Hello and a warm welcome to the School of Chemical and Biomedical Engineering (SCBE) at Nanyang Technological University. As a part of the fast-rising university and a young and vibrant community, our school is committed to build on our strength in three areas of excellence, namely, teaching, research, and staying connected with industry. Our mission at SCBE is to provide enduring excellence in educational and research experiences, with depth and breadth, for our programmes.

The school was established in 2005 to meet the increasing global demand for engineers who are specifically trained in engineering and life sciences. As we enter the 21st century, it is our mission to develop and groom new generations of young engineers, who integrate closely with society and serve the needs of our nation Singapore, and forge beyond into the international arenas.

Today, our students and faculty engaged in an inspiring and integrated research and educational environment, with the aspiration to continue contributing actively to the society and community. The school will continue to draw upon our pool of committed faculty, innovative research staff and bright students, to create technological leadership and excellence. Our team of faculty members is actively engaged in breakthrough research that places the researchers at the forefront of their respective fields. The next breakthrough will come at the interface of two or more disciplines; in this respect, the School has positioned a number of interdisciplinary research areas such as such as Chemical Engineering, Biotechnology & Synthetic Biology, Translational Healthcare and, Biomedical Technology and Food Science & Technology.

It is my hope that we will look beyond our campus to establish the connections with industry partners to enrich our students, faculty members and alumni. We will carry on accomplishing significant work for the greater good of School, University and Nation, and leading the change in chemical and biomedical engineering and striving for higher goals.

Xu Rong
Professor and Interim Chair
SCBE AT A GLANCE

DEGREES OFFERED

- BEng (Hons) Chemical & Biomolecular Engineering
- BEng (Hons) in Bioengineering
- PhD in Chemical and Biomolecular Engineering
- PhD in Bioengineering
- MEng in Chemical and Biomolecular Engineering
- MEng in Bioengineering

Sciences & Engineering

The above information is correct as at time of printing.

POPULATION

UG: 985
PG: 144
39 Full-time faculty
151 Researchers

2017 GLOBAL RANKING

Academic Ranking of World Universities

QS World University Rankings

#14

#17

JOURNAL PAPERS (2016-2017)

>730

ACTIVE RESEARCH GRANTS

>963M

RECENT FACULTY HONORS

2017 Highly Cited Researchers (Chemistry & Materials Science)
- Prof. David Lou Xiong Wen

2017 Energy and Environmental Science Readers’ Choice Lectureship Award
- Prof. David Lou Xiong Wen

Sabic Young Professional Award 2017
- Asst Prof Chew Jia Wei

Koh Boon Hwee Scholars Award
- Prof. Tech Swee Hnin (2017)
- A/Prof. Steen Lim (2017)
- Dr. Mark Chong (2016)

SCBE offers direct honours degree programmes in Chemical & Biomolecular Engineering and Bioengineering, to empower a new generation of engineers. The rigorous curriculum integrates principles of engineering with fundamentals of life and chemical sciences giving our graduates an edge in the economy.

With modern infrastructure, state-of-the-art research and teaching facilities as well as dynamic faculty from internationally renowned universities, the School provides a stimulating learning environment and opportunities for students to achieve personal and professional milestones.

Chemical & Biomolecular Engineering (CBE) deals with the application of physical sciences and life sciences with mathematics and economics to the process of converting raw materials (of chemical or biomolecular nature) into more useful or valuable forms. Modern chemical engineering is also concerned with pioneering valuable new materials and techniques such as nanotechnology, fuel cells and biomedical engineering. CBE aims to hone quantitative and analytical skills to produce a new generation of graduates. It also aims to equip them with engineering knowledge to excel in traditional chemical/petrochemical/pharmaceutical industries, as well as other emerging fields.

PROGRAMMES OFFERED

B.Eng. (Hons) Chemical & Biomolecular Engineering

Related Programmes:
- CBE with a Second Major in Business
  - B.Eng. (Hons) Chemical & Biomolecular Engineering with 2nd Major in Business
  - B.Eng. (Hons) Chemical & Biomolecular Engineering with 2nd Major in Business (Int’l Trading Programme)
- CBE with Second Major in Food Science Technology
  - B.Eng. (Hons) Chemical & Biomolecular Engineering with 2nd Major in Food Science and Technology
- Double Degree
  - B.Eng. (Hons) in Chemical & Biomedical Engineering & B.A. (Hons) in Economics
  - CN Yang

The above information is correct as at time of printing.
SCBE OFFERS TWO POSTGRADUATE PROGRAMMES BY RESEARCH:

• Doctor of Philosophy (PhD)
• Master of Engineering (MEng)

BioEngineering (BIE) blends the various disciplines of engineering and biomedical sciences together and combines modern biological principles with advanced engineering methods in medical imaging, instrumentations, electronics, materials and tissue engineering to train high-calibre engineers for the healthcare industry. Its curriculum blends modern biological principles with advanced engineering methods in electronics, materials, mechanics, bionanotecnology, and informatics to train high standard engineers for biomedical and biotechnology industries as well as healthcare and clinical services.

SCBE focuses on the above areas of research, which are of emerging relevance and importance to Singapore and beyond. The school is equipped with state-of-the-art laboratories, advanced computing facilities and an intellectually stimulating environment - the key ingredients of an excellent research institution.

POSTGRADUATE PROGRAMMES

Studying for MEng or PhD in SCBE can be a very satisfying and exciting experience; it also means dedication and hard work. The graduate curriculum blends core courses, such as molecular biophysics, bionanotechnology, reaction engineering and thermodynamics, with specialised electives in biomaterials, biomechanics, biomedical systems and nanotechnology.

Graduate studies in research programmes provide an opportunity for one to seek new knowledge, explore new research grounds and create new ideas.

SCBE OFFERS TWO POSTGRADUATE PROGRAMMES BY RESEARCH:

• Doctor of Philosophy (PhD)
• Master of Engineering (MEng)

RESEARCH AREAS
Researchers in this area focus on integrating expertise and techniques using innovative biomaterials, biomedical device, bioimaging, monitoring technologies, diagnostic, therapeutic, and prosthetic devices or tools to promote enhancements in prevention, diagnosis, and therapies in order to improve the global healthcare system significantly.

Researchers in this area focus on bioprocess, biocatalysis, bacteriology, protein engineering and systems biology for the production of chemicals, pharmaceutical and biologics.

Researchers in this area focus on the catalysis and reaction engineering, colloids and interface sciences, energy technologies, and process systems engineering to solve fundamental chemical engineering problems arising in chemical and pharmaceutical industries.

Researchers in this area focus on integrating expertise and techniques using innovative biomaterials, biomedical device, bioimaging, monitoring technologies, diagnostic, therapeutic, and prosthetic devices or tools to promote enhancements in prevention, diagnosis, and therapies in order to improve the global healthcare system significantly.

Researchers in this area focus on bioprocess, biocatalysis, bacteriology, protein engineering and systems biology for the production of chemicals, pharmaceutical and biologics.

Researchers in this area focus on catalysis and reaction engineering, colloids and interface sciences, energy technologies, and process systems engineering to solve fundamental chemical engineering problems arising in chemical and pharmaceutical industries.
Researchers in this area focus on diverse aspects relating to sustainable food production, processing technology and reduction of food wastage through better processing technologies, food safety, to nutrition and functional food.

**FOOD SCIENCE & TECHNOLOGY**

**KEY FACULTY**

1. Chen Wei Ning William (pg10)
2. Chan Bee Eng Mary (pg12)
3. Chew Jia Wei (pg18)
4. Jorgen Schlundt (pg20)
5. Miao Yansong (pg46)

**SCBE FACULTY LISTING**
Membrane technology is an energy efficient and environmentally friendly separation process that can work continuously in mild operation conditions. However, current membranes made with pure polymeric materials need to be replaced with new membrane materials exhibiting a higher separation efficiency. We aim to develop high-performance membranes containing nanoporous materials such as zeolites and metal-organic frameworks.

**RESEARCH TRAINING**

Dr Bae Tae Hyun received his BS (1999), MS (2001), and PhD (2006) degrees from the School of Biological Resources and Materials Engineering, Seoul National University, after studying polymeric membranes and their processes for water treatments. He earned his second PhD (2010) in chemical engineering at the Georgia Institute of Technology under the supervision of Prof Christopher W. Jones and Prof Sankar Nair. His research at Georgia Tech was focused on engineering nanoporous materials for applications in gas separation membranes. He then worked as a postdoctoral fellow in Jeffrey Long’s research group in the Chemistry Department at the University of California, Berkeley, where he performed research on CO2 capture with metal-organic frameworks and other porous materials. Since 2013, he has been an assistant professor in the School of Chemical and Biomedical Engineering.

**RESEARCH DESCRIPTION**

**Nanoporous Materials**

Zeolites are microporous aluminosilicates widely used as catalysts and adsorbents in many industrial processes. Metal-organic frameworks or MOFs, a new class of nanoporous materials, are constructed from strong chemical bonds between metal ions and organic linkers. Metal-organic frameworks have great potential utility for molecular separations due to their large surface areas and tunable chemical functionalities.

**Membrane Technology**

Membrane technology is an energy-efficient and environmentally friendly separation process that can work continuously in mild operation conditions. However, current membranes made with pure polymeric materials need to be replaced with new membrane materials exhibiting a higher separation efficiency. We aim to develop high-performance membranes containing nanoporous materials such as zeolites and metal-organic frameworks.

**ACHIEVEMENTS**

Dr Bae has published about 40 papers including high impact papers published in Chem. Rev., Energy Environ. Sci., J. Am. Chem. Soc., and Angew. Chem. As of January 2018, his papers have been cited more than 4600 times with an average citation of more than 130 per paper according to Web of Science.

**KEY PUBLICATIONS**

8. T. H. Bae, J. R. Long*, CO2/N2 Separations with mixed-matrix membranes containing Mg0(podic) nanocrystals, Energy Environ. Sci., 2013, 6, 3565-3569

**LAB STAFF**

Postdoctoral researchers: Kuri Goh, H. Euns Karkhan, Jaewon Lee, Juan Hai Low, Lima Nie, Wichitpan Rongwong, Piyanat Weerachanchai, Euntae Yang, Yanqin Yang, Jeonghun Yun

PhD students: Wen Li, Sulashi Samarasinghe (IGS), Dilhara Sethunga (IGS), Chong Yang Chua
Antimicrobial POLYMERS

There is an overwhelming demand for new antimicrobial materials that are not vulnerable to the development of microbial resistance and which are also non-toxic and biocompatible. Contact active antimicrobial materials, such as positively charged (cationic) polymers, kill bacteria by disrupting their membranes rather than targeting microbe metabolism and consequently are believed to be less likely to lead to resistant bacteria. My lab has developed a novel class of antimicrobial materials based on positively charged “sugar” polymers. Most cationic polymers are non-selective toxic so that they kill microbes but also mammalian cells. Their “sugar-based” cationic polymers are highly selective for microbes and have record high specificity. Further, we have designed new biomedical coatings based on nanoporous hydrogels which are highly effective to kill microbes and sort the nanotubes, which is a prerequisite to exploitation of the high mechanical and electronic properties of CNTs.

