Applied Environmental Nanotechnology Workshop

1-2 June 2017

Lo Ka Chung Building, Lee Shau Kee Campus

The Hong Kong University of Science and Technology

Hong Kong, China

Organizer

香港科技大學 THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

Co-organizer

Washington University in St. Louis

Sponsors

IAS HKUST JOCKEY CLUB INSTITUTE FOR ADVANCED STUDY

王寬誠教育基金會 K. C. WONG EDUCATION FOUNDATION

McDonnell Academy Global Energy and Environment Partnership (MAGEEP)

Organizing Committee Members

Prof. Irene M. C. Lo, The Hong Kong University of Science and Technology (Chair)
Prof. Daniel E. Giammar, Washington University in St. Louis (Co-chair)
Prof. John D. Fortner, Washington University in St. Louis (Co-chair)

Welcome Message

It gives me great pleasure to welcome you to participate in the Applied Environmental Nanotechnology Workshop at the Hong Kong University of Science and Technology (HKUST) from 1-2 June, 2017. I am honored to be hosting this prestigious workshop at HKUST in collaboration with Washington University in St. Louis and also want to express my sincere gratitude to Jockey Club Institute for Advanced Study (IAS), McDonnell Academy Global Energy and Environment Partnership (MAGEEP), and K. C. Wong Education Foundation for sponsoring this workshop and making it happen.

In the last decade, nanotechnology for environmental applications has received much attention and increasingly moved from research to practical applications. The purpose of the workshop is to share the latest findings and stimulate discussions regarding the forefront of research in environmental nanotechnology. We have invited renowned speakers in the field of environmental nanotechnology from all around the world to present their research works and share their prestigious experiences in developing this technology. The two-day workshop will focus on (i) design, synthesis, characterization, and environmental behaviors of nanomaterials, (ii) use of nanomaterials as sorbents for pollutant removal and resource recovery, (iii) use of nanomaterials for photocatalytic transformation of pollutants, (iv) use of nanomaterials for energy production, and (v) nanomaterials involved in advanced membrane treatment processes.

The workshop also features collaboration-building activities, with aims to stimulate networking and exchange of ideas, knowledge and experience with scholars and professionals from local and around the world. All of the participants in this workshop are by invitation since we intend to keep this workshop in a small scale, as we believe it can foster more effective discussions and communications between participants for future collaboration in research.

Despite the intense program schedule, I hope that you will be able to get some glimpses of Hong Kong. Hong Kong is a cosmopolitan and modern city, which is also rich in history and culture. Last but not least, I truly believe we will have wonderful discussions and insights generated for applied environmental nanotechnology in these two days, and sincerely wish that you will have a fruitful experience from this workshop.

Professor Irene M. C. LO
Chair of Organizing Committee, Applied Environmental Nanotechnology Workshop
Professor, Department of Civil and Environmental Engineering,
Hong Kong University of Science and Technology
Academician, European Academy of Sciences and Arts

Applied Environmental Nanotechnology Workshop

Table of Contents

Program Schedule

June 1, 2017

Time	Program
08:30-09:20	On-site Registration
09:20-09:40	**Welcome and Opening Session** ***(Chair: Prof. Irene M.C. Lo, Hong Kong University of Science and Technology)***
09:20-09:30	Welcome Remarks (TBD)
09:30-09:40	Opening Remarks ***– Prof. Irene M.C. Lo, Hong Kong University of Science and Technology*** ***– Prof. Daniel E. Giammar / Prof. John D. Fortner, Washington University in St. Louis***
09:40-10:30	**Highlighted Plenary Lecture I** **Nanoparticle Aerosol Science and Technology Enabling Environmental Engineering Applications *– Prof. Pratim Biswas, Washington University in St. Louis***
10:30-11:00	**Photo-taking and Coffee Break**
11:00-12:20	**Session 1** **Use of Nanomaterials as Sorbents for Pollutant Removal and Resource Recovery** ***(Chair: Prof. Daniel E. Giammar, Washington University in St. Louis)***
11:00-11:20	Magnetic Nanoparticles for Removal and Recovery of Metal Anions from Wastewater ***– Prof. Irene M.C. Lo, Hong Kong University of Science and Technology***
11:20-11:40	Observation and Modeling of U(VI) Adsorption to Engineered Iron Oxide Nanoparticles ***– Prof. Daniel E. Giammar, Washington University in St. Louis***
11:40-12:00	Preparation of Regenerable Granular Carbon Nanotubes by a Simple Heating-filtration Method for Efficient Removal of Typical Pharmaceuticals ***– Prof. Shubo Deng, Tsinghua University***
12:00-12:20	Selective Nanosorbents for Removal of Heavy Metals from Seawater ***– Prof. King Lun Yeung, Hong Kong University of Science and Technology***
12:20-14:00	**Lunch + Poster Session**

Program Schedule

June 1, 2017

Time	Program
14:00-15:20	**Session 2** **Nanomaterials for Advanced Membrane Treatment Processes** ***(Chair: Prof. King Lun Yeung, Hong Kong University of Science and Technology)***
14:00-14:20	Engineered Crumpled Graphene Oxide Nanocomposite Membrane Assemblies for Advanced Water Treatment Processes ***– Prof. John D. Fortner, Washington University in St. Louis***
14:20-14:40	Electronanofiltration (ENF)-Novel Membrane Processes for Treating Metal Ions Contained Wastes ***– Prof. Tongwen Xu, University of Science and Technology of China***
14:40-15:00	Engineering Inorganic Nanomaterials and Their Composites for Environmental Applications ***– Prof. Jianping Xie, National University of Singapore***
15:00-15:20	Sunlight Enables Reduced Graphene Oxide/Bacterial Nanocellulose Ultrafiltration Membranes to Resist Biofouling ***– Prof. Young-Shin Jun, Washington University in St. Louis***
15:20-15:40	**Coffee Break**
15:40-17:00	**Session 3** **Design, Synthesis, Characterization, and Environmental Behaviours of Nanomaterials (i)** ***(Chair: Prof. Wey Yang Teoh, City University of Hong Kong)***
15:40-16:00	BiOCl Nanosheets Oxygen Vacancy Associated Surface Fenton Chemistry ***– Prof. Lizhi Zhang, Central China Normal University***
16:00-16:20	Modelling the Transport of Engineered Nanomaterials in Simulated Landfills ***– Prof. Orhan Yenigün, Boğaziçi University***
16:20-16:40	Photonic Nanostructures for Environmental Pollution Prevention ***– Prof. Liwu Zhang, Fudan University***
16:40-17:00	Modeling the Transport of Engineered Nanoparticles in Saturated Sand ***– Prof. Nadim K. Copty, Boğaziçi University***
17:00-18:30	**Workshop Activities I – Future Perspective of Nanotechnology for Environmental Application *(Chair: Prof. John D. Fortner, Washington University in St. Louis)***
17:00-18:00	Group Discussion
18:00-18:30	Workshop Outcome Summary
19:00-21:30	**Gala Dinner (by invitation only)**

Program Schedule

June 2, 2017

Time	Program
09:00-09:50	**Highlighted Plenary Lecture II** ***(Chair: Prof. Irene M.C. Lo, Hong Kong University of Science and Technology)*** **Semiconductor Electrochemical Wastewater Treatment: From a Design Concept to Full-scale Manufacturing in 5 Years** ***– Prof. Michael Hoffmann, California Institute of Technology***
09:50-10:50	**Session 4** **Use of Nanomaterials for Energy Production** ***(Chair: Prof. Jimmy C. Yu, Chinese University of Hong Kong)***
09:50-10:10	Harnessing Solar Electricity from Wastewater through Photocatalytic Fuel ***– Prof. Wey Yang Teoh, City University of Hong Kong***
10:10-10:30	Photocatalytic Methane Conversion using Morphology-Controlled Semiconductor Microcrystals ***– Prof. Bryce Sadtler, Washington University in St. Louis***
10:30-10:50	Photocatalytic N_2 Fixation: a New Route to Solar Fuel ***– Prof. Wenzhong Wang, Shanghai Institute of Ceramics, Chinese Academy of Sciences***
10:50-11:10	**Coffee Break**
11:10-12:50	**Session 5** **Nanomaterials for Photocatalytic Transformation of Pollutants** ***(Chair: Prof. Po Keung Wong, Chinese University of Hong Kong)***
11:10-11:30	Photocatalytic Technology – From Lab to Market ***– Prof. Jimmy C. Yu, Chinese University of Hong Kong***
11:30-11:50	Enhanced photocatalytic inactivation of Escherichia coli by a novel Z-scheme g-C_3N_4/m-Bi_2O_4 hybrid photocatalyst under visible light: the role of reactive oxygen species ***– Prof. Dehua Xia, Guangdong University of Technology***
11:50-12:10	Photocatalytic Mineralization and Detoxification of Pentachlorophenol ***– Prof. Po Keung Wong, Chinese University of Hong Kong***
12:10-12:30	Constructions of Hierarchical Nanostructures of TiO_2 NTAs for Efficient Degradation of Organic Pollutants in Wastewater ***– Prof. Changjian Lin, Xiamen University***
12:30-12:50	Enhanced Photocatalytic Degradation of Ibuprofen under Visible Light using Magnetically Recoverable Bi_2O_4/Fe_3O_4 Nanocomposite ***– Prof. Irene M.C. Lo, Hong Kong University of Science and Technology***
12:50-14:30	**Lunch + Poster Session**

Applied Environmental Nanotechnology Workshop

Program Schedule

June 2, 2017

Time	Program
14:30-15:30	**Session 6** **Design, Synthesis, Characterization, and Environmental Behaviours of Nanomaterials (ii)** ***(Chair: Prof. Young-Shin Jun, Washington University in St. Louis)***
14:30-14:50	Development of Millimeter-sized Nanocomposites for Full-Scale Advanced Water Treatment ***– Prof. Bingcai Pan, Nanjing University***
14:50-15:10	Electro-active Filter Technology for Environmental Applications ***– Prof. Yanbiao Liu, National University of Singapore***
15:10-15:30	The Fate and Behaviour of Engineered Nanomaterials in Landfills ***– Prof. Burak Demirel, Boğaziçi University***
15:30-15:50	**Coffee Break**
15:50-17:20	**Workshop Activities II – How to Promote Future Research Collaboration?** **Panel members:** ***– Prof. Irene M.C. Lo, Hong Kong University of Science and Technology*** ***– Prof. King Lun Yeung, Hong Kong University of Science and Technology*** ***– Prof. Daniel E. Giammar, Washington University in St. Louis*** ***– Prof. John D. Fortner, Washington University in St. Louis***
15:50-16:50	Group Discussion
16:50-17:20	Workshop Outcome Summary
17:20-17:30	**Closing Remarks** ***– Prof. Irene M.C. Lo, Hong Kong University of Science and Technology***

Day 1 June 1, 2017

Time	Program
08:30-09:20	On-site Registration
09:20-09:40	**Welcome and Opening Session** ***(Chair: Prof. Irene M.C. Lo, Hong Kong University of Science and Technology)***
09:20-09:30	Welcome Remarks (TBD)
09:30-09:40	Opening Remarks ***– Prof. Irene M.C. Lo, Hong Kong University of Science and Technology*** ***– Prof. Daniel E. Giammar / Prof. John D. Fortner, Washington University in St. Louis***
09:40-10:30	**Highlighted Plenary Lecture I** **Nanoparticle Aerosol Science and Technology Enabling Environmental Engineering Applications – *Prof. Pratim Biswas, Washington University in St. Louis***
10:30-11:00	**Photo-taking and Coffee Break**

Applied Environmental Nanotechnology Workshop

Highlighted Plenary Lecture I June 1, 2017

Nanoparticle Aerosol Science and Technology Enabling Environmental Engineering Applications

Pratim Biswas

Aerosol and Air Quality Research Laboratory, Center for Aerosol Science and Engineering (CASE)
Department of Energy, Environmental and Chemical Engineering, Washington University in St. Louis, MO
Tel: +13149355548 E-mail: pbiswas@wustl.edu

The ability to synthesize nanomaterials with tightly controlled characteristics enables advancement of both fundamental science and applications in the field of nanotechnology. The first part of the talk will describe several aerosol reactors ranging from furnace, flame and electrospray systems for synthesis of nanoparticles with controlled size, morphology and composition. Systems to deposit these nanoparticles to create thin film devices and membranes will be discussed. The use of real time instrumentation to monitor size and composition during synthesis will be discussed. The second part of the talk will describe the relationship of functional property to nanoparticle characteristics that will be aided by the ability to produce such particles with tightly controlled characteristics. The ability to tune aerosol reactors for producing functional materials for specific environmental applications will be discussed. The final part of the talk will describe a few of the latest innovative applications in the environmental sector. Nanocomposites of graphene oxide-catalyst for water purification will be discussed. The use of novel pristine and doped semiconductors for light harvesting and water and air cleaning will be described. Nanomaterials to promote carbon dioxide capture and conversion to useful chemicals will be discussed. Targeted foliar delivery of plant nutrients for precision and smart agriculture to minimize fertilizer use and promote water conservation will be presented.

