



DOI: 10.1002/ijch.202000075

The 18th Asian Chemical Congress and the 20th General Assembly of the Federation of Asian Chemical Societies (FACS): December 8–12, 2019, Taipei International Convention Center, Taiwan

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Chemists have been doing much better than politicians in meeting global challenges, including global warming, food for everybody, the race for sustainable energy, water quality, dwindling raw materials, and health problems. Humankind cannot meet these challenges without the chemical sciences and will not solve any of these problems without global cooperation. We chemists work together across borders through unique collaboration and friendship. Despite fundamentally different political systems and cultural diversity, chemists go beyond borders, find each other, share their findings, and solve problems together.

In his best-seller, *Clash of Civilizations*, Samuel Huntington argues that cultural conflicts along the cultural interfaces shape global politics. Huntington lists nine cultures, including the African, Buddhist, Chinese, Hindu, Islamic, Japanese, Latin American, Orthodox, and Western civilizations. This alphabetically ordered list does not imply that one culture has an advantage over the others, and all should be equally respected. Of the four regional associations of chemists, the European Chemical Society (EuChemS), the Federation of Asian Chemical Societies (FACS), the Latin American Federation of Chemical Societies (FLAQ), and the Federation of African Societies of Chemistry (FASC) the FACS represents the most diverse community, spanning seven different cultures (Buddhist, Chinese, Hindu, Islamic, Japanese, Orthodox, and Western). The enormous heterogeneity, which has created significant challenges throughout the long Asian history, also offers exciting opportunities in our times.

Considering the steady shift of the center of gravity of the global economy to Asia, and the unique role of chemistry in meeting global challenges, the FACS is positioned at a unique crossroad with new opportunities and significant responsibilities. The FACS, which has recently celebrated its 40th anniversary, can and should assume a leadership role in catalyzing the collaboration and cooperation among multiple communities of chemists of various cultures across the Asia-Pacific expanse. By the end of 2019, the FACS included 31 chemical societies in the Asia Pacific, and the list keeps growing.

The FACS has held its flagship, biennial international conference, Asian Chemical Congress (ACC), to provide a communication channel and collaboration among the professional chemists in the region. The 1st ACC took place on 1981

in Singapore, the 2nd on 1987 in Seoul, South Korea, the 3rd on 1989 in Brisbane, Australia, the 4th on 1991 in Beijing, China, the 5th on 1993 in Kuala Lumpur, Malaysia, the 6th on 1995 in Manila, Philippines, the 7th on 1997 in Hiroshima, Japan, the 8th on 1999 in Taipei, Taiwan, the 9th on 2001 in Brisbane, Australia, the 10th on 2003 in Hanoi, Vietnam, the 11th on 2005 in Seoul, South Korea, the 12th on 2007 in Kuala Lumpur, Malaysia, the 13th on 2009 in Shanghai, China, the 14th on 2011 in Bangkok, Thailand, the 15th on 2013 in Resorts World Sentosa, Singapore, the 16th on 2015 in Dhaka, Bangladesh, and the 17th on 2017 in Melbourne, Australia.

The Chemical Society Located in Taipei (CSLT) hosted the 18th ACC and the 20th General Assembly of the FACS at the Taipei International Convention Center, Taiwan, on December 8–12, 2019. The CSLT traced its roots to the establishment of the Chinese Chemical Society in Nanjing in 1932. In 1950, following ROC government's move from mainland China to Taiwan, the Society changed its name. The CSLT focuses on the general advancement of the Chemical Science and its application. Currently, the CSLT has over 2,000 active members. It is governed by a committee of 21 board members from academia and industry, directly elected by the individual members for a four-year term. Half of the board members are re-elected every two years, and the board members elect the President. Prof. Yuhlong Oliver Su is the current President (2019–20). The CSLT publishes a monthly periodical with Wiley, *Journal of the Chinese Chemical Society* (Taipei).

Taipei, Taiwan's capital, is a modern metropolis with Japanese colonial lanes, busy shopping streets, and contemporary buildings. Taipei was founded in the early 18th century, and its current population around 4 million, including nearby metropolitan areas. It is an energetic city blended with modern technologies and historical cultures. The city also has long been noted as one of the gourmet's paradises, featuring a wide variety of Chinese and international cuisines. The city skyline is crowned by the famous 509 m-tall, bamboo-shaped Taipei

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101 skyscraper, with many shops and a rapid elevator to an observatory near the top.

Scientific Program

The scientific program included 7 Plenary Lectures, including the FACS Foundation Lecture, 47 Keynote Lectures, including three FACS Award Lectures, 99 Invited Lectures, and other oral presentations. Altogether the 18ACC featured 902 presentations, including 455 posters, which were distributed among three poster sessions. One of those featured the “Best of the Best” poster competition. As the CSLT held its 2019 Annual Meeting on December 8 at the same venue, featuring an additional 440 posters, the total number of posters in the combined event reached 900.

The 86 sessions included three Presidential Lecture sessions, featuring 12 lectures by society presidents. Three RSC-sponsored sessions featured six Sponsored Lectures and a panel discussion on “Women’s Progress and Retention in Chemistry.” The 2nd ACES-GDCh Symposium featured two sessions and 6 Sponsored Lectures, including the Ryoji Noyori ACES Award Lecture. The ACS session on “CAS, Publication, and Communications” featured three Sponsored Lectures.

A selected group of 21 young chemists, named “Asian Rising Stars,” delivered each a 25-minute Lecture. Merging the 18ACC, the 2019 CSLT Annual Meeting, added 15 scientific sessions. The half-sponsored/half-contributed scientific sessions included the IUPAC/ChemRAWN Symposium of two sessions on Green Catalysis, the ITRI Symposium, which included two sessions on Green Technology and CO₂ Utilization, and seven sessions on “Aggregation Induced Emission.” Two special sessions took place on the last day of the event, featuring short oral competition of the selected “Best of the Best” speakers. A unique plenary forum took place at the end of the congress, featuring three industry panelists.

The 18ACC attracted more than 2,000 participants, including 650 international chemists from 50 countries, mainly from Taiwan, Japan, China, South Korea, the USA, Hong Kong, Saudi Arabia, Singapore, Australia, Philippines, Thailand, Nigeria, India, Turkey, and Malaysia. Special delegations arrived from international organizations, including the American Chemical Society (ACS), the Royal Society of Chemistry (RSC), the German Chemical Society (GDCh), the International Union of Pure and Applied Chemistry (IUPAC), the Asian Chemical Editorial Society (ACES), the European Federation of Medicinal Chemistry (EFMC), and Asian Federation of Medicinal Chemistry (AFMC). All congratulated the FACS for its 40th anniversary. The Congress featured a large commercial exhibition by providers of lab equipment, scientific instrumentation, chemicals, materials, services of analytical chemistry, publishing houses, higher education institutions, etc. The mix of excellent lectures, colorful poster sessions, exhibitions and other activities created a vivid atmosphere with vibrant discussions, exchange of information

and social gathering, all reflected by the collage of photographs (Figure 1).

Organizing Committees

The 18ACC was managed by Chairman Reuben Jih-Ru Hwu of the National Tsing Hua University, Secretary General Ling-Kang Liu of Academia Sinica, and Honorary Chairmen, Chain-Shu Hsu of the National Chiao Tung University, and Yuhlong Oliver Su of the National Chi Nan University, President of the CSLT.

The International Organizing Committee included FACS representatives, Professors Jasim Uddin Ahmad, Mustafa Culha, Chulbom Lee, Long Lu, Sourav Pal, Roger Stapleford, Choon-Hong Tan, Supawan Tantayanon, Datok Dr. Soon Ting Kueh, and Dave Winkler. Non-FACS members included Prof. Sergey O. Bachurin of the Russian Academy of Sciences, Ms. Lori Brown of the ACS, Dr. Patrick Charchar of RMIT University, Australia, Prof. Koichi Fukase of Osaka University, Prof. Kuo-Wei Huang of King Abdullah University of Science and Technology, Saudi Arabia, Prof. Andy Hor of the University of Hong Kong, Prof. Takumi Konno of Osaka University, Prof. Brindaban Chandra Ranu of the Indian Association for the Cultivation of Science, Prof. Ilhyong Ryu of the National Chiao Tung University, Prof. Ben Zhong Tang of the Hong Kong University of Science & Technology, Dr. Sarah Thomas of the RSC, Prof. Susan Shwu-Chen Tsay of the National Tsing Hua University, Prof. Jun-ichi Yoshida of Kyoto University, Dr. Suping Zheng of the Chinese Chemical Society, China.

The Program Committee included Professors Fa-Kuen Shieh of the National Central University, Man-kit Leung of National Taiwan University, and Ming-Hua Hsu of the National Changhua University of Education.

The Local Organizing Committee included Professors Jer-Young Chen of the Industrial Technology Research Institute, Kan-Nan Chen of Tamkang University, Yit-Tsong Chen of National Taiwan University, Yun-Ru Chen of Academia Sinica, Cheng-Ting Chien of Academia Sinica, Mei-Hung Chiu of National Taiwan Normal University, Hsing-Pang Hsieh of the Institute of Biotechnology and Pharmaceutical Research, Shang-Cheng Hung of Academia Sinica, Ju-Hsiou Liao of National Chung Cheng University, Chun-Cheng Lin of National Tsing Hua University, Chun-Hung Lin of Academia Sinica, Wenwei Lin of National Taiwan Normal University, Shaw Chen Liu of Academia Sinica, Lee-Chiang Lo of National Taiwan University, Chi-Kung Ni of Academia Sinica, Chi-Wi Ong of National Sun Yat-sen University, Shie-Ming Peng of National Taiwan University, Chin-Kang Sha of Academia Sinica, Bo-Cheng Wang of Tamkang University, Ming-Jung Wu of National Sun Yat-sen University, Jye-Shane Yang of National Taiwan University, Chen-Sheng Yeh of National Cheng Kung University, and Chen-Yu Yeh of National Chung Hsing University.



Figure 1. Collage of random photos that reflect the general atmosphere on the first day of the 18ACC, including registration, commercial exhibition, poster session, and Welcome Reception. Photographs by the CSLT.

The Finance Committee included Three CSLT members, Ito Chao, Keh-Ming Horng, and Fang-Chen Lee. General Affairs Committee included Wen-Chieh Huang of National Tsing Hua University, and Publication Committee included Dr. Theresa Kueckmann of Wiley-VCH, Chemistry – An Asian Journal, Germany, Prof. Abdulsallam Bakdash of the Arab Society for Forensic Sciences and Forensic Medicine (ASFSSFM), Saudi Arabia, and Dr. Yu-Tai Tao of Academia Sinica.

The actual operation, including all technical aspects, administration, organization of the exhibition, promotion, etc., was carried out by the experienced team of Elite PCO of Taipei (<http://www.elitepc.com.tw>) in the Taipei International Convention Center (TICC), which is operated by the Taiwan External Trade Development Council since 1992 (<https://www.ticc.com.tw>).

Sponsors

The 18ACC attracted a respectable group of sponsors. The congress was hosted by the CSLT, National Tsing Hua University, National Taiwan University, and National Chi Nan University. The co-organizers included Wiley, RSC, Taiwan Chapter of the ACS, Asian Chemical Editorial Society (ACES), the German Chemical Society (GDCh), IUPAC, National Chiao Tung University, National Central University, National Yang Ming University, University System of Taiwan, and Academia Sinica.

The list of Gold Sponsors included Sayling Wen Foundation, CPC Corporation of Taiwan, and YungShin Global Holding. Silver Sponsors were the ACS, RSC, ACES, and GDCh. Bronze Sponsors included CTCI Foundation, Far Eastern New Century Corporation, and Formosa Petrochemical Corporation. Singular Sponsors included AST Science Corporation, Bruker Taiwan Co., Ltd., CONFLEX Corporation, Elsevier Taiwan LLC, KANTO-PPC Inc., KingLab Laboratory Equipment CO., Ltd., Kohan Instruments Co., Ltd., Labtech Equipment Corp., Ker Taur Company Ltd., King Abdullah University of Science and Technology, Gelie Co., Ltd., Jie Dong Co., Ltd., Doctor Science Instrument Co., Ltd., Echo Chemical Co., Ltd., Carl Zeiss Co., Ltd., Chang Chun Group, Advanced Education Technology Corporation, Asia-Wong Enterprise Co., Ltd., Merck, People Life Tek Co., Ltd., San King Technology, SUNTEX Instruments Co., Ltd., San Fu Chemical Co., Ltd., UNI-ONWARD Corp., Zimmerman Scientific Co, Ltd., Taiwan Hopax Chems. Mfg. Co., Ltd., Y.S. Educational Foundation, Zensor Research & Development, Taiwan Sugar Corporation, Sunway Scientific Corporation, San-Hsiung Technology Co., Ltd., Shimadzu Scientific Instruments (Taiwan) Co., Ltd., STAREK Scientific Co., Ltd. PerkinElmer Taiwan Corporation, Rightek Co., Ltd., Nova Materials Co., Ltd., Orgchem Technologies, Inc., Nova Materials Co., Ltd., and Zensor Research & Development.

The 20th General Assembly of the FACS

The FACS 20th General Assembly took place on December 8, 2019, in the TICC (Figure 2). Representatives of 24 Member Societies participated: Vicki Gardiner (Royal Australian Chemical Institute), Iqbal Rouf Mamun (Bangladesh Chemical Society), Sieng Huy (Cambodian Chemical Society), Zhigang Zhuai (Chinese Chemical Society), Raymond W.Y. Wong (Hong Kong Chemical Society), Narayanasami Sathyamurthy (Chemical Research Society of India), Dulal Chandra Mukherjee (Indian Chemical Society), Tatas H.P. Brotosudarmo (Himpunan Kimia Indonesia), Ehud Keinan (Israel Chemical Society), Mitsuo Sawamoto (Chemical Society of Japan), Hyun-Joon Ha (Korean Chemical Society), Hassan Alshemari, (Kuwait Chemical Society), Edward Jaun Joon Ching, (Institiut Kimia Malaysia), Niranjana Parajuli (Nepal Chemical Society), Sarah Masters (New Zealand Institute of Chemistry), Ghulam Abbas Miana (Chemical Society of Pakistan), Fabian Millar Dayrit (Integrated Chemists of the Philippines), Zeid Al-Othman (Saudi Chemical Society), Dien Pandiman (Singapore National Institute of Chemistry), Priyani Parangama (Institute of Chemistry, Ceylon), Yuhlong Oliver Su (Chemical Society Located in Taipei), Supa Hannongbua (Chemical Society of Thailand), Dr. Bahattin Yalçın (Turkish Chemical Society), Nguyen Viet Bac (Chemical Society of Vietnam), and various guests and observers.

