BRITISH COUNCIL
英国文化教育协会
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2018 Researcher Links Workshop on membranes for energy and environmental applications (MEEA2018)

膜技术及其在能源环境领域中的应用中英双边研讨会

October 15-17, 2018
Nanjing China

2018年10月15日-17日
中国 南京

Organised by:

南京工业大学 NANJING TECH UNIVERSITY

Newcastle University

材料化学工程国家重点实验室
State Key Laboratory of Materials-Oriented Chemical Engineering

Supported by:

BRITISH COUNCIL RESEARCHER LINKS

国家特种分离膜工程技术研究中心
National Engineering Research Center for Special Separation Membrane

Newton Fund

化工学院
COLLEGE OF CHEMICAL ENGINEERING

Sponsored by:

Organization

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Heqing Jiang, workshop mentor
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Xinran Li(CN)

Xi Chen(CN)

Qingbo Huang(CN)

Guanyu Zhou(CN)

Sijian Zhang(CN)

Chi Zhang(CN)

Qiang Zhao(CN)

Social program and practical information

Registration

Registration is made at the hotel reception lobby, schedule for registration

Sunday, October 14, 2018, 14:00-18:00, 20:00-22:00

Presentations

- The speakers are kindly asked to upload their presentations on the PC in the conference hall before their sessions, assisting staff will be available in the hall.
- The conference hall will be equipped with a computer projection, a laptop with presentation setup, remote control and digital laser pointer
- Time for each talk is 20 min (15 min speech+5 min discussion)

Welcome reception

A welcome reception will be organized in the Mingfa Pearl Spring Hotel, schedule for welcome reception

Sunday, October 14, 2018, 18:00-20:00

Lab tour

Lab tour in State Key Laboratory of Material-Oriented Chemical Engineering (MCE) and Membrane Science Technology Center (MST) will be take place on Tue, October 16, 2018, schedule for lab tour

Tue, October 16, 2018 14:00-16:30

Workshop banquet afternoon

The workshop banquet will be served in the Red Restaurant. Before the banquet, we will visit the Imperial Examination Museum of China and Confucius Temple. After the banquet, a boat trip on the Qinhuai River will be served, schedule for banquet afternoon on Tue, October 16, 2018

16:00-16:40	Bus transfer to the city center
16:40-19:00	Chinese Confucius culture and Chinese examination history introduction
19:00-20:45	Banquet at the Red Restaurant
20:45-21:30	Boat trip on Qinhuai River
21:30-22:00	Bus transfer to the hotel

Membrane Industry Park Tour

A tour of Membrane Industry Park will take place on Web, October 17, 2018, schedule for the membrane industry park tour

Web, October 17, 2018 14:30-17:30

Optional tours:

We offer a free ticket to Pearl Spring Scenic Area to every attendee. Obtain the tickets from the hotel reception desk.

Transportation during the workshop

Bus Transportation between hotel and venue :

	From Hotel to Venue, ***bus shuttle departs at in front of hotel at***	From Venue to Hotel, ***bus shuttle departs at in front of state key laboratory at***
Mon, October 15, 2018	9:00	17:30
Tue, October 16, 2018	8:20	-
Wed, October 17, 2018	8:20	-

Bus transport of the banquet afternoon at Tue, October 16, 2018

From Venue to city center ***bus shuttle departs at in front of state key laboratory at***	16:00
From city center to Hotel, ***bus shuttle departs at boat trip gather point at***	21:30

Bus transport of the Membrane Industry Park Tour afternoon at Wed, October 17, 2018

From Venue to Membrane Industry Park ***bus shuttle departs at in front of state key laboratory at***	14:00
From Membrane Industry Park to Hotel, ***bus shuttle departs at in front of cafeteria at***	17:30

Contacts

For all the inquires, attendees could contact **Dr. Guangru Zhang, (86)139 2142 9871.** Attendees could also contact the student volunteers who are responsible for specific matters listed below:

Registration:

Tianlei Wang, (86) 159 5196 9104

Presentation:

Zhengkun Liu, (86) 158 5051 6403

Hotel:

Tianlei Wang, (86) 159 5196 9104

Meals (Tea break and lunch):

Kaiping Jiang, (86) 158 5072 0380

Banquet and Dinner

Tianlei Wang, (86) 159 5196 9104

Bus transportation:

Tianlei Wang, (86) 159 5196 9104

Phone Apps:

- Strongly Recommended Download 'WeChat', it is cheaper for price of data than that of call for the U.K. users.
- You can download the WeChat app via visiting http://www.wechat.com/en/ or scanning the QR code below
- You can add friends in your WeChat via their phone numbers.

Workshop Coordinator

Wanqin Jin

Professor of Chemical Engineering,

Nanjing Tech University

State Key Laboratory of Materials-Oriented Chemical Engineering, College of Chemical Engineering,

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Dr. Wanqin Jin is a professor of Chemical Engineering at Nanjing Tech University, Fellow of the Royal Society of Chemistry, the Deputy-director of the State Key laboratory of Materials-oriented Chemical Engineering and the Chief-scientist of the National Basic Research Program of China (973 Program) and Major Program of National Natural Science Foundation of China (NSFC).

He received his Ph.D. from Nanjing University of Technology in 1999. He was a research associate at Institute of Materials Research &Engineering of Singapore (2001), an Alexander von Humboldt Research Fellow (2001-2013), visiting professors at Arizona State University (2007) and Hiroshima University (2011, JSPS invitation fellowship).

His currently research focuses on the development of membrane materials, membrane processes and membrane reactors. He has published nearly 300 peer-reviewed journal publications in Nature, Adv. Mater., Angew. Chem., J. Am. Chem. Soc., Chem. Soc. Rev., AIChE J., J. Membr. Sci., Chem. Eng. Sci. et al., with 10000+ citations; written 2 monographs, contributed 6 book chapters and hold 40 authorized patents.

He presented over 40 plenary, keynote lectures and invited speeches in international conferences, and was co-chair of the 10th International Congress on Membrane and membrane Processes (ICOM2014). He is now an editor of Journal of Membrane Science, and on the Editorial Boards of Chinese Journal of Chemical Engineering, Asia-Pacific Journal of Chemical Engineering and Inorganic Materials, and is a council member of Aseanian Membrane Society (AMS).

Workshop Coordinator

Ian Metcalfe

Professor of Chemical Engineering,

Newcastle University

School of Engineering

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Ian Metcalfe obtained his first degree in chemical engineering from Imperial College where he was awarded the Hinchley Medal. He then performed his graduate study at Princeton University obtaining his MA in 1984 and his PhD in 1987. He returned to the UK to take up a position as a Lecturer and later Senior Lecturer at Imperial College. In 1997 he was appointed to the Chair of Chemical Engineering at the University of Edinburgh and in 2001 he became Professor of Chemical Engineering at UMIST. In 2005 he moved to Newcastle University as the Professor of Chemical Engineering.

Ian is a Fellow of the Institution of Chemical Engineers and a Fellow of the Royal Society of Chemistry. He was elected a Fellow of the Royal Academy of Engineering in 2012. He has held both an Esso Centenary Education Award (1989) and an ICI Fellowship (1993). Whilst at Imperial College he received the Imperial College Award for Excellence in Teaching (1996). He currently holds a European Research Council Advanced Grant and acts as director of the virtual UK membrane centre (EPSRC – SynFabFun). He has authored a text book on chemical reaction engineering which has sold 10 000 copies and has published more than 130 refereed research articles. He has supervised 50 PhD students.

His research is in the area of the thermodynamics of chemical conversion with an emphasis on energy processes. He has a particular interest in membrane processes and solid-gas chemical looping cycles.

Workshop Mentor

Kang Li

Professor of Chemical Engineering，

Imperial College London

Department of Chemical Engineering

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Professor Kang Li has been a Professor of Chemical Engineering at Imperial College London since 2007. Currently, he leads a research group (10 post-docs/PhDs) at Imperial to conduct multidisciplinary research in membrane science, solid oxide fuel cells, wastewater treatment, membrane catalysis, separation processes and reaction engineering. He received Rector's Award and Research Excellence Award at Imperial in 2007 and MND R&D Award 2013, Singapore.

His commitment to working at interdisciplinary boundaries is evidenced by his involvements as an editor in Current Opinion in Chemical Engineering, Elsevier (Chemical Engineering), as an editorial board member of Journal of Membrane Science, Elsevier (Membrane Technology) Journal of Chemical Technology and Biotechnology, Wiley (Chemical Technology) and Polymers, MDPI, Switzerland (Polymer Science) and as a guest editor in Reactive and Functional Polymers, Elsevier (Functional Polymers) and International Journal of Hydrogen Energy, Elsevier (Energy).

He has published extensively in international referred journals (cited over 13,770 times) with h-index of 63 (Google Scholar) and has authored a book on Ceramic Membranes for Separation and Reaction (Wiley 2007). Kang Li has been named as one of most cited researchers in Chemical Engineering by Shanghai Jiaotong University

Workshop Mentor

Davide Mattia

Professor of Chemical Engineering

University of Bath

Department of Chemical Engineering

Claverton Down, Bath BA2 7AY, Avon, England

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Davide Mattia is a full Professor in the Department of Chemical Engineering and Associate Dean (Research) in the Faculty of Engineering and Design at University of Bath, UK. He obtained a MEng degree in Materials Engineering in 2002 from the University 'Federico II' of Naples, Italy, and a PhD in Materials Engineering from Drexel University, PA, USA, in 2007. He joined the University of Bath as Assistant Professor in 2008, was promoted to Associate Professor in 2013 and full Professor in 2016. In 2010 he was awarded a 5-year UK Royal Academy of Engineering Research Fellowship and in 2017 he has been awarded a 5-year EPSRC Established Career Fellowship in Water Engineering. He is a Chartered Engineering and a Fellow of the Institution of Chemical Engineers.

He has a current grant portfolio of over £5M and holds over 80 publications and 3 patents.

His research group works on the development of (i) novel 1D and 2D hybrid membranes for water treatment; (ii) nanostructured catalysts for micropollutant degradation and for the conversion of carbon dioxide to fuel and chemicals; and (iii) the continuous manufacturing of materials using membranes.

Workshop Mentor

Haihui Wang

Professor of Chemical Engineering

South China University of Technology

School of Chemistry & Chemical Engineering

381 Wushan Rd, Guangzhou 510640, Guangdong, Peoples R China. hhwang@scut.edu.cn

Dr. Haihui Wang is a Changjiang Chair professor at the South China University of Technology, China.

Dr. Wang received Ph.D (2003) from Dalian Institute of Chemical Physics, Chinese Academic Science. He was an Alexander von Humboldt Fellow and research associate (2005 – 2007) at Leibniz University of Hannover, Germany (2003 - 2007). In 2007 Dr. Wang joined the School of Chemistry & Chemical Engineering at South China University of Technology as a full professor. He published over 200 refereed papers in chemical engineering and materials science SCI journals; he also holds 36 patents; his papers have received more than 6500 citations (with H-index of 47).

