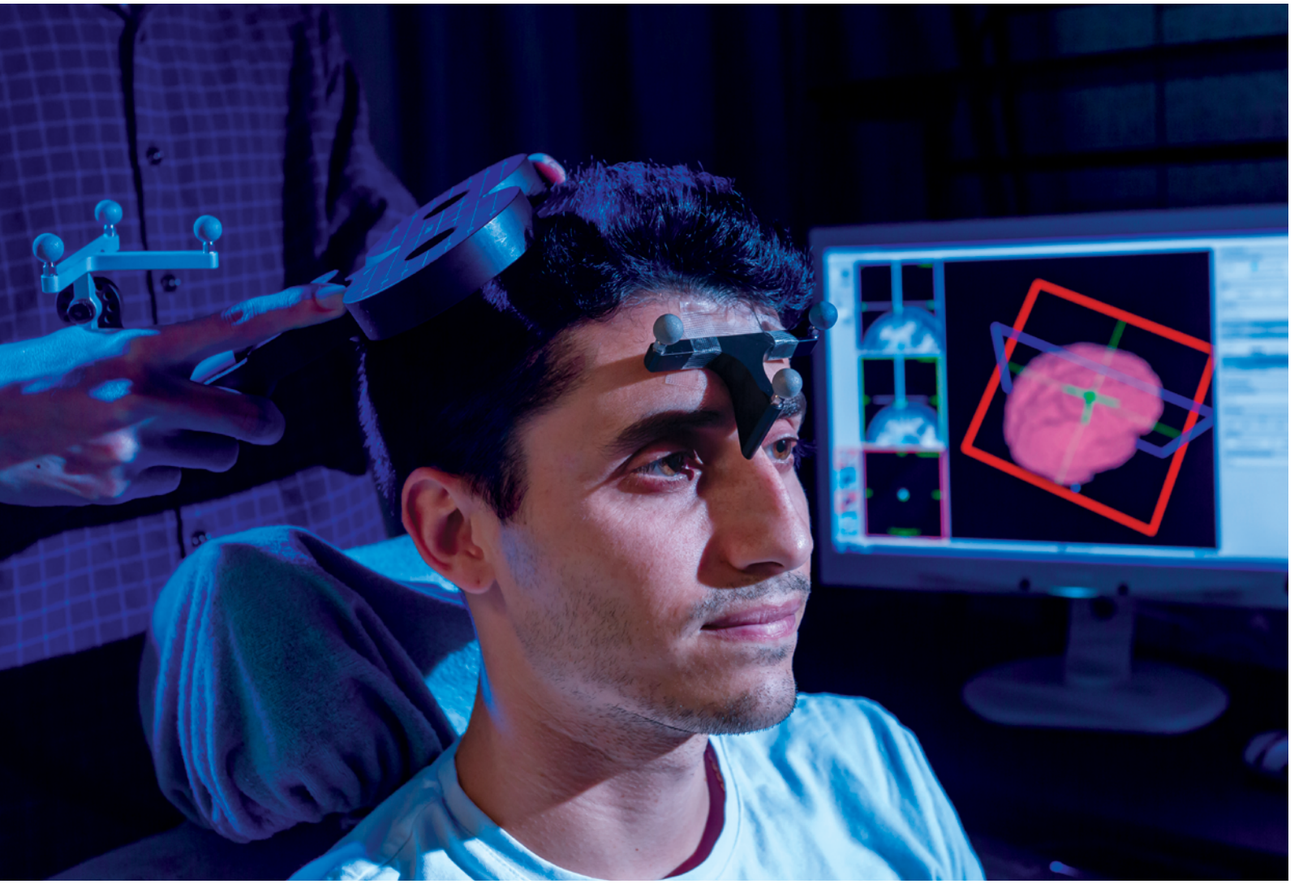
WORLD-CLASS RESEARCHERS MAKING BOLD ADVANCES

科研精英　勇於嘗新

PolyU scientists eagerly break new ground in different disciplines, contributing to a better and more sustainable world.

