2013 PSTA WINNER CITATIONS

PRESIDENT'S SCIENCE AND TECHNOLOGY MEDAL 2013

Professor Freddy Boey

Deputy President and Provost
Nanyang Technological University

"For his distinguished contributions to Singapore's science and engineering landscape, particularly in advancing the bioengineering and nanomedical sector through R&D and his role in nurturing young research talent"

Professor Freddy Boey, Nanyang Technological University (NTU) Deputy President and Provost, has a sterling track record of breakthrough commercial applications that have given the "made in Singapore" label pride of place on the international stage. Before becoming Provost, he served as the Chair of NTU's School of Materials Science and Engineering from 2005 to 2010. He was instrumental in leading its transformation into one of the world's largest materials engineering institutions with about 1,000 undergraduates and close to 250 research students. Through his efforts, the school has developed a solid reputation for materials science research, generating industry leading technologies that can be commercialised.

After 27 years at NTU, Professor Boey has witnessed its transformation from a teaching university into a research-intensive university. He has graduated 33 PhDs to date and mentored 15 post-doctorates. For Professor Boey, who received the Public Administration Medal (Silver) in 2010, the best ideas are always global. That is why he prefers NTU's PhD students to do part of their research overseas. His current biomedical research team comprises 12 PhDs and more than 10 post-doctorates and Senior Research Fellows. Under his exemplary mentorship, about 15 of his past and current students and staff have been or are now involved in their own or his start-up companies. Indeed, Professor Boey's own research in biomaterials for medical devices has contributed to the school's and NTU's growing global profile and standing, besides generating a buzz in international healthcare.

Professor Boey's spirit of experimentation is matched by a prolific output and paired with the belief that his work should improve the lives of others. He also believes in teamwork – each of his inventions involves collaboration with other professors, graduate students and research staff. His first invention is a piezoelectric heart pump that was the world's smallest when it was unveiled in 2003. At 50 grams, the pump is four times lighter and uses less power than conventional heart pumps. His second in 2004 is a fully biodgradable coronary stent, co-developed with Professor Subbu Venkatraman from NTU, which has been successfully implanted in human patients in ColombiaColumbia for the past nine months, with no adverse events. His current inventions, again

with Professor Subbu Venkatraman, include a fully biodegradable device that helps to plug heart defects like a hole in the heart as well as an injectable nano-liposome based device to treat Glaucoma, developed in collaboration with Dr Tina Wong from the Singapore Eye Research Institute. The latter has recently been successfully implanted into several patients in Singapore, showing excellent results.

An exceptional materials science and engineering pioneer, Professor Boey has developed 30 original patents, the majority of which have been licensed. These patents have also resulted in several spin-off companies, which he founded to commercialise some of his biomedical inventions. Several of his biomedical devices have received US Food and Drug Administration (FDA) approval for sale and the Conformité Européenne (CE) mark. These include a surgical tissue retractor that has been sold in the US, India, Japan and Europe as well as a customisable hernia mesh that uses a new functional material to lower the risks of inflammation and infection, the first such surgical mesh approved by the US FDA.

Research and education remain Professor Boey's abiding passions. He has won more than S$42 million in competitive funding for research including a prestigious S$10 million individual grant under the National Research Foundation's (NRF) Competitive Research Programme to develop fully biodegradable cardiovascular implants for hole-in-the-heart conditions. He has also clinched a S$20 million NRF Technion–Singapore grant for his research in nanomedicine for cardiovascular diseases, and a S$1.25 million grant from the NRF Translational Flagship Project. Professor Boey has published 344 top journal papers with a citation of 7,436 and an H-Index of 44.

Professor Boey's sustained contributions to Singapore's research and development (R&D) scene are not just in academic and scientific research. He serves as Director on the boards of the Intellectual Property Office of Singapore and the DSO National Laboratories, and is a founding Fellow of the Singapore Academy of Engineers. He is also on the boards of several nationally funded research centres. He was also an appointed member of both the University Blue Ribbon Commission and the Blue Ribbon Implementation Commission.