Dr. Wang received several awards, including Excellent Presidential Award, Chinese Academy of Sciences (2003), The Alexander von Humboldt Fellow (2003), New Century Excellent Talents in Universities of China (2007), Award from Fok Ying Tung Education Foundation, Hongkong (2008), Pearl River Scholar for Distinguished Professor (2011). He got Distinguished Young Scientist Foundation, National Nature Science Foundation of China (2012), the highly reputable and supports young scholars who have made outstanding achievements in fundamental research. He was awarded as Fellow of The Royal Society of Chemistry in 2016. He was awarded for Changjiang Chair Professor of Chinese Minister of Education in 2017.

Dr. Wang's services to the scientific community include serving as a referee for over 20 journals and 5 funding agencies. He was chair of the first Sino-German Symposium on Inorganic Membrane with Nano Design (2010, Guangzhou) and Co-Chair of the Second Sino-German Symposium on Inorganic Membrane for Clean Energy and Clear Environment (2012, Hannover).

Workshop Mentor

Heqing Jiang

Professor of Chemical Engineering,

Qingdao Institute of Bioenergy and Bioprocess Technology

Chinese Academy of Sciences

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Dr. Heqing JIANG is currently a professor at Qingdao Institute of Bioenergy and Bioprocess Technology, Chinese Academy of Science (QIBEBT, CAS). He studied Chemistry at Henan University (China), where he received his B.Sc. in 2001, and M.Sc. in 2004. From 2004 to 2007 he worked as research assistant at Changchun Institute of Applied Chemistry, CAS. He completed his Ph.D. at Leibniz Universität Hannover (Germany) with Prof. Caro in 2010. After his postdoctoral stay with Prof. Schuth at Department of Heterogeneous Catalysis in the Max-Planck-Institut für Kohlenforschung in Mülheim, he joined QIBEBT as a full professor in 2013. Dr. Jiang is the recipient of National Thousand Talents Program for Distinguished Young Scholars, China. His main research interest focuses on the functional membranes and their application in catalysis and separation. So far, Dr. Jiang has published more than 40 papers. He is the Associate Editor of Frontiers in Chemistry and among the editorial board of the journal Current Catalysis, Technology of Water Treatment and the Chinese Journal of Process Engineering.

Program

October 14, 2018	
Location: Mingfa Pearl Spring Hotel	
14:00-18:00 20:00-22:00	Registration at the hotel reception lobby
18: 00-20:00	Welcome Reception at hotel

October 15, 2018		
Location: Conference Center at State Key Laboratory of NJTech		
Opening ceremony		
09:00-09:30	**All attendees**	**Bus transfer to the Membrane Industry Park**
9:30-9:40	Wanqin Jin	Opening remark
9:40-9:45	Weihong Xing	Opening remark by the vice president of the NJTech
9:45-10:05	Ian Metcalfe	Membrane activities in UK
10:05-10:35	Wanqin Jin	Membrane activities in China
10:35-11:00	**All attendees**	**Group Photo/Tea break/Networking**
11:00-11:15	Kang Li	Brief introducing and specific activities
11:15-11:30	Haihui Wang	Brief introducing and specific activities
11:30-11:45	Davide Mattia	Brief introducing and specific activities
11:45-12:00	Heqing Jiang	Brief introducing and specific activities
12:00-14:00	**All attendees**	**Lunch at campus and Networking**
Topic 1: Gas separation		
14:00-14:20	Gongping Liu	Metal-Organic Framework Mixed-Matrix Membranes for Gas Separation
14:20-14:40	Kang Huang	Preparation and Application of Ceramic-supported Metal-Organic Framework Membranes
14:40-15:00	Jing Zhao	Ultrathin Membranes Based on Single-Layer Graphene and Laminar Graphene Oxide for Molecular Separation
15:00-15:20	Faisal Asfand	Performance Analysis of Membrane Contactors Integrated into Absorber of Absorption Cooling Systems
15:20-15:40	**All attendees**	**Tea break and Networking**
15:40-16:00	Mariolino Carta	Polymers of Intrinsic Microporosity (PIMs) for Gas Separation Membranes
16:00-16:20	Haoli Zhou	Molecular Separation of Nitrogen and Volatile Organic Compounds via Microporous Polymer Membrane
16:20-16:40	Greg Mutch	Single Pore Engineering and Measurement of Permeation Rates via Visualisation
16:40-17:00	Bernardo Castro-Dominguez	Development of a Large-scale Multitube Palladium-based Membrane Module for H_2 Separation
17:00-17:20	Faizan Ahmad	Membrane Processes for CO_2 Capture and Hydrogen Purification
17:30-17:50	**All attendees**	**Bus transfer to the Hotel**
18:30-20:00	**All attendees**	**Dinner at Hotel and Networking**

October 16, 2018		
Location: Conference Center at State Key Laboratory of NJTech		
Topic 2 Membrane reactors		
8:20-8:50	**All attendees**	**Bus transfer to NJTech**
8:50-9:10	Francisco Garcia-Garcia	Multifunctional Catalytic Reactors for a Fast Growing World
9:10-9:30	Zhentao Wu	Micro-Structured Ceramic Membranes for Catalytic Reactions
9:30-9:50	Guanghu He	Titanium-based Oxygen Transporting Membrane Reactor
9:50-10:10	Guangru Zhang	Design, Fabrication and Applications of Dense Ceramic Catalytic Membrane Reactors
10:10-10:30	Hong Jiang	Membrane Dispersion: An Efficient Technology for Heterogeneous Catalysis
10:30-10:50	**All attendees**	**Tea break and Networking**
Topic 3 Membranes for Energy Production		
10:50-11:10	Liping Wen	Biomimetic Asymmetric Nanochannel Membrane for Energy Conversion
11:10-11:30	Gyorgy Szekely	Nanofiltration: A Sustainable Platform for Molecular Separations
11:30-11:50	Tao Li	Functional Ceramic Hollow Fiber--From Advanced Fabrication to 3D Characterization
11:50-12:10	Dengjie Chen	Solid-state Electrolyte Membranes with Enhanced Ionic Conductivity for Lithium-ion Batteries
12:10-12:30	Chenxi Xu	Advanced Electrolytes for High Temperature Proton Exchange Membrane Fuel Cells
12:30-14:00	**All attendees**	**Lunch at campus and Networking**
14:00-16:00	**All attendees**	**Lab tour (State Key Laboratory & Membrane Science and Technology Center)**
16:00-16:40	**All attendees**	**Bus transfer to the city center**
16:40-19:00	**All attendees**	**Chinese confucius culture and Chinese examination history introduction**
19:00-21:30	**All attendees**	**Banquet**
21:30-22:00	**All attendees**	**Bus transfer to the hotel**

October 17, 2018		
Location: Conference Center at State Key Laboratory of NJTech		
Topic 3 Water treatment		
8:20-8:50	**All attendees**	**Bus transfer to NJTech**
8:50-9:10	Zhining Wang	Construction of Biomimetic Channels for High Performance Water Purification Membranes
9:10-9:30	Gary Dunderdale	Polymer Brushes as Components of Stimuli-Responsive Membranes
9:30-9:50	Naixin Wang	Nano-Confined Zeolitic Imidazolate Framework Membranes with Surface Layers of Nearly Zero Thickness
9:50-10:10	Jing Ji	Fouling Resistant 2D Boron Nitride Nanosheet – PES Nanofiltration Membranes
10:10-10:30	Zhaoliang Cui	Design and Industrialization of PVDF Membranes with High Anti-fouling Property
10:30-10:50	**All attendees**	**Tea break and Networking**
10:50-11:10	Peng Song	Spatial Variation of Flux for Microfiltration Fouled with Activated Sludge in Stirred Dead–End Microfiltration Cell
11:10-11:30	Christopher Davey	Membrane Technologies for Decentralised Sanitation, Energy Recovery and Anaerobic digestion.
11:30-11:50	Alireza Abbassi Monjezi	Decentralised Production of Freshwater Using Membrane Wastewater Treatment and Desalination Processes Coupled with Solar Energy
11:50-12:10	Tanveer Tabish	Nanostructured graphene for effective water cleaning
12:10-12:30	**Wanqin Jin**	**Wrap-up/workshop summary**
12:30-14:00	**All attendees**	**Lunch and Networking**
14:00-14:30	**All attendees**	**Bus transfer to the Membrane Industry Park**
14:30-15:30	Ming Zhou	Introduction of MST
15:30-17:30	**All attendees**	**Membrane Industry Park Tour**
17:30-18:00	**All attendees**	**Bus transfer to the hotel**
18:30-20:00	**All attendees**	**Dinner at hotel and Networking**

October 18, 2018		
Location: Mingfa Pearl Spring Hotel		
All day	**All attendees**	**Pearl Spring Scenic Area (Free tickets provided)**

Abstracts and Biography

(ECRs List, in alphabetical order)

Alireza Abbassi Monjez

Postdoctoral Research Associate
University of Edinburgh
a.abbassi@ed.ac.uk

Biography

The focus of my research, during PhD studies and post-doctoral career, has been the development of decentralised, carbon-free and environmentally friendly water treatment and desalination systems coupled with renewable sources of energy. My previous roles at the University of Surrey and Queen Mary University of London were based on coupling the latest innovations in water treatment and desalination with solar energy to introduce novel methods for off-the-grid production of freshwater for irrigation, sanitation and drinking purposes. These processes can also be employed to ensure water and food security in the context of sustainable development. I have also developed a compact, modular and self-powered process for wastewater treatment which can contribute towards alleviating water stress in remote areas.

Presentation abstract

Decentralised production of freshwater using membrane wastewater treatment and desalination processes coupled with solar energy

Alireza Abbassi Monjezi
University of Edinburgh

With growing population and shrinking resources, it is predicted that about 40% of the world's population will be living in areas of serious water stress by 2050. Urbanisation has also resulted in utilisation of freshwater resources for urban areas leading to drainage of aquifers which have always been the sources of freshwater for irrigation. With the consequences of climate change causing further precipitation uncertainties and pollution of water resources due to increased industrialisation, consumption of chemical fertilizers and floods, it is important to explore innovative solutions to ensure consistent freshwater supply for human consumption and irrigation purposes. Membrane processes such as forward osmosis (FO), reverse osmosis (RO) and electrodialysis (ED) coupled to solar energy generation methods can be employed to treat wastewater and desalinate seawater leading to the provision of freshwater for human consumption and irrigation as well as mitigation of the environmental impact of agricultural and industrial activities by preventing the pollution of water resources. Two novel processes concerning solar energy powered desalination will be presented for coupling FO with a solar pond and RO with a PVT solar energy generation module. The developed methods significantly reduce the specific energy consumption of desalination whilst providing a substantial reduction in the environmental impact in comparison with conventional desalination techniques. Furthermore, the deployment of forward osmosis in wastewater treatment and desalination for agricultural development through fertigation will be discussed.