理大科學家熱衷於不同領域中開天闢地，為更美好和更可持續發展的世界作出貢獻。



RESEARCH FUNDING
科研經費

In addition to receiving funds allocated by the University, academics at PolyU applied for research funding from external sources, through competitive or non-competitive means, for their research projects. Total funding in 2017/18 amounted to HK$2,186 million, supporting nearly 3,260 projects undertaken by more than 1,100 academic staff and around 1,700 research personnel.

除了大學提供的科研經費，理大的學術人員同時透過競爭或非競爭渠道，申請校外不同種類的科研基金，以資助他們的科研項目。2017/18年度，理大科研項目的總資金為二十一億八千六百萬港元，資助近三千二百六十項計劃，參與其中的學術人員逾一千一百名，科研人員約一千七百名。

Newly-funded research projects in 2017/18
2017/18 年度新獲資助的科研項目

Funding source 資金來源	No. of projects 計劃數目	Amount (HK$m) 資助額（百萬港元計）
Research Grants Council 研究資助局	191	143.53
Innovation and Technology Fund 創新及科技基金	52	137.27
Other competitive grants 其他透過競爭渠道獲取的科研經費	75	52.54
Funds from China# 中國境內科研基金	60	55.94
Non-competitive grants* 非競爭性資助	538	286.41
Total 總數	916	$675.69

The amount is calculated at an exchange rate of RMB1: HKD1.1406
根據 1 人民幣：1.1406 港元的匯率計算

*Including industrial/commercial support and donations
包括工商機構贊助及捐款

MAJOR RESEARCH PROJECTS
主要研究項目

Healthy living 健康生活

Defocus Incorporated Multiple Segments Spectacle Lens

The Defocus Incorporated Multiple Segments (DIMS) Spectacle Lens was invented by Prof. Carly Lam and Prof. To Chi-ho of the School of Optometry, together with research collaborator Hoya Vision Care. The DIMS lens was found to be effective in slowing the progression of short-sightedness in children by 60%, with 20% of clinical trial subjects experiencing no increase in myopia. These results were obtained from a randomised double-blind clinical trial conducted from August 2014 to July 2017 with the support of an industrial fund provided by HOYA Lens Thailand Ltd.

The DIMS spectacle lens provides myopic defocus for slowing eye growth in the wearer as well as clear vision at all viewing distances. The innovation won the Grand Prize (Overall Championship), Grand Award and Gold Medal with Congratulations of Jury at the 46th International Exhibition of Inventions of Geneva.

「多區正向光學離焦」眼鏡片 1

眼科視光學院林小燕教授及杜嗣河教授，與豪雅光學共同研發出「多區正向光學離焦」(DIMS) 眼鏡片。根據由泰國豪雅光學資助並在2014年8月至2017年7月進行的隨機雙盲臨床實驗的結果，證實DIMS眼鏡片有效減慢兒童近視加深的速度達六成，其中兩成參與臨床研究的兒童之近視更停止加深。

DIMS眼鏡片利用光學離焦原理減慢近視加深，同時為佩戴者提供清晰的視力以觀看不同距離的景物。這項發明在瑞士日內瓦舉行的「第四十六屆國際發明展」上贏得「全場總冠軍」、「特別大獎」及「評判特別嘉許金獎」。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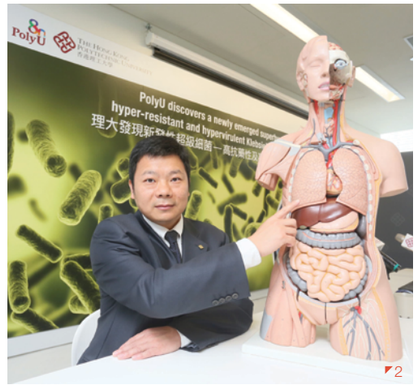

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Dangerous superbug discovered

Supported by the State Key Laboratory of Chemical Biology and Drug Discovery (The Hong Kong Polytechnic University), Prof. Chen Sheng in collaboration with the Second Affiliated Hospital of Zhejiang University discovered a new superbug, the hyper-resistant and hyper-virulent *Klebsiella pneumoniae*, which may cause fatal, untreatable infections in relatively healthy individuals.