Prof. Pratim Biswas is the Lucy and Stanley Lopata Professor & Chair of the Department of Energy, Environmental and Chemical Engineering at Washington University in St. Louis. He is also the Asst. Vice Chancellor for International Programs at the University; and Director of the McDonnell Academy Global Energy and Environmental Partnership (MAGEEP) a network of 32 leading Universities across the globe. He obtained his B.Tech degree from IIT Bombay, M.S. from the University of California, Los Angeles, and his PhD from the California Institute of Technology. His work has received recognition and he has won the Whitby and Sinclair Awards (AAAR), Cecil Award (AIChE) and White Award (ISEP) to name a few. He is a Fellow of the AAAR and the International Aerosol Research Assembly. He has more than 325 refereed journal publications with his 50 or so doctoral students. His research and educational interests are in aerosol science and technology, air and water quality, energy and environmental nanotechnology.

Day 1 June 1, 2017

Time	Program
11:00-12:20	**Session 1** **Use of Nanomaterials as Sorbents for Pollutant Removal and Resource Recovery** ***(Chair: Prof. Daniel E. Giammar, Washington University in St. Louis)***
11:00-11:20	Magnetic Nanoparticles for Removal and Recovery of Metal Anions from Wastewater ***– Prof. Irene M.C. Lo, Hong Kong University of Science and Technology***
11:20-11:40	Observation and Modeling of U(VI) Adsorption to Engineered Iron Oxide Nanoparticles ***– Prof. Daniel E. Giammar, Washington University in St. Louis***
11:40-12:00	Preparation of Regenerable Granular Carbon Nanotubes by a Simple Heating-filtration Method for Efficient Removal of Typical Pharmaceuticals ***– Prof. Shubo Deng, Tsinghua University***
12:00-12:20	Selective Nanosorbents for Removal of Heavy Metals from Seawater ***– Prof. King Lun Yeung, Hong Kong University of Science and Technology***
12:20-14:00	**Lunch + Poster Session**

Session 1 June 1, 2017

Magnetic Nanoparticles for Removal and Recovery of Metal Anions from Wastewater

Irene M.C. Lo[1,*], Jing Hu[2], Samuel C.N. Tang[2]

[1] Department of Civil and Environmental Engineering, The Hong Kong University of Science and Technology, Hong Kong, China

[2] Former PhD students, Department of Civil and Environmental Engineering, The Hong Kong University of Science and Technology, Hong Kong, China

* Presenting author. Tel: +852 23587157, Fax: +852 23581534, E-mail: cemclo@ust.hk

Nanomaterials have gained enormous interests in wastewater treatment due to their high surface area and large number of reactive sites. However, daunting recovery and poor regeneration of nanomaterials hinder their applications. Our studies to tackle these two issues by developing magnetic nanoparticles (MNPs) for metal anions removal from wastewater will be presented. Various iron-based MNPs, including Fe_3O_4, γ-Fe_2O_3, and γ-Fe_2O_3 based hydrogel, have been synthesized. The MNPs are characterized using transmission electron microscopy (TEM) for size and morphology investigation, X-ray diffractometer (XRD) for crystal identification, Brunauer-Emmett-Teller (BET) analyzer for surface area measurement, and vibrating sample magnetometer (VSM) for magnetic property analysis. The removal and recovery of metal anions from wastewater using MNPs will be presented. The removal mechanisms will be discussed based on the findings from XRD, Raman spectroscopy, Fourier transform infrared spectroscopy (FTIR) and X-ray photoelectron spectroscopy (XPS). A wastewater treatment prototype is further developed featuring a magnetic separation unit for recovering MNPs. The efficacy of this prototype in removing and recovering chromate from electroplating wastewater will be shown. In summary, MNPs is promising and cost-effective for wastewater treatment because of their short adsorption time, large adsorption capacity, high MNP recovery, and high regeneration of spent MNPs.

Prof. Irene M. C. Lo is currently a full professor in the Department of Civil and Environmental Engineering at The Hong Kong University of Science and Technology (HKUST) and has been joining HKUST since 1992. She received her Master and PhD degrees in Civil (Environmental) Engineering from the University of Texas at Austin. Prof. Lo is an elected Academician of the European Academy of Sciences and Arts (EASA). She is the first Hong Kong scholar inducted into the EASA. She is a Fellow of the Hong Kong Institution of Engineers (FHKIE), and the American Society of Civil Engineers (FASCE). She has been acknowledged through the recognition of very prestigious international honors and awards, including ASCE James Cores Medal, ASCE Samuel Arnold Greeley Award, ASCE Wesley Horner Award, ASCE EWRI Best Practice-Oriented Paper Award twice, among others. Prof. Lo has held 2 patents, edited 9 technical books, and published over 270 SCI journal articles and conference papers. Her research areas include magnetic nanomaterial-based technology for water and wastewater treatment; soil/sediment/groundwater remediation; and fate and transport of nanoparticles.

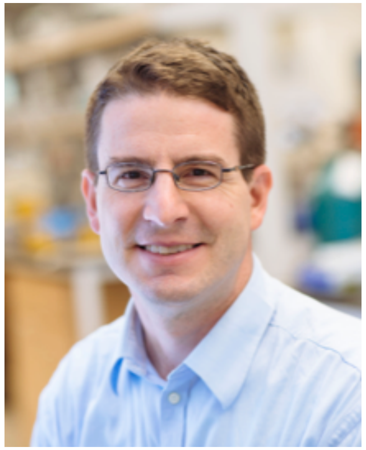
Session 1 June 1, 2017

Observation and Modeling of U(VI) Adsorption to Engineered Iron Oxide Nanoparticles

Zezhen Pan[1], Wenlu Li[1], John D. Fortner[1], Daniel E. Giammar[1,*]

[1]Department of Energy, Environmental & Chemical Engineering, Washington University in St. Louis, MO, USA.
* Presenting author. Tel: +1 314-935-6849, Fax: +1 314-935-7211, E-mail: giammar@wustl.edu

Surface functionalized magnetite nanoparticles (Fe_3O_4-nano) have high capacity for U(VI) adsorption and can be easily separated from the aqueous phase by applying magnetic field. Surface bilayer structure enables the stabilization of nanoparticles in aqueous suspension. Functional groups of organic coatings with stearic acid, oleic acid and octadecylphosphonic acid led to different adsorption extents under the same condition (pH 4.5 to 10, 1×10^{-5} M of initial U(VI)). U(VI) adsorption by OA-coated nanoparticles was studied to examine the impact of initial U(VI) loadings (~5×10^{-6} to 1.5×10^{-5} M), pH (4.5 to 10), and the presence/absence of carbonate. Surface complexation modeling for metal adsorption in various conditions can benefit the prediction of U(VI) removal in water treatment process. The double layer model with adsorption of uranyl hydroxide and uranyl carbonate complexes to surface sites could successfully simulate the entire adsorption dataset over all uranium loadings, pH values, and presence/absence of carbonate. The model could also predict the acid-base behavior of the nanoparticle suspension and determine pH-dependent surface potential values that were consistent with measured zeta potentials. The results show that the adsorption was related to U(VI) species and properties of surface coatings on Fe_3O_4-nano.



Prof. Daniel E. Giammar is the Walter E. Browne Professor of Environmental Engineering in the Department of Energy, Environmental and Chemical Engineering at Washington University in St. Louis. Professor Giammar's research focuses on chemical reactions that affect the fate and transport of heavy metals, radionuclides, and other inorganic constituents in natural and engineered aquatic systems. His recent work investigated the removal of arsenic and chromium from drinking water, control of the corrosion of lead pipes, geologic carbon sequestration, and biogeochemical processes for remediation of uranium-contaminated sites. Professor Giammar is currently an Associate Editor of Environmental Science & Technology. He completed his B.S. at Carnegie Mellon University, M.S. and Ph.D. at Caltech, and postdoctoral training at Princeton University before joining Washington University in St. Louis in 2002. Professor Giammar is the McDonnell International Scholars Academy Ambassador to the Hong Kong University of Science and Technology.

Session 1 June 1, 2017

Preparation of Regenerable Granular Carbon Nanotubes by a Simple Heating-filtration Method for Efficient Removal of Typical Pharmaceuticals

Shubo Deng[1,*], Danna Shan[1], Mark R. Wiesner[2]

[1] School of Environment, Beijing Key Laboratory for Emerging Organic Contaminants Control, State Key Joint Laboratory of Environment Simulation and Pollution Control (SKLESPC), Tsinghua University, Beijing, China
[2] Department of Civil and Environmental Engineering, Duke University, P.O. Box 90287, Durham, NC, USA
* Presenting author. Tel: +861062792165, Fax: +861062794006, E-mail: dengshubo@tsinghua.edu.cn

A simple and convenient method is used to prepare novel granular carbon nanotubes (CNTs) for enhanced adsorption of pharmaceuticals. By heating CNTs powder at 450°C in air, followed by filtration, the obtained granular adsorbent exhibits high surface area and pore volume since the heating process produces some oxygen-containing functional groups on CNT surface, making CNTs more dispersible in the formation of granular cake. The porous granular CNTs not only have more available surfaces for adsorption but also are more easily separated from solution than pristine CNTs powder. This adsorbent exhibits relatively fast adsorption for carbamazepine (CBZ), tetracycline (TC) and diclofenac sodium (DS), and the maximum adsorption capacity is 369.5 μmol/g for CBZ, 284.2 μmol/g for TC and 203.1μmol/g for DS, increasing by 42.4%, 37.8% and 38.0% in comparison with the pristine CNTs. Moreover, the spent granular CNTs are successfully regenerated at 400°C in air without decreasing the adsorption capacity in five regeneration cycles. The adsorbed CBZ and DS are completely degraded, while the adsorbed TC is partially oxidized and the residual is favourable for subsequent adsorption. This research develops an easy method to prepare and regenerate granular CNT adsorbent for the enhanced removal of organic pollutants from water or wastewater.

Prof. Shubo Deng is currently a full professor in the School of Environment at Tsinghua University and has been joining Tsinghua since 2005. He has nearly 20 years of experience in environmental research. Prior to this he worked as a postdoctoral fellow at Tsinghua University during 1999-2001. Subsequently, he completed the postdoctoral and research fellowship at National University of Singapore till 2005. Prof. Deng received Bachelor and PhD degree from Northeastern University, China. He published more than 150 SCI journal articles and held over 20 patents. He ever served as the Management Member in Adsorption Groups in International Water Association. Currently, he is the editor of Frontier of Environmental Science and Engineering, Editorial Board of Current Environmental Engineering, International Scholarly Research Notices, and The Scientific World Journal. Prof. Deng mainly focuses on novel adsorbent preparation for pollutant removal from water or wastewater, emerging contaminants control technology, and CO_2 adsorption.

