

# Imperial College London: Visit of Taiwan Top University R&D Delegation

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## Hosting Delegation:

1. Professor Mary Ritter, Pro Rector (International Affairs)
2. Professor Tim Green, Professor of Power Engineering, Department of Electrical and Electronic Engineering, Faculty of Engineering
3. Professor Sir Brian Hoskins, Director, Grantham Institute ([b.hoskins@imperial.ac.uk](mailto:b.hoskins@imperial.ac.uk))
4. Professor Elaine Holmes, Professor of Chemical Biology and Head of Biomolecular Medicine, Department of Surgery and Cancer, Faculty of Medicine.
5. Dr. Rob Fenton, Research Development Director, Institute of Biomedical Engineering ([r.fenton@imperial.ac.uk](mailto:r.fenton@imperial.ac.uk), [www.imperial.ac.uk/biomedeng](http://www.imperial.ac.uk/biomedeng))
6. Dr. Margaret Christie, Contracts Administrator (Europe), Research Office ([m.christie@imperial.ac.uk](mailto:m.christie@imperial.ac.uk))
7. Mrs. Lynne Cox, Director of Central Research Office ([l.cox@imperial.ac.uk](mailto:l.cox@imperial.ac.uk))
8. Ms. Angela Lin, East Asia Manager, International Office ([shan.lin@imperial.ac.uk](mailto:shan.lin@imperial.ac.uk), [www.imperial.ac.uk/international](http://www.imperial.ac.uk/international))

## Taiwan Delegation:

1. Prof. Si-Chen Lee, President of NTU ([sclee@cc.ee.ntu.edu.tw](mailto:sclee@cc.ee.ntu.edu.tw))
2. Prof. Ching-Ray Chang, Director General, Department of International Cooperation, National Science Council, Taiwan ([crchang@nsc.gov.tw](mailto:crchang@nsc.gov.tw))
3. Ms. Cheng-Tung Tao, Program Director, Department of International Cooperation, NSC ([cttao@nsc.gov.tw](mailto:cttao@nsc.gov.tw))
4. Prof. Ji-Wang Chern, Dean of R&D, NTU ([jwchern@ntu.edu.tw](mailto:jwchern@ntu.edu.tw))
5. Prof. Chao-Tsen Chen, Group Leader of Strategic Planning, Office of R&D, NTU ([chenct@ntu.edu.tw](mailto:chenct@ntu.edu.tw))
6. Prof. Yonhua Tzeng, Dean of College of Electrical Engineering and Computer Science, National Cheng Kung University ([tzengyo@mail.ncku.edu.tw](mailto:tzengyo@mail.ncku.edu.tw), [tzengyo@gmail.com](mailto:tzengyo@gmail.com))
7. Prof. Yeng-Horng Perng, Vice President, National Taiwan University of Science and Technology ([vpresident@mail.ntust.edu.tw](mailto:vpresident@mail.ntust.edu.tw))
8. Prof. Tsun-Yee Chiu, Dean of R&D, National Chang Gung University ([dtychiu@mail.cgu.edu.tw](mailto:dtychiu@mail.cgu.edu.tw))
9. Prof. Yen-Hsyang Chu, Dean of R&D, NCU ([yhchu@jupiter.ss.ncu.edu.tw](mailto:yhchu@jupiter.ss.ncu.edu.tw))
10. Prof. Chuan-Mu Chen, Dean of R&D, NCHU ([chchen1@dragon.nchu.edu.tw](mailto:chchen1@dragon.nchu.edu.tw))

Taiwan top university R&D delegation led by President Si-Chen Lee of National Taiwan University visited Imperial College of London (ICL: [www.imperial.ac.uk](http://www.imperial.ac.uk)) on July 14, 2010. Imperial College London ranks the 3<sup>rd</sup> in Europe

and the 5<sup>th</sup> in the world according to Times Higher Education World Ranking. It ranks 4<sup>th</sup> in Europe and 26<sup>th</sup> in the world according to Shanghai Jiao Tong University Top 500 World Universities in 2009.

