

## PROVISIONAL PROGRAMME

# NEXT GENERATION MATERIALS FOR SOLAR PHOTOVOLTAICS

A 1-day Symposium Hosted by The Royal Society of Chemistry Energy Sector

The Chemistry Centre, Burlington House, London

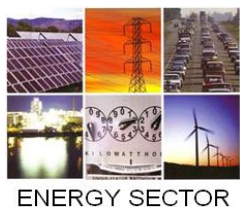
**15 January 2014**

The meeting will cover recent advances in Solar Photovoltaics with a focus on materials for organic, inorganic and hybrid thin film cells. The day will comprise presentations by six guest speakers and six contributing speakers and poster presentations during the lunch and coffee breaks.

### ORGANISING COMMITTEE

Nigel Mason (RSC-ES)     James Durrant (ICL)

Henry Snaith (Oxford)     Stuart Irvine (Glyndŵr)



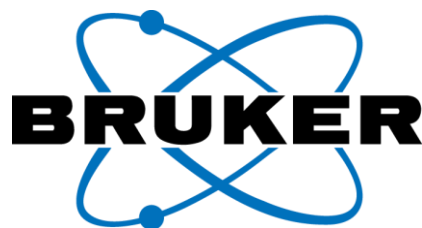
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## SPONSORS

This meeting has been underwritten by the RSC Energy Sector interest group.  
Our thanks to the Royal Society of Chemistry for financial support.

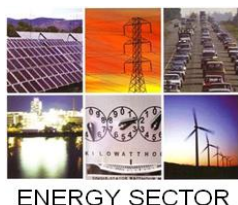
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## GUEST SPEAKERS

**Prof Sir Richard Friend, University of Cambridge**

### **Organic PV diodes: Control of electron spin**

There is generally a large ( $>0.5$  eV) exchange energy between higher energy singlet and lower energy triplet photoexcited state (exciton) in organic semiconductors. I will address two areas where this has important consequences for PV operation. First, this can limit PV efficiency through non-radiative recombination to triplet states, but with specific device architectures this can be avoided. Second, large exchange energies in materials such as pentacene allow efficient splitting of one singlet exciton to a pair of triplet excitons, both of which can be later ionised to charge pairs.

**Dr Karsten Walzer, Heliatek GmbH**

### **Vacuum deposited organic solar cells: From challenging science to commercial opportunities**

Oligomer based organic solar cells may be made by vacuum processing, which is less common than printing approaches from the liquid phase. I will report why Heliatek has chosen this way, and give some update on the current status of the technology, as well as an overview of the up-scaling activities towards full roll-to-roll production. Finally, an outlook will be given in which market segments for OPV can make a difference, as seen from Heliatek's perspective.

**Prof Ayodhya Tiwari, EMPA, Switzerland**

### **Advancements in flexible CIGS and CdTe solar cell technologies for low cost solar electricity systems**

Low energy payback time of CIGS and CdTe polycrystalline thin film solar modules and recent advancements in processing of high efficiency devices have enhanced their competitive positioning - amongst mainstream photovoltaics (PV) - to provide low cost solar electricity solutions. Flexible CIGS solar cells with 20.4% efficiency and monolithically connected mini-modules of 16% efficiency have been achieved on polymer films. Adaptation of roll-to-roll manufacturing and innovative product integration extend numerous advantages for low cost PV systems. The talk will provide an overview of the current state of the art of high efficiency flexible CIGS and CdTe PV.

**Prof Stuart Irvine, Glyndŵr University**

### **Synthesis of inorganic thin film PV from the laboratory to in-line process**

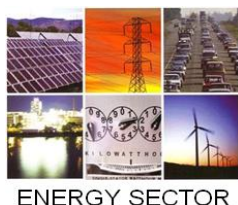
The different approaches to thin film PV deposition will be reviewed and in particular the current production scale processes. The challenge for future advanced thin film PV will be to combine low cost with high volume of manufacture and excellent materials control. Metal-organic chemical vapour deposition (MOCVD) is a production scale batch process and is the process of choice for multi-junction III-V solar cells but is not compatible with high volume in-line processes. This gap is being bridged by a new design of in-line MOCVD and results will be presented on the application to thin film CdTe PV devices and modules.

