

Research Assessment Exercise 2020
Impact Overview Statement

University: The University of Hong Kong

Unit of Assessment (UoA): 9 – Chemistry

Total number of eligible staff of the university in the UoA: 21

(1) Context. HKU Chemistry is a world-class academic centre. A key aim is to translate research into products and services that benefit society through active collaborations and partnerships with other universities, industry and enterprises. With Synthetic Chemistry and Physical Chemistry & Computation as our core expertise, we have prioritized interdisciplinary research clusters in Material Science & Energy and Chemical Biology to enable our emergence as a centre of innovation. This is reflected in by our attraction of unprecedented industrial investment and licensing. Over HK\$88 M has been obtained for OLED translational research; we successfully applied to the Health@InnoHK Program to establish The Laboratory for Synthetic Chemistry and Chemical Biology; AIR@InnoHK funded a Centre of Machine Learning for Energy Materials and Devices. Both centres have laboratory space of 1200 m² in Hong Kong Science Park with projected funding of HK\$500 M for each centre. The direct principal beneficiaries of our research and its translation are industrial sectors, such as OLED display, electronics, and pharmaceutical companies, as well as public health and environmental authorities. Impact achieved includes: proprietary OLED materials which provide a great opportunity in China to challenge business monopolies in the field; a new generation of metal emitters based on Thermally Activated Delayed Fluorescence (TADF) mechanism; an innovative Serine/Threonine Ligation technology to synthesize and develop antibiotics; the discovery of the combined use of bismuth and antibiotics to kill drug-resistant bacteria; and application of research findings on nano-silver in diverse areas of nanotechnology, public health and environmental impact assessment.

(2) Approach to impact

Our approach to impact involves strong engagement with the industry and other stakeholders, promoting technology transfer, and encouraging effective manpower utilization and collaborations by participating in large scale funding programmes.

(a) Engagement with Industry and Other Stakeholders: We have formed the Departmental Advisory Committee (DAC) comprising local and international experts in key enterprises that has provided external perspectives and counsels on the Department's strategic research and translational priorities. In addition, we have appointed impact champions: Che, Sun and Li, who are experts in New Materials and Chemical Biology and experienced in attracting industrial investments. They are working closely with enterprises, DAC, and the Technology Transfer Office (TTO) to exploit new opportunities for impact. In addition, we will continue to regularly organize educational activities such as school visits, knowledge exchange seminars, and lectures to increase awareness of the relevance and potential impact of our research (e.g., "Industrialist Forum 2016").

(b) Promoting Technology Transfer: Our activities in promoting technology transfer involve encouragement of contract research and close interaction with TTO on patenting and licensing our discoveries. The encouragement of contract research is achieved by mentoring junior staff and the recognition of impact generating activities in staff Performance Review and Development (in which translational research is a formal objective).

Demonstrating the success of this approach we have many examples of contract and applied research that commercialize inventions. In drug discovery, we launched strategic partnerships with Servier Laboratory, Charm Grace, Cubist, Bayer, and Youbo. Notably, Aglaia and KEIIT has signed an agreement to establish the Aglaia-KEIIT Laboratory for Drug Discovery and Development with Endowment fund of HK\$30 M and with Che as the Leading Principal Investigator. Sun's innovative work has attracted his long-term pharmaceutical partner Livzon's further investment for preclinical evaluation of bismuth drugs (HK\$4.01 M). For OLED materials, Che received industrial investments (> HK\$25 M) from Samsung, Aglaia, Truly, Irico, and Ever Friendly to develop fit-for-purpose Pt-emitters, signing a five-year agreement with KEIIT to co-

