

2009 PSTA WINNER CITATIONS

PRESIDENT'S SCIENCE AND TECHNOLOGY MEDAL 2009



Professor Miranda Yap
Executive Director, Bioprocessing Technology Institute
Executive Director, A*STAR Graduate Academy
Agency for Science, Technology and Research

“For her sustained, distinguished and strategic contributions to Singapore’s Biomedical Sciences landscape particularly in the areas of developing the biologics industry sector, building the research culture and nurturing young talent”

Professor Miranda Yap is one of the pioneers who has played a pivotal role in developing the biomedical sciences landscape in Singapore. Her contributions have helped develop the biologics industry sector, anchoring some of the leading multi-national biologics manufacturing companies here in Singapore. She has cultivated a vibrant bioprocess R&D environment that has led to important industry collaborations and partnerships, bringing the translation of research closer to potential healthcare applications.

Instrumental contributions by the Bioprocessing Technology Institute (BTI) under the leadership of Professor Yap have enabled Singapore to gain a foothold in the rapidly growing global biologics sector. Through BTI, Singapore has attracted six commercial scale biologics plants. Building a critical mass in biologics will enhance Singapore’s status as a global hub for biopharmaceutical manufacturing, and raise the bar for competing locations because of the highly-skilled manpower and complexities associated. The establishment of the six biologics manufacturing plants here will employ almost 1,300 staff, bringing in about S\$2.5 billion in investments.

Professor Yap has led the BTI since its origins as the Bioprocessing Technology Unit (BTU) in 1990, and nurtured its growth from a small unit into a successful research institute. Bridging between discovery and commercialisation, BTU developed research capabilities, supported manpower training and provided core services for the biotechnology industry. This included the establishment of a cGMP facility, the Biopharmaceutical Manufacturing Technology Centre (BMTC), in 1999 for the production of clinical grade materials as contract service to local and overseas biotechnology companies. BMTC was subsequently spun out in 2004 as A-Bio Pharma, a commercial entity and the first biologics contract manufacturing company in Singapore. A-Bio Pharma quickly built up a successful client base of companies, providing process development, optimisation, manufacturing scale-up, GMP production, quality control and regulatory compliance to pharmaceutical and biotech companies.

The bioprocess R&D efforts at BTI, spearheaded by Professor Yap, has resulted in several successful collaborations and partnerships with academia and industry. The Consortium for Chinese Hamster Ovary (CHO) Cell Genomics, which was jointly organised by BTI and the University of Minnesota in 2006, helped place BTI and Singapore on the world map. The Consortium, started with up to US\$2 million provided by companies through the Society for Biological Engineering (USA), has attracted the participation of nine leading pharmaceutical and biotechnology companies including Bayer Healthcare AG, Boehringer Ingelheim, Bristol-Myers Squibb, SAFC Biosciences and Schering Plough. BTI has also developed research collaborations and projects with industry partners where the companies commit resources and funds to jointly develop projects to build up research competencies in industrially important areas. A case in point is the more recent development of GSK Biologicals SA Belgium's S\$2 million commitment to BTI in three vaccine and adjuvant system related research.

BTI actively builds up a ready pool of talent trained in biologics manufacturing, which is a critical component in attracting companies to Singapore for their various investments. Through teaching relevant courses and in supervising research projects, BTI supported early programmes such as the Specialist Manpower Programme and the Postgraduate Manpower Programme to address projected needs by offering specialisation in biopharmaceutical engineering to chemical engineering undergraduates and Masters students at NUS. In 2005, Professor Yap also initiated an intensive hands-on training programme, the Bioprocess Internship Programme, to prepare science and engineering graduates for careers in bioprocessing.

As the Executive Director of A*GA since 1 November 2006, A*GA has made tremendous in-roads into the top schools, junior colleges and universities in Singapore through its flagship scholarship programmes. Professor Yap is also instrumental in launching new initiatives under the Youth Science programme to cultivate students' interest in science and to enthuse young Singaporeans to pursue careers in Science and Technology. Some examples include providing opportunities for A*STAR scientists to engage teachers and students to develop in them an awareness of R&D, as well as establish and administer scholarships for bright Singaporeans in upper secondary schools. Through these initiatives, A*GA has built up a healthy pipeline of young Singaporeans keen on pursuing research as a career.

