

# 2015 Green Tech: Integrating Efforts for Sustainable Development

By SONG Jianlan (Staff Reporter)

“The legal approach to combatting pollution, however, only reduces the exposure to pollution, rather than the hazard itself,” asserted Prof. Kenneth R. Seddon from Queen’s University Belfast (QUB), UK, in his plenary lecture when reviewing the rise of pollution in the West as a by-product of the Industrial Revolution and the enhanced legal regulation in USA as an answer to this plight. “The real solution

lies in green chemistry,” he continued. Calling for joint efforts from the scientific community to meet the challenges, and highlighting the role of green technology in the global battle against pollution, the prestigious chemist, who is widely acknowledged as a founder of green chemistry, echoed the theme for the 2015 CAS-TWAS Symposium on Green Technology for Sustainable Development (2015 Green Tech) in Beijing.



“The real solution lies in green chemistry,” Prof. Kenneth R. Seddon from Queen’s University Belfast, UK comments in a brief review of the combat against pollution ahead of his plenary speech on application of ionic liquids. (Photo by SONG J.)



Participants of the 2015 Green Tech.(Photo by SONG J.)

### “Bonding” Time

Held from July 23 to 25, the symposium was organized jointly by CAS and TWAS (the World Academy of Sciences for the advancement of science in developing countries), and co-hosted by CAS-TWAS Centre of Excellence for Green Technology (CEGT) and the CAS Institute of Process Engineering (IPE), in which CEGT is based.

One of the main targets of this symposium, according to Prof. ZHANG Suojiang, head of CEGT and IPE, is to bring together academic researchers in different fields to discuss the possibility of integrating new green technologies for the common goal of sustainable development, and encourage better communication among engineering scientists, practitioners, and policy makers from both developing and developed countries.

For this sake, the symposium invited leading researchers from all over the world to report their latest progress in different areas, hoping to encourage brainstorming and inspire interdisciplinary cooperation.

Revolving around sustainable development, topics of the symposium covered a wide spectrum of engineering science, ranging from green solvents and green chemistry, catalytic reaction and process engineering, biotechnology and bioprocess, nanotechnology and materials, renewable energy and green technology, to pollution control and other related topics.

Since 2013, GEGT has organized several training workshops and symposia on the subject.

### Aiming at Sustainable Development

#### *Ionic Liquids and Green Solvents*

A star in the spotlight was the ionic liquid, a type of liquids formed with ions only. Some salts, due to their

special structure, melt down so easily that they turn into liquids at ambient temperature. Ionic liquids possess a lot of excellent properties – for example they are less volatile – therefore promise widespread applications in synthesis of organic and macromolecular materials, meanwhile avoiding at least pollution derived from volatile organic compounds (VOCs).

Given its bright prospects, ionic liquids have attracted intense attention since the 1990s. In line with the developments over the latest years, the symposium invited a number of speakers distinguished in this field to give plenary lectures and invited lectures. Among these prominent speakers stood Prof. Seddon, whose keynote speech was previously mentioned. As the first lecturer at the conference, in his plenary lecture titled “Applications of Ionic Liquids I” he gave a comprehensive overview and vivid description of the properties of such magical liquids, and introduced their application in environment



Prof. Seddon explains to the audience his ideas.(Photo by SONG J.)



"The more you sweat, the nicer you smell." – Dr. Harambage Quintus Nimal Gunaratne from Queen's University Belfast, UK introduces how his team managed to develop a system based on ionic liquids to make this anti-intuitive idea possible. (Photo by SONG J.)



Dr. Arunprakash T. Karunanithi from University of Colorado Denver gives a lecture under the title "Computer-Aided Ionic Liquid Design: Potential and Opportunities", introducing how they designed ionic liquids of desired properties. (Photo by SONG J.)



Dr. Harambage Quintus Nimal Gunaratne discusses with Dr. Arunprakash T. Karunanithi during the Q/A session in the wake of the latter's lecture on computer-aided design of ionic liquids. (Photo by SONG J.)

preservation, including mercury removal from natural gas, and CO<sub>2</sub> capture.