**Prof Iain McCulloch, Imperial College London**

### **Photoactive materials for organic solar cells**

**Dr Henry Snaith, University of Oxford**

### **Organometal trihalide perovskite solar cells**

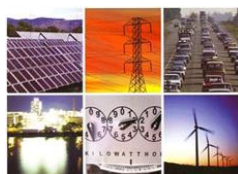


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## PROGRAMME

10.00	Registration and coffee
10.20	Welcome and opening remarks
10.30	<a href="#">Photoactive materials for organic solar cells</a> Iain McCulloch, Imperial College London
11.00	<a href="#">Vacuum deposited organic solar cells: From challenging science to commercial opportunities</a> Karsten Walzer, Heliateg GmbH
11.30	<a href="#">Increased photocurrent in small molecule organic photovoltaic devices using a dual heterojunction cascade structure</a> Edward New, University of Warwick
11.45	<a href="#">High efficiency polymer semiconductors for organic photovoltaics with improved stability</a> Owen Lozman, Merck Chemicals
12.00	<a href="#">New concepts and design rules for hybrid inorganic–polymer nanocomposite solar cells</a> Saif Haque, Imperial College London
12.15	Lunch
13.00	Posters
14.00	<a href="#">Advancements in flexible CIGS and CdTe solar cell technologies for low cost solar electricity systems</a> Ayodhya Tiwari, EMPA, Switzerland
14.30	<a href="#">Synthesis of inorganic thin film PV from the laboratory to in-line process</a> Stuart Irvine, Glyndŵr University
15.00	<a href="#">Material and device parameter extraction in bulk heterojunction solar cells</a> Beat Ruhstaller or Stéphane Altazin (tbc)
15.15	Coffee & Posters
16.00	<a href="#">Organic PV diodes: Control of electron spin</a> Richard Friend, University of Cambridge
16.30	<a href="#">Organometal trihalide perovskite solar cells</a> Henry Snaith, University of Oxford
17.00	<a href="#">Hole-transport materials and dyes for solid-state dye-sensitised solar cells</a> Neil Robertson, University of Edinburgh
17.15	<a href="#">The challenge of scale for next generation photovoltaics</a> Dave Worsley, SPECIFIC University of Swansea
17.30	Closing remarks

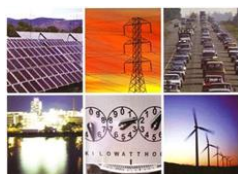


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## POSTER PRESENTATIONS

- 1 CuSbS<sub>2</sub> thin films for PV applications  
Enzo Peccerillo and Ken Durose
- 2 Effect of side chain design on organic photovoltaic device performance  
Michelle Vezie, Iain Meager, Alisyn Nedoma, Mariano Campoy-Quiles, Raja Shahid Ashraf, Hugo Bronstein, Iain McCulloch, Thomas Kirchartz and Jenny Nelson
- 3 Towards a New Age of Energy Efficient Glazing via Dye-Sensitized Solar Cells  
Ann-Louise Anderson, Queen Mary University London
- 4 Photoelectrochemistry of lead halide perovskite materials for solar cell applications  
Adam Pockett and Petra J Cameron
- 5 High Performance Bulk-Heterojunction Organic Solar Cell Using Molybdenum (VI) Oxide Bis(2,4-pentanedionate) As a Precursor for Anode Interfacial Layer  
Rania S Alqurashi and Alastair Buckley
- 6 The physical meaning of charge extraction by linearly increasing voltage transients from organic solar cells  
Roderick. C. I. MacKenzie
- 7 Novel Ruthenium dyes as Sensitizers for Dye-Sensitized Solar Cells  
Yue Hu and Neil Robertson
- 8 Degradation studies of low bandgap Organic Photovoltaics OPVs  
Huw Waters, Noel D Bristow, Omar Moudam, J Kettle and M Horie
- 9 Determining the degree of fullerene crystallinity in polymer:fullerene blends via luminescence spectroscopy  
Jizhong Yao, Anne A Y Guilbert, Thomas Kirchartz and Jenny Nelson
- 10 Ultrasonically Sprayed Aluminium-doped Zinc Oxide Layers for Transparent Conductive Oxides in Thin Film Solar Cells  
Panagiota Arnou, Jake W Bowers and John M Walls
- 11 Photon Frequency Management for Efficient Sunlight Trapping  
Andrew J. Weston, Lefteris Danos, Nicholas Alderman, Liping Fang and Tomas Markvart
- 12 Transmission Electron Microscopy Studies on Cu<sub>2</sub>ZnSnS<sub>4</sub> Solar Cell Absorber Material  
Nessrin Kattan, Bo Hou, David J. Fermín, David Cherns
- 13 Zinc Oxide: Shedding Light on the Photocurrent Response  
Kieren Bradley, David Cherns, David Fermin and Martin Cryan
- 14 Phase Selection and Optimisation of Tin Sulfide for Low-Cost Solar Cells  
Lee A Burton and Aron Walsh
- 15 Using Near Infrared (NIR) Radiation to Drastically Reduce Heating Times on FTO Coated Glass for Dye-sensitised Solar Cells  
Katherine Hooper, Cecile Charbonneau, Matthew Carnie, Bruce Philip, Trystan Watson and Dave Worsley
- 16 Drift-diffusion Modelling of Hybrid Perovskite Solar Cells  
Timo Peltola and Alison B Walker
- 17 Scale-up of organolead halide perovskite solar cells on metallic substrates  
Joel R Troughton, Daniel T Bryant, Matthew L Davies, Matthew J Carnie, Trystan M Watson and David A Worsley



