RSC | Advancing the Chemical Sciences

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Newsletter of the Energy Sector

FROM THE CHAIR

Dear Members of the RSC Energy Sector,

Welcome to the first issue in 2013 and my first newsletter from Edinburgh! It turned out to be just as cold as they warned me (they forgot to tell me about the snow!).

The last months have been very busy for the Energy Sector, both holding successful events and planning activities for 2013 and beyond. Please read more about this in the Upcoming Events section.

In May, we held 'The Influence of Chemistry on Degradation of Materials in Nuclear Reactor Systems' jointly co-sponsored by the Institute of Materials, Minerals and Mining (IOM^3) – a successful event both in terms of the technical programme and attendance. The event was run following the model set up by the Future Strategy Task Force and it proved the financial robustness of the model. We are very grateful to Richard Wain for his sterling work in organizing this event.

In November we held the first RSC Energy Sector Early Careers Event at Cranfield University. It was a pleasure working with Anna Weston and Chris Satterley to put together this event. We'd like to build upon this successful event, and I'd like to you're your suggestions for upcoming events for Early Careers in 2013. You can find more details about our 2012 event on the next page.

There have been some changes in our Committee. Giorgio Caramanna has taken over as Newsletter Editor and we look forward to working with him. We'd like to thank Rachel Gomes for her service as Newsletter Editor going back to issue 13 and for her work transitioning to electronic copies. We also say goodbye to Michael Whitehouse as member of the Committee and we are very grateful for his long service back to the inception of the ES. Please do not hesitate to contact me if you want to be involved with the Committee or propose an event.

Mercedes Maroto-Valer

FROM THE EDITOR

Dear Readers,

I am honoured to have been chosen as Editor of the RSC Energy Sector newsletter. I hope to follow in the footsteps of Rachel Gomes in continuing to produce both an interesting and enjoyable source of information about what is happening in the Energy Sector of the RSC and in the broad field of energy-related issues.

Energy is one of the biggest challenges, if not *the* biggest challenge, for the future wellbeing of humanity. A growing population, an increasing use of energy to sustain development, and an uncertainty about the long-term availability of reliable energy sources are all extremely demanding issues which are also coupled with the mandatory need to reduce the environmental impact of energy production.

The decrease in public confidence about nuclear power, with several countries phasing-out their nuclear energy programmes, will require the development of new sources in a very short time.

The UK has a strong commitment to reducing its CO_2 footprint with a minimum target of cutting greenhouse gases emissions by 80% below 1990 levels by 2050. This will require substantial progresses for low-carbon electricity and the improvement of fuel efficiency. It is likely that a range of different approaches will be needed such as the further development of renewable energy, an increase in biofuel utilization, and application of Carbon Capture and Storage technologies.

We will witness a revolution in the energy sector in the coming years. The choices of today will determine in what kind of society we will live in tomorrow.

I hope you enjoy this issue.

Giorgio Caramanna

RSC ENERGY SECTOR EARLY CAREERS CHEMISTS EVENT HELD AT CRANFIELD UNIVERSITY ON TUESDAY 27TH NOVEMBER 2012

by Anna Weston, RSC Energy Sector Executive Committee

In 2011, the RSC set a challenge for all attendees of their Annual General Assembly to build a legacy for the International Year of Chemistry to inspire people with chemistry in 2012. The Energy Sector committee decided to take on this challenge and set to work on the organisation of an event to celebrate and bring together early career researchers in all areas of energy research.

The RSC Energy Sector Committee held their Early Career Energy Sector Chemists Symposium on the 27th November 2012 at Cranfield University. The event formed part of the official opening of Cranfield's new £2million Energy Technology Laboratory funded by the Dept. of Energy and Climate Change (DECC) as part of the UK CCS Research Centre. Cranfield's Energy Technology Laboratory houses a range of near industrial-scale equipment for the research and development of clean and renewable energy technologies. The facilities support research into carbon capture and transport systems, clean fossil fuel technologies, bioenergy, and energy from waste. At the event, the Energy Laboratory was opened by Jonathan Holyoak, Head of Policy for the Office of Carbon Capture and Storage, on behalf of the DECC.

The Early Career Energy Sector Chemists Symposium attracted 43 delegates (even including a few non-chemists) from industry and academia. The RSC Energy Sector was thrilled to have attendees from as far as Edinburgh, Durham, Newcastle and Bristol.