Published in *The Lancet Infectious Diseases*, this study involved five patients who were infected with severe pneumonia in a hospital's intensive care unit and eventually died of septicaemia and multiple organ failure. The causative agent of these five patients was found to be a carbapenem-resistant K. pneumoniae strain (ST11 CR-HvKP), which can cause pneumonia and also invade the bloodstream and other internal organs.

發現危險超級細菌

在化學生物學及藥物研發國家重點實驗室(香港理工大學)的支持下，陳聲教授與浙江大學第二附屬醫院合作，發現了高抗藥性和高毒力的肺炎克雷伯菌這種新型超級細菌，即使相對健康的人士亦可能出現無法治癒的致命感染。

有關研究在《The Lancet Infectious Diseases》發表，涉及五名在醫院深切治療部感染嚴重肺炎並其後因敗血症和多重器官功能衰竭而死亡的病人。研究發現他們的致病因子是ST11碳青黴烯類抗性高毒性肺炎鏈球菌 (ST11CR-HvKP)。這些菌株不但可令患者感染肺炎，更可入侵血液和其他器官。

3

3D-printed spinal orthosis

The Department of Biomedical Engineering used 3D printing technology to develop a spinal orthosis for adolescent idiopathic scoliosis. The orthosis is light in weight and provides better ventilation, allowing patients to increase the amount of time it can be worn and prolonging its effectiveness. A mechanical test proved that the 3D-printed nylon orthosis is capable of repeatedly opening/closing more than 300 times without observable damage. The orthosis is currently under clinical trial.

三維打印脊柱矯形器

生物醫學工程學系開發了一個以三維打印技術製造的脊柱矯形器，供患有原發性脊柱側彎問題的青少年使用。該矯形器輕身且通氣，讓患者可加長佩戴的時間以延續矯形效力。機械測試證明了以尼龍物料三維打印出來的矯形器經過重複開合超過三百次仍沒有肉眼可見的破損。該矯形器目前正在進行臨床測試。

Photochemical air pollution

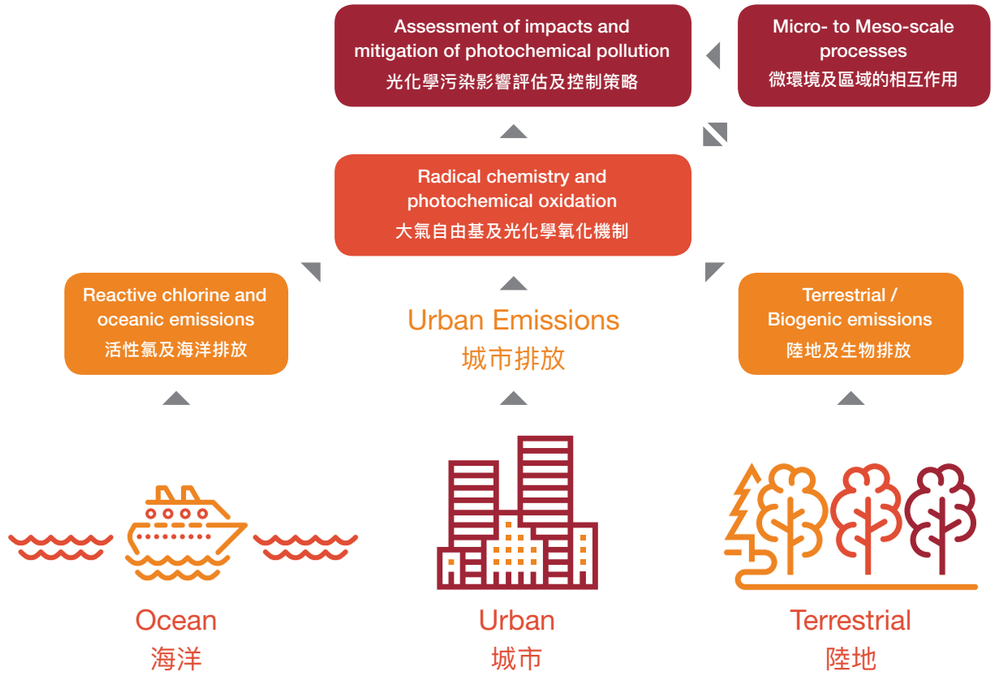
Prof. Wang Tao, Chair Professor of the Department of Civil and Environmental Engineering, was awarded HK$30 million in the 2017/18 Research Grants Council (RGC) Theme-based Research Scheme for a five-year collaborative project, “Photochemical air pollution in highly urbanised subtropical regions: from micro environments to urban-terrestrial-oceanic interactions”.