Professor Boey was conferred the prestigious Imperial College London Fellowship in the Faculty of Medicine in 2012, for his exceptional achievements in medical technology and his outstanding contribution in developing the Lee Kong Chian School of Medicine, a joint medical school between Imperial College and NTU. He was also conferred an honorary doctorate from Loughborough University in December 2011 for his outstanding achievements as an engineer and academic leader. In November the same year, he received the Distinguished Alumni of the Year Award from Monash University in recognition of his achievements as a teacher, researcher and innovator, including his exceptional contributions to nanomedicine, as well as his volunteer work since his student days. In September 2013, Professor Boey was awarded an honorary professorship from Nanjing University of Technology, in recognition of his academic and scientific leadership in NTU.

For his distinguished, continuous and relentless contributions to Singapore's science and engineering landscape, particularly in advancing the bioengineering and nanomedical sector through R&D and his role in nurturing young research talent, as well as his contributions in developing NTU into a global University with a strong focus on world-class education, research and innovation, Professor Freddy Boey is awarded the 2013 President's Science and Technology Medal.

Professor Barry Halliwell
Deputy President (Research & Technology) and Tan Chin Tuan Centennial Professor
National University of Singapore

"For his outstanding contributions to development of the research landscape in Singapore and his excellent research on the role of free radicals and antioxidants in human health, nutrition and disease"

Professor Barry Halliwell, the Deputy President (Research and Technology) and Tan Chin Tuan Centennial Professor at the National University of Singapore (NUS) has played a pivotal role in developing research excellence in Singapore in his capacity as Deputy President at NUS and as a role model in conducting excellent personal research and training local manpower.

Prof Halliwell has occupied important roles at NUS and in national bodies that support research in the past 15 years that he has been based in Singapore. In particular, he has played a key role in the development of Singapore's R&D landscape, particularly in the biomedical sciences area but also way beyond that. As co-chair of the NUS Life Sciences Curriculum from 2004 to 2008, Prof Halliwell helped to steer the introduction of an integrated life sciences curriculum at NUS, which trains graduates to contribute to the manpower required for Singapore's initiatives in Life Sciences. He is currently the Deputy President in charge of Research and Technology (DPRT) at NUS, a position that was newly created in 2006 to help NUS increase its research quality and productivity to aid Singapore's transition to a knowledge-based economy. Prof Halliwell is responsible for driving the University's research agenda and promoting a broad base of globally competitive quality research from which peaks of excellence can grow. Prof Halliwell was involved in the recruitment and mentoring of many excellent researchers at both junior and senior levels. His office steered the development of a detailed and effective research policy framework at NUS which helped to enable NUS researchers to compete successfully for 3 of Singapore's 5 Research Centres of Excellence (RCEs), plus a fourth RCE in partnership with NTU. Several other peaks of research excellence in a broad range of areas have also developed at NUS, with the result that NUS is now globally ranked very highly for its achievements in research across a broad range of topics relevant to Singapore, from Asian studies to membrane technologies to cancer biology. NUS competitive research grant income during his tenure as Deputy President has tripled.

By working closely with government agencies and industry, Prof Halliwell promoted the development of core new intellectual activities in Singapore in fields including ageing, clean energy, sustainability and interactive and digital media. The NUS "Virtual Institute for the Study of Ageing" has achieved high visibility and attracted funding from government and private donors. Prof Halliwell has also worked closely with the Singapore Economic Development Board in facilitating the growth of strong University-Industry partnerships in Singapore, e.g. the Solar Energy Research Institute of Singapore (SERIS) in NUS. He continues to be actively involved with SERIS in his role as DPRT and also

as Chairman of the Supervisory Board of SERIS. Prof Halliwell has also assisted the National Research Foundation (NRF) in its mission to promote research in Singapore. One example is in CREATE (Campus for Research Excellence and Technological Enterprise). Prof Halliwell provided most of the input for the research and education components of the document proposing location of CREATE and the Singapore-MIT Alliance for Research and Technology (SMART) on the NUS campus in 2006, which has led to many exciting synergies in research and technology. Prof Halliwell was involved in in-depth discussions with overseas Universities including ETH Zurich, Hebrew University of Jerusalem, Technion-Israel Institute of Technology and Cambridge (UK) which have since set up CREATE centres in Singapore.