Bernardo Castro-Dominguez

Lecturer
University of Bath
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Biography

Dr Bernardo Castro joined the University of Bath (UK) in September 2017, as Lecturer (Assistant Professor) in Chemical Engineering. Previously, he was a Postdoctoral Fellow at the Synthesis and Solid State Pharmaceutical Centre at the University of Limerick (Ireland), working in the area of continuous manufacturing of pharmaceutical products and the development of “smart” membranes for drug delivery. Bernardo held a position from 2014-2016 as a Research Professor in Chemical Engineering and Teaching Professor in Chemistry at Worcester Polytechnic Institute (USA), working in the area of palladium and palladium/alloy membranes, process intensification, economic assessments, hydrogen production and catalysis. In 2013, he obtained his PhD in Chemical Systems Engineering from the University of Tokyo (Japan), specializing in the area of liquid membranes and mixed matrix membranes. He earned his MSc and BSc degrees in Chemical Engineering from the University of Utah (USA).

Presentation abstract

Development of a Large-scale Multitube Palladium-based Membrane Module for H_2 Separation

Bernardo Castro-Dominguez
Centre for Advanced Separations Engineering, Department of Chemical Engineering, University of Bath, Bath, UK.
Center for Inorganic Membrane Studies, Worcester Polytechnic Institute, Worcester, USA.

Palladium/alloy membranes were synthesized under porous stainless steel supports with surface area of 150 cm^2. Seven of these membranes were used to construct a large-scale multitube membrane module with a total permeable area of 1050 cm^2 was tested under actual coal-derived syngas. The remaining membranes were integrated in reactors for the generation of H_2 via water gas shift and methane or ethanol steam reforming. The membranes were evaluated further by detailed computational fluid dynamic (CFD) simulations to further understand the phenomena occurring as this technology evolves. The multitube module was tested under industrial conditions, producing 6 lb of H_2 day^{-1} and displaying an excellent stability for 800 h. The implementation of a large-scale catalytic membrane reactor modules for water gas shift, ethanol steam reforming and methanol steam reforming enhanced the generation of H_2 and clearly proved the capacity to support the concept as well as advance key objectives of process intensification. In particular, the large-scale water gas shift membrane reactor produced 1.2 lb of H_2/day. Certainly, these composite membranes showed outstanding long term performances in actual coal derived syngas with high resilience towards gasifier trips and process upsets under actual industrial conditions. It has been concluded that: (i) the tests under actual coal derived syngas further demonstrated that the membrane manufacturing technology under consideration is becoming mature, reliable with viable commercialization prospects. (ii) the membrane technology of interest is now ready for its application at larger-scales.

Chenxi Xu

Associate Professor
Hefei University of Technology
xuchenxi31@126.com

Biography

Assoc. Prof. Chenxi Xu is currently an associate professor of School of Materials Science and Engineering, Hefei University of Technology (HFUT), China. He is deputy director of institute of hydrogen energy systems and engineering- a cross faculty Institute at HFUT promulgating multi-disciplinary research leading to a sustainable hydrogen energy supply. He received his PHD degree from Newcastle University in 2013. His research interests include functional nanomaterials and their applications in PEM fuel cells (electrolyte, catalyst etc.). He has authored 3 books chapters and more than 40 scientific publications in prestigious journals including Advanced Materials, Journal of Materials Chemistry, Journal of Power Sources, Fuel etc. with more than 600 citations.

Presentation abstract

Advanced electrolytes for high temperature proton exchange membrane fuel cells

Chenxi Xu

School of Materials Science and Engineering, Hefei University of Technology

Compared to traditional low temperature Nafion based fuel cells, High temperature (over 200°C) proton exchange membrane fuel cells (HTPEMFC) performed such advantages: 1) a lower activation energy requirement and faster reaction rates, 2) lower Pt loading requirements or even the use of a non-noble catalyst, 3) improved CO tolerances leading to simplified fuel pre-treatment techniques, and, 4) higher ionic conductivities and simple heat and power co-generation systems. The solid proton conductors are the suitable materials to use as high temperature electrolyte. The inorganic materials including 2D materials, cesium dihydrogen phosphate (CsH_2PO_4) and tetravalent metal ion pyrophosphates (MP_2O_7, M=Sn, Ti, Ce, or Zr) could be used as filler in polymer matrix or solid electrolyte between 100 °C and 400 °C. In this presentation, our recent efforts in developing highly temperature PEMFC will be overviewed.

Christopher Davey

Research Fellow
Cranfield University
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Biography

Chris received his MSci degree in Chemistry from the University of Nottingham in 2012. After which he joined the Centre for Sustainable Chemical Technologies and Department of Chemical Engineering at the University of Bath to undertake his PhD investigating the application of the membrane processes of nanofiltration, reverse osmosis and pervaporation for the low energy recovery of fermentation products. He joined Cranfield University in 2017 as a Research Fellow in Membrane Science as part of the Nanomembrane toilet project supported by the Bill & Melinda Gates Foundation's reinvent the toilet challenge. Currently his work is focussed on a number of membrane technologies for the processing of faecally contaminated urine including membrane distillation and ultrafiltration as well as reverse electrodialysis for energy recovery within a decentralised sanitation system. In addition to this Chris has been working on a number of different membrane processes for wastewater treatment including ammonium salt production in membrane contactors and reverse electrodialysis for thermal energy recovery.

Presentation abstract

Membrane Technologies for Decentralised Sanitation, Energy Recovery and Anaerobic digestion

C. J. Davey, F. Kamranvand, P. Liu, A. Hulme, E. Mercer, M. Hermassi, E. J. McAdam

Cranfield Water Science Institute, Cranfield University, Bedfordshire, United Kingdom

Membrane technologies provide unique solutions to challenging separations and processes. The application of these technologies; however, presents specific process engineering problems. This talk focusses on our current work on various membrane technologies for water and energy recovery for decentralised sanitation and for separations within anaerobic digestion and the production of biomethane from biogas.

Water recovery from highly concentrated black water consisting almost entirely of urine and faeces is a challenging separation due to the complexity and dynamic nature of the mixture. Despite the high fouling propensity of the target feed, membrane technologies exhibit promising characteristics for separations of this nature whilst adhering to the low energy consumption required for a decentralised sanitation system. Membrane distillation (MD) has been identified as a suitable technology to achieve this separation. For the application of MD in this manner, investigations into the advantages of different module configurations (air gap MD, direct contact MD, vacuum MD, sweep gas MD) and the practical application of these have been undertaken. In addition, further enhancement to the resilience of the separation is being explored through upstream application of ultrafiltration.

A decentralised sanitation system must have a low and preferably self-sufficient energy requirement. As human faeces presents itself as a potential fuel, the low grade heat released on its combustion could be utilised with a robust thermal-to-electrical system. A process based on the production of salinity gradients using MD and the generation of electrical energy from these using reverse electrodialysis (RED) is being developed.

Membrane contactors provide a potential solution to many separations within anaerobic digestion and the production of biomethane from biogas. The main focus of this work is investigating the removal of ammonia via membrane facilitated liquid-liquid extraction from anaerobic digestate sludge to change the value proposition of the sludge, and membrane module development for gas-liquid separation.

Dengjie Chen

Professor
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Biography

Dr. Dengjie Chen is an Associate Professor at Jinan University, Guangzhou, China. He has been supported by Pearl River S&T Nova Program since 2018. He received his B.E. (2008) and Ph.D. (2013) from Nanjing Tech University (used to be Nanjing University of Technology), where he carried out his research on the development and optimization of perovskite-type materials for solid oxide fuel cells under the supervision of Prof. Zongping Shao. After that, he joined Francesco Ciucci's group at the Hong Kong University of Science and Technology as a Post-Doctoral Research Associate in 2013. Dr. Chen has authored or co-authored more than 60 publications in internationally renowned journals such as Chemical Reviews, ACS Catalysis, Journal of Membrane Science, etc. Dr. Chen has served as an editorial board member of Current Catalysis, and as a reviewer of more than 20 journals. His current research is focused on advanced materials for electrochemical energy storage and conversion devices, perovskite oxides for oxygen separation membranes, and solid-state electrolyte membranes for batteries.

Presentation abstract

Solid-state electrolyte membranes with enhanced ionic conductivity for lithium-ion batteries

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Solid-state electrolytes have gained increased attention, thanks to the improved safety, the prolonged service life, and the effective suppression on the lithium dendrites. However, a low ionic conductivity (<10^{-5} S cm^{-1}) of solid-state electrolytes at room temperature needs to be greatly enhanced. In addition, the sizeable interfacial resistance between the electrodes and the electrolyte is a significant bottleneck in the employment of solid-state electrolytes. In this talk, natural halloysite nanotubes (HNTs) was tried as an efficient filler to poly (vinylidene fluoride) (PVDF) to fabricate composite polymer electrolytes (CPEs). For example, CPE-5 (HNTs 5 wt.%) shows an ionic conductivity of ~3.5×10^{-4} S cm^{-1}, which is ~10 times higher than the CPE-0 (without the addition of HNTs) at 30 °C. The greatly increased ionic conductivity is attributed to the negatively-charged outer surface and a high specific surface area of HNTs, which facilitates the migration of Li^+ in PVDF. In other work, ceramic oxides (e.g. $Li_{6.4}La_3Zr_{1.4}Ta_{0.6}O_{12}$, LLZTO) were introduced to PVDF to form CPEs, characterized by high conductivity, tensile strength, and flexibility as well as low impedance if interfacially modified by a minute amount of liquid electrolyte. A solid-state lithium-ion battery using LLZTO-PVDF with $LiFePO_4$ and Li as electrodes delivers excellent rate capability and cycling stability at room temperature. In particular, the battery shows an initial discharge capacity of 155 mAh g^{-1} and, after 100 cycles at 1 C, of 145 mAh g^{-1}. Even at 4 C, the discharge capacity is 96 mAh g^{-1}. Our study suggests that a composite polymer electrolyte with high conductivity can be realized by introducing natural HNTs or ceramic oxides, and can be potentially applied in solid-state lithium-ion batteries after the interfacial modification.

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Biography

Dr. Faisal Asfand is a Research Fellow in Thermodynamic Modelling at Cranfield University. He received his Bachelor's degree (2008) in Mechanical Engineering and a Master's degree (2012) in Fluid Thermodynamics Engineering. In his Master's thesis he performed thermodynamic analysis of combined power and cooling cycles utilizing low grade heat sources. He received his PhD degree from Universitat Rovira i Virgili (Spain) in 2016, where he worked on the heat and mass transfer analysis of a membrane-based absorber for absorption cooling systems. After completion of PhD, Dr. Asfand joined Cranfield University where he is involved in many national and international research projects. These include EU Horizon 2020 projects (WASCOP and SOLWATT) the aim of which is to investigate novel cooling technologies for CSP plants. Under the Newton Institutional Link program he is collaborating with Egyptian partner to investigate low grade heat recovery for absorption chiller and desalination from CSP plants in Egypt. Moreover, he is also involved in investigating supercritical CO_2 power generation cycles, a project funded by Biomass and Fossil Fuel Research Alliance. In addition, he is participating in teaching and supervision of MSc and PhD students.