In this project, Prof. Wang is leading a team of academic collaborators from Hong Kong, the Chinese mainland, US and Europe to study photochemical air pollution in highly urbanised subtropical regions. In addition to the funding from the RGC, local universities participating in the project will provide over HK$3.33 million in matching funds, bringing the total budget of the project to more than HK$33.33 million.

大氣光化學污染

土木及環境工程學系講座教授王韜教授於研究資助局(研資局)2017/18年度主題研究計劃中獲得三千萬港元撥款，以資助其統籌的五年研究項目「亞熱帶城市群區域大氣光化學污染：從微環境到城市－陸地－海洋的相互作用」。

王教授帶領一個由香港、中國內地和歐美學者組成的合作團隊，研究亞熱帶城市群區域大氣光化學污染。除研資局的撥款外，參與該研究項目的本地大學亦將提供逾三百三十三萬港元作配對基金，令整個研究項目的總預算超過三千三百三十三萬港元。

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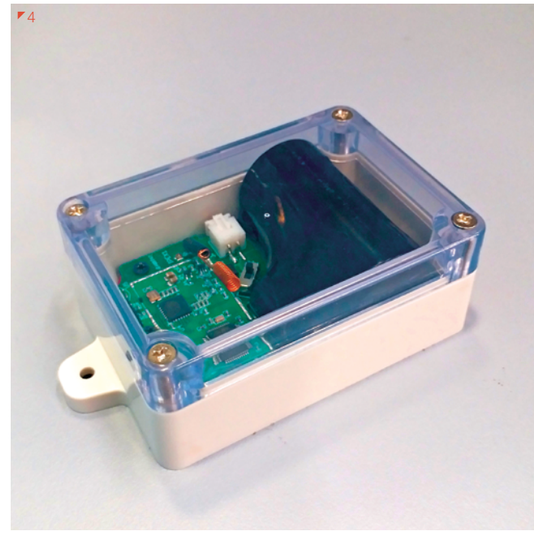
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The project will research cutting-edge science in atmospheric chemistry, including the sources and formation mechanisms of photochemical pollution and the interplay of emissions, chemistry and meteorology/climate. The research findings will provide evidence-based support to the governments of Hong Kong and Guangdong for developing more effective mitigation measures against current regional photochemical and roadside pollution in Hong Kong and the Pearl River Delta.

該項目將研究大氣化學領域的尖端科學，包括大氣光化學污染的來源和形成機制，以及排放–化學–氣象/氣候的相互作用。研究結果將為香港和廣東省政府提供實證支援以制定更有效的措施，緩解香港及珠三角地區當前的光化學和路邊污染問題。

4

Tree stability monitoring system

With the funding support from the Hong Kong Jockey Club Charities Trust, the Department of Land Surveying and Geo-Informatics led a cross-institutional team to manage the Jockey Club Smart City Tree Management Project with the aim of increasing the efficiency of tree management for longer tree life. The project involved the installation of specialised sensors on the lower trunk of more than 8,000 trees across the city to monitor their tilting angle over a three-year period using Smart Sensing Technology. Big data collected via the Geographic Information Systems-based platform will be used for the analysis of the trees’ root-plate stability. Other collaborators in the project include the University of Hong Kong, the Hong Kong University of Science and Technology, and Friends of the Earth (Hong Kong).

