

# Innovations in Renewable Energies

Friday, 27 April 2012 09:00 - 17:00

Peter Jost Enterprise Centre, Liverpool John Moore's University, United Kingdom

The UK government has announced significant investment in renewable energy research throughout the UK. UK researchers have been involved in the development of many new processes and technologies. Some companies have found it sufficiently economical to build UK biorefineries. This meeting aims to bring researchers from all fields of renewable energy together to share experiences and the latest technologies employed, maximising UK-wide collaboration and looking at access to funding opportunities.

Meeting Chair: *Professor Ahmed Al-Shamma'a*, Liverpool John Moores University, UK

- 9:00 – 9:45      **Registration**
- 9:45 – 10:00    **Introduction by the chair:** *Professor Ahmed Al-Shamma'a*, Liverpool John Moores University, UK
- 10:00 – 10:30    **The Algal Bioenergy Special Interest Group**  
*Dr Michele Stanley*, Scottish Marine Institute  
The Natural Environment Research Council and the Technology Strategy Board are funding over the next 2 years an Algal Bioenergy Special Interest Group (AB SIG). This Network has been tasked with bring research to bear on understanding the opportunities and risks to the quality of freshwater and marine environments of using algal biomass as a source of renewable energy both at the academic and commercial levels.
- 10:30 – 10:45    **BBSRC funding opportunities for the bioenergy sector**  
*Dr Michael Booth*, Strategy & Policy Officer , Biotechnology and Biological Sciences Research Council , UK  
The Biotechnology and Biological Sciences Research Council (BBSRC) has identified Industrial Biotechnology and Bioenergy as one of its three high level strategic research priorities within the 2010 – 2015 strategic plan (<http://www.bbsrc.ac.uk/publications/planning/strategy/priority-bioenergy.aspx>). The BBSRC Sustainable Bioenergy Centre (BSBEC; <http://www.bbsrc.ac.uk/research/biotechnology-bioenergy/bsbec/bsbec-index.aspx>) is an example of our current funding in this area. Working both internally, across Research Councils and Internationally a number of funding opportunities have been developed to encourage further research within the bioenergy area. These will be presented here, along with a discussion on the mechanisms of industrial collaborations within BBSRC funding.
- 10:45- 11:15    **Microwave enhancement of pretreatment, hydrolysis and fermentation in 2nd generation bioethanol production**  
*Dr Alex Stavrinides*, Liverpool, UK  
2nd generation cellulosic ethanol is limited by pretreatment and hydrolysis methods. Work conducted by the Radio Frequency group of Liverpool John Moores University as part of the "Micrograss" FP7 project has addressed pretreatment by microwave enhanced delignification of the biomass feedstock prior to hydrolysis. PhD work by A. Stavrinides (LJMU) has shown a fourfold increase in initial cellulase enzymatic rates and 42% yield increase on cellulosic materials by the use of isothermal microwave methods. The work presented highlights the variety of work being carried out in 2nd generation processing at LJMU.
- 11:15 – 11:45    **Speakers' photo then mid-morning break and trade show**  
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- 11:45 – 12:15    **A Thermophilic Solution for Cellulosic Ethanol: A Case Study**  
*Paul Milner*, TMO Renewables, Guildford  
There is increasing global requirement for substantial quantities of biofuels, in particular cellulosic ethanol. Microbially produced cellulosic ethanol faces three major hurdles, high capital costs, high enzyme costs & efficient conversion of these mixed sugars into ethanol. TMO has developed a cellulosic ethanol process which reduces the major barriers to commercialization and delivers an economically viable process. This fully integrated process has been running successfully in TMO's Process Demonstration Unit (PDU) for more than 3 years. The main process features will be illustrated with representative data from our lab, pilot and demonstration scale.
- 12:15 – 12:45    **Future Batteries for Energy Storage**  
*Dr. Laurence Hardwick*, The University of Liverpool, UK  
Lithium-ion batteries have revolutionised portable electronics and will play a crucial role in the electrification of transport; however, the highest energy storage possible for Li-ion batteries is insufficient for the long-term needs of society, e.g. extended range electric vehicles. To go beyond the horizon of Li-ion batteries is a formidable challenge;

there are few alternatives. New battery chemistries that could potentially deliver game-changing increases in energy storage will be discussed.