Reuben Jih-Ru Hwu, President-elect and organizer of the 18ACC, welcomed everyone to the meeting and noted a very good turnout of member societies that included those that haven't attended for several years. He also provided encouraging statistics concerning the 18ACC and some details of the scientific and social programs. **Yuhlong Oliver Su**, President of the CSLT, welcomed the meeting delegates on behalf of the host society and wished them well and hoped they would enjoy the 18ACC.

President Dave Winkler welcomed all member society representatives, executive committee members, and observers to the general assembly and thanked Prof. Hwu for the meeting's preparation and organization. At the end of his two-year presidency, it was a good time to review the original goals' progress. His original plans included balancing regional inclusiveness with international engagement beyond the region, expanding membership of FACS and interactions with kindred societies internationally, and restructuring the FACS to run more efficiently and capture the attractive opportunities Asia-Pacific region.

He reported on visiting societies, especially those not very active in FACS. He identified two potential new members, Myanmar and Timor Leste. He discussed closer interactions with ACS, RSC, EuChemS, Royal Society, IUPAC, Commonwealth Chemical Societies, African Federation, Institution of Chemical Engineers (IChemE). The FACS operations were restructured by better defining the EXCO members' roles, simplifying the operational documents, and objective fee structure, allowing for faster decisions using electronic communication. The ACC was renamed to Asiachem con-



Figure 2. Collage of random photos that reflect the general atmosphere of the 20th General Assembly of the FACS. Photographs by the CSLT.

gresses to compete with Pacificchem and ABCChem in the Asia-Pacific region.

The rules under which FACS operates needed revision. The Statutes have been revised several times over the past 10–20 years, by correction and amendment rather than major revision. The previous Statutes mixed constitution rules and operations, making the document hard to read and interpret. Winkler explained that separate Statutes of constitution and rules were created, Operations (how the FACS runs), and Conference (guidance to those hosting congresses) documents are ready for ratification by GA. Ambiguous parts of the Statutes were corrected, and explanations were added for which the Statutes are silent.

New roles for EXCO members were defined. Most roles will remain (President, Secretary, and their – elect counterparts, Treasurer). The new project structure requires oversight by two new Science Directors (the old terms were Coordinator of Projects and Director of Scientific Affairs roles respectively). Communications is essential and now must cover web, social media, blogs, and a revitalized FACS Newsletter. The new role is named Communications Director. Regional representatives provide essential two-way communications between the EXCO and the member societies they represent.

The new project structure provides better funding, strong incentives to propose innovative activities in the region. It is more flexible in starting and ending projects once they have achieved their aims. All existing Projects will cease at the end of 2019. However, those that have been performing well are strongly encouraged to seek funding in the new scheme. A pool of \$ 20,000 will be available at the start of each year. Existing activities, and new activities proposed by member societies, should submit bids for seed funding. Activities will be reviewed, and money allocated on a first-come basis. Once annual funding is exhausted, any late applications cannot be funded. New activities should be proposed by representatives of at least three different member societies.

Membership Subscription Revision was needed because the membership fees had been static for over a decade while inflation had increased by 70% in the same period. Also, some of the member societies had changed over the interim and could afford to pay more. The revised subscription was linked to the World Bank's list of development with some adjustments. Three levels of subscription fees were proposed: High level (\$1000) countries, including Australia, China, Israel, Japan, Korea, Kuwait, Saudi Arabia, and Taiwan; Medium level (\$500) countries, including Hong Kong, Malaysia, New Zealand, Singapore, Thailand, and Turkey; and Regular level (\$200), including all other 17 countries. Also, from 2023, congresses' organizers will collect a levy of 5% of the registration fee per delegate on behalf of FACS. Organizers of the 2019 and 2021 congresses can do this at their discretion. The GA approved all revision proposals.

The Turkish Chemical Society reported on their preparations for the 19ACC and 21GA, which will occur in Istanbul on September 4–10, 2021. Following the bids to host the 21ACC in 2023, the GA decided to hold it in Bangkok,

Thailand. The application of Timor-Leste to join FACS as a new member was approved unanimously. Confirmation of awards recommendations proposed by the EXCO.

As part of the discussion on external relations, the GA voted for setting up an MOU agreement with the RSC and Renewing the MOU with the ACS.

Sarah Thomas of the RSC discussed the MOU recently completed and to be signed by Paul Lewis, president-elect of the RSC, and Dave Winkler for FACS. The RSC had been collaborating with FACS through involvement in the congress for several years and working individually with many of the FACS members. The MOU will formalize the relations. The RSC is looking forward to exploring how the two organizations can work together in the future.

Ale Palermo of the RSC shared their involvement in forming the Federation of Commonwealth Chemical Science Societies (COM CHEM) that grew out of the Royal Society's commonwealth Science conferences. The RSC gauged societies' interest in the Commonwealth to form a federation focusing on the UN's sustainable development goals (SDGs) and early career chemist development and received a very positive response. The organization will be launched at the first conference planned for the Caribbean in May 2020. With many common members, it is envisaged the two federations can work closely together.

Lori Brown of the ACS gave an overview of the ACS's drive to get all chemical societies to sign up to a joint framework to address the UN's SDGs. They started the process at the IUPAC Centenary Congress in Paris earlier that year, where the presidents of chemical societies who were present signed up, including 3 FACS members, and now are building momentum around the world and invited the remaining FACS members to sign up. The undersigned chemical societies commit to collaborating and identifying local solutions to global challenges - using the SDGs as a guide.

Finally, the GA elected the Executive Committee members for the biennial term of 2019–2021: Reuben Jih-Ru Hwu, President; Dave Winkler, Past President; Mustafa Culha, President-elect; Ling-Kang Liu, Secretary General; Onder Metin, Secretary General-elect; Edward Juan Joon Ching, Treasurer; Bong June Sung, Communications director; Mitsuo Sawamoto, Science Director; Ehud Keinan, Science Director; Suping Zheng, representative of the East & Pacific Asia region; Dien Pandiman representative of South East Asia & Papua New Guinea region; Wahab Khan representative of the South & West Asia region.

Opening Ceremony

On Monday morning, December 9, all representatives of the FACS member societies participated in the ceremony, which took place in the Plenary Hall (Figure 3).

Prof. Reuben Jih-Ru Hwu of the National Tsing Hua University, Chairman of the 18ACC, opened the conference: "Dear distinguished colleagues and friends, on behalf of the



Figure 3. Collage of random photos taken in the Opening Ceremony. Photographs by the CSLT.

18th Asian Chemical Congress Organizing Committee, I would like to extend our warmest welcome to all participants attending the 20th General Assembly of the Federation of Asian Chemical Societies and the 18th Asian Chemical Congress held at the Taipei International Convention Center in Taiwan on December 8–12, 2019. Members of the FACS organize both biennial events. The federation general objective is to promote the advancement and appreciation of chemistry and provide a channel of communication and collaboration among the professional chemists in the Asia Pacific region and all other areas around the world. We are grateful to receive much help and support from seven societies and institutions that helped organized six distinguished symposia: the Chemical Society Located in Taipei, the Royal Chemical Society, Asian Chemical Editorial Society, German chemical society, American Chemical Society, International Union of Pure and Applied Chemistry, and Industrial Technology Research Institute. More than 2000 participants came from 50 countries attending this conference, and about 650 scientists came from abroad. For the very first time, we introduced two new programs at the ACC: Presidential Symposium and Best of the Best Prizes (BBP) ChemCompetition of students. We are also honored to have Nobel laureates to deliver plenary lectures. Also, several appealing social programs and tours offer the participants a unique fusion of Taiwanese and other cultural lifestyles in this energetic city, Taipei. I deeply thank all of

you for contributing to the success of the 2019 ACC. May all of us have a wonderful and beneficial congress!”

Prof. David Winkler, FACS President, greeted the audience: “Good morning, Prof. Reuben Jih-Ru Hwu, conference chair and President-Elect of the FACS, Nobel laureates Professors Fraser Stoddart and Yuan-Tseh Lee, distinguished guests, colleagues, ladies, and gentlemen. I have been President of the FACS for the last two years, and it has been my honor to hold that role. I want to thank, in particular, professor Hwu for his excellent organization of this conference. I think it is going to be very successful. I am looking forward to its scientific content. I like to thank him and his organizing committee for organizing his great conference and taking on the initiatives that we passed our General Assembly yesterday. You are probably aware of the fact that this is the 40th anniversary of the FACS. The FACS was founded 40 years ago it held its conferences every two years, and every meeting has been the primary activity of the FACS. We do have other activities that were discussed yesterday at the General Assembly, which is the governing council of the FACS. When the Federation was founded 40 years ago, Asian science and Asian commerce and industry were very different from how they look now. As everyone knows, Asia is now the epicenter of business and science globally, and I am sure it will continue to grow. So, the FACS is going to change to reflect these opportunities in the Asian Pacific region. And I

am very grateful to the governing council for putting these new missions in place. One of those initiatives is our attempt to improve the visibility of this conference. Instead of being called the Asian Chemical Congress, the meeting will be called AsiaChem 2019. I wish to thank the organizers again and encourage you to explore Taiwan and Taipei culture, food, and beauty and engage in the vibrant scientific content this conference has. Thank you very much.”

Dr. Dar-Bin Shieh, Deputy Minister of Science and Technology, greeted all participants: “Distinguished guests, welcome to Taiwan and good morning. It is my pleasure to welcome the participants for the 18th ACC and 20th GA of the FACS. I thank Professors David Winkler, Reuben Hwu, and Ling-Kang Liu for their tremendous efforts in putting together this wonderful, engaging program. Special thanks go to the event’s supporters and co-sponsors, including IUPAC, ACS, RSC, ACES, and GDCh. This gathering’s general objective is to promote the advancement and appreciation of chemistry and take this opportunity to build up communication and networking to further collaborations between the professional chemists and other fields, especially in the Asian and Pacific regions. The congress theme, which was just mentioned by Prof. David Winkler, “performing excellent chemistry to make life wonderful,” is fascinating and insightful. I take this opportunity to welcome all foreign guests to Taiwan. In my view, the most appealing aspect of Taiwan is the people. They represent the most precious elements of humanity, such as warmth, kindness, and friendship. I urge everyone to enjoy the traditions and the cultures and learn some language while staying in this beautiful island country. Under my capacity as Deputy Minister of Science and Technology, I promise to offer the Congress and the General Assembly full support. Finally, I feel that this gathering is of professional and personal benefits for all participants, and you’ll flourish your time in Taiwan.”

Prof. Richard Hartshorn, Secretary General of IUPAC: “First, I would like to offer my apologies on behalf of professor Qi-Feng Zhou, President of IUPAC. He had intended to be here but was prevented from traveling at short notice, so I am speaking on his behalf at this opening ceremony. I want to thank the organizers, Prof. Hwu, and his team for putting together an excellent Congress, and I look forward to seeing the rest of the scientific program throughout the week. I want to talk to you a little bit about IUPAC to provide you with some background because IUPAC is now 100 years old. IUPAC is a global organization that provides objective scientific expertise and develops the essential tools for applying and communicating chemical knowledge to benefit humankind and the world. We are privileged to have about 2300 Volunteers, many of them are here in the audience. We have over 800 Affiliate Members, which is a way that chemists who would like to participate in IUPAC activities can join without necessarily being a member of the 54 national member countries. Many of those 54 National Adhering Organizations are also members of the FACS. We also have 31 Associated

Organizations and about 32 Company Associates. The FACS is one of those Associated Organizations of IUPAC.

As you know, IUPAC is deeply involved in curating the Periodic Table and developing the nomenclature and the Color Books, which compile recommendations and technical reports. The Green Book provides quantities, units, and symbols in physical chemistry. The Red Book is about the nomenclature of inorganic chemistry, the Blue Book about organic chemistry’s nomenclature, the Purple Book is a compendium of polymer terminology and nomenclature, and the Orange Book provides analytical nomenclature. The Silver is a compendium of terminology and nomenclature of properties for clinical laboratory sciences, the White Book provides biochemical nomenclature, and the Gold Book is about chemical terminology.

In the next 100 years, we foresee that it will be particularly important to develop standards Cheminformatics, of which the international chemical identifier (InChI) is an important area. Green chemistry and sustainable development, and, of course, education and training with a particular focus on diversity and bringing in the younger chemists. So, IUPAC is trying to look at the future as we start our 2nd century. We also value our collaborations with other international organizations, including UNESCO, ISC, BIPM, OPCW, IUPAP, etc. For example, the International Union of Pure and Applied Physics (IUPAP) collaborates with us to determine when a new element has been synthesized and identified. The OPCW is an essential international organization in chemistry. IUPAC has just been awarded the Hague award of the OPCW for its work in collaboration with OPCW.

IUPAC has been taking many other events and activities over its centenary year and the periodic table’s international year. I hope that some of you had had the opportunity of participating in these events. One of the more notable ones was the periodic table of younger chemists, and I want to highlight that these are the future of our discipline. These people, young men and women, are people we will hear a lot more often. We have to bring them together in the future and provide them with opportunities to take out this thing forward and share with them the next 100 years of IUPAC. We also have the periodic table challenge, which has allowed many young people to engage with chemistry and chemical questions.

Finally, I would like to thank our dedicated volunteers, who are central to what we do, and I hope you all consider joining IUPAC’s work. We are a family of chemists throughout the world who join together to reach a consensus on scientific issues and scientific problems, and we need more of you to be involved in what we do. I want to offer my thanks and very best wishes for this Congress and congratulate the organizers for pointing to us such an exceptional group of delegates, speakers, and an excellent organization. Thank you.”

Dr. Bonnie A. Charpentier, President of the American Chemical Society, offered her welcome remarks: “Dear Members of the Federation of Asian Chemical Societies and esteemed guests, it is honor and a privilege to be invited to

speak with you today. Thank you for the opportunity to address this congress and bring greetings from the American Chemical Society members. As ACS President, I am thrilled to participate in the opening of the 18th Asian Chemical Congress. I want to thank the FACS leadership for their kind invitation to participate in this event and their efforts to facilitate the ACS delegation's attendance. I want to extend a special thanks in particular to Professors Reuben Jih-Ru Hwu, Dave Winkler, and Roger Stapleton for their hospitality and assistance in supporting the ACS presence at the 18ACC. ACS has a long and fruitful partnership with FACS, and it is always a pleasure for us to participate in this biennial meeting. Your efforts and contributions to the global chemistry enterprise are a model for international cooperation and an example of the transcending and transforming power of chemistry.