監測樹木穩定性系統

在香港賽馬會慈善信託基金撥款支持下，土地測量及地理資訊學系率領一個跨院校團隊進行「賽馬會智慧城市樹木管理計劃」，以提升樹木管理的效率，從而使樹齡得以延長。該項目涉及在全港市區八千多棵樹木的樹幹底部安裝特製的傳感器，運用智能傳感技術監測樹木的傾斜狀況，為期三年；同時透過地理資訊系統的平台收集大數據以進行分析，從而評估樹木根部的穩定性。此項目的其他合作夥伴包括：香港大學、香港科技大學及香港地球之友。

Advancing technology 創新科技

Novel micro-embossing device for manufacturing precision glass lenses

Developed by the team led by Prof. W.B. Lee and Dr Lily Hua, the micro-embossing device for precision optical microstructures is both environmentally-friendly and cost-effective. Adopting a moulding design with graphene-like coating and PolyU-developed heating technology, it heats the optical glass precisely and quickly, with little energy required, to reduce thermal expansion and deformation of the mould. The device can be applied in various fields, ranging from astronomy, national defence and medical scanning to consumer applications such as cameras and mobile phones. It has been granted eight patents and was awarded a Gold Medal at the 46th International Exhibition of Inventions of Geneva.

新型微壓印設備以製造微細鏡頭

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由李榮彬教授和李莉華博士率領團隊開發的精密光學微結構微壓印設備，不但環保，而且具成本效益。該設備所用的模具設計，是採用了仿石墨烯塗層及理大研發的加熱技術，能精確並迅速地將光學玻璃加熱，不但可減低能量消耗，更可減少熱膨脹和模具變形。該設備的應用範疇十分廣泛，涵蓋天文、國防、醫學掃描以至相機和手機等消費產品。該設備已取得八項專利，並在日內瓦舉行的「第四十六屆國際發明展」上獲得金獎。

Advanced precision manufacturing technology

The State Key Laboratory of Ultra-precision Machining Technology (The Hong Kong Polytechnic University) developed a multi-sensor system for 3D surface measurements and improved precision manufacturing. Consisting of a motion sensor and laser scanner, the system can be integrated into a variety of machine tools to perform in-situ and in-process high-dynamic-range 3D surface measurements. Led by Prof. Benny Cheung, this project—"An In-situ Multi-sensor 3D Metrology System for Precision Manufacturing"—was the winner in the IET Innovation Awards 2017 (manufacturing technology category).

先進精密製造技術

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超精密加工技術國家重點實驗室(香港理工大學)研發出用於三維表面測量的多傳感器系統，優化了精密加工的程式。該系統由一個運動感測器和一個雷射掃描儀組成，可安裝於各類機電器械，進行原位和生產線上高動態範圍的三維表面測量。這名為「應用於精密製造的原位多傳感器三維測量系統」的項目由張志輝教授帶領，獲得「2017年國際工程技術學會創新獎(製造技術組別)」。


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Fibre Bragg Grating (FBG) technology

The Hong Kong Branch of the National Rail Transit Electrification and Automation Engineering Technology Research Center (CNERC-Rail) at PolyU, in collaboration with the China Academy of Railway Sciences, commenced on a research project named "HSR slab track wheel load transmission measurement". With the specially designed FBG-based embedded sensor arrays, this technology can quantify concrete slab interior strain. The embedded sensors have since been placed inside both the track slab and concrete basement of Beijing-Shenyang HSR at 115 locations.

Also based on FBG sensing technology, research on an online railway tunnel deformation monitoring system has been undertaken by CNERC-Rail in partnership with China Southwest Jiaotong University Railway Development Co., Ltd. The objective of this project is to develop a system that timely monitors the health of a tunnel's operational state with built-in intelligent tunnel state automatic warning and an alarm system.