Jonathan Holyoak from DECC gave the keynote speech, in which he discussed the future of CCS on a global level and the UK's role. Professor Simon Pollard of Cranfield University chaired the afternoon session with presentations by:

Harikrishna Erothu from Aston University on block copolymers and their application in organic solar cells;

Liam France from Oxford University on lanthanum doped supported bimetallic carbide catalysts for dry methane reforming;

Sian Green from E.ON New Build & Technology on the Wilhelmshaven post combustion carbon capture plant;

Susan Jones from Cage Concepts Ltd on carbon capture and utilization using zeolite molecular sieves and catalysts;

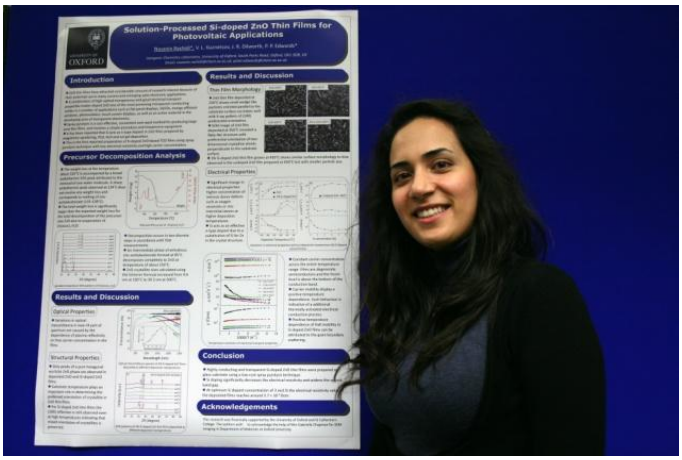
Jonathan Morrison from the University of Birmingham on the corrosion and deposition in nuclear reactors;

Oluwafunimilola Ola from Heriot-Watt University on whether solar fuels can change future energy options;

Emanuele Pagone from Cranfield University on future sustainable electricity generation;

Nazanin Rashidi from the University of Oxford on solution-processed Si-doped ZnO thin films for photovoltaic applications.

Attendees had a chance to present their scientific posters over lunch. An awards panel selected the top posters based on their scientific content and the ease in which it was communicated to the viewer. Top-scoring posters were awarded prizes by Philip Sharman (Board Chair of the UKCCS Research Centre) and Mercedes Maroto-Valer (Chair of RSC's Energy Sector Committee). Eight prizes in total were awarded by the RSC Energy Sector Committee and the Coal Research Forum.



ABOVE: 1ST PRIZE WINNER, MS. NAZANIN RASHIDI
(Photo credit: Anna Weston)

Prize winners included: 1st prize: Nazanin Rashidi (University of Oxford); 2nd prize: Jack Rowbotham (University of Durham); 3rd prizes: Robert Mitchell (University of York), On Ying Wu (University College London), Sian Green (E.ON New Build & Technology); CRF prizes for the Best Three Fossil Fuel Posters: Nelia Jurado, Janthanee Dumrongsak and Chechet Biliyok (all three from Cranfield University).

All award winners received a cash prize to help support their educational endeavours into R&D or at least pay for some well deserved R&R!

TWO NEW SOLAR PV EFFICIENCY WORLD RECORDS ALREADY ANNOUNCED IN 2013

by Nigel B Mason, PV Consulting Ltd

On 16th January 2013, Heliatek announced a new world record of 12% efficiency for an organic photovoltaic (OPV) cell.

ABOVE: THE RECORD-BREAKING OPV *(Photo credit: Heliatek)*

This was a significant increase on their previously held record of 10.7% announced in April 2012. The 1.1 cm^2 area device was fabricated by vacuum deposition of thin layers of small molecule organic compounds (oligomers) into a glass substrate using much of the same technology as employed in OLED display devices. Read more at: www.heliatek.com

Just two days later on 18th January 2013, the Swiss Federal Laboratories for Materials Science and Technologies (EMPA) announced a world record efficiency of 20.4% for a thin film solar cell based on the inorganic compound CdInGaSe2 (or CIGS).