develop phosphorescent platinum emitters for practical use (HK\$15 M). His team has ongoing dialogue with Samsung and KEIIT on gold-TADF emitters and inexpensive tungsten emitters. Yam's innovative work on Au(III) emitters has attracted TCL to co-fund the establishment of the HKU-TCL Joint Laboratory on New Printable OLED Materials and Technology (HK\$20 M), as well as sponsorship (> HK\$9 M) for co-developing new printable Au(III) OLED materials and technology. In addition, Aglaia and Truly have jointly sponsored Che to co-develop practical phosphorescent Pt(II) and Pd(II) OLED materials in the University-Industry Collaboration Program (UICP) administered by HKSAR. Close interaction with TTO lead by our Impact Champions (Che, Sun, and Li), has resulted in filing of 8 patents for antibacterials and 25 patents for OLED materials. Li's patent "Antibacterial cyclic lipopeptides" was licensed to Youbo, which committed to spending >HK\$25 M on pre-clinical studies, while Che's 3 patents were licensed to Samsung with a total fee of US\$2.3 M, plus another 8 patents were licensed to Aglaia for RMB¥2 M.

(c) Encouraging Effective Manpower Utilization: Key specialist appointments providing capability in Materials Engineering, Device Fabrication, and Biological Mass Spectrometry have bridged the interdisciplinary gaps among PIs aiding translational research and interaction with industry. Chemistry also encourages secondments to and from industry (e.g. Aglaia) and provides skills, expertise and equipment to collaborators and industry stakeholders.

(d) Encouraging Collaboration by Participating in Large-scale Funding Programs: Large-scale interdisciplinary research programmes ensure that research with a competitive edge, which in turn facilitates translational activities and IP rights. We have facilitated this by nurturing scientists (by for example, actively mentoring junior staff), establishing infrastructure and facilities, and forming a system of allocating postgraduate students which rewards participation in large interdisciplinary projects. Our efforts have secured two InnoHK, three Area of Excellence, one Theme-based Research Scheme, one National Basic Research Program of China, one Research Impact Fund, and one State Key Laboratory (SKL) of Synthetic Chemistry – all with key translational deliverables.

(3) Strategy and plans

We will support the impact generating activities with approaches outlined in section (2) and by:

- Continuation and expansion of our engagement with stakeholders (e.g governments and translational funding agencies).
- Strategic investment in nurturing/growing potential pipelines of impact by seeking sustainable large local and national funding (e.g., additional SKLs, InnoHK, and 973 programs).
- Prioritizing needs of developing future impact in infrastructure investments and staff hiring.
- Expanding our industrial connections through thematic industry-HKU workshops via TTO.
- Organizing seminars on spin-off companies and promoting entrepreneurship for staff development.

Activities in progress arising from our strategies include nurturing SKLs or equivalents in both the Chemical Biology and New Materials areas; preparing CRF grant applications related to "Energy & Photo-catalysis"; incubating KY Chan's "Electrochemical Power Cells", which has the potential to be the next big impact story; establishing a cross-disciplinary effort soliciting Shenzhen funding for a Chemistry and Chemical Biology Research Platform; collaborating with Shanghai Institute of Materia Medica on developing anticancer drugs from natural products. We are interacting with new industrial partners (e.g., Guangdong Pharmaceuticals for anticancer metal drugs, Charm Grace for anticancer *Fufang*), initiating new industry-relevant research topics (e.g., nano-devices, soft matter), strengthening links with funding agencies (e.g. Hong Kong Jockey Club, Hospital Authority, the Ministry of Science and Technology of China), supporting UICP projects (e.g., hydrogel drug delivery), and exploiting new capability platforms (e.g., multi-omics). We will further promote our consultancy, skills and expertise to industry and encourage set up of spin-off companies.

(4) Relationship to case studies The development of phosphorescent OLEDs by Che and Yam has benefitted from funding support by industrial partners such as Aglaia, KEIIT, and TCL, resulting in setting up a new factory to produce Pt(II) emitters and a joint laboratory to develop Au(III) emitters. The development of antibacterial agents has benefitted from industry engagement strategy through support for contract research (Youbo) and industry investment in research (Livzon).