At the ACS, our overall mission is to advance the broader chemistry enterprise and its practitioners to benefit Earth and its people. We wish to improve people's lives through the transforming power of chemistry. The ACS provides information solutions to accelerate the pace of scientific discovery. In case you're not familiar with the work of the ACS, allow me to give you a short introduction. We have over 152,000 members in more than one hundred countries representing chemists, chemical engineers, and allied chemical science professionals in academia, industry, and government. Of those members, almost 20% live outside the USA. Approximately 11,000 reside in countries represented here at the Asian Chemical Congress. please allow me to extend a special greeting to all of you. ACS also publishes more than 50 peer-reviewed journals and is home to the Chemical Abstracts Service. I am very proud of our global membership and the great work they do to advance science and society. The ACS includes 32 Technical Divisions, 24 International Chemical Sciences Chapters, and 67 International Student Chapters.

As ACS President, I have the opportunity to select a theme for my year, and my overarching theme for 2019 is promoting collaboration to advance chemistry's potential. My primary areas of focus are advocacy safety and the environment. It is important for me to support sustainable programs that build on my predecessors' gains and engage ACS members' ideas and enthusiasm toward that goal. I am so glad that participating in the FACS conference will help me achieve my goal of increased collaboration, and hope that the discussions here this week will further cement the ties between ACS and FACS. We've enjoyed a long partnership beginning with signing the first ACS/FACS Memorandum of Understanding in 2015, which I was fortunate enough to participate in. Since then, our societies have supported each other through various activities and events at our respective meetings.

I look forward to looking for ways that we can evolve this partnership at the 18th ACC. An essential component of collaborating with our sister chemical societies is through the ACS International Chemical Sciences Chapters. These chapters are meant to give ACS members living outside of the United States to meet and network in their home countries. Roughly half of the 24 ACS international chapters are in

countries that are represented at this congress. They provide an excellent opportunity for ACS and FACS member societies to interact on a more regular basis. I hope to see interactions between these ACS groups and our sister chemical societies throughout the region to continue to deepen.

In addition to this conference being the 18th Asian Chemical Congress, there is a special recognition for this year's meeting – the 40th anniversary of the founding of FACS! This is a momentous occasion. Over the past four decades, FACS has grown from ten societies to 31-member chemical societies in the Asia Pacific region, with new societies still joining. The latest member of the Timor-Leste Chemical Society was welcomed yesterday at the General Assembly meeting. This community's strength and organization is admirable, and your continued growth is an indication of the importance and influence of this group. On behalf of the ACS, I congratulate the FACS member societies on this momentous occasion and wish you the best of luck over the next 40 years and beyond.

The program for this conference certainly reflects this special occasion. There are talks from two Nobel Laureates, symposia organized by preeminent scholars from across Asia and worldwide, and various exciting social events planned throughout this congress. If you would like to participate in ACS planned ACC activities, please stop by the ACS booth in the exposition hall or attend our symposium on Tuesday, December 10.

One timely example of a successful global collaborative effort is the proclamation by the United Nations of 2019 as the International Year of the Periodic Table of Chemical Elements, IYPT. IYPT created an opportunity for collaborations both internationally and locally. This was not chosen arbitrarily: 2019 marks the 150th anniversary of Dmitiri Mendeleev's creation of the Periodic Table of Elements. Although many chemists throughout history have contributed to the periodic table, Mendeleev's version is the basis for the table used all over the world today. The year began with a beautiful opening ceremony at the UNESCO headquarters in Paris. The January celebration involved organizations from many different countries, including several FACS member societies. ACS has sponsored various IYPT activities and programs throughout the year, including online educational resources for kindergarten through postdoctoral levels. ACS curated a calendar of IYPT-related events, which is available at www.acs.org/iypt. One final major event occurred just last week: the official UNESCO recognized closing ceremony for IYPT hosted by FACS member society, the Chemical Society of Japan. I was proud to participate in this event on behalf of ACS, and I am equally proud of the global chemistry community's work throughout the year.

Local sections and regional meetings led IYPT events in the USA, all celebrated with periodic table-themed programs and activities. Several local sections obtained proclamations recognizing IYPT and acknowledging the value of chemistry in state legislatures, local governments, and the public. ACS international chapters and student affiliates all over the world

also held exciting IYPT outreach programs. The USA National Chemistry Week incorporated the periodic table of elements into its “Marvelous Metals” theme. And on November 20, ACS and the National Science Foundation hosted a colloquium celebrating 150 years of the periodic table.

Outside of ACS activities, I know that many IYPT events celebrating the periodic table have taken place worldwide and will continue through the end of 2019, including dozens of reported events in Asia on the official IUPAC IYPT2019 webpage. ACS is committed to supporting sister chemical societies and the global community of chemists. We work to highlight and amplify the transforming power of chemistry and the critical importance of the periodic table of elements. I hope that the global chemistry community can carry the spirit of this special celebratory year beyond 2019, and I look forward to working with all of you to achieve this.

One way to carry the spirit of IYPT past 2019 is through working together on the United Nations Sustainable Development Goals (SDGs). The U.N. built this list from the Millennium Development Goals in 2015 with a deadline of 2030 to achieve these ambitious objectives. This collection of 17 cross-cutting goals provides a mechanism and language for the scientific community to work together with the public, government, academia, and industry to address our time’s most pressing issues. The SDGs focus on widespread problems like gender equality, climate change, and eradicating hunger with 169 specific targets to better measure impact and progress in achieving the 17 goals. Although a case can be made for the chemical science community to be involved in all of the goals, ACS has identified at least 12 that chemistry can directly impact solving. As the ACS seeks out new partnerships or initiatives with sister chemical societies, we frame those conversations with the SDGs. Organizations such as ACS, FACS, universities, and industrial partners can take advantage of the power of collaboration to advance these goals. One of the initiatives that ACS has worked on over the past year is coordinating the world’s top chemical societies’ signatures on a joint agreement to collaborate on the SDGs. To date, there are over two dozen chemical societies who have signed this agreement, including several member societies of FACS. I hope to add additional signatures to this important pledge from the leadership of the chemical societies present here today throughout the conference.

Thank you again for inviting me to Taipei to present to all of you and join the chemical community for what I am sure will be excellent discussions. I wish you all the best for a productive and fruitful conference. Thank you all for your attention, happy 40th anniversary to FACS, and I look forward to speaking with you throughout the coming days.“

Award ceremony

At the end of the opening ceremony, David Winkler and Reuben Hwu awarded the prestigious FACS Awards (Figure 3, top). **Prof. Vivian Yam** received the Foundation Lecturer

Award; **Dr. Wenent Pan** received the Distinguished Contribution to Economic Advancement medal; **Prof. David Warren** received the Distinguished Contribution to Chemical Education medal; **Datin Prof. Zuriati Zakaria** received the FACS Citation Medal; and **Prof. Jasim Uddin Ahmad** received the FACS Fellowship medal.

Plenary Lectures

Prof. Yuan Tseh Lee of the Academia Sinica of Taiwan and the University of California at Berkeley, Laureate of the 1986 Nobel Prize in Chemistry, presented the first plenary lecture on “Facing the Challenges of Global Environmental Problems,” (Figure 4). Lee argued that the greatest danger to Humanity is climate change, which is even more alarming than a nuclear war. For the first time, we have the power to change our environment to the point where it cannot support life anymore. We can only conclude that the development model started by the rich countries and adopted by the developing nations is not the right one. Individual consumerism is not the best use of technology. If we wish to remain on this Earth for centuries to come, we must find other ways to develop and improve people’s lives. The rich countries are already “over-developed,” whereas the “not-yet-over-developed” countries cannot follow them. The difficult problem of climate change needs a global solution. We face a global problem today, neither a single country nor scientists can solve this problem alone. In December 2015, 195 political leaders from worldwide came to Paris to attend the COP21. The final agreement to limit the global temperature rise to 2.0°C was a tremendous historical awakening. They also agreed that human society must decarbonize and become carbon neutral in the second half of this century to accomplish this goal. We will also need better global institutions. Scientists believe that if we instill sufficient funds for research related to energy transformation, storage, and transportation, it is likely that we can accomplish carbon neutrality by the middle of this century. Lee expressed his belief that for global sustainability, we have to follow the following pathways: the global response to a global problem; learn to store, transform, and share energy from the sun; live better for less control population explosion, and improve equality around the world. These issues are critical because we do not have much time left. Unless we learn to connect Humanity as One Global Unit, connect knowledge to action immediately, the survival and prosperity of Humanity will be challenging.

Sir Prof. James Fraser Stoddart of Northwestern University, Nobel Prize in Chemistry 2016, lectured on “Chemically and Electrically Driven Molecular Pumps and Motors.” He explained that in 2010, his research group discovered an example of radically enhanced molecular recognition, which represents a valuable tool for the design and synthesis of artificial molecular pumps (AMPs) and artificial molecular motors (AMMs). Stoddart described how this breakthrough has led to the fabrication of (1) two AMPs,

(2) a duet and a dual pump, (3) an electrically driven AMM and (4) a precise polyrotaxane synthesizer, which can be produced by attaching an AMP to each end of a polymeric connecting chain. All these molecular machines operate away-from-equilibrium, using energy ratchet mechanisms, in the presence of fuels and environments dominated by Brownian motion. Stoddart predicted that it would soon be possible to generate highly engineered polyrotaxanes with palindromic arrays of co-constitutionally heterotopic rings positioned on constitutionally symmetrical polymer dumbbells and then, ultimately, transcribe their programmed information back into the domain of sequence-controlled polymer synthesis.

Prof. Valery N. Charushin of the of the Urals State Technical University, Ekaterinburg, Russia, who serves as Vice-Chairman of the Russian Academy of Sciences, lectured on “Nucleophilic C(sp²)-H functionalization: a new logic of organic synthesis.” He explained that the last decade has shown a growing interest in direct modification of the C-H bonds in aromatic and heteroaromatic compounds. In particular, the nucleophilic C-H functionalization of arenes proved to be of a great importance, as a powerful tool of green chemistry, changing the logic of traditional organic synthesis. There are two principal approaches to incorporate fragments of nucleophilic reagents into an aromatic ring through displacement of hydrogen of the C-H bond. The first one is based on catalytic activation of the C-H bond, and it involves the step of deprotonation followed by the formation of organometallic intermediates, which then react with nucleophiles to produce the final products. The second approach (S_N^H) suggests a direct nucleophilic attack at an aromatic ring, leading to σ^H-adducts, followed by their oxidation and departure of proton (Addition-Elimination Protocol). The metal-free S_N^H reactions provide a good complimentary basis for transition-metal-catalyzed cross-coupling reactions. Charushin proposed that recent advances in the field of direct functionalization of the C-H bond in aromatics should be considered as a very promising methodology of organic synthesis.

Prof. Chi-Huey Wong of The Scripps Research Institute and the Academia Sinica of Taiwan spoke about “Carbohydrate Chemistry and Translational Innovation.” He presented recent advances in carbohydrate chemistry and biology, emphasizing a scientific research path from curiosity-driven to discovery research and innovative development to illustrate the important contribution of this process to the field of glycoscience. Wong explained that glycosylation is a reaction used by nature to modulate the structure and function of molecules. The significance of glycosylation at the molecular level is not well understood, and as such, the pace for the development of carbohydrate-based medicines and materials is relatively slow. Thus, it is important to develop new tools and methods to study glycosylation’s effect on the structure and function of proteins and other molecules. He focused on developing new methods for the synthesis of oligosaccharides and homogeneous glycoproteins, study of glycosylation effect on protein folding and function, development of glycan arrays

for disease detection, and design of carbohydrate-based therapeutics to tackle the problems of cancer and infectious diseases.

Marinda Li Wu, Past President of the American Chemical Society, lectured on “The Evolving Role of Professional Societies in International Collaboration: Partners for Progress and Prosperity.” She pointed out that the chemistry enterprise is evolving, becoming increasingly multidisciplinary and global. The roles of societies that support the chemistry profession must also evolve and adapt. Traditional roles for professional societies have included sharing research, providing access to information and technologies, and supporting educational excellence. Global challenges now provide sister international societies with opportunities to collaborate on 1. improving the public image of chemistry, 2. identifying and supporting global job opportunities as markets shift, and 3. promoting diversity and inclusion to accelerate progress. Moreover, societies can work together to foster sustainable development by tackling grand challenges to provide clean water, affordable energy, zero hunger, and much more. As reflected in the United Nations Sustainable Development Goals, Sister society’s collaboration on such challenges is the basis for the American Chemical Society’s new Chemistry Enterprise Partnerships. Professional organizations can truly help transform our world by partnering for progress and prosperity.

Eiichi Nakamura of the University of Tokyo lectured on “Molecular Electron Microscopy - A New Tool for Chemistry Research.” He explained that a molecule is a quantum mechanical entity. “Watching motions and reactions of a molecule with our eyes” has been an impossible dream of chemists for a century. Single-Molecule Atomic resolution Real-Time electron microscopic (SMART EM) imaging that his group has been developing since 2004 made this dream come true. The method provides a hitherto inaccessible possibility to in situ observe mechanical motions of motions under quantum control and the time evolution of chemical events, as recently demonstrated for the kinetics study of [2 + 2] cycloaddition of [60]fullerene. The method also allows them to isolate and study at a single molecule level, minute intermediates of chemical reactions in rapid equilibrium with each other in solution, and hence hardly characterizable by the conventional time and molecular averaged methods. SMART EM imaging is thus opening up a new dimension of studies on the mechanism of catalytic reactions.

Vivian Wing-Wah Yam of the University of Hong Kong lectured on “From Simple Discrete Metal Complexes to Supramolecular Assembly and Nanostructures.” She explained that her group’s recent work has shown that various metal-ligand chromophoric building blocks could assemble to novel classes of chromophoric and luminescent metal-containing molecular materials. She described the different design and synthetic strategies. A number of these simple discrete metal complexes undergo supramolecular assembly to give various nanostructures and morphologies. Subtle changes in the micro-environment and nanostructured morphologies have led to

drastic changes in these supramolecular assemblies' electronic absorption and emission properties. Explorations into the underlying factors that determine their spectroscopic properties and morphologies and their assembly mechanisms have provided new insights into the understanding of the interplay of the various intermolecular forces and interactions for the directed assembly of novel classes of metal-containing soft materials and hybrids.