ABOVE: THE NEW WORLD RECORD CELL *(Photo credit: EMPA)*

In this case, the substrate was a flexible polyimide film and, once again, this was a step-change improvement on their previous efficiency record of 18.7% achieved in May 2011. For more information: www.empa.ch

EARLY ANNOUNCEMENT

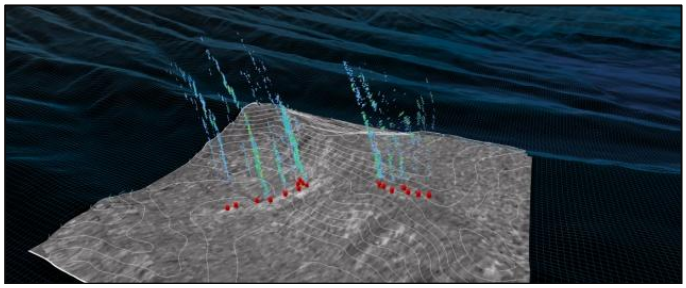
The Energy Sector is organizing a one-day seminar on *"Solar PV – Next Generation Materials"* to be held at Burlington House, London, on 15th January 2014. The seminar will focus on the latest advances in materials for both organic and inorganic thin film solar cells. An exciting programme is being planned with renowned guest speakers that are leaders in the field. Further details will be published in the next newsletter. Please check our website for the latest updates.

DEEP METHANE SEEPS IDENTIFIED BY NEW SONAR TECHNOLOGY

Deep methane seeps are emitted from the seafloor in several areas and play an important role both as gas exchange with the surrounding oceans and overlying atmosphere and as potential indicators of mineable methane reservoirs.

At the end of 2012, NOAA's ship "Okeanos Explorer" discovered at least 25 vents offshore the US Atlantic coast north of Cape Hatteras at depths ranging from 1,000 to 1,600 metres. The gas plumes rise through the water column as high as 1,100 metres.

Dr. Carolyin Ruppel, Chief Scientist of the USGS "Gas Hydrates Project," declared: "It is important to find and understand such seeps because they have global significance for the transfer of methane carbon from long-term storage in ocean-floor sediments into the ocean and atmosphere. Methane released into the water column is often oxidized to carbon dioxide, leading to changes in ocean chemistry, such as ocean acidification."



ABOVE: THE METHANE SEEPS
(Photo credit: NOAA)

The vents were identified using specifically designed multi-beam sonar able to process the signal generated by gas plumes in the water column.

For more information:
http://www.noaanews.noaa.gov/stories2012/20121219_gas_seeps.html

FIRE AND ICE

The USA Energy Department (DOA) is supporting with $2 million funding 14 new research projects on methane hydrates.

Hydrates are composed by a lattice structure of ice surrounding methane molecules and are formed under cold and high-pressure conditions both offshore and inside permafrost.

METHANE HYDRATES ARE 3D ICE-LATTICE STRUCTURE
(Photo credit: Energy.gov)

Following an experimental test along the Alaska North Slope, where methane was successfully extracted as gas from hydrates deposits through CO_2 injection; the DOE decided to further fund the research aiming to achieve a viable method for methane hydrates production in the coming years.

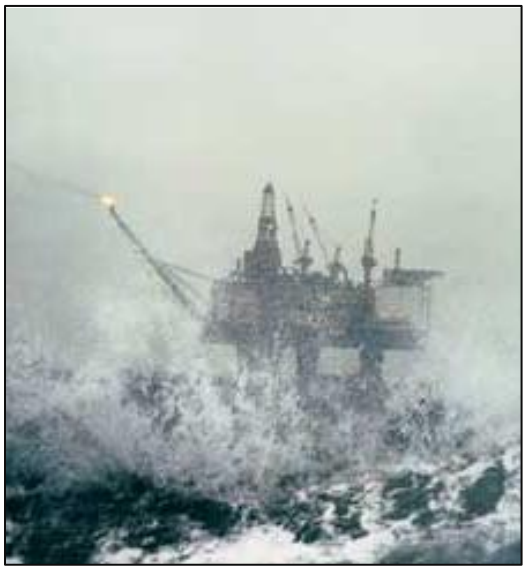
The projects will be managed by the DOE's National Energy Technology Laboratory and will be aimed at deepwater hydrate characterisation; the response of methane hydrates to climate change, and advances in understanding the methane hydrates hosting structures.

This research is one of the key points President Obama's agenda for the USA's energy future.