Dispensing and Sorting Carbon Nanotubes with POLYMERS and carbon nanotube (CNT) composites

The lab has also investigated the application of polymers in carbon nanotubes and organic electronics. We have invented various polymers and small molecules that can individually disperse carbon nanotubes and sort the nanotubes, which is a prerequisite to exploitation of the high mechanical and electronic properties of CNTs.

KEY PUBLICATIONS


ACHIEVEMENTS

As a mark of her standing in the field, Prof. Chan has recently been elected a Fellow of the American Institute of Medical and Biological Engineering (AIMBE).

ANY OTHER INFORMATION

(e.g. major grants, editorial board membership, etc.)

Prof Chan is Lead PI of a multi-PI MOE Tier 3 project on Antimicrobial Polymers (2014 to 2019) and PI of a MOE industry alignment fund on antibacterial hydrogels. She contributes actively to industry and sits on a number of committees and boards. She is also a member of various editorial boards of journals, including the Journal of the Biomedical Materials Research Part A, and Polymers for Advanced Technologies.

She is an Associate Editor of the ACS Applied Materials & Interfaces (since Nov 2016).

RESEARCH TRAINING

Prof Chan Park B. Mary obtained her BEng (Chem) and PhD (polymers) from the National University of Singapore and MIT in 1986 and 1993 respectively. Prior to joining NTU in 2001, she worked in the chemical industry in Singapore and USA. She was formerly a senior technical manager in Sipix Imaging (CA, USA, now part of E-link) working on e-paper before joining NTU. Professor Chan is presently the Director of the Centre for Antimicrobial Bioengineering.

RESEARCH DESCRIPTION

1. Antimicrobial POLYMERS

There is an overwhelming demand for new antimicrobial materials that are not vulnerable to the development of microbial resistance and which are also non-toxic and biocompatible. Contact active antimicrobial materials, such as positively charged (cationic) polymers, kill bacteria by disrupting their membranes rather than targeting microbe metabolism and consequently are believed to be less likely to lead to resistant bacteria. My lab has developed a novel class of antimicrobial materials based on positively charged "sugar" polymers. Most cationic polymers are non-selective toxic so that they kill microbes but also mammalian cells. Their “sugar-based” cationic polymers are highly selective for microbes and have record high specificity. Further, we have designed new biomedical coatings based on nanoporous hydrogels which are highly effective to kill microbes. Most antimicrobial coatings are non-porous solids, and the polymers significantly lose antibacterial efficacy when immobilized. The hydrogel coatings, on the other hand, have interior space to "receive" the disrupted mammalian cell membranes and have excellent antimicrobial efficacy. Our discovery of a new contact-activem mechanism for killing microbes forms the basis for the design and synthesis of a wide range of polycationic antimicrobial materials for diverse applications, ranging from biomedical implants to paints and other surface coatings for asptic environment in medical facilities.

KEY PUBLICATIONS


RESEARCH DESCRIPTION

My group works on various nanomaterials and their applications in biology, as well as sustainable energy. Most recently, we have been working on new fascinating zero-dimensional materials called graphene quantum dots (GQDs). We are revealing the GQD properties, developing synthesis methods, and applying GQDs for novel bio-imaging, optical sensing, electrochemical detection, and catalysis. Working at the interface of biology, nanotechnology, and engineering, we are particularly interested in developing interdisciplinary and integrative approaches to address biomedical problems.

ACHIEVEMENTS

Dr Chen has published >180 papers in journals such as Advanced Materials, Angewandte Chemie International Edition, Nano Letters, ACS Nano, Physical Review Letters, Advanced Functional Materials, Chemical Society Reviews, etc. His work has received ~11800 citations.

LAB STAFF

Research Fellows:
  Li Kaixin, Tian Jingqi, Yan Yibo, Than Aung
  Project Officer:
  Krishnamoorthi Shalini

PhD students:
  Chen Jie, Dang Phan Khanh (03), Gong Jun, Zan Ping

KEY PUBLICATIONS


2. Wang X, Sun G, Li Nan, Chan P (2016) Quantum dots derived from two-dimensional materials and their applications for catalysis and energy Chemical Society Reviews 45, 2239–2262


Prof William Chen Wei Ning received his university education (both BSc and DSc) from Université Catholique de Louvain in Belgium. Prof Chen joined NTU as an Associate Professor in 2002, and received his tenure award (Associate Professor) in 2008. He was promoted to tenured Full Professor of Biomolecular Engineering in 2011. Prof Chen’s inter-disciplinary research may include the following: 1. Food Waste Management; 2. Food Processing & Tech Innovations; 3. Metabolic & Microbial Engineering for Valuable Chemicals; 4. Sustainable Production of Food Ingredients; 5. Fermentation Technology; 6. Biomarkers Identification for Nutrition and Food Safety.

His food research focuses mainly on fermentation and green processing technologies. His technology innovation in converting food waste to high value food ingredients has generated significant interests from food industry and government agencies. His food research in generating a Circular Economy with Zero Waste Food Processing was featured in the local and international media, including Channel News Asia, The Straits Times, Lianhe Zaobao, and IFT Newsletter (http://www.ift.org/IFTNEXT/011618.asp). IFT Newsletter (by editors of Food Technology) is a magazine reporting on the next big things in the science of food through original reporting of scientific breakthroughs, leading-edge technology, novel food components, and transdisciplinary R&D.

He has published extensively (with more than 170 papers) in peer-reviewed international journals, and has been invited as Plenary Speaker and/or Panelist at various international conferences and roundtable discussions. Prof Chen is active as Principal Investigator and Co-Principal Investigator of competitive external research grants from major government funding agencies as well as leading international food industries, totalling more than S$16 million. He has also been invited as a Visiting Professor by Zhejiang University of Technology in 2016. In recognition of his contributions, he is now a Fellow of the US Food Systems Leadership Institute (FSLI).

KEY PUBLICATIONS


ACHIEVEMENTS

• Director, NTU Food Science & Technology Programmes, 2013-now
• Member, Singapore Food Standard Committee (TCS), 2015-now
• Member, Inter-ministerial Committee on Food Security (WSG), 2014-now
• Invited Speaker (on Food Sustainability) at APEC meeting, Tianjin, China, 2017
• Invited Speaker/Panelist in EU Delegation Seminar on Plastic Waste, Singapore, 2017
• Invited Participant to UN-FAO Meeting on Agricultural Biotechnology and Sustainable Food Systems, Kuala Lumpur, 2017
• DAAD Fellow, German Academic Exchange Service, 2016

• Visting Prof, Zhejiang University of Technology, 2016
• Fellow, US Food System Leadership Institute, USA, 2015-now
• Member, Management Board of JRL, Sino-Singapore Knowledge City, 2016-now
• Judge, DutchCham Wesermius Awards 2016 for Sustainability & Innovation, 2016

• Member of Expert Panel, NRF, Singapore, 2013
• Invited Speaker/Panelist (on Food Sustainability), The 27th Commonwealth Agriculture Conference, 2016

• Director, NTU Food Science & Technology Programmes
• NRF Principal Investigator, Food Science & Technology Programmes
• NRF Principal Investigator, US Food System Leadership Institute
• NRF Principal Investigator, Food Systems, including Sustainability and Food Safety

• Placed more than 160 papers in peer-reviewed international journals
• Awarded more than 160 international awards for research excellence
• Invited to give over 160 talks at conferences and seminars across the world
• Published over 20 book chapters and edited books

• Professor Chen is active as Principal Investigator and Co-Principal Investigator of competitive external research grants from major government funding agencies as well as leading international food industries, totalling more than S$16 million. He has also been invited as a Visiting Professor by Zhejiang University of Technology in 2016. In recognition of his contributions, he is now a Fellow of the US Food Systems Leadership Institute (FSLI).
Dr Chew Jia Wei received her BEng and MEng degrees in Chemical Engineering from the National University of Singapore, then her PhD in Chemical Engineering from the University of Colorado at Boulder. After finishing her doctoral research in 2011, she worked as a research scientist at MEMC Electronic Materials Inc., Pasadena, TX, before being recruited back to Singapore to her current post in 2013. As well as holding an assistant professorship in the School of Chemical & Biomedical Engineering, Dr Chew has been the Associate Chair (Students) since 2017.

My research interest is in enabling practical, cost-effective engineering solutions to sustainability challenges related to water supply.

Global water crises, ranging from major droughts to simple access to safe drinking water, are the biggest threat to the world faces over the next decade. Membrane-based water treatment processes are increasingly important for water supply strategies, but they are prone to fouling when membrane pores become progressively blocked. Although advances in nanotechnology and biotechnology have heralded new membranes with remarkably high fluxes, they pose a new problem, which defines the focus of my lab’s research: how to control the more severe fouling effects associated with higher throughput.

We take a three-pronged approach: firstly, we are developing energy-efficient, unsteady-state shear strategies, which, compared to conventional desalination by reverse osmosis, have been shown to provide an enhancement of two- to five-fold at an incremental power cost of about 10%; secondly, we are optimising the hydrodynamics of the membrane module, which in turn reduces the fouling and thereby the energy cost, and lastly, we are characterising the membrane pore-size distribution, a critical performance indicator. My group has developed a novel Evapoporometry (EP) technology, to enable non-destructive, accurate characterization of nano- to micro-scale membrane pores, which control the selectively and throughput of membrane-based water treatment processes.

**Key Publications**

Chew Sing Yian is an Associate Professor at the School of Chemical & Biomedical Engineering (SCBE) and the Lee Kong Chian School of Medicine (LKC Medicine), Nanyang Technological University (NTU), Singapore. Dr Chew obtained her PhD at Johns Hopkins University in 2006, under the sponsorship of the NTU Overseas Scholarship, and joined SCBE as an Assistant Professor later in the same year. In 2012, Dr Chew received her tenure and was promoted to Associate Professor in SCBE. In March 2014, Dr Chew received a joint appointment with LKC Medicine. She was the Associate Chair of Research & Graduate Studies in SCBE from 2014 to 2017.

RESEARCH TRAINING

The Chew laboratory engineers bio-functional micro- and nano-structured scaffolds to understand and direct cellular behavior. We use combinatorial approaches involving substrate topology/compliance and biochemical cues to mediate tissue regeneration and host-implant integration.