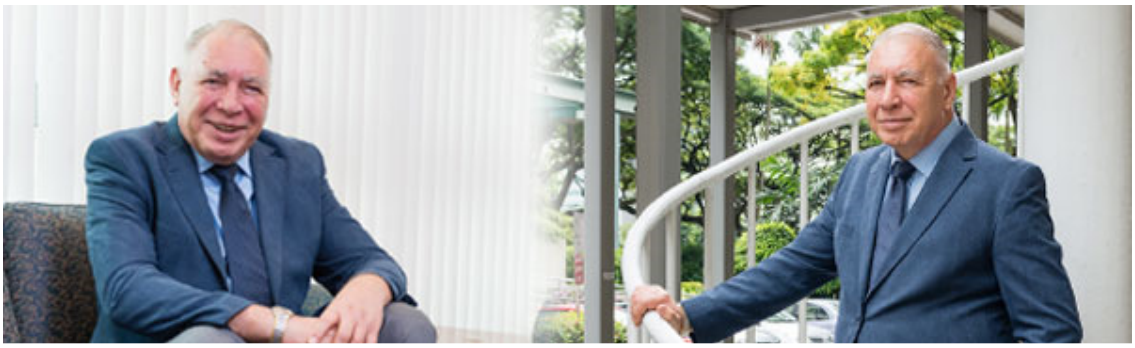
Prof Halliwell has been a member of several boards which make strategic decisions on the development of R&D sectors in Singapore. On the biomedical front, Prof Halliwell sits on the National Medical Research Council (NMRC) panel evaluating proposals from the Translational and Clinical Research (TCR) Flagship Programme. He was the co-chairman of the research grant evaluation panel of the National Medical Research Council (NMRC) from 2007 to 2011. He was also actively involved in the research grant evaluation panel of the Biomedical Research Council (BMRC) as Deputy Chairman from 2001 to 2008. Prof Halliwell sits on the executive committee on Environmental and Water Technologies (EWT), providing input on the development of the EWT sector in Singapore, an area in which NUS has been ranked among the best in the world. Prof Halliwell is also widely sought as a consultant and advisor on research strategies to industry, public bodies and other organizations in Singapore and internationally. Prof Halliwell was also the Founding Executive Director of the NUS Graduate School of Integrative Sciences and Engineering (NGS) from 2003 – 2008. Established in 2003, NGS offers scholarships to bright students to encourage them to undertake Ph.D. education that transcends traditional disciplinary boundaries, encouraging interdisciplinary research. NGS has built up an internationally diverse Ph.D. talent pool with over 700 graduates and current students, 46% of whom are Singaporean citizens or Permanent Residents. NGS rapidly built up strong links with relevant NUS Faculties/Schools/Research Institutes and especially with the Agency for Science, Technology and Research (A*STAR). NGS has also built up synergistic, complementary partnerships with a select number of world-leading overseas research institutes and knowledge organizations in the USA, UK, Continental Europe, Japan, Australia, and China. Thus, NGS is able to offer gifted students the opportunity to engage in globally progressive research in superb research facilities both within Singapore and further afield. Although Prof Halliwell stepped down as Executive Director in 2008, he still has oversight of NGS in his role as DPRT.

