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CHEMPLUSCHEM Editorial

Celebrating 50 Years of Chemistry in Singapore

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This special issue of *ChemPlusChem* is dedicated to the Golden Jubilee Chemistry Conference held in commemoration of Singapore's 50th birthday on August 9, 2015. In half a century, the country has witnessed phenomenal progress on many fronts, in education and research, as well as economic and national development. In tandem with growing economic prosperity, the chemistry landscape in Singapore has been transformed from merely basic chemistry education to the current state of grooming highly motivated talent in a society that thrives on open innovation. Chemistry and chemical engineering in this knowledge-based system are privileged as they fuel high-value-added industries such as biological products, energy, and electronics as well as a host of emerging manufacturing and biomedical industries.

Chemistry in the island republic can be traced back to 1929, when the Department of Chemistry was officially established at Raffles College (the predecessor of National University of Singapore). During the first decade after the College opened, the Department of Chemistry was housed in the right wing of the Manasseh Meyer Science Building at the Bukit Timah campus (Figure 1). This building was inadequate, with only two lecture rooms and two laboratories.

Figure 1. The old Manasseh Meyer Science Building at the Bukit Timah campus.

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The influx of students upon Singapore's independence from Malaysia in 1965 accelerated the pace and raised the quality of higher education. This led to the rapid growth of chemical science, which soon became a pillar in Singapore's industrial development starting from 1980. Sustained government support in higher education coupled with massive investment in research and development led to a stellar rise of the local universities and inflow of international talent from the world's elite universities and prominent research institutions. Today, chemistry has become the top research field in Singapore in terms of total citations (216 167 times, ISI Web of Knowledge Data in June 2015).[1] The strength of chemistry, both in education and research, has fuelled the emergence of associated disciplines such as environmental science, food and drug research, chemical biology, nanoscience, and material science. The leap of Singapore from a regional hub to one of the global leaders in chemical research over a short time span also raised the standing of the local universities. The latest Quacquarelli Symonds World University Rankings by Subject puts chemistry in the National University of Singapore (NUS) and Nanyang Technological University (NTU) at 7th and 18th in the world, respectively, while chemical engineering at NUS and NTU is placed at 5th and 21st, respectively.[2] These figures would have been considered "unthinkable" even a decade ago. The chemical industry, accordingly took off, with petroleum and petrochemicals accounting for about 5.3% of Singapore's gross domestic product in 2014, and a thriving pharmaceutical and biomedical industry (Figure 2). These are remarkable feats in a land that has no natural resources like fuels and metals, limited space for agriculture, and even insufficient fresh water.

Figure 2. National University of Singapore with the port at the background and Jurong Island (an island created though connection of a number of islets through reclamation, hence dubbed the "chemical island") at the horizon.

Amidst the development of a world-class education system based on schools, universities, and polytechnics, Singapore embarked on the journey of translational research at the national level. This led to the establishment of the Agency for Science, Technology & Research (A*STAR) in 1991 (formerly National Science & Technology Board (NSTB)) as a "mission-oriented" body that runs 18 research institutes and centers in the modern integrated environments of Biopolis and Fusionopolis. The latest addition in the second phase of Fusionopolis is additional evidence of the commitment to research, innovation, and enterprise at the national level (Figure 3). The formation of the National Research Foundation (NRF) under the Prime Minister's Office in 2006 provided more funding to fuel university development in a knowledge-intensive economy. The Energy Research Institute at NTU, Solar Energy Research Institute of Singapore (SERIS), and the Graphene Research Centre at NUS are among the many examples of the outcomes of chemistry innovations in the development of advanced materials and energy solutions. Another example is the set-up of the NRF-funded NUS Centre for Advanced 2D Materials in 2014 with a budget of S$ 50 million over 10 years.

Figure 3. Completion of the research hub Fusionopolis in which different science and engineering research institutes are in close proximity with corporate laboratories and start-up companies to collaborate and capture research value.

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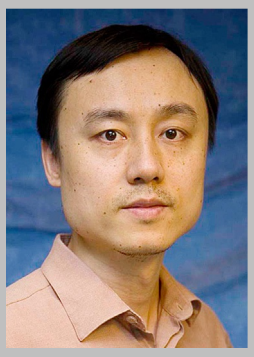

Xiaogang Liu earned his BE degree in Chemical Engineering from Beijing Technology and Business University (P. R. China). He received his MS degree in Chemistry from East Carolina University (USA) and completed his PhD at Northwestern University. After a postdoctoral stay at MIT he joined the faculty of the National University of Singapore. He holds a joint appointment with the Institute of Materials Research and Engineering. His research interests include luminescent materials synthesis, supramolecular chemistry, transition-metal-based catalysis, and surface science for sensing, optoelectronic, and biomedical applications.