- Our work ranges from fundamental science to scaffold, drug/gene delivery technology development and translational research. Currently, we focus on scaffold-mediated gene-silencing approaches to understand and direct neural tissue regeneration and remyelination after spinal cord injuries; stem cell differentiation and host-implant integration.
- Our main objective is to provide improved platforms for better understanding and control over cell fate for regenerative medicine.
- The Chew Lab - Engineering bioinspired drug/gene-delivery scaffolds for directing cell fate.

ACHIEVEMENTS

Dr Chew is known for her contributions to the field of regenerative medicine and scaffold-mediated gene silencing. Her research interest lies in understanding the combined effects of substrate topography and biochemical signaling in directing cell fate and stem cell engineering.

Since joining NTU, Dr Chew has been a visiting scholar/professor at Johns Hopkins University, Center for Regenerative Medicine (University of Edinburgh), INSERM (U888 and U971); University of Paris 13; University of Nantes; Jinan University in Guangzhou, China; and the Wyss Institute at Harvard. Her professional experience also includes evaluating research grants for local and international funding bodies including the Research Grant Council (RGC) of Hong Kong.

ANY OTHER INFORMATION

(e.g. major grants, editorial board membership, etc.)

Dr Chew is an editorial board member for Drug Delivery and Translational Research, an official journal of the highly regard Controlled Release Society.

Current active grants:
- Singapore-China 12th Joint Research Program Grant, PI, 2017-2020
- Rehabilitation Research Institute of Singapore (RRIS) Rehabilitation Research Grant, PI, 2016-2018

KEY PUBLICATIONS


Other publications please see: http://www.ntu.edu.sg/home/sychew/our-works.html
RESEARCH TRAINING

Dr. Dang Thuy Tram joined the School of Chemical and Biomedical Engineering in January 2016. She received her bachelor degree from the University of Illinois, Urbana-Champaign and her PhD degree from Massachusetts Institute of Technology, both in Chemical Engineering. She also conducted her postdoctoral training at a Controlled Release Society fellow at Brigham and Women’s Hospital, Harvard Medical School. Prior to joining SCBE, she was a Senior Research Fellow at the Institute of Medical Biology, A*STAR Singapore where she currently remains affiliated as an Adjunct Investigator.

RESEARCH DESCRIPTION

The Dang lab’s multidisciplinary research interests span the fields of biomaterials, drug delivery and cell-based therapeutics. We aim to integrate a fundamental understanding of the cellular and molecular microenvironment with engineering advances in the design of biocompatible materials, biologically responsive drug delivery and microfabricated cell-based systems to develop more effective treatments for diabetes and wound healing.

Our current research activities centre on the following three areas:

1. **Wound healing response to implanted biomaterials**
   - We seek to understand the influence of the physical and chemical properties of materials on their interaction with the surrounding cellular microenvironment in the wound healing response to implanted biomaterials. Our long term goal is use this knowledge for rational design of biomaterial surfaces to promote successful clinical integration of implanted medical devices, drug delivery systems and tissue-engineered scaffolds.

2. **Biologically responsive drug delivery systems**
   - We are interested in designing novel drug delivery systems that harness altered biochemical signals in pathological states to program the release of therapeutics for effective restoration of physiological balance.

3. **Modular programming of pancreatic micro-tissues**
   - Therapeutic cells, such as pancreatic islets for diabetes treatment, often suffer from decreased viability and function when transplanted into the body of recipients, due to the absence of supporting blood vessels. Our team seeks to overcome this limitation by re-programming the pancreatic islets’ modular micro-structures to optimize their cellular configuration for enhanced oxygen and nutrient transports.

ACHIEVEMENTS

Dr. Dang is the winner of multiple fellowships and awards including the Sung Wan Kim CRS Postdoctoral Fellowship from the Controlled Release Society Foundation (USA), the Edward Clark Walsh Presidential Graduate Fellowship from MIT, the National Science fellowship (BiSc-PhD) from the Agency for Science, Technology and Research (A*STAR) of Singapore.

KEY PUBLICATIONS


RESEARCH TRAINING

After a BSc in Chemical Engineering at Rensselaer Polytechnic Institute, USA, Dr. James Jing Kwan moved to Columbia University, where he obtained his MSc, MPhil, and PhD in Chemical Engineering. After completion of his degrees in 2012, he started a postdoctoral position at the University of Colorado, Boulder, prior to moving to Oxford University’s Institute of Biomedical Engineering for a second postdoc. In 2015, Dr. Kwan joined an Oxford spinout company for a year before being recruited to the SCBE as an Assistant Professor in 2016. He later joined as the Co-Director of the NTU Institute for Health Technologies.

RESEARCH DESCRIPTION

The research conducted in my lab group is aimed at advancing painless noninvasive therapeutic technologies. We use harmless high frequency sound waves (ultrasound) that are focused to a point, providing a controllable and targetable mechanical force capable. This technique is known as therapeutic ultrasound, and with sufficient acoustic energy it is possible to create gas or vapour bubbles that oscillate in response to the ultrasound wave. These bubble dynamics, better known as cavitation, is capable of providing therapies to diseases that are otherwise inaccessible. Our research group uses the mechanical effects from ultrasound and cavitation to provide noninvasive and pain free therapies across a multitude of diseases, including cardiovascular, diabetes, cancer, and infectious diseases. Unfortunately, it is often the case that to generate cavitation requires ultrasound intensities that cause of target damage. Thus, one of my research goals is to develop responsive copolymers that enable in situ hydrogel formation (Figure 2) for the treatment of chronic venous diseases. We are also investigating the different bioeffects of ultrasound on drug resistant bacterial biofilms in hopes to provide alternative therapeutic strategies. Ultimately, we hope that our work will lead to new pathways in providing therapies to diseases that still use invasive procedures or drug regiments.

Figure 1. Examples of cavitation nucleation agents. These sub-micron particles are capable of enabling convective enhanced transport of itself and any surrounding therapeutics into diseased tissue.

Figure 2. The formation of a hydrogel from ultrasound-induced activation.

KEY PUBLICATIONS


ACHIEVEMENTS

In 2013, Dr. Kwan was awarded the W.W. Spooner Junior Research Fellowship at New College Oxford for his most recent work on ultrasound-responsive gas-stabilizing nanoparticles.

ANY OTHER INFORMATION
(e.g. major grants, editorial board membership, etc.)

Dr. Kwan has two awarded patents that were both licensed by spin-off companies in the UK (Oxsonics Ltd.) and the US (Advanced Microbubble Laboratories LLC). He has recently been awarded an NMRC Young Investigator Research Grant and an Industrial Alignment Pre-Positioning Grant in Specialty Chemicals. In March 2016, Dr. Kwan joined the NTU Institute for Health Technologies as the Co-Director.

LAB STAFF

Postdoctoral Researchers: Umesh Jonnalagadda
PhD students: Lakshmi Deepika Bharatula, Su Xiaogang
RESEARCH TRAINING

Prof. Jørgen Schlundt received his DVM (Doctor of Veterinary Medicine) from the Royal Veterinary and Agricultural University (RVAU), Copenhagen, Denmark 1978. He proceeded to achieve a PhD degree at the same University in 1982. Thereafter he was trained as a Post-Doc at the Institute of Veterinary Microbiology and Hygiene at RVAU 1982-84, with additional training at the Environmental Protection Agency of Denmark 1984-85. JS has international experience through a 6 months research stay at USEPA Health Effects Laboratory in Research Triangle Park, Raleigh, North Carolina 1994, as has taken up posts as Head of Bacteriology at Nat. Vet. Laboratory at Harare in Zimbabwe 1985-87 and 1993-94. From 1999-2010 he was Director Department for Food Safety and Zoonoses at the World Health Organization, Geneva, 2011-14 Director National Food Institute of Denmark.

RESEARCH DESCRIPTION

Investigating bacteriological and epidemiological aspects of Salmonella infection in animals and survival rates of zoonotic pathogens in the environment; Describing the intestinal microbial colonisation process through the use of novel test methodology including the development of test methodology for the assessment of genetically modified microorganisms as relates to survival and colonization on animal and human gut; Creating new Farm-to-fork (now One Health) surveillance systems for zoonotic pathogens, including antimicrobial resistance (DANMAP), and new risk assessment models for such pathogens based on stochastic modelling.

Initiation of the formalized international expert body: the WHO/FAO Joint Expert Meetings on Microbiological Risk Assessment (JEMRA) and the first development of 16 international microbiological risk assessments for important foodborne pathogens, including Salmonella, Campylobacter, Listeria and Vibrio among others.

Initiating the start-up of a novel international initiative to develop and use Next Generation Sequencing in Microbiology, proposing a global machine to identify and track all microorganisms: GMI - the Global Microbial Identifier.

Creation of research initiatives focusing on the use of Next Generation Sequencing techniques relative to food science and food technology innovation. At the international level JS has participated in scientific evaluations and management activities in a number of international bodies: OECD work relative to Existing chemicals and Genetically Modified Organisms, WHO and FAO Expert Consultations in microbiology, food safety risk management and microbiological risk assessment, EU Scientific Committee for Veterinary Public Health and the Scientific Committee for Food Risk analysis

The WHO/FAO food safety risk analysis framework. Reproduced with permission from WHO

ACHIEVEMENTS

- Creating the internationally agreed formats for scientific risk assessment of microorganisms (WHO and Codex) and genetically modified organisms (OECD, WHO).
- Building and developing INFOSAN (International Food Safety Authorities Network), strengthening the potential for international action in food safety emergency cases.
- Initiating the first ever estimation of the global burden of foodborne diseases, as well as the WHO Ad Hoc Group of Integrated Surveillance of Antimicrobial Resistance (AGISAR).
- Developing and disseminating the WHO ‘Five Keys to Safer Food’, including keys to safer primary production in aquaculture and plant agriculture.
- Participating in the conceptual development of the One Health paradigm, with a specific focus on promoting Nordic experiences in the zoonosis area.

KEY PUBLICATIONS


ANY OTHER INFORMATION

(e.g. major grants, editorial board membership, etc.)

The Twenty-Ninth Blawden Award, British Crop Protection Council, Nov. 2002.

The John H. Silliker Award, International Association for Food Protection, Annual Meeting, 2011

Chai, Steering Committee, Global Microbial Identifier (GMI) 2012 – present
RESEARCH TRAINING

Dr. Kunn Hadinoto Ong earned his bachelor degree in chemical engineering from the University of Washington (USA) in 2000, and his doctoral degree from Purdue University (USA) in 2004 under the tutelage of Prof. Jennifer Sinclair Curtis. He joined the School of Chemical & Biomedical Engineering as an assistant professor in 2007 and became associate professor in 2014. Prior to that, he worked as a research fellow at the Agency of Science Technology & Research (A*STAR) Singapore.

