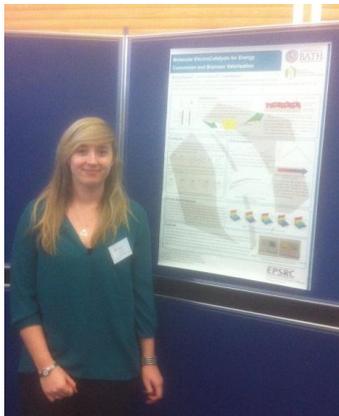


3rd UK Solar Fuels Symposium, Heriot-Watt University

*Emma Sackville
University of Bath*



Last week I attended the 3rd Solar Fuels Network Symposium in a snowy Edinburgh. Spread over two days, the conference comprised talks from leading academics and early career researchers, as well as several poster sessions. The first day of the symposium was the postgraduate event, giving students the opportunity to present their work. Evidently the standard of the presentations was very high and a wide variety of topics were presented, ranging from biology to computational work. In particular there were two notable talks which I enjoyed: Molecular Driven Precious Metal Free PEC Cell (Tim Rosser) and Polymeric Watersplitting Photocatalysts (Pierre Guiglion). The first of these had a focus on catalysts for the water oxidation reaction which is relevant to my own work and the second described the application of computational methods to understanding why some materials, in particular polymeric materials, can or cannot achieve water splitting.

On the second day there were talks from leading academics in the field, and again the breadth of topics and research made for a stimulating day. For me the stand out talk was given by Lee Cronin (Water Splitting with Redox Mediators); I found it especially interesting to hear his opinion that scalability was in many ways a more important objective than efficiency for development of this technology.

In terms of helping my research, the conference was beneficial in several ways. Firstly, hearing from speakers from such a wide range of areas of research really helped me place my own research in the context of the wider picture. As a first year student at the beginning of my PhD I found this particularly useful. Secondly a number of the talks gave really excellent introductions and this helped me to cement my own understanding of the chemistry behind my work.

In addition to the academic content, this symposium was also the first opportunity I have had to present a poster externally. This was invaluable experience and I was pleased to have my poster commended. Being able to listen to other researchers at a similar stage allowed me to observe other presenting styles as well as learn about some fascinating research; I noted several techniques and styles that I would like to try and incorporate into my own talks!

Overall I thoroughly enjoyed my visit to Edinburgh and would like to thank the Solar Fuels Network for their generous subsidising of my travel costs. I found the whole conference both interesting and useful and am looking forward to incorporating some of the ideas and knowledge in my own research.



3rd UK Solar Fuels Symposium, Heriot-Watt University

Emily Glover

University College London

I attended the 3rd Annual Solar Fuels Network Symposium as a PhD student, developing materials to be used as photocatalysts for water splitting. The talks were wide ranging, from computational analyses to discussion of inorganic and bioinspired materials; all areas of interest were covered.

Particularly I would like to highlight the success of the first day of the conference, which focussed on PhD student contributions. This session was very well subscribed, with eight postgraduate students giving talks (myself included) and many more presenting posters. The atmosphere of the afternoon was supportive and helpful; after each talk there was thorough discussion of the work, allowing all of us to practise defending our research and allowing the more experienced members of the audience not only to question and pass comment on our presentations but also to encourage us and offer suggestions.

As a PhD student from a small research group, I rarely get the chance to present to more than 10 people and having a “safe space” such as a postgraduate symposium in which to hone my skills as a presenter was an exceptionally valuable experience. I would like to thank the organisers and other attendees for creating such a positive atmosphere- it would be great to have other opportunities such as this.



3rd UK Solar Fuels Symposium, Heriot-Watt University

*Dr Federico M Pesci
Imperial College London*

Attending the 3rd Solar Fuel Symposium in Edinburgh was extremely interesting and stimulating, as in both the PG and the main symposia, several talks covered different aspects of the research carried out on solar fuel at the moment. I have particularly appreciated the variety of subjects covered during the symposia: from fundamental spectroscopic studies and theoretical calculations to design and development of solar fuel devices. While the talks in the main symposium were more general, offering an extensive overview of the progresses and applicability of solar fuels in the UK, the presentations of the PG symposium were more specific and offered the chance to have constructive discussions between post-graduate students and early stage researcher, followed by well-organised poster sessions. I have particularly enjoyed three talks, two given during the PG symposium and one during the main symposium.