Hua Zhang obtained his BS and MS degrees from Nanjing University in 1992 and 1995, respectively, and completed his PhD with Prof. Zhongfan Liu at Peking University in 1998. He conducted postdoctoral research at Katholieke Universiteit Leuven (Belgium) and Northwestern University (USA). After working at NanoInk Inc. (USA) and the Institute of Bioengineering and Nanotechnology (Singapore), he joined Nanyang Technological University in July 2006. His current research interests focus on the synthesis of two-dimensional nanomaterials and carbon materials (graphene and carbon nanotubes), and their applications. He is a member of the International Advisory Board of *ChemPlusChem*.

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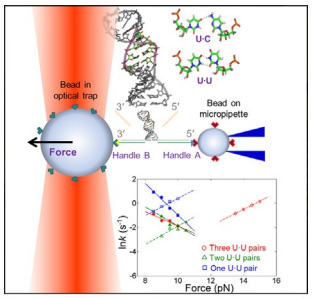

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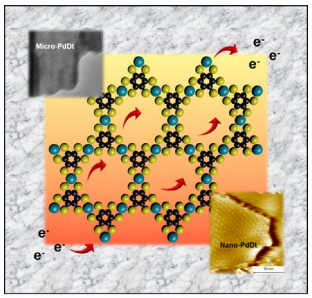

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Marking Singapore's 50th anniversary this year, the Singapore National Institute of Chemistry (SNIC) hosts a commemorative Golden Jubilee Chemistry Conference in August 6–8, 2015, just before the National Day on August 9, 2015. The objective of this meeting is to bring together a select group of scientists and researchers from around the world to celebrate this special moment in our history and strengthen our collaborations in areas of mutual interest in sustainable chemistry, functional materials, and innovative technologies. It also provides a platform to exchange ideas and discuss scientific solutions towards global challenges in, for example, energy, environment, health, and urbanisation.

To celebrate 50 years of accomplishment, the guest editors invited several speakers presenting at the conference to contribute their best multidisciplinary research for this special issue of *ChemPlusChem*. We are delighted that many have responded positively, and hence in this commemorative issue, there are 2 Minireviews, 7 Communications and 12 Full Papers. The broad coverage of diverse research fields—nanocatalysis, transition-metal catalysis, molecular magnets, fuel cells, medicinal and biological chemistry, metal–organic frameworks, and polymer chemistry/materials—reflects the influence and applications of chemistry in a host of merging areas in science. To showcase the truly international reach of Singapore's influence, among the speakers who have contributed articles are Pierre Braunstein (Strasbourg University, France), Mark Humphrey (Australian National University, Australia), Robert Raja (University of Southampton, UK), Tanja Weil (Ulm University, Germany), Ben Zhong Tang (The Hong Kong University of Science and Technology, Hong Kong) and from Singapore we have Shiqiang Bai, Zhaolin Liu, and Jian Wei Xu who are all based at the Institute of Research Materials and Engineering, A*STAR.

The merlion, a mythical creature with the head of a lion and the tail of a fish, is a popluar symbol of Singapore. The fish tail represents Singapore's origin as a fishing village and the lion head reflects its original name "lion city". The merlion icon was used to label all contributions to this special issue, and two covers feature the symbol. As guest editors, we hope that you are truly inspired by the excellent science of this special issue.

We wish to thank our contributing authors for their support. We are also indebted to Dr. Marisa Spiniello, Editor of *ChemPlusChem*, for meticulous organisation of this issue.

Singapore has performed academic, research and economic miracles over 50 years and has turned into a city state with thriving manufacturing, finance, service, and business communities (Figure 4). However, the future will only be more challenging and competitive, and there is no room for complacency. We call on the continued support of the government and the private sector, as well as the entire scientific community to work together to build an prosperous society with a sustainable economy. This can be accomplished by using chemistry as an enterprise to create and capture social and economic value.

Figure 4. A view of the Singapore skyline today.

[1] Data accessed on June 29, 2015.
[2] http://www.topuniversities.com/university-rankings.