Presidential Symposium

Presidential lecture sessions: To celebrate the 40th anniversary of FACS, twelve Society Presidents accepted the invitation to deliver 30-minute keynote lectures either on scientific content or community service achievements. The organizers proposed that the initiative would become a standard feature of all future ACC events. Representatives of 29 member chemical societies attended the 18ACC and the 20th General Assembly, the majority of them were presidents. Those who did not participate in the three Presidential lecture sessions presented invited ACC lectures in their disciplinary sessions (Figure 4).

David A. Winkler of Monash University, Parkville, Australia, President of the FACS, lectured on "Designing Materials for Bespoke Modulation of Biological Responses." He explained that the past decade, in particular, has seen a spectacular rise in research into materials, with biomaterials, playing a dominant role in regenerative medicine. This has, in part, been driven by improvements in instrumentation and rapid rise in high throughput synthesis and characterization methods that now generate orders of magnitude more data than in previous eras. It is essential to extract as much information as possible on the molecular details of materials' interaction with biological systems to use this for the rational design of materials that generate desirable biological outcomes while minimizing undesirable side effects. Winkler showed how a concomitant rise in computational and algorithmic research methods allows complex, rich data sets to be efficiently analyzed and used to design new materials. New artificial intelligence and machine learning methods, coupled with improved ways of representing the molecular and physicochemical properties of materials to train such models and effective sparse feature selection methods, have addressed the critical need for useful modeling tools. As in many other areas of science and technology, deep learning methods play increasingly important roles in providing models that make robust, accurate predictions of biological properties for increasingly diverse classes of materials. He illustrated how these powerful but accessible modeling methods had been used to model various material-biology systems. His group focused on developing immune-instructive materials, materials that support growth and proliferation of stem cells, polymers that do not support the attachment of microbial pathogens or proteins, and materials that minimize foreign body responses to implantable medical devices.

Fabian M. Dayrit of the Ateneo de Manila University, President of Philippines Federation of Chemical Societies, lectured on "Application of NMR for the Profiling and Standardization of Medicinal Plant Extracts." He explained that two significant challenges in the commercialization of medicinal plants are the profiling of extracts to facilitate the identification and standardization of commercial products to ensure quality. NMR spectroscopy is a reliable and reproducible technique for the unbiased profiling and standardization of medicinal plant extracts. The key metrics are reproducibility and accuracy. NMR methods are advantageous for this study because they are non-destructive, quantitative, and do not require separation or derivatization. Although ^1H NMR is more sensitive, ^{13}C NMR spectra are more straightforward with less overlapping signals and are less affected by different magnetic field strengths. Dayrit compared the use of ^1H and ^{13}C NMR and demonstrated their application in the profiling of ten Philippine medicinal plants. He proposed a collaborative Asia-wide project on the profiling of common medicinal plants.

Ismail Yalcin of Ankara University, President of Computer Aided Drug Design & Development Society in Turkey, spoke about "Structure-Activity Relationships of Some New 2,5-Disubstituted Benzoxazoles as hGSTP1-1 Enzyme Inhibitors." He explained that glutathione S-Transferases (GST) are a family of enzymes that play an important role in detoxification by catalyzing the conjugation of many hydrophobic and electrophilic compounds with reduced glutathione. However, human GST P1-1 enzyme leads to resistance against chemotherapeutic agents. Consequently, it is clinically named multidrug resistance (MDR) and nowadays it becomes a challenge in cancer treatment. GST is overexpressed in many cancers and contributes to MDR by directly conjugating to chemotherapeutic agents. Therefore, hGST is considered a promising target for inhibition in cancer treatment. His group carried out molecular docking study using CDocker to predict binding properties between the hGST P1-1 enzyme H-site and the 2,5-disubstituted benzoxazoles, which were found active as the *in vitro* GST enzyme inhibitors. Replacing of the NO_2 group with the CF_3 group at the para position of the benzene ring bound to sulphonamide moiety on the benzoxazole ring predicted higher hGST P1-1 inhibitory activity. Benzoxazoles that are holding CF_3 group at the para position of the benzene moiety, possessing a halogen bonding interactions with the H-site residue. The halogen bonding interaction changes the conformation of the molecule in the H-site through increased binding energy of the molecule.

Dr. Vojislav V. Mitić, of the Institute Technical Sciences of SASA, Belgrade, Serbia, President of the Serbian Ceramics Society, lectured on "Brownian Motion and Fractal Nature in Chemistry and Material Sciences." He explained that the main area of his research group is the similarity between the motion of microparticles and microorganisms, which can be analyzed in terms of Brownian Motion in the light of their fractal nature. This is important from ceramics and general material science perspective at particle motion, especially between the



Figure 4. Collage of random photos that reflect the general atmosphere of the various oral presentations. Photographs by the CSLT.

grains and pores. The idea was to achieve control over order-disorder of particle motion and their collision effects by Brownian's Motion phenomena. Biomimetic correlation between particles and microorganisms could shed light on such dynamic systems, aiming at control over the motion of electro-ceramic particles.

Datuk Dr. Ting-Kueh Soon, President of the Institut Kimia Malaysia, spoke about "FACS & ACC: Forty years of Advancing Chemistry in Asia." He discussed the roles and involvement of the FACS and the Asian Chemical Congress (ACC) played in advancing chemistry in Asia and the Pacific.

Dr. Supa Hannongbua, President of the Chemical Society of Thailand, spoke about "Impact of Chemical Society Driven the Country Development."

Dr. Tatas H.P. Brotosudarmo, President of the Himpunan Kimia Indonesia, spoke about "Chemistry for Indonesia Biodiversity."

Niranjan Parajuli of Tribhuvan University, Kathmandu, Nepal, President of the Nepal Chemical Society, spoke about "Recent Advances in Directed Evolution of Enzymes." He explained that directed evolution helps natural evolution by selecting desirable variants from a library of mutants derived from a parental enzyme. It has allowed researchers to enhance the catalytic activity of enzymes toward their natural substrate. In this method, large libraries of mutant enzymes are screened for improved activity or stability. These libraries are of the order of 10^4 , screened in the 96-well plate format. But the plate-based method is laborious and time-consuming. To address this issue, research was focused on emulsion-based *in vitro* compartmentalization (IVC) technique. For this purpose, a 'water-in-oil-in-water' emulsion was widely used in the compartmentalization of droplets for ultrahigh throughput screening. Presumably, these compartments are occupied by one gene. After translation and transcription of the enclosed gene, the protein can be employed as a catalyst for bioconversion. IVC provides a complete cell-free approach for the production of novel targeted proteins. IVC is also a powerful tool for directed evolution allowing for the use of large libraries and has been employed for the development of a number of different enzymes.

Sarah L. Masters of the University of Canterbury, President of the New Zealand Institute of Chemistry, spoke about "Utilising the Combined Power of Theory and Experiment to Understand the Quirks of Molecular Structure." She explained that the diversity of chemistry yields, molecules and materials that can still surprise us. Many structures are counter-intuitive, and may be poorly predicted by computational methods. Nevertheless, the determination of such structures, the key to understanding properties, remains a core enabling technique for the support of synthetic chemistry. Molecular imaging using gas electron diffraction (GED) provides a mechanism to determine gaseous structures without the distorting effects of intermolecular interactions. Such experimentally determined gas-phase structures are used by chemists to gain further insight into chemical and physical properties of molecules and into chemical reactions, thermody-

namics and mechanisms of processes. Structural data for model systems are also vital for theoreticians, who can use the information to gauge the accuracy of new computational methods. By utilising a combination of theory and GED, her group can determine gas-phase structures for ever-larger systems. Using computational methods for isolated and periodic systems they can also rationalise distinctions between gaseous and solid-state structures in terms of energy differences and the influence of intermolecular interactions. Recent developments have been made to not only model the potential energy surface to locate all the conformers invariably found in these larger systems, but to attain significantly higher temperatures of vaporisation to observe them. The Masters group are also making significant inroads towards imaging liquid jets with electrons, significantly broadening the range of systems that can be studied. She introduced GED and outlined some very different applications of the technology and recent methodology that was developed. She discussed the rather tricky study of tris(chloromethyl)amine, outlining an enduring story of a low-frequency, large amplitude vibrational mode and discussed recent study of amine-borane systems as hydrogen storage materials. She illustrated how these powerful but accessible modeling methods have been used to model a variety of material-biology systems. She focused on the development of immune-instructive materials, materials that support growth and proliferation of stem cells, polymers that do not support attachment of microbial pathogens or proteins, and materials that minimize foreign body responses to implantable medical devices.

Ehud Keinan of the Technion - Israel Institute of Technology, President of the Israel Chemical Society, lectured on "Bio-inspired synthesis of spherical containers." He explained that Nature uses spherical containers ubiquitously in both the inanimate and living worlds. The convex regular icosahedron (or its dual, dodecahedron) is the polyhedron that is closest in symmetry to the sphere. Consequently, the optimal bottom-up strategy to achieve spherical objects involves the construction of these Platonic solids. Spherical viruses use this approach to create particles ranging in size from 15 to 500 nm, which form spontaneously from their components under the proper conditions and disassemble under other conditions. Chemical mimicry of viral capsids is highly desirable because stable spherical structures can be applied for microencapsulation and transport of sensitive cargo, drug delivery and targeting, synthesis of nanoparticles of uniform size, reactivity modulation of bound guests, molecular recognition, catalysis, and even safe immunization. The best synthetic strategy to achieve spherical chemical capsids involves the self-assembly of twelve pentatopic tectons, which have complementary edges or can be stitched together using either digonal or trigonal connectors. Beyond the synthetic challenge of such tectons, the entire system must be kept under conditions of uninterrupted fast equilibrium, allowing for self-correction *en route* to the capsid, representing the global energy minimum. These goals were recently achieved by the synthesis of deca-heterosubstituted corannulene that bears five terpyridine

ligands. A collaborative research effort between the Keinan group at the Technion and the group of Yi-Tsu Chan at National Taiwan University has led to spontaneous self-assembly of twelve such tectons with 30 cadmium(II) cations produced a giant icosahedral capsid as a thermodynamically stable single product in high yield. This spherical capsid has an external diameter of nearly 6 nm and a shell thickness of 1 nm.

Dr. Narayanasami Sathyamurthy, President of the Chemical Research Society of India, spoke about “Non-adiabatic coupling and conical Intersection(s) between potential energy surfaces for HeH_2^+ .”

Dr. Ghulam Abbas Miana, President of the Chemical Society of Pakistan, spoke about “Alkaloids from Medicinal Plants of Pakistan.”

Keynote Speakers

Esin Aki-Yalçın of Ankara University, Turkey, lectured on “Anticancer Active Bicyclic Compounds and Their Mechanism of Action.” She explained that DNA topoisomerase II enzyme, which controls and modify the topological states of DNA and plays key roles in DNA replication, transcription and chromosome segregation, is one of the popular targets in treatment of cancer. The DNA binding and cleavage domain is the most important active site of this enzyme. She showed that one class of topoisomerase II inhibitors, known as topo II poisons, bind to the transient enzyme-DNA complex and inhibit the religation of DNA generating single- and double-stranded breaks. Introduction of these breaks subsequently leads to apoptosis and cell death. The synthesized benzazole derivatives were tested for their eukaryotic DNA topoisomerase II inhibitory activity in a cell free system. She described the interactions between DNA topoisomerase II and the series of compounds, which were examined in detail using molecular modeling studies such as molecular docking and pharmacophore analysis performed by using Discovery Studio and LigandScout. This study also provided a model to design novel and more potent anticancer agents as human topoisomerase II poisons.

Sergey M. Aldoshin of the Institute of Problems of Chemical Physics, Russian Academy of Sciences, Lectured on “Single-Ion Magnet Behavior of a Hexacoordinated Co(II) Complex with Easy-Axis and Easy-Plane Type Magnetic Anisotropy. Prospects of Development.” He explained that the possibility to store magnetization within single molecules discovered in the 1990s initiated the era of single-molecule magnets (SMMs) and triggered exponential growth in research on the chemistry of magnetically active coordination compounds. Broad interest in these materials has been stimulated by promising technological advances in quantum computing, spintronics, ultrahigh-density memory storage devices, and other applications. SMMs and single-ion magnets (SIMs) based on 3d metals are of great interest within the coordination chemistry community because they provide the flexibility to

affect local electronic (and spin) states and magnetic anisotropy of metal ions by varying ligand fields and coordination polyhedron symmetry. Among such systems, cobalt (II) coordination compounds are particularly promising SIMs due to the strong spin-orbit coupling of the metal ion, which might, in combination with ligand field effects, lead to high magnetic anisotropy. Aldoshin complexes with the most stable Co (II) metal coordination number, namely, six, are considered. His group realized that most mononuclear hexacoordinated Co (II) complexes exhibit strong positive (easy-plane type) magnetic anisotropy, whereas only a few compounds show negative anisotropy (easy-axis type). They used polydentate ligands to distort the ligand field and the ideal octahedral geometry to achieve magnetic anisotropy. Accurate determination of the spin Hamiltonian parameters in transition metal complexes with large zero-field splitting (ZFS) is an actual challenge in studying magnetic and spectroscopic properties of high-spin transition in metal complexes. The determination of these parameters based only on the magnetic data has low accuracy and reliability. He showed that combination of X-band electron paramagnetic resonance (EPR) spectroscopy, advanced techniques such as Multi High Frequency EPR Spectroscopy (MHF-EPR) and Frequency-Domain Fourier-Transform THz-EPR (FD-FT THz-EPR), and SQUID magnetometry is a more convincing and accurate approach. He demonstrated that FD-FT THz-EPR spectroscopy could detect a high-energy EPR transition between the two Kramers doublets. Magnetic parameters derived using the proposed spectroscopic method are in good agreement with those obtained from high-level CASSCF/NEVPT2 quantum-chemical calculations. Based on literature data and his results, the conclusion is made that small (even mononuclear) complexes are more promising for obtaining good SMMs than large complexes with large spin but weak magnetic anisotropy.

