KOH condition. The enhanced catalytic activity is attributed to its high porosity and large surface area. The Mo$_2$C material also shows excellent stability in alkaline solution after cyclic testing. The high activity and the good stability suggest that Mo$_2$C is favorable for hydrogen evolution under alkaline conditions.

Anjon Kumar Mondal “A facile microwave synthesis of NiCo$_2$O$_4$ nanosheets and its enhanced electrochemical properties for lithium ion batteries”

In this work, we report a facile microwave method to synthesize NiCo$_2$O$_4$ nanosheets and the investigation as an anode material for lithium ion batteries. The structural and morphological characterizations are carried out by X-ray diffraction, field emission scanning electron microscopy and transmission electron microscopy, respectively. At the current density of 500 mA g$^{-1}$, the as-prepared NiCo$_2$O$_4$ nanosheets show a high reversible capacity of 1087 mA h g$^{-1}$, good rate capability and reasonable cycling stability. The excellent electrochemical performance can be ascribed to the thin nanosheet structure, which may provide high specific surface area to increase electrode-electrolyte contact area and facilitate rapid lithium ion and electron transportation.

Da Wei Wang “A new catholyte for Li-S batteries”

In this work, we report a facile approach to modify the catholyte used in Li-S batteries. Li-S batteries suffer from the polysulfide shuttle which causes the continuous capacity decay. To circumvent this issue, a broad range of approaches have been devised, including novel carbon-sulfur nanocomposites, solid state electrolyte, carbon-based separator and compatible solvents. Many of the approaches aim at preventing/reducing polysulfide dissolution or adsorbing dissolved polysulfides. From the operation mechanism, it is understood the charge and discharge of Li-S batteries rely on the dissolution of polysulfides. In other words, the battery
tends to achieve a better performance in a liquid state. We designed a catholyte that allows the polysulfides to be charged and discharged in a liquid phase. The results show that with this new catholyte, the performance of battery is clearly improved and the shuttle of polysulfides is also partially inhibited.

PSENG20 Dean Cardillo “Self-assembled 3D architecture of polymer coated graphene-hematite nanorods: a facile route to free standing electrodes for energy storage material”

A novel free standing composite electrode of hematite nanorods (α-Fe₂O₃) combined with poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS) coated graphene oxide has been prepared by a simple mixing, solution casting and convenient chemical reduction method. Highly porous hematite nanorods are able to be distributed between polymer coated liquid crystalline graphene oxide (LC GO) sheets through chemical interaction and form layer-by-layer self-assembled 3D architecture. This ternary composite with an advanced interconnective network will be investigated as a flexible electrode material for high performance energy storage devices. PEDOT:PSS layer on graphene sheets enhance the conductivity and make a suitable platform for further chemical interaction with highly porous nanorods forming an appropriate ion channel between these layers. It is strongly believed that the synergistic electrochemical effect of pseudocapacitive porous hematite nanorods and conductive polymer wrapped graphene sheets are subsequently capable of providing promising electrochemical performance in a real supercapacitor devices including for better capacity retention.

PSENG21 Jianjian Lin “Mesoporous titania single nanocrystals for efficient dye-sensitized solar cells”

Metal oxides with concurrent well-defined mesoporous structures, a long-range crystalline-ordered framework and controllable nanoparticle sizes are of great significance for diverse practical applications due to their excellent electronic connectivity, structural coherence, diffusion-free channels, and large surface area/pore volume. Herein, we report for the first time on the fabrication by a facile and efficient hydrothermal synthesis of nanosized and uniform, mesoporous anatase titania single nanocrystals (MTSNs) with a special ellipsoidal morphology. The key structural parameters, such as morphology, nanostructure, pore size and particle size can be easily controlled by changing the concentrations of reaction precursors and the duration of hydrothermal synthesis. When the nanosized MTSNs were applied as photoanode in N719-sensitized solar cells, the overall device performance reached an efficiency of 9.5 % power conversion. This can be attributed to the unique nanostructures of the MTSNs, such as well-defined mesopores for efficient dye adsorption and electrolyte diffusion, and single-crystal structure for long-range electronic connectivity and faster electron transport, as well as slower recombination and enhanced light-scattering capability. Therefore, the generation of nanosized MTSNs can efficiently increase their performance and extend the applications of well-known TiO₂-based nanomaterials, especially in relation to clean energy and other environmental issues.

PSENG22 Md Monirul Islam “PEDOT:PSS coated liquid crystalline graphene oxide-MWCNTs composite: advanced 3D architecture for high performance flexible supercapacitor”

The engineering of hierarchical architectures for composite electrodes is the key point which significantly impacts the performance of energy storage devices. Here we describe large scale adaptable fabrication of poly(3,4-ethylene-dioxythiophene):poly(styrenesulfonate) (PEDOT:PSS) coated liquid crystalline graphene oxide-multiwalled carbon nanotube (MWCNT) composite. The intrinsic soft self-assembly properties of ultra large graphene oxide liquid crystalline dispersions facilitates the formation of a self-assembled layer-by-layer 3D architecture flexible composite. Content of p-p interacted conductive polymer and MWCNTs result in an
electroactive network on the graphene oxide sheets, which ultimately contributes to superior electrochemical properties of particular graphene sheets. The advanced ion transport networks of such composite materials are promising for energy storage applications. Furthermore, the flexible self-assembled 3D architecture should result in superior charge storage capacity and cycling stability in a supercapacitor device, as well as high energy and power density. This study provides a new route to prepare novel flexible electrode for high performance energy storage devices.