RESEARCH DESCRIPTION

Nanopharmaceuticals, defined as drug particles prepared in the nanoscale, have emerged as the preferred formulation platform for bioavailability enhancement of poorly water-soluble drugs, which represent a vast majority of newly discovered drugs. My lab’s current research is focused primarily on the four aspects of the nanopharmaceuticals lifecycle, i.e. their production, solid dosage formulation, delivery, and therapeutic application, with the common goals of engineering better solutions for each. My group has also established research expertise in dry powder inhaler formulation of nanopharmaceuticals for pulmonary delivery, where we pioneered the use of spray and spray-freeze drying to produce inhalable nanopharmaceuticals having a controlled morphology, resulting in their superior lung deposition compared to the traditional formulation. Concurrently, we have been working on the development of inhalable nanoantibiotics targeted for chronic lung infection therapy, with the aim of enhancing the antibacterial efficacy of the nanoantibiotics upon their deposition in the lung by means of controlled antibiotic release and active targeting delivery. The other area of ongoing research in my group is targeted at (i) understanding the flow behaviour of powders in processes relevant to the pharmaceutical industry (e.g. fluid-bed granulator, pneumatic conveyor, dry powder inhaler), and (ii) developing numerical tools to accurately predict this flow behaviour.

KEY PUBLICATIONS


ACHIEVEMENTS
1) Tan Chin Tuan Exchange Fellowships (2014)
2) Nanyang Education Award (School) 2014

ANY OTHER INFORMATION
(e.g. major grants, editorial board membership, etc.)
Major grant:
Sustainable Manufacturing of Stable Amorphous Drug Nanoplex as a New Nanomedicine Formulation Strategy (Supported by the GSK-EDB Sustainability Partnership, 2013–2017)

LAB STAFF
Researchers:
Lim Li Ming, Tran The Thien
Postdoctoral fellow: Nguyen Minh Hiep
Project Officers: Lim Li Ming, Jerome Wong
PhD students: Dong Bingxue, Khamila Nural Khaqqi, Tran The Thien
**RESEARCH TRAINING**

Dr Lau Wai Man Raymond received his BS and PhD degrees in Chemical Engineering from Ohio State University. After three years’ further postdoctoral study there, he was recruited to the NTU School of Chemical and Biomedical Engineering in 2005. He is now Associate Chair (Academic).

Dr Lau has wide research interests in various applications of multiphase flow processes in powder technology, pharmaceutical engineering and process engineering on microalgae.

**RESEARCH DESCRIPTION**

Our research in multiphase flow systems concentrates on applying fundamental principles to various applications in healthcare, energy, and process development.

- One of our projects is focused on the development of pollen-shape drug carriers, whose surface morphology reduces particle-particle interactions and improves flowability. The pollen-shape surface also allows high drug loading with improved respirable fractions in inhalation drug delivery.

- Microalgae have gained a lot of attention due to their fast-growth rate, their ability to sequester carbon dioxide via photosynthesis, and their potential as feedstocks and health supplements. Using a lumostatic cultivation strategy that improves the growth rate of microalgae by increasing light intensity, we developed a patent pending lumostatic photobioreactor. A spin-off company has been formed, and the technology is to be tested in a farm on the Guangdong-Fujian coastline.

- Multiphase processes are often encountered in industry, involving gas-solid, liquid-solid, gas-liquid, and gas-liquid-solid systems. Due to the complex interactions among the different phases, it is important to characterise the system behaviour and find potential applications to make use of the multiphase contacts. We are studying bubble/particle size distribution, liquid weeping phenomena at the distributor region, and particle attrition in gas-solid fluidised beds.

**KEY PUBLICATIONS**


**ACHIEVEMENTS**

Dr Lau has published more than 60 papers in refereed journals and 2 patents. He is also the recipient of Nanyang Awards for Excellence in Teaching in 2012.

**ANY OTHER INFORMATION** (e.g. major grants, editorial board membership, etc.)

Dr Lau has received over S$3 million in external funding including:

- **SPRING-TECS POC on Soybean Meal Replacement for the Livestock Feed Industry with a Novel, Patent-Pending Lumostatic Technology** (2013-2014)
- **NEA ETRP on Combined Physical and Chemical Recovery of Rare Earth and Heavy Metals from Incinerator Bottom Ash** (2012-2015)

He currently serves as the associate editor of Advanced Powder Technology by Elsevier Science and Scientific Director of Agronosis Pte Ltd, a spin-off company based on his microalgae technology.

**LAB STAFF**

Researchers:

Sankaran Krishnamoorthy

PhD Students:

Daryl Lee, Paul Mahasweta
RESEARCH TRAINING
Dr Lee Jong Min obtained a PhD from the Department of Chemical Engineering at Columbia University. He worked in Chemical Science Division at Lawrence Berkeley National Laboratory and at Department of Chemical Engineering in University of California at Berkeley as a postdoctoral fellow. Later, he moved to Singapore. He is currently an Associate Professor in Chemical and Biomedical Engineering at Nanyang Technological University.

RESEARCH DESCRIPTION
Electrochemical processes play an important role in many applications, such as energy conversion, corrosion, electrodeposition, etc. Mass transfer processes, electrode reaction mechanism, etc can be analyzed by electrochemical techniques. My laboratory is interested in analysis and design of electrochemical systems where careful analysis and fundamental understanding are required, and development of nanomaterials for electrochemical energy systems.

In addition, much attention has been given to ionic liquids because they are generally stable at high temperatures and have negligible vapor pressure at ordinary temperatures. Thus, we are interested in development of new ionic liquids as green solvents for various applications. We have used ionic liquids as media for chemical and biomedical reactions, extraction of metal ions from aqueous solutions, and deconstruction of biomass feedstock to produce fermentable sugars.

ACHIEVEMENTS
His group has made contributions to the fields through the development and wide applications to achieve understanding the role of parameters on electrochemical performance, enhancement of electrochemical performance by fine-tuning electrode material properties, design of ionic liquids for large-scale use across numerous industries, and model to predict ionic liquid properties.

His group has provided good research training to students through Nanyang Research Programme and Undergraduate Research Experience on Campus, and led their research awards.

KEY PUBLICATIONS

ANY OTHER INFORMATION
(e.g. major grants, editorial board membership, etc.)
NRF CREATE
LAB STAFF
PhD students: Anjali Jayakumar, Huang Tan

Schematic representation of electrode material preparation
Solar energy is a primary source of environmentally sustainable as well as inexhaustible carbon-neutral energy: one hour of the total solar energy striking the earth’s surface could meet a year of global energy requirements. However, the barrier to widespread use of solar energy is its high cost. Towards this end, our research focuses on economically viable strategies for renewable energy with particular reference to photovoltaics and photocatalysis. We concentrate on solving problems in solar-to-electric and solar-to-fuel conversion.

Figure 1. In-situ techniques to study electrocatalysis.

Figure 2. A TiO2 nanorod array

KEY PUBLICATIONS


ACHIEVEMENTS
Dr Liu has published more than 90 research articles, 2 book chapters and 3 US patents.

ANY OTHER INFORMATION (e.g. major grants, editorial board membership, etc.)
Thermal and Electrical Transport in nanostructured TiO2; A*STAR Science and Engineering Research Council – Public Sector Funding (2015-2018);

LAB STAFF
Researchers: Peng Yanfen, Li Xuning, Tao Huabing, Yang Hongbin, Gao Jiajun
PhD students: Cai Weizheng, Wangarathna J. A, Darshika Kumari (IGS), Zhang Liping (IGS), Huang Jiayang, Zhang Jianming (IGS)

Name: Liu Bin
Job title(s), affiliation: Associate Professor
Website: http://www.ntu.edu.sg/home/liubin/Home.html
Lab Name: Photovoltaics and Photocatalysis Research Lab

Dr Liu Bin received his BEng (2002) and MEng (2004) in chemical engineering from the National University of Singapore and PhD in chemical engineering from the University of Minnesota (2011). Following this, he worked as a postdoctoral researcher (2011-2012) in the Department of Chemistry at the University of California, Berkeley.
RESEARCH DESCRIPTION

Biomedical optics, in which light is used as a sensing or treatment tool for biomedical applications, has achieved tremendous growth since the 1980s. Several optical techniques, such as pulse oximetry, optical coherence tomography and confocal microscopy, are now in routine use in hospitals and laboratories.

My group’s research in biomedical optics is focused on developing hyperspectral optical imaging and optical spectroscopy techniques for medical diagnostics. These techniques can non-invasively characterize the pathological status of tissues or biological fluids for medical diagnostics to reduce or even remove the need for physical biopsies and histopathological analysis. We strive to enhance optical imaging and spectroscopy in various aspects, which include speed, spatial resolution, optical sectioning and multiplexing capability, by developing novel optical techniques and incorporating other complementary techniques. In parallel to technical development, we also perform translational research to transfer preclinically validated optical techniques from benchtop to bedside.

Exploring the power of light in biomedicine is an exciting task with high return. It is our hope that our research will contribute to the translation of technical advances in optics and photonics into solutions for practical problems in health care and biological science research. With the rapidly growing biomedical optics and biophotonics community and market as support, we believe that this goal is not far away.

ACHIEVEMENTS

Dr Liu has published more than 50 journal papers/book chapter and held 15 US patents/applications. He has delivered nearly 20 invited presentations and more than 50 contributed presentations in academic conferences and universities. His group has made significant contributions to the field in the development of new techniques to achieve

1) the acceleration of spectroscopic imaging by several orders of magnitude while keeping high spectral resolution;
2) non-contact depth sensitive optical spectroscopy to probe the layered structure of epithelial tissue for disease diagnosis;
3) ultra-sensitive surface enhanced Raman spectroscopy for malaria diagnosis and minimally invasive microneedles for intradermal measurements.

Dr Liu won the Edmund Optics Educational Award (First Place in Asia) in 2012 for technical merits and innovation in malaria research. The prototype devices developed by his group have been showcased in TechtInnovation 2013 and InnovFest 2014, Singapore. His group’s work in malaria diagnosis has been featured by the SPIE Newsroom and The Scientist Magazine in 2016.

KEY PUBLICATIONS

2. Dong Wei, Shuo Chen, Yi Hong Ong, Clint Peraki and Liu Q (2016) Fast wide-field Raman spectroscopic imaging based on simultaneous multi-channel image acquisition and Wiener estimation Optics Letters 41, 2783–2786

ANY OTHER INFORMATION

(e.g. major grants, editorial board membership, etc.)