For more information: energy.gov/node/387289

OFFSHORE PRODUCTION WITHOUT PLATFORMS

The platform is the most vulnerable part of an extraction rig since it is exposed to extreme weather conditions. This is particularly true in harsh environments such as the North Sea.



ABOVE: "GULLFAKS C" BATTERED BY STORM-FORCE SEA
(Photo credit: Arnulf Husmo-Stone, Getty Images)

One solution is to move the facilities underwater where they will be sheltered from adverse weather conditions on the surface. A prototype compressor is already working on the seafloor offshore Norway in the Royal Dutch Shell's Ormen Lange natural gas field.

Another advantage of having a deep-submerged compressor is that it is closer to the reservoir and under higher hydrostatic pressure, therefore reducing the energy needed for gas extraction.

"This means you're squeezing out more, an extra 5 to 10 per cent, possibly more or less, depending on the specifics," says Alan Brunnen, the subsea chief of Aker Solutions, which is working with both Shell and Statoil on subsea compression.

A limitation for a fully submerged rig is that providing energy from the shore at a distance of over 100 km is very difficult. New technologies are in development that should make possible a submerged power line up to 500 to 600 km from the shore.

For more information:
http://www.akersolutions.com/en/

CO_2CHEM MINERAL CARBONATION RESEARCH CLUSTER WORKSHOP

by Aimaro Sanna, Centre for Innovation in Carbon Capture and Storage, Heriot-Watt University

Mineral carbonation represents a promising alternative for long-term geological storage, especially for regions where CO_2 underground storage is not possible. It involves reaction of minerals (silicate rocks or inorganic wastes) with CO_2 to give inert carbonates, which can be reused in construction or as fillers. The process presents favourable thermodynamics, but for a viable mineral carbonation process on an industrial scale, its reaction rate needs to be accelerated.

MINERAL CARBONATION PROCESS

(Photo credit: A. Sanna)

The workshop "Mineral Carbonation: Identifying the R&D Priorities" organised by CO_2Chem and ESKTN, was hosted on 28th November 2012 at the Royal Society of Chemistry, Burlington House, to identify key scientific and industrial research priorities for the development of mineral carbonation technology. It was a very successful event where more than thirty people with industrial and R interests and expertise in mineral carbonation attended the workshop to review and discuss the current challenges and opportunities relating to CO_2 mineralisation in the UK. The discussion focused on:

- Mineral carbonation applications & roadmap
- Barriers to progress
- Key R&D priorities
- The UK's strengths and activities
- ETI's findings on large-scale CO_2 mineralisation in UK

The morning section began with an introductory presentation by Michael Priestnall, CEO of Cambridge Carbon Capture Ltd and industry chair of the workshop; followed by a description of the natural carbon cycle by Professor Mike Bickle of Cambridge University; and an overview of the mineral carbonation international research progress and status by Professor Mercedes Maroto-Valer of Heriot-Watt University and academic chair of the workshop.

The morning session continued with presentations on large-scale deployment of mineral carbonation. In particular, Dr Rebecca Sweeney (Energy Technologies Institute) illustrated the challenges for large-scale mineralisation of CO_2 identified in the Energy Technologies Institute's recent major study, and Dr Mike Styles of the British Geological Survey talked about the ETI's Mineralisation Project outcome from the influence of mineral type on reactivity.

The morning section ended with a presentation and discussion on mineral carbonation R&D activities and development opportunities.

The afternoon activities of the workshop were dedicated to the industrial applications and commercial development of CO_2 sequestration technology. The potential production of different materials such as silica, metals, Mg/Ca oxides and aggregates from minerals and wastes were presented through the experiences of successful companies including Cambridge Carbon Capture Ltd and C8S Aggregates Ltd.

For more information on the outcome of the CO_2Chem Mineral Carbonation Research Cluster Workshop, visit the CO_2Chem website where a summary report on the mineral carbonation challenges and a development roadmap will soon be made available: http://co2chem.co.uk.

BLOWN IN THE WIND

Sources: The Guardian and Repower System

A new peak of wind-produced electricity has been reached at the end of 2012 with 282 GW of total installed capacity worldwide.

New installation of wind turbines in 2012 accounted for 45 GW; China and the USA are leading the way with 13 GW each, followed at distance by India, Germany and the UK installing about 2 GW each.