ICL was founded in 1907 as a constituent college of the University of London by merger of City and Guilds College, Royal College of Science, and Royal School of Mines, which were formed in 1851-1890 in realization of Prince Albert's vision for the pursuance of science and learning following the Great Exhibition in 1851. In 1988-2000, ICL merged with four London Medical Schools: St. Mary's Hospital Medical School, National Heart & Lung Institute, Charing Cross/Westminster & Royal Postgraduate Medical Schools, and Kennedy Institute to build up its strength in medicine. Imperial has been awarding its own degrees since 2007 when it left the University of London and became an independent university. Imperial College London created the UK's first Academic Health Science Centre through partnership with Imperial College Healthcare NHS Trust. The Center was recognized by the government in 2009. The University focuses on applying knowledge of science, engineering, medicine and business across industry, commerce and healthcare. It has currently seven London campuses and one campus at Silwood Park, Ascot in South East England.

It has over 3,000 academic and research staff members, which include 67 Fellows of the Royal Society, 69 Fellows of the Royal Academy, and 78 Fellows of the Academy of Medical Sciences. ICL's distinguished past or present faculty members include 14 Nobel laureates, 2 Fields Medalists, and 4 Crafoord Prize winners. ICL has 13,000 students including 8,500 undergraduates, 2,200 taught postgraduates and 2,500 research postgraduates. ICL is a very much internationalized university. Among full time students 48% are non-UK nationals. Non-UK nationals also account for 35 of its staff. It has 3,100 support staff, 2,000 honorary staff, and 1,000 academic visitors and visiting researchers. The Staff to Student ratio is 1:10.9 which is the second best in UK. ICL offers over 300 students annually the Undergraduate Research Opportunities (UROP), which provides students the chance to explore the world of research with hands-on experience in one of the College's outstanding research teams.

In the 2009 Times Higher Education world university rankings, ICL received the top score of 100 points along with Harvard, Yale, Oxford, and Cambridge as the most popular institutions in the world for employers to recruit from. 93.3% of those with ICL undergraduate degree found graduate-level jobs – the highest in the UK. The average starting salary with ICL undergraduate degree is 28,116, which is the highest in UK.

ICL's 2008 Research Assessment Exercise (RAE) had the highest percentage of staff rated internationally leading or internationally excellent among all multi-faculty universities in UK. Compared to King's College London we visited during this trip to UK, ICL is a close competitor while having complementary strengths. KCL is strong in clinical medicine and humanities while ICL has strong programs in engineering, natural sciences, medical research, and business.



Modern buildings with cheerful and colorful glass exterior in the one hundred and three years old Imperial College London.

Imperial College of London has a high profile alumnus from Taiwan. Professor Winston Wong, the Taiwanese founding Director of Grace Semiconductor Manufacturing Corporation, a son of the founder, late Mr. Wong, of Formosa Plastic, and an alumnus of Imperial College, London, made a generous donation of 2M in 2010 to found

the Winston Wong Centre for Bio-Inspired Technology ([www.imperial.ac.uk/.../bioinspired](http://www.imperial.ac.uk/.../bioinspired)). The Center is inventing, developing and demonstrating devices by mimicking living systems to create innovative and advanced technologies and is part of the College's Institute of Biomedical Engineering of which Dr. Wong is a Visiting Professor.

Professor Wong was inspired by Professor Toumazou's research and chose to endow the Centre in recognition of his innovative approach to developing silicon based technology for personalized healthcare. The Center's aim is to provide low cost and disposable solutions to diagnosis and personalized healthcare devices which can be applied at the point of care, often outside the clinic or hospital. Professor Wong graduated from Imperial College in 1971 with a degree in Physics, and later, in 1976 with a PhD. In 2007 he was awarded the degree of DSc at Imperial College, and honour bestowed by HM The Queen. In the entrance hall of ICL, it displays an exploration vehicle, on which both national flag of UK and that of Taiwan, ROC are clearly printed in celebration of the contributions by Dr. Winston Wong in promoting international sponsorship and collaboration between Taiwan, ROC and UK.



A vehicle which is displayed in ICL in honor of Dr. Winston Wong's sponsorship.