PSENG23 Meng Wang “Co/CoO Anchored on nitrogen doped graphene aerogel as a bifunctional electrocatalysts for oxygen reduction and evolution reactions”
The oxygen reduction reaction (ORR) is a kinetically limited step of the fuel cell or metal-air batteries because of its sluggish reaction mechanism, while the oxygen evolution reaction (OER) is a challenging energy conversion reaction of water splitting and solar fuel cells. Both reactions require efficient catalysts. For ORR, commonly used Pt are inhibiting from large commercialization because of the high cost, low methanol tolerance and poor stability; while for the OER, ruthenium- and iridium based compounds and oxides are known best catalysts, however these catalysts are among rare element on earth and hence not suitable for large scale production. In light of this, there is a desirable trend to develop low-cost efficient catalysts which could be used for both OER and ORR. Herein, we demonstrate the facial synthesis of cobalt/cobalt oxide anchored on a nitrogen doped 3D structure porous graphene aerogel using one-pot hydrothermal method and the application of this catalysts as efficient catalysts to catalyze both the OER and ORR. The catalysts showed efficient catalytic activities towards ORR with full methanol tolerance and longer durability and much more efficient catalysts towards the OER compared with the commercial available Pt/C.

PSENG24 Sha Li “One-step synthesis of graphene/polypyrrole nano fiber composites as cathode material for bio compatible zinc/polymer battery”
In this work, we choose polypyrrole as the base material in terms of its predominant properties including environmental stability, ease of synthesis and processing. Fibre like polypyrrole is synthesized using micro-micelles templates and incorporated with graphene nano sheets (GNs) to enhance its catalytic activity and thus optimize its function as the cathode material. The battery is designed for dry implantation and thus simulated body fluid is utilized as electrolyte for battery testing. The discharge performance of such battery suggests its feasibility as a promising power source for micro implantable medical devices (MIMDs).

PSENG25 Wenbin Luo “A facile approach to synthesize stable CNTs@MnO electrocatalyst for high energy lithium oxygen batteries”
A composite of manganese monoxide loaded onto carbon nanotubes (CNTs@MnO) has been synthesized by a facile approach, in which the CNTs form a continuous conductive network connecting the electrocatalyst MnO nanoparticles together to facilitate good electrochemical performance. The electrocatalyst MnO show favourable rechargeability, and good phase and morphology stability in lithium oxygen batteries. Excellent cycling performance is also demonstrated, in which the terminal voltage is higher than 2.4 V after 100 cycles at 0.4 mA cm⁻², with 1000 mAh g⁻¹ (composite) capacity. Therefore, this hybrid material is promising for use as a cathode material for lithium oxygen batteries.

PSENG26 Yuede Pan “Improved Li-S battery performance with a hydrothermal treated graphite paper for double-layered cathode”
Li-S batteries are the next generation batteries for their theoretical specific capacity of 1675 mA h/g, as well as the abundance and low price of sulfur. The capacity of Li-S batteries has been affected by the inherently
electronic resistance of sulfur and the polysulfide shuttling problem, both of which reduce the utilization of active material. To overcome these issues, there have been applications of new carbon materials to confine the sulfur, ultrafine nanosized sulfur, novel electrolytes. Recently, modification of the Li-S battery configuration has been proved to be an effective route to higher capacity and better cycling performance. Herein, we present a hydrothermal treated graphite paper to construct a double-layered sulfur cathode. After the cell configuration modification, the capacity almost doubles the original one, and the capacity retention increases significantly. This improved electrochemical performance could be ascribed to the new reaction sites provided by the graphite paper, which facilities the utilization of active material.

**PSENG27 Zhian Zhang “Enhanced electrochemical performance of lithium-sulfur batteries using polydopamine-coated separator”**

Lithium sulfur batteries have attract great attention as one of the most promising systems for the next generation high energy density rechargeable lithium batteries because of their high theoretical specific capacity (1675 mAh g⁻¹) and energy density (2600 Wh kg⁻¹). However, the practical applications of lithium sulfur batteries are still hindered by some major basic obstacles. One of the major challenges is the shuttle effect. Polysulfides (Li₂Sₓ, 4 ≤ x ≤ 8) produced in discharge/charge processes can dissolve into organic electrolyte, and then diffuse to the anode and be reduced to lower-order polysulfides at the interface of the lithium anode. These reduced products will migrate back to the cathode where they may be reoxidized. In this work, in order to prevent polysulfides shuttling in organic electrolyte, polymer coating layer on routine separator was proposed to suppress the polysulfide diffusion and to improve cycling stability, as well as increase the discharging capacities. The lithium sulfur batteries with polydopamine-coated separator show a higher Coulombic efficiency and an improved electrochemical performance, with a specific capacity of 670 mAh g⁻¹ after 200 cycles at 0.5 C. These results indicate that the polydopamine-coated separator is more suitable in lithium sulfur battery applications.

**PSENG28 Jinqiang Zhang “Honeycomb-like porous gel polymer electrolyte membrane for lithium ion batteries with enhanced safety”**

Gel polymer electrolyte membranes based on poly(vinylidene difluoride -cohexafluoropropylene) (PVDF-HFP) were prepared by a breath-figure method. Field emission scanning electron microscopy analysis identified that gel -polymer membranes have a honeycomb-like multi-sized porous architecture. The as -prepared polymer electrolyte membranes contain porosity as high as 78%, which leads to the high electrolyte uptake of 86.2 wt%. The PVDF-HFP gel polymer electrolyte membranes exhibited a high ionic conductivity of 1.03 mS cm⁻¹ at room temperature, which is much higher than that of commercial polymer membranes. Moreover, the as obtained gel polymer membranes are also thermally stable up to 350 °C and non combustible in fire (fire -proof). When applied in lithium ion batteries with LiFePO₄ as cathode materials, the gel polymer electrolyte demonstrated excellent electrochemical performances. This investigation indicates that PVDF-HFP gel polymer membranes could be potentially applicable for high power lithium ion batteries with the features of high safety, low cost and good performance.