Presentation abstract

Performance analysis of membrane contactors integrated into absorber of absorption cooling systems

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The absorption refrigeration technology is gaining global acceptance due to its potential to use thermal energy either from solar or waste heat energy sources, instead of mechanical power. However, high initial costs and bigger size are some of the main obstacles that impede their wide use in small scale residential buildings and transport sector. In the conventional absorption refrigeration systems, absorber is an important component and plays a critical role in the overall performance, size, and capital cost of the system. Absorber of an absorption cooling system employing water as a refrigerant works under vacuum conditions and therefore the size of the equipment is usually very big. In this study, a novel membrane-based absorber with a plate-and-frame configuration (Figure 1) has been investigated. Membrane contactors integrated into the absorber module not only improve the heat and mass transfer characteristics but can also allow design of compact components as a result of higher area to volume ratio.

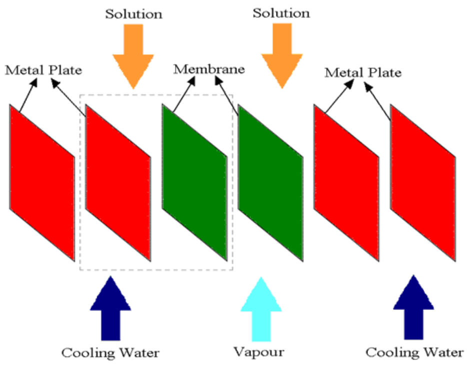

Figure 1: Plate-and-frame absorber with membrane contactor

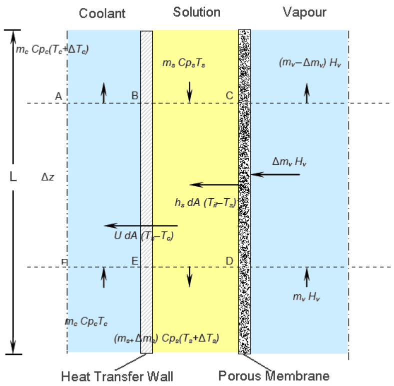

Figure 2: Heat and mass transfer processes in an absorber cell

A steady-state global model based on energy and mass balance equations has been developed to investigate the effect of membrane characteristics on the absorption performance of a membrane based absorber. Figure 2 shows the schematic of heat and mass transfer processes in a membrane absorber cell segment. In addition, a CFD model was developed to study the fluid dynamic behaviour and heat and mass transfer performance of a membrane based absorber. CFD results showed that the absorption rate increases by a factor of 3 when the solution channel thickness is reduced from 2 mm to 0.5 mm however a 50% decrease in the solution film thickness causes an increase in the accumulative pressure drop by a factor of approximately 7.5. Moreover, results show that the effect of membrane characteristics is different in the case of different solution channel thicknesses. For instance, increasing the membrane mean pore size from 0.25 μm to 1 μm enhances the absorption rate by 75% in the case of a 0.1 mm solution channel, whereas in a 0.5 mm solution channel the absorption rate increases by 40%. It is concluded that the membrane mass transfer resistance plays a dominant role when the solution channel thickness is reduced however absorption rate is higher in the case of thinner solution channels because of the lower solution mass transfer resistance.

Faizan Ahmad

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Biography

Dr. Faizan Ahmad is senior lecturer of chemical engineering in the School of Science, Engineering and Design at Teesside University. He has previously worked, in various capacities, in universities and research organizations in South Korea, Pakistan, Malaysia and Germany. He has completed his post-doctoral training from Yeungnam University Korea, PhD from University Technology Petronas Malaysia, MSc from Otto-von Guericke University Magdeburg Germany, and BSc from University of the Punjab Pakistan, all in chemical engineering.

Faizan's research experience includes membrane separation technology, CO2 Capture, clean energy and process simulation. Faizan has 23 publications in the field of process simulation and membrane technology. As a part of his research, "Hollow fibre membrane performance prediction program (HFM3P)" was developed that has been filed for a patent. In addition, the research work has been presented in more than 17 international conferences and 3 invention exhibitions while receiving two gold medals and one silver medal.

Presentation abstract

Membrane Processes for CO2 Capture and Hydrogen Purification

In moving to a Hydrogen Economy and Hydrogen Energy Network there will be a requirement to convert gas supply streams of mixed compositions to hydrogen fuel streams, thereby enabling the consumer to take full advantage of this low carbon fuel. By using best current technology and process intensification methodology, innovative processes can be developed to deliver the lowest practical cost base in terms of installation and running costs per unit of the required purity hydrogen delivered to the consumer. The process feed stream composition variability will range from natural gas to steam methane reformer hydrogen (almost pure hydrogen). The process developed, including system component specifications, will enable SME's to offer scalable and cost effective process systems to hydrogen consumers (domestic, commercial, industrial and transport sectors).

Francisco R. García-García

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Biography

Dr Francisco R. García-García is a Lecturer in Chemical Reaction Engineering at the School of Engineering at University of Edinburgh. His research seeks sustainable solutions to today's emission control and energy production challenges by mimicking nature strategies. The aim of his research group is to design, develop and fabricate multifunctional catalytic reactors inspired by how biological cell works, which allows the integration of multi-process in a single device. Dr Francisco R. García-García holds an MSc in Chemistry by the Autónoma University of Madrid (Madrid, Spain. 1997-2002) and a PhD in Chemical Engineering by the Institute of Catalysis and Petroleum-chemistry, CSIC (Madrid, Spain. 2004-2008). He gained his first post-doctoral experience working at the Department of Chemical Engineering of Imperial College London (2009-2013). In this period, he focused in the design and development of catalytic multifunctional reactors for hydrogen production. Afterwards, he worked as a Senior Scientist at Johnson Matthey in the Emissions Control Department (2013). Despite having a very rewarding experience working in industry, he soon realized that he preferred to be involved in more fundamental science and he moved back to the academia. Hence, he joined the UK Catalysis Hub as a research fellow working at the Chemical Engineering Department at Cambridge University (2014-2015), and at the Chemical Engineering Department at Newcastle University (2015-2016). During this time his research focused in chemical looping reforming for syngas and hydrogen production. Dr Francisco R. García-García is recognized for his knowledge in the area of gas phase heterogeneous catalysis, new materials development, membrane technology and chemical looping in the interphase between chemistry and chemical engineering.

Presentation abstract

Multifunctional Catalytic Reactors for a fast growing world

F.R. Garcia-Garcia

School of Engineering, Institute of Materials and Processes, The University of Edinburg

My research seeks sustainable solutions to today's emission control and energy production challenges by mimicking biological cell strategies. Biological cells can be seen as enhanced multifunctional reactors specifically designed to solve fundamental chemical engineering issues such as thermodynamic limitations, catalyst deactivation, and product separation. For example, cells can overcome the thermodynamic limitations because the reaction sites are enclosed within the cell membrane, which is permeable to some of the reaction products. Likewise, cyclic vs linear pathways allow a quick and economic solution to chemical problems. While these approaches are common in cells, they are only sporadically applied technologically in a purposeful manner. The aim of my research group is to design, develop and fabricate multifunctional catalytic reactors inspired by how biological cells work, which allows the integration of multi-processes in a single device. So far the difficulty of combining chemistry, materials science and engineering knowledge in a single unit has prevented the full development of this concept.

Gary J. Dunderdale

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Biography

I studied as an undergraduate at The University of Sheffield and continued with my PhD under the supervision of Patrick Fairclough studying surface interactions. I obtained a Prize Postdoctoral Fellowship during which I studied pH-responsive polymer brushes, before moving to AIST Japan. There I applied my knowledge of polymer brushes to the field of wetting phenomena under the supervision of Atsushi Hozumi. I returned to the UK and briefly worked in industry for Unilever on shampoo formulation, and then returned to The University of Sheffield again, now studying flow-induced crystallization in polymers.

Presentation abstract

Polymer Brushes as Components of Stimuli-Responsive Membranes

Gary J. Dunderdale

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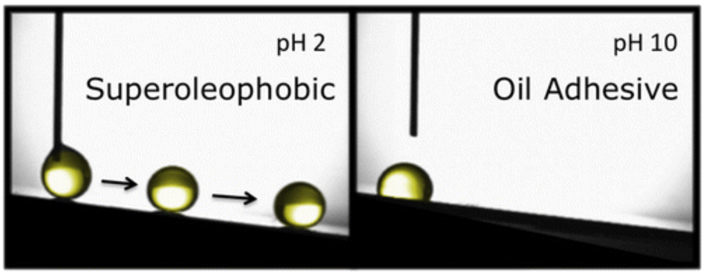
Surface initiated polymerizations are a convenient way to functionalize everyday surfaces such as metals or plastics with extraordinary properties. For example, coatings have been reported which vastly improve the physical properties of surfaces, giving them better optical properties, lower coefficients of friction, or ice-repellent properties. These surfaces can be flat planar objects, or they can be pores in materials such as membranes, or in fact the polymer itself can be used to create a self-assembling membrane similar to those found in nature such as cellular membranes.

These polymeric coatings can also be made to respond to external stimuli such as dissolved ions, pH, temperature, etc., and change their physical properties in the presence of these stimuli. In previous research I have shown that responsive polymeric coatings can be used to switch the affinity of the surface towards oil droplets when submerged in water – at high pH or high salt concentrations, oil drops stick to the surface and are immobilised; whereas at low pH or low salt concentrations, oil drops are completely repelled by the surface and can easily slide across the surface (see fig. 1).



These concepts of surface initiated polymerization and suitable choice of responsive behaviours can be used to create intelligent membranes, which depending of the presence of external stimuli either allow or do not allow the passage of certain materials through the membrane.

I have shown in previous research how metal mesh material can be functionalized with polymers and used to separate large volumes of oily wastewater from industrial processes such as mining, and food production. However, to successfully achieve this separation it is necessary to have two membranes which act in an antagonistic fashion – one purifying the water component (>99.9% mol/mol), and another purifying the oil component (>99% mol/mol). Otherwise, one component of the mixture accumulates on the upstream side of the membrane eventually leading to failure of the membrane.

While the vast majority of published research has labelled functionalized meshes as either “water-selective hydrophilic” or “oil-selective hydrophobic”, this concept of hydrophilicity is too simplistic. In fact it is the advancing contact angles of water-in-oil and oil-in-water which are key to successful purification of oily wastewater. When these contact angles are taken into account it is possible to create a functionalized mesh which can either be used to filter out oil at high purity (>99%), or water at high purity (>99.9%). The decision as to which component is allowed to pass through the filter is made by pre-programming the mesh by first wetting the mesh with either a drop of water (water-selective) or a drop of oil (oil-selective).