Despite his heavy administrative duties, Prof Halliwell has been a role model by maintaining a strong personal research reputation. He is a world-leading expert on the role of antioxidants and free radicals in living organisms and their participation in human disease and nutrition. He began his work in 1976 by elucidating a key antioxidant defence mechanism (the ascorbate-glutathione cycle, now often called the Halliwell-Foyer-Asada cycle) that is used by plants to remove peroxides and protect the chloroplast against damage. This cycle has taken on a new importance recently because enhancing it allows crop plants to resist environmental changes such as increased temperature and drought stress. In later work Prof Halliwell was a pioneer in establishing the key role of transition metal ions in catalyzing free radical reactions in vivo. In particular, his work showed the importance of “mal-placed” iron and its ability to promote oxidative damage in several human disorders, including iron overload disease, problems of premature babies, cancer chemotherapy, rheumatoid arthritis and atherosclerosis. Prof Halliwell is also renowned for his development of robust methodology for measuring the oxidative damage caused by free radicals and related species in vivo. These methods helped to establish the mechanism and significance of oxidative damage to key biomolecules in cancer development resulting from chronic inflammation, and in the affected brain regions in sufferers from Alzheimer or Parkinson diseases. In the field of molecular nutrition, Prof Halliwell has shown, using direct measurements of oxidative damage in the human body, that in

well-nourished individuals the “important” diet-derived antioxidants are not vitamins C, E and -carotene as commonly supposed, in that supplements of these agents do not generally decrease oxidative damage in vivo. This helps to explain why many of these antioxidants are showing limited efficacy in human intervention trials testing for disease prevention. His laboratory has now identified more important antioxidants in the human diet. Prof Halliwell has also made substantial contributions to our knowledge of the biological role of reactive nitrogen species such as peroxynitrite and to our fundamental understanding of the mechanisms by which oxidizing air pollutants (especially ozone, nitrogen dioxide and PM2.5) damage the human body.

Prof Halliwell has published 225 papers in leading international journals since he joined NUS in 1998. He has trained multiple research assistants, fellows and students, over half of whom are Singapore citizens. The textbook Free Radicals in Biology and Medicine, where he is the lead author, is in its fourth edition (published Jan 2008 by Oxford University Press; fifth edition in preparation), and is used worldwide (cited over 19,000 times to date) and regarded by many as the “bible” in the field. Thomson Reuters identified Prof Halliwell as a highly cited scientist in three areas, indicative of the broad relevance of his research contributions, namely Biology and Biochemistry, Neuroscience and Behaviour, and Pharmacology and Toxicology. His Hirsch index is 139. Prof Halliwell has received numerous awards, including the Lifetime Achievement Award by the Society for Free Radical Biology and Medicine in the USA, Ken Bowman Research Award from the Institute of Cardiovascular Sciences (Canada), Fellow of the Society for Free Radical Biology and Medicine, Fellow of the American Association for the Advancement of Science and the NUS Outstanding Researcher Award 2012. He received Singapore’s Public Administration Medal (Silver) in 2010.

PRESIDENT’S SCIENCE AWARD 2013



Professor Boris Luk’yanchuk
Data Storage Institute Agency for Science, Technology and Research

“For his outstanding input to the theory of laser-matter interactions and light scattering by nanoparticles, in particular to Fano resonance in plasmonic materials”

The development of modern Data Storage Technologies depends on the achievements in nanoengineering and many fields of modern physics (nanomagnetics, nanophotonics, plasmonics, spintronics, etc.). Over the past 14 years, Professor Boris Luk’yanchuk has been working with different projects related to advanced concepts in Data Storage Technologies. Working in Data Storage Institute he published pioneering papers in the theory of laser-matter interactions, plasmonics and modern optics. Among the recent discoveries of Prof. Boris Luk’yanchuk and his group the following five achievements can be mentioned:

1) the creation of laser beam with longitudinally polarized light (Nature Photonics 2, 501 (2008));

2) pioneering investigation of Fano resonance in plasmonic materials and metamaterials (Nature Materials 9, 707 (2010));
3) nanoscopy with virtual image and superresolution (Nature Communications 2, 218 (2011));
4) Creation of "magnetic light" by laser induced magnetic moments in dielectric materials with high refractive index (Nature / Scientific Reports 2, 492 (2012)); 5) First realization of the Kerker`s resonance in optical range (directional light scattering by spherical silicon nanoparticles) (Nature Communications 4, 1527 (2013)).