**PSENG29 Xiuqiang Xie “SnS₂ nanoplatelet@graphene nanocomposites as high capacity anode materials for sodium ion batteries”**

Rechargeable Na-ion batteries as alternatives to Li-ion batteries have been attracting extensively interest. Among all the potential anode materials for Na-ion batteries, Sn-based nanoarchitectures receive extra attention because it delivers a high specific capacity of 847 mAh g⁻¹ when it alloys with Na to form Na₁₅Sn₄. However, it falls short of satisfying cycle life due to pulverization resulting from volumetric change upon repeated charge-discharge processes. Herein, we report the synthesis of SnS₂ nanoplatelet@graphene nanocomposites
by a morphology-controlled hydrothermal method. The as-prepared SnS$_2$/graphene nanocomposites present a unique two-dimensional platelet-on-sheet nanoarchitecture. When applied as the anode material for Na-ion batteries, the as-synthesized SnS$_2$/graphene nanosheets exhibited decent electrochemical performance, including a high reversible specific sodium ion storage capacity of 725 mAh g$^{-1}$, stable cyclability, and an enhanced high-rate capability. The improved electrochemical performance for reversible sodium ion storage could be ascribed to the synergistic effects of the SnS$_2$ nanoplatelets/graphene nanosheets as an integrated hybrid nanoarchitecture, in which the graphene nanosheets provide electronic conductivity and cushion for the active SnS$_2$ nanoplatelets during Na-ion insertion and extraction processes.

**PSENG30 Jun Wang “PbGeO$_3$ nanowires as a novel anode material for lithium-ion batteries”**

Lead germanate (PbGeO$_3$) nanowires with diameters of 100 to 200 nm have been prepared by a hydrothermal method. The lithiation and delithiation reaction mechanism of PbGeO$_3$ electrode during the charge-discharge process have been investigated by X-ray diffraction and electrochemical characterizations. The PbGeO$_3$ electrode exhibits high reversible capacity of 574 mAh g$^{-1}$ after 40 cycles at 100 mA g$^{-1}$, with a stable coulombic efficiency of > 95 % after the 2$^{nd}$ cycle, and a capacity of 523 mAh g$^{-1}$ at 800 mA g$^{-1}$, indicating that it could be used as a candidate anode material for lithium-ion batteries.

**PSENG31 Zhixin Tai “Porous carbon foam from dandelion seeds via carbonization for liquid adsorption and high performance supercapacitor electrodes”**

Production of activated carbon (AC) from nature product is a research field that has gained increased interest in recent years. In this study, a 3D microporous carbon foam with a high surface area of about 1153 m$^2$g$^{-1}$ is synthesized by pyrolysis and activation of dandelion seeds and studied for supercapacitor application. The as-prepared carbon foam shows a 3D graphene-like structure with the excellent electrochemistry and the adsorption performance. Its high surface area and intersection networks realized in our carbonaceous materials are key to the high energy supercapacitor application. Our synthesized carbon foam exhibits a very high specific capacitance of 260 F/g at a current density of 1 A/g in aqueous 2M KOH. In organic electrolyte, the carbon foam shows a specific capacitance of 150 F/g and the energy density of 75 W/kg at a current density of 1 A/g. Carbon foam and its composite would be innovative candidates as electrode materials for high-performance supercapacitors and low-cost energy devices.

**PSMS01 Zhimin Ao “Tuning the wettability of graphene under external electric field and UV irradiation”**

It is known that graphene is a highly hydrophilic material. However, in same applications, such as in biomaterials, medical instruments, and micro fluid devices, it is required graphene is hydrophobic. In this talk, I will show our recent results on reversibly tuning the wettability of graphene between hydrophilic and hydrophobic through combing experiments and first-principle calculations. We found that a perpendicular electric field or UV irradiation can act a catalyst to facilitate the water dissociative adsorption on graphene, thus changing graphene from hydrophilic to hydrophobic, while the wettability of graphene can reverse back to be hydrophilic again if removing the electric field or dark storage for a few days after irradiation. The transition mechanism is understood through discussing the water dissociative adsorption reaction pathway and comparing the Raman spectra from both experiments and calculations.

**PSMS02 Yuhai Dou “A novel device for oil collection and separation from water surface”**

Oil spills, which cause serious environmental destruction, are worldwide issues nowadays. Even though great
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Scientific Reports will publish Conference Proceedings papers from the 5th Australia-China Symposium for Materials Science. Submissions open June 18th and close August 20th.
Efforts have been put into oil-water separation materials, no effective devices have been fabricated to date, mainly because the materials are easily blocked and then cease to work. Herein, a novel device has been designed, based on the use of a special mesh that can properly deal with the spilled oils. In detail, ultrathin Co$_3$O$_4$ nanosheets are grown onto the stainless steel mesh by a hydrothermal method. The obtained Co$_3$O$_4$-coated mesh shows superhydrophilic and underwater superoleophobic properties. When wetted by water, the mesh also exhibits high water permeability and oil impermeability. By installing the wet mesh on a ship model with a certain inclination angle and moving it along the oil-water interface, the water flow can easily pass through the bottom of the mesh, while the oil flow can be blocked and driven upward along the mesh to a rotating temporary storage facility with another separation mesh fixed at the bottom by which can realize rapid purification. Such a novel device can effectively “shovel” the oil layer off the water surface and efficiently purify the oil. It may find wide application in the near future to deal with various oil spills happened in the sea environment.