Session 1 June 1, 2017

Selective Nanosorbents for Removal of Heavy Metals from Seawater

King Lun Yeung[1,*], Xinqing Chen[1]

[1] Department of Chemical and Biomolecular Engineering, The Hong Kong University of Science and Technology, Hong Kong, China

* Presenting author. Tel: +852 23587123, Fax: +852 23580054, E-mail: kekyeung@ust.hk

The global distribution and impact of heavy metals on marine organisms and human health are of great concern due to their persistent, non-biodegradable and toxic nature. Many of the heavy metals found in coastal water and harbours near populated urban areas are strongly associated with anthropogenic activities. Their ecological impacts on marine environment are well documented and their tendency to bio-accumulate in the food chain poses a real health threat to the population. Long-term consumption of heavy metal tainted foods is known to cause neurological disorder, organ damages and even increased cancer risk. Effective removal and treatment of heavy metal pollutions in seawater through adsorption by salt-tolerant, fouling-resistant adsorbents that are designed to selectively remove a target pollutant or class of pollutants from contaminated seawater. Copper and chromium are two target metals commonly used in heat exchangers found in district cooling installation. In the study, two nanosorbents were designed and made that can remove 99 % copper with Kd of 106 from seawater containing other competing metal ions. Similarly chromium can be removed from seawater with removal percentage better than 99 % and Kd of 106.

Prof. King Lun Yeung is currently a full professor in the Department of Chemical and Biomolecular Environment with joint appointment in the Division of Environment at The Hong Kong University of Science and Technology (HKUST) and has been joining HKUST since 1996. He received her Master and PhD degrees in Chemical Engineering from the University of Notre Dame. Prof. Yeung is Editor of Chemical Engineering Journal and Member of Editorial Board of Catalysis Today. He has held more than 15 Invention (30 patents) and published more than 300 SCI Journal articles and conference papers. His research is in the area of nanostructured and nanoporous materials for environmental applications of treating air and water pollutions.

Day 1 June 1, 2017

Time	Program
14:00-15:20	**Session 2** **Nanomaterials for Advanced Membrane Treatment Processes** ***(Chair: Prof. King Lun Yeung, Hong Kong University of Science and Technology)***
14:00-14:20	Engineered Crumpled Graphene Oxide Nanocomposite Membrane Assemblies for Advanced Water Treatment Processes ***– Prof. John D. Fortner, Washington University in St. Louis***
14:20-14:40	Electronanofiltration (ENF)-Novel Membrane Processes for Treating Metal Ions Contained Wastes ***– Prof. Tongwen Xu, University of Science and Technology of China***
14:40-15:00	Engineering Inorganic Nanomaterials and Their Composites for Environmental Applications ***– Prof. Jianping Xie, National University of Singapore***
15:00-15:20	Sunlight Enables Reduced Graphene Oxide/Bacterial Nanocellulose Ultrafiltration Membranes to Resist Biofouling ***– Prof. Young-Shin Jun, Washington University in St. Louis***
15:20-15:40	**Coffee Break**

Session 2 June 1, 2017

Engineered Crumpled Graphene Oxide Nanocomposite Membrane Assemblies for Advanced Water Treatment Processes

Yi Jiang[1], Pratim Biswas[1], John D. Fortner[1,*]

[1] Department of Energy, Environmental & Chemical Engineering, Washington University in St. Louis, MO, USA.
* Presenting author. Tel: +1 314-935-9293; E-mail: jfortner@wustl.edu

In this work, I will describe multifunctional, crumpled graphene oxide (CGO) porous nanocomposites that are assembled as advanced, reactive water treatment membranes. Crumpled 3D graphene oxide based materials fundamentally differ from 2D flat graphene oxide analogues in that they are highly water stable (i.e. π - π stacking resistant) and allow for the incorporation (wrapping) of other, multifunctional particles inside the 3D, composite structure. Here, assemblies of nanoscale, monomeric CGO with encapsulated (as a quasi core-shell structure) TiO_2 (GOTI) and Ag (GOAg) nanoparticles, not only allow high water flux via vertically tortuous nanochannels, but also demonstrate excellent separation efficiencies for model organic and biological foulants. Further, multifunctionality is demonstrated through the in situ photocatalytic degradation of methyl orange (MO), as a model organic, under fast flow conditions (t_{res} < 0.1 s); while superior antimicrobial properties, evaluated with GOAg, were observed for both biofilm (contact) and suspended growth scenarios (> 3 log effective removal, *Escherichia coli*). Lastly, we go on to demonstrate the regeneration of (enhanced) antimicrobial properties through in situ (re)forming Ag NPs via photoreduction of Ag+ at the membrane surface under UV irradiation. This is the first demonstration of 3D, crumpled graphene oxide based nanocomposite structures applied specifically as (re)active membrane assemblies and highlights the material's platform potential for a truly tailored approach for next generation water treatment and separation technologies.

Prof. John D. Fortner is the Professor of Environmental Engineering in the Department of Energy, Environmental and Chemical Engineering at Washington University in St. Louis. He completed his B.S. at Texas A&M University and Ph.D. at Rice University. In 2010, Professor Fortner joined the faculty at Washington University in St. Louis. Prior to WashU, he was a Postdoctoral Research Fellow at Rice University, Georgia Tech, and ETH-Zurich. In 2015, he was awarded the Sustainable Nanotechnology Organization (SNO) Emerging Investigator Award for his excellence in research in sustainable nanotechnology and his commitment to mentoring students at all levels.

Applied Environmental Nanotechnology Workshop

Session 2 June 1, 2017

Electronanofiltration (ENF)-Novel Membrane Processes for Treating Metal Ions Contained Wastes

Liang Ge, Tongwen Xu*

CAS Key Laboratory of Soft Matter Chemistry, Collaborative Innovation Center of Chemistry for Energy Materials, School of Chemistry and Material Science, University of Science and Technology of China, Hefei 230026, P.R. China
* Presenting author. Tel: +86-551-63601587, Fax: +86-551-63602171, E-mail: twxu@ustc.edu.cn

The hurried expansion and growth of so many industrial production houses like metal finishing, electroplating, mining and steel processing industries produced an excessive amount of metal ions contained wastewaters, which is regarded as the major trepidation from the environmental stance. Worldwide most nations, by now established a huge number of waste water industries plus processing plants to get rid of this concern. The available well-known methods to treat such wastes include crystallization, neutralization, extraction or membrane technologies such as electrodialysis, nanofiltration and diffusional dialysis, etc. Generally, membrane-base technologies show advantages over traditional ones due to the convenient operation and less energy cost and widely accepted by the industries. However, they also show some disadvantages. For example, elctrodialysis was limited by the lack of monovalent-selective ion exchange membrane, nanofiltration is limited by the concentration polarization and treating ability for diffusional dialysis is very low. The objective of this presentaion is to develop an new membrane process-electronanofiltration or electrodialysis with nanofiltration like membrane for treating metal ions contained wastes. Both the membrane formation and the process detail will be investigated.

Prof. Tongwen Xu is currently a full professor in the School of Chemistry and Material Science at the University of Science and Technology of China (USTC) and has been joining USTC since 1997. He received his Master in Hefei University of Technology and PhD degrees in Tianjin University. Prof. Xu has been a short-term visiting scientist of University of Tokyo and Tokyo Institute of Technology in 2000, 2001 respectively. He received a Brain Pool Program from Korea (2006) and worked one year in Gwangju Institute of Science and Technology. Prof. Xu was awarded Outstanding Youth Foundation of China in 2010, selected as FRSC in 2013 and as Changjiang Scholars Program Chair Professor in 2014. He is serving as execution/guest editors and editorial boards of 11 international journals. He has held 52 patents, edited 5 technical books, and published over 350 SCI journal articles with H-index 47. His research interests cover membranes and the related processes.

Session 2 June 1, 2017

Engineering Inorganic Nanomaterials and Their Composites for Environmental Applications

Jianping Xie[1,*]

[1] Department of Chemical and Biomolecular Engineering, National University of Singapore, Singapore
* Presenting author. Tel: +65 65161067, Fax: +65 67791936, E-mail: chexiej@nus.edu.sg

Recent advances in inorganic nanomaterials provide promising technological solutions to some challenging environmental issues. For example, rationally integrating functional inorganic nanomaterials into polymeric membranes might enhance the performance of polymeric membranes in water treatment. In this talk, I will discuss our recent studies in the development of thin-film composite (TFC) membranes, highlighting the unique contributions of inorganic nanomaterials to the performance of TFC membranes for wastewater treatment. In particular, I will discuss some examples to use inorganic nanomaterials (e.g., noble metals, oxides and carbon) to address challenging issues in TFC membranes, including internal concentration polarization (ICP), membrane fouling, and poor organic molecule rejection.

Prof. Jianping Xie is currently an Associate Professor at the Department of Chemical & Biomolecular Engineering at National University of Singapore (NUS). He received his B.S. and M.S. in Chemical Engineering from Tsinghua University, China, and his Ph.D. from the Singapore-MIT Alliance (SMA) program. Prof. Xie joined NUS in 2010 and established the BioNanoMetals research group. His group is known for the work on engineering subnanometer-sized metal nanoclusters for biomedical and environmental applications. Prof. Xie has 120+ publications, 7600+ citations, an H-index of 45, an average field-weighted citing impact (FWCI) of 5.6 (2013-2016, SciVal), and 28 highly cited papers (ISI). His research interests include noble metal nanoclusters, nanomedicine, and applied environmental nanotechnology.

Applied Environmental Nanotechnology Workshop

Session 2 June 1, 2017

Sunlight Enables Reduced Graphene Oxide/Bacterial Nanocellulose Ultrafiltration Membranes to Resist Biofouling

Young-Shin Jun[1,*] Qisheng Jiang[2], Deoukchen Ghim[1], Sirimuvva Tadepalli[2], Hyuna Kwon[1], Keng-ku Liu[2], Yujia Min[1], Jingyi Luan[2], Srikanth Singamaneni[2]

[1]Department of Energy, Environmental & Chemical Engineering, Washington University in St. Louis, MO, USA.
[2]Department of Mechanical Engineering and Materials Science, Washington University in St. Louis, MO, USA.
* Presenting author. Tel: +1-314-935-4539, Email: ysjun@wustl.edu

Potable water scarcity is becoming a critical global issue, and various membrane technologies are being actively investigated for water purification and reclamation. However, membrane fouling remains a vexing problem for most of these membrane processes. Here, we present a novel and facile approach for the fabrication of an anti-biofouling ultrafiltration membrane, involving in situ incorporation of graphene oxide (GO) flakes into bacterial nanocellulose (BNC) during its growth. The anti-biofouling activity of these membranes is powered by the most abundant renewable energy source, sunlight: The localized photothermal effect of the embedded reduced GO (rGO) hinders microbial growth and biofilm formation on membranes. The RGO/BNC membrane also was highly stable under vigorous mechanical agitation and harsh chemical conditions, and it showed good water flux. Importantly, the membrane exhibited high bactericidal capability under solar illumination, obviating the need for any treatment of the feed water or for external energy. This novel design and method represent an important step towards a highly efficient and environmental-friendly membrane system for water purification.