Papers of Prof. Luk'yanchuk yielded high international reputation and citation, his paper on Fano resonance in plasmonic materials and metamaterials has the highest citation among the papers published for the last years by A*STAR Institutes.

Professor Boris Luk'yanchuk was awarded IES Prestigious Engineering Achievements Award 2004 (Team). He is a Honorary Professor of Johannes Kepler University, Linz, Austria and Fellow of the Optical Society of America. He was a Chair of a few International Conferences in Singapore, including Symposia of ICMAT Conferences. He is the topical Editor of "Journal of Optics" and the Editor of many Special Issued of Applied Physics A.

Professor Luk'yanchuk`s achievements also include novel discoveries in laser cleaning, laser thermochemistry, laser ablation, plasmonics, optics and photonics, and nanoscopy with virtual image. He investigated interference phenomena in the near field, and suggested combining "nano-Fano" with "nano-vortices" in nanostructures. This method permits to control a topological charge on a nanoscale. It has a promising application in future information technologies and quantum optics. For his outstanding input to the theory of laser-matter interactions and light scattering by nanoparticles, in particular to Fano resonance in plasmonic materials, Prof Boris Luk'yanchuk has been awarded the 2013 President's Science Award.

Professor Yu Hao
National University of Singapore

"For his outstanding research in plant functional genomics and its biotechnological applications to economically important crops"

In the last decade, Prof Yu Hao has been dedicated to uncovering the molecular genetic mechanisms of plant reproductive development, with a focus on flowering time control, floral organ development, and phytohormone signalling. Flowering plants are the most diverse and ecologically successful group of organisms on earth. They reproduce in an unpredictable environment through generating flowers that contain reproductive organs. As this reproductive process determines yield in crop plants and affects the survival of plant varieties that are adapted to changing environment and

climatic conditions, Prof Yu's research on plant reproductive development provides important solutions to vital problems relevant to our everyday life, such as the supply of food, medicine, and bioenergy.

Using Arabidopsis as a model plant, Prof. Yu's laboratory integrates molecular genetic approaches with deep sequencing, proteomics and bioimaging tools to study the fundamental mechanisms of cell proliferation and differentiation. Several of his recent findings provided ground-breaking understanding in plant reproductive development. His lab found the first regulator that controls the transport of florigen that is synthesized in leaves, but transported to the shoot tip to generate flowers. This finding contributes significantly to addressing the famous "Florigen" question raised in 1930s, and provides the key information for manipulating flowering time in crops. His major recent breakthroughs also include the discovery of a conserved genetic pathway determining inflorescence architecture across flowering plants and a "Relief of Repression" mechanism that balances plant growth and defence through modulating two phytohormone pathways.

These major findings have not only contributed greatly to plant science, but also provided essential gene resources and mechanisms for classical breeding and genetic engineering of economically important crops. Based on the fundamental discoveries in plant reproductive development of Arabidopsis and the platform technologies established, Prof Yu's laboratory is creating novel and high-value varieties with desirable flower and seed traits for rice, orchid and oil palm.

Prof Yu's research has gained wide international recognition and was published in many prestigious journals. The research materials generated in his lab have been distributed to over 60 labs in more than 18 countries. He has been invited to serve as Editorial Board member for international refereed journals published by 7 publishers, including the reputable ones published by PLoS, Springer, and Oxford University Press. He was invited as reviewer for 36 international refereed journals, including those top-notch ones like Science and Nature Genetics, and also as reviewer for 11 foreign and local grant agencies. He was the recipient of Singapore National Academy of Science Young Scientist Award (2006), NUS Young Researcher Award (2007), Singapore Youth Award for Science and Technology (2007), Dean's Chair Professorship in Faculty of Science, NUS (2011), and Outstanding Scientist Award in Faculty of Science, NUS (2011).