- 12:45– 13:45 **Lunch and trade show**  
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- 13:45 – 14:45 **Question and Answer Session**  
Delegates will be asked to submit questions to a panel of experts. Questions can be submitted before the event or on the day
- 14:45 – 15:15 **Talk to be confirmed**  
TBC, Sartorius Stedim UK Limited
- 15:15 – 15:45 **Afternoon Tea/Coffee and trade show**
- 15:45– 16:15 **Thin film solar cells**  
*Professor Ken Durose, Stephenson Institute for Renewable Energy, Stephenson Institute for Renewable Energy, UK*  
This talk aims to give an overview of new and sustainable low cost solar cells, and to be an essential guide to how they work, what limits them and what we can expect to get from them. Many of the challenges for the solar revolution are centered on materials: there are opportunities for the enhance operation the photovoltaic devices and for transparent conducting electrodes used in their construction. This must be achieved sustainably and economically. Also I will attempt to answer the question: 'Is a tree more efficient than a solar cell?'
- 16:15 – 16:45 **Re-commercialisation of the Butanol Fermentation**  
*Dr Edward M Green, Green Biologics Ltd*  
Biobutanol is an important commodity chemical with a global market worth approximately \$5 billion and also a superior next generation biofuel. Biobutanol has the potential to substitute for both ethanol and biodiesel in the biofuel market estimated to be worth \$247 billion by 2020.  
The butanol fermentation process was first developed in the UK in 1912 and commercial production quickly spread around the globe, first to produce acetone for ammunitions and then later to produce butanol for paint lacquers. The fermentation process fell out of favour in the 1950's when it could no longer compete with synthetic production from oil. We report on of the key technical advances required to drive down production cost and efforts on re-commercialization.
- 16: 45 – 17:00 **Chairman's summing ups**

This meeting was organised by Euroscicon ([www.euroscicon.com](http://www.euroscicon.com)), a team of dedicated professionals working for the continuous improvement of technical knowledge transfer to all scientists. Euroscicon believe that they can make a positive difference to the quality of science by providing cutting edge information on new technological advancements to the scientific community. This is provided via our exceptional services to individual scientists, research institutions and industry.

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**Keywords:** microalgae, macroalgae, bioenergy, environment and ecosystem services, Cellulosic Ethanol, Thermophil, Thin film solar cells, nano-wire, solar electricity, quantum electronics, thin-film; photovoltaic; solar cell, transparent conductor, lithium batteries, energy storage, BBSRC, funding, bioenergy, biobutanol, advanced fermentation, re-commercialisation, next generation biofuels, Microwave, biofuel, cellulosic, 2<sup>nd</sup> generation, ethanol, Amylase, *Bacillus*, chromosome, co metabolic, medium, Proficiency productivity

### About the Chair

**Ahmed Al-Shamma'a** is the director of Built Environment and Sustainable Research Institute (BEST) at the School of Built Environment. Ahmed has extensive research area covers a wide range of applied industrial science including advance technologies for renewable energies from waste including biodiesel, bioethanol and biobutanol, waste recycling, environmental and sustainable agendas, wireless sensors for the construction, healthcare, automotive and aerospace industries, Material processing, Bespoke software solution to monitor real time energy levels in various industrial applications and Near zero carbon initiatives for the energy sectors. Ahmed is one of the EU scientific officer on Renewable Energies and has obtained various supported applied research projects funded nationally and internationally by the EU, UK and USA Ministry of Defence, Carbon Trust, Technology Strategy Board and direct funding from industry with portfolio of various Knowledge Transfer programs between academia and Industry. The success of the research has led to the establishment of three spin out companies in Liverpool John Moores University. Ahmed has published over 250 per reviewed scientific publications, 15 patents and coordinated over 20 research projects

### About the Speakers

**Michele Stanley** is the Director of the AB-SIG network, hosted by the Technology Strategy Board Biosciences KTN. Michele was appointed on a secondment from the Scottish Association for Marine Science (SAMS) to the KTN Plant Sector team for one day per week over the two year duration of the AB-SIG. Michele is a Senior Lecturer in Marine Molecular Biology at SAMS and an internationally recognized expert in the field of algal biofuels. Michele brings extensive knowledge to the AB-SIG of commercial activities which use algal biomass for renewable energy and chemicals production, and the environmental considerations associated with the large-scale use of micro- and macro-algae.