Prof. Young-Shin Jun is the Harold D. Jolley Career Development Associate Professor of Energy, Environmental & Chemical Engineering (EECE) and the EECE Director of Graduate Studies at Washington University in St. Louis, where she leads the Environmental NanoChemistry Laboratory. Prof. Jun received a 2011 U.S. National Science Foundation CAREER award. She serves on the Advisory Board of Environmental Science: Processes & Impacts and the Editorial Board of Geochemical Transactions. She now serves as the American Chemical Society's Committee on Science and was the 2016 Division Chair of the American Chemical Society's Geochemistry Division. Prof. Jun has been named a 2015 Kavli Fellow by the U.S. National Academy of Sciences and a 2016 Frontier of Engineering Fellow by the U.S. National Academy of Engineering. She received her Master and PhD degrees in Environmental Chemistry from Harvard University, and conducted her postdoctoral research at the University of California-Berkeley/ Lawrence Berkeley National Laboratory.

Day 1 June 1, 2017

Time	Program
15:40-17:00	**Session 3** **Design, Synthesis, Characterization, and Environmental Behaviours of Nanomaterials (i)** ***(Chair: Prof. Wey Yang Teoh, City University of Hong Kong)***
15:40-16:00	BiOCl Nanosheets Oxygen Vacancy Associated Surface Fenton Chemistry ***– Prof. Lizhi Zhang, Central China Normal University***
16:00-16:20	Modelling the Transport of Engineered Nanomaterials in Simulated Landfills ***– Prof. Orhan Yenigün, Boğaziçi University***
16:20-16:40	Photonic Nanostructures for Environmental Pollution Prevention ***– Prof. Liwu Zhang, Fudan University***
16:40-17:00	Modeling the Transport of Engineered Nanoparticles in Saturated Sand ***– Prof. Nadim K. Copty, Boğaziçi University***
17:00-18:30	**Workshop Activities I – Future Perspective of Nanotechnology for Environmental Application *(Chair: Prof. John D. Fortner, Washington University in St. Louis)***
17:00-18:00	Group Discussion
18:00-18:30	Workshop Outcome Summary
19:00-21:30	**Gala Dinner (by invitation only)**

Applied Environmental Nanotechnology Workshop

Session 3 June 1, 2017

BiOCl Nanosheets Oxygen Vacancy Associated Surface Fenton Chemistry

Lizhi Zhang[1,*], Hao Li[1]

[1] Central China Normal University, Wuhan, China
* Presenting author. Tel: +86 27 67867535, Fax: +86 27 67867535, E-mail: zhanglz@mail.ccnu.edu.cn

Understanding the chemistry of hydrogen peroxide (H_2O_2) decomposition and hydroxyl radicals (•OH) transformation on the surface molecular level is a great challenge for the application of heterogeneous Fenton system in the fields of chemistry, environmental and life science. We report in this study a conceptual oxygen vacancy associated surface Fenton system without any metal ions leaching, exhibiting unprecedented surface chemistry based on the oxygen vacancy of electron-donor nature for heterolytic H_2O_2 dissociation. By controlling the delicate surface structure of catalyst, this novel Fenton system allows the facile tuning of •OH existing form for targeted catalytic reactions with controlled reactivity and selectivity. On the model catalyst of BiOCl nanosheets, the generated •OH tend to diffuse away from the (001) surface for the selective oxidation of dissolved pollutants in solution, but prefer to stay on the (010) surface, reacting with strongly-adsorbed pollutants with high priority. These findings will extend the scope of Fenton catalysts via surface engineering and consolidate the fundamental theories of Fenton reactions for wide environmental applications.

Prof. Lizhi Zhang received his Ph.D. degree in environmental science from Chinese University of Hong Kong, China in 2003. After his postdoctoral research in department of Chemistry, Chinese University of Hong Kong, he joined in college of chemistry, Central China Normal University located at Wuhan and became a full professor of chemistry since 2005. He worked at Max-Planck Institute of Colloid and Interface as an Alexander von Humboldt Scholar from 2006 to 2007. His current research mainly aims to develop green environmental pollution control methods based on photocatalysis, Fenton reaction, and molecular oxygen activation induced by low valent iron species. He has published more than 200 peer-reviewed articles with more than 14000 citations and a h-index of 65. In 2014, he won National Natural Science Funds for Distinguished Young Scholars of China. In 2015, he was selected as a Changjiang Scholar Distinguished Professor of the Ministry of Education of China.

Session 3 June 1, 2017

Modelling the Transport of Engineered Nanomaterials in Simulated Landfills

Orhan Yenigün[1,*], Nadim K. Copty[1], Burak Demirel[1], Turgut T. Onay[1]

[1] Institute of Environmental Sciences, Boğaziçi University, Istanbul, 34342, Turkey
* Presenting author: Tel: +90 212 3597040, Fax: +90 212 2575033, :E-mail: yeniguno@boun.edu.tr

The number of commercial products containing engineered nanomaterials (ENM) has increased significantly in recent years. Large fractions of these products are expected to end up in landfills. Despite the interest in the fate of ENMs in the environment, few studies focusing on the mathematical modelling of the fate and transport of ENMs in municipal solid waste (MSW) can be found in the literature. This paper describes the main processes influencing the fate and transport of ENMs in the presence of a solid matrix. A numerical model used to simulate the fate and transport of ENMs in simulated landfills is then presented. The Derjaguin-Landau-Verwey-Overbeek (DLVO) theory was used for quantifying the ENMs in MSW since MSW can be treated as a partially water-saturated porous medium. The constructed model was used to evaluate the leaching behavior of nano-TiO_2 and nano-ZnO in MSW under various experimental conditions. Results of the model show that ENM detachment rates are low, indicating that the ENMs will be mostly retained with the solid waste matrix.

Prof. Orhan Yenigün was born in Istanbul in 1954. A graduate of Robert College in 1972, he received B.S. in Chemical Engineering from Middle East Technical University in Ankara; M.S. and Ph.D. in Chemical Engineering from Swansea University in the U.K. He started working in Bogazici University, Institute of Environmental Sciences in 1984 as an assistant professor, where he became a full professor in 1995. He is presently the Director of the Institute of Environmental Sciences and a member of the University Senate. He is a board member and national representative of the International Water Association (IWA); executive board member of the Turkish National Committee for Water Pollution Control and an elected member of the Science Academy of Turkey. His main areas of scientific research are water and wastewater treatment, renewable energies, environmental biotechnology and air pollution. He has supervised 12 PhD dissertations and 57 MS theses. He has published two books, 57 research articles in journals covered by Science Citation Index and 158 conference papers.

Session 3 June 1, 2017

Photonic Nanostructures for Environmental Pollution Prevention

Liwu Zhang[1,*]

[1] Department of Environmental Science and Engineering, Fudan University, Shanghai, China
* Presenting author. Tel: +86 21 65642981, E-mail: zhanglw@fudan.edu.cn

Photonic nanostructures, manipulating and confining light on the nanometer scale, provide new opportunities to environmental pollution prevention. Plasmonic metal nanostructures with surface plasmon resonances can act as antennas to localize optical energy and control the location of charge carrier generation. Photonic crystals can enhance the interaction of light with a semiconductor. Integrated photonic crystals and plasmonic effects of micro-structural materials may have the superposition effect in light controlling. Some applications and practical examples about improving the efficiency of pollutant treatment with photonic nanostructures have been studied, demonstrating how such structures can enhance the light absorption and improve the generation and separation of photoexcited charge carriers in photoelectrochemical pollutant degradation, NO_x, SO_2 removal and CO_2 photoreduction. Photonic nanostructures also allow for highly sensitive structural detection of low concentration analytes through the amplification of electromagnetic fields generated by the excitation of localized surface plasmons. Enhanced Raman Spectroscopy has progressed from studies of model systems on roughened electrodes to highly sophisticated photonic nanostructures, such as single molecule spectroscopy. Due to advantageous features such as sensitivity, specificity, ease of operation and rapidity, enhanced Raman Spectroscopy for environmental analysis especially atmospheric aerosol detection is further studied.

Prof. Liwu Zhang joined the Department of Environmental Science and Engineering at Fudan University in November 2014. Prior to his faculty appointment, he did his postdoctoral work under the supervision of Prof. Jeremy J. Baumberg (FRS) at the Nanophotonics Centre in Cavendish Laboratory and collaborated with Dr. Erwin Reisner from the Department of Chemistry at University of Cambridge. Before that he was an Alexander von Humboldt Research Fellow under the supervision of Prof. Detlef Bahnemann in the Hannover University in Germany. He received a PhD in Chemistry from Tsinghua University under the supervision of Prof. Yongfa Zhu. He is a recipient of the Marie Curie Intra-European Research Fellow award. He has over a decade of experience in nanophotonics, nanomaterials and a strong background in photocatalysis and has published more than 30 highly cited papers in this field. His work have been cited for >2700 times, and he has an h-index of 23.

Session 3 June 1, 2017

Modeling the Transport of Engineered Nanoparticles in Saturated Sand

Nadim K. Copty[1,*]

[1] Institute of Environmental Sciences, Boğaziçi University, Istanbul, 34342, Turkey
* Presenting author.Tel: +90-212-359-6695, Fax: +90-212-257-5033, E-mail: ncopty@boun.edu.tr

In recent years engineered nanoparticles have been proposed for numerous applications including in-situ groundwater remediation. A critical step for the development of such a technology is the effective deliverability of the nanoparticles suspension to the zone of contamination. This paper examines the effect of nanoparticle concentration on nanoparticle mobility. The nanoparticle considered in this study is poly(acrylic acid) (PAA) supported magnetite (Fe_2O_3). The transport experiments were conducted in a water-saturated sand-packed column. Particle size analysis of the synthesized nanoparticle solutions showed that PAA provides good size stability. Time-moment analysis of the engineered nanoparticle breakthrough curves, on the other hand, revealed that nanoparticles mass recovery from the column decreased consistently with dilution, with greater attenuation, sharper fronts and longer tails compared to that of the tracer. To further interpret the experimental results, a transport model that accounts for deposition/detachment kinetics was developed. The best agreement between the observed breakthrough curves and model simulations was obtained using a kinetic time-dependent deposition term with finite deposition capacity and a kinetic detachment term. The model results suggest that the decrease in mass recovery with decrease in input particle concentration may be due to time-dependent blocking that hinders further deposition. The implications of these results on the use of engineered nanoparticles for groundwater remediation applications are discussed.

Prof. Nadim Copty is currently a professor at the Institute of Environmental Sciences at Bogazici University, Istanbul, Turkey. Prof. Copty has more than 25 years of experience working on environmental pollution related problems. He received his doctoral degree in 1995 from the Department of Civil and Environmental Engineering at the University of California, Berkeley. Subsequently, he worked for 5 years as a senior hydrogeologist at Bechtel Corporation in San Francisco, USA. In 2000 he joined the Institute of Environmental Sciences at Bogazici University. His research interests focus on environmental remediation with emphasis on the modelling of groundwater flow and contaminant transport, characterization of heterogeneous subsurface formations, and groundwater remediation. He is the co-author of more than 60 refereed international journal articles and conference proceedings.