For his outstanding research in plant functional genomics and its biotechnological applications to economically important crops, Prof Yu Hao is awarded the 2013 President's Science Award.

PRESIDENT'S TECHNOLOGY AWARDS 2013

(from left to right)
Professor Li Haizhou, Ms Aw Ai Ti (seated infront)
Dr Su Jian, Dr Ma Bin (standing behind)
Institute for Infocomm Research
Agency for Science, Technology and Research

"For their outstanding contributions to human language technology that have empowered the industry and benefited the Asian society"

Professor Li Haizhou, an internationally-renowned scientist, and his team Dr Ma Bin, Ms Aw Ai Ti, and Dr Su Jian have made a remarkable breakthrough in human language technology that transforms the interface of mobile applications and breaks down the language barriers for Asian society.

Among the 7,105 living spoken languages that Ethnologue documented in 2013, 2,304 are spoken by Asians, representing more than half of the world's population. However, traditional human language technologies were developed using English and other major languages as the workbench, which cannot be applied to many Asian languages. Over the past nine years, Professor Li and his team pioneered new approaches to speaker recognition, multilingual speech recognition, tonal language processing, as well as lexical, syntactic, semantic and discourse analysis. These novel inventions now serve as the foundation of the Abacus language engine, a commercial grade technology solution for the Bahasa Indonesian, English, Malay, Mandarin Chinese, Thai, and Vietnamese languages. Abacus accurately converts continuous speech into text, identifies the accents, dialects, and languages being spoken, establishes a speaker's identity by his/her voice, and translates languages between one another.

The technological breakthrough is significant. The Abacus engine achieved a leading performance in US National Institute of Standards and Technology (NIST) international benchmarking competitions, including NIST Language Recognition Evaluation 2007, NIST Speaker Recognition Evaluation 2008 and 2012, and NIST Text Analysis Conference 2011, representing the state-of-the-art in academia and industry. In developing the Abacus engine, the team addressed the unique research problems that Asian languages face, such as multilingual speech and tonal language processing, and translation between Asian languages. The team also formulated a novel industry process for rapid technology deployment that has been adopted widely by the industry.

The team's recent achievements have put Singapore on the world map. In 2009, Professor Li was elected as a Board Member of the International Speech Communication Association (ISCA) and named one of the two Nokia Visiting Professors by the Nokia Foundation. In 2012, Dr Su Jian was

elected as an Executive Committee Member of the Association for Computational Linguistics (ACL). Their work has also been published as an 'Invited Paper' in the Proceedings of the IEEE in 2013, the most highly-cited general interest journal in electrical engineering and computer science, and honored as 'The Most Cited Article' in Elsevier Speech Communication during 2008-2013. One major outcome of the team's research is the establishment of the Baidu-I2R Research Centre (BIRC) in Singapore. In 2012, the internet giant Baidu and I2R set up BIRC as Baidu's first overseas joint laboratory to further the research of speech information processing and Asian language processing. The establishment of BIRC is an endorsement of the team's technological achievements.

The Abacus language engine has become one of the most sought after solutions internationally for text input, question and answering, spoken dialogue, and voice biometrics in mobile applications. For the past three years, the Abacus engine has been licensed to more than 15 leading international companies to enable many innovative products. In particular, the Abacus engine was adopted in 2012 to power the Lenovo A586, the world's first voiceprint smartphone. The team also contributed to ITU-T F.745 and H.625 international standards for network-based speech to speech translation in 2010.

For their outstanding contributions to human language technology that have empowered the industry and benefited the Asian society, Professor Li Haizhou, Dr Ma Bin, Ms Aw Ai Ti and Dr Su Jian from the Institute for Infocomm Research are awarded the 2013 President's Technology Award.