Koen Augustyns of the University of Antwerp, Belgium, spoke about “Regulated Necrotic Cell Death: Novel Opportunities for Medicinal Chemistry.” He explained that homeostasis of organisms is highly dependent on a fine balance between cell survival and cell death. For several decades, apoptosis was described as the only pathway for cells to die in a programmed way, whereas necrosis was considered unregulated. The understanding that necrosis can also occur in a highly controlled manner revitalized cell death research. It opened new opportunities for the development of novel drugs that interfere with these non-apoptotic cell death pathways involved in inflammation, neurodegeneration and other diseases. Nowadays, regulated cell death is classified according to the molecular mechanisms involved. Two of these forms of regulated cell death, necroptosis and ferroptosis, are under intensive investigation and recently the University of Antwerp Medicinal Chemistry (UAMC) research group has developed interesting necroptosis and ferroptosis inhibitors. Necroptosis is a form of regulated necrosis that can be triggered by e.g., tumour necrosis factor (TNF) and in which receptor-interacting protein kinase 1 (RIPK1), RIPK3 and MLKL play a crucial role. His group has identified existing kinase inhibitors

sorafenib and tozasertib as potent RIPK1 inhibitors and have improved their potency and selectivity. Ferroptosis is characterized by iron-dependent lipid peroxidation. It can be inhibited with radical trapping agents such as Ferrostatin-1 (Fer-1). They have developed a large series of Fer-1 analogues with improved potency and ADME properties. The optimized lead compound UAMC-3203 shows promising potential in mouse disease models of ferroptosis.

Sergey O. Bachurin of the Institute of Physiologically Active Compounds RAS, Russia, spoke about “Contemporary Approaches for the Developing Therapeutic Agents for Dementia Treatment.” He explained that Alzheimer’s disease (AD) is characterized by a chronic and progressive neurodegenerative process resulting from the intracellular and extracellular accumulation of fibrillary proteins: betaamyloid and hyperphosphorylated Tau. Over accumulation of these aggregates leads to synaptic dysfunction and subsequent neuronal loss. The precise molecular mechanisms of AD are still not fully understood but it is clear that AD is a multifactorial disorder and that advanced age is the main risk factor. Over the last decade more than 50 drug candidates have successfully passed phase II clinical trials, but none have passed phase III. He summarized data on “anti-Alzheimer’s” agents currently in clinical trials based on findings available in the Thomson Reuters “Integrity” database, on the public website www.clinicaltrials.gov, and on database of the website Alzforum.org. As a result, it was possible to outline some major trends in AD drug discovery: 1) the development of compounds acting on the main stages of the pathogenesis of the disease – the so-called “disease-modifying agents”. These drugs could potentially slow the development of structural and functional abnormalities in the CNS providing sustainable improvements of cognitive functions, which persist even after drug withdrawal. 2) Focused design of multitargeted drugs acting on multiple molecular targets involved in the pathogenesis of the disease. 3) The repositioning of old drugs for new application offers a very attractive approach to facilitate the completion of clinical trials.

Konstantin V. Balakin of the Scientific and Educational Center of Pharmaceutics, Kazan, Russia, spoke about “Innovative Drug Candidates Developed at the Kazan Federal University in 2010–2019: a Brief Survey.” He reported that the distinctive features of the new drug candidates are the focus on the treatment of socially significant diseases, 100% originality with the intellectual property protection in key world markets, high manufacturability. Anti-inflammatory agent KFU-01 is a dipharmacophore prodrug which releases, after peroral administration, two active components, pyridoxine and naproxen, which exhibit unique synergistic effects. In all key pharmacological parameters (acute and chronic anti-inflammatory activity, analgesic activity, acute toxicity, gastric ulcerogenicity), KFU-01 outperforms other market available NSAIDs. KFU-02 is a first-in-class inhibitor of ABC efflux transporters which significantly potentiates the efficacy of anticancer drugs, since most of them are substrates of ABC-transporters. A fixed-dose combination of KFU-02 with

doxorubicin (MDR-dox) is superior to unmodified doxorubicin in terms of safety and in vivo antitumor efficacy. Antibacterial drug KFU-03 is a structural modification of a fluoroquinolone antibacterial agent. The modification resulted in increased antibacterial activity and improved safety. KFU-04 is a first-in-class antifungal drug which efficiently inhibits the most dangerous fungal pathogens and outperforms the market available analogs in terms of efficacy and safety. KFU-05 is a first-in-class antiseptic drug for topical use with a broad-spectrum microbicidal activity against the most common and dangerous bacterial, fungal and viral pathogens. A unique feature of KFU-05 is the ability to suppress the potential of pathogens to develop drug resistance. KFU-06 is a first-in-class peroral antiepileptic agent acting via mechanisms of indirect inhibition of NMDA and activation of GABA receptors. In animal models, KFU-06 effectively treats even severe epileptic seizures and demonstrates excellent level of safety after chronic administration. KFU-07 is a first-in-class anticancer agent with a unique mechanism of action based on biochemical reprogramming of malignant cells. KFU-08 is a drug for the treatment of diabetes complications, inhibitor of advanced glycation end products formation. KFU-08 demonstrates potent cardio-, neuro- and nephroprotective activity and excellent safety profile. Antimycobacterial drug KFU-09 is a structural modification of isoniazid which is active against MDR M. tuberculosis strains. For the six agents (KFU-01 – KFU-06), preclinical studies have been successfully completed. For the other three compounds (KFU-07 – KFU-09), preclinical studies are ongoing. Clinical trials have been initiated for the two leading drugs (KFU-01 and KFU-02). The concepts of medchem design of these drug candidates, and their key pharmacological parameters were presented.

Martin G. Banwell of the Australian National University at Canberra, spoke about “Studies in natural products synthesis – pathways to biologically active systems.” He explained that ongoing studies within his group focus on developing new methodologies and strategies that enable the assembly of a structurally diverse range of natural products and biologically active analogues. He reported various case studies that have culminate in total syntheses of several important compounds, such as (+)-viridianol, 1-acetylaspidolbidine, gilbertine, and discopyrrole D. He also described their studies on probing the modes of action of these compounds.

John P. Burrows of the Institute of Environmental Physics, University of Bremen, Germany, lectured on “Observing the changing Atmospheric Composition in the Anthropocene from space and from aircraft.” He explained that the world has now entered a new geological epoch the Anthropocene. To assess accurately the impact of man in the evolving Anthropocene both space-based and airborne measurement of atmospheric composition are a prerequisite. The SCIAMACHY (SCanning Imaging Absorption spectrometer for Atmospheric CHartography) project was proposed in 1988 to meet this need. SCIAMACHY flew on the ESA Envisat (2002 to 2012). SCIAMACHY, a passive remote sensing double monochromator, measured the up-welling radiation from the

top of the atmosphere. The GOME (Global Ozone Monitoring Experiment) was a smaller version of SCIAMACHY, on ESA ERS-2 (1995 to 2011) viewing only in nadir. GOME-2 is a somewhat improved version of GOME, aboard the ESA/EUMESAT. SCIAMACHY, GOME, and GOME-2 are best known for the retrievals of trace gases in the troposphere and the stratosphere, where measurements of the total and tropospheric columns of the trace gases O₃, NO₂, HCHO, CHO, BrO, IO, H₂O, CO as well ocean color, cloud and aerosol optical properties. In addition, SCIAMACHY observations made the first dry column mixing ratios of CO, CH₄ and CO₂. In addition to space measurements, aircraft are needed to provide high spatial resolution measurements of trace atmospheric constituents to test our understanding of the transport and transformation of atmospheric emissions. EMERGE (Effect of MEGacities on the Regional to Global Scales) was proposed to exploit the capabilities of the German HALO research aircraft to study the outflow from MPC. This presentation will provide highlights from both spaced based remote sensing and provisional observations from the EMERGE campaigns.

Eugene Y.-X. Chen of Colorado State University, Fort Collins, USA, spoke about “Towards A Circular Materials Economy: Design and Methodology for Reversible Polymers with Robust Properties and Chemical Circularity.” He explained that the ever-worsening worldwide plastic pollution, which is accompanied by enormous materials value loss to the global economy, is largely caused by current unsustainable practices in the generation and disposal of synthetic polymeric materials. To address this global challenge several approaches have been intensively pursued. Among such approaches the development of chemically recyclable polymers that can be completely and repeatedly depolymerized back to their building-block monomers for virgin-quality polymer reproduction promises a circular materials economy approach to address these dire environmental and economic issues. However, realization of such reversible polymers must solve three challenges: energy cost, depolymerization selectivity, and depolymerizability/performance tradeoffs. To address these challenges, Chen introduced a synthetic methodology to render an important class of biorenewable and biodegradable polymers with a full chemical lifecycle. He described the design and discovery of infinitely recyclable plastics that are not only thermally and mechanically robust to be practically useful but also thermally and/or chemically depolymerizable with quantitative selectivity for clean monomer recovery and polymer reproduction under cost-effective polymer assembly and disassembly conditions.

Debbie C. Crans of Colorado State University, Fort Collins, USA, spoke about “Menaquinone composition, structure, redox potential and enzyme activities.” She explained that lipoquinones are organic hydrophobic compounds, which are ubiquitous in mammals and most bacteria where they are essential components of the electron transport chain and participate in aerobic cellular respiration. Depending on the system at hand they are known as ubiquinones (in

mammals and *E. coli*), menaquinones (in bacteria), and phyloquinone (in plants). In the case of menaquinones, her group has been preparing truncated derivatives with much better properties than the natural water insoluble MK-9. Using truncated derivatives, they studied the effects of chain length and structure on enzyme selectivity. The enzyme MenJ is a contextually essential enzyme and uses NADH and FAD during the reaction. MenJ specifically hydrogenate the second double bond on the isoprene link and little is known regarding its reaction, the structure, its location and selectivity of the enzyme products. As a result, the properties of both saturated and unsaturated truncated derivatives were investigated with regard structure and properties. Structures were investigated using first principles as well as experimental data. They found that saturation and chain length are important parameters that impact compounds redox potential, and may be important for their potential roles in biology.

Paul S. Cremer of Penn State University at University Park, USA, spoke about “Exploring the Function of PI(45)P2 Lipids with Supported Bilayer Systems.” He explained that phosphatidylinositol lipids are an essential component of plasma membranes. In particular, phosphatidylinositol 4,5 bisphosphate, PIP2, has functions ranging from membrane targeting and endocytosis to serving as a second messenger and is involved in cytoskeletal attachment. He described two particular roles of this lipid. First, he showed that calcium, but not magnesium ions, can dimerize PIP2 and thereby make it unavailable for binding of Plekstrin Homology domains. The dimerization process may help to regulate calcium ion signaling. Second, he demonstrated that PIP2 is capable of interacting with a variety of interfaces ranging from silica substrates to protein coatings. Such binding may be analogous to the type of interactions that occur in vivo as PIP2 uniquely helps to attach the plasma membrane to the cytoskeleton via its interactions with actin-binding proteins. These mechanisms were explored using supported lipid bilayers and lipid monolayers at the solid/liquid and air/water interfaces, respectively. He highlighted the use of techniques such as fluorescence microscopy, sum frequency generation vibrational spectroscopy, and pH modulation sensing.

Hai-Lung Dai of Temple University at Philadelphia USA, spoke about “Observing Molecular Adsorption and Transport at Living Cell Membranes through Second Harmonic Light Scattering and Microscopy.” He pointed out that nonlinear light scattering in the form of Second Harmonic Generation, due to its symmetry properties, has been proven effective for observing molecular adsorption and transport at the membranes of living biological cells. This method affords membrane specificity, real time resolution and the ability to image single cells in examining molecule-membrane interactions. He discussed the basic principles of Second Harmonic Light Scattering. The method has been used to determine the fundamental mechanism of the century old Gram stain for classifying bacteria. He presented examples that illustrate the molecular structure and membrane structure in influencing molecular adsorption and transport at living cell membranes.

Second Harmonic Light Scattering applied in the imaging mode showed that molecular transport can be examined with spatial resolution and that the transport rate varies greatly from regions to regions at a cell membrane. Furthermore, this second harmonic microscopic tool can be used to determine membrane viscosity within a single biological cell.

Scott E. Denmark of the University of Illinois at Urbana Champaign, USA, lectured on “Lewis Base Activation of Lewis Acids - an Evolving Paradigm for Catalysis in Main Group Chemistry.” He explained that catalysis is a chemical evergreen. Ever since Michael Faraday first recognized that platinum wire could bring about the combination of hydrogen and oxygen with spectacular speed, chemists have been fascinated with the origins, principles, scope and applications of catalysis. Despite Berzelius’s unfortunate choice of the word for this phenomenon (from the ancient Greek for destruction), the field of chemical (abiological) catalysis has grown immensely in the past century. Surprisingly, however, catalysis of reactions of the p-block (main group) elements is almost non-existent. Over the past decade, his group has investigated reactions based on elements in Groups 13, 14, 16 and 17, under the newly developed paradigm of “Lewis-base activation of Lewis acids.” Denmark described the most recent efforts in his laboratories to design, understand and apply synthetically useful reactions of, *inter alia*, the halogens and the chalcogens under catalysis by Lewis bases. These reagents are particularly useful for the vicinal functionalization of alkenes initiated by chalcogens and halogens with capture of the putative η^2 -iridium ions by various nucleophiles both inter- and intramolecularly with oxygen, nitrogen and carbon-based nucleophiles. The ability of various Lewis basic moieties to activate the electrophilic functionalization of double bonds has been demonstrated for S, Se, Cl, Br and I. Extensive mechanistic investigations have established the intermediacy and configurational stability of η^2 -iridium and seleniridium ions as well the corresponding haliridium ions. These studies have led to the development of catalytic enantioselective chalcogeno- and halofunctionalization reactions. Most recently, the use of enantioselective sulfenofunctionalization has enabled highly selective polyene cyclizations and 1,2-metalate rearrangements. All of these methods have been investigated mechanistically to elucidate the origins or reactivity and selectivity through kinetic, spectroscopic, crystallographic and computational analysis.

Vy M. Dong of the University of California at Irvine lectured on “Make it or Break it with Metal-Hydrides.” She explained that metal hydrides promote a wide range of organic transformations that include both C-C bond making and C-C bond-breaking processes. She highlighted the development of Rh and Co-catalysts for use in enantioselective hydrofunctionalizations, including hydroacylation, hydroamination, and hydrothiolation. Also, she described unique transfer hydroformylation that allows the conversion of aldehydes/alcohols to olefins. The presentation emphasized mechanistic studies that showcase the role of counter-ions in catalytic pathways. Lastly, she disclosed these catalysts’ applications for trans-

forming feedstocks into complex building blocks and natural products.