Day 2 June 2, 2017

Time	Program
09:00-09:50	**Highlighted Plenary Lecture II** ***(Chair: Prof. Irene M.C. Lo, Hong Kong University of Science and Technology)*** **Semiconductor Electrochemical Wastewater Treatment: From a Design Concept to Full-scale Manufacturing in 5 Years** ***– Prof. Michael Hoffmann, California Institute of Technology***
09:50-10:50	**Session 4** **Use of Nanomaterials for Energy Production** ***(Chair: Prof. Jimmy C. Yu, Chinese University of Hong Kong)***
09:50-10:10	Harnessing Solar Electricity from Wastewater through Photocatalytic Fuel ***– Prof. Wey Yang Teoh, City University of Hong Kong***
10:10-10:30	Photocatalytic Methane Conversion using Morphology-Controlled Semiconductor Microcrystals ***– Prof. Bryce Sadtler, Washington University in St. Louis***
10:30-10:50	Photocatalytic N_2 Fixation: a New Route to Solar Fuel ***– Prof. Wenzhong Wang, Shanghai Institute of Ceramics, Chinese Academy of Sciences***
10:50-11:10	**Coffee Break**

Highlighted Plenary Lecture II June 2, 2017

Semiconductor Electrochemical Wastewater Treatment: From a Design Concept to Full-scale Manufacturing in 5 Years

Michael R. Hoffmann

California Institute of Technology, Engineering & Applied Science, Linde-Robinson Labs, Pasadena, California

We have developed, tested, and implemented transportable reactor systems that have been designed for the onsite treatment of domestic wastewater. After pre-treatment with a sequential anaerobic/aerobic baffled bioreactor, the effluent is processed sequentially through semiconductor electrochemical arrays where the COD and microbial loads are reduced to below US EPA reuse standards. Special mini-reactors are used to convert the treated wastewater to handwashing and drinking water standards. The treated black water is recycled into a flush water reservoirs without discharge to the surrounding environment. Human wastewater can be clarified with the elimination of suspended particles along with >95% reduction in chemical oxygen demand (COD), and a total elimination of fecal coliforms, *E. coli*, viruses, and total coliforms. Enteric organism disinfection is achieved for bacteria and viruses via anodic reactive chlorine generation from in situ chloride coupled with cathodic reduction of water to form hydrogen. Improvement of the performance and durability of the core semiconductor anodes along with materials modifications to lower their production costs ongoing. Second-and third-generation prototypes are undergoing field-testing in locations that lack conventional urban infrastructure for wastewater discharge and treatment; the packaged treatment systems can operate without an external source of electricity or fresh water. Manufacturing and extensive field-testing in China is underway. Two Caltech-China joint-venture companies, Eco-San and Entrustech, have been established in Yixing, China to manufacture solar units for the developing world and electrochemical reactor systems, while at the same time additional industrial collaborations have been established in India with ERAM Scientific and with the Kohler Company (USA/India) for production of units to be used in urban and peri-urban environments in India. At the current time, larger-scale units are assembed for use in South Africa, Peru, Southern China, and Cambodia.

Prof. Hoffmann received a BA from Northwestern University and a PhD degree from Brown University. He joined the Environmental Science & Engineering faculty at Caltech in 1980. Prof. Hoffmann has more than 50,100 citations on Google Scholar. His Google Scholar H-Index is 100. Professor Hoffmann has also been recognized by the Web of Science as one of the most highly cited researchers in engineering in the world. Prof. Hoffmann was awarded an Alexander von Humboldt Prize in 1991, the American Chemical Society Award for Creative Advances in 2001, a second von Humboldt Prize in 2005, and the Jack E. McKee Medal presented by the Water Environment Federation in 2003. He was honored as a Distinguished Chair Professor of Atmospheric Sciences, Chemistry, and Environmental Engineering at the National Taiwan University, Taipei in 2010. Prof. Hoffmann is a Member of the National Academy of Engineering and the De Tao International Master's Academy based in Beijing and Shanghai.

Session 4 June 2, 2017

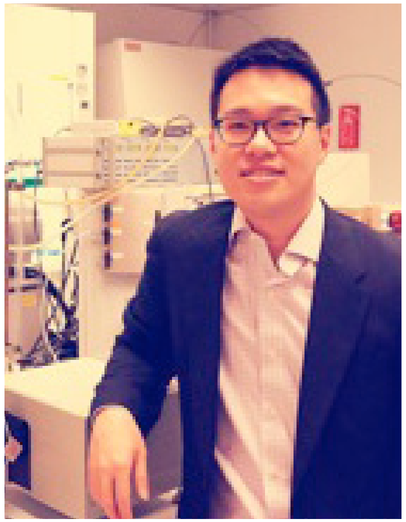
Harnessing Solar Electricity from Wastewater through Photocatalytic Fuel

Chenyan Hu[1], Xincong Lv[1], Wey Yang Teoh[1,*]

[1] Clean Energy and Nanotechnology (CLEAN) Laboratory, Joint Laboratory for Energy and Environmental Catalysis, City University of Hong Kong, Kowloon, Hong Kong, China

* Presenting author. E-mail: wyteoh@cityu.edu.hk

One of the on-going efforts in contemporary wastewater treatment is to reduce its large carbon footprint, in line with the wider support for the Sustainable Development Goals set up by the United Nations in 2015. Here, we demonstrate the ability of the photocatalytic fuel cells (PFCs) technology to harness solar electricity from wastewater while at the same time also remediate the wastewater. To understand the effects of different wastewater contents at the most fundamental level, we first studied the influence of different types of organic substrate on the photocurrent responses. In particular, we found the direct dependence of the organics adsorption profiles and the associated mechanisms of degradation on the efficiencies of the oxide semiconductor-based PFCs. Strong adsorbates, such as carboxylic acids, generated high photocurrent enhancements. Simple and short-chained molecules are the most efficient as a result of their fast degradation kinetics. Because the open-circuit voltage of the PFCs is dependent on the Fermi level of the photoanode, this was maximized through the selection of materials used in the construction of photoanodes. This was carried out with another aim of targeting the wide visible light spectrum of the solar irradiation. Lastly, we show the long-term performance of the PFCs in the treatment of actual wastewater collected from different sewage treatment plants around Hong Kong.



Prof. Wey Yang Teoh is tenured Associate Professor at the School of Energy and Environment, City University of Hong Kong, where he heads the Clean Energy and Nanotechnology (CLEAN) Laboratory. He is also an Associate Editor of the Frontiers in Materials (Nanoenergy Technologies and Materials). His research is dedicated to the fundamentals of heterogeneous thermal- and photocatalysis, and particularly in solving various Energy and Environmentally-related problems. To do so, he and his group establish new strategies for rational catalysts design based on the photocharge transport, surface molecular catalysis, and photochemical conversions. In recognition of his contribution, he received a number of awards including the more recent Joseph Wang Award for Young Scientist in Nanomaterials 2016. His research has been funded by national funding bodies such as the Australian Research Council and Research Grant Council of Hong Kong. He serves on the Scientific Board of HeiQ AG, a leading Swiss innovator in textiles.

Session 4 June 2, 2017

Photocatalytic Methane Conversion using Morphology-Controlled Semiconductor Microcrystals

Wenlei Zhu[1], Meikun Shen[1], Alicia Yang[1], Bryce Sadtler[1,*]

[1] Washington University in St. Louis, MO, USA.
* Presenting author. Tel: +1 314 395-4665, Fax: +1 314 935-4481, E-mail: sadtler@wustl.edu

Methane, the primary component of natural gas, is a major fuel source for electricity generation and used as a precursor for commodity plastics and chemicals. The on-site conversion of methane gas to methanol using low-temperature catalysis would provide a liquid fuel that could be transported and stored without the need for high-pressure containment vessels. Bismuth vanadate is a semiconductor photocatalyst that absorbs visible light and can catalyze the oxidation of water, methane, and other organic molecules. We have synthesized bismuth vanadate microcrystals with different morphologies and compared their activity and selectivity for photocatalytic methane oxidation. Bipyramidal bismuth vanadate microcrystals with {120} and {021} surface facets are more stable, more active, and more selective for methane to methanol conversion compared to platelet particles that expose {010} crystal facets as their top and bottom surface. Photocatalytic conversion of methane with the bipyramidal bismuth vanadate microcrystals showed more than 88% selectivity towards methanol formation. Compared to other crystal morphologies, such as thick and thin platelets, the bipyramids exhibit 50% higher mass activity and specific activity. We rationalize these activity differences based on the selective reactivity of photogenerated electrons and holes at different facets of the bismuth vanadate crystals.

Prof. Bryce Sadtler earned B.S degrees in Chemistry and Materials Chemistry from Purdue University in 2002. He was a Fulbright scholar in 2003, where he worked with Jean-Pierre Sauvage on molecular motors at the University of Strasbourg in France. He began his graduate work in 2003 at the University of California, Berkeley under the guidance of Paul Alivisatos, where he developed chemical transformations in colloidal semiconductor nanocrystals. Bryce received a Ph.D. in Physical Chemistry in 2009. He was then a Beckman Postdoctoral Fellow at the California Institute of Technology, where he worked with Nathan Lewis to develop light-driven growth processes in inorganic nanostructures. He joined the Department of Chemistry at Washington University in St. Louis in the fall of 2014. His research interests include solid-state chemistry and light–matter interactions of nanoscale materials for applications in solar energy conversion and catalysis.

Applied Environmental Nanotechnology Workshop

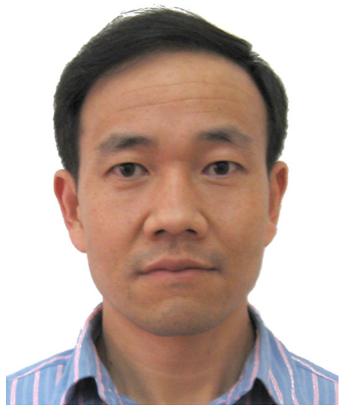
Session 4 June 2, 2017

Photocatalytic N_2 fixation: a New Route to Solar Fuel

Wenzhong Wang[1,*], Songmei Sun[1], Xiaoman Li[1], Xiang Sun[1]

[1] Shanghai Institute of Ceramics, Chinese Academy of Sciences, Shanghai 200050, China
* Presenting author. Tel: +86 21 52415295, Fax: +86 21 52413122, E-mail: wzwang@mail.sic.ac.cn

The reduction of N_2 to NH_3 is a requisite transformation for the life growth and survival. At present, most of the required nitrogen for human beings is still originated from the energy-intensive Haber–Bosch ammonia synthesis process, which consumes ~2% of the world's energy supply and generating more than 300 million tons of carbon dioxide annually. In contrast, dinitrogen photoreduction to ammonia by solar light represents a green and sustainable ammonia synthesis route without fossil fuel consumption and CO_2 emissions, which helps to suppress the global warming and energy crisis. In this report, we will present that BiO quantum dots are highly efficient in photocatalytic N_2 reduction to ammonia. The rate is up to 1226 $\mu mol \cdot g^{-1} \cdot h^{-1}$ without the assistant of any sacrificial agent or co-catalyst. The photocatalytic activity does not show any obvious deactivation even after 120 h. Moreover, efficient ammonia evolution was also achieved over carbon-tungstic acid ($WO_3 \cdot H_2O$) under simulated sunlight (205 $\mu mol \cdot g^{-1} \cdot h^{-1}$). Our study may open up new opportunities for designing highly efficient and robust solar light photocatalysts for artificial ammonia synthesis under ambient conditions.



Prof. Wenzhong Wang is currently a full professor at Shanghai Institute of Ceramics, Chinese Academy of Sciences (SICCAS) and has been joining SICCAS since 2003. He received his Master and PhD degrees in Inorganic Chemistry from the University of Science and Technology of China. He is the vice chairman of the committee of the Photocatalysis Industry Association of China, and expert advisor of the Shanghai Indoor Contamination Control Industry Association. Prof. Wang has held 12 patents, and published over 130 SCI journal articles and these papers have been cited for ~7000 times. His research areas include photocatalysts for VOC removal and wastewater remediation, photocatalytic N_2 fixation, CO_2 reduction and water splitting.