光纖光柵傳感技術

理大的國家軌道交通電氣化與自動化工程技術研究中心香港分中心(鐵路工程香港分中心)與中國鐵道科學研究院就「高速鐵路無砟軌道荷載傳遞測試方法研究」進行合作，利用基於光纖光柵傳感技術設計的嵌入式長距離感測器列陣，量化混凝土板內部勞損情況。這些嵌入式感測器列陣已安裝於京沈客專線無砟軌道的軌道板及地基板共一百一十五個測點。

此外，鐵路工程香港分中心亦夥拍西南交大鐵路發展股份有限公司研究以光纖光柵傳感技術為基礎的隧道位移在線監測系統。這項目旨為開發一個具備智能隧道狀態自動預警及警報系統並可適時監測隧道營運健康狀態的系統。


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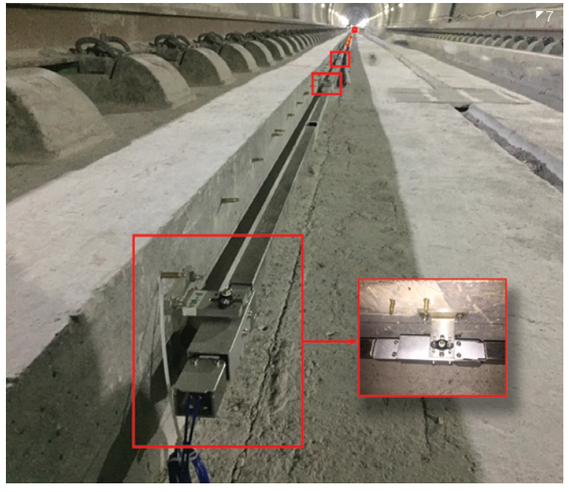
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Automated System for Surface Pitting Analysis on Airplane Jet Engines

The Aviation Services Research Centre (ASRC) has developed a new automated system which, employing robotics with artificial intelligence and deep learning, together with image processing, 3D scanning and optical metrology, is able to obtain information on the position, depth and diameter of surface defects on the components of an airplane's jet engine in a non-destructive way. It can be used with an automated surface defect removal system, also developed by ASRC, to repair surface defects on jet engines. The system significantly shortens aircraft maintenance time from 4 hours to 1.5 hours, with enhanced quality, reliability and accuracy as well as reduced airplane turnover time. This system was awarded a Gold Medal at the 46th International Exhibition of Inventions of Geneva.

飛機噴射引擎部件表面點蝕自動分析系統 8

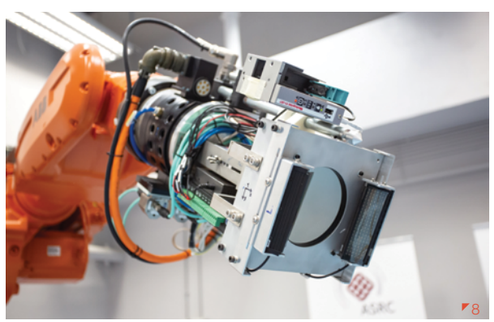
航空服務研究中心(中心)研發了嶄新的自動系統，利用具人工智能與深度學習能力的機械人，配合先進的圖像處理、三維掃描和光學計量技術，以非破壞性方式獲取飛機噴射引擎部件表面的輕微缺陷位置、深度和直徑。此技術更可配合中心研發的自動化復修系統使用，將偵測到的表面缺陷打磨修復。這系統令維修工時由四小時大幅縮短至一個半小時，提升了飛機維修的質素、可靠性及準確度，並縮短準備續航的時間。這個系統在日內瓦舉行的「第四十六屆國際發明展」上獲得金獎。

New approach for aircraft damage inspection and assessment

ASRC has also developed a new approach for identifying aircraft damage. In the inspection phase, a long focal length camera lens is used to acquire images of the airframe from a distance of about 30 metres. In the damage assessment phase, a device comprising a flash thermography system and a structured light 3D camera system will create a 3D model of the suspected damage area, which will be transmitted to the aircraft manufacturer for analysis. Corrosion assessment will be conducted using a hyperspectral imaging camera or a borescope. ASRC tested the inspection technology on a Boeing 747 fuselage and successfully identified the simulated lightning damage from 30 metres.