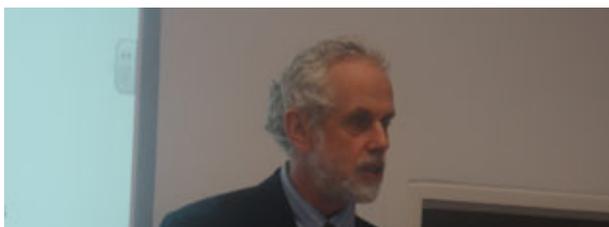
Ms. Angela Lin, East Asia Manager of the International Office guided the delegation to a meeting room for briefings on ICL's strengths and opportunities of collaboration. An overview of ICL was first presented by Pro-Rector (International Affairs) Professor Mary Ritter. Professor Tim Green introduced to the Taiwan delegation about R&D in Department of Electrical and Electronic Engineering. Professor Elaine Holmes talked about R&D in bio-molecular medicine. Professor Sir Brian Hoskins' introduction of the Grantham Institute of Climate Change. Professor Rob Denton gave the Taiwan delegation an overview of the Institute of Biomedical Engineering and then offered us a guided tour of the laboratories where researchers were carrying out research in medical devices.



Pro-Rector (International Affairs) Professor Mary Ritter



Professor Tim Green introduced R&D of the Department of Electrical and Electronic Engineering.





Professor Sir Brian Hoskins of the Grantham Institute of Climate Change.



Professor Rob Denton of Institute of Biomedical Engineering.

Imperial College London had its mission stated as follows: Imperial College embodies & delivers world-class scholarship, education and research in science, engineering, and medicine, with particular regard to their application in industry, commerce and healthcare. It fosters interdisciplinary working internally and collaborates widely externally. The mission is well reflected in many interdisciplinary workings at ICL such as (i) Global Challenge Institutes, which brings together expertise from across Imperial to tackle some of world's greatest problems, and to influence international policy; (ii) Energy Futures Lab; (iii) Grantham Institute for Climate Change; (iv) Institute for Security Science and Technology; (v) Institute for Global Health and Innovation.

The innovating and enterprise culture of Imperial was proven to be very profitable, making ICL one of the most successful universities in the world in terms of tech transfer income. It established equity holdings in spin-out companies and manages commercial agreements and license agreements. ICL's "Imperial Innovations" became the first majority university-owned technology transfer company to float in the UK. The company generated 5.3M in profit in last financial year and has a market value of 230M. A spin-out obesity drug company was sold to US-based Wyeth Pharmaceuticals in Dec 2008 for up to 100M payable to all shareholders. This could bring in up to 22M (3.2M received) to Imperial Innovations for its shares plus additional royalties upon completion of milestones. A significant proportion of this income will flow back to College under the revenue share agreement.

The Electrical and Electronic Engineering Department has 40 faculty members, 60 research associates, 150 PhD students and 90 MS students besides the undergraduate program. It focuses on (i) circuit and systems, for example, smart health-care and low-power analog systems; (ii) security such as network security; (iii) digital economy such as next generation internet; (iv) intelligent autonomous systems such as robotics; (v) sensors and actuators; (vi) electrical energy network such as smart grid simulation facility; (vii) robust & reliable systems; and (viii) 3-D Electrical MEMS. The Department has at least two on-going EU FP-7 grants.

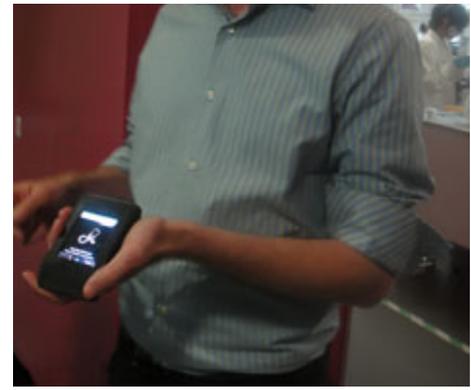
The Biomedical Engineering platform at ICL is based on enabling microelectronics and bio-inspired technology to develop new solutions and added value to semiconductor. Research involves a strong combination of integrated miniature sensing with biologically inspired, intelligent processing, leveraging on state-of-the-art semiconductor technology. Electronics are designed to work with biological processes while remaining small and consuming tiny amount of electricity. In order to cope with the huge problems of ageing populations and surges in chronic ailments, a more portable, precise and personal way to deliver health care will resort to user-friendly devices such as personal digital assistants and mobile phones. Electrical and Electronic Engineering Department is closely collaborating with the Institute of Biomedical Engineering.