Gongping Liu

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Biography

Dr Gongping Liu received his Batchelor’s degree in chemical engineering at Nanjing University of Technology and went on to complete his PhD there in Prof. Wanqin Jin group in 2013 on mixed-matrix membranes and pervaporation process. Following completion of his PhD, Dr Liu joined Nanjing Tech University as a lecturer, and undertook a post-doctoral position in Prof. William J. Koros group at Georgia Tech working on hollow fiber membranes and mixed-matrix membranes during 2015-2017. He then took up an associate professor position at Nanjing Tech University where his current research interests lie in the area of two-dimensional-materials membranes and mixed-matrix membranes for molecular separations.

Dr Liu has published over 60 papers in Nature Materials, Angewandte Chemie, ACS Nano, Advanced Functional Materials, Chemical Society Reviews, Journal of Membrane Science and AIChE Journal with over 2500 citations (H-index: 26). He has received the North American Membrane Society (NAMS) Young Membrane Scientist Award in 2018 and the International Forum on Advanced Materials Young Scientist Award in 2017. He is a Session Editor of BMC Chemical Engineering (part of Springer Nature).

Presentation abstract

Metal-Organic Framework Mixed-Matrix Membranes for Gas Separation

Gongping Liu, Jianwei Yuan, Jiajia Sun, Jie Shen, Wanqin Jin*

State Key Laboratory of Materials-Oriented Chemical Engineering, College of Chemical Engineering, Nanjing Tech University

Membrane gas separation technology offers energy-saving and smaller footprints compared to traditional thermally driven gas amine absorption processes. Polymeric membranes, the dominant commercial membranes for gas separation, are limited by a performance due to trade-off between permeability and selectivity. Although inorganic membranes exhibit much higher gas separation performance, their scalable fabrication remains a challenge. On the other hand, mixed-matrix membranes (MMMs) offer an excellent balance between separation performance and scalability, driven by highly selective and permeable molecular sieve particles dispersed in an appropriate polymer matrix. Purely inorganic zeolite generally shows poor compatibility with organic polymer and often requires additional surface modification to eliminate non-selective interfacial voids. Alternatively, metal-organic frameworks (MOFs) consisting of metal ions/clusters connected by organic linkers are another important class of crystalline molecular sieve porous materials, can be a suitable candidate for MMMs, owing to the diverse functionalities and tunable pore structures.

This presentation will discuss a diverse array of MOF MMMs we developed by introducing different kinds of MOF crystals (e.g., RE-**fcu**-MOF[1], ZIF-300[2], UiO-66[3]) in various polymers (e.g., 6FDA-polyimides, PEBAX) for CO_2 capture, natural gas purification, butane isomers separation. Transport properties were systematically studied via interpreting the sorption and diffusion behaviors. Theoretical framework was employed to predict permeation properties of pure MOF membrane and MOF MMMs using other polymer matrices. Pure-gas and mixed-gas permeations showed that both permeability and selectivity of the polymeric membranes were highly improved by rationally incorporating MOF crystals. The performance of the resulting MOF MMMs were beyond the upper-bounds for traditional polymeric membranes. We demonstrated that MMM is a promising platform for providing high-performance and scalable gas separation membranes, as well as a powerful tool for studying the transport properties of pure MOF membrane.

Greg Alexander Mutch

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Biography

Dr Greg Alexander Mutch obtained a 1st Class Masters of Chemistry degree and a PhD in Chemical Engineering at The University of Aberdeen, Scotland. He was awarded both the William Rudolph Center Medal and the David Christie Memorial Prize for scholarly activities. His PhD thesis was awarded a prize by the Royal Society of Chemistry for UK PhD theses addressing clearly identified needs in the energy sector. He subsequently secured a prestigious EPSRC Doctoral Prize Fellowship to develop new membrane processes and investigative methods. His research interests focus primarily on carbon capture and storage, using both membranes and adsorbents, currently working with Prof. Ian Metcalfe at Newcastle University.

Presentation abstract

Single pore engineering and measurement of permeation rates *via* visualisation

G.A. Mutch*[1], S. Tsochataridou[1], E.I. Papaioannou[1], R.I. Merino[2], M.L. Sanjuan[2], V.M. Orera[2], I.S. Metcalfe[1]

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Dual phase molten salt-ceramic membranes offer the potential for efficient and continuous separation of CO_2 at temperatures where adsorbents (*e.g.* zeolites and carbons) and other membranes (*e.g.* polymeric and microporous inorganic) are generally ineffective. Uniquely placed for operation at > 400 °C, an important step for future development and scale-up of these devices is the determination of an accurate flux equation. In this work, we present a wholly new method of measuring permeation rates, by optically visualising the effect of permeation on molten salts confined to a single pore. We compare single pore data with a novel tubular membrane geometry, providing two comparable leak free systems with well-defined chemical potential gradients across the membrane. Both membrane structures are prepared by microfabrication methods that allow unprecedented control over pore geometry. The combination of microfabrication and visualisation allows us to determine fluxes at low driving forces unobtainable in conventional membrane experiments due to limitations with analytical equipment and the impact of leaks. We will show how the use of such low driving forces is critical in understanding both membrane behaviour and performing rigorous membrane design.

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Biography

Dr. Guanghu He is an associate professor in the group of membrae separation and catalysis, Qingdao Institute of Bioenergy and Bioprocess Technology, Chinese Academy of Sciences (QIBEBT, CAS), and is also a Visiting Scientist in the Institute of Energy and Climate Research (IEK-1) at Forschungszentrum Jülich GmbH.

He completed his master's degree in Chemical Engineering at the University of Tianjin (China) in 2009. After graduation, he started his PhD. under the supervisor of Prof. Ray Allen and Dr. Rachael Elder at The University of Sheffield (UK), on the performance degradation and recovery of YSZ membrane under the sulphuric acid thermal decomposition. After obtaining his PhD. in 2013, he jointed Prof. Jiang's group in QIBEBT where he obtained six personal reserach grants from NSFC, CPSF and CAS, and in 2018, he was elected as a member of Youth Innovation Promotion Association, CAS. His research interest focuses on mixed ionic-electronic conductors for gas separation, coupling of multi-reactions using catalytic membranes reactor.

Presentation abstract

Titanium-based oxygen transporting membrane reactor

G. He[1, 2], F. Liang[1], S. Baumann[2], W. A. Meulenberg[2], H. Jiang*[1]

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Oxygen transporting membrane (OTM) reactors combine catalytic reactions and separation processes in one single unit,[1] thus in such systems process intensification could be easily achieved. Conventional OTM reactors are based on cobalt or iron perovskite oxide and exhibit high oxygen permeability, but their performance always drops rapidly becuase of the low tolerances to low oxygen partial pressure atmospheres.[2-3] As a consequence, there is urgent need to develop new membrane materials that might allow the deployment of the next generation of catalytic OTM reactors exhibiting reasonable oxygen permeability and highly chemical stability under various atmospheres.

Titanium dioxide (TiO_2) is much more thermodynamically stable in reducing atmosphere than most 3d transition metal oxides.[3] Ti^{4+} in titanates can be reduced to Ti^{3+} under low oxygen partial pressure atmospheres, resulting in the formation of oxygen vacancies with the generation of two electrons and enabling these titanates to improve their electrical conductivities.[4]

Herein, we firstly report a novel titanium-based perovskite-type membrane reactor for coupling methane reforming and water splitting reactions. Ti-based membrane exhibits significantly high chemical stability and desired oxygen permeability under reducing atmospheres. These performance of Ti-based membrane reactor may point out towards the development of next generation oxygen transporting membrane reactors that would possess high oxygen permeability and chemical stability for coupling multiple reactions and applying the concept of process intensification.

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Biography

Dr. Zhang received his PhD degree in chemical engineering from Nanjing Tech University in 2013. He went to the UK to continue his research as a postdoctoral Research Associate in Newcastle University. In 2016 Dr. Zhang joined the School of Chemical Engineering and State Key Laboratory of Materials-Oriented Chemical Engineering at Nanjing Tech University as an Associate Professor.

His current research is focused on ionic transport membrane for oxygen separation membranes and catalytic membrane reactors. He has published 25 papers in peer-reviewed journals including Energy and Environmental Science, Advanced Materials, Journal Membrane Science, etc. He has also received 5 patents. He currently holds a National Natural Science Foundation of China and a Natural Science Foundation of Jiangsu Province.

Presentation abstract

Design, Fabrication and Applications of Dense Ceramic Catalytic Membrane Reactors

Guangru zhang, Zhengkun Liu, Wanqin Jin*

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Catalytic membrane reactors (CMR) which carry out separation and reaction in a single unit are expected to be a promising approach to achieve green and sustainable chemistry with less energy consumption and lower pollution. One of the typical CMRs is incorporated with the dense mixed ionic electronic conducting ceramic membrane, which exhibits high oxygen ionic and electronic conductivities at an elevated temperature. The features of high oxygen permeability and excellent catalytic activity make these membranes attractive in energy and environmentally related catalytic reaction processes.

This presentation will review our recent progress on catalytic membrane reactors based on the dense mixed ionic electronic conducting membranes, covering from fundamental study to engineering application. It aims to give an overview of membrane reactor design, fabrication and applications related to utilization of natural gas (eg. partial oxidation of methane) and biofuels (eg. ethanol oxidative steam reforming) and treatment of greenhouse gases (eg. thermal decomposition of carbon dioxide). Synergy between separation and reactions in the membrane reactor and their control strategies will be presented and discussed in detail. Meanwhile, novel membrane material development associated with low temperature application and large-scale hollow fiber membrane fabrication will be introduced. Finally, the emerging challenges and opportunities on this subject will also be discussed.

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Biography

Dr Szekely received his MSc degree in Chemical Engineering from the Technical University of Budapest, Hungary and he earned his PhD degree in Chemistry under the European Commission's Marie Curie Actions from the Technical University of Dortmund, Germany. He worked as an Early Stage Researcher in Hovione PharmaScience and an IAESTE Fellow at the University of Tokyo, Japan. He was a Research Associate working with Andrew Livingston on molecular level separations in Imperial College London, UK. He is currently a Lecturer in Chemical Engineering at The University of Manchester, UK since 2014. Dr Szekely is an Adjunct Faculty at Saveetha University, and recipient of the Distinguished Visiting Fellowship of the Royal Academy of Engineering. His multidisciplinary professional background covers supramolecular chemistry, molecular recognition, molecular imprinting, process development, waste utilization, nanofiltration and pharmaceutical impurity scavenging. He serves as an Academic Editor for the journal Advanced Materials Letters, the Secretary General for the Marie Curie Fellows Association, and a Member of the Royal Society of Chemistry. His research interests and activities can be followed through his personal website at szekelygroup.com.