飛機損壞檢查及評估新方法 9

中心亦開發了一個用作檢查飛機損壞的嶄新方式。在檢查階段，使用長焦距相機鏡頭來獲取機身表面的圖像。檢測可在約三十米的距離進行。在損壞評估階段，由閃光熱成像系統和結構光三維相機系統組成的設備，會把懷疑損壞區域的影像建成三維模型，然後再傳輸到飛機製造商進行分析。腐蝕評估則利用高光譜成像相機或管道鏡進行。中心利用檢測技術在波音747機身進行測試，並成功在距離三十米之處識別模擬的雷擊損壞。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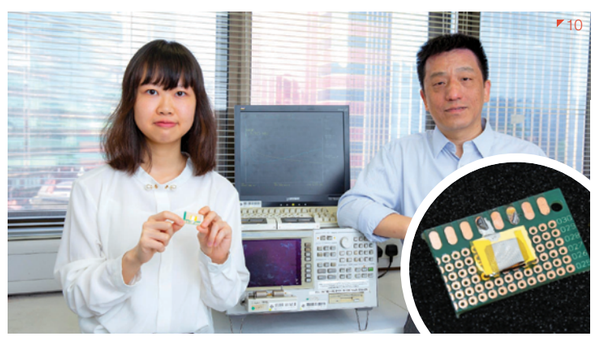
MAJOR AWARDS
主要獎項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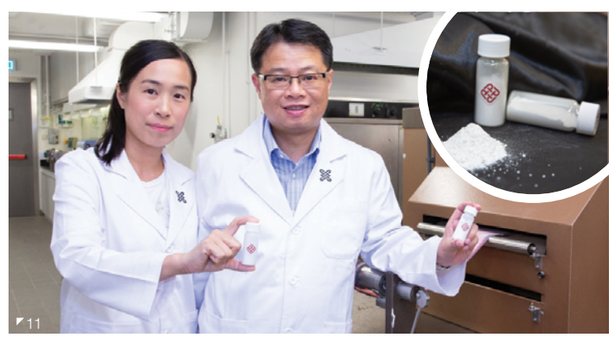
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2017 Ministry of Education Higher Education Outstanding Scientific Research Output Awards (Science and Technology)
2017 年國家教育部高等學校科學研究優秀成果獎（科學技術）

Award 獎項	Project 項目	Principal investigator/Department 主要研究人員/學系
Natural Science Award (First Class) 自然科學獎一等獎	Optimisation and Control Theory of Demand-side Flexible Resources in Renewable Power Systems 新能源電力系統需求側靈活資源的優化及控制理論	Prof. Xu Zhao, Department of Electrical Engineering 電機工程學系許昭教授
	Representation Learning Theories and Methods for Visual Information 視覺信息的表示學習理論與方法	Prof. Zhang Lei and Dr Yeng Meng, Department of Computing 電子計算學系張磊教授及楊猛博士
Natural Science Award (Second Class) 自然科學獎二等獎	Clustering, Knowledge-leverage and Learning in Neural-Fuzzy Systems 神經模糊系統建模中的聚類、知識利用與學習方法	Dr Korris Chung, Department of Computing and Dr Thomas Choi, School of Nursing 電子計算學系鐘富禮博士及護理學院蔡及時博士

TechConnect World Innovation Conference and Expo 2018
2018 TechConnect 世界創新會議暨博覽會

Award 獎項	Project 項目	Principal investigator/Department 主要研究人員/學系
10 Global Innovation Award 全球創新獎	Composite multilayer capacitors with colossal permittivity for electronics and energy storage applications 應用於電子及能源儲存的巨介電複合材料多層電容器	Prof. Hao Jian-hua and Ms Tse Mei-yan, Department of Applied Physics 應用物理學系郝建華教授和謝美恩女士
11 Global Innovation Award 全球創新獎	Low cost flame retardant treatment for cotton with co-catalyst system 低成本、應用助催化劑系統的織物阻燃處理方法	Dr Kan Chi-wai, Institute of Textiles and Clothing 紡織及服裝學系簡志偉博士