ICL has been studying inner ear implants (cochlear. Vestibular prosthesis), vision processing towards retinal implants, digital plaster (cardiac monitor), SAW devices (implantable blood pressure monitor for chronic uses), silicon pancreas (towards closed-loop insulin regulation, and DNA electronics (point of care genetic testing), etc. For the silicon pancreas system, bio-inspired metabolic technology is under trial in a



therapeutic domain, diabetes treatment, where analogue semiconductor chips have been configured to mimic the function of pancreatic beta cells that usually regulate insulin. A glucose sensor is measuring blood sugar whilst the semiconductors are gathering data and determines the insulin dispensed by an insulin pump. The whole system continuously monitors blood sugar and secretes the amount of insulin required at any time to keep them in balance.

Another example of medical device project is the Prediction of Drug Response (SNP-Dr) Project. Semiconductors are used to detect single-nucleotide polymorphisms (SNPs), the small mutations in the genome that distinguish one person from another, for early detection of disease. Some of these SNPs are also medically significant in determining whether someone can metabolize a particular drug. Professor Christofer Toumazou, Winston Wong Chair in Biomedical Circuits, Institute of Biomedical Engineering has been collaborating with Dr. Wong on various projects related to bioengineering.



A researcher showing a hand-held genetic testing device based on DNA electronics.

Prof. Elaine Holmes highlighted examples of pioneering biomolecular medicine. In the Surgical & Cancer @ Imperial Program led by Professor Jeremy K. Nicholson, Integrated Surgical Metabonomics was studied. Solid state NMR is used in Sir Mary's Hospital to analyze the metabolites in biopsies to reveal whether cells in the sample are healthy and relay that information back to the operating theatre within minutes. Nature news reported a story about surgeons getting real-time tissue profiling in December 2009. Prof. Jonathan Swann conducted social environment and biomarkers of aging study (SEBAS) in Taiwan. The study collected self-reports of physical, psychological, and social well-being, plus extensive clinical data based on medical examinations and laboratory analysis. Urine samples were collected from Taiwanese cohort. NMR was applied to analyze the urine. Impact of ageing on the metabolic profile of males and females Taiwanese was compared. Effect of ethnicity between Hakka and Mainlanders was also compared. Gender difference in the impact of stress on the metabolic profile was studied.

The Grantham Institute for Climate Change is led by Professor Sir Brian Hoskins with initial funding of 12.8M over 10 years from Grantham Foundation based on Imperial's strengths. Research themes include Earth System Science (Ocean dynamics and climate change, extreme and risks, earth observation), Vulnerable Ecosystems and Human Wellbeing (Impacts on biodiversity, ecosystems & ecosystem services, Changing Water Cycle, Integrated land management), Sustainable Futures (Mitigation pathways to 2050, Potential for short-term emissions reduction, Zero carbon production, Smart Energy Future with zero-carbon electricity).

Mrs. Lynne Cox introduced ICL's very successful accomplishments and strategies in winning contracts from the EU Framework program. A team of five full-time staff members play the roles in studying call-for-proposals and pre-contractual aspects of FP-7, and manage FP-7 contractual negotiations and agreements. It ranks the 5<sup>th</sup> in Europe in the participation in EU Framework 6 projects and has won 260 awarded contracts, and ranks the 4<sup>th</sup> in Europe in the participation in EU Framework 7 projects. It would be helpful for Taiwan delegation to identify ICL's coordinators for their EU FP-7 projects, and with the assistance by ICL research officers, match Taiwanese outstanding research teams with ICL led EU FP-7 projects. This effort should be able to help link Taiwanese researchers with those of ICL for successful participation in EU FP-7 projects.

The strengths of Imperial College London stated above match well with the core capabilities of top universities in Taiwan including NCKU. Further discussion between researchers of common interest in specific subjects on both sides should be arranged through thematic research workshops to team up Taiwan researchers with those of ICL.

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