The 4th Energy Materials Annual lecture was delivered by Dame Sue Ion, Chair of the Nuclear Innovation Research Advisory Board (NIRAB) on Thursday 13th July at the IOM3 headquarters in Euston Road. The well attended lecture drew interest from across the materials spectrum and once again demonstrated how crucial understanding materials properties and new materials discovery is to energy generation. A more detailed report is given later in the newsletter and a link to the slides can be found on the EMG micro-site.

Materials for nuclear power generation are a wonderful illustration of the need for long term durability and the need for a better understanding of failure mechanisms. The new generation of pressurised water reactors will be designed to last for 60 years and this makes me think that, by comparison, the current guarantee period of crystalline silicon PV solar energy modules of 25 years is somewhat short of this and are deployed in a less harsh environment. The need for more energy storage and the rise of electric vehicles is challenging battery technology to survive more charge-discharge cycles, which will help to make them more affordable. Replacing the batteries after just a few years is very costly, not to mention the impact on recycling. A study I conducted for DECC three years ago on the carbon footprint impact of new PV technology showed that the biggest impact on reducing the carbon footprint was for the PV modules to keep running for more than 40 years. New materials technology is making this possible. As more PV solar and wind energy are connected to the grid so there will be an increasing need for energy storage at all levels but at present it is expensive. A recent paper published by the Grantham Institute in Nature Energy predicts that the cost of batteries for electric vehicles will be competitive with fossil fuels by 2022 and for domestic energy storage by 2030. This analysis is based on learning curves for manufacturing scale and opens the way for disruptive new materials technology to extend battery lifetime.

The electricity generation scene in the UK might be changing faster than we think with the demand for coal falling faster than previously predicted with coal supplying just 2% of our power in the first six months of 2017 with figures from BEIS. In 2012 coal supplied a total of 150 tWh of electricity but for 2016 this was down to 30 tWh. This has been driven by the increase in installation of wind and solar energy that, despite reduction in government subsidy have continued to grow. Perhaps we are going to need more energy storage to balance the grid sooner than anticipated!

Professor Stuart Irvine
Chair EMG
Energy Materials Information Streams

The EMG microsite is a mine of information relating to Energy Materials with links to various sources of information, including funding sources for collaborative research/development.

The EMG micro website is actively managed and regularly updated; the link to the appropriate location on the micro site is given below


PARSONS 2019: The 10th International Charles Parsons Turbine Conference

Monday 16 September to Wednesday 18 September 2019

Organising Committee: Jon Wells (Siemens), Scott Lockyer (Uniper), Joy Sumner (Cranfield), Nigel Simms (Cranfield), Philippa Reed (Southampton Uni), Keith Harrison (IoM3), Matthew Appleton (Rolls Royce), Doug Gass (Siemens), Geoff Horseman (Siemens)

Organised by IOM Communications on behalf of the High Temperature Materials Committee of the Institute of Materials, Minerals and Mining

Charles Parsons' concepts and designs have been instrumental in developing turbo-machinery for the mass generation of electricity and propulsion. His legacy has been honoured through the series of Parsons Conferences, on a 4 year cycle, focused on the developments in materials for steam and gas turbines, and this series is set to continue in September 2019. The 2015 conference focused on the challenge of increased flexibility in thermal power plant, and industrial and aero gas turbines and generators, whilst maintaining high efficiency.

These prestigious events attract a worldwide attendance, typically from over 15 countries and over 120 attendees. Shortly the event details will be confirmed and a dedicated webpage for abstract submission, registration and notifications will be available on the IOM3 website.

This advance notification gives a chance for the reader to consider the expected status of ongoing research suitable for submission and presentation to this prestigious event, so keep the dates in your diary and forge ahead with your research efforts and we looked forward to meeting with you in Sept 2019.
Committee Member Profile – EMG Webmaster

Dr Michael Gorley

Materials Technology Programme Manager – UK Atomic Energy Authority

(Mike.Gorley@ukaea.uk)

Short CV

I’m a recent member to the Energy Materials Group Board having joined early 2016 and I’m enjoying the broader view of the energy market this position brings. I have had a long-standing interest in future energy considerations and I believe materials hold the key to developing a better future. My interest started during my time as an undergraduate with a project on fusion energy and, after receiving a first-class M.Phys in 2010, I adamantly applied for and started a fusion materials focused D.Phil at the University of Oxford. My research at Oxford focused on oxide dispersion strengthened steels for fusion reactors. During this time, I gained experience in design, development and manufacture of novel alloys along with microstructural evaluation of metals and powders. I have always believed in the need for developing the next generation of scientists and I was an active tutor at Oxford and I continue to support developments as an industrial supervisor for several PhD projects across the UK.

