The fight against ozone pollution
對抗臭氧污染

Hong Kong and its neighbouring districts have long been affected by serious air pollution characterized by high concentrations of ozone and other oxidants. These pollutants are not only harmful to human health, but also reduce visibility, change the regional climate and influence ecosystems. On this front, PolyU researchers have initiated many projects and developed a variety of methodologies to fight against ozone pollution.

Study of photochemical air pollution

Atmospheric research station at Hok Tsui
位於鶴咀的大氣研究站

Recently, Prof. Wang Tao of PolyU's Department of Civil and Structural Engineering and his team have been collaborating with the Institute for the Environment at the Hong Kong University of Science and Technology on the "Study of photochemical air pollution in Hong Kong". Supported by the HKSAR's Environment and Conservation Fund, the project is adopting integrated methodologies including ground-based and satellite-based measurements as well as advanced meteorological and chemical models to measure atmospheric concentrations of photochemical oxidants and precursors at three sites in Hong Kong: Hok Tsui, Hung Hom and Tung Chung.

The measurement data will be useful in analysing the formation of photochemical smog pollution and in assisting the HKSAR and Guangdong governments in developing strategies to mitigate pollution and control air quality in the region.

Research on tropospheric ozone pollution and processes

Since 1995, Prof. Wang Tao, Dr Aijun Ding and Mr Steven C.N. Poon of the Department of Civil and Structural Engineering have been conducting "Research on tropospheric ozone pollution and processes in China". The project is investigating the impact of Asia's rapid industrialization and urbanization on air quality, studying the sources of emission, chemical transformation and meteorological transport affecting ozone and related air pollutants, and providing scientific support for the development of pollution control strategies.

Not only has the project contributed to the advancement of knowledge on atmospheric chemistry and air pollution, but it has also aided the HKSAR government in its formulation of policies to mitigate photochemical ozone pollution. In 2009, this research won a Natural Science Award (Second Class) from the Ministry of Education's Centre for Science and Technology Development.

Prof. Wang Tao (third from left) and his research team conduct airborne experiment.
王韜教授(左三)及其研究團隊進行航測實驗。

一直以來，香港及鄰近地區都受着空氣污染的嚴重影響，以至空氣中含高濃度的臭氧及其他氧化劑。這些污染物不但對人體有害，而且導致能見度下降、改變地區氣候及影響生態系統。針對有關問題，理大研究人員已開展多個計劃及研發不同的方案來對抗臭氧污染。

光化學空氣污染研究

理大土木及結構工程學系王韜教授及其團隊最近與香港科技大學環境研究所合作在香港進行「光化學空氣污染研究」。此項目獲得香港特別行政區環境及自然保育基金資助，利用地面及衛星測量，以及先進氣象學和化學模型等綜合方法，在香港的鶴咀、紅磡及東涌三個地點，監測大氣中光化學氧化劑及初級粒子的濃度。

從研究收集到的數據，將有助分析光化學煙霧污染成因，以及幫助香港特別行政區和廣東省地區政府制訂策略，改善污染情況及監控地區的空氣質素。

流層臭氧污染及過程研究

自一九九五年起，土木及結構工程學系王韜教授，丁愛軍博士及潘振南先生一直致力「我國對流層臭氧污染及過程研究」，探討亞洲地區高速工業化和都市化對空氣質素的影響、臭氧及相關污染物的源排放、化學轉化及氣象傳輸過程，並為制定污染控制政策提供科學依據。

此項目不僅有助各界增進對大氣化學及空氣污染的知識，同時亦為香港特區政府制定控制光化學臭氧污染對策提供了支援。此研究項目獲教育部科技發展中心頒發二零零九年度「自然科學獎」(二等獎)。

Atmospheric halogenated hydrocarbons in the PRD

With an aim of exploring the source regions and atmospheric transport of halogenated hydrocarbon emissions in the Pearl River Delta (PRD), Dr Guo Hai, Assistant Professor of PolyU's Department of Civil and Structural Engineering, has teamed up with Prof. Wang Xinming of the Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, to conduct grid sampling at 45 sites simultaneously and long-term monitoring at three representative sites in the region.