**Alex Stavrinides** is a research scientist for the Radio Frequency and Microwave (RFM) group within the Built Environment and Sustainable Technology (BEST) Research Institute at Liverpool John Moores University. He recently completed his Ph.D. in isothermal microwave biology, designing a microwave system to enhance the cellulase function and modification of ethanogen metabolism. With a background in biotechnology, his research investigates field effects on biological systems at non-lethal energy densities. Alex, funded through FP7, has been involved in the physical and process design of the "Micrograss" reactor, as well as the provision of background biological research and the projects analytical testing.

**Edward Green** gained a Ph.D. in Biochemical Engineering from the University of Manchester Institute of Science and Technology (UMIST) in 1993. Edward spent five years in academia at Rice University, Texas, US and at Gothenburg University, Sweden developing novel microbes for biofuels and chemicals. In 1998, he joined Agrol Ltd., a UK start up where he established a multi-disciplinary team that developed a high temperature ethanol process. In 2003 he founded Green Biologics Limited (GBL) to develop and commercialise the butanol fermentation. Edward has pioneered technical improvements in microbial fermentation processes for biofuel production over the past 20 years contributing to numerous scientific publications and patents.

**Laurence Hardwick** received a MChem in Chemistry in 2003 from the University of Southampton and a PhD in Chemistry from ETH-Zurich in 2006. Before joining the Stephenson Institute for Renewable Energy at the University of Liverpool he spent his postdoctoral time working at the Lawrence Berkeley National Laboratory and at the University of St Andrews investigating Li-ion battery electrode degradation mechanisms, lithium diffusion pathways through carbon and the chemical and electrochemical processes in Li-air cells.

**Paul Milner** graduated from Liverpool Polytechnic in 1984 before going to do a Masters degree in Biotechnology in 1986. After 13 years working in academia & government research institutions, he moved to the industrial sector in 1999. Paul now has over 9 years experience working thermophilic bacilli & biofuels development

**Ken Durose** is Professor of Applied Physics in the new Stephenson Institute for Renewable Energy in the University of Liverpool. He has published over 140 papers on thin film solar cells and his research team is active in nanowire solar cells, transparent conductors, and new materials for solar energy.

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## POSTERS

### AMYLOLYTIC PROFICIENCY AND CHROMOSOMAL NATURE OF SOME MICROBIAL STRAINS OF THE GENUS *BACILLUS* IN STARCHY SUBSTRATES.

by

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Some microbial strains of the genus *Bacillus* were screened for their ability to produce amylase for industrial, environmental and related scientific use. The *Bacillus* species isolated from soil, waste-water and food sources were identified and categorized into seven groups as *B. subtilis*, *B. licheniformis*, *B.circulans*, *B.coagulans*, *B. megaterium* and *B. polymyxa*. Low values of phosphate were observed for *Bacillus* strains with high amylase proficiency such as *B. licheniformis* (WBL), *B. subtilis* (WBS) and *B.macerans* (MBM) with 0.108%, 0.095% and 0.149% respectively while some bacillus strains with low amylolytic activity constitute more phosphate such as *B.polymyxa* (WBP) had -0.220% P. Similarly, the amount of DNA for highly amylolytic *Bacillus* species such as *B.subtilis* (WBS) and *B.licheniformis* (WBL) was 10.23µg/ml (1.461 cfu/ml) and 10.28µg/ml (2.056 cfu/ml) respectively, compared with other *Bacillus* strains with higher DNA quantity and low amylolytic activity such as *B. megaterium* with 81.11µg/ml (7.37 cfu/ml). Two or Three different *Bacillus* strains were paired into a starchy substrate medium for amylase production. The physiologic and genetic interplay among some paired strains improved their amylolytic activity. The paired strains of *B.subtilis* and *B.licheniformis* (WBS and WBL) showed high enzymatic value of 12.0 unit/ml. *B.megaterium* and *B. coagulans* (SBG and WBC) also showed relatively high amylase value of 11.52 unit/ml. In the assay systems, the *Bacillus* strains showed higher amylolytic values in starchy substrates than glucose and sucrose. Furthermore, peptone nitrogen source was generally good for amylase production than yeast extract. Ca<sup>2+</sup> cation enhances amylolytic activity than Na<sup>+</sup> that was less effective.

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