Mohamed Eddaoudi of the King Abdullah University of Science and Technology (KAUST), Saudi Arabia, spoke about “Reticular Chemistry: MOF Design Strategies to Applications.” He explained that the demand for functional materials targeted for specific applications is ever increasing as societal needs and demands mount with advancing technology. One class of inorganic-organic hybrid materials, metal-organic frameworks (MOFs), has burgeoned in recent years due, in part, to effective design strategies, *i.e.*, reticular chemistry, for their synthesis, and their inherent and readily interchangeable, hybrid, highly functional character. The MOFs have emerged as a unique class of materials amenable to design and manipulation for desired function and application. Several design strategies have been utilized and developed to target viable MOF platforms, from the single-metal-ion molecular building block approach to the hierarchical supermolecular building block and supermolecular building layer approaches to our newly introduced merged net approach allowing for the construction of intricate MOFs with multiple ligands. This inherent built-in information allows access to highly stable and made-to-order porous materials toward applications pertaining to energy and environmental sustainability. The deliberate control of the pore-aperture size of various selected MOFs and its impact on storage and various energy-intensive separations was discussed.

Antonio Facchetti of Northwestern University, USA, spoke about “Unconventional polymer-based materials and thin-film architectures for circuit and solar devices.” He explained that organic and hybrid organic-inorganic semiconductors have been envisioned for a myriad of optoelectronic and energy applications where mechanical flexibility, light weight, and low temperature fabrication processes possibly by printing are major advantage. He described the design, synthesis, and characterization of several semiconducting materials for printed/flexible thin-film transistors (TFTs), circuits, displays, photovoltaic cells (PVs). He emphasized the design of semiconducting organic polymers with p-deconjugated units, which enabled stabilizing electron transport and greatly enhance mechanical flexibility and elasticity. He also disclosed recently discovered polymer-doped metal oxide semiconductors where the amorphous phase is achieved by the addition of an insulating polymer instead of conventional elemental doping. His group aims at understanding these materials, charge-transport/performance characteristics as a function of the semiconductor film processing, device architecture, and device interfacial modifications. Their materials enabled the realization of printed TFTs with carrier mobilities $> 3\text{--}40\text{ cm}^2/\text{Vs}$, mass-producible flexible displays with resolution of 200 dpi, sensors, and, printed OPV cells with efficiencies $> 14\%$.

Koichi Fukase of Osaka University, Japan, spoke about “Synthesis and biofunctional studies of immunomodulating glycoconjugates.” His group has studied the synthesis of various microbial glycoconjugates such as peptidoglycans and

lipopolysaccharides (LPS) to investigate their immunological functions. He reported on the application of their immunomodulatory effects to the developments of immune adjuvants and cancer vaccines. They found that LPS from *Alcaligenes faecalis*, a symbiotic bacterium inhabiting in dendritic cells of Peyer's Patches, shows low inflammatory but effectively promotes antibody production. He reported on the structural determination of *A. faecalis* LPS and its active entity lipid A, and the synthesis and biological studies of *A. faecalis* lipid A. Self-adjuvanting vaccines consisting in antigens and adjuvants have been investigated to improve vaccine efficacy and safety. They synthesized self-adjuvanting cancer vaccines composed of a trimeric tumor-associated carbohydrate antigen Sialyl-Tn (STn), a TLR2 agonist Pam3CSK4 as an adjuvant, and a T-helper epitope, since clustered STn antigens are highly expressed on many cancer cells. Immunization of vaccines in mice induced the anti-triSTn IgG antibodies, which recognized triSTn-expressing cell lines PANC-1 and HepG2. Humans do not have α -gal trisaccharide but have natural antibodies against α -gal. The reaction of anti-Gal antibodies with α -gal causes hyperacute rejection in xenogeneic organ transplantation. In this study, α -gal-antibody conjugates were developed that dramatically increased cellular cytotoxicity by recruiting natural antibodies through the interaction between α -gal and anti-Gal antibodies.

Betty J. Gaffney of Florida State University at Tallahassee USA, spoke about "Lipoxygenases: EPR Studies of a Radical Enzyme." She explained that polyunsaturated fatty acids are sources of diverse natural, and chemically designed products. The enzyme lipoxygenase performs selective oxidations of fatty acid acyl chains using controlled free radical chemistry; the products of the reactions are regio- and stereo-chemically unique hydroperoxides. Lipoxygenases have a conserved structural fold of around 600 amino acids that harbors a long and narrow channel for acyl chains and a well-shielded catalytic iron. Oxygen, a co-substrate, is blocked from the active site until a hydrogen atom is abstracted from a substrate bis-allylic carbon, in a redox cycle involving the non-heme iron. EPR spectroscopy of the ferric intermediates in lipoxygenase catalysis reveals changes in the metal coordination and leads to a proposal on the nature of the reactive intermediate. Remarkably, free radicals are so well controlled in lipoxygenase chemistry that spin label technology can be applied as well. A substrate analog, spin labeled lysolecithin, has a very dynamic head group when bound to enzyme, signifying a surface location for the head group. This is relevant to questions about which end of an acyl chain is buried deeply in the protein. In contrast, with lipids bearing spin labeled acyl chains, the spin probe is grasped tightly by the enzyme. To locate the entrance to the substrate cavity, five spin-label reference points were placed on the lipoxygenase surface, and EPR dipolar spectroscopy (DEER) was applied to locate, by triangulation, spins of lipid analogs relative to the reference points. A more focused examination of protein side chain motions, associated with lipid-binding, revealed the importance of bending of a helix forming the active site

entrance. Indeed, mutations of the enzyme near the proposed entrance lead to changes in the geometric details of the iron site >20 Å away. This level of understanding of steps in lipoxygenase catalysis prepares the way to use directed mutagenesis to control the outcome of polyunsaturated fatty acid oxidation reactions.

Richard Hartshorn of the University of Canterbury at Christchurch, New Zealand, lectured on "Marrying Ruthenium and Cobalt – something old something new something borrowed and something blue." He explained that cobalt(III) is an ion with a venerable and distinguished history in coordination chemistry. It was one of the key ions for Werner and Jørgensen, as they set about preparing the compounds on which coordination theory was based, and was central to many of the mechanistic studies of the '50s, '60s, and '70s. His group is exploring its potential use in medicine, as part of dinuclear Ru(II)-Co(III) assemblies, and, in passing, we find ourselves doing some classic Werner-type chemistry as well as functional group chemistry on coordinated ligands. Photo-induced electron transfer from Ru(II) to Co(III), through a bridging ligand (L), has been shown to result in ligand release from the Co centre. The synthetic challenges are to put the metal centers in the right places and to prepare systems containing cytotoxic ligands without having to handle the free cytotoxin. The cytotoxin is much less reactive when bound to the inert Co(III) centre and can be prepared late in the synthesis, on the metal ion, after coordination of a precursor molecule.

Martijn J. van Hemert of Leiden University Medical Center, the Netherlands, spoke about "Antivirals against chikungunya virus." He explained that chikungunya virus (CHIKV) is a mosquito-transmitted virus that can cause a high fever, skin rash, and severe muscle and joint pains that can persist for many months. Millions of people have suffered from CHIKV infections over the past 15 years, mainly in Asia and Latin America. The virus is a serious public health threat in many tropical and subtropical areas, as it continues to cause outbreaks and its geographic distribution has expanded dramatically over the past decade. The current lack of vaccines and specific antiviral therapy to prevent or treat CHIKV infections stresses the need to provide drug development pipelines with novel inhibitors. Various approaches can be distinguished to discover such inhibitors, like structure-based drug design and cell-based screening of compound libraries. Considering the enormous costs involved in drug development, antivirals with a broad spectrum of activity or repurposed approved drugs are particularly interesting options. He described his group's efforts to identify compounds with anti-CHIKV activity through various approaches. He demonstrated how antiviral compounds can be identified and how their mode of action can be elucidated, e.g., by resistance selection and reverse genetics on CHIKV and by biochemical assays with purified viral proteins. By analyzing the activity of analogs of original hit compounds, structure activity relationships (SAR) can be established, which can provide mechanistic information and can also be used for further medicinal

chemistry efforts to improve efficacy and other properties of the original hit compound. He also explained that alphaviruses employ a unique mechanism to cap their RNA, which involves methyltransferase and guanylyltransferase activities of the viral nsP1 protein, making it an attractive target for the development of antivirals. He illustrated this approach by mode-of-action studies on different classes of anti-CHIKV compounds that target alphavirus nsP1, including novel carbocyclic nucleoside analogs. Several of these nsP1-targeting compounds potently inhibit CHIKV replication and exhibited a high barrier to resistance, which makes them interesting potential candidates for further clinical development.

Rolf Hilgenfeld of the University of Luebeck, Germany, spoke about “Broad-Spectrum Antivirals Targeting the Proteases of Coronaviruses and Enteroviruses.” He explained that the development of antiviral drugs targeting individual (re-) emerging viruses is often not commercially viable because of the relatively low number of patients and the self-limiting nature of the viruses. Therefore, his group aims at discovering broad-spectrum antivirals with activity against larger groups of viruses. The main protease of coronaviruses and the 3C protease of enteroviruses share a similar active site architecture and a unique requirement for glutamine in the P1 position of the substrate. Because of their unique specificity and essential role in viral polyprotein processing, these proteases are suitable targets for antiviral drugs. To obtain near-equipotent, broad-spectrum antivirals against alphacoronaviruses, beta-coronaviruses, and enteroviruses, they performed structure-based design of peptidomimetic alpha-ketoamides as inhibitors of main and 3C proteases. Close inspection of crystal structures of their early lead compound in complex with the target proteases HCoV-NL63 Mpro, SARS-CoV Mpro, and Coxsackievirus B3 (CVB3) 3Cpro revealed that the S2 pocket differs between these proteases: it is small and covered by a lid in the HCoVNL63 enzyme, large and covered in SARS-CoV Mpro, and large and not covered in CVB3 3Cpro. Further, the SARS-CoV Mpro features high plasticity of the S2 site, in contrast to the two other enzymes. The best non-toxic, near-equipotent inhibitors have P2 = cyclopentylmethyl or cyclohexylmethyl and display low- or sub-micromolar EC50 values against enteroviruses, alphacoronaviruses, and beta-coronaviruses in cell cultures. In Huh7 cells, one of the compounds exhibited the highest activity of any antiviral described against Middle East Respiratory Syndrome coronavirus. Named DZL08, this compound was subjected to optimization of pharmacokinetics and pharmacodynamics. The optimized leads exhibited improved solubility, decreased binding to plasma proteins, increased half-life, and showed no sign of toxicity.

Teh Chung Ho of the ExxonMobil Corporate Strategic Research Laboratories at Annandale NJ, USA, spoke about “Ultra-Deep Diesel Hydrodesulfurization Catalysis and Process: A Tale of Two Sites.” He explained that hydrodesulfurization catalysts have two types of active sites for hydrogenation and hydrogenolysis reactions. While hydrogenation sites are

more active for desulfurizing refractory sulfur species, they are more vulnerable to organonitrogen inhibition than hydrogenolysis sites. In contrast, hydrogenolysis sites are less active for desulfurizing refractory sulfur species but are more resistant to organonitrogen inhibition. This dichotomy was exploited to develop an ultra-deep hydrodesulfurization stacked-bed reactor comprising two catalysts of different characteristics. The performance of this catalyst system can be superior or inferior to that of either catalyst alone. A theory was developed to predict the optimum stacking configuration for maximum synergies between the two catalysts. The best configuration provides the precise environment for the catalysts to reach their full potentials, resulting in the smallest reactor volume and maximum energy saving. Model predictions are consistent with experimental results. A selectivity-activity diagram is developed for guiding the development of stacked-bed catalyst systems.

Alex Jen of the City University of Hong Kong at Kowloon, spoke about “Development of Highly Efficient Stable and Environmentally Stable Perovskite Solar Cells and Their Integration with OPV.” He explained that advances in controlled synthesis, processing, and tuning the properties of NIR non-fullerene acceptors and composition/interface engineering of 3D and 2D/3D perovskites have enabled significantly enhanced performance of perovskite and perovskite/organic hybrid solar cells. The performance of these solar cells is strongly dependent on their efficiency in harvesting light, charge transport, and charge collection at the interfaces. He presented an integrated approach, combining material design, interface, and device engineering to significantly improve the performance and long-term stability of perovskite and OPV/perovskite hybrid photovoltaic cells will be. Several new approaches to make efficient tandem cells explored the full promise of their applications.

Dong-Pyo Kim of POSTECH, Pohang, South Korea, spoke about “Taming Diverse Flash Chemistries in Various Microreactors.” He explained that the flash chemistry for short-lived organolithium intermediates in the microreactor has been developed and pursued by Prof. J. Yoshida. This approach enables impossible reactions under traditional conditions, via highly reactive lithiated species. Kim presented his group’s achievements on taming the flash chemistry in various unique microreactors fabricated from different materials for synthesis of biologically active thioquinazolinones and ibuprofen, single hoop of phenylene, chemoselective control of anionic Fries rearrangement. A precise control over the residence time allowed for generating lithium species, bearing sensitive functional groups, without significant decomposition with respect to batch conditions. First, an integrated one-flow microfluidic synthesis of thioquinazolinones was carried out with sequential reactions involving short-lived NCS-substituted aryllithium species, within 10 sec at room temperature. Three-step synthetic process was involved with lithium thiolate intermediate. Alternatively, ibuprofen was synthesized from economic p-xylene by a three-step flow-assisted reaction via in-situ generation of lithiated superbase. The chemo-

selective metalation of benzyl proton was sequentially optimized to be nearly complete at both 1st and 2nd steps. At 3rd step, the ibuprofen was obtained by biphasic reaction between metalized intermediate and CO₂. Cycloparaphenylene (CPP) as a 'carbon nanohoop' molecule was synthesized by generating mono- and di-lithiated benzene in precise time and flow control in a capillary microreactor. A selective nucleophilic addition of unprotected diketone in high yield was achieved with no protection/deprotection step. Subsequently, the obtained compound was reacted with di-lithiated benzene to form a U-shaped precursor in a separate microreactor. The [10]CPP was produced by two step reaction in a flask, as bottom-up approach of carbon nanotubes (CNT). Rapid intramolecular rearrangements often foil attempts at site-selective bimolecular functionalization. Unique design of a chip microreactor enabled sub-millisecond mixing time even at cryogenic temperatures, which was used for outpacing anionic Fries rearrangement to attain high chemoselectivity. He also demonstrated the synthesis of afesal, a bioactive molecule exhibiting anthelmintic activity. Furthermore, 3D-printed stainless steel microreactor with circular shape of cross-sectional fluidic channel enhanced the control of anionic Fries rearrangement for higher yield of the un-rearranged product. The high mixing efficiency of simple T-shaped channel structure was simulated and experimentally validated at the residence time less than milliseconds.