Funded by the National Natural Science Foundation of China (NSFC) and the Research Grants Council (RGC) of Hong Kong Joint Research Scheme, this research will investigate the spatiotemporal patterns of atmospheric halocarbons and explore their variation trends in comparison with historical data. Based on the field measurement results, the project will be able to locate hot spots of halocarbon emission in the region, make source apportionments of halocarbons and estimate the amount of halocarbon emissions. In the long run, the field measurements will aid in the provision of air quality assessment tools specific to Hong Kong and southern China.

The equipment used to measure meteorological parameters (top)
測量氣象特徵的儀器 (上)

The canister used for halocarbon sampling (middle)
收集鹵化碳樣本的筒 (中)

Dr Guo Hai (second from right) and his research team (bottom)
郭海博士(右二)及其研究團隊 (下)

珠江三角洲地區的大氣鹵代烴

土木及結構工程學系助理教授郭海博士聯同中國科學院廣州地球化學研究所王新明教授，通過在珠江三角洲內四十五個站點的面上網格化同步觀測，以及三個代表性站點的長期觀測，研究區內大氣鹵代烴的主要排放源區及輸送情況。

此研究項目獲得國家自然科學基金委員會及香港研究資助局聯合資助計劃提供資助，主要研究大氣鹵代烴的時空分佈特徵，並與前期觀測資料比較，探討大氣鹵代烴的演化趨勢。該研究將根據實地觀測所得的數據資料，確定鹵代烴排放的熱點地區，分析不同排放源的貢獻率，並估算各地區的鹵代烴排放量。長遠而言，這些實地觀測數據將有助為香港及南中國提供獨特的空氣質素評估工具。

An innovative and economical way to produce multi-walled carbon nanotubes
新法生產多壁碳納米管　成本大降

The discovery of multi-walled carbon nanotubes (CNTs) opened the door to many useful applications, but they cost around HK$1 million per tonne to produce. Scientists around the world have thus been exploring ways to economically produce multi-walled CNTs.

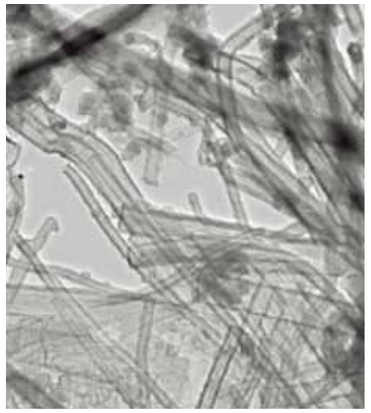
At PolyU's Institute of Textiles and Clothing, Assistant Professor Dr Shang Songmin, Chair Professor of Textile Technology and Head Prof. Tao Xiao-ming, and ex-Postdoctoral Fellow Dr Yang Xiaoming have developed a novel method of synthesizing multi-walled CNTs at a very low cost with polymer nanotubes as the carbon precursor.

As the polymers used are abundant and the required equipment is simple and easy to operate, this is the most economical method of producing multi-walled CNTs with high yield. The method is also safe because no dangerous raw materials or by-products are used in or generated by the process, making it viable for industry applications relating to nanotechnology, electronics, optics and material science. This discovery won a Gold Medal and a Special Prize at the Brussels Innova 2009.