Dr Liu has secured a total of around S$5M of external funding to support his group. His group’s work in a precision probe for cancer margin assessment won the highly competitive National Research Foundation Proof of Concept grant in 2013 and was featured in Strait Times 2013.

LAB STAFF

Researchers: Ji Jun, Hisel Chao Mao, Yoo Yeu Cian, Kang Jian, Varun Kumar
Postdoctoral fellows: Nityanand Sharma, Kang Jian, Tian Yao, Manish Verma, Jian Ju
Research Assistants: Wang Qiang, Li Xiang
PhD student: Bai Yanru
RESEARCH TRAINING

Dr Liu Wen Paul did undergraduate chemical engineering at University of Cambridge. He stayed to do a PhD under the supervision of Prof J.S. Dennis in the same department. After successfully defending his Thesis titled “Production of Hydrogen using Chemical Looping”, Dr Liu spent one year in Cambridge as a postdoctoral researcher (with Dr S.A. Scott) before joining the Cambridge CREATE project (CARES C4T) in Singapore.

He was appointed a lecture/assistant professor at Newcastle University in 2016 and have been teaching and conducting research in chemical engineering at their Singapore campus.

RESEARCH DESCRIPTION

Application of chemical looping

Chemical looping represents a class of processes that run conventionally homogeneous reactions in separate, heterogeneous steps (depicted in Figure 1). In doing so, the mixing of reactants and the products is inherently avoided, bringing about a number of advantages, such as high exergy efficiency, high product selectivity, improved process safety, etc. Examples of chemical looping applications include carbon capture, thermochemical water splitting and methane reforming.

Developing a new chemical looping application involves the following steps:

(i) Identifying an existing process that could potentially benefit from being run as a chemical looping process

(ii) In silico screening of suitable heterogeneous carriers that are capable of facilitating the looping reactions

(iii) Ab initio investigation of the performance of the screened candidate carriers

(iv) In-depth investigation of the reactions' kinetics, thermodynamics and transport phenomena involved during the looping reactions using advanced analytical techniques (such as in situ synchrotron XRD, shown in Figure 2)

(v) Hypothesis-driven synthesis of carriers with functional structures (e.g. nano-structured oxygen carriers shown in Figure 3) which can improve the overall process efficiency.

KEY PUBLICATIONS


ACHIEVEMENTS

• Hargreaves Prize, Selwyn College, University of Cambridge
• Frost Prize, Selwyn College, University of Cambridge
• Danckwerts-Pergamon Prize, University of Cambridge

ANY OTHER INFORMATION (e.g. major grants, editorial board membership, etc.)

• Associated Member of IChemE
• Fellow of Cambridge Philosophical Society
Controllable synthesis of functional materials from metal-organic frameworks

Our lab focusses on developing functional materials for electrochemical energy storage and conversion. We have shown that by manipulating the chemical composition and micro-/nanostructure of the materials, their physical/chemical properties can be significantly altered or improved. Novel synthesis methods have been explored to obtain the desired functional materials in a cost-effective and controllable way.

Metal-organic frameworks (MOFs) are a large family of ordered porous materials constructed from metal clusters and organic ligands. The wide variation in chemical composition and pore structure enables MOFs to be used for many important applications, such as gas storage, separation, catalysis, and ion conduction. MOFs are also unique platforms for making other functional materials useful for electrochemical energy storage and conversion.

Many cost-effective and scalable approaches could be used to controllably convert MOFs into desirable functional materials (Figure 1). For instance, MOFs could be converted into metal carbides, metal oxides or carbons by simply annealing under inert or oxidative conditions. Solution-based methods are also applicable to obtain metal oxides/hydroxides/sulfides. Compared with other methods, synthesis of functional materials from MOFs simultaneously offers control over chemical composition and micro-/nanostructure.

Controlable synthesis of functional materials from metal-organic frameworks

RESEARCH TRAINING

Dr David Lou Xiong Wen received his BEng (1st class honors) (2002) and MEng (2004) degrees from the National University of Singapore. He obtained his PhD degree in Chemical Engineering from Cornell University in 2008. Right after graduation, he joined Nanyang Technological University (NTU) as an Assistant Professor. He was promoted to Associate Professor in September 2013 and has been a full professor since September 2015.

RESEARCH DESCRIPTION

Hollow and porous functional materials for electrochemical energy storage

Starting from several common MOFs, we have successfully prepared a series of functional materials in well-defined hollow or porous structures with various shapes and morphologies, including iron oxide (Fe3O4) microboxes, microporous carbon polyhedrons, and Co nanoparticle-embedded carbon®Co65Ni double-shelled nanocages.

These materials have promising applications in lithium-ion (Li-ion) and lithium-sulphur (Li-S) batteries (Figure 3). Fe3O4 microboxes can be used as an anode material for Li-ion batteries with much higher specific capacity compared with the commercially used graphite anode. After loading sulphur into the microporous carbon, the composite can serve as cathode material in Li-S batteries, a novel rechargeable battery that potentially offers higher energy density than current Li-ion batteries.

KEY PUBLICATIONS

6. Xia BY, Yan Y, Li N, Wu HB, Lou XW, Liu LM,  Lou XW (2016) A new sulfur composite as cathode material in Li-S batteries, a novel rechargeable battery that potentially offers higher energy density than current Li-ion batteries. Nature Communications, 7, 13065

ANY OTHER INFORMATION

(e.g. major grants, editorial board membership, etc.)

Associate Editor for Journal of Materials Chemistry A Science Advances

LAB STAFF

Research Staff: Yonglin Fang, Binyaun Guan, Zhen Li, Liamei Nai, Sibo Wang, Peng Zhang, Le Yu, Xiankai Wan, Xiao Wang, Huabin Zhang, Xuefeng Lu

PhD students: Jinto Zhang, Songlin Zhang

ACHEEEMENTS

Dr Lou is a well-known scientist in the field of nanostructured materials for different energy and environmental applications. As of January 2018, he has published over 275 papers with a total h-index of 84, and an h-index of 134. He was listed as a Highly Cited Researcher by Thomson Reuters in 2014, 2015, 2016 and 2017. Dr Lou has received several important awards, including the Young Scientist Award 2012 of the National Academy of Science of Singapore and the Nanyang Research Award 2012. Dr Lou was awarded the National Research Foundation (NRF) investigationship in 2015.

PhD students: Jintao Zhang, Songlin Zhang
Dr Manojit Pramanik received his PhD degree (2010) in Biomedical Engineering from Washington University in St Louis, St Louis, USA. He obtained his masters (MTech) degree from Indian Institute of Science (IISc), Bangalore, India in 2004 and his undergraduate (BTech) degree from Indian Institute of Technology (IIT), Kharagpur, India in 2002. He joined the School of Chemical and Biomedical Engineering (SCBE) as Assistant Professor in January 2014. Prior to joining NTU he served as Assistant Professor in the Department of Electrical Engineering at Indian Institute of Science (IISc), Bangalore, India. His industry experiences include two years at General Electric Global Research (GRC), Bangalore, India and one year at Philips Medical System, Bangalore, India.

RESEARCH TRAINING

My lab works on photoacoustic imaging, a hybrid imaging technique that uses light and sound. When a short-pulsed laser irradiates biological tissues, wideband ultrasonic waves (photoacoustic waves) are induced as a result of transient thermoelastic expansion. In photoacoustic tomography (PAT), a short-pulsed laser irradiates the tissue, and the PA waves are measured by wide-band ultrasonic transducers around the tissue. These photoacoustic waves are then used to reconstruct the optical absorption distribution. Since optical absorption is sensitive to physiological parameters such as the total concentration and oxygenation of haemoglobin, PAT can provide functional imaging. PAT overcomes the limitations of other optical modalities and combines optical contrast with ultrasonic resolution. We have demonstrated 7000 frames per second photoacoustic B-scan imaging, the fastest reported photoacoustic imaging system so far, and are also developing an image reconstruction technique to improve the imaging speed and image quality.

In parallel with this work, we have developed integrated acoustic-optical resolution photoacoustic microscopy for high resolution vasculature imaging, a low-cost portable PAT system using a pulsed laser diode, hand held clinical dual modal ultrasound and photoacoustic imaging systems.

To complement these studies, the lab is also interested in light-tissue interaction. We do simulations on photon transport in biological tissue. Monte-Carlo Modeling on light transport in biological tissue has been modified for several applications including photoacoustic tomography, optical coherence tomography, and Raman imaging.

RESEARCH DESCRIPTION

Medical imaging modalities, such as X-ray, computed tomography (CT), magnetic resonance imaging (MRI), single-photon emission computed tomography (SPECT), positron emission tomography (PET), and ultrasound, are powerful diagnostic tools, but all have disadvantages. New techniques seek to overcome these disadvantages, and one of the most promising of these is optical imaging.

In photoacoustic imaging, a hybrid imaging technique that uses light and sound. When a short-pulsed laser irradiates biological tissues, wideband ultrasonic waves (photoacoustic waves) are induced as a result of transient thermoelastic expansion. In photoacoustic tomography (PAT), a short-pulsed laser irradiates the tissue, and the PA waves are measured by wide-band ultrasonic transducers around the tissue. These photoacoustic waves are then used to reconstruct the optical absorption distribution. Since optical absorption is sensitive to physiological parameters such as the total concentration and oxygenation of haemoglobin, PAT can provide functional imaging. PAT overcomes the limitations of other optical modalities and combines optical contrast with ultrasonic resolution. We have demonstrated 7000 frames per second photoacoustic B-scan imaging, the fastest reported photoacoustic imaging system so far, and are also developing an image reconstruction technique to improve the imaging speed and image quality.

In parallel with this work, we have developed integrated acoustic-optical resolution photoacoustic microscopy for high resolution vasculature imaging, a low-cost portable PAT system using a pulsed laser diode, hand held clinical dual modal ultrasound and photoacoustic imaging systems.

KEY PUBLICATIONS

9. Sivasubramanian K, Pramanik M (2016) High frame rate photoacoustic imaging at 7000 frames per second using clinical ultrasound system Biomedical Optics Express 7, 312-323
10. Upputuri PK, Pramanik M (2015) Performance characterization of low-cost, high-speed, portable pulsed laser diode photoacoustic tomography (PLD-PAT) system Biomedical Optics Express 6, 4116-4129
RESEARCH TRAINING

Dr. Miao graduated from Zhejiang University in China as Bachelor degree. Dr. Miao received MPhil and PhD training at the Chinese University of Hong Kong as Plant Cell Biologist. Dr. Miao graduated from Zhejiang University and received highly prestigious Postdoc Fellowship: Human Frontier Science Program (HFSP): Long-Term Fellow, and worked in the Molecular Cell Biology Department, University of California, Berkeley. At UC Berkeley, Dr. Miao worked on cytoskeleton regulation using yeast model. With the interdisciplinary-research nature, Dr. Miao lab works on actin-cytoskeleton regulations in multiple species, including fungi and plants, in understanding the actin functions in the cellular aging process, the fungal development, and plant innate immunity.