Under her watch, A*GA also introduced other scholarships and awards to encourage international students to do their PhDs in Singapore and A*STAR so as to build up an internationally diverse PhD talent pool as well as strengthen the network of PhD talent connected with Singapore and A*STAR. These include the Singapore International Graduate Award (SINGA), the A*STAR Research Attachment Programme (ARAP), and the Singapore International Pre-graduate Award (SIPGA). In addition, Professor Yap has also worked tirelessly at strengthening linkages between A*STAR and internationally renowned research institutions and universities such as the University of Cambridge and University of Oxford so as to increase the opportunities available for A*STAR scholars and fellows to be trained there. It is due to no small effort on the part of Professor Yap that some of the best opportunities for top-notch scientific training and networking have been made available to A*STAR scholars and fellows to give them the grounding and space to be developed into world-class scientific leaders.

Professor Yap's other achievements include starting the Centre for Natural Product Research (CNPR), a joint venture between GlaxoWellcome and the Institute for Molecular & Cell Biology (IMCB) in 1993, and heading it for seven years until 2000. In 2002, CNPR was privatised and became MerLion Pharmaceuticals, a start-up which has established itself as a leading natural product-based R&D company. It has received several awards and accolades including the Frost & Sullivan Market Penetration Leadership Award in March 2006. It was also named as one of the top biotech

companies of 2007 in the annual FierceBiotech "Fierce 15" list and the 'Best Company in an Emerging Market' at the industry's annual Scrip Awards in 2007.

Professor Yap also led the development of the Singapore Stem Cell Bank (SSCB) under the auspices of the Singapore Stem Cell Consortium (SSCC). The SSCB, which began operations in August 2006, is a centralised repository and distributor of high quality research-grade human stem cell lines that are maintained and characterised according to validated and standardised processes for basic and translational research. The bank, which also provides technical support and educational opportunities through hands-on training of research students and post-doctoral researchers in specialist techniques of human embryonic stem cell culture and characterization, represents an important initiative in Singapore to advance stem cell research and the development of stem cell-based technologies.

Professor Yap's outstanding achievements in education, research and management in the field of mammalian cell culture were recognised by the prestigious U.S. National Academy of Engineering, which elected her as a Foreign Associate in February 2006. She became the first foreign female associate and the only engineer in Singapore to be elected into the academy. For her contributions, Professor Yap was honoured with the National Day's Public Administration Medal (Silver) in 2003.

For her sustained, distinguished and strategic contributions to Singapore's Biomedical Sciences landscape, particularly in the areas of developing the biologics industry sector, building the research culture and nurturing young talent, Professor Miranda Yap is awarded the President's Science and Technology Medal 2009.

PRESIDENT'S SCIENCE AWARD 2009



(from left to right)

Associate Professor Aung Tin

Professor Roger Beuerman

Professor Donald Tan

Singapore Eye Research Institute, Singapore National Eye Centre

Yong Loo Lin School of Medicine, National University of Singapore

“For their innovative breakthroughs in “bench-to-bedside” medical research in blinding corneal diseases, leading to major advancements in scientific knowledge and treatment of corneal blindness”

Over the last decade, Professor Donald Tan, Professor Roger Beuerman and Associate Professor Aung Tin have solved many mysteries of corneal diseases, and invented treatment modalities which are now mainstream approaches adopted world-wide. The trio has spearheaded pivotal corneal

research programmes that span the range of fundamental research from clinical innovations to public health interventions. This is a true “bench to bedside to population” approach which has direct impact on reducing corneal blindness and has placed Singapore at the forefront of corneal research.

At the Bench, the team’s efforts have led to new insights into corneal and ocular surface stem cell biology and the causes of inherited corneal diseases. Their Ocular Surface Stem Cell Research Programme has succeeded in growing adult ocular stem cells in the laboratory. They have patented a novel serum-free technique to culture conjunctival stem cells, thus reducing the risk of disease transmission by eliminating the use of animal cells or serum. The team also discovered the gene responsible for congenital hereditary endothelial dystrophy (CHED), a severe form of blindness occurring in children. They found that this same gene is also mutated in the commonest form of age-related corneal degeneration, Fuch’s endothelial dystrophy, which opens up opportunities for gene therapy for this disorder.