PSMS03 Wei Kong Pang “Operando neutron powder diffraction studies of batteries on WOMBAT”

Neutron powder diffraction (NPD) is a non-destructive method increasingly being used in the studies of the structural and phase evolution of electrode materials within batteries during electrochemical cycling. In particular, the sensitivity of NPD to lighter elements Li, O, and Na, in the presence of other heavier atoms, enables the direct measurement of the charge-carrier location and content within electrodes at the same time as redox-active couples are determined by tracking the transition-metal valence via the oxygen to transition-metal distance in the oxide electrodes, i.e. commercial Li(Ni$_{1/3}$Mn$_{1/3}$Co$_{1/3}$)O$_2$, high-voltage LiNi$_{0.5}$Mn$_{1.5}$O$_4$ cathode, and zero-strain Li$_4$Ti$_5$O$_12$ anode. NPD allows to probe in real-time the bulk crystallographic changes of electrodes in functioning batteries, opening the way for exciting in-operando studies. Ultimately, operando NPD can be used to “track” not only the reaction mechanism and lattice parameter evolution, but also the details of the charge-carrier insertion/extraction process in electrode materials. WOMBAT, a high-intensity neutron powder diffractometer at the OPAL research reactor at ANSTO allows rapid collection of data and is used widely for operando studies of Li-ion batteries. We report an overview of the approach and technique taken on WOMBAT to obtain operando NPD data of Li-ion batteries with sufficient information to extract details of the Li-ion insertion/extraction mechanism.

PSMS04 Wei Kong Pang “In-situ synchrotron diffraction study of the phase evolution of the novel Na$_{x}$ (Fe$_{1/2}$Mn$_{1/2}$)$_2$O$_2$ cathode for use in sodium-ion batteries”

Sodium-ion batteries are considered one of the best alternatives to lithium-ion battery technology, due to their similar electrochemistry, potentially non-toxicity, and the greater elemental abundance of sodium leading to low-cost. However, there remains concern regarding the optimization of sodium-based electrode materials for capacity and energy performance, as well as structural and electrochemical stability. This work presents the promising P2-type Na$_{2/3}$ (Fe$_{1/2}$Mn$_{1/2}$)$_2$O$_2$ cathode material for use as a cathode in sodium-ion batteries. We prepare Na$_{2/3}$ (Fe$_{1/2}$Mn$_{1/2}$)$_2$O$_2$ via a facile single-step sol-gel method, with the nano-sized powders obtained delivering an initial discharge capacity of ~ 175 mAh.g$^{-1}$ with an average working potential of 3 V and a moderate capacity retention of 64.0% over 80 cycles at 0.1 C. We use in-situ synchrotron X-ray diffraction to explore the sodiation/desodiation mechanism and establish the structure-function relation of the Na$_{2/3}$ (Fe$_{1/2}$Mn$_{1/2}$)$_2$O$_2$ cathode in a functioning cell. This work reveals that Na$_{2/3}$ (Fe$_{1/2}$Mn$_{1/2}$)$_2$O$_2$ sodiation/desodiation proceeds through a solid-solution reaction involving a relatively minor (0.27%) volume change where the c lattice parameter increases during charging and decreases during discharging, with the opposite behavior found for the a lattice parameter. Overall, this mechanistic understanding will be useful to rationally improve the related family of sodium-based cathode materials.
PSMS05 Dongliang Tian “Photoelectric cooperative patterning of liquid permeation on the micro/nano hierarchical structured mesh with low adhesion”
Stimuli-responsive surface wettability has been intensively studied, especially wettability controlled by photoelectric cooperation seems a trend for more effective surface wetting. In this field, patterning of controllable surface wettability is still a challenge in the application of liquid printing techniques because of the high adhesion and high responsive voltage as well as low mechanical strength of the substrate. Here we have demonstrated the patterning of liquid permeation controlled by photoelectric cooperative wetting on the micro/nano hierarchical structured ZnO mesh film. The permeation process and mechanism have been detailedly discussed. The results indicate that the micro/nano hierarchical structured ZnO mesh is beneficial to precisely control microscale liquid movement with much lower threshold voltage and lower adhesion force on the mesh surface than those of the TiO$_2$/AAO nanopore array films reported before. Moreover, the stainless steel mesh with different pore size as a substrate behaves higher mechanical strength and lower cost compared with the anodized Ti mesh. Thus this work is promising to accelerate the development of patterned water permeation for liquid reprography, and this work would also extend the application in the field of micro/nano-fluidic system, microreactors and micro/nano-electronic technology.

PSMS06 Linqing Pei “Brittle-to-ductile fracture transition in nanotwinned nickel”
Here, we investigate the brittle-to-ductile fracture transition in twinning nickel using molecular dynamics simulation. It was observed that the fracture transition occurs with the increasing temperature and decreasing twin spacing distance. At extremely low temperature, the crack shows a complete atomic cleavage on {111} and {100} plane, where this process is accompanying the appreciable elastic wave dispersion along {111} cleavage plane from the crack tip. For intermediate temperature, the crack propagation does not synchronize along the crack front direction at later stage, leading to a series of steps formation at the crack tip. This formed of atomic steps contribute to the stress concentration on them, which triggers the nucleation and emission of dislocation movement. At higher temperature, the fracture shows complete ductile manner by dislocation nucleation and emission with aid of the increase thermal perturbation effect. The twining boundary is regarded as a barrier in blocking the elastic wave release, resulting in a larger elastic energy accumulation at the twin boundaries in vicinity of crack tip. When the twinning spacing distance reduces sufficient small, larger stress distribution concentrating on the twinning boundary induces the homogeneous dislocation nucleation and emission. Plastic deformation is gradually dominated by dislocation activities rather than the perfect atomic cleavage, leading to a final brittle-to-ductile fracture transition.