RESEARCH DESCRIPTION

Dr. Miao received highly prestigious Postdoc Fellowship: Human Frontier Science Program (HFSP): Long-Term Fellow, and worked in the Molecular and Cell Biology Department, University of California, Berkeley. At UC Berkeley, Dr. Miao worked on cytoskeleton regulation using yeast model. With the interdisciplinary-research nature, Dr. Miao lab works on actin-cytoskeleton regulations in multiple species, including fungi and plants, in understanding the actin functions in the cellular aging process, the fungal development, and plant innate immunity.

KEY PUBLICATIONS

5. Best Paper Award, Chinese Plant Physiology Association, Kading, China, August, 2009
6. Keynote Symposium: Honours/Awards
   - NTU Nanyang Assistant Professorship, Nanyang Technological University, Singapore, 2014
   - Human Frontier Science Program- Long-Term Postdoc Fellowship, 2010-2013
   - Postgraduate Best Research Output Award: The Chinese University of Hong Kong, Hong Kong, 2009
   - Young Scholars Dissertation Award, The Chinese University of Hong Kong, Hong Kong, 2009
   - Best Paper Award, Chinese Plant Physiology Association, Kading, China, August, 2009
   - President Wong Siew Khoon Scholarship Awardee, The Chinese University of Hong Kong, Hong Kong, 2007

ANY OTHER INFORMATION (e.g. major grants, editorial board membership, etc.)

- NTU Nanyang Assistant Professorship (NAP) Start-up grant
- NTU NMIBLES grant
- NTU ARISE research grant
- MOE Tier 2 grant
- MOE Tier 1 grant

LAB STAFF

Postdoctoral Fellow: Dr Tran Minh Tuan
Postdoctoral Fellow: Dr Ma Qianqian
Research Associate: Gonca Guzel
Project Officer: Luo Yuanjuan
Dr Ni Ran received his BS (2005) in Computational Mathematics and MS (2008) in Chemical Engineering from Beijing University of Chemical Technology. From 2008 to 2012, he did his PhD in Physics with Prof Marjolein Dijkstra in Utrecht University (the Netherlands) focusing on the computational study on the self-assembly of colloidal systems. From 2012 to 2014, he did his postdoc with Prof Martien A. Cohen Stuart (the Netherlands) focusing on the computational study on the self-assembly of colloidal systems. From 2012 to 2014, he did his postdoc with Prof Martin A. Cohen Stuart and Peter G. Bolhuis focusing on the self-assembly of fibril-forming polypeptides. In 2014, he was awarded the NWO VENI fellowship, which is the most prestigious personal grant for young scientists in the Netherlands to start independent research. In March 2016, he joined the School of Chemical and Biomedical Engineering in Nanyang Technological University as an assistant professor.

**RESEARCH DESCRIPTION**

The concept of “soft matter” was first introduced by Pierre-Gilles de Gennes in his Nobel lecture in 1991. Essentially, soft matter is a subfield of condensed matter comprising a variety of physical systems that are deformed or structurally altered by thermal or mechanical stress of the magnitude of thermal fluctuations. Because of their responsibility with respect to perturbations, e.g. thermal fluctuations, mechanical deformation, external fields, etc., soft matter have shown great promise as the next generation “smart materials”.

In our group, we use computer simulation as a tool to study and predict the structural properties and dynamic behavior of soft matter systems in and out of equilibrium to direct the experimental fabrication of functional materials. In particular, we are interested in the self-assembly of colloidal and (bio) polymer systems and work synergically with experimentalists to design new functional materials with application in photonic devices, bio-sensor, bio-materials, etc.

In particular, we are interested in:

1. Dynamic assembly of active matter
2. Glass transition of anisotropic colloids
3. Hierarchical self-assembly of anisotropic colloids
4. Self-assembly of fibril-forming polypeptides

**ACHEEEMENTS**

**Awards**

2016: Best Research Prize by the European Cooperation in Science and Technology (COST) Action – Flooding Matter [An annual prize for European Early Stage Researchers in soft matter within eight years after the date of PhD]

2015: Thousand Young Talents Program from Chinese Central Government [declined]

2014: NWO VENI Talent Personal Grant [Top 10%]

2011: Chinese Government Award for Outstanding Self-financed Students Abroad

2000: The First Prize in National Postgraduates Mathematical Contest in Modelling in China

2004: The Honorable Mention in International Mathematical Contest in Modelling,

2002: The Cup of Higher Education Press (Champion) in National Wide Mathematical Contest in Modelling in China

**KEY PUBLICATIONS**


**ANY OTHER INFORMATION**

(e.g. major grants, editorial board membership, etc.)

**Grant:** 2017: Academic Research Fund Tier 1 by Ministry of Education, Singapore

2017: Advanced Manufacturing and Engineering Young Individual Research Grant by A*STAR Science & Engineering Research Council (SERC), Singapore

2016: Academic Research Fund Tier 1 by Ministry of Education, Singapore

2014: NWO VENI Talent Personal Grant

**LAB STAFF**

Postdoc Research Fellow: Hao Hu

Quinti Lei

PhD students:

Krongtum Sankaewtong

Pablo Sampredo Ruiz

Zhan Ma
Dr. Pu Kanyi joined the School of Chemical and Biomedical Engineering (SCBE) at NTU as an Associate Professor in June 2015. He did his MS (2007) at Fudan University in China, where he learned the chemistry and photophysics of semiconducting polymers. He then came to Singapore and did his PhD (2011) at National University of Singapore. He moved to Stanford University School of Medicine for his postdoctoral training on biomedical imaging in 2011, under the supervision of Prof. Jianghong Rao and the directorship of Prof. Sanjiv Sam Gambhir at the Molecular Imaging Program at Stanford (MIPS).

**RESEARCH DESCRIPTION**

The broad research objective of my group is to develop multifunctional platform technologies for understanding, detecting and treating life-threatening diseases. Towards this goal, we take an interdisciplinary approach that brings together organic chemistry, nanotechnology and molecular biology to synthesize functional polymers, polish their optoelectronic and biochemical properties, and shape them into smart and biocompatible nanagents for advanced molecular imaging and amplified therapy.
RESEARCH TRAINING
Dr Song Juha graduated with the first class honours from Seoul National University in 2004. In 2011, she obtained her PhD in Materials Science and Engineering from Massachusetts Institute of Technology, studying biomimetics and biomechanics for an understanding of material design principles of natural exoskeleton systems. She did her post-doctoral training at the Advanced Institute of Convergence Technology, Seoul National University, where she conducted research on the development of hybrid biomaterials for dental, orthopaedic, cardiovascular and soft tissue implants, actively working with local biomedical companies. During 2014-2015, she was also a professor at Korea University, School of Biomedical Engineering. Dr Song joined the School of Chemical and Biomedical Engineering in April 2016.

RESEARCH DESCRIPTION
My lab’s research interests focus on experimental and theoretical investigations of natural and synthetic composite materials across all length scales, particularly in the field of biomimetic and bioinspired engineering, as well as biomedical engineering, covering various topics on nanomechanics, biomechanics, biomimetic design, fabrication and prototyping, biomimetic material design, synthesis and evaluation.

1) Development of bioinspired functional materials
Compared to man-made materials, many biological materials often exhibit multifunctionality and superior capabilities, with intricate and hierarchical structures. Thus, bioinspired design principles allow the development of new materials that are stiffer/stronger/tougher, adaptive or actuating, and/or more sustainable and environmentally benign across all length scales. Adopting the approach of using bioinspired material systems to understand the design principles of natural model systems, the lab works in the areas of biomechanics, biomimetic design, prototyping and verification, and fabrication through both theoretical and experimental approaches.

2) Development of highly functionalised smart hydrogel systems
Recently, by introducing smart materials which are responsive to external stimuli, a new concept of 3D printing, called ‘4D printing’, has been applied to the development of highly functional and dynamic systems. Despite their low mechanical stability, hydrogels should be a good candidate for 4D printing due to their pH-, temperature- or humidity-sensitive characters. Thus, the lab is interested in the development of various hybrid bioinks for environment-responsive, functional hydrogels to be used in tissue engineering, biomedical devices and sensors.

KEY PUBLICATIONS

ACHIEVEMENTS
Dr Song’s research on materials design principles of natural exoskeletons was reported by MIT News, NPR, Discovery Channel, and Nature News in 2008. She is the author of a total of 29 papers including nine as first author, eleven as co-author, and six as corresponding author. Her present Sc-I citation is >1000 since 2011, and her h-index is 16.

ANY OTHER INFORMATION
(e.g. major grants, editorial board membership, etc.)
Member of Singapore Centre for 3D Printing (SC3P)

LAB STAFF
Researchers:
Pan Houwen Matthew, Jang Taesik, Kajana Sivarasa
PhD students:
Osten Shengyang, Gunter Eric Luis Adiwati, M.D., Han Win Tun

Figure 1. A typical approach of bioinspired material systems in terms of a structure-property-function relationship for an understanding of design principles of natural model systems.

Figure 2. Development of bioinspired functional synthetic material systems through a structure-property-function relationship for an understanding of design principles of a biological system (Song, 2011).

Figure 3. Development of highly functional and dynamic hydrogels through 3D printing with newly designed bioinks followed by various post-fabrication processes (e.g., UV or heat treatment).
Dr Tan read mechanical engineering and economics at the University of California – Berkeley, aeronautics at California Institute of Technology, and biomedical engineering at Nanyang Technological University, before embarking on his doctoral studies in postdoctoral training, first with Mylene Yao and Wing Hung Wong (2009-2010) and then with Jin Billy Li (2011-2013), where he applied cutting edge genomics technologies to investigate cell fate decisions and RNA editing.

RESEARCH DESCRIPTION

We are interested in DNA and RNA editing, particularly in the context of cell identity. Although living cells have biological information hardwired into their genomes, this information can be naturally or artificially altered, either at the level of DNA, where the changes can be permanent, or at the level of RNA, where the changes can be dynamic. We work in the following areas:

1) DNA editing
   (a) Development of novel genome engineering technologies.
       Powerful genome editing tools, such as CRISPR-Cas9, have greatly enhanced our ability to modify the human genome. However, CRISPR-associated technologies currently suffer from three major problems: efficiency; specificity; and limited targeting range. These shortcomings must be addressed before CRISPR-based technologies can be used clinically, for example, to correct disease-causing mutations in patients. We aim to improve the editing enzymes, with the goal of developing new human therapeutics. In addition, we are developing related technologies, such as inducible genome editing systems and CRISPR-based transcriptional or epigenetic regulators, for biomedical and biotechnological applications.