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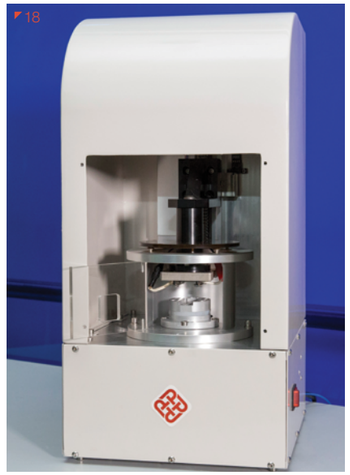

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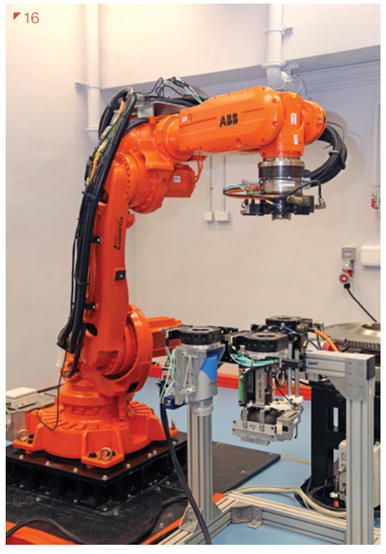

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7th Hong Kong Innovative Technologies Achievement Awards
第七屆香港創新科技成就大獎

Award 獎項	Project 項目	Principal investigator/Department 主要研究人員/學系
Hong Kong Innovative Invention Award: Gold Award 香港創新發明獎：金獎	Body Integrated Supercapacitor for Next Generation of Electric Vehicles 用於下一代電動汽車的車身集成超級電容	Prof. Eric Cheng Ka-wai, Department of Electrical Engineering 電機工程學系鄭家偉教授

46th International Exhibition of Inventions of Geneva
第四十六屆日內瓦國際發明展覽會

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12 Grand Prize (Overall Championship), Grand Award and Gold Medal with the Congratulations of Jury 全場總冠軍、特別大獎及評判特別嘉許金獎	Defocus Incorporated Multiple Segments (DIMS) Spectacle Lens for Myopia Control (more on p.70) 控制近視加深的「多區正向光學離焦」眼鏡片(詳見第70頁)	Prof. Carly S.Y. Lam and Prof. To Chi-ho, School of Optometry 眼科視光學院林小燕教授及杜嗣河教授
13 Gold Medal with the Congratulations of Jury 評判特別嘉許金獎	Intelligent 3D Stereoscopic Imaging System on Plenoptic Camera 全聚焦光場相機的智能三維成像系統	Ir Prof. Lee Wing-bun, Department of Industrial and Systems Engineering 工業及系統工程學系李榮彬教授工程師
14 Gold Medal with the Congratulations of Jury 評判特別嘉許金獎	Scalable All-Textile Energy Harvesters for Electric Power Generation 用於產生電能的可擴展全紡織能量收集器	Dr Xu Bin-gang, Institute of Textiles and Clothing 紡織及服裝學系徐賓剛博士
15 Special Merit Award and Gold Medal 特別優異獎及金獎	Sprayable Smart Sensing Network Coating for Structural Health Monitoring 用於結構健康監測的噴塗式智能傳感器網絡	Prof. Su Zhong-qing, Department of Mechanical Engineering 機械工程學系蘇眾慶教授
16 Gold Medal 金獎	Automated System for Surface Pitting Analysis on Airplane Jet Engine (more on p.76) 飛機噴射引擎部件表面點蝕自動分析系統(詳見第76頁)	Dr Stephen O'Brien, Aviation Services Research Centre 航空服務研究中心區柏賢博士
17 Gold Medal 金獎	eNightLog – Nighttime Monitoring System for Caring Elderly with Dementia eNightLog – 照顧腦退化症患者的監測系統	Ir Prof. Zheng Yong-ping, Department of Biomedical Engineering 生物醫學工程學系鄭永平教授工程師
18 Gold Medal 金獎	Micro-embossing Equipment for Precision Optical Microstructures 用於光學微結構的精密微納印壓設備	Dr Li Li-hua, Department of Industrial and Systems Engineering 工業及系統工程學系李莉華博士