PSMS07 Majharul Khan “Large area few atomic layers of hexagonal boron nitride synthesis in melted copper and anticorrosion property study in saline water”
Hexagonal boron nitride (h-BN) has been proposed as an ideal substrate for graphene based electronic devices, but the synthesis of high quality h-BN is still challenging. In this contribution, we report a facile synthesis of few-layer h-BN using melted copper as a substrate in atmospheric pressure chemical vapor deposition process. Comparative studies confirm the advantage of using melted copper over solid copper as a catalyst substrate. The former leads to the formation of large area h-BN that is micron sized single crystalline, and mostly mono- and bi-layers, in contrast to multi-crystalline and mixed multiple (3–10) layers yielded by the latter. This difference is likely due to the significantly reduced but uniformly distributed nucleation sites on the smooth liquid surface, compared with uneven distributed large amounts of nucleation sites on the solid surface associated with grain boundaries, oxides, and other defects. Electrochemical measurements were conducted and compared between the h-BN deposited solid copper and on a blank annealed copper in 3.0% NaCl solution. Electrochemical impedance spectroscopy and scanning electrochemical microscopy analysis under AC mode shows at least an order of magnitude higher corrosion resistance of copper in presence of h-BN. This finding
will facilitate the investigation of atomic layers of h-BN for fundamental property studies and incorporation to the future two dimensional hybrid nanoelectronics applications with graphene.

**PSMS08 Junying Zhang “DFT study and morphology tuning of photo-conversion materials”**

Electronic structure and morphology are two important factors affecting the photo-conversion properties. We devote to investigating the photocatalysts and luminescent materials both using first-principle calculation and experiment, studying the photo-conversion properties’ dependence on the crystal structures and morphologies. Using first-principle calculation, the electronic structures such as band gap, conduction band minimum, valence band maximum and local energy band were studied. Influence of intrinsic defects and dopant on the electronic structure and the photo-conversion properties was exploited. For photocatalysts, compensated coping is effective approach to narrowing the band gap, upraising the conduction band minimum and removing local energy band, and hence benefits the visible light photocatalytic activity. For luminescent materials, doping influences the charge transfer between the anions and cations, as well as the defects energy level, consequently changes the luminescent properties. Photocatalytic activity depends intimately on the size and the shape of the materials. Exposing high-energy facets, decreasing particle size, forming porous surface all benefit the photocatalytic activity. For luminescent materials, microsphere particles have high luminescent intensity. Decreasing the size of the nano-particles deduces the blue-shifted emission.

**PSMS09 Dipakkumar Patel “Persistent joints of MgB₂ wires for persistent-mode operation”**

Owing to soaring prices of liquid helium, magnesium diboride (MgB₂) will take place of traditional niobium titanium for magnetic resonance imaging magnet based on cryogen-free or hybrid cryogen operation with solid nitrogen alternatively. To explore the possibility, still reliability and consistency in the persistent joints of MgB₂ conductors are further requested. Herein, we have developed the new simplified technique for fabricating the persistent joints of MgB₂ wires. The persistent joints using different types of unreacted MgB₂ conductors with different precursors have been fabricated and tested under different temperatures and magnetic fields. Together with these, detail microstructure analysis of the joint parts using the scanning electron microscope and the x-ray diffraction has been done.

**PSMS10 Huiyuan Liu “Facile fabrication of free-standing ultrathin reduced graphene oxide membranes”**

Graphene membrane, consisting of 2-dimensional reduced graphene oxide (rGO) layers, promises to be a new class of highly permeable, highly selective molecular sieve materials for separation of both gas and chemical mixtures. In rGO membranes, molecules travel a tortuous path through the interlayer region between rGO nanosheets. Thus, higher permeability can be expected for thinner membranes due to the shorter path length. Recent advances in synthesis of solvated graphene materials have enabled deposition of uniform ultrathin graphene oxide (GO) and rGO layers on various substrates. However, remains a challenge to separate the ultrathin rGO layer from the substrate to form a free-standing membrane, which limits its potential applications such as osmotic driven filtration process. We report here a facile and efficient method to fabricate free-standing ultrathin rGO membranes using HI vapor and water-assisted treatment, after the supported GO membrane is obtained by vacuum filtration. The thickness of the free-standing rGO membranes can be down to 20 nm. The resultant 100-nm-thick membrane exhibits an unprecedented water flux of ~60 L m⁻² h⁻¹ in forward osmosis (FO), which is 5 times as great as that of the commercial FO membrane upon the same condition.
**PSMS11 Liang Zhang** “Dislocation nucleation from copper bicrystal with $<1\ 1\ 0>$ tilt grain boundaries”  
Grain boundary (GB), the interface between different oriented crystals of the same material, can significantly affect many properties of materials. When the average or entire range of grain size is reduced to less than 100 nm, the conventional plastic deformation mechanisms based on lattice dislocation become difficult and GB mediated deformation mechanisms become increasingly important. One of the mechanisms that can play a profound role in the strength and plasticity of metallic polycrystalline materials is the heterogeneous nucleation and emission of dislocations from GB. In this study, molecular dynamics simulations are performed on the dislocation nucleation from copper bicrystal with a number of $<1\ 1\ 0>$ tilt GBs. Simulation results indicate that the mechanic behaviour of copper bicrystal and the critic stress that required for dislocation nucleation are closely related to the crystallographic orientation of GB and the GB structures. Atomistic analysis on this mechanism provide details of the emission process that can help us to better understanding the dislocation source in GB and it can provide the theoretical basis for the grain boundary engineering.