Currently I’m the Materials Technology Programme Manager at UKAEA. Within this role I’m the project leader of the Engineering Data and Design Integration projects within the €800 million H2020 EUROfusion programme, leading structural integrity and materials interfaces for new fusion reactors. I’m head of UKAEA’s Materials Technology Laboratory and I’m the group leader for UKAEA Materials Technology Group, developing programme strategy and managing an enthusiastic, and very hard working, team.

Materials Interests

All materials that could form part of the future fusion reactors; this is a wide-ranging list but I have a focus on a few key areas including: structural integrity of new nuclear reactors, development of materials for extreme/demanding environments, evolution of materials during irradiation, powder metallurgy (including additive manufacturing) and development and validation of small specimen testing techniques.

Outside Interests

I have a range of interests, mostly relating to my love of adventure and the outdoors. Although I don’t get enough time any more I was a keen fencer having fenced (Sabre) at international level, winning county championships and receiving top university honours. More recently I have started to focus on mountaineering, where I have climbed Mt Blanc, Mt Kilimanjaro and most recently Mt Elbrus in Russia. Of course, most of my time goes to relaxing with my wonderful wife, and with nieces and nephews, who keep me tired and happy whenever I see them.
Organisation Profile

ERA

The Energy Research Accelerator (ERA) is a cross-disciplinary and multi-partner energy research hub in the Midlands. As part of the Midlands Innovation group of higher education institutions, ERA aims to foster research and develop new technologies to shape the UK’s energy landscape over the next 40 years. It is a cross-disciplinary hub of technology research and energy talent which brings the region’s combined research expertise together with the surrounding industrial base to deliver a step change in energy innovation.

The ERA partnership is made up of six internationally-renowned Midlands universities, namely Aston University, University of Birmingham, University of Leicester, Loughborough University, The University of Nottingham and The University of Warwick and the British Geological Survey.

ERA aims to:
• Make better use of primary resources;
• Create smarter energy systems;
• Reduce our dependence on imported energy;
• Enhance energy security;
• Help to achieve the UK’s carbon reduction targets.

Through the initial themes of geo-energy, integrated energy and thermal energy systems, ERA is focused on delivering results that will lead to the long-term transformation of our energy landscape. ERA will provide a training ground for a wide range of energy aware research leaders, addressing both energy generation and energy demand/usage.

The ERA doctoral training programme is designed to provide scholars with a solid grounding in your research area during your PhD. This programme will enable high quality PhD students to address industry-led research challenges. The programme is designed to broaden your horizons and empower and support you in developing contacts and links within the broader energy environment. ERA provides a ready-made network of people who can help you on your chosen career path focussed around one of the core themes — Geo-Energy, Thermal and Integrated Energy Systems.

For more information on the activities of ERA please visit their web site http://www.era.ac.uk/
Editor’s Titbits Section

Invenergy's New 2000MW Wind Farm

Invenergy, North America's largest independent, privately-held renewable energy company, along with GE Renewable Energy, today announced a 2,000 megawatt wind farm that will be the largest in the U.S. and second-largest in the world, once operational. The Wind Catcher facility is currently under construction in the Oklahoma panhandle and will generate wind electricity from 800 state-of-the-art GE 2.5 megawatt turbines.

The wind facility is part of the $4.5 billion Wind Catcher Energy Connection that also includes an approximately 350-mile dedicated, extra-high voltage power line. American Electric Power (AEP) utility subsidiaries Public Service Co. of Oklahoma (PSO) and Southwestern Electric Power Co. (SWEPCO) are asking utility regulators in Louisiana, Arkansas, Texas and Oklahoma to approve plans to purchase the wind farm from Invenergy upon completion of construction and to build the power line to serve PSO and SWEPCO’s more than 1.1 million customers.