Presentation abstract

Nanofiltration: A Sustainable Platform for Molecular Separations

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Sustainable manufacturing is one of the grand challenges of the 21st century. It has recently been realized that conventional downstream separation processes are unsustainable because they account for as much as 80% of the total manufacturing costs, and eventually contribute 50% of the industrial energy usage. With profit margins growing thin, there is an imperative drive for minimizing both the cost and environmental impact via process intensification (PI). PI through minimizing solvent and raw material consumption, as well as utilizing waste, can make a significant difference towards environmentally benign and economically viable chemical production. As an effective PI tool, nanofiltration is getting recognized as an emerging technology, which provides green process engineering.[1]

The presentation covers the development of sustainable separation processes using solvent-resistant nanofiltration membranes. Examples and case studies for solvent recovery and recycling,[2–4] yield enhancement,[4–5] integrated catalysis-separation platforms,[5] valorization of waste[2] are discussed. Investigation into the polymer memory effect for nanofiltration membranes as well as its exploitation are explained.[6] The potential of imprinted membranes for unique separations such as three-way fractionation of solutes is discussed. Synergistic coupling of nanofiltration and imprinting technologies for hybrid processes is presented. Examples will demonstrate that separation processes based on nanofiltration and molecular imprinting can reduce carbon footprint by 90% and process mass intensity by 99%. Surface modification of polybenzimidazole membranes for catalytic membrane reactors and improved stability will be discussed.

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Biography

Haoli Zhou received the Bachelor of Science degree from North University of China and the Master degree from Tianjin University. In 2011, he got the Ph.D. in biochemical engineering from Institute of Process Engineering, CAS under the supervision of Professor Yinhua Wan. From 2011 to 2012, he worked at University of Waterloo, Canada, as a visiting scholar. Then, he joined the college of chemical engineering, Nanjing Tech University as lecture in October 2012. He is currently associate professor of chemical engineering. His current research interest focuses on fabrication of polymer membranes such as organic-inorganic membranes, microporous polymer membranes and their industrial applications in molecular separation such as VOCs recovery, VOCs separation from aqueous solution, etc. He has received a number of competitive external research grants from National Natural Science Foundation of China, Ministry of Science and Technology of the People's Republic of China, and so on. He has published more than 20 papers in peer-reviewed journals including Angewandte Chemie International Edition、Advanced Functional Materials、Journal Membrane Science, etc. He has also received over 7 patents.

Presentation abstract

Molecular separation of nitrogen and volatile organic compounds via microporous polymer membrane

Haoli Zhou*, Chuanxin Zong, Tong Tong, Yuxue Li, Wanqin Jin*

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VOCs can be easily released to atmosphere in the chemical processes because of the difficulty in operation under full air tight conditions. Escaping VOCs will not only be harmful to people and environment but also cause a great waste. Membrane technology with potential advantages of high selectivity, low operating cost, simple and compact equipment, and easy operation requiring no regeneration steps etc. has been regarded as a more attractive technology for recovering volatile organic compounds over the traditional methods. Here, a novel N_2 perm-selective microporous polymer membrane was developed and used for the VOCs treatment. This membrane exhibits outstanding separation performance and good stability for the molecular-sieving separation of N_2 over VOCs such as cyclohexane. The rejection rate of the membrane can reach above 99% under the feed pressure only about 4 kPa. This approach promotes development of microporous membranes for separation of condensable gases.

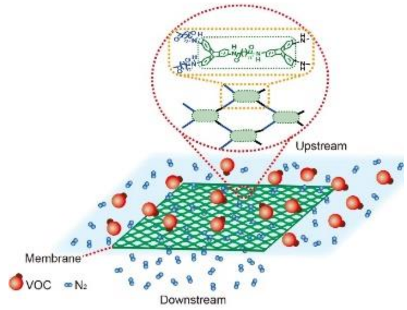

Fig.1 Schematic diagram of N_2 perm-selective membrane

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Biography

After receiving her Ph.D. from Nanjing University of Technology in 2012, she joined National Engineering Research Center for Special Separation Membrane, Nanjing Tech University as a lecturer. Her current research interest focuses on the rational design and engineering of membrane reactors based on ceramic membrane, and their application in heterogeneous catalysis. She has published over 30 SCI papers in *Industrial & Engineering Chemistry Research*, *Chemical Engineering Journal*, *Journal of Membrane Science,* etc.

Presentation abstract

Membrane Dispersion: An Efficient Technology for Heterogeneous Catalysis

Hong Jiang, Yucheng Liu, Yefei Liu and Rizhi Chen*

State Key Laboratory of Materials-Oriented Chemical Engineering, Nanjing Tech University

Heterogeneous catalysis plays an important role in the chemical and petrochemical industries. Heterogeneous hydrogenation and oxidation are two kinds of widely applied and valuable reaction, which need to be operated at low temperature and high pressure or fed excess reactants to achieve a desirable reaction rate, leading to a great amount of energy consumption. Hence, it is urgent to develop new technologies for the intensification of heterogeneous processes.

In our study, a slurry reactor and a fixed-bed reactor with porous ceramic membranes as the dispersion media of reactants, has been developed for gas/liquid/solid and liquid/liquid/solid heterogeneous catalytic reaction systems [1-3]. Normally, one of the gas-phase or liquid-phase reactants can be dispersed into another liquid-phase reactant through a porous membrane with nano- and micron-sized pores. The mixing scale and reaction performance can be controlled by membrane structure, flow rate, and fluid properties. In these studies, the ceramic membranes could provide controllable and uniform distributed reactants in micro-scale size, meanwhile the controlled addition of reactants limited the side reactions or promoted the transformation of reactant and thereby enhancing the product selectivity or conversion and reducing the reactant consumption.

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Biography

Dr. Jing Ji is currently working as a post doc at University of Bath in the UK. She obtained her MEng degree in Polymer Science and Engineering from Zhejiang University. Then she further pursued her study of master and PhD in Chemical Engineering at Imperial College London. She received the MSc degree with distinction and then completed her PhD under the supervision of Prof. Kang Li. In 2017, she joined the Department of Chemical Engineering at University of Bath working with Prof. Davide Mattia. Her research interest is mainly focused on developing membranes for water purification ranging from microfiltration to ultrafiltration and nanofiltration. Currently, she is working on membranes incorporating 2D nanomaterials such as boron nitride nanosheets.

Presentation abstract

Fouling resistant 2D boron nitride nanosheet – PES nanofiltration membranes

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The preparation of graphene oxide (GO) membranes has opened the way to investigating the use of other 2D materials in mixed matrix membranes. Boron nitride nanosheets (BNNS), less investigated than GO, due to higher difficulty in exfoliating the initial material, are of interest as a filler material due to promising physico-chemical properties. In our work, a gentle exfoliation method was proposed to produce large and thin BNNS rapidly. Then a novel fouling-resistant nanofiltration mixed-matrix membrane was obtained by incorporating BNNS in polyethersulfone (PES). The addition of just 0.05 wt% of BNNS into the PES matrix led to a 4-fold increase in pure water permeance with a 10% decrease in the rejection of the dye Rose Bengal; up to 95% rejection of humic acid and nearly 100% flux recovery over two cycles in cross-flow fouling tests without the need for chemical cleansing. This performance is attributed to the uniform distribution of the BNNS in the PES matrix, observed via Raman mapping, and the surface chemistry and structure of the BNNS, which hydrophilised the polymer matrix and reduced its surface roughness. The low amount of BNNS filler needed to render the mixed-matrix membrane fouling-resistant opens the way to its use in waste-water treatment applications where organic fouling remains a major challenge.

Jing Zhao

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Biography

Jing Zhao received her Bachelor and Doctor of engineering degree from Tianjin University under the supervision of Prof. Zhongyi Jiang in 2010 and 2015, respectively. Since 2015, she started working in Nanjing Tech University. She did her postdoc research in Ecole Polytechnique Fédérale de Lausanne (EPFL, Switzerland) from 2017.03 to 2018.09. Her current research interest focuses on ultrathin membranes, two-dimensional-material membranes and their applications in molecular separation such as gas separation and pervaporation. She is the principal investigator of several grants from National Natural Science Foundation of China, Natural Science Foundation of Jiangsu Province. She has published about 40 papers in journals including Prog. Polym. Sci., Adv. Mater., J. Mater. Chem. A, J. Membr. Sci., and received 8 patents.

Presentation abstract

Ultrathin membranes based on single-layer graphene and laminar graphene oxide for molecular separation

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As the thinnest membrane, single-layer graphene is highly promising to achieve ultrafast molecular transport. One of the bottlenecks in realizing the potential of atom-thick single-layer graphene membrane for molecular-sieving is the difficulty in incorporating nanopores in graphene lattice, with a narrow pore-size-distribution at a high-enough pore-density. This is especially challenging for gas-sieving which requires an Å precision in the lattice-etching. We achieved this by developing a synergistic, decoupled defect-nucleation and pore-expansion strategy with O_2 plasma and O_3 treatments to achieve a record-high gas separation performance for H_2/CH_4 and H_2/C_3H_8. This pore-etching strategy is reproducible and scalable and will accelerate the development of single-layer-graphene-based energy-efficient membranes.

Compared with single-layer graphene, laminar membranes assembled from graphene oxide (GO) provide a more practical approach for separation application. However, for precise molecular separations in liquid environment, the implementation of high performance in terms of flux, separation factor and stability remains a critical challenge. We proposed a synchronous manipulation strategy in terms of the chemical and physical structures of GO interlayer channels to intensify the water-selective transport through GO membrane for pervaporation dehydration application. A superior water/ethanol and water/butanol separation performance can be achieved with a desirable long-term stability.

Kang Huang

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Biography

Dr. Kang Huang is a post-doctor at Imperial College London in Prof. Kang Li's group. He graduated from Nanjing Tech University, Prof. Wanqin Jin's group. Dr. Huang is actively engaged in the fields of the fabrication and application of metal-organic framework (MOFs) and graphene oxide (GO) membranes.

Presentation abstract

Preparation and Application of Ceramic-supported Metal-Organic Framework Membranes

Kang Huang

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Membrane-based separation outperforms other techniques for separation of matters at molecular level because of its low cost, energy saving potential, high capacity, continuous operation and easy scale-up, but raise high requirements for the membrane materials. Recently, metal-organic frameworks (MOFs) have attracted great attention because of their large surface areas, chemically functionalized cavities, flexible skeletons, and intriguing electronic properties. These unique features make them excellent candidates for applications in membrane separation fields. In the presentation, I will briefly introduce my works on the preparation and application of MOF membranes based on ceramic supports (ceramic disc and hollow fiber), including [Ni_2(L-asp)$_2$(bipy)], [Zn_2(cam)$_2$dabco], ZIF-8, ZIF-71 and UiO-66 membranes.