Day 2 June 2, 2017

Time	Program
11:10-12:50	**Session 5** **Nanomaterials for Photocatalytic Transformation of Pollutants** ***(Chair: Prof. Po Keung Wong, Chinese University of Hong Kong)***
11:10-11:30	Photocatalytic Technology – From Lab to Market ***– Prof. Jimmy C. Yu, Chinese University of Hong Kong***
11:30-11:50	Enhanced photocatalytic inactivation of Escherichia coli by a novel Z-scheme g-C_3N_4/m-Bi_2O_4 hybrid photocatalyst under visible light: the role of reactive oxygen species ***– Prof. Dehua Xia, Guangdong University of Technology***
11:50-12:10	Photocatalytic Mineralization and Detoxification of Pentachlorophenol ***– Prof. Po Keung Wong, Chinese University of Hong Kong***
12:10-12:30	Constructions of Hierarchical Nanostructures of TiO_2 NTAs for Efficient Degradation of Organic Pollutants in Wastewater ***– Prof. Changjian Lin, Xiamen University***
12:30-12:50	Enhanced Photocatalytic Degradation of Ibuprofen under Visible Light using Magnetically Recoverable Bi_2O_4/Fe_3O_4 Nanocomposite ***– Prof. Irene M.C. Lo, Hong Kong University of Science and Technology***
12:50-14:30	**Lunch + Poster Session**

Applied Environmental Nanotechnology Workshop

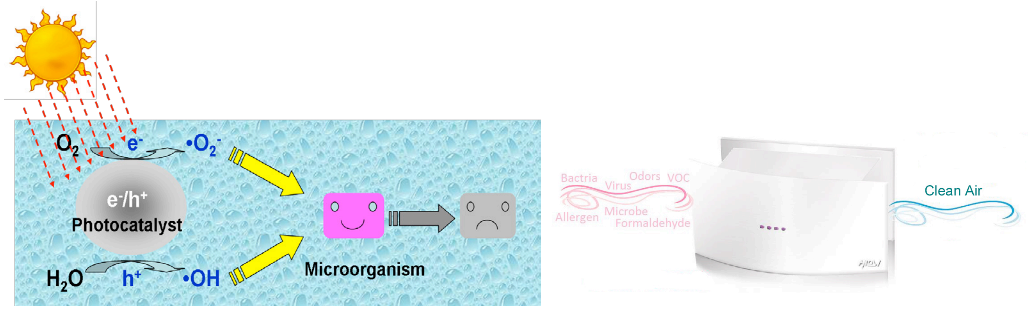
Session 5 June 2, 2017

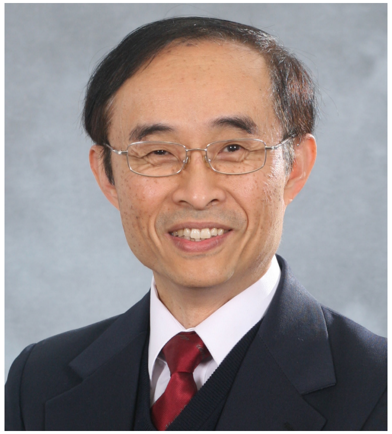
Photocatalytic Technology – From Lab to Market

Jimmy C. Yu[1,*]

[1] Department of Chemistry, The Chinese University of Hong Kong, Hong Kong, China
* Presenting author. Tel: +852 39436268, Fax: +852 26035057, E-mail: jimyu@cuhk.edu.hk

Photocatalysis is an attractive method for environmental remediation. This presentation describes our recent progress in the design, fabrication, and modification of photocatalysts. A wide range of novel photocatalysts, from simple elemental substances to the complex graphene-based composite materials, will be introduced. Ideas for more effective utilization of the solar spectrum, such as upconversion and plasmonic enhancements, will be discussed. Our experience in knowledge transfer and product commercialization will also be shared. Commercial products for photocatalytic water disinfection and air purification will be used as examples.





Prof. Jimmy Yu received a Ph.D. degree in Environmental Analytical Chemistry from the University of Idaho in 1985. He taught in the USA before joining The Chinese University of Hong Kong in 1995. Prof. Yu is now Choh-Ming Li Professor of Chemistry, Head of United College and Associate Director of the Institute of Environment, Energy and Sustainability. As a leading scientist in the field of photocatalysis, Prof. Yu appears on the lists of Highly Cited Researchers 2016 in both Chemistry and Materials Science. The editorial of Chemistry of Materials on 10 March 2015 was dedicated to Prof. Yu as he "had an enormous impact on the many areas that use TiO_2".

Session 5 June 2, 2017

Enhanced photocatalytic inactivation of Escherichia coli by a novel Z-scheme g-C_3N_4/m-Bi_2O_4 hybrid photocatalyst under visible light: the role of reactive oxygen species

Dehua Xia[1,*], Wanjun Wang[1]

[1] Institute of Environmental Health and Pollution Control, School of Environmental Science and Engineering, Guangdong University of Technology, Guangzhou 510006, Guangdong, China
* Presenting author. Tel: +86 13437834990, E-mail: xiadehua2010@hotmail.com

Biohazards are widely present in wastewater, and contaminated water can arouse various waterborne diseases. Therefore, effectively removing biohazards from water is a worldwide necessity. In this study, a novel all-solid-state Z-scheme g-C_3N_4/m-Bi_2O_4 heterojunction was constructed using a facile hydrothermal approach. Using the optimum g-C_3N_4/m-Bi_2O_4 (1:0.5), 6 log_{10} cfu/mL of *E. coli* K-12 could be completely inactivated within 1.5 h under visible light irradiation, while only 1.2 log_{10} cfu/mL and 3.2 log_{10} of *E. coli* K-12 were respectively inactivated by pure g-C_3N_4 and Bi_2O_4 at the same experimental condition. Emphasis is placed on identifying how the charge transfers across the g-C_3N_4/m-Bi_2O_4 heterojunction and a Z-scheme charge transfer mechanism is verified by active species trapping and quantification experiments. The Z-scheme charge separation within g-C_3N_4/m-Bi_2O_4 populates electrons and holes into the increased energy levels, thereby enabling one-step reduction of O_2 to H_2O_2 and facilitating more generation of hole. This greatly accelerates photocatalytic inactivation towards *E. coli*. Moreover, microscopy images indicate that cell structures were damaged and intracellular components were leaked during the photocatalytic inactivation process. This study concludes that water disinfection can be achieved by using this newly fabricated Z-scheme hybrid photocatalyst.

Prof. Dehua Xia is currently an Associate Professor in the School of Environmental Science and Engineering at The Guangdong University of Technology (GDUT) and has been joining GDUT since 2016. He received his Bachelor and MPhil degrees in Environmental Engineering from the Sun Yat-sen University, and PhD degree in Biology from The Chinese University of Hong Kong. He also achieved the "Excellent Publication Award" from The Chinese University of Hong Kong during his PhD study. Prof. Xia has published over 25 SCI journal articles such as Environmental Science & Technology, Water Research, etc. His research areas include photocatalyst design, photocatalytic disinfection, and photocatalytic degradation of volatile organic compounds (VOCs).

Session 5 June 2, 2017

Photocatalytic Mineralization and Detoxification of Pentachlorophenol

Po Keung Wong[1,*]

[1] School of Life Sciences, The Chinese University of Hong Kong, Hong Kong, China
* Presenting author. Tel: +852 3943 6383, E-mail: pkwong@cuhk.edu.hk

Optimal physico-chemical conditions for the photocatalytic degradation of pentachlorophenol (PCP) by UV-TiO_2 system were determined. Under the optimized conditions (200 mg/L of TiO_2, 6.7 mM of H_2O_2, 17 mW/cm^2 UV light intensity and pH at 10), the removal of total organic carbon (TOC) reached 95% after 60 min. The photocatalytic degradation pathway of PCP was determined by analysis of the degradation products and intermediates using gas chromatography/mass spectrometry (GC/MS). The major intermediates were tetrachlorohydroquinone (TeHQ) and tetrachlorobenzoquinone (TeBQ). There was no detectable intermediates after 60 min photocatalytic treatment. The Microtox® test and amphipod survival test were used to monitor the toxicity of degradation intermediates/products during photocatalytic treatment PCP. The toxicity of treated sample was non-detectable by the Microtox® test, while a significantly reduced toxicity was still detected by the amphipod survival test after 60 min treatment.

Prof. P. K. Wong has 40 years working experience on environmental technology and biotechnology. He received his Ph.D. degree in Microbiology from University of California at Davis in 1983. Currently, he is a professor in School of Life Sciences and the Associate Director of Environmental Science Programme, The Chinese University of Hong Kong. He serves as visiting professors for Nankai University, South China University of Technology, Central China Normal University and Guangdong University of Technology in China. He is also an Associate Editor of Journal of Environmental Sciences and a Coordinating Editor of Environmental Geochemistry and Health. He receives a Higher Education Outstanding Scientific Research Output Awards 2015 (Science and Technology) in the category of Natural Sciences (Second Class) of Ministry of Education, China for his contribution in the field of photocatalytic treatment of water and wastewater. He has published more than 220 journal articles in various aspects of environmental technology and biotechnology including many ESI highly cited papers.

Session 5 **June 2, 2017**

Constructions of Hierarchical Nanostructures of TiO_2 NTAs for Efficient Degradation of Organic Pollutants in Wastewater

Mengye Wang[1], Kunpeng Xie[1], Lan Sun[1], Changjian Lin[1,*]

[1] College of Chemistry and Chemical Engineering, and State Key Laboratory of Physical Chemistry of Solid Surfaces, Xiamen University, Xiamen, Fujian, China

* Presenting author. Tel: +86 592 2189354, Fax: +86 592 2186657, E-mail: cjlin@xmu.edu.cn

In this work, we focus on developing various hierarchically nanostructured TiO_2 NTAs for efficient degradation of organic pollutants in wastewater. An ultrasonication-assisted sequential chemical bath deposition (S-CBD) method was developed to modify anatase TiO_2 NTAs with Cu_2O nanoparticles to form p-n heterojunction photoelectrodes for enhancing visible light photocatalytic performance through manipulating the size and content of deposited Cu_2O nanoparticles. The as-prepared heterojunction of Cu_2O@TiO_2 NTAs possessed the highest photoelectrocatalytic degradation rate of rhodamine-B under both UV and visible illumination. The $ZnFe_2O_4$-decorated anatase TiO_2 NTA electrodes was constructed via a hydrothermal reaction. It displayed that the photocatalytic efficiency of $ZnFe_2O_4$@TiO_2 NTA in degrading Acid Orange II under visible light illumination were incredibly increased. The electrochemical measurements revealed that the modification of $ZnFe_2O_4$ nanoparticles promoted the charge carrier transfer at the interface, which efficiently inhibited the recombination of photogenerated charge carriers. And finally a novel photocatalytic reactor with TiO_2 NTAs photoelectrode was designed and applied in the treatment of dyeing wastewater in field. It was demonstrated that such photocatalytic reactor was highly promising to realize a continuous deep degradation of dyeing pollutants in wastewater in high efficiency and durability.

Prof. Changjian Lin is currently a distinguished professor in both Department of Chemistry and State Key Laboratory for Physical Chemistry of Solid Surfaces at Xiamen University, and has been joining Xiamen University since 1982. He received his Master and PhD degrees in Physical Chemistry respectively in 1981 and 1985 from Xiamen University. Then he conducted his postdoctoral research at National Institute of Standards and Technology in USA in 1987-1990, and visiting professor at University of Science and Technology of Hong Kong and Alberta University in 1997 and 1999 respectively. Prof. Lin is vice chairman of Chinese Society of Corrosion and Protection and council member of Chinese Society of Biomaterials. Prof. Lin has published over 460 papers in peer-review journals and held 46 issued patents, and he has won 15 important scientific awards and honors. His research interests include materials electrochemistry, corrosion and protection, biomaterials/biosurface, dye sensitized/perovskite solar cells, and photoelectrocatalysis for water splitting and wastewater treatment.