Takumi Konno of the Osaka University, Japan, spoke about "Creation of Non-Coulombic Ionic Crystals via Metalloligand Approach." He explained that design and creation of supramolecular coordination compounds have been a research subject of considerable attention. In this subject, a self-assembly approach that spontaneously affords molecular aggregates from organic building blocks and metal ions is commonly employed to construct highly organized molecular/crystal structures. His group is interested in a metalloligand approach, in which pre-designed metal complexes with thiol-containing ligands are stepwise treated with different kinds of metal ions. They found that the monogold(I) complex with two D-penicillamines (D-pen), [Au(D-pen-S)₂]³⁻, functions as a multidentate metalloligand to produce a variety of polynuclear/supramolecular coordination compounds that show unique structures and properties. They also found that digold(I) complexes with mixed D-pen and diphosphine ligands serve as a flexible, functional metalloligand to create fascinating chiral metallosupramolecular structures. He presented several metallosupramolecular ionic crystals that feature a new conceptual arrangement of ionic species.

Fuk-yeo Kwong of the Chinese University of Hong Kong, spoke about "Palladium-Catalyzed Site-Selective Multicomponent Process for Assembling Substitution-Manipulated Polycyclic Arenes." He described a straightforward π -extension reaction that was based on the three-component cross-coupling of versatile aryl halides, 2-haloarylcarboxylic acids and norbornadiene. He found that this transformation is driven by the direction and subsequent decarboxylation of the carboxyl group while norbornadiene serves as an ortho-C-H activator

and ethylene synthon via a retro-Diels Alder reaction. This method also offers a facile regioselective manipulation of non-planar fused arene structures and also heptagonal-fused scaffolds. With this initial success, his group explored the cascade process of C-H activation/decarboxylation/annulation sequence. Most recently, they employed the arylhydrazone substrate for direct access of unsymmetrical fluorenes.

Yuan Chuan Lee of the Johns Hopkins University, USA, spoke about "Serendipity in Scientific Discoveries: Examples in Biology and Chemistry." He explained that serendipitous discoveries in scientific research typically occurs because the "theory" deduced from the accumulated data is never perfect or sufficient. Examples of serendipitous discoveries include the discovery of penicillin by Fleming, invention of the soft laser desorption in mass spectroscopy by Tanaka, and the discovery of carbohydrate-receptor of the liver by Ashwell and Morell. Serendipity can be classified in many ways. In the original usage of serendipity, the discovery is totally unexpected from the original intention. For example, K. Tanaka did not realize he was doing such an important work as to receive the Nobel prize. Serendipity in this sense is discovery of "unknown unknowns". Pseudo-serendipity, however, is an unplanned discovery of solution to a predefined purpose, such as vulcanization of rubber by C. Goodyear or the successful cultivation of *Helicobacter pylori*. He presented the circumstances to induce serendipity. For example, L. Pasteur said, "Chance favors prepared mind". Fleming would have just dismissed the phenomenon of Staphylococci dissolved by Penicillium mold, were it not for his prior experience with lysozyme. Some attempts have been made to understand the mechanism of serendipitous discoveries, even attempting to develop algorithms for it. However, one cannot reach serendipity by simply plotting a course for it (John Barth). Designing for a serendipity is a contradictory task (Amacker). Although there is a saying "Better be Lucky than Good", one has to be good to discern luck. Serendipitous discoveries are more important in the areas of research where unknowns are prevalent, such as the field of biology).

Aiwen Lei of Wuhan University, China, spoke about "Oxidation Induced C-H Activation and Catalytic Oxidative Cross-Coupling." He explained that C-H functionalization strategy is one of the most important reaction for synthesis of natural products, pharmaceuticals, and organic materials. By treating a suitable oxidative method, oxidation-induced C-H activation, a directed oxidative cross-coupling strategy between a radical cation and a nucleophile, could be proceeded. Therefore, his group focus on the design and development of cross-coupling reactions by introducing catalytic methods with single-, or two-electron transfer reagents. They have achieved cross-coupling reactions that proceed through electrochemistry. In these protocols, two different R-H bonds were activated by oxidative cross-coupling reaction without the utilization of extra-oxidant, thus providing a green, mild, and clean approach. Several photo-redox and electrochemical C-H/X-H oxidative cross-coupling reaction methods were demonstrated, such as C-N, C-O, and C-C bond formation. These reactions

involve high product diversity and synthetic efficiency, furnishing valuable products. His group investigated key intermediates and mechanism of these oxidative coupling reactions. Spectroscopic tools, such as XANES, EXAFS, in situ IR, Raman, EPR, and NMR afforded structural information of organometallic complexes under the reactive conditions.

Jürgen Liebscher of the Humboldt-University at Berlin, Germany, spoke about “Polydopamine – Famous but Structurally Challenging.” He explained that polydopamine is easily formed by oxidation of dopamine under various conditions, most simply by air oxidation in Tris-buffer. It sticks to all types of surfaces in a mussel like fashion even under water, is hydrophilic, exhibits radical character and is non-toxic. It has found wide interest, as expressed by more than 2 000 publications, and was applied in many fields, such as in reactive hydrophilic coating, as interlayer, in medicine, nanobiology, electronics, energy conversion, batteries, membrane-technology and catalysis. Despite the great popularity of polydopamine it is somewhat surprising that its structure is still not fully understood. Liebscher provided an overview about polydopamine, including a critical discussion of structural models proposed so far.

Bin Liu of the National University of Singapore, spoke about “Aggregation-Induced Emission: Materials and Biomedical Applications.” She explained that the recent years have witnessed fast growth of fluorogens with aggregation-induced emission characteristics (AIEgens) in biomedical research. The weak emission of AIEgens as molecular species and their bright luminescence as nanoscopic aggregates distinguish them from conventional organic luminophores and inorganic nanoparticles, making them wonderful candidates for many high-tech applications. She presented his group’s recent AIE work in the development of new fluorescent bioprobes for biosensing and imaging. The simple design and fluorescence turn-on feature of the molecular AIE bioprobes offer direct visualization of specific analytes and biological processes in aqueous media with higher sensitivity and better accuracy than traditional fluorescence turn-off probes. The AIE dot probes with different formulations and surface functionalities show advanced features over quantum dots and small molecule dyes in noninvasive cancer cell detection, long term cell tracing, and vascular imaging. In addition, their recent discovery that AIEgens with high brightness and efficient reactive oxygen species generation in aggregate state further expanded their applications to image-guided cancer surgery and therapy.

Todd Lowary of the University of Alberta at Edmonton, Canada, spoke about “Synthesis of Complex Microbial Glycan Probes.” He pointed out that synthetic glycoconjugates are essential biological probes. He described ongoing investigations focused on synthesizing three classes of complex glycans: 1) fragments of capsular polysaccharides from *Campylobacter jejuni*, an important food borne pathogen; 2) N-linked glycans from chlorella viruses; and 3) glycosylphosphoprenols that are intermediates in the assembly of lipopolysaccharide in gram-negative bacteria.

Atsuhiko Osuka of Kyoto University, Japan, spoke about “Stable Porphyrin Radicals.” He explained that in recent years, his group has revealed that various porphyrinoids such as subporphyrin, meso-arylsubstituted porphyrin, and hexaphyrin can stabilize meso-oxy radicals, meso-aminy radicals, and meso-carbon radicals to the extent that radicals can be handled like usual closed-shell molecules under ambient conditions. The high stabilities of these radicals have been ascribed mainly to the effective spin delocalization over the large and flexible conjugation systems of porphyrinoids. These radicals show characteristic structural, magnetic, optical, and electrochemical features. Typically, these radicals show significantly red-shifted absorption bands in the near-IR region and undergo one-electron oxidation and reduction in a reversible manner within narrow potential windows. At the next step, they explored an aminyl triradical that possesses the quartet ground state with a doublet–quartet energy gap of +3.1 kJ/mol. Despite the high-spin nature, this triradical is remarkably stable, allowing for its separation and recrystallization under ambient conditions. Moreover, this triradical can be stored as solids more than one year without serious deterioration. We also synthesized a porphyrin-stabilized trimethylenemethane (TMM) diradical that has the triplet ground state with a positively large DEST. Despite the apparent TMM structure, the diradical is tolerant towards usual manipulations under ambient conditions and storable over months in the solid state.

Jacob J. Plattner of Research, Boragen Inc., Durham, USA, spoke about “Applications of Boron in Medicinal Chemistry.” He explained that the element boron holds tremendous potential in medicinal chemistry. Its chemical reactivity, which stems from the ability to form complexes with alcohols or metals, offers a unique opportunity to bind biological targets in a novel manner. However, despite these advantages, the exploration of boron-containing drug candidates has only recently been pursued in drug discovery efforts. A focus of this recent work has been the incorporation of unique benzoxaborole templates into optimized drug candidates. Recent advances in this area have highlighted a number of novel boron-containing compounds achieving FDA approval or clinical development status. These compounds have demonstrated novel binding modalities to their biological target, predictable pharmacokinetics & metabolism, and good safety profiles. He described the design and properties of benzoxaborole derivatives that are currently in development for the treatment of infectious and inflammatory diseases.

Daniel G. Nocera of Harvard University, USA, spoke about “Artificial and Bionic Leaf: Food and Fuel from Sunlight, Air and Water.” He explained that hybrid biological inorganic (HBI) constructs have been created to use sunlight, air and water, as the only starting materials, to accomplish carbon and nitrogen fixation, thus providing a path to a sustainable nitrogen and carbon cycle for distributed and renewable fuels and crop production. The carbon and nitrogen fixation cycles begin with the Artificial Leaf, which was invented to accomplish the solar process of natural photosynthesis – the splitting of water to hydrogen and oxygen using

sunlight – under ambient conditions. To create the artificial leaf, self-healing catalysts were created to permit water splitting to be accomplished in natural water under benign conditions and thus the system may be interfaced to bioorganisms to accomplish fuels and fertilizer production. To this end, engineered bioorganisms convert carbon dioxide and nitrogen from air, along with the hydrogen produced from the catalysts of the artificial leaf, into liquid fuels and ammonia, respectively. The HBI, called the Bionic Leaf, operates at carbon-fixing efficiency that is ten times greater than natural photosynthesis. For the case of the nitrogen-fixing cycle, the bioorganisms when introduced into soil, increase crop yields by > 300%. By interfacing energy with agriculture via the Bionic Leaf, his group showed that for a 400-acre farm there is a budget saving of carbon dioxide of 125,000 lbs of CO₂. He showed that using only sunlight, air and water, distributed and renewable systems may be designed to produce fuel (carbon neutral) and food (carbon negative) within sustainable cycles for the biogenic elements.

Norbert O. Reich of the University of California at Santa Barbara, USA, spoke about “Intracellular delivery of proteins for basic research and therapeutic applications.” He explained that the delivery of proteins and peptides into cells remains a challenge. His group has developed a nanoparticle-based platform for protein and peptide delivery with spatio and temporal control. Proteins were attached to hollow gold nanoshells and upon irradiation with benign near infra-red laser, released this cargo into cells. Cell targeting is also enhanced through the orthogonal attachment of peptides that direct the particles to particular cells. He described the use of this approach to deliver therapeutic peptides that induce apoptosis *in vivo*. Also, two distinct particles activated at different wavelengths were used to first deliver a gene editing enzyme, and then down regulate this by delivery of siRNA. The same technology was used to track the dynamics of proteins in live cells without relying on large protein fusions, such as green fluorescent proteins. This platform provides a simple and robust means to control intracellular protein delivery that is more effective with greater spatio-temporal control than current methods.

Tibor J. Sabo of the University of Belgrade, Serbia, spoke about “Moving towards clinical trials of O,O'-diethyl-(S,S)-ethylenediamine-N,N'-di-2-(3-cyclohexyl)propanoate dihydrochloride.” He explained that cisplatin, which was a pioneer in antitumor drug designing, shows several significant side effects. In order to get cisplatin analogues that will overcome the side effects, his group has synthesized numerous platinum (II) and platinum(IV) complexes with ethylenediamine based ligands. Among all synthesized ligands and complexes one ligand and its corresponding Pt(IV) complex showed significant *in vitro* antitumor activity. *In vitro* antitumor activity was tested on human glioma cell lines (U251), rat glioma cell lines (C6), fibrosarcoma in mice (L929) and mice melanoma (B16). *In vitro* and *in vivo* activity research of O,O'-diethyl-(S,S)-ethylenediamine-N,N'-di-2-(3-cyclohexyl)propanoate L3 showed four-fold better antitumor activity on mice melanoma

cells (B16) than cisplatin. They found that L3 significantly reduces the growth and progression of breast cancer, as reflected in the reduction in size and area of the primary tumor. Preclinical studies have shown, in addition to the antitumor effect, a similar pro-oxidation potential of L3, as well as, a slightly more pronounced cardio-depression compared to other antitumor agents. In terms of toxicological preclinical studies, L3 has less nephrotoxicity, hepatotoxicity and immunotoxicity than cisplatin.

Mitsuo Sawamoto of Kyoto University, Japan, spoke about “Precision Polymerizations: Present and Future.” He explained that the development of precision polymerizations has dramatically contributed to the progress in polymer and materials sciences in the recent 3–4 decades. We have developed cationic and radical living polymerizations, both based on metal catalysis and dormant species. In the author's view, the most important in these developments has been the discovery and generalization of the concept of dormant species. Another factor has been the design of catalysts that catalyze the (reversible) formation of the true propagating species. Precision synthesis of functional polymers is of course the direct outcome, and the future challenges include precision control of functionality sequence to generate sequence-controlled macromolecules that would rival biopolymers such as peptides, enzymes, and genes. Following an overview of the development, discussion will be directed to the future challenges in precision polymerizations and the precision synthesis of functional polymers and related materials.