**PSMS12 Solmaz Jahangir** “In-situ investigation of thermal instabilities in polycrystalline platinum thin films via confocal laser microscopy”  
The kinetics of dewetting and the subsequent morphological changes for platinum thin films grown on zinc oxide (ZnO) buffered (001) silicon substrates (Pt/ZnO/SiO2/(001)Si system) is investigated under vacuum conditions via a custom-designed confocal laser microscope coupled with a laser heating system. Live imaging of thin film dewetting under a range of heating and quenching vacuum ambients reveals events including hillock formation, hole formation, hole growth that leads to formation of a network of Pt ligaments, break up of Pt ligaments to individual islands and subsequent Pt islands reorientation, in chronological fashion. These findings are corroborated by ex-situ atomic force microscopy and secondary electron microscopy quantitative analysis. A secondary hole formation via blistering before film rupture is revealed to be the critical stage, after which a rapid dewetting catastrophe occurs. This process is instantaneous and can not be captured by ex-situ methods. Finally an intermetallic phase forms at 900 °C and alters the morphology of Pt islands, suggesting a practical limit to the thermal environments that may be used for these platinized silicon wafers in vacuum conditions.

**PSEM01 Jincheng Zhuang** “Enhancement of transition temperature in $FexSe_{0.5}Te_{0.5}$ film via iron vacancies”  
The effects of iron deficiency in $FexSe_{0.5}Te_{0.5}$ thin films (0.8 ≤ x ≤ 1) on superconductivity and electronic properties have been studied. A significant enhancement of the superconducting transition temperature ($T_c$) up to 21 K was observed in the most Fe deficient film (x = 0.8). Based on the observed and simulated structural variation results, there is a high possibility that Fe vacancies can be formed in the $FexSe_{0.5}Te_{0.5}$ films. The enhancement of $T_c$ shows a strong relationship with the lattice strain effect induced by Fe vacancies. Importantly, the presence of Fe vacancies alters the charge carrier population by introducing electron charge carriers, with the Fe deficient film showing more metallic behavior than the defect-free film. Our study provides a means to enhance the superconductivity and tune the charge carriers via Fe vacancy, with no reliance on chemical doping.

**PSEM02 Faizun Nesa** “Determination of magnetic order in nanoparticles of Zn ferrite via neutron diffuse scattering with polarization analysis”  
We have studied a series of nanostructured ZnFe$_2$O$_4$ samples produced by mechanical milling (with mean particle sizes from 9 to 90 nm) by neutron diffuse scattering, over the temperature range (1.5 – 295 K). In this study we have used polarization analysis to unambiguously differentiate between atomic and magnetic
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It is known that inversion between Zn and Fe sites in these compounds systematically increases with increased milling (as particle size decreases), leading to marked changes in the magnetic correlations. Consistent with earlier reports on zinc ferrites, we find that the long range magnetic order (which appears below $T_N \sim 10$ K) gradually transitions from antiferromagnetic to ferrimagnetic with decreasing particle size. In addition we note an increasing tendency to short range ferromagnetic correlations and changes in the nature of the non-ferromagnetic short range order (above $T_N$) with decreasing particle size. We are working on an interpretation of the change in magnetic properties from bulk to nano-particulate zinc ferrite through combination of crystallographic and microstructural factors based on a model with distinct core and shell contributions.

PSEM03 Feixiang Xiang “Quantum oscillations in BiTeCl”
Topological insulators are new quantum matters which receive a lot of attention. Recently it was discovered by the angle-resolved photoemission spectroscopy that BiTeCl is the first strong inversion asymmetric topological insulator (SIATI), which is predicted to have new properties and promise applications at high temperature. To gain insight into the topology of Fermi surface and the electronic structure, transport measurement in high magnetic field was performed on BiTeCl single crystals. Shubnikov-de Haas oscillation was observed and analyzed, and the topological origin is discussed.

PSEM04 Frederick Wells “Magneto-optical imaging of superconducting thin films”
Magneto-Optical Imaging is a versatile and widely-used technique for the investigation of magnetic properties of superconducting films. This technique uses the rotation of polarisation of light in a Faraday active material in proportion to magnetic field to create a visual image of the magnetic field distribution. Cameras are often used to capture static images of such field distributions around superconductors, which can then be used to identify regions of high magnetic flux such as micro-sized cracks and scratches and to map supercurrents in the film. We further extend the possibilities for analysis using a high-speed video camera to capture the dynamic magnetic behaviour of the film including transient effects such as the response of a film to a changing external magnetic field. Using this high-speed magneto-optical video, we quantitatively analyse the penetration of magnetic flux into a superconducting film along with the accompanying redistribution of current in penetrated areas.

PSEM05 Guangqing Liu “Epitaxial PbZrxTi1-xO3 ferroelectric bilayers with giant electromechanical properties”
In this study, a practical approach has been demonstrated to improve domain wall motion in thin films by simple layering of different ferroelectric compositions. A giant electromechanical response via ferroelastic domain switching is achieved in epitaxial (001) ferroelectric tetragonal (T) PbZr$_{0.3}$Ti$_{0.7}$O$_3$ (PZT)/ rhombohedral (R) PbZr$_{0.45}$Ti$_{0.55}$O$_3$ (PZT) bilayers, grown on La$_{0.7}$Sr$_{0.3}$MnO$_3$ (LSMO) buffered SrTiO$_3$ (STO) substrates. High-resolution XRD and TEM show that the domain structure of the PZT (T) films is tuned as a function of its thickness, from a fully in-plane $a_1/a_2$-domains (for a 30 nm PZT (T) layer) to a three domain stress-free $c/a_1/c/a_2$ polytwin state (for a 100 nm thick PZT (T) layer). Large switchable polarizations of up to 65 μC/cm$^2$ were observed. Quantitative PFM reveals enhanced piezoelectric coefficients, with d$_{33}$ coefficients ranging from 250 to 350 pm/V, which is 7 times higher than the nominal thin film values. These large numbers are attributed to the motion of nanoscale ferroelastic domains. Fatigue testing proves that these ferroelastic domain motions are reversible and repeatable up to 10$^7$ cycles. Pump-and-probe in-situ x-ray synchrotron measurements reveal that the ferroelastic domain switching is promoted by a pulsating strain effect imposed by the PZT (R) layer. The R-layer is able to couple to the applied electric field along the c-axis and induce an in-plane compressive stress, which facilitates the ferroelastic domain motion.
PSEM06 Jonathan Knott “Skin effect and heat generation in metallic coil formers for superconducting bias coils in saturated-core Fault Current Limiters”