Liping Wen

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Biography

Dr. Liping Wen is currently a professor at the Technical Institute of Physics and Chemistry, Chinese Academy of Sciences (TIPCCAS). He received his MS degree in organic chemistry from Liaoning Normal University in 2007. Then, he received his Ph.D. degree in physical chemistry from the Institute of Chemistry, Chinese Academy of Science (ICCAS) in 2010 at Prof. Lei Jiang's group. Prof. Wen's current scientific interests are mainly focused on the construction and application of bioinspired asymmetric smart nanochannel membranes. He was granted the "2016 National Science Fund for Distinguished Young Scholars of China" and the "2017 National Key Research and Development Program of China" for supporting his work in environment, health, energy, and desalination fields.

Presentation abstract

Biomimetic Asymmetric Nanochannel Membrane for Energy Conversion

Liping Wen

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Learning from nature has inspired the creation of intelligent devices to meet the increasing needs of the advanced community and also to better understand how to imitate biology.[1] As one of biomimetic nanodevices, nanochannels or nanopores aroused particular interest because of their potential applications in nanofluidic devices, biosensing, filtration, and energy conversions. Here, by manipulating and modifying the surface of the artificial nanochannels, we developed some biomimetic smart nanochannels for practical applications, such as energy conversion,[2] bioinspired photo-driven ion pump.[3] Such applications with biomimetic nanochannels can not only help people to know and understand the living processes in nature, but also inspire scientists to study and develop novel nanodevices with better performance for the mankind.

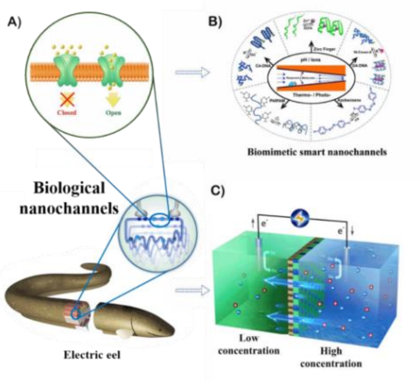

Figure 1. A) Biological nanochannels. Nanochannels in electric eel for discharging. B) Biomimetic smart nanochannels. C) Nanochannels based membrane for salinity gradient energy generation

Mariolino Carta

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Biography

My research started with a Master's degree in Organic Chemistry in Italy in 2004, working on pharmaceutical active compounds (PNAs). In 2005, I moved to *Cardiff University* to do my PhD in Organic Material Chemistry. After completing the PhD in 2008, I held a PDRA position in Cardiff until 2014, when I moved to the *University of Edinburgh* for another PDRA position. In October 2017, I have been appointed as Lecturer in Chemistry at *Swansea University*, which is my current workplace. To date I published over 70 scientific outputs including peer-reviewed papers, patents, conference proceedings and chapters. These outputs have been cited over 1500 times, which yield me an h-Index of 22. (Scopus). I am a Fellow of the Higher Education Academy (HEA), a member of the Royal Society of Chemistry (MRSC) and a STEM Ambassador. I contributed to very successful multi-million, multi-disciplinary consortia such as the EPSRC *Supergen XIV*, the EU consortium *M4CO2* and the EPSRC funded *SynFabFun*

Presentation abstract

Polymers of Intrinsic Microporosity (PIMs) for gas separation membranes

Polymers of Intrinsic microporosity (PIMs) are materials whose porosity is induced by the inefficient packing of their long chains in the solid state, which leaves pores of nano-dimension. They provide advantages over similar polymers as they are composed of only light elements such as C, H, N, O. Their high BET surface areas make them suitable for application as gas storage and gas separation.[1] Particular emphasis is placed on the functionalisation of organic monomers to introduce a *site of contortion*, an essential characteristic to induce microporosity, and on the development of novel synthetic procedures for the preparation PIMs to be used for high performing membranes for gas separation and purification. Recently, the very challenging quest for new selective membranes with enhanced gas separation performance, led us to the design and synthesis of a brand-new class of polymers based on the formation of *Tröger's base* units.[2] The improvement of the performance of PIMs can be enhanced by preparation of novel Mixed Matrix Membranes (MMMs), which are new materials that link the use of organic polymeric supports (our polymeric materials) to the inorganic nature of MOFs or other additives. Along with the work on gas separation, in the past few years, we started extending the range of applications for PIMs. For instance, in collaboration with other excellent research groups, we exploited our polymers in different scientific fields such as catalysis,[3] ionic diodes[4], and highly conductive anionic exchange membranes.[5]

Naixin Wang

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Biography

Dr. Naixin Wang received his PhD in Applied Chemistry from Beijing University of Technology. From March to September 2011, he was exchanged to Curtin University of Technology. After graduated since July 2013, he joined the Department of Chemical and Chemical Engineering in Beijing University of Technology. His current research fields include novel functional nanomaterial for separation membrane and the application of novel membrane process. To date, he has co-authored over 40 SCI papers and applied 10 patents.

Presentation abstract

Nano-Confined Zeolitic Imidazolate Framework Membranes with Surface Layers of Nearly Zero Thickness

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The key to preparing dense composite membranes is reducing the thickness of the separation layer with stable separation performance. Herein, we report a nano-confined composite (NCC) membrane prepared by in situ growth of Zeolitic Imidazolate Framework (ZIF) nanocrystals in the nanoporous layer of the substrate. The size and distribution of particles can be controlled by using the confined space within the substrate. The thickness of the separation layer on the membrane surface was nearly zero. Therefore, the fabricated composite membranes almost have no barrier layer on top surface of the substrate. Nanoporous particles are embedded in the nanopores of the sub-surface to form a selective mass transfer channel. The formed ZIF nano-confined composite membranes showed state-of-art flux and high stability in removing dyes from water. This new strategy is expected to offer great opportunities for the potential practical application of polymer-supported metal-organic framework (MOF) composite membranes.

In this study, NCC membranes were fabricated using a fine-tuning contra-diffusion method. Metal organic framework (MOF) nanocrystals were formed in the nanoporous layer of the sheet polyacrylonitrile (PAN) ultrafiltration support membrane. Metal ion solution (zinc acetate, Zn^{2+}) and organic ligand solution (Benzimidazole, Bim) were separated on each side of the hydrolyzed PAN porous substrate. Both of the solutions diffused to the opposite side through the pores of the substrate. Zn^{2+} and Bim interacted in the pores to form MOF crystals (ZIF-11) through coordination. The ZIF-11 nuclei were immobilized in the pores because of the coordination interaction between Zn^{2+} and the carboxylate groups of the hydrolyzed PAN substrate. The nanoparticles consequently grew in this nano-confined

space. Subsequently, the ZIF-11/PAN NCC membranes were finally prepared. The separation performance for the ZIF-11/PAN membrane had a flux of 464 L/m^{2}hMPa and a rejection of 98.4%. This membrane can stably run for 60 h without performance degradation. The excellent separation performance as well as the good stability of the membrane make it has a great potential application in nanofiltration fields. In view of these advantages, we anticipate that this strategy may contribute to the preparation of various MOF membranes on polymer porous substrates in many separation fields.

Key words: Nano-confined membrane, zero thickness, nanofiltration, high flux

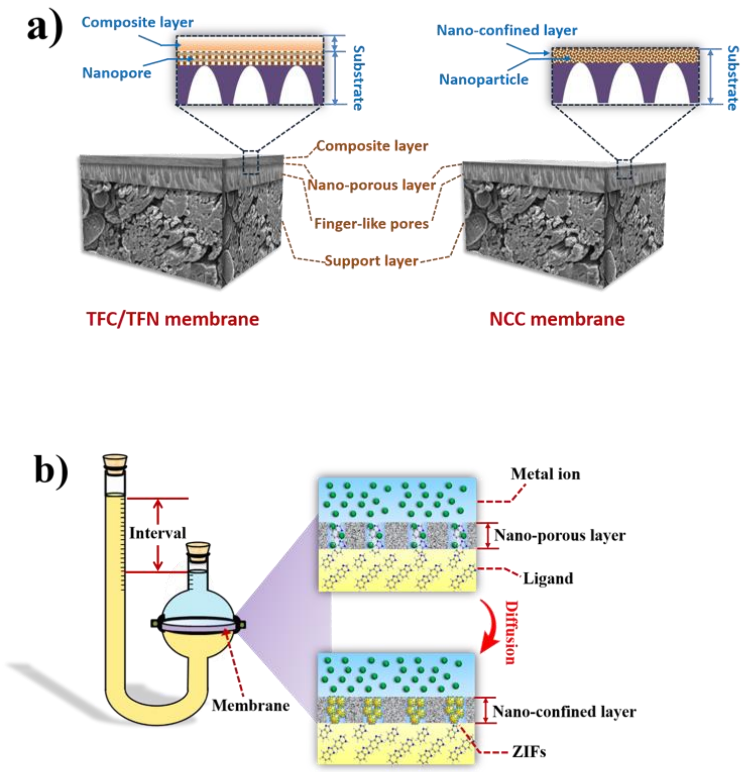

Figure 1. (a) Comparison of the microstructure of the TFC/TFN membrane and the NCC membrane; (b) Illustration of the home-made U type diffusion cell and contra-diffusion process.

Peng Song

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Biography

Dr. Peng Song is currently a lecturer in the Department of Chemistry and Chemical Engineering, Beijing University of Technology where he has been a faculty member since August, 2017. His current research interests are membrane fouling and cleaning study as well as electrochemical analysis.

Peng completed his Ph.D. in Chemical Engineering under the supervision of Dr. Adrian C. Fisher at the Department of Chemical Engineering and Biotechnology, University of Cambridge. Afterwards he carried on as a research associate in the same department under Singapore CREATE Cambridge programme for two years. His research interests lie in the area of electrochemical analysis, electrochemical sensing of sulfide and electrochemical microfabrication. Peng received his Bachelor degree in Chemical Engineering in Beijing University of Chemical Technology. He has published more than 10 peer-reviewed papers in collaboration with the research groups across UK, Singapore and China.

Presentation abstract

Spatial variation of flux for microfiltration fouled with activated sludge in stirred dead–end microfiltration cell

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Based on the variation of cake properties (the specific cake resistance and the cake solidosity) and shear stress with time, a fouling model was proposed to determine the model parameters by fitting experimental data. Moreover, space variation of flux were quantitatively analyzed by the proposed equations containing variation of shear stress with time and location. These results showed that: the proposed fouling model could accurately described the membrane flux and filtration resistance under different fouling conditions (MAE < 5.9 %, R2 > 0.93), which was more accuracy than Z.Wang,s model (MAE < 34.8 %, R2 > 0.75). The denudation coefficient (K) was proportional to suspension concentration, operation pressure and agitation velocity and was inversely proportional to feed temperature. Variation of flux fluctuation was dependent on the variation of cake properties (cake thickness, specific cake resistance and cake solidosity) in the range of 0 to δmin when cake resistance was much more than membrane resistance. However, flux fluctuation was dependent on the variation of cake properties (cake thickness fluctuation) in the range of δmin to δmax when membrane resistance was much more than cake resistance. In conclusion, this study demonstrated a robust technique to predict the filtration cake structure in dead-end microfiltration cell.