Prof. Seddon's QUB colleague, Dr. Harambage Quintus Nimal Gunaratne continued on and reported the results from his latest work in ionic liquid application, which immediately caught the eyes of the audience. "The more you sweat, the nicer you smell," he hinted on an anti-intuitive idea in his lecture named "Applications of Ionic Liquids II: Water-triggered Release of Fragrances from Pro-fragrantionic Liquids".

"Ionic liquids are not supposed to vaporize – they do not smell," he said. After a brief pause he approached his idea: "But people would like to get something nice-smelling from a controlled system based on ionic liquids. For example, long-lasting perfume." Based on ionic liquids, his team managed to develop a system capable of scavenging odor and releasing fragrant molecules while mixed with water, the major content of human sweat. He also further detailed how they optimized the kinetics of the release to improve its stability and durability.

Those who would not content with cases of applications might find it marvellous to get inspired by research in how to design an ionic liquid of desired properties. The invited lecture given by Dr. Arunprakash T. Karunanithi from University of Colorado Denver might meet their need. Under the title "Computer-Aided Ionic Liquid Design: Potential and Opportunities", he presented a very informative lecture.

On the other hand, the speech titled "Structure-properties and Application System of Ionic Liquids" given by ZHANG Xiangping from IPE summarized the latest progress in this field and reported the results from her team's work. Other invited speeches on this topic included the one by her IPE colleague Prof. CHEN Shimou, titled "Ionic Liquids in Electrochemistry: from Fundamentals to Applications".



Prof. HAN Buxing from the Institute of Chemistry, CAS gives a lecture titled "Properties of Green Solvents and Applications in Green Chemistry". (Photo by courtesy of CEGT.)



Green solvents beyond ionic liquids also made an important topic at the conference. A typical example could be the second plenary speech titled “Properties of Green Solvents and Applications in Green Chemistry”, presented by Prof. HAN Buxing from the Institute of Chemistry, CAS.

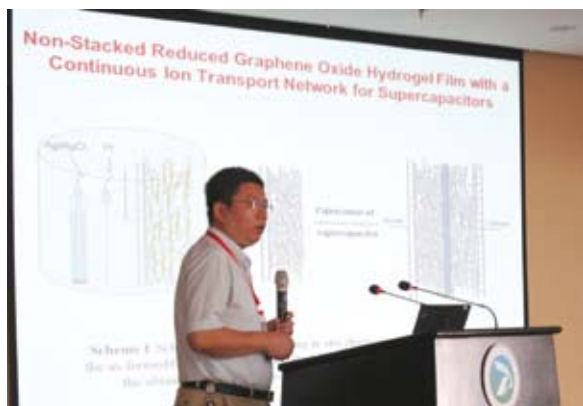
Dr. Patrick Mountapmbeme Kouotou, a Cameroonian scientist who moved to Beijing to work as a post-doctoral researcher with the Institute of Engineering Thermophysics (IET), CAS on the CAS President’s International Fellowship Initiative after obtaining his PhD from Germany, found the lectures lovely, especially the first plenary speech. “It appears to be very interesting for me. From these speeches I’ve learnt some ionic liquids of excellent properties. Now what I use in my experiments are mainly ethanol; maybe I can try on some ionic liquids to get better dissolution,” he remarked.

Patrick also found some other lectures inspiring, despite the fact that his own work is not directly related to the speakers’. “I love the second plenary speech too, as it revealed some subtle mechanisms underlying oxidation, which connects to my work, which involves oxidation of cobalt, in another way.”

#### Advanced Materials and Novel Catalysts

The past decade witnessed the rise of advanced carbon nano-materials represented by graphene, carbon nanotubes and others of novel structures and promising applications. Naturally research in this field, including the synthesis, self-assembly, structure and applications of such materials, attracted due attention at the symposium. The lecture titled “Green Synthesis of Graphene-based Materials and Their Application” given by Prof. YAN Lifeng from the University of Science and Technology of China could make a good representative.