At the Bedside, they were the first in the world to perform a series of bioengineered human conjunctival stem cell transplants in patients with chemical and burn injuries, Stevens Johnson syndrome and pterygium. The team has also transformed the field of corneal transplantation and artificial cornea surgery. The innovations in transplantation, in which only partial layers of the cornea are surgically replaced, have led to reduced rates of graft rejection and improved graft survival. The Tan EndoGlide, a patented surgical device invented at SERI, is used by surgeons around the world to perform keyhole, sutureless corneal transplantation, also known as Endothelial Keratoplasty (EK). Where corneal or stem cell transplantation would not be successful, the team have turned to the Artificial Cornea, and pioneered the first Asian series of Osteo-Odonto Keratoprosthesis (OOKP) procedures in which the patient’s own tooth is removed and used to implant an artificial cornea into the eye.

Finally, the group’s research at the Population level prevented a major outbreak of blinding corneal infections on a global scale. In 2006, through a nation-wide epidemiological study, the group was the first to identify that a major outbreak of Fusarium Keratitis, a severe fungal corneal infections, was due to contamination of a well known contact lens cleaning solution.

For their outstanding contributions in translational, clinical and epidemiological corneal research leading to the discovery of new knowledge and the pioneering of novel medical and surgical therapies for improved outcomes for patients suffering from blinding corneal diseases, the SERI team made up of Professor Donald Tan, Professor Roger Beuerman and Associate Professor Aung Tin is awarded the 2009 President’s Science Award.

PRESIDENT’S TECHNOLOGY AWARDS 2009



(from left to right)

Mr Goh Szu Huat

Mr Alfred C.T. Quah

Professor Jacob C.H. Phang

Mr Chua Choon Meng

Department of Electrical and Computer Engineering, National University of Singapore

SEMICAPS Pte Ltd, Singapore

“For their outstanding contributions to the research, development and commercialisation of scanning optical microscope systems for design debug and failure analysis of advanced integrated circuits which have been adopted by some of the world’s top semiconductor manufacturers”

Failure analysis is integral to the development and manufacture of semiconductor integrated circuits. With every technology node that results in smaller geometries and faster devices, the incidence of failure increases significantly.

The new circuit architecture and advanced fabrication processes associated with the new technology nodes mean that new failure mechanisms have evolved which would require new failure analysis techniques for fault localisation and characterisation. Since failure analysis is a reactive step, the tools and techniques which lag behind the design and process technologies have, in recent years, been responsible for the delay in transition to the next technology node.

Led by Professor Jacob Phang, the team developed an integrated multi-laser near-infrared scanning optical microscope system for the design debug and failure analysis of advanced integrated circuits down to the 32 nm technology node. The system incorporates a suite of backside techniques for fault localisation jointly developed by National University of Singapore and SEMICAPS Pte Ltd. The joint project has resulted in active fault localisation techniques with the highest sensitivity and spatial resolution achievable.

Recently, the resolution and sensitivity enhancements techniques have also led to the successful imaging of a single defective via from 65 nm technology node. The joint project has also established a new paradigm of tester-based fault localisation techniques which allows design debug and failure analysis to take place at full device operating speeds.

This project has resulted in 13 publications, two best paper awards, four invited papers, four invited presentations and six patents.

In addition, SEMICAPS has also developed and commercialised five system configurations for analytical, tester-docked and wafer prober applications that meet the diverse needs of design debug, product engineering, yield enhancements and customer returns for integrated device manufacturers, foundries, fab-less and failure analysis service companies.

The impact of the project is evident from the extensive adoption of these systems and techniques by integrated device manufacturers, foundries, fab-less companies and failure analysis service providers. As of 31 December 2008, the systems have been adopted by seven of the world’s top 25 semiconductor manufacturers. Twenty-five systems with invoice values of more than SGD25M have been delivered worldwide, more than 90% of which were to destinations outside Singapore.

The development has provided the team with a strategic position to collaborate with leading semiconductor companies, research institutes and technology companies in projects that will lead to

failure analysis technologies that will meet the future challenges of advanced semiconductor technology nodes.

For their outstanding contributions to the research, development and commercialisation of scanning optical microscope systems for design debug and failure analysis of advanced integrated circuits which have been adopted by some of the world's top semiconductor manufacturers, the team, made up of Professor Jacob C.H. Phang, Mr Chua Choon Meng, Mr Alfred C.T. Quah and Mr Goh Szu Huat from the Department of Electrical and Computer Engineering, National University of Singapore, and SEMICAPS Pte Ltd, Singapore, is awarded the 2009 President's Technology Award.