In this poster we discuss the low temperature behaviour of metals - in particular copper and stainless steel - when used in saturated-core Fault Current Limiter applications. A critical component of saturated-core FCLs are biasing coils that require engineering current densities that are only possible with superconducting elements. Using a metallic former for these superconducting coils allows for simpler conduction cooling, and the former can act as a heat-sink for transient heat loads experienced in the system during a fault. Significant magnetic field fluctuations during a fault event can lead to transport currents in the metallic former that are usually mitigated by inserting an electrically-insulating slit in the former. In this poster we present data showing this practice can increase rather than decrease Joule heating by transport currents due to the very small skin depth in metals at low temperatures allowing the transport currents to continue to flow in the former skins. We discuss alternate methods to mitigate this issue, and provide a suggested best-practice for designing of metallic formers for saturated-core FCL applications.

PSEM07 Jonathan George “Room temperature deposition of ultra thin niobium films“

Nb thin films are common in superconducting electronic circuits, SQUIDs, and metrology. However the emerging hybrid technologies for quantum computing, spintronics set new challenging demands. In spite high Tc of Nb, desirable for applications, the film deposition technology is rather delicate due to the volatile nature of niobium, which can be easily oxidised. It is particularly problematic for the films thinner than about 50 nm because substrates are the source of the undesirable contaminating elements, with the interfacial layer being affected the most. As a result of contamination, the transition temperature and other superconducting properties, such as critical current density, degrade substantially. Different heat treatments can be an effective remedy from this degradation. However, in the hybrid technologies, it is desirable to combine niobium films with other materials. For such hybrid material architectures, any additional heat-treatments or the deposition of niobium at high temperatures is impossible. In this work, the Nb thin films are produced via dc magnetron sputtering on different substrates such as sapphire (Al₂O₃) and STO. The deposition parameters have been optimised for the best superconducting properties enabling the transition temperature of 9.1 K. We show the results for deposition of the films as a function of thickness, as well as at different deposition temperatures, and background pressures.

PSEM08 Muhamad Faiz Md Din “Tuneable magnetic phase transitions in layered CeMn₂Ge₂-xSix compound”

RMn₂X₂ series (where R is a rare earth and X is Si or Ge) have attracted interest in recent years due to their natural layered structure in which R and Mn atoms lie in alternate layers, separated by layers of X atoms. Due to strong magnetoelastic coupling of both R and Mn sites, magnetic phase transitions in these compounds are often accompanied by structural changes and possible to induce transitions by changing chemical composition, temperature and mechanical pressure or magnetic field applied. The investigations of the CeMn₂Ge₂-xSix compound (x = 0−2) magnetic phase diagram as functions of both composition and Mn–Mn spacing have been carried out using x-ray and neutron diffraction, magnetization and differential scanning calorimetric measurements. The replacement of Ge by Si results in a significant modifications to the magnetic states - a crossover from ferromagnetism at room temperature for Ge-rich compounds to antiferromagnetism for Si-rich compounds. The magnetic phase diagram has been constructed over the full range of CeMn₂Ge₂-xSix compositions and over the temperature range of interest (T = 3−480 K). CeMn₂Ge₂-xSix is found to exhibit two magnetic transitions with decreasing temperature from the paramagnetic region: (i) paramagnetism to intralayer antiferromagnetism (AFI) at T_N intra ~ 402 K; (ii) AFI to conical magnetic ordering of the Mn sublattice (FmCm) at T_C inter ~ 318 K.
PSEM09 Vivian Liu “Interface-dependent electrochemical behavior of nanostructured manganese (IV) oxide (Mn$_3$O$_4$)”

We report on the crystallographic orientational dependence of the electrochemical behaviour in nanostructured manganese oxide. Manganese Oxide (Mn$_3$O$_4$) nanocrystals have been deposited on Nb: doped Strontium Titanate (Nb:SrTiO$_3$) substrate via pulsed laser deposition. (001), (101) and (112) orientated nanocrystals were successfully grown on (100), (110) and (111) Nb:SrTiO$_3$ substrates respectively. Analysis of the lattice arrangements suggests that nanostructure growth may be driven more by polarity rather than the epitaxial strain such that electrostatic repulsion can be minimised. Cyclic voltammetry (CV) in 1M Na$_2$SO$_4$ electrolyte was performed to understand how specific capacitance values vary with changing lattice orientations. The maximum specific capacitance calculated for the (100) orientation was 34 F/g, obtained after the 3000$^{th}$ cycle. Beyond this the CV loop plateaus rapidly and structural analysis of this sample revealed a morphological transformation from the (001) orientation to the (101) platelet structures. The maximum specific capacitance obtained was for the (112) sample (120F/g) suggesting that such non-primary planes in spinel oxides may be most attractive for electrochemical applications.