High Temperature Research Centre at Coventry

The High Temperature Research Centre (HTRC) is a joint collaboration between the University of Birmingham and Rolls-Royce.

The 5,800 sqm Centre is funded through a £40M investment by Rolls-Royce plc, matched by a £20M government grant through the Higher Education Funding Council for England’s (HEFCE) UK Research Partnership Investment Fund (UKRPIF).

The Centre, based near Coventry, enables production scale research and experimentation to deliver rapid high quality product and process innovation and is a unique casting, design, simulation and advanced manufacturing research facility. It focusses initially on the key design and manufacturing aspects of investment casting.

The Centre is a self-contained investment casting foundry with the following processes: Core, Wax, Shell, Cast, Chemical Leach & Etch, Finish (abrasive blast, emery dress), Measurement & Inspection and Laboratories.

Further details at http://www.birmingham.ac.uk/research/activity/htrc/about.aspx
Editor's Titbits Section

66th Energy Science Lecture - Integrated Energy Network
2nd October 2017, London
(Organised by the Biomass & Fossil Fuel Research Alliance (BF2RA))

This year's lecture will be presented by Dr Arshad Mansoor, Senior Vice President of Research and Development for the Electric Power Research Institute (EPRI).

Dr Mansoor is responsible for EPRI's portfolio of R&D and Demonstration Programmes spanning all sources of generation, power delivery and utilisation and the environment. Previously Arshad served as Vice President of EPRI's power generation and utilisation sector. Prior to that he was Vice President of the former EPRI subsidiary, EPRI Solutions and Vice President and director of engineering with the EPRI Power Electronics Applications Center.

Arshad has a Bachelor of Science in electrical engineering from the Bangladesh University of Engineering and Technology. He earned his Master of Science and PhD in electrical engineering focusing on power systems engineering from the University of Texas in Austin and completed the MiT Reactor Technology Course.

Arshad’s lecture will describe the Integrated Energy Network that envisions a future in which customers have flexibility to use, produce and manage energy as they choose, while improving access to reliable, safe, affordable and cleaner energy. Arshad will focus on three areas: Using Cleaner Energy through Efficiency and Electrification, Producing Cleaner Energy and Integrating Energy Resources. Arshad will highlight insights from this work with implications for research and infrastructure development.

The lecture will take place at Prince Philip House, 3 Carlton House Terrace, London SW1Y 5DG at 2.15pm on Monday, 2nd October 2017 preceded by a buffet lunch from 1.00 pm for all those attending the lecture.

At the end of the lecture there will be a short ceremony during which the Energy Science Medal will be presented to Dr Arshad Mansoor. After this presentation, there will be tea and biscuits served to all those attending.

BF2RA Research Presentations

Again, this year, a selection of PhD students will be presenting projects for which BF2RA has given them grants. The students will be giving their presentations between 10.45am and 1.00pm also at Prince Philip House. There will be a cash prize to the student with the best presentation. If you accept the invitation to attend the lecture then please indicate if you will be arriving earlier for the presentations.

Attendance will be by e-ticket only, which will be e-mailed to you or your colleagues on application to John Gardener at bf2ra@gardnerbrown.co.uk.
EMG Annual Lecture

Dame Sue Ion, FREng FRS FIOM3 FNucl
Thursday 13th July, at IOM3, 297 Euston Rd, London

46 attendees ventured into the Mine for a most excellent lecture followed by a buffet and drinks. The subject of the lecture: “Materials challenges to deployment of 21st century nuclear reactor systems – Can we do better than the early pioneers?”

I won’t attempt to try and give this lecture justice as it’s outside my experience, but the presentation may be found on the EMG microsite http://www.iom3.org/energy-materials-group. Yes the presentation is large at 56Meg but is worth the trouble to download and view. For me there were some startling facts, e.g. spot the reactor vessel in the below pictures

Well that’s the small reactor on this huge construction site but what about the reactor vessel, i.e. the bit that does all the work. By work what we mean is that in one Pressurised Water Reactor fuel pellet (~5g of UO2) there are around 6 trillion fissions per second. Each fission produces around 200 MeV (32 pico-Joules) therefore each pellet produces around 200 W, so over a typical 3 year life, this is equivalent to ~20 GJ, or 5000 kW-h. That’s a fantastic energy density for 5g of fuel
When you see the vast infrastructure that goes around this reactor vessel there’s no wonder at the financial costs involved.