多壁碳納米管的應用範疇非常廣泛，可是它的生產成本高達每公噸一百萬港元。因此，全球科學家一直在尋找低成本生產多壁碳納米管的新方法。

理大紡織及製衣學系助理教授尚頌民博士、講座教授兼系主任陶肖明教授及前博士後研究員楊曉明博士，共同開發一種以聚合物納米管為前驅體合成多壁碳納米管的嶄新方法，能以很低的成本生產多壁碳納米管。

由於這種創新技術所用的聚合物原料供應充裕，而所需的儀器既簡單，又易於操作，因此是目前成本最低、而又高效的生產多壁碳納米管方法。由於沒有使用危險原料，而生產過程中亦不會產生有害副產品，因此這種方法也很安全，更適用於有關納米技術、電子、光學及材料科學等工業範疇。這發明於二零零九布魯塞爾世界創新科技博覽會中奪得金獎及特別獎。



The TEM of the CNTs produced by the novel method
以嶄新方法所生產的碳納米管的透射電子顯微鏡照片

Dr Shang Songmin (right) and Dr Yang Xiaoming
尚頌民博士（右）及楊曉明博士

Portable biosensor quickly detects bacteria
便攜式快速檢測細菌儀器

A portable, high-speed and easy-to-operate biosensor developed by Drs Yang Mo and Leung Hang-mei, Assistant Professors at the Department of Health Technology and Informatics, can perform food screening in a mere 30 minutes with good accuracy.

Using nanotechnology, this revolutionary sensor comprises a small disposable membrane with millions of nanopores. Harmful micro-organisms, such as *Escherichia coli* and *Staphylococcus aureus*, block the nanopores and generate a change in electrical signal. After the biosensor analyses the impedance spectrum of the nano membrane, the concentration level of the pathogen can be identified.

Conventional laboratory tests to detect food contamination usually require one or two days to yield results. Using this simple device, food tests can be conducted by non-skilled personnel on the spot. This will allow timely food screening and surveillance, offering much convenience to government regulation bodies, food manufacturing industries, supermarkets and restaurants alike. This groundbreaking invention won a Gold Medal at the Brussels Innova 2009.

醫療科技及資訊學系助理教授楊莫博士與梁杏媚博士開發了一種既輕便，又易於操作的快速檢測細菌儀器，該儀器可在僅三十分鐘內完成準確的食物測試。

這革命性測試儀內含以納米傳感技術製成的用完即棄多孔納米測試薄膜。吸附在納米孔薄膜表面的有害細菌(如大腸桿菌和金黃葡萄球菌) 會阻塞納米孔，並引起電子訊號的變化，經儀器分析納米薄膜阻抗頻譜後，便可確定細菌的含量。

在測試食物污染的過程中，傳統的實驗室測試需時一至兩日才會得出結果，但這簡單的儀器卻讓非技術人員進行現場食品測試。該儀器更方便政府監管部門、食品製造業、超級市場及餐廳進行及時的食物篩查和檢驗。這創新發明於二零零九布魯塞爾世界創新科技博覽會中獲得金獎。

Disposable testing membrane with nanopores
用完即棄納米測試薄膜

Dr Yang Mo
楊莫博士

Multi-antenna GPS technology enhances structure monitoring
多天線全球衛星定位技術提升結構監測效能

Led by Chair Professor of Geomatics and Head of the Department of Land Surveying and Geo-Informatics (LSGI) Prof. Ding Xiao-li, an interdisciplinary research team including Visiting Chair Professor of Land Surveying Prof. Chen Yong-qi, Research Assistant Mr Yang Wen-tao of LSGI and Prof. Yin Jian-hua of the Department of Civil and Structural Engineering, has developed multi-antenna global positioning system (GPS) technology to monitor the deformations and irregularities of landslides and mega-structures. The team has worked with researchers in the Chinese mainland and Australia to develop the new technology.

Applying special GPS data management and processing algorithms, hardware and software to enable one GPS receiver to work with multiple antennae, this technology has made possible the close monitoring of deformations at all points equipped with the antennae. This Multi-Antenna GPS Structure Monitoring System can be applied to landslide monitoring and warning, tracking mega-structure (e.g. dam and bridge) deformations and the measurement of ground subsidence.

As compared to standard GPS systems, the overall cost of this system is significantly reduced but the capacity in monitoring structural deformations and irregularities is greatly enhanced. This innovative technology won a Silver Medal at the Brussels Innova 2009.