Session 5 **June 2, 2017**

Enhanced Photocatalytic Degradation of Ibuprofen under Visible Light using Magnetically Recoverable Bi_2O_4/Fe_3O_4 Nanocomposite

Irene M.C. Lo[1,*], Dehua Xia[2]

[1] Department of Civil and Environmental Engineering, The Hong Kong University of Science and Technology, Hong Kong, China

[2] Institute of Environmental Health and Pollution Control, School of Environmental Science and Engineering, Guangdong University of Technology, Guangzhou 510006, Guangdong, China

* Presenting author. Tel: +852 23587157, Fax: +852 23581534, E-mail: cemclo@ust.hk

Ibuprofen (IBU) is one of the persistent organic pollutants (POPs). The existence of IBU in water bodies can cause adverse effects to humans and environment. Meanwhile, conventional wastewater treatment processes cannot remove IBU effectively. A novel superparamagnetic Bi_2O_4/Fe_3O_4 nanocomposite was successfully synthesized for visible-light-driven photocatalytic degradation of IBU in the current study. Fe_3O_4 nanoparticles with diameter of 10 nm were deposited on the Bi_2O_4 nanorods to form Bi_2O_4/Fe_3O_4 nanocomposite. Under visible light irradiation, Bi_2O_4/Fe_3O_4 with an optimum molar ratio of 1:2.5 (Bi_2O_4:Fe_3O_4) achieved a complete photocatalytic degradation of IBU within 2 hours (i.e., 1.7 times higher efficiency than pure Bi_2O_4), and a complete mineralization of IBU in 4 hours. In addition, efficient photocatalytic degradation of IBU by Bi_2O_4/Fe_3O_4 (1:2.5) in real drinking water was also achieved, indicating its potential practicality. Regarding its mechanism, the effective separation of electron-hole pairs after surface modification of Fe_3O_4 enhanced the photocatalytic degradation performance. The primary reactive species for the photocatalytic removal of IBU was the photogenerated hole. Moreover, Bi_2O_4/Fe_3O_4 (1:2.5) can be magnetically separated and reused. Cyclic experiments showed a good reusability of Bi_2O_4/Fe_3O_4 (1:2.5) even after reuse over five cycles.

Prof. Irene M. C. Lo is currently a full professor in the Department of Civil and Environmental Engineering at The Hong Kong University of Science and Technology (HKUST) and has been joining HKUST since 1992. She received her Master and PhD degrees in Civil (Environmental) Engineering from the University of Texas at Austin. Prof. Lo is an elected Academician of the European Academy of Sciences and Arts (EASA). She is the first Hong Kong scholar inducted into the EASA. She is a Fellow of the Hong Kong Institution of Engineers (FHKIE), and the American Society of Civil Engineers (FASCE). She has been acknowledged through the recognition of very prestigious international honors and awards, including ASCE James Cores Medal, ASCE Samuel Arnold Greeley Award, ASCE Wesley Horner Award, ASCE EWRI Best Practice-Oriented Paper Award twice, among others. Prof. Lo has held 2 patents, edited 9 technical books, and published over 270 SCI journal articles and conference papers. Her research areas include magnetic nanomaterial-based technology for water and wastewater treatment; soil/sediment/groundwater remediation; and fate and transport of nanoparticles.

Day 2 June 2, 2017

Time	Program
14:30-15:30	**Session 6** **Design, Synthesis, Characterization, and Environmental Behaviours of Nanomaterials (ii)** ***(Chair: Prof. Young-Shin Jun, Washington University in St. Louis)***
14:30-14:50	Development of Millimeter-sized Nanocomposites for Full-Scale Advanced Water Treatment ***– Prof. Bingcai Pan, Nanjing University***
14:50-15:10	Electro-active Filter Technology for Environmental Applications ***– Prof. Yanbiao Liu, National University of Singapore***
15:10-15:30	The Fate and Behaviour of Engineered Nanomaterials in Landfills ***– Prof. Burak Demirel, Boğaziçi University***
15:30-15:50	**Coffee Break**
15:50-17:20	**Workshop Activities II – How to Promote Future Research Collaboration?** **Panel members:** ***– Prof. Irene M.C. Lo, Hong Kong University of Science and Technology*** ***– Prof. King Lun Yeung, Hong Kong University of Science and Technology*** ***– Prof. Daniel E. Giammar, Washington University in St. Louis*** ***– Prof. John D. Fortner, Washington University in St. Louis***
15:50-16:50	Group Discussion
16:50-17:20	Workshop Outcome Summary
17:20-17:30	**Closing Remarks** ***– Prof. Irene M.C. Lo, Hong Kong University of Science and Technology***

Session 6 June 2, 2017

Development of Millimeter-Sized Nanocomposites for Full-Scale Advanced Water Treatment

Bingcai Pan[1,*]

[1] School of the Environment, Nanjing University, Nanjing 210023, China
* Presenting author. Tel: +86 25 8968 0390, E-mail: bcpan@nju.edu.cn

Nanomaterials exhibit promising performance in water decontamination via adsorption, catalytic degradation, and other processes. However, the ultrafine particle size also brings issues including excessive pressure drop in flow-through systems and environmental risk arising from nanoparticle release. To overcome the bottleneck of most nanomaterials in full-scale manipulation, a series of millimetre-sized nanocomposites have been developed via *in situ* formation of nanoparticles (e.g. metal oxides/hydroxides/phosphates) confined in the pore channels of ion exchanger hosts. Such nanocomposites are suitable for application in fixed-bed reactors owing to their tunable size (0.6-1.0 mm) and excellent hydrodynamic properties. The confinement effect induced by the network pore structure of the cross-linked hosts tend to maintain the nanoscale nature of the embedded nanoparticles. Furthermore, the non-diffusible charges fixated on the host skeleton enhance the permeation of ionic pollutants inside the pore channels. Thus, the polymer-supported nanocomposites have demonstrated favorable adsorption of ionic pollutants such as Pd(II), Cd(II), Cu(II), As(V), F-, P(V), and have been successfully applied in full-scale advanced water treatments. Recently, novel millimeter-sized nanocomposites of inorganic skeleton (e.g. Ce-Ti-Zr ternary oxide) have been developed for catalytic oxidation processes, and have showed satisfactory performance in mineralization of recalcitrant pollutants such as oxalic acid.

Prof. Bingcai Pan is a Distinguished Professor of Changjiang Scholars Program in School of the Environment, Nanjing University (NJU), China. He is currently the Deputy Dean of School of the Environment of NJU, and Deputy Director of National Engineering Center for Organic Pollution Control and Resource Reuse. He received his B.S. (Environmental Chemistry), Master, and PhD degrees (both in Environmental Engineering) all from Nanjing University. Prof. Pan now holds 64 patents on water treatment including 4 US patents, and has published over 140 SCI journal articles, most of which are in the field of environmental nanotechnology. His research areas include (i) nanomaterials and nanotechnology-enabled water treatment, (ii) advanced oxidation technologies for water treatment, (iii) adsorption technologies for water treatment and resources reuse; and (iv) drinking water treatment and purification. Prof. Pan was conferred the National Tech-Invention Award in 2015.

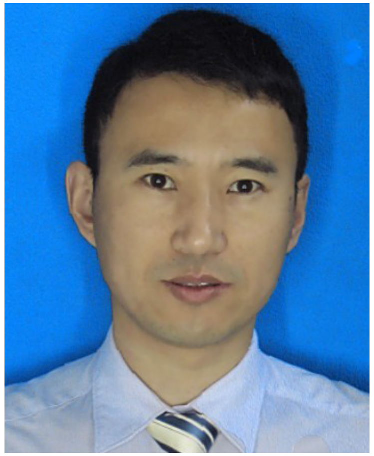
Session 6 June 2, 2017

Electro-active Filter Technology for Environmental Applications

Yanbiao Liu[1,2]*, Choon Nam Ong[2], Jianping Xie[3]

[1] School of Environmental Science and Engineering, Donghua University, Shanghai, China.
[2] NUS Environmental Research Institute, National University of Singapore, Singapore.
[3] Department of Chemical and Biomolecular Engineering, National University of Singapore, Singapore
* Presenting author. Tel: +86 21 67792159, Fax: +86 21 67792522, E-mail: yanbiaoliu@dhu.edu.cn or eriliuyb@nus.edu.sg

Development of highly-efficient and cost-effective water treatment techniques is critical to tackle global water crisis and membrane processes are promising among state-of-the-art water treatment technologies. We recently developed a few novel carbon-based electro-active filter technologies that could not only physically adsorb, but also electrochemically oxidize various refractory chemical contaminants. The efficacy and efficiency towards organic compounds electrooxidation were examined by several commonly detected organic pollutants (e.g. antibiotic tetracycline and phenols). The filter materials we are currently working on include graphene, carbon nanotubes and other conductive nanofibers. The energy consumption per volume for our electroc-active filters were calculated to be <0.1 kW·hr/m^3, which is comparative or even better than other recently developed electrochemical systems, as well as other advance oxidation processes for water purification. In this presentation, I will share some of our recent experimental results that exemplified the advantages of contaminants removal using filters constructed with various nanomaterials in a flow-through system. The overall findings demonstrate that this integrated strategy is attractive and useful for both waste water treatment, drinking water purification as well as the air purification applications.



Prof. Liu received his master and Ph.D. degree in environmental science from Shanghai Jiao Tong University (in 2012, China). He served as Research Scientist at the NUS Environmental Research Institute (NERI) of National University of Singapore (NUS, Singapore) in 2012-2016. Prof. Liu is currently holding a research professorship at Donghua University of China since 02/2017. His current research interests are environmental functional materials with a focus on the development of electrochemical filters for water purification and photocatalysis. He has published more than 40 peer-reviewed articles/chapters (e.g., Environ. Sci. Technol., Water Res., Appl. Catal. B, Chem. Comm., Chem. Mater. & Nano Res. etc.) with total citations over 1400 times, and held 3 patents.

Session 6 June 2, 2017

The Fate and Behaviour of Engineered Nanomaterials in Landfills

Burak Demirel[1,*], Ilknur Temizel[1], Nadim K. Copty[1], Orhan Yenigün[1], Turgut T. Onay[1]

[1] Institute of Environmental Sciences, Boğaziçi University, Istanbul, 34342, Turkey
* Presenting author. Tel: +90 2123594600, Fax: +90 2122575033, E-mail: burak.demirel@boun.edu.tr

The extensive use of engineered nanomaterials (ENMs) in commercial consumer products and their eventual release to the environment through various pathways have recently raised concern about the potential impacts of these materials on the environment and human health. It is predicted by the scientists that a huge amount of ENM containing materials eventually end up in sanitary landfills. However, information about the behaviour of these materials in landfill environment is particularly lacking in literature. Therefore, this long term study investigated the behaviour of nano ZnO in simulated landfill reactors using real municipal solid waste (MSW) and two different landfill operation modes, namely conventional and bioreactor. The results obtained for more than a year of experimental work indicated that the Zn mostly tended to stay within the MSW matrix rather than moving with the leachate and about 98-99% of the Zn retained within bioreactor and conventional landfill reactors, respectively. In addition, the reactors without nano ZnO addition (control reactors) produced about 15% more biogas than those of the reactors with nano ZnO. This finding revealed that the nano ZnO might have inhibitory impacts on the biological activity during waste stabilization in landfills.

Prof. Burak Demirel is currently a full time faculty member in the Institute of Environmental Sciences at Boğaziçi University, Istanbul, Turkey and has been joining Boğaziçi University since 2009. Prof. Demirel was born in Ankara in 1972. He graduated from Kadıkoy Anatolian College in Istanbul in 1990. Then, he obtained his BS from the Technical University of Istanbul (ITU) in Metallurgical Engineering in 1994. Prof. Demirel obtained his MSc and PhD degrees from the Institute of Environmental Sciences at Boğaziçi University in the field of Environmental Technology. Between 2005 and 2009, he carried out a post-doc study at the University of Applied Sciences Hamburg (HAW Hamburg) Germany, as a German Academic Exchange Service (DAAD) scholar at the Faculty of Life Sciences. His main areas of teaching and research are biogas engineering, anaerobic digestion process, solid waste management, nanomaterials, renewable energy sources and climate change.