The main portion of the presentation was the materials developments required for the next generations of reactors both large scale and the small modular reactors. These developments, mainly related to a better understanding of how materials behaviour over a 60 year period in a radioactive environment are aimed at answering the original question, i.e. Can we do better than the early pioneers? Well the answer to that must be a definitive yes, with all the materials testing and examination that has been conducted over the years and continues today. For me the use of SiC/SiC composite fuel cladding looks very exciting, taking me back to the exciting days of researching ceramic composites for gas turbine combustion chambers.

Sue Ion also covered the work on-going for life extension of the existing fleet that will be required to cover the time before any new plant comes on stream, as indicated in the graph left. Graphite core degradation and stress corrosion cracking of 316H and alloy 600 seem to be the presenting the most challenges with regard structural integrity of existing plant.
EMG Annual Lecture

During the presentation Dame Sue Ion paid tribute to Admiral Rickover, whom she considers to be the pioneer of commercialisation of nuclear energy through the first use of nuclear propulsion for submarines.

At the end of the presentation Dame Sue Ion was presented with an Honorary Fellowship, by Martin Cox the IOM3 President, and thanked by Stuart Irvine the chair of the EMG.

Discussion is now underway within the EMG for the topic and presenter for the next lecture in 2018. Whilst we have lots of ideas we would welcome any suggestions from our readership so if you have any thoughts please advise peter.barnard@doosan.com

Anyway enough rambling from me, so I just remind you again to visit the website and download Sue’s presentation http://www.iom3.org/energy-materials-group
### Upcoming Events

**Next Committee Meetings**

Wednesday 1st Nov 2017, at IOM3, 297 Euston Rd, London

**EMG Workshops/Conferences**

None announced, but several in the planning

**Other Workshops/Conferences of Interest**

- 4th Energy Materials Symposium, 7th September 2017, University of Bath, UK
- ECCC Creep & Fracture 2017, 10th – 14th Sept 2017, Düsseldorf, Germany
- AEM 2017, 11-13\textsuperscript{th} Sept 2017, University of Surrey, UK
- High Temperature Degradation Workshop, 12\textsuperscript{th} Sept 2017, IOM3 Grantham, UK
- Euromat 2017, 17\textsuperscript{th} – 22\textsuperscript{nd} Sept 2017, Thessaloniki, Greece
- Asia Power Week, 19\textsuperscript{th} – 21\textsuperscript{st} Sept 2017, BITEC, Bangkok, Thailand
- 14th International Conference on Functional Energy Materials, 6\textsuperscript{th} – 7\textsuperscript{th} Dec 2017 Dallas, USA
- 3\textsuperscript{rd} IEA CCC Workshop on A-USC Power Plants, 13\textsuperscript{th} - 14\textsuperscript{th} Dec 2017, CSM, Rome
- ASME Symposium on Elevated Temperature Applications of Materials for Fossil, Nuclear, and Petrochemical Industries, 3\textsuperscript{rd} – 5\textsuperscript{th} April 2018, Seattle, USA
- EuroSuperalloys 2018, 9\textsuperscript{th} – 13\textsuperscript{th} Sept 2018, Oxford University, UK
- Parsons 2019, 16\textsuperscript{th} – 18\textsuperscript{th} September 2019, Cranfield University, UK

For a list of events visit [www.iom3.org/energy-materials-group/events](http://www.iom3.org/energy-materials-group/events)

### Interested in EMG Activities?

Contact: Prof Stuart Irvine, [s.j.c.irvine@swansea.ac.uk](mailto:s.j.c.irvine@swansea.ac.uk)

Items Relating to Newsletter Contact: Dr Peter Barnard, [peter.barnard@doosan.com](mailto:peter.barnard@doosan.com)