Catalysis research also got an important place. Presentations at the symposium involved research



Prof. YAN Lifeng from the University of Science and Technology of China gives a lecture titled “Green Synthesis of Graphene-based Materials and Their Application”. (Photo by SONG J.)



Dr. Sharifah Rafidah Wan Alwi from the Universiti Teknologi Malaysia introduces the latest progress in energy management in her country.(Photo by SONG J.)

in mechanism, property prediction, development and application of novel catalysts targeted at more environmentally friendly industrial processes and affordable renewable energy sources.

For example, the lecture on catalytic systems for CO<sub>2</sub> conversion under mild conditions given by Prof. LIU Zhimin from the Institute of Chemistry, CAS and the one on CO<sub>2</sub> conversion at ambient pressure by Prof. HE Liangnian from Nankai University, China both provided economical and green solutions for CO<sub>2</sub> recovery and recycled use.

#### Green and Renewable Energy in Focus

Given its vital role in sustainable development, research on renewable energy and related strategic studies outstood as a focus of discussion.

The two plenary speeches, namely the one titled “Advance on ‘Coal to Ethyl Glycol’” given by Prof. YAO Yuangen from the Fujian Institute of Research on the Structure of Matter, CAS and the one titled “Tandem Bio-refineries for Efficient Biomass Conversions to Bio-fuels and Bio-chemicals” by Prof. Z. Conrad ZHANG from the Dalian Institute of Chemical Physics, CAS could have mirrored the great concern shared by the S&T community. Integrating the latest advances in green process engineering and catalytic reaction, they might also represent the joint efforts of the S&T community to address the energy crisis, which is of global importance.

Some other speakers from developing countries shared with the audience their experience in energy management and strategies. Dr. Malti Goel from the Climate Change Research Institute of India introduced the innovative solar energy policies in her country for sustainable development, and Dr. Sharifah Rafidah Wan



Prof. Salah Ud-Din Khan from King Saud University, the Kingdom of Saudi Arabia gives a summary of his strategic thoughts on the issue of energy crisis in his presentation titled "Sustainable Energies: Targeting Solution to Global Energy Demand". (Photo by SONG J.)

危機

"This paradoxical combination might hint that *wherever a danger lies, an opportunity lurks*," Prof. Salah Ud-Din Khan from King Saud University tries to awaken awareness in the audience of the pressing situation as well as potential opportunities in terms of energy crisis, using the Chinese word for "crisis" as an illustration.

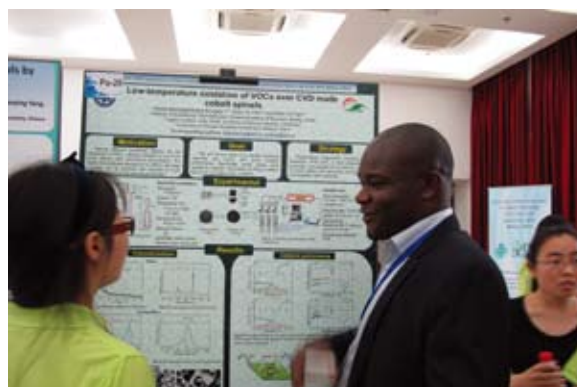
Alwi from the Universiti Teknologi Malaysia introduced the latest progress in energy management in her country, under the title "Advances in Process Integration Research for Hybrid Power System Supply Planning and Demand Management."

Prof. Salah Ud-Din Khan from King Saud University, the Kingdom of Saudi Arabia (KSA), who is also currently working at the CAS Institute of Plasma Physics based in Hefei, capital city of Anhui Province, gave a summary of his strategic thoughts on this issue. In his presentation titled "Sustainable Energies: Targeting Solution to Global Energy Demand", he compared the advantages and disadvantages of different energy sources and concluded that the best solution lies in sustainable energy resources like solar, wind, hydrogen and biomass.

"In Chinese language, the word 'crisis' contains two characters, namely 'wei' and 'ji'. The first one means 'danger' while the latter, 'opportunity'." In a peaceful tone he awakened the awareness in the audience in an unexpected way: "This paradoxical combination might hint that *wherever a danger lies, an opportunity lurks*."