Student Poster Session

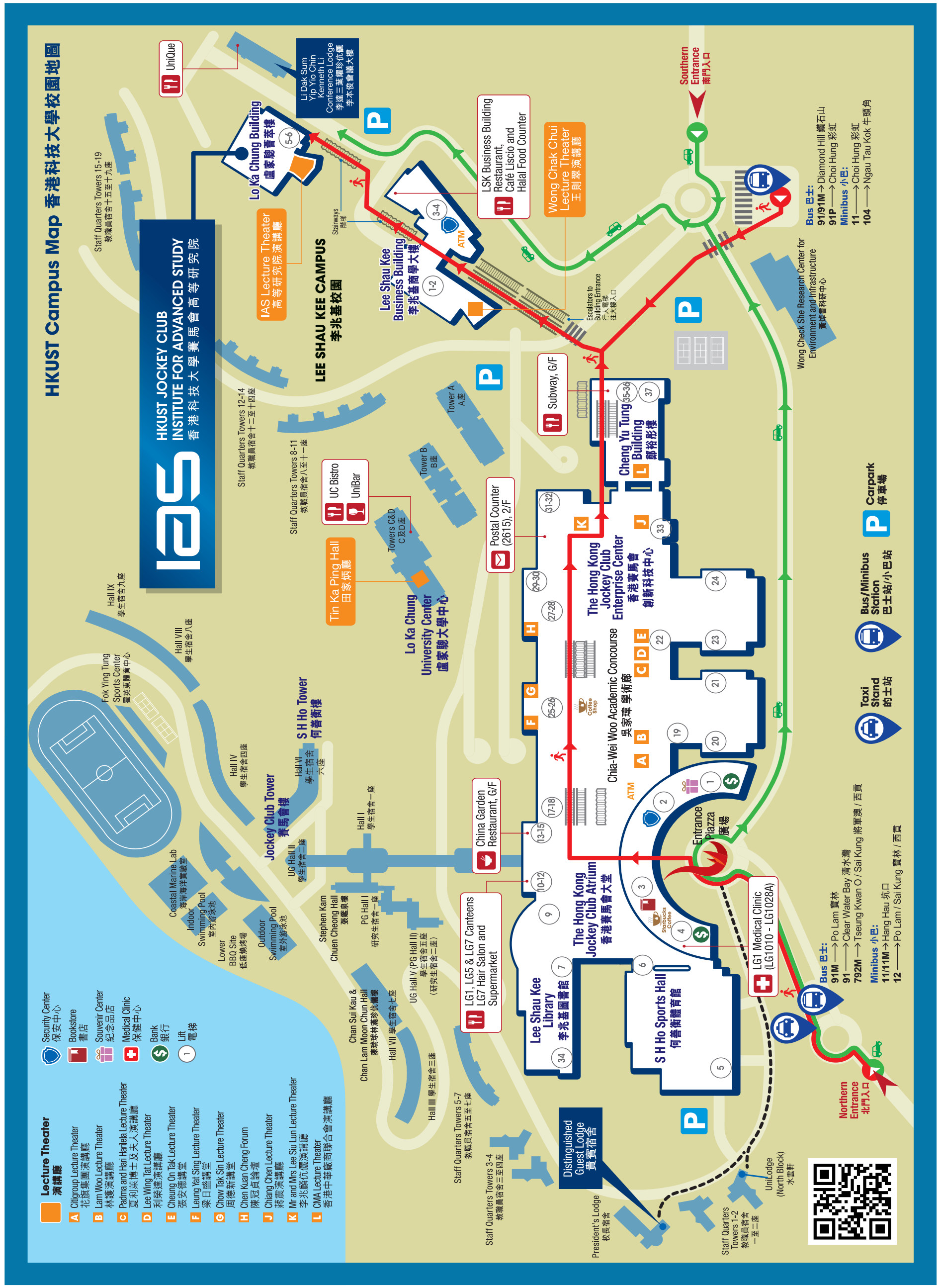
Poster title *(listed in alphabetical order)*	**Authors***
Bismuth oxybromo-iodide nanosheets as efficient visible-light-driven photocatalysts for PPCP removal	**Christopher S. L. Fung**, Kishore Sridharan, Musharib Khan, Irene M. C. Lo (HKUST)
Development of bismuth oxyhalide-based magnetic photocatalysts for visible-light-driven photocatalytic degradation of PPCPs from wastewater — Effect of surface modifications	**Musharib Khan**, Irene M. C. Lo (HKUST)
Development of visible-light-driven magnetic N-TiO_2/Fe_3O_4@SiO_2 nanophotocatalysts for photocatalytic removal of POPs	**Ashutosh Kumar**, Irene M. C. Lo (HKUST)
Efficient visible light photocatalytic degradation of emerging pollutants using Ag doped organic-inorganic semiconductors composite synthesized by a facile one-step hydrothermal method	**Rokhsareh Akbarzadeh**, Dennis H. C. Lam, Irene M. C. Lo (HKUST)
Enhanced photocatalytic H_2 evolution by modified amorphous red phosphorus with one-step incorporation of metal oxide nanocrystal	**Wai Ming Chan**, Jimmy C. Yu (CUHK)
Liquid bismuth assisted growth of Hittorf's phosphorus microbelt photocatalyst	**Yang Liu**, Jimmy C. Yu (CUHK)
Optimization of phosphate removal from sewage by novel lanthanum hydroxide nanorods using a response surface methodology	**Julie K. M. Chan**, Liping Fang, Irene M. C. Lo (HKUST)
Photocatalytic reduction of carbon dioxide reduction using rhenium-based compounds	**Amy C. T. Wang**, Wey Yang Teoh (CityU)
Selective removal of phosphate from water and wastewater using $La(OH)_3$/Fe_3O_4 nanocomposites: performance and mechanisms	**Baile Wu**, Irene M. C. Lo (HKUST)
Theoretical and molecular-level investigation of phosphate removal mechanism by lanthanum hydroxide nanorods	**Liping Fang**, Irene M. C. Lo (HKUST)
Visible light degradation of acetaldehyde over g-C_3N_4/WO_3 photocatalysts	**Chung Ting Yeung**, Wey Yang Teoh (CityU)

* Author's name in bold represents the presenter

Applied Environmental Nanotechnology Workshop

Hong Kong Map

Campus Map



How to Get to HKUST?

From the Airport

Public transportation in Hong Kong is very efficient. Getting to HKUST from the Hong Kong International Airport by bus, MTR metro, or taxi, is as accessible as it is to go by car.

1) By Airport Bus

You may take the Airport Bus A22 to Lam Tin and then take a taxi to HKUST. The total traveling time is approximately 90 minutes with a total charge of HKD 120.

Or you may take the Airport Bus A29 to Po Lam and then take a taxi to HKUST. The total traveling time is approximately 80 minutes with a total charge of HKD 100.

Please visit the bus company website for the most updated information:
http://www.nwstbus.com.hk/

2) By Mass Transit Railway (MTR) – The metro in Hong Kong

You may take the Mass Transit Railway (MTR) from the Airport by Airport Express, and then interchange at Tsing Yi station, Lai King station and Prince Edward station to reach Choi Hung station along Kwun Tong Line. The Choi Hung MTR station is one of the closest ones to the University, and you can board a bus or taxi (details in P.41) to the main entrance of HKUST. The total traveling time is approximately 90 minutes with a total charge of HKD 80.

A system map is available on MTR website:
http://www.mtr.com.hk/en/customer/services/system_map.html.

3) By Taxi

Taxis are easily available from the airport. You may expect to pay approximately HKD 300-380 for the journey. Note that only HK dollars will be accepted by your driver. The taxi drop-off point on campus is near the red sundial at the North Entrance. For heading to IAS, you may use the campus map of driving route to IAS to give the taxi driver directions. For on-campus conference lodge, it is just next to IAS.

How to Get to HKUST?

From Downtown

The nearest MTR stations to the University are Choi Hung (Kwun Tong Line) and Hang Hau (Tseung Kwan O Line). You can then take a bus, minibus or taxi to the HKUST. A stored-value electronic card, Octopus card is widely accepted for bus and minibus fares. Please kindly check the details in
http://www.octopus.com.hk/get-your-octopus/choose-your-octopus/on-loan-octopus/standard-octopus/en/index.html

1) By Bus

Bus No.	From	Via	To
91	Diamond Hill MTR Station (Exit C2)	• Choi Hung MTR Station (Exit C2) • HKUST (South Entrance)	Clear Water Bay
	Clear Water Bay	• HKUST (North Entrance) • Choi Hung MTR Station	Diamond Hill MTR Station
91M	Diamond Hill MTR Station (Exit C2)	• Choi Hung MTR Station (Exit C2) • HKUST (North Entrance)	Po Lam MTR Station
	Po Lam MTR Station (Exit B1)	• HKUST (South Entrance) • Choi Hung MTR Station	Diamond Hill MTR Station
792M	Tseung Kwan O MTR Station (Exit A1)	• Tiu King Leng MTR Station (Exit A1) • HKUST (North Entrance)	Sai Kung

2) By Minibus

Minibus No.	From	Via	To
11	Choi Hung MTR Station (Exit C1)	HKUST (North Entrance)	Hang Hau MTR Station
	Hang Hau MTR Station (Exit B1)	HKUST (South Entrance)	Choi Hung MTR Station
11M	Hang Hau MTR Station (Exit B1)		HKUST (North Entrance)
12	Sai Kung	HKUST (North Entrance)	Po Lam
	Po Lam		Sai Kung
104	HKUST (South Entrance)	Ngau Tau Kok MTR Station (Exit A)	Kwun Tong
	Kwun Tong		HKUST (South Entrance)
1S	Choi Hung MTR Station (Exit C1)	HKUST (North Entrance)	Sai Kung
	Sai Kung		Choi Hung MTR Station
	Operates from 2:30 am to 12:30 am daily		
11S	Choi Hung MTR Station (Exit C1)	HKUST (North Entrance)	Po Lam
	Po Lam	HKUST (South Entrance)	Choi Hung MTR Station
	Operates from 5:00 am to 12:00 am daily		

Applied Environmental Nanotechnology Workshop

How to Get to HKUST?

From Holiday Inn Express Hong Kong Kowloon East / Crowne Plaza Hong Kong Kowloon East

1) By taxi (estimated traveling time is 10 minutes and a fare of about HKD 60)

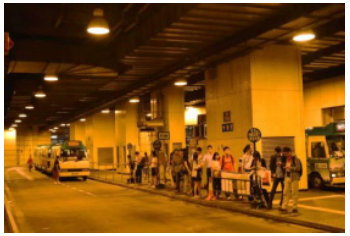
2) By bus no. 792M (estimated traveling time is 25 minutes at a fare of HKD 6.9)

i. Get on the bus at Tseung Kwan O Station (Tong Chun Street inside Tseung Kwan O station Public Transport Interchange)

ii. Get off at HKUST (North Gate)

3) By MTR with minibus (estimated traveling time is 20 minutes at a fare of HKD 11.6)

i. Travel by MTR from Tseung Kwan O Station to Hang Hau Station
ii. Alight at Exit B1, Hang Hau Station
iii. Take minibus no. 11 at Hang Hau Station Public Transport Interchange



iv. Get off at HKUST (South Gate)

Workshop webpage:

http://ias.ust.hk/events/201706aent/index.html