Prof. Ding Xiao-li
丁曉利教授

由土地測量及地理資訊學系講座教授兼系主任丁曉利教授領導的跨學科研究團隊，開發了一種多天線全球衛星定位技術，用以監測斜坡崩塌及大型結構的變異情況。團隊成員包括：土地測量及地理資訊學系客座講座教授陳永奇教授、研究助理楊文濤先生，以及土木及結構工程學系殷建華教授。研究團隊亦與中國內地和澳洲的研究人員合作開發該技術。

該技術採用特別的全球衛星定位數據處理和運算方法，以及軟件和硬件，把多條天線連接到同一個全球衛星定位接收器上，使每個裝上天線的觀測點的變異情況都受到密切的監測。這個多天線全球衛星定位結構監測系統可以監測及預報斜坡崩塌、追蹤水壩和橋樑等大型結構的變形情況，以及測量地表沉降現象。

這套結構監測系統的整體成本遠較標準的全球衛星定位系統為低，但監測結構變異的效能卻大大提升。這嶄新技術於二零零九布魯塞爾世界創新科技博覽會中獲得銀獎。

System hardware
系統的硬件

Tourist Satisfaction Index assesses the tourism competitiveness of HK
旅客滿意指數評估香港旅業競爭力

Prof. Song Haiyan (pictured), Chair Professor of Tourism and Associate Director of the School of Hotel and Tourism Management, has developed the PolyU Tourist Satisfaction Index (TSI) to evaluate the satisfaction level of inbound tourists to Hong Kong.

Based on interviews with 3,000 respondents from different countries and regions, satisfaction indices of the six tourism-related sectors for each of the seven important regional source markets for Hong Kong have been produced. The six service sectors included hotels, restaurants, transportation, paid attractions, retail shops and immigration services. The seven source markets are: the Americas, Australia, New Zealand and the Pacific, Europe, Africa and the Middle East, Japan and Korea, the Chinese mainland, South and Southeast Asia, and Taiwan and Macau.

The Index is based on a sophisticated model and vigorous research framework that captures the multiple dimensions of tourist satisfaction. The framework is able to produce tourist satisfaction indices for individual service sectors as well as for the destination as a whole. The PolyU TSI will be updated annually to monitor the dynamics of a destination's competitiveness over time through estimating individual indices on a regular basis.

The first PolyU TSI study showed that tourists from North America have the highest satisfaction level with a score of 78.43 out of 100. Among the six tourism-related sectors, the transportation sector received the highest tourist satisfaction index score of 77.79. The overall PolyU TSI stood at 72.65, indicating that inbound tourists are generally satisfied with the services of Hong Kong's tourism sectors during the year of 2009.

The Index not only provides a benchmark of local indices against those of other destinations, but also supplies authorities concerned and industry personnel with much needed information for decision making and planning.

酒店及旅遊業管理學院旅遊業講座教授兼副院長宋海岩教授（見相）研發出一套「理大旅客滿意指數」系統，以評估訪港旅客的滿意程度。

旅客滿意指數是根據三千名來自不同國家及地區的被訪旅客的意見，統計出香港七大主要客源市場的旅客對六項旅遊相關行業的滿意程度。該六個行業包括：酒店業、餐廳食肆、交通、收費景點、零售商店、以及出入境服務。七大主要客源市場包括：美洲、澳洲、紐西蘭和太平洋地區、歐洲、非洲和中東、日本和韓國、中國內地、南亞和東南亞、以及台灣和澳門。

這指數是根據精密的模型和研究框架而構建，以反映旅客滿意度的多樣性特點。該框架可以為個別旅遊服務行業統計旅客滿意指數，並提供旅遊目的地的整體滿意指數。「理大旅客滿意指數」將每年更新，並定期估算個別行業於各個客源市場的指數，以持續監測旅遊目的地競爭力之變化。