ABOVE: THE "THORNTON BANK" WIND-FARM
(Photo credit: Repower System)

Globally, the biggest wind-power user is China with 77 GW installed, followed by the USA with 60 GW. In Europe, Germany has the largest asset of wind turbines (31 GW) while Spain with its 23 GW is a close second. The UK is currently operating 8.5 GW of wind-farms, 3 GW of which are offshore, making the UK the world leader in offshore deployment.

The last of the world's 30 largest offshore wind turbines (nominal power of 6.15 MW) developed by Repower System have been deployed in the Thornton Bank wind farm offshore of Belgium. The new turbines, with the previously deployed 6 models of 5MW, give a total potential output of 215 MW.

UPCOMING EVENTS

The emissions control of NOx, SOx and particulates
Wednesday 10th April 2013, Cranfield University. Joint seminar by the Coal Research Forum and Environment Division and RSC Energy Sector. For more details contact: davidja.mccaffrey@tiscali.co.uk

The Solar Energy Society
will be holding its annual three-day Science & Technology conference (PVSAT-9) at Swansea University from 10th-12th April 2013. www.pvsat.org.uk

The European PV Solar Energy Conference
and Exhibition will be held in Paris this year from 30th September through 4th October 2013. www.photovoltaic-conference.com

The IPA's 6th Annual "Power Scotland" Conference: "The New Power Market"
will be hosted on Tuesday 12th March 2013 in the James Watt Building, SE Technology Park, East Kilbride, G75 0QD. The conference will review the Energy Bill, the Electricity Market Reform, the Gas Strategy and the impacts of these initiatives on the future investment and employment in the electricity sector. For further information and to register, contact: events@ipa-scotland.org.uk

Challenges in Chemical Renewable Energy
will take place in Cambridge from 3rd-6th September 2013. Outstanding researchers will present their latest results in the field of: photovoltaic, solar fuels, new battery materials, fuel cells and molecular catalysis. The vent will be an excellent opportunity of networking. For further information: http://www.rsc.org/ConferencesAndEvents/ISACS/ISACS12/index.asp

COMMITEE MEMBERSHIP

CHAIR
Prof. Mercedes Maroto-Valer
School of Engineering and Physical Sciences
Institute of Petroleum Engineering
Heriot-Watt University
Edinburgh EH14 4AS
Tel: +44 (0) 131 451 8028
Email: m.maroto-valer@hw.ac.uk

TREASURER
Dr. David McCaffrey
McEnergy Consultancy
35 Roberts Road
Prestbury, Cheltenham
Gloucestershire GL52 5DJ
Email: davidja.mccaffrey@tiscali.co.uk

SECRETARY
Dr. Chris Satterley
E.ON New Build & Technology Ltd
Technology Centre
Ratcliffe on Soar
Nottingham NG11 0EE
Tel: +44 (0) 247 618 3312
Email: chris.satterley@eon-engineering.com

NEWSLETTER EDITOR
Dr. Giorgio Caramanna
School of Engineering and Physical Sciences
Heriot-Watt University
Edinburgh EH14 4AS
Tel: +44 (0) 131 451 3299
Email: g.caramanna@hw.ac.uk

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Dr. Martin Brown
GL Industrial Services UK Ltd
Holywell Park
Ashby Road
Loughborough
Leicestershire LE11 3GR

Mr. Neil Edwards
Johnson Matthey Technology Centre
Blounts Court
Sonning Common
Reading, Berkshire RG4 9NH

Mr. John Greene
Chemistry for Power and Energy
10, Lychgate, Higher Walton
Warrington, Cheshire WA4 6TF

Prof. Jenny Jones
Energy and Resources Research Institute
Houldsworth Building
The University of Leeds
Leeds LS2 9JT

Dr. Nigel B Mason
PV Consulting Ltd
Holmedene Farm
Moor Lane, Elton
Matlock DE4 2DA

Dr. Will Quick
E.ON New Build & Technology Ltd
Technology Centre
Ratcliffe on Soar
Nottingham NG11 0EE

Mr. Richard Wain
Rolls-Royce PLC
PO Box 2000
Derby DE21 7XX

Dr. Anna Weston
Corporate Relations.
The Vice-Chancellor's Office
Building 30
Cranfield University
Cranfield
Bedfordshire MK43 0AL