Ben Zhong Tang of the South China University of Technology, Guangzhou, China, and the Hong Kong University of Science and Technology, China, spoke about “Aggregation-Induced Emission: Making the Impossible Possible.” He explained that as a milestone of photophysical study, aggregation-induced emission (AIE) opens new areas in many different research fields, such as fundamental theories, smart materials and advanced applications. AIE effect exists in the luminogens, which show no or weak emission in solution but strong emission in the aggregate state. Due to the strong emission in the solid state, AIE luminogens (AIEgens) have attracted much interest in light emitting devices. Especially, the AIEgens with aggregation-induced delay fluorescence (AIDF) feature show external quantum efficiencies up to 23%. Meanwhile, the restriction of intramolecular motion (RIM) mechanism endows AIEgens with great potentials in biosensor and chemosensor. A representative application is the tumor cells visualization. AIE-related researches also bring new ideas and theories in photophysical processes. For example, his group found that the conical intersection effect contributes a lot to the nonradiative decay of AIEgens in solution. Also, for some non-conventional AIEgens, through-space conjugation is proved to play an important role in the clusteroluminescence.

Lutz F. Tietze of the Georg-August-University at Göttingen, Germany, lectured on “Domino Reactions. The Green and Economical Art of Chemical Synthesis.” He explained that the efficient synthesis of natural products, drugs, agrochemicals and materials is a very important aspect in academia and

industry. To allow an ecologically and economically favorable approach in a green fashion, the former, stepwise procedures must be replaced by domino reactions which allow the preparation of complex molecules starting from simple substrates in a straightforward way. Domino reactions allow the reduction of the amount of waste being formed and the preservation of resources. Moreover, they are also favorable in an economical way since they consume less time and less material. The usefulness of the domino concept was demonstrated with the syntheses of some fungal metabolites as blennolide A and secalonic acid E with a dimeric tetrahydro-anthenone skeleton using an enantioselective domino-Wacker/carbonylation/methoxylation reaction. And of the natural aryldihydronaphthalene lignan linoxetine was prepared by employing a domino-carbopalladation/Heck reaction. The approach has also been applied for the synthesis of novel materials such as molecular switches and fluorescence dyes using a domino-Sonogashira/carbopalladation/CH-activation reaction.

Weitao Yang of Duke University, USA, and South China Normal University, China, spoke about “Quasiparticle and Excitation Energies from Ground State DFT Calculations.” He explained that the perspectives of fractional charges and fractional spins provide a clear analysis of the errors of commonly used density functional approximations (DFAs). These errors, the delocalization and static correlation error, of popular DFAs lead to diversified problems in present-day density functional theory calculations. To achieve a universal elimination of these two errors, his group developed a localized orbital scaling correction (LOSC) framework. The LOSC-DFAs lead to systematically improved results, including the dissociation of ionic species, single bonds, multiple bonds without breaking space or spin symmetry, the band gaps of molecules and polymer chains, the energy and density changes upon electron addition and removal, and photo-emission spectra. Comparison of experimental quasiparticle energies for many finite systems with calculations from the GW Green function approach and LOSC shows that LOSC orbital energies achieve slightly better accuracy than the GW calculations with little dependence on the semilocal DFA, supporting the use of LOSC DFA orbital energies to predict quasiparticle energies. This leads the Quasiparticle Energy DFT (QE-DFT) approach to the calculations of excitation energies of the N -electron systems from the ground state DFA calculations of the $(N - 1)$ -electron systems. Results show good performance for valence excitations with commonly used DFAs with or without LOSC, for Rydberg states only with the use of LOSC-DFA, and the accurate description of conical interactions. This highlights a new and simplest pathway to describe excited states.

Jackie Yi-Ru Ying of the NanoBio Lab, Agency for Science, Technology and Research (A*Star), Singapore, spoke about “Nanomaterials and Nanosystems for Catalytic Energy and Biomedical Applications.” She explained that nanostructured materials can be designed with sophisticated features to fulfill the complex requirements of advanced material applica-

tions. She described the synthesis of metallic, metal oxide and semiconducting nanocrystals of controlled size, morphology and architecture. The nanocrystalline building blocks were used to create multifunctional systems with excellent dispersion and unique properties. Nanoporous materials of metal oxide and organic backbone have also been synthesized with high surface areas and well-defined porosities. The nanostructured materials were successfully tailored towards catalysis and pharmaceuticals synthesis, biomass conversion, greenhouse gas sequestration and utilization, fuel cells and batteries. Her laboratory has also designed organic and inorganic nanoparticles and nanocomposites for advanced drug delivery, antimicrobial, antifouling, stem cell culture, tissue engineering, and biosensing applications. In addition, they have fabricated nanofluidic systems for drug screening, *in vitro* toxicology, clinical sample preparation, and diagnostic applications. Their nanosystems allowed for the rapid and automated processing of drug candidates and clinical samples in tiny volumes, greatly facilitating drug testing, genotyping assays, infectious disease detection, point-of-care monitoring, as well as cancer diagnosis and prognosis.

Samir Z. Zard of the Ecole Polytechnique at Palaiseau, France, spoke about “Radical Alliances. Solutions and Opportunities for Organic Synthesis.” He explained that radical reactions offer many of the features desired by synthetic organic chemists in terms of variety, mildness of conditions, and a selectivity that is often complementary to that of ionic chemistry, making many protection steps superfluous. There is, however, one major difficulty, which derives from the propensity of radicals to interact with themselves (dimerisation, disproportionation) with extremely fast rates that are close to diffusion. In order to overcome this complication, it is essential to keep the steady-state concentration of radical species very low. This can be accomplished by contriving a chain reaction where the propagating steps are themselves quite fast, as in the typical, and extremely popular, stannane based processes. While various unimolecular cyclisation and fragmentation steps can be efficiently incorporated into the radical sequence, kinetically slower bimolecular transformations, and in particular intermolecular additions to electronically unbiased alkenes, have proven more difficult to implement. In the case of stannanes, the relatively slow addition to the alkene has to compete with premature hydrogen atom abstraction from the organotin hydride, a step that is usually thousands of times faster. Over the years, the Zard group has shown that thiocarbonylthio derivatives such as xanthates allow the generation of radicals under conditions where the radicals possess a considerably increased effective lifetime, even in a concentrated medium. Intermolecular additions to unactivated alkenes, as well as a variety of reputedly difficult radical transformations can now be easily accomplished. No metals, heavy or otherwise, are required, and the starting materials and reagents are cheap and readily available. Complex, densely functionalized structures, including diverse organofluorine and organoboron compounds, heterocycles, aromatics and heteroaromatics, can be constructed in a

convergent, modular fashion. Zard presented and discussed their recent results and applications.

Social Programs

The Welcome Reception (Figure 1) took place in the lobby of the TICC on December 8 at 18:00. Nearly 2000 participants visited the exhibition and posters that were on display in the lobby area. The Chairman's Dinner took place on December 9, at the Kun Lun Room on the 12th floor of the Grand Hotel Taipei. Approximately 80 invited guests enjoyed the dinner and night view of the City of Taipei (Figure 5, top).

A four-hour guided Culture Tour (Figure 5, middle) took place on December 11 from 13:00 to 17:00. The participants went by several buses to visit scenic sites on the seashore and a traditional Taiwanese village.

The Gala Dinner & Celebration of the 40th Anniversary of FACS took place on December 11, in the Grand Ballroom I on the 6th floor of the Taipei Dazhi Denwell restaurant (Figure 5, bottom). Approximately 500 participants enjoyed a long evening, watching cabaret performances of dancing and singing teams, and participated in active group dancing. A formal ceremony of the 40th anniversary of the FACS included addresses by current and past FACS presidents, and active participation of the audience.

Prof. Reuben Jih-Ru Hwu awarded a FACS medal of appreciation (Figure 5 bottom left, clockwise) to Prof. David Winkler, FACS President; Prof. Chin-Kang Sha of the National Tsing Hua University, previous chair of CSLT financial committee; Prof. Chain-Shu Hsu of the National Chiao Tung University, Immediate Past President of CSLT; and Dr. Fang-Chen Lee of YungShin Global Holding and YungShin Pharmaceutical Industrial Co., CSLT President-elect.

EXCO meeting

The 76th meeting of the FACS Executive Committee (EXCO) took place on the afternoon of December 9, in the TICC (Figure 6) in the presence of President Reuben Jih-Ru Hwu, Past President Dave Winkler, Secretary-General Liu Ling-Kang, Secretary General-elect Onder Metin, Treasurer Edward Juan Joon Ching, Science Director Mitsuo Sawamoto, Science Director Ehud Keinan, Representative of Southeast Asia & Papua New Guinea Dien Pandiman, Representative of South & West Asia Wahab Khan, Xuefeng Jiang (on behalf of Suping Zheng, Representative of East & Pacific Asia). Dr. Ale Palermo of the RSC attended as a guest. Three members apologized for not attending, including President-elect Mustafa Culha, Communications Director Bong June Sung, and Suping Zheng.

FACS President Reuben Jih-Ru Hwu welcomed all EXCO members, mentioning that this was the first EXCO meeting of his term, which provided an opportunity to greet the incoming members and thank the outgoing members. The Immediate

Past President Dave Winkler was pleased with the previous EXCO members' contributions and wished to see more progress on modernizing the governance of FACS, looking forward to more standard operating procedure (SOP) rules and templates for operations. All members approved the minutes of the 75th EXCO Meeting in Tokyo, Japan. The Memorandum of Understanding between FACS and RSC has recently been completed and is to be signed by Paul Lewis, president-elect of the RSC, and Dave Winkler for FACS on December 10, 2019. The RSC had been collaborating with FACS through involvement in the congress for several years and worked individually with many FACS members. The MOU will formalize the relations. A course of action worth debating was for FACS to become a legal entity, such as an incorporated body, or become a holder of such an incorporated body. This would allow FACS to enter into contracts, have bank accounts, and hold copyrights and trademarks. The next meeting was planned at KAUST of Saudi Arabia upon an invitation by the Saudi Chemical Society.

Closing Ceremony

The one-hour closing and award ceremony took place on December 12 at 17:00. Two groups of students, from Taiwanese primary schools and high schools, who have led the International Year of the Periodic Table (IPCT) activities, received the FACS Award from Prof. Mei-Hung Chiu. She described some of the IPCT activities in Taiwan, including promoting the events through exhibitions and dynamic activities in the Taipei Mass Rapid Transit (MRT) system and the Taipei 101 Tower.

The Asian Rising Stars (ARS) program has launched in the ACC 2013 in Singapore to recognize young chemists at the initial stage of their career. The ARS speakers were first identified and selected based on their academic record. The speakers were invited to present a 25-minute lecture and receive a medal at the end of the presentation. The 21 ARS speakers included four students from China, Xuefeng Jiang, Hai-Bo Yang, Shou-Fei Zhu, and Feng Wang. Six students from Japan, Kazuhiro Takanabe, Satoshi Maeda, Shinya Hagihara, Yasuhide Inokuma, Aiko Fukazawa, and Shuhei Furukawa. Abhishek Dey from India, Tae-Lim Choi from South Korea, Osman Bakr and Jr-Hau He from Saudi Arabia, Yu Zhao from Singapore, Hao Ming Chen and Kui-Thong Tan from Taiwan, Montree Sawangphruk from Thailand, Xing Yi Ling from Singapore, Ustyugov Aleksey from Russia, and Ying Yeung Yeung from Hong Kong.

The Best of the Best (BBP) competition, which took place for the first time in the 18ACC, was organized by Prof. Susan Shwu-Chen Tsay and Dr. Patrick Charchar. The two-stage competition started with 40 selected graduate students who presented a poster followed by a 3-minute oral presentation and a 1-minute discussion. The BBP Judging Panel included Professors Jürgen Liebscher (Chairman, Germany), Martijn van Hemert (The Netherlands), Chun-



Figure 5. Collage of random photos from the various social events, including Chairman's Dinner (top), Culture Tour (middle), and gala dinner (bottom). Photographs by the CSLT.



Figure 6. Collage of random photos that reflect the general atmosphere on the EXCO meeting. Photographs by the CSLT.

Hung Lin (Taiwan), Mario Milani (Italy), Vojislav Mitić (Serbia), David Winkler (Australia), and Ismail Yalcin (Turkey).

Susan Shwu-Chen Tsay and David Winkler presented the BBP award certificate, a medal, and a \$150 award to ten winners: Patricia Abarquez (the Philippines), Merfat Alsabban (Saudi Arabia), Mavis Dambi (Zimbabwe), Qiaoxian Huang (China), Alvin Teik Zheng Lim (Malaysia), Shavneet Mani (Fiji), Benjamin Martinez (France), Jen-Hao Ou (Taiwan), Ryoko Oyama (Japan), and Benny Wahyudianto (Indonesia).

The other 30 competitors received a “Best Prize” certificate and a \$50 award.

Dr. Marinda Wu, Past President of the ACS, and Dr. Bonnie Charpentier, current ACS President received the FACS Medal.

Prof. Onder Metin of Koc University, Turkey, Secretary General-Elect of the FACS, presented the preparations for AsiaChem conference, 19ACC, which will take place in Istanbul on September 4–10, 2021. “Members of the Turkish Chemical Society are excited and honored to host the 19th Asian Chemical Congress and the 21st General Assembly of

the FACS in Istanbul. We have already started to organize the events and already contracted a highly experienced professional company in organizing international conferences. We have arranged a conference venue and launched the website. We have invited several plenary lectures, waiting for their response. We keep in mind that the objectives of the FACS are to promote and advance chemistry and the related disciplines by allowing scientists and professionals to communicate and collaborate in the Asia Pacific region. In this regard, we believe that the 19th ACC will be unique among all ACCs organized so far because it will be organized in Asia's very west end. We will do our best to make it a memorable event.

Istanbul is an ancient city with many museums, historic streets, mosques, churches, and synagogues, all providing a blend of history of the Hellenic, Roman, Byzantine, and Ottoman cultures. Istanbul is the largest city in Turkey and one of the most important economic, financial, and trade centers. The city is located in a beautiful landscape, on both sides of Phosphorous, which bridges Europe and Asia, rendering it one of the unique tourist destinations worldwide.

It is the city of two continents! We welcome you to attend the conference and share your experiences and research with the FACS members and scientists from the non-member countries of FACS. We are looking forward to seeing you in Istanbul."

The ceremonial transfer of the FACS flag from Taipei to the 19ACC organizers in Istanbul marked the end of the 18ACC.

Acknowledgment

I thank the 18ACC organizers, particularly Chairman and FACS President, Prof. Reuben Jih-Ru Hwu and Secretary-General, Prof. Ling-Kang Liu, for providing me with photos, statistical data, video recordings, archive records, PP presentations, and other valuable materials for the preparation of this report.