首份「理大旅客滿意指數」研究報告顯示，來自北美的旅客滿意度最高，以一百分計，其得分為78.43分。在六個旅遊相關行業中，旅客對交通方面的滿意度最高，得77.79分。「理大旅客滿意指數」的總平均分為72.65分，顯示二零零九年訪港旅客對香港旅遊業界提供的服務普遍感到滿意。

該項指數不但為香港提供了一個旅客滿意指數的本地指標，可與其他旅遊目的地的指數互相比較，而且更為有關當局和業內人士提供決策及規劃所需的資料。

Research reveals lifestyle of middle-class families on the Chinese mainland
中國內地中產家庭生活方式研究

Sample mobile phone design according to the research findings
根據研究結果而設計的流動電話樣本

The Asian Lifestyle Design Research Lab (ALDL) of the School of Design (SD) has conducted a two-year long study on the lifestyles of middle-class families in the Chinese mainland, covering city dwelling, food, communication, leisure and clothing. Led by Mr Benny Leong, Assistant Professor of SD and ALDL person-in-charge, researchers conducted 200 household visits in 10 major cities and captured snapshots through photos, case studies and literature reviews, giving birth to the world's first image database of the lifestyle of middle-class Chinese families.

With respect to city dwelling, the study found that Shanghai residents valued privacy and that bedrooms in their apartments tend to be far apart, whereas Chengdu residents are green conscious with more plants in their homes. Residents in Guangzhou consider an "in-house garden" a must-have in an ideal urban dwelling, and quite a number of apartments in Zhengzhou feature a balcony-like sunroom.

The researchers also assessed the subjects' communication needs by exploring their preferences for mobile phone features. Those from Shanghai, many of them professional migrants, demanded Global Positioning System (GPS)-integrated services to facilitate driving. Respondents from Zhengzhou favoured electronic cash functions, whereas Tianjin people considered the information-screening feature important in filtering deceitful SMS messages. In Guangzhou, where safety is a concern, the respondents preferred alarm and torch functions.

In gathering the research data, PolyU teamed up with 10 top design schools on the Chinese mainland to form the Lifestyle Design Research Network of China. The massive amount of visual and textual data collected will help designers and industries to explore upcoming trends and create innovative and sustainable products and services for regional/national and Asian lifestyles.

Mr Benny Leong
梁清河先生

理大設計學院的亞洲生活風尚設計研究實驗室用了兩年時間，研究中國內地中產家庭生活方式，包括居住空間、食品、通訊、休閒及服裝。在設計學院助理教授兼亞洲生活風尚設計研究實驗室主任梁清河先生帶領下，研究人員走訪了中國內地十個主要城市，並訪問了二百多個家庭，透過記錄相片、專題研究和文獻分析，建立了全球首個中國內地中產家庭生活方式的圖像資料庫。

在居住空間方面，研究發現上海居民非常重視私隱，因此屋內睡房與睡房之間的距離往往較遠。另外，成都居民具綠化意識，喜歡在屋內放置植物；廣州居民則認為一個理想的城市家園必須擁有「入戶花園」；而某部份鄭州的房屋設有類似陽台的陽光房。

另外，為研究受訪者對通訊的要求，研究人員探討了他們喜歡流動電話具備什麼功能。很多來自上海的受訪者是專業移民，他們認為電話應提供全球衛星定位綜合服務，方便駕駛時使用；而鄭州的受訪者就希望流動電話具備電子金錢功能。天津的受訪者則認為電話最重要是能夠篩選訊息，以便識別虛假短訊。廣州人十分關注個人安全，因此受訪者希望自己的手機配備警報及電筒功能。

理大更與中國內地十所優秀的設計學院攜手建立「生活方式設計研究聯盟（中國）」以搜集數據。研究中得到的大量圖像及文字數據將有助設計師及工商業界掌握未來時尚趨勢，從而為地區、國家及亞洲獨特生活方式設計創新及具可持續性的產品和服務。