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- 18 Structural, Optical and Electrical properties of nanocrystalline Cu<sub>2</sub>O thin films grown by Pulsed Laser Deposition  
Syed Farid Uddin Farhad and David Cherns
- 19 Charge transport in quantum-dot sensitised ZnO nanorod arrays  
David Parker, David J Fermin and David Cherns
- 20 Towards Optimizing Photocurrent Generation from Fullerene Excitons in Organic Solar Cells  
Stoichko D Dimitrov, Florent Deledalle, Zhenggang Huang, Christian B Nielsen, Bob C Schroeder, Shahid Ashraf, Safa Shoaee, Iain McCulloch and James Durrant
- 21 Triplet sensitized conjugated polymers for use in solar cells  
Rolf Andernach, Stoichk D Dimitrov, Hendrik Utzat, Martin Heeney, James R Durrant, Hugo Bronstein
- 22 Electron-Hole Diffusion Lengths Exceeding 1 Micrometer in an Organometal Trihalide Perovskite Absorber  
Samuel D Stranks, Giles E Eperon, Giulia Grancini, Christopher Menelaou, Marcelo J P Alcocer, Tomas Leijtens, Laura M Herz, Annamaria Petrozza, Henry J Snaith
- 23 Simulation of charge pair separation as probed by transient Stark spectroscopy  
R C I MacKenzie and J Nelson
- 24 Outdoor Organic Photovoltaic Monitoring  
Noel D Bristow and Jeff Kettle
- 25 Scalable Droplet Flow Techniques for the Controlled Synthesis of Semiconducting Polymers  
James H Bannock, Siva H Krishnadasan, Jonathan J M Halls, Martin Heeney and John C de Mello
- 26 Co-deposition of the alumina/perovskite active layer for efficient, solution processable organolead halide solar cells  
Matthew J Carnie, Cecile Charbonneau, Matthew Davies, Trystan Watson and David Worsley
- 27 Flexible thin film PV encapsulation  
Alf Smith, David Bird, Andrew Cook, Steve Ede, Phil Hollis, Paolo Melgari and Steve Spruce
- 28 Compositions, colours and efficiencies of organolead halide perovskites for solar cells  
Matthew L Davies, Matt Carnie, Peter J Holliman, Arthur Connell, Trystan Watson, Cecile Charbonneau, Joel Troughton and David Worsley
- 29 Novel room temperature laminate technology to enable the mass manufacture of flexible HOPV devices  
Daniel Bryant, Peter Greenwood, Joel Troughton, Trystan Watson, Maarten Wijdekop and Dave Worsley
- 30 Pathways to 50% Photovoltaic Power Conversion  
Ned.J.Ekins-Daukes, Diego Alonso-Alvarez, Markus Führer, Nicholas Hylton, Kan-Hua Lee, Tomos Thomas, Chris Phillips, Roland Piper and Megumi Yoshida

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