   (b) Application of genome engineering technologies to understand cell fate decisions.
       A human body contains many different types of cells carrying essentially the same DNA, so how does a cell know what it should be? We employ advanced genome engineering to investigate human stem cell biology, using targeted genetic perturbations to understand the underlying regulatory networks orchestrating development and stem cell differentiation, and CRISPR-based screens to identify novel factors involved in cell fate decisions.

2) RNA editing
   (a) Functions of RNA editing events.
       The most prevalent type of RNA editing in mammals is adenosine-to-inosine editing catalysed by the ADAR family of RNA-binding proteins. Since inosines are recognized by cellular machines as guanosines, this type of editing effectively results in nucleotide changes. Neutrophil lineage sequencing experiments have revealed that A-to-I editing is prevalent in humans, but the functional consequences are unknown. We are investigating the roles of A-to-I editing in stem cell differentiation, and how defective editing can contribute to the pathogenesis of diseases such as cancer and neurodegeneration.

   (b) Regulation of A-to-I editing.
       We and others have extensively profiled A-to-I editing in numerous normal and diseased tissues, and have seen strikingly diverse spatiotemporal editing patterns. As there are only three ADAR genes, regulation of this diversity must require additional cellular factors. To understand the different mechanisms of regulation, and how they relate to human development and disease, we aim to map the full repertoire of editing regulators.

Dr. Timothy Tan Thatt Yang obtained his BEng and PhD in Chemical Engineering in 2000 and 2004 respectively from the University of New South Wales, Australia. He then joined the Institute of BioEngineering and Nanotechnology, A*STAR Singapore, as a postdoctoral fellow for two years, before moving on to become an Assistant Professor in the School of Chemical and Biomedical Engineering. He was promoted to Associate Professor in February 2012.

Dr. Tan is interested in nanophotonic structure and materials engineering using lanthanide and zero dimensional carbon nanomaterials (graphene quantum dots) with applications in alternative energy, chemical transformation and medicine.

His group works closely with clinicians on the design and tailoring of up- and down-conversion nanomaterials with new and useful properties directed at clinical translation. He recently demonstrated a 2-order magnitude enhancement in 800nm upconverted fluorescence, bringing upconversion technology closer to clinical applications.

The group has also taken a keen interest in enhancing solar and bio-energy harvesting, chemical transformation and waste water remediation via a self-cum-directed assembly approach.

ACHIEVEMENTS

Dr. Tan’s recent awards include the Public Administration Award 2015 by the President of Singapore, Tan Chin Tuan Fellowship for Engineering 2014 by NTU, and Young Investigator Award in “International Symposium of Materials on Regenerative Medicine 2012”.

He has 4 patents (granted and applied), edited a book, and published four book chapters and more than 90 original papers.
RESEARCH TRAINING

Prof Teoh Swee Hin is Distinguished Renaissance Engineering (REP) Fellow, Nanyang Technological University. He is a Fellow of the Academy of Engineers Singapore. He was the Director of the Centre for Biomedical Materials & Applications (Biomat), Department of Mechanical Engineering and Executive Member of the NUS Tissue Engineering Program, National University of Singapore (NUS). From 1999 to 2005 he was the Founder Chairman of the NUS Graduate Bioengineering Programme.

He was the Founder Deputy Director of the Institute of Materials Research and Engineering from 1997 to 1998. He has spun off 3 companies and has been the Chairman of the Board of Directors of Osteopore International since 2003.

From 1995-2012, he was the Director of the Centre of Biomedical Materials & Applications (BIOMAT), Department of Mechanical Engineering and Executive Member of the NUS Tissue Engineering Program, National University of Singapore (NUS). From 1999 to 2005 he was the Founder Chairman of the NUS Graduate Bioengineering Programme.

RESEARCH DESCRIPTION

Prof Teoh’s main field of research is biomaterials and tissue engineering, focusing on the integration of medical imaging, biomaterials 3D printing and the study of mechanisms that promote cell proliferation and differentiation as a result of mechano-induction in 3D scaffolds (Figure 1) for bone tissue engineering (BTE). His invention of the bi-axial bioreactor mimicking the fetus rotation (Figure 2) is unique and commercialised. He has done pioneering translational work in large cranioplasty (Figure 3) and bone regeneration in dentistry using stem cells and growth factors. Currently, the group is working towards the development of a physiologic bioreactor system for bone tissue engineering that allows application of physiologically relevant mechanical strains on premature bone grafts that are cultured in a modified bi-directional rotation bioreactor. Further, the physiologic bioreactor has been integrated with sensing modalities that allows real-time, non-invasive sensing of culture parameters like dissolved oxygen and pH. The developed platform is hypothesized to generate structurally and functionally relevant bone grafts. Our lab is also looking into the conversion of fish waste into useful biomaterials for tissue engineering as fish waste contains a rich untapped source of collagen. Our research involves the extraction of collagen from tilapia fish skin to fabricate electrospray collagen membranes for guided bone regeneration, and the decellularization of tilapia fish skin to obtain acellular scaffolds for skin regeneration. By developing tissue engineering scaffolds out of fish waste, we hope to overcome the immunological risks and religious restrictions associated with commercial mammalian collagen scaffolds, and to reduce wastage in the fish-processing industry. Another area of interest lies in the decellularization of tissues. Here, animal tissues such as arteries are treated to obtain a biological scaffold that maintains the mechanical properties and protein content but is free from cellular material. This can be used as a substitute to existing synthetic grafts and development of disease models.

KEY PUBLICATIONS


ANY OTHER INFORMATION

(e.g. major grants, editorial board membership, etc.)

Prof Teoh contributes significantly to professional bodies. He chairs the Singapore Academy of Medical Professional Association (ARM) Professional Association (ARPA). He sits on the board of editors of Tissue Engineering, Journal of Mechanical Engineering and Regenerative Medicine, Journal of Mechanical Behaviour of Biomedical Materials and Journal of Oral & Maxillofacial Research.

LAB STAFF

Researchers: Luvita Suryani, Hassanbhai Ammar Mansoor, Wen Feng

Project Officers: Jin Zhiyao

PhD Students: Sathya Moorthy Bhaskar, Lau Chai Seng, Luvita Suryani
**RESEARCH TRAINING**

Dr. Wang Dongan studied at Zhejiang University, where he took a BEng in Polymer Materials and a PhD in Biomaterials. After postdoctoral work in the USA at Johns Hopkins University, he moved to Singapore in 2005 as an assistant professor in Biomedical Engineering. Promoted to Associate Professor in 2010, he has been Associate Chair of Graduate Studies in the School of Chemical and Biomedical Engineering, and is now Director of the Bioengineering Programme.

**ACHIEVEMENTS**

Dr. Wang has authored >100 peer reviewed articles including Nature Materials, Advanced Functional Materials, etc., and a number of patents. One of his papers won the Best Paper Award conferred by European Federation for Pharmaceutical Sciences and Elsevier.

**ANY OTHER INFORMATION**

(e.g. major grants, editorial board membership, etc.)

Dr. Wang has been an invited guest editor of Theme Issues in Advanced Drug Delivery Reviews (Issue 7-8, 2010), Pharmaceutical Research (Issue 6, 2011), and Molecular Pharmaceutics (Issue 7, 2014), Stem Cells International, Volume 2016, (2016), respectively. Dr. Wang is also an Editorial Board Member of Pharmaceutical Research (since 2013).

**Major Grants:**


**LAB STAFF**

Postdoctoral Researchers: Xie Shuying

PhD students: Zhu Wenzhen, Nie Xiaole, Auyeung Shang Yong Benjamin, Tao Chao

**KEY PUBLICATIONS**


**RESEARCH TRAINING**

Dr Wang Mingfeng received his BSc degree in Chemistry at Jilin University in 2001, followed by his MSc degree in Polymer Chemistry and Physics under the supervision of Prof Xi Zhang. In 2004, he joined Prof. Mitchell A. Winnik's group at the University of Toronto and obtained his PhD degree in Polymer Chemistry and Materials in 2009. In the same year, Dr Wang was awarded a Postdoctoral Fellowship supported by the Natural Sciences and Engineering Research Council of Canada (NSERC), and joined Prof Fred Wudl's group at the University of California, Santa Barbara. Dr Wang's postdoctoral research under the direction of Prof. Wudl, with close collaboration with Prof. Alan J. Heeger's group and Prof. Thuc-Quyen Nguyen's group, focused on new semiconducting polymers and fullerene derivatives for organic solar cells. Dr Wang further broadened his research experience at the Center for Functional Nanomaterials in Brookhaven National Laboratory before he joined Nanyang Technological University in July of 2012 as a Nanyang Assistant Professor in the School of Chemical and Biomedical Engineering.

**RESEARCH DESCRIPTION**

Biological systems are characterized by emergent properties in many processes such as energy and chemical transduction, communication, adaptation, self-repair and reproduction. They provide the proof-of-concept for what can physically be achieved with nanotechnology. For example, the ways in which biological systems transform and store energy, as well as their capabilities to perform self-repair and to adapt to external conditions inspire materials scientists and engineers wishing to manipulate energy, entropy and information in synthetic nano/micro systems.

The mission of my research group is to develop novel polymeric and supramolecular materials with bioinspired hierarchical structures and advanced functions, broadly defined, for energy sustainability and human health. We enable this goal through a highly interdisciplinary research program across chemistry, materials science, biology and engineering. Our specific aims include:

1. To explore “greener” synthetic tools towards new conjugated semiconducting molecules and polymers.
2. To develop bioinspired light-harvesting complexes by design, synthesis and assembly of functional molecules, polymers and nanoparticles, and understand interfacial transport of energy, charge and mass in hierarchically assembled structures with integrated functions.
3. To explore new polymeric materials and device structures for sustainable energy conversion, biodiagnostic, nanomedicines and tissue engineering.

**KEY PUBLICATIONS**


**ACHEVEMENTS**

1. We have employed C-H direct arylation coupling that enables the synthesis of a variety of pi-conjugated molecules and polymers in fewer synthetic steps without use of highly flammable and toxic organometallic agents.
2. We have developed a general and facile strategy to suppress the aggregation-caused fluorescence quenching and enhance the photostability of organic fluorophores for bioimaging applications. Specifically, well-defined synthetic polymers consisting of an organic fluorophore covalently linked in the middle of a polymer chain as a biocompatible and bioreversible matrix show bright and robust fluorescence in solid states that will be highly desirable for bioimaging and long-term tracking of bioabsorbable interfaces.
3. We have explored a “see and treat” (“theranostics”) platform of nanomedicines by integrating imaging-contrast agents (“see”) and anticancer drugs (“treat”) into self-assembled nanostructures such as those formed by amphiphilic block copolymers or silica precursors.