Jan Rongè from Cambridge University gave the first talk that particularly caught my attention (PG symposium, 19th of January). In the presentation he described the design and development of a solar fuel reactor, which captures water vapours directly from air and could be operated entirely off-grid. This reactor represents an example of a practical device employed for splitting water into molecular hydrogen and oxygen and, thanks to its simple design and principle of operation could, for instance, provide a solution to the energy demand of a single household. I personally believe that at this stage, where the fundamental principles of water splitting have been widely investigated, the development of water splitting devices is particularly important in order to show to the industrial community a practical applicability of the ideas developed in academia, leading to a constructive cooperation between these two communities.

The second talk I particularly enjoyed was given by Elizabeth Bay from Heriot-Watt University (PG symposium, 19th of January). She raised a really interesting point, showing how different scientific communities use various parameters to define the efficiency of solar fuel reactors, leading to misinterpretations when comparing the reported efficiencies of practical devices. A standardisation of these parameters could in fact be beneficial in order to facilitate the comparison between several reactors and define a communal efficiency target.

Finally, I have enjoyed the talk given by Lee Cronin from Glasgow University (main symposium, 20th of January) where he provided a general overview of the progresses achieved in photoelectrochemical water splitting and in particular the possibility to produce at separate times molecular hydrogen and oxygen using the concept of electron-coupled-proton-buffer, overcoming many of the problems associated with the simultaneous production of H₂ and O₂ during water splitting.

On the whole, I have found both the symposia extremely interesting as several active discussions have been induced during these two days. In my opinion, the variety of topics has contributed to the success of this meeting; therefore I would highly recommend to anyone with an interest in solar fuels to attend future meetings organised by the Solar Fuels Network.



3rd UK Solar Fuels Symposium, Heriot-Watt University

Habib Ullah

University of Exeter

I attended all the sessions of this symposium besides presenting my own poster entitled, "Metal Ferrites Semiconductor Electrodes for Photosynthetic Cell". I was not fully aware of solar fuel before attending this conference, both of the invited and graduate student talks are proved helpful in my research. The speech of Prof Richard Cogdell and Mercedes were encouraging for our future research perspectives. Basically, I am working on the synthesis and fabrication of metal ferrites photo-anodes for water splitting and do Density Functional Theory (DFT) study of these materials as well. I had few queries regarding DFT study of my research work which are overcome in this symposium from the talk of Dr. Martin, Emily Glover, Pierre Guiion, Frank Jackel, and Enrico Berardo. During the break time I enjoyed the useful discussion with the invited speakers. I am a first year Ph.D student and this was my first time to attend a symposium outside the country. The talk of Dr Leroy (Lee) Cronin (University of Glasgow) on the last day of the symposium was amazing/interesting, encouraging and knowledgeable. I like the devotion of Dr Lee and methods he used for the generation of Hydrogen energy fuel. Dr Lee discussed that photoelectrochemical membranes electrolyzers, solar to fuel systems and artificial leaves are able to deal with varying energy inputs and have rapid start-up times. Everyone knows that Renewable energy inputs tend to be sporadic and fluctuating, and hence the systems that are developed to cultivate this energy and convert it to hydrogen fuel required modification. In this regard he proposed a new concept of the electron-coupled-proton buffer, which can act to decouple electrolytic hydrogen and oxygen production, producing these gases at separate time. Prof Jeffery Chi-Sheng Wu of the National Taiwan University, very simply and adequately discussed the CO₂ photo-reduction to renewable energy, using a novel twin reactor. One of the best point of Prof Jeffery talk, he used theory prior to synthetic effort which is awesome for successful research laboratory. In this symposium, I learnt a new technique which I have had little information, Transient Absorption Spectroscopy (TAS) and fortunately this technique was efficiently explored by different speakers such as Dr. Stephanie Pendlebury (Imperial College London), Ernest Pastor, Yimeng Ma, and Dr alex Cowan (University of Liverpool). TAS is a very useful technique for the measurement of charge transferring phenomena and photocatalytic reaction mechanism. So, with the help of this technique one can explore the tuning of a photocatalyst for water splitting and pollutants degradation efficiently.

Finally, I would express my opinion regarding solar fuel that it is an immense need to build such types of electrodes that can harvest solar energy and generate clean energy (hydrogen energy) for our bright future. Although, this field is quite new but hopefully the reward is not too far away. I am very thankful to the Solar Fuel Network (SFN) for giving me the membership opportunity. Being a part of SFN, I can get success in the designing of new solar fuel material, through conferences, symposiums and workshops.

3rd UK Solar Fuels Symposium, Heriot-Watt University

Jeffrey C. S. Wu

National Taiwan University

I was invited to give a talk in this symposium by Professor Mercedes Maroto-Valer of Heriot-Watt University. My topic is CO₂ photoreduction to renewable energy using a novel twin reactor in the afternoon on 20th January. After the symposium, I stay 2 days to meet and discuss some members of Mercedes's research team. We had collaborative research in the past. I am glad we come to some common topics, which can be cooperated in the future.

The symposium is very interesting because all presentations, orals and posters, are related to solar energy conversion. I got the first-hand progress of current research in the subjects, and they are very helpful in my research direction in the future. Some presentations got my special attention.

(1) Prof. Adam Lee presented the Nanostructured materials for CO₂ photoreduction. I work on the photocatalytic CO₂ for more than 10 years, and always look for high-efficient photocatalysts to increase quantum efficiency significantly. The unique nanostructure of Cu oxides would be worth to try in my CO₂ reaction system.

(2) The poster, Visible-light induced CO₂ photoreduction using g-C₃N₄ by James J. Walsh gave a potential candidate of CO₂ photocatalyst, especially in the real sunlight condition.

(3) Prof. Hugo Ignacio de Lasa presented a novel photoreactor design from the viewpoint of reaction engineering. The design is very practical for industrial applications.

(4) The poster, Decoupled hydrogen evolution from a molecular metal oxide redox mediator and a catalyst in water splitting by Lewis MacDonald is an interesting method. Hydrogen is stored during the water oxidation, then, can be released at very fast rate later. However, I suspect the conversion efficiency may be too low to be practical at current stage.

Finally, the bioresearch concept using 3D printing technology by Prof. Leroy Cronin is very interesting. I look forward to hearing his results in the future.



3rd UK Solar Fuels Symposium, Heriot-Watt University

Jonathan Lee

University of Liverpool

Speeding northwards and bound for Edinburgh, we skirted the Lake District, snaking between the snowy hills of the Scottish lowlands. At Waverley station, we left the stale air of the train cabin behind us – along with the tube containing four of our group's posters – and emerged excitedly into the frigid Lothian evening. After a frantic dash back onto the train for a dramatic rescue operation, we went in search of our hotel.

The next day, we made our way to Heriot-Watt University for the 3rd UK Solar Fuels symposium, following on from gatherings at the University of Liverpool and University College London. These symposia bring together members of our research community to present their work and to connect with one another at a specialised event, facilitating more in-depth discussions.

Before Tuesday's main event, a session for postgraduates was organised for Monday afternoon to allow a more informal opportunity to present posters and speak about ongoing research. Jan Rongé, a PhD student visiting the University of Cambridge from KU Leuven, set the bar with the first talk of the day. He discussed his work developing an air-based photoelectrochemical cell for hydrogen production, which creatively captures ambient water using zeolite stubs embedded in a proton-exchange membrane (RSC Adv., 2014, 4, 29286). After the day's talks, Jan was recognised with a prize for best talk. Contributing to the diversity of topics was Katharina Brinkert of Imperial College London, who spoke about her efforts examining photosystem II and the role of dioxygen radicals in photocurrents. Her presentation offered a useful perspective for those that employ molecular systems for their studies to appreciate the complexity of biological-scale systems and the insights they can offer. Coffee breaks permitted time to drift between posters and speak with other young researchers about their successes and struggles. From the field of poster presentations, Mark Forster from the University of Liverpool was awarded for his poster on the mechanism of water oxidation at hematite photoanodes.

The session on Tuesday comprised talks from invited speakers and more established young researchers. I had been attracted to a poster the previous day, and got talking to its creator, Lewis MacDonald, a PhD student in Lee Cronin's group at the University of Glasgow. He described the work he had been involved in since the publication of an interesting paper by the group last year (Science, 2014, 345, 1326-1330). Their approach allowed hydrogen and oxygen production to be separated by means of a reversibly reducible polyoxometallate redox mediator. Lee Cronin himself spoke about the work the following day, and brought it to life memorably with a video showing the rapid, spontaneous hydrogen evolution that was observed with their system.

As with past symposia, this meeting of UK solar fuels network members was worth the trip. We can of course learn about the scientific efforts of others in our community by simply keeping an eye on the literature, but it is an altogether superior experience to be able to learn from the people themselves.



3rd UK Solar Fuels Symposium, Heriot-Watt University

*Joshua Karlsson
Newcastle University*

My initial thoughts regarding going to a symposium after having just started a PhD at Newcastle University two weeks prior might have left me expecting not to be able to make the best of it. The truth was in fact the exact opposite as I quickly realised the importance of getting to know one's contemporaries, and what they are contributing to your field of research. Although at this point I only know my research will involve charge transfer in molecular species suitable for use in solar cells, the conference was an excellent demonstration of how wide a range of research paths there are in solar energy, even in the specific context of solar fuels.

Having previously studied at the University of York as an undergraduate and Imperial College London as an MRes student, it was pleasing to see familiar research groups represented in the conference. My previous work at Imperial College investigated charge transfer in plant photosynthesis. This was a good window into many of the talks given during the symposium. Naturally there was tendency to draw analogies with photosynthesis during discussions of water-splitting applications.

Closer to my future research, which will be doing absorption spectroscopy on molecular candidates of interest with an eye to solar cell applications, transient absorption spectroscopy was another stand out topic mentioned in many talks. It will no doubt be a technique I could be investigating myself in more detail soon.

The two day conference had a nice contrast between each session with an emphasis on postgraduates during day one and senior researchers on day two. There was an impressive turn out of both guest speakers and poster presentations, all of very high quality. The postgraduate session provided a useful opportunity to focus on the work of early career researchers.

What perhaps is quite refreshing from the discussions during the symposium was the admission of how much we do not know. Also it quickly becomes apparent how much interdisciplinary co-operation is required to tackle the considerable obstacles in implementing viable solar cells for generating fuels or chemical feedstocks. Clearly there are scientific hurdles even in defining what we are measuring sometimes and in events such as this symposium there is an open discussion on what is the way forward. Another recognised challenge includes real-world obstacles such as getting highly theoretical or lab-scale ideas turned into large-scale industries. Take for example Professor Lee Cronin's pragmatic idea of using wind energy in Scotland to generate hydrogen and use the existing gas network for distribution.

Perhaps as a new research student all the academic hurdles can seem overwhelming but, as was mentioned during the conference, the scale of research is large. Even being one cog making a small contribution is still significant. After all if the field of research can be brought together periodically in these conferences, one day the solutions will inevitably follow.



3rd UK Solar Fuels Symposium, Heriot-Watt University

*Patrycja Stachelek
Newcastle University*

The 3rd UK Solar Fuels Symposium has taken place on the 20th of January in Heriot-Watt University, Edinburgh. The main symposium was preceded by the Post-Graduate symposium on the 19th of January at the same venue. It was a hugely successful meeting, attended by some very accomplished professors, post-docs, and PhD students alike. It attracted speakers from the UK and abroad; some of the invited speakers were Professor Adam Lee, Aston University; Professor Hugo de Lasa, Western Ontario University; Professor Lee Cronin, University of Glasgow and Professor Jeffrey Wu, National Taiwan University. Everyone came with a lot of enthusiasm for the subject. It was an excellent opportunity to learn about progress that has been made in the field of solar fuels as a wide area of topics was covered.

The Post-Grad Symposium was opened by Prof Richard Cogdell and Prof Mercedes Maroto-Valer. It was an excellent opportunity for younger members of the SFN to present and discuss their work. There were two sessions; one concentrated on photoelectrochemical processes, the other one was on photocatalytic processes. Both sessions were equally interesting and each talk was followed by a lively discussion. The quality of all talks was excellent. The first speaker of the day, Jan Rongè won the best talk prize.

The 3rd Solar Fuels Network Symposium took place on the 20th of January. The day was divided into three sessions: 'Selection of Solar Cells', 'Reaction systems and mechanisms' and 'Photocatalysis and Photosystems'. Each session was very informative and the quality of talks was excellent. The meeting further highlighted the importance of the research into solar fuels, and the high quality of work that's being done. There was a great turn out, especially amongst younger members eager to gain further understanding of the subject and listen to the experts in the field of solar fuels.

Over the two days there was also a chance for research groups to present posters and discuss their work. It was an excellent opportunity especially for younger members of the community to exchange ideas and their research experience with others. All posters were of exceptional quality and very informative.

I believe that overall as PhD students we gained more understanding of the field. We had an opportunity to meet some great people, exchange ideas and new collaborations were discussed. This meeting has definitely further motivated us to keep working hard.

On behalf of all participants of the symposium we would like to thank Professor Richard Cogdell and Professor Mercedes Maroto-Valer for organising such a fantastic meeting. I'm already looking forward to the next one. I would also like to thank the Solar Fuels Network for the travel expense support.



3rd UK Solar Fuels Symposium, Heriot-Watt University

Tim Rosser and Janina Willkomm

University of Cambridge

This year's Solar Fuels Symposium, the third such event, took place in the pleasant surroundings of Heriot-Watt University in Edinburgh on the 19th and 20th of January. An addition to the programme this year was the Post Graduate Symposium, on the afternoon of the 19th, giving the chance for young researchers to present and discuss their work through both oral presentations and posters. This was an opportunity that the post graduates took to with relish. In the first session, we heard mainly of photoelectrochemical processes, from a PEC cell operating in air through enzymes, materials, and molecular catalysts. The coffee break allowed us to browse the excellent posters on show, ably demonstrating the breadth of activity engaged in by members of the Solar Fuels Network. We again saw enzymes, materials and molecules, often in combination, used to achieve a variety of oxidative and reductive chemical transformations, all with the aim of effectively storing solar energy as fuel. The second session of talks in the PGS focussed mainly on photocatalytic processes, and we heard how these processes can be studied spectroscopically and computationally, as well on scales ranging from nanoparticle ligands to reactor design.

After an evening in Edinburgh, we returned to Heriot-Watt for the Solar Fuels Symposium, and the day began with two of the invited speakers. First, Adam Lee introduced the field of photocatalytic carbon dioxide reduction, and took us through some of his exciting results in the area. Following was Lee Cronin, who was brave enough to show us a video of himself performing an experiment in his lab! Closing the morning's proceedings was Alex Cowan, who described his group's recent findings on oxygen-deficient photoanodes.

The afternoon brought the next of the invited speakers. Jeffery Wu, joining us from Taiwan, spoke of his innovative approach to spatially separating hydrogen and oxygen production – using a membrane permeable to electron mediators but not the colloidal photocatalysts. Following this, we heard from Jin Xuan about his Solar Fuel Cell, from Frank Jaeckel about a size distribution of CdS quantum dots for improved utilisation of the solar spectrum, and more insights into the true nature of co-catalysts on photoanodes, this time from Steph Pendlebury.

The fourth invited speaker, Hugo de Lasa, began the final session by giving an engineering and reactor design perspective to photocatalytic hydrogen production. He was followed by Martijn Zwijnenburg, who switched the perspective on titanium dioxide photocatalysis to the computational. The day was closed by Heiko Lokstein, who once again reminded us the important role biological systems have to play in the study of solar fuels devices.

We thought the symposium, and particularly the inclusion of the PGS, was a great success and are grateful to the Solar Fuels Network for travel bursaries. Janina and I are also grateful to the organising committee for giving us the opportunity to present and discuss our work, which was invaluable, and to the other presenters for offering fascinating insights into theirs. We now look forward to welcoming you to Cambridge next year!



3rd UK Solar Fuels Symposium, Heriot-Watt University

Xiaoping Chen

University of Southampton

First, thanks very much for organizing the 3rd UK Solar Fuels Network Symposium on 19th-20th January 2015 at Edinburgh Conference Centre of Herriot-Watt University and providing me as a PhD student with the excellent opportunity to discuss the latest advances in the field of solar-driven fuels and artificial photosynthesis research.

During last two years, my research is about photocatalytic hydrogen production using low cost nickels modified CdS under visible light irradiation. And the work is very similar to the one of Dr Frank Jaeckel from university of Liverpool, who has published their work in nature materials magazine. I am so pleased that we found the same phenomena that nickel modified CdS can improve its photocatalytic hydrogen evolution activity and the pH of the solution influence the activity significantly almost at the same time. However, I could not explain the mechanism for it and so just published papers on catalysis communications and applied catalysis b: environmental magazines. It is so fortunate to see him show their work during the symposium. And maybe in near future, I will conduct this work much more easily and better.

In the next step of PhD career, I would like to do some research about photoelectrochemical water splitting. Photoelectrochemical (PEC) water splitting has been extensively investigated as well for water splitting using heterogeneous semiconductors. Compared with photocatalytic water splitting using heterogeneous semiconductors, PEC water splitting has some advantages as follows: Firstly, the external or self-biasing voltage can improve the separation and transfer of excited electron-hole pairs, which can improve the efficiency of photocatalysts; Second, the hydrogen and oxygen can be easily separated because they can be collected at different photoelectrodes respectively; In addition, it does not need stirring, which need less power; Last, semiconductors films can be coated on the surface of electrodes, which facilitates its application in the near future. However, I have never conducted similar research about PEC water splitting before. As a new hand, there are many things needed to learn.

However, during in the oral presentation by Dr Jin Xuan from Heriot-Watt University, He showed his work about solar fuel cell for us that different kinds of solar fuel cells were also introduced. In his work, the solar fuel cells were used for photodegradation of organic waste and electricity generation. The structure of PEC water splitting is similar to solar fuel cell. But, there is some different in choosing photocatalysts for photoelectrodes materials. Further, in his work, for using visible light, sulfides are used which may be not stable. Thus, in PEC water splitting system, sulfides should be avoided. Maybe C₃N₄ would be a promised choice. And I will try this material in my future research about PEC water splitting. Wish excellent results will be got.

Last, thank you again for organizing this symposium, which not only provide me with useful messages and suggestions for my future research, but also let me enjoy the beautiful scenery of Edinburgh city. See you this July in London and wish that I will present my work with you together. Best wishes!



3rd UK Solar Fuels Symposium, Heriot-Watt University
Zhixiang Zhang
University of Southampton

With great pleasure and interest, I attended the 3rd UK Solar Fuels Network Symposium at Edinburgh Conference Centre, Heriot-Watt University from 19th-20th Jan., 2015. Both the post-graduate solar fuel symposium and the UK solar fuel symposium were very well organized and academy-oriented. The invited talks and the posters well presented the individual research results, but showed common sense to the related scientific problems, which covered light and energy fields, e.g., photocatalytic oxidation, CO₂ reduction, water splitting, methane reforming and so on.

What lightened me with the deepest impression in the 2 days symposium is the interval speech made by chair Prof. Richard J. Cogdell from University of Glasgow. During the interval of talks, he put forward a novel but simple advice to the academic researchers seated, that is to open the mind of researchers and to learn or to quote the principle of mother nature. For instance, in the photocatalysis reaction, the reduction and oxidation processes are separated to generate H₂ and O₂ respectively rather than mixed, the mechanism is lively like that of photosynthesis occurring on the chlorophyll molecules. So, the academic research cannot be limited to the laboratory experiments; above all, it is of nature and science interrelated study.

Another concern raised from the symposium is the passive state art of China pollution. The present water, air pollution has been a serious and urgent problem in China and even all over the world. Obviously, the environment, energy and pollution have inherent complicated relationship. When we brought damages to break the harmonious balance existed, remedy actions must be introduced to release and to recovery it. The technology of solar fuel is one of the directions, which depends on solar resource rather than fossil fuel. Taking into consideration of my research of methane reforming, the inevitable biogas and greenhouse gas of CH₄ can be converted to other hydrocarbons, which have less destroyable effect and can be utilized as multifunctional materials. Many researches is studying on it with thermal or light induced catalysts. I have noticed that James J. Walsh, Oluwafunmilola and et.al, groups made progressive results on another greenhouse gas of CO₂ reduction by photocatalysis. Only such green technology boosted can the pollution be controlled and the economy be developed sustainably.

The symposium meeting is well organized and is held successfully as expected. Being a new member like me, I think I should come earlier. Because the notice board outside the James Watt Centre 2 is a bit small, so that I spend over an hour to look for the conference site. The 1# reception desk could not get the schedule information, so we have to look around without any guidance. Fortunately, we went to the office of Prof. Mercedes Maroto-Valer for inquiry with kind help of a Phd student from Heriot-Watt University. It's an interesting experience before the meeting.

As my first attendance of SFN symposium and also first trip to Edinburgh city, I feel satisfied with the academic exchange and symposium presentation as well. It do impress me deeply with all I see and learn. I will keep my interest and effort on the works of the environment and energy issues, and share my research experience with members. Thanks for your support very much and best regards.

3rd UK Solar Fuels Symposium, Heriot-Watt University

*Camilo Mesa-Zamora
Imperial College of London*

Besides the lack of snow in this winter, the fantastic UNESCO world heritage capital of Scotland held the third UK solar fuels symposium in January. This symposium was an exceptional opportunity not only to talk about research, but to have a complete perspective of the solar fuels production state-of-the-art in United Kingdom. In addition to that, meeting young researchers and their approaches towards the problems of producing solar fuels was very stimulating.

At some point in school, every student is told about the carbon cycle and how the carbon in the atmosphere (i. e. carbon dioxide) is captured by any photosynthetic system. Plants, bacteria or algae, can convert that captured CO₂ in organic and more complex molecules, using the sunlight to mediate this conversion. Then, students are told that those small molecules are transformed again into oil which afterwards, people extract it from the Earth and use it as our primary energy source releasing CO₂ into the atmosphere. The problem with this cycle is that the rates of those processes are tremendously different leading to a net result, a massive and increasing amount of CO₂. In fact, as noted by Prof. Adam Lee during his presentation, approximately 10 GTON of carbon were released for 2013. This increasing problem cannot be addressed without taking into consideration the production of solar fuels where different ways to address the synthesis, characterisation and analysis of materials to produce them were discussed during the symposium. In addition to that, their application to produce solar fuels and their posterior use at scalable levels from different raw materials were presented.

Taking a close look at solar fuels production, fields such as, feedstock, materials, devices and engineering work are fundamental. As raw materials, the use of water, carbon dioxide and ethanol were shown through different talks in the main symposium, in order to produce hydrogen, oxygen, methane and methanol, by splitting water and reducing CO₂. Different materials in various conditions are called to accomplish this task, titanium dioxide and titanates, hematite, bismuth vanadate, carbon nanotubes, photosystem II, among others. This fact shows the importance of having different materials to achieve proper light absorption and reasonable photogenerated charge separation.

The symposium also provided good information in the computational research on some of the mentioned materials with the aim to demonstrate the origin of the performance of the material, whether it is considered successful or not. Also and just as important as the laboratory and computational work, is the further production of reasonable amounts of solar fuels. For example, as stated by Prof. Hugo de Lasa ethanol 1% in water should be used with the appropriate device to produce power for a little town.

One conclusion that I arrived after these two days of exciting talks and posters is that all of those achievements presented during the postgraduate and main symposium, have been possible due to the understanding of the different processes taking place during the light absorption, the charge separation and the charge transfer to surface species and its subsequent reaction. An outstanding contribution to this understanding was shown by Dr. Pendlebury, Dr. Cowan and PG students Brinkert, Ma, and Pastor through their



interesting talks, which motivates me to contribute to this enlightening process that Durrant's group is carrying out. – Let the snow comes back –



3rd UK Solar Fuels Symposium, Heriot-Watt University

Wei Li

University of Liverpool

The 3rd UK Solar Fuels Symposium offered me and all the other attendants a fantastic opportunity to present our recent research, to discuss the latest advances in the field and to interact with the rapidly expanding network of researchers in the UK.

There were lots of interesting topics and research outcomes demonstrating the cutting edge of the field, from nanostructured inorganic materials to photoactive biomaterials, from CO₂ photoreduction to water splitting and solar fuel cell, from charge dynamics to mass transfer and reactor design.

The Symposium also invited international researchers (e.g. Canada, Taiwan, etc) to share their research and vision. The globally expanding network will not only bring benefits to all our UK based researchers with more and more collaborative opportunities but also help to spread the impact of our UK based research internationally.

Personally, as an early-career post-doc, the most interesting part of the Symposium was Post-Grad Symposium for postgraduate students and early-career post-docs. It gave us a great platform to present and communicate your research and knowledge with your peers. The established network among us will further bring benefits to our research afterwards.

I would love to say thanks for all the organisers who brought us all these amazing experiences I mentioned above. I am looking forward to attending the 4th Symposium next year.