PSEM10 Wenxian Li “Performance modulation of $\alpha$-MnO$_2$ nanowires by crystal facet engineering”

Modulation of material physical and chemical properties through selective surface engineering is currently one of the most intensive research fields, aimed at optimizing functional performance for applications. The activity of exposed crystal planes determines the catalytic, sensory, photocatalytic, and electrochemical behavior of a material. In the research on nanomagnets, it opens up new perspectives in the fields of nanoelectronics, spintronics, and quantum computation. Here, we demonstrate controllable magnetic modulation of $\alpha$-MnO$_2$ nanowires, which may display surface ferromagnetism or antiferromagnetism, depending on the exposed plane. First principles density functional theory calculations confirm that both Mn- and O-terminated $\alpha$-MnO$_2$ (110) surfaces exhibit ferromagnetic ordering. The investigation of surface-controlled magnetic particles will lead to significant progress in our fundamental understanding of functional aspects of magnetism on the nanoscale, facilitating rational design of nanomagnets. The significant influence of surface variation on band gaps and electrochemistry is also demonstrated in the present research on the semiconducting properties and lithium battery performance of the $\alpha$-MnO$_2$ nanowires.

Xinqi Chen “Preparation of surfactant-free copper selenide nanowires and their thermoelectric properties”

Copper chalcogenides, current interest to energy-related research, have shown great potential in various energy applications. The conductivity of copper chalcogenides arises from Cu deficiency, and can be adjusted by controlling the ratio between copper and chalcogen. The excellent conductivity of copper chalcogenides is due to the copper deficiency. Since their nanostructures have large ratio of surface atoms to internal atoms, they are expected to show higher conductivity than bulk analogues due to pronounced copper deficiency. Thereby a variety of approaches have been developed to prepare 1-dimensional copper chalcogenide nanostructures. In this work, uniform surfactant-free copper selenide (Cu$_{2-x}$Se) nanowires were prepared via an aqueous route. The effects of reaction parameters such as Cu/Se precursor ratio, Se/NaOH ratio, and reaction time on the formation of nanowires were investigated. The results show that Cu$_{2-x}$Se nanowires were formed through the assembling of CuSe nanoplates, accompanied by their self-redox reactions. The resultant Cu$_{2-x}$Se nanowires were sintered into pellets and explored as a potential thermoelectric candidate in comparison with commercial copper selenide powder. The synthetic nanowire sample shows higher electrical conductivity, smaller Seebeck coefficient, and lower thermal conductivity than commercial sample, leading to a comparable figure of merit with commercial sample.
PSEM12 Xun Xu “Tuning band gap in silicene by oxidation”
Silicene monolayers grown on Ag(111) surface demonstrate a tunable band gap from semimetallic to semiconducting type by oxygen adatoms. By using low-temperature scanning tunneling microscopy, it is found that the initial adsorption sites and amounts of oxygen adatoms on silicene surface are critical for band gap engineering, which is dominated by different buckled structures in $\sqrt{13} \times \sqrt{13}$, $4 \times 4$ and $2\sqrt{3} \times 2\sqrt{3}$ silicene layers. The Si-O bonds are main species formed on $\sqrt{13} \times \sqrt{13}$ and $2\sqrt{3} \times 2\sqrt{3}$ structures, whereas Si-O-Si is the major oxidation form on $4 \times 4$ structure during the initial oxidation stage which is verified by an in-situ Raman spectroscopy. The silicene monolayers remain its structures when fully covered by oxygen adatoms. Our work demonstrates the feasibility of tuning the band gap of silicene with oxygen adatoms, which in turn expand the base of available two-dimensional electronic materials for devices with properties that is hardly achieved with grapheme oxide.

PSEM13 Yuanhe Tang “A new technology of liquid crystal for strong light partial imaging”
Liquid crystal is used to display for the screen of TV, computer or mobile, but the liquid crystal as a new technology is first used by us for the imaging. The high contrast imaging results are obtained under the strong light intensity of larger than $2.2 \times 10^5$ lx by controlling each pixel of the liquid crystal. Four novel prototypes of partial light intensity imagers are made, they are two generations of prototype partial light intensity imager based on FPGA (field programmable gate array) and liquid crystal, the partial gating smart network camera for controlling strong light intensity based on DSP (digital signal processor) and liquid crystal, partially light-controlled imager based on liquid crystal plate and image intensifier for aurora and airglow measurement. The LCoS (liquid crystal on silicon) is proposed as a novel device with no moving part for effectively measuring the upper atmospheric temperature and wind velocity. Samples of indoor objects and outdoor car license plate are photographed by the partial gating prototype imager under strong light. The imaging results of this novel system are satisfactory with better restored details, compared with the photos taken by normal CCD camera which uses aperture and shutter to control the overall light intensity.

PSEM14 Abolfazl Jalalian “High performance low dimensional lead-free piezoelectric materials”
High performance Ba(Ti$_{0.80}$Zr$_{0.20}$)O$_3$-(Ba$_{0.70}$Ca$_{0.30}$)TiO$_3$ (BTZ-BCT) lead-free piezoelectric thin films and nanofibers are investigated. The nanofibers and thin films are fabricated via versatile and efficient techniques including sol-gel assisted electrospinning and spin-coating methods respectively. The large piezoelectric coefficient of the nanofibers ($d_{33} = 180$ pm V$^{-1}$) and thin films ($d_{33} = 140$ pm V$^{-1}$) are comparable to or higher than those for PZT films and nanofibers, respectively. Strong reduction of the coercive field induced by interface stress, improved piezoelectric response and high electrical resistivity make BTZ-BCT nanofibers and thin films promising candidates for integration in piezoelectric nanodevices and power generator systems.
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