**ANY OTHER INFORMATION**

(e.g. major grants, editorial board membership, etc.)

Academic Research Fund Tier 2 (2014-) [by MOE]

**Lab staff**

Postdoctoral Fellows: Jia Tao, Wu Yingfe

Research Associate: Peng Yanyan

PhD student: Zakiruddin Bohra Hassan
Dr. Wang Xin received his Bachelor’s (1994) and Master’s (1997) degrees in Chemical Engineering from Zhejiang University, and his PhD (2002) in Chemical Engineering from Hong Kong University of Science and Technology. From 2003 to 2005, he worked as a research fellow at the University of California, Riverside, and concurrently, as R&D director and vice president for a startup fuel cell company listed in NASDAQ. He joined Nanyang Technological University as assistant professor in 2005 and was promoted to associate professor in 2010 and full professor in 2016.

My lab works on electrocatalysis and electrochemical technology for energy harvesting. Recent research focuses include:

1) material development and investigation of the mechanisms of energy systems, including fuel cells, microbial fuel cells.
2) electrocatalysis for CO2 reduction and water splitting.
3) electrochemical reactor with co-generation of electricity and valuable chemicals.

**RESEARCH DESCRIPTION**

N-doped carbon nanotube frameworks derived from MOFs as bifunctional electrocatalyst for OER and OIR.

**KEY PUBLICATIONS**

Dr Xu Chenjie received his BS from Nanjing University (2002) and MPhil from Hong Kong University of Science and Technology (2004). After a one-year internship at Stanford University (2005), he continued his PhD under the supervision of Professor Shouheng Sun at Brown University (2005-2009), where he was the recipient of the Vince Werrig Fellowship, Joukowsky Outstanding Dissertation Prize, and Potter Prize for Outstanding Doctoral Thesis. From 2009 to 2012, he was a research fellow under Professor Jeffrey Karp at Brigham and Women’s Hospital. Dr Xu joined NTU in 2012.

**RESEARCH DESCRIPTION**

My group aims to develop new medicines based on nanotechnology for biomedical challenges. There are currently two focuses in the laboratory:

1. **Cell labeling and tracking with nanoparticles**
   - Exogenous cell therapy aims to replace/repair diseased or dysfunctional cells and promises to revolutionise medicine by restoring tissue and organ function. To develop effective cell therapy, the biodistribution, status and functions of transplanted cells must be evaluated. Nanoparticle-based imaging technologies have the potential to track transplanted cells non-invasively. One area in our lab is to develop non-invasive imaging technologies based on nanoparticles for revealing the distribution, status and differentiation of administered therapeutic cells.

2. **Monitoring and self-treatment of abnormal scarring with nanotechnology**
   - People have become more self-conscious of their scars, given the increasing media focus on aesthetics. The worst result from scars is the development of abnormal scars (hypertrophic or keloid scars), which are painful, disfiguring, and are aesthetically unpleasant. More annoyingly, they frequently persist at the site of injury, recurring after treatment. Although much has been learnt about their pathophysiology, existing treatments including corticosteroid injection, pressure dressing, and surgery have limited efficacy, and are neither readily accessible nor patient-friendly. To address these problems, we are developing an efficient, convenient, and user-friendly nanotechnology to prevent the formation of such abnormal scars.

**KEY PUBLICATIONS**

1. Obesity compounds to subcutaneous adipose tissue with polymeric microneedle patches. Small Methods, 2017, 1, 1700269. https://doi.org/10.1002/smtd.201700269


**ACHEEEMENTS**

Dr Xu develops several methods for modifying and functionalizing magnetic nanoparticle, smart nanosensors for tracking stem cell viability and functions in vitro and in vivo, microneedle patch for treating scar and obesity, and transdermal sensors for examining skin abnormality. His papers have a total ISI citation of over 5500 (>60 citations per article) and an H-index of 29.

**ANY OTHER INFORMATION**

(e.g. major grants, editorial board membership, etc.)

- Chair of symposium “Nanomaterials in translational medicine” at ICMAT 2017, Singapore (June 19-22, 2017)
- Chair of symposium “Current status and future of nanomaterials in translational medicine” at MRS 2015 spring (April 14-19th 2015, SF, CA)
- Chair of “New frontiers in biomedical engineering” subtrack of Biomedical Engineering Society 2011, October 12-15th.
- Associate editorial board member of “American Journal of Nuclear Medicine and Molecular Imaging”
- Editorial board member of Quantitative Imaging in Medicine and Surgery, Journal of Laboratory Automation, NPG Asia Materials 8, and Molecular Imaging”
- Associate editorial board member of “American Journal of Nuclear Medicine and Molecular Imaging”
- Guest editor of “Theranostics”, 2012

**LAB STAFF**

Research Fellows: Hao Chang, Christian Wiraja, David Yeo

PhD students: Mingyue Cui, Daniel Lio, Zayim Razina Di O Seeni Syed, Mengjia Zheng, Sharon Chew
RESEARCH TRAINING
Prof Xu Rong is the interim Chair of the School of Chemical & Biomedical Engineering (SCBE) at NTU. She received her Bachelor, Master and PhD degrees in Chemical Engineering from the National University of Singapore (NUS) in 1998, 2000 and 2004, respectively. She joined SCBE as an Assistant Professor in 2004. She was promoted to Associate Professor in 2010 and to Full Professor in 2017. She served as Associate Chair Research (2011-2014).

RESEARCH DESCRIPTION
Her lab is involved in areas related to energy and environmental applications including solar fuel generation, water treatment, and chemical transformation by designing functional materials and molecules. She is particularly interested in molecular design of solid catalysts for photocatalysis and electrocatalysis to achieve the conversion of solar energy to chemical energy via water splitting and carbon dioxide reduction. Recently her research interest has also been extended to the use of flame synthesis for the generation of cheap and efficient catalysts for versatile applications.

Functional materials & molecules
- Water reduction to $H_2$
- Water oxidation to $O_2$
- $CO_2$ reduction
- Adsorption
- Advanced oxidation
- Disinfection
- Chemical transformation
- Biocatalysis

Catalysis, photocatalysis
Solar to chemical energy
Water treatment

KEY PUBLICATIONS

ACHIEVEMENTS
To date, Prof Xu has published over 140 papers. She received the Top-Cited Papers for 2010 and 2011 Award from Elsevier, New York, USA for her paper on supported cobalt oxide catalysts for water treatment published in Applied Catalysis B: Environmental.

ANY OTHER INFORMATION (e.g. major grants, editorial board membership, etc.)
She has won grants with a total value of more than $88 million from funding agencies such as Agency for Science, Technology & Research (A*Star), Ministry of Education, National Environmental Agency, and National Research Foundation. She also collaborates with ExxonMobil Research and Engineering Company on energy related topics.

She is currently an Associate Editor the Beilstein Journal of Nanotechnology, and Editorial Member of ACS Sustainable Chemistry & Engineering.

LAB STAFF
Postdoctoral Researchers: Yin Shengming, Tu Wenguang, Sheng Yuan, Lu Yan
PhD students: Wu Shuyang, Wang Haojing
**RESEARCH TRAINING**

Dr Zhao Wenting was previously a Postdoctoral Scholar at Stanford University, working in both Prof Yi Cui’s group in Materials Science and Engineering and Prof Binhao Cui’s group in Chemistry. She obtained her BEng in Bioengineering from Zhejiang University in China. After that, she was awarded the JPB Scholarship from Hong Kong University of Science and Technology to pursue her Master degree and later her PhD degree in Bioengineering with Prof I-Ming Hsing.

**RESEARCH DESCRIPTION**

Dr Zhao’s research works focus on the interplay between biology and materials. Biological cells constantly interact with their environment to receive nutrients and to collect survival signals, e.g. growth factors and signalling molecules. Comprehension of such interaction is crucial for the next generation biomaterial design and cellular engineering. However, since most of the interactions happen at nanometer to micrometer scale, technologies to control cellular interface with nanometer precision are highly demanded but difficult to achieve. To meet this challenge, our research aims to leverage cutting-edge nanofabrication technologies, e.g. electron-beam lithography and nanoimprinting lithography, to develop new methodologies and platforms for the manipulation of nanoscopic features at the cell-environment interface, as well as the elucidation of the molecular interplay between cells and materials. We aim to develop new technologies enabling the detection of disease markers, screening of potential drug targets and new therapeutics. Our current targets are aging-related neurodegenerative disease, cancer metastasis, infectious disease, and diabetes.

**KEY PUBLICATIONS**


**ACHIEVEMENTS**

Dr Zhao’s research works have been published in several reputable journals, including Nature Nanotechnology, PNAS, Nano Letters, ACS Nano, Chemical Communications, etc., as well as one patent granted. Her published works have attracted 1334 total citations with h-index of 12 according to ResearcherID. Bodies including the Research Grant Council (RGC) of Hong Kong.

**ANY OTHER INFORMATION**

(e.g. major grants, editorial board membership, etc.)

Start-up grant of NTU, (2017-2021).

**LAB STAFF**

Research Associate: Zhuang Yinyin
PhD Student: Zeng Yong Peng
FYP student: Bun Senkosal
CN Yang: Tang Kai Xin
**HIGHLIGHTS OF STUDENTS**

**BES 11TH SCIENTIFIC MEETING 2017 (UG)**

Tan Aiwei Janice (BIE Recent Graduate - SCBE) won Gold award (Undergraduate Podium Category) in the BES 11th Scientific Meeting 2017. This also marks the 5th consecutive Gold Awards achieved by our SCBE students for the past BES scientific meetings.

BES Scientific Meeting is an annual national symposium organized for students from junior colleges, polytechnics, undergraduates, and graduate levels to participate in this scientific meeting, to showcase their interesting projects and to find out what others have done.

**IGEM SYNTHETIC BIOLOGY COMPETITION 2017 (UG)**

Gold medal at iGEM synthetic biology competition 2017 for their project titled “Exploration of Crispr/Cas Systems”. The team consists of engineering and biology students who aspires to contribute to the field of science to improve the quality of life of people.

The iGEM competition is an annual, worldwide, synthetic biology event aimed at undergraduate university students, as well as high school and graduate students.

Ng Wei Kai (BIE Recent Graduate – SCBE) and his supervising professor, Dr Mark Chong, were ranked 1st under the “Biomedical & Medicine” category for their poster titled: "Microfluidic Platform for Investigating Prostate Cancer Metastasis". Their poster have also won the most number of votes at the Peer