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Biography

Dr Tao Li graduated with a BS in Applied Chemistry from Dalian University of Technology in 2010. He earned his MSc (2011) and PhD (2015) from Imperial College London, department of chemical engineering.

Currently he is a research associate at Imperial College London. Dr. Li is actively engaged in the fields of (i) ceramic membrane design/advanced manufacturing (ii) energy-related membrane applications, such as oxygen permeable membrane, high-temperature membrane reactor, solid oxide fuel cells (SOFCs), etc. His expertise also involves the application of 3D characterization technique to further understand the influences from the unique hierarchical structure from phase inversion process, which provides a useful tool to provide real spatial information of a 3D structure.

Presentation abstract

Functional Ceramic Hollow Fiber --From Advanced Fabrication to 3D Characterization

Tao Li[1], Mohamad F. Rabuni[1], Xuekun Lu[2], Paul R. Shearing[2] and Kang Li[1]

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Ceramic hollow fibers have received considerable research interest due to their unique benefits. However, some challenges remain which limit wider applications, including expensive manufacturing process and relatively low mechanical strength.

In this study, new manufacturing processes featuring process simplicity and improved geometry design have been developed. The ‘multi-layer’ design obtained via a co-extrusion technique effectively reduces the numbers of sintering step that is energy intensive. Moreover, this technique improves interlayer adhesion, as well as provides flexible micro-structure tailoring. The ‘multi-channel’ design successfully miniaturizes the dimension of conventional ceramic honeycombs to millimetre scale and integrates the advantages from various traditional designs. SOFCs with new designs have shown a marked increase in power density, 10-fold drop in contact loss and up to 5-fold increase in mechanical strength. Based on this new multi-channel design, attempts have also been conducted to expand the application of SOFC from the energy generation to multi-task electrochemical reactor, targeting at nitrous oxide (N_2O) abatement as a greenhouse gas. Additionally, advanced 3D characterization has been conducted by applying X-ray micro-CT technology. This technology not only provides the 3D-reconstruction and visualization, but also enables the precise quantification of micro-structural parameters for the first time. These measured parameters could be subsequently applied for more accurate mass transport and electrochemical modelling.

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Biography

Tanveer received his PhD in early 2018 from the University of Exeter, UK. His PhD research focused primarily on the development of graphene-based anti-cancer nanomedicine. Through his association with the EPSRC CDT in Metamaterials, he investigated the efficacy of nanotechnology for developing the next generation of image based therapeutic and diagnostic tools in nanomedicine. He has authored or co-authored more than 20 peer-reviewed articles on basic and applied research topics, with a primary focus on nanomedicine, medical physics and environmental decontamination. His areas of particular interest include, but are not exclusive to, nanostructured biomaterials, image-guided light-triggered theranostic options for the diagnosis and treatment of cancer and infectious diseases in a single modality and water treatment, mainly focussing on the fate and management of microplastics in water/wastewater. He is currently working with the internationally-leading team of multidisciplinary UK-based scientists from University of Exeter, University of Cambridge and University College London

Presentation abstract

Nanostructured graphene for effective water cleaning

Nanostructured graphene is a versatile two-dimensional carbon-based nanomaterial for applications in environmental remediation since the structure, molecular weight, surface area, high electron mobility, mechanical strength, porous morphology, size-dependent luminescent features and chemical composition as well as functionalization can be precisely controlled. These properties also enable them to be one of the most promising candidates for water and wastewater treatment. Graphene-based materials exhibit higher separation selectivity and absorption capacity, good regeneration and cycling ability and light weight for high gravimetric capacity. This talk will provide an overview of our recent developments in the design of graphene nanostructures to interface with micropollutants for water and wastewater treatment. This talk will also describe the state-of-the-art developments in design, preparation, properties and applications of graphene-based materials for the removal of heavy metal species, oil and other organic pollutants from water/wastewater. Parameters could be subsequently applied for more accurate mass transport and electrochemical modelling.

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Biography

Dr. Zhaoliang Cui made a technological bottleneck of highly-antifouling poly(vinylidene fluoride) (PVDF) membrane production, developed theory and method of greener organic membrane fabrication, realized the accurate control of PVDF membrane pore size, significantly increased its steady flux. He was funded by projects such as the National Key R&D Program of China, National Natural Science Foundation of China, the Natural Science Foundation of Jiangsu Province, et. al. He was selected by the Six Talent Peaks Project in Jiangsu Province, and the Jiangsu Innovation and Startup Plan. He has published more than 20 papers in the important journals such as Prog Polym Sci, J Membr Sci, et al, applied 8 Chinese patents and one PCT patents, wrote one chapter of a book, and involved in Encyclopedia of Membranes. His achievement supports the development and industrialization of Highly-antifouling PVDF hollow fiber membranes, and was awarded as the First Class Prizes of the Jiangsu Scientific and Technological Progress Award (5/10).

Presentation abstract

Design and Industrialization of PVDF Membranes with High Anti-fouling Property

Zhaoliang Cui, Zhaohui Wang, Xiaozu Wang, Yue Zhou

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Poly(vinylidene fluoride) (PVDF) membrane has found wide applications in water treatment, but membrane fouling, which dramatically decreases filtration efficiency, is a major problem during long term run [1]. Developing PVDF membranes with high anti-fouling property is a key target for its application [2]. Fouling mechanism of PVDF membrane was deeply analyzed, and the relationship between membrane microstructure and performance was built, indicating proper ways to enhance its anti-fouling property. Then, PVDF hollow fiber membrane was prepared by vapor-induced phase separation coupled with non-solvent-induced phase separation (VNIPS), and PVDF hollow fiber membrane with ideal structure was developed and industrialized. The achievements incubated Nanjing Jiuying Membrane Technology Co., Ltd, which focuses on polymeric membrane manufacture. Finally, the commercialized PVDF membrane was applied in projects related to ground water and wastewater treatment. This type of PVDF membrane showed excellent property and has been obtained large-scale application in water reuse project.

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Biography

Dr. Zhentao Wu, lecturer in Chemical Engineering at Aston University, Birmingham, UK. My research (58 peer-reviewed publications of more than 1000 citations, h-index of 20, 5 book chapters and 3 patents) focuses mainly on the development of micro-structured inorganic hollow fibre membranes and use of these membranes for applications related to energy, environment and water. In addition to the performance oriented micro-structure control over the inorganic membranes, I am interested in combining new materials and material processing processes with different types of membrane and membrane processes.

Presentation abstract

Micro-Structured Ceramic Membranes for Catalytic Reactions

Zhentao Wu

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Catalytic reactions are critical to chemical industry. To perform a catalytic process, all the aspects over a multi-dimensional scale should be appropriately controlled, e.g. from the molecular aspects of the reaction at the active site (nm scale) to the several metre scale of an industrial catalytic reactor.

The successful development of micro-structured ceramic membranes offers a new way of intensifying interactions between reactants and catalysts, at a scale of several tens of micrometres. This presentation outlines some major findings from recent studies, focusing on how the unique bi-model pore structure of ceramic hollow fibre membranes can benefit a catalytic process, and based on which how to further functionalize such membranes from the view of material development and micro-structure control.

Zhining Wang

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Biography

Professor Wang received his B.S. and M.S. degrees from Shandong University in China and his Ph.D. in Chemistry from the Hong Kong University of Science and Technology. In his first appointment, Wang served as associate professor of the Marine Chemistry Theory and Technology, Key Laboratory of Ministry of Education at Ocean University of China. In 2017, he moved to school of Environmental Science and Technology at Shandong University as professor

The research interests of Professor Wang primarily lie in three major areas: (1) Water treatment and seawater desalination, (2) Design and fabrication of high performance membranes, and (3) Fabrication of environmentally benign nano-materials for water treatment and remediation.

Presentation abstract

Construction of biomimetic channels for high performance water purification membranes

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Membrane materials play an important role in the membrane water treatment technology, and how to overcome the permeability-selectivity trade-off is the key of the development of membrane materials. The water flux was improved through building high selectivity water molecules channel in the membrane material, at the same time maintaining high rejection. Due to the good selectivity, aquaporins and carbon nanomaterials (carbon nanotubes, graphene oxide, graphitic carbon nitride, etc.), can be used as water molecules channel into the membrane material. In this study, we synthesised several new membrane materials embedded in aquaporins, carbon nanotubes, graphene oxide, graphene oxide quantum dots and single layer graphitic carbon nitride respectively by used layer by layer self-assembly, covalent bond combined, interfacial polymerization, and a variety of preparation methods. The addition of water channel materials increase the flux of membrane materials, while the carbon nanomaterials further increase the membrane antifouling performance. This research has the beneficial exploration for the preparation of high flux, fouling resistant composite membrane, and enriches the membrane material types, providing new support for water treatment technology.

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Biography

Zhuang Liu received his B.S. and Ph.D. degrees from Sichuan University (SCU) in 2009 and 2014. After he got his Ph.D degree, he started his research work in Sichuan university, and now he was an associate professor in department of chemical engineering with research interests on membrane materials, functional hydrogel materials, and interface functionalization. He also is the member of key laboratory of polymer materials engineering, the member of chemical industry and engineering society of china, and the committee member of national heterogeneous separation of academic group. He has published over 40 papers in SCI journals such as *Chemical Society Reviews*, *PNAS*, *Advanced Functional Materials*, *Advanced Science*. Last year, he got the Hou Debang youth award of chemical science and technology as the youngest prize-winner.

Presentation abstract

Graphene-based membranes with uniform 2D nanochannels for precise sieving of mono-/multi-valent metal ions

Yue-Heng Xi[a], Zhuang Liu[a,b,*], Junyi Ji[a], Yuan Wang[a], Yousef Faraj[a], Yudan Zhu[c], Rui Xie[a,b], Xiao-Jie Ju[a,b], Wei Wang[a,b], Xiaohua Lu[c], Liang-Yin Chu[a,b,*]

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Ion sieving is of great importance in a variety of applications, such as water desalination/purification, biomedical engineering and so on. The currently available techniques, based on ion size sieving by constructing membranes with nanochannels and nanopores, are still not able to achieve precise sieving of mono-/multi-valent metal ions. Here, we report on the fabrication of graphene-based membranes by constructing uniform twodimensional (2D) nanochannels with effective channel heights of ~ 8 Å for precise and efficient sieving of mono-/multi-valent metal ions. Our membranes with uniform 2D nanochannels are built using facilely reduced graphene oxide (FRGO) nanosheets, which are controllably fabricated by avoiding the corrugation of graphene oxide (GO) nanosheets and controlling the content of oxidation groups during the reduction process. We illustrate the ability of precise sieving of mono-/multi-valent metal ions afforded by this technique by fabricating FRGO membranes with uniform 2D nanochannels, and demonstrate the excellent repeatability and long-term stability of FRGO membranes for sieving of mono-/multi-valent metal ions.

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