### Budding Seeds

Aside from a total of five plenary lectures, 24 invited lectures and two oral presentations, poster sessions were also available at the 2015 Green Tech venue, providing a



Dr. Patrick Mountapmbeme Kouotou explains his work to a participant in the 2015 Green Tech. Patrick won an Award for Excellent Posters at the closing ceremony of the symposium. Born in Cameroon, he moved to Beijing to work as a post-doctoral researcher with IET after obtaining his PhD from Germany. (Photo by SONG J.)

platform for junior researchers of this area to present their results and to discuss with the senior.

All participants were endowed with the right to vote for their favorite posters. At conclusion of the conference a simple and brief ceremony was held to award the authors of the winner posters. Patrick was among them.

Patrick's work is aimed to find a cheap, green and efficient catalyst to help turning VOCs in waste gases, like tail gas exhausted by cars, into CO<sub>2</sub>. "VOCs are very pollutive, therefore it is very important to turn them into something less poisonous," he explained. "On the other hand, it is pressing to find substitutes for the catalysts we are currently using in cars, which are based on noble metals, such as gold and platinum. We are running out of such noble metals; and after all, cobalt oxide is much cheaper."

"The work might not stop at carbon dioxide as the end product," he added: "A week ago I met a professor here and saw some possibility to cooperate with him to use the CO<sub>2</sub> transformed from VOCs to produce ethanol. That would be great, as you know CO<sub>2</sub> is not totally harmless; it warms up our planet."

Patrick did not think his work would help his homeland to deal with local pollution immediately, however. "I am from Cameroon," he remarked: "We do not have any big problem of pollution right now, but it is important to have such knowledge prepared in advance, right?"

Sadia Akram, a Pakistani student in the third year of her PhD program at the University of CAS supported by the CAS-TWAS Fellowship for PhD Students, also presented a poster at the conference. "It is nice to learn what others are doing, getting informed with what is going on at the frontiers," she expressed her satisfaction with the arrangement of the lectures.



Prof. ZHANG Suojiang, head of IPE and CEGT, announces the winners for the Awards of Excellent Posters.(Photo by SONG J.)

### The Same Dome

At first glance, it might look strange that countries in Middle-East region, which are rich in fossil resources like oil, would make great efforts to find solutions to energy crisis. According to Prof. Khan, however, this is a natural response, as oil and gas give off incredible amount of CO<sub>2</sub>. “We must reduce the emission to a certain extent so we really need to move forward to renewable energies,” he said.

According to Prof. Khan, KSA is already working to set a schedule for carbon reduction, and meanwhile working on some projects for carbon capture and conversion to offset the emission.

To further address this issue, KSA announced in 2010 as a national strategy to develop renewable energies. “Yes, it was announced in 2010,” confirmed Prof. Khan: “We are

dealing with all kinds of renewable energy sources, like wind and solar, which are abundant in the deserts.”

Green technologies might be particularly important for developing countries, which are facing the dual challenge of development and pollution control, and hence are more anxious to maintain a harmonious balance between the environment and economic growth, to achieve a sustainable development. While the developed countries, who have gained valuable experience from their past struggle to curb pollution, could be important contributors in the current round of battle.

Over the two years, CEGT, which aims to promote science excellence in the South in terms of green technology, hosted two symposia in green technology to boost cooperation in the South and beyond.

Actually the renaming of IPE, the host institution of CEGT, might make a good illustration for the historic shift in the field of metallurgy and chemical engineering. Formerly named the “Institute of Chemical Engineering and Metallurgy, CAS”, IPE assumed the current name in 2001 to highlight its renewed focus of research: She turned to fundamental and applied research on green processes that might catalyze a revolution in high-efficiency transformation and substitution of resources, to boost the switch to a less energy-consuming and less pollutive track of manufacturing.

The confluence of efforts under the same dome, made by scientists on different frontiers from both developed and developing countries, might constitute the real opportunity to combat the environment crisis of our planet.



Winners of the Awards for Excellent Posters pose for a group picture together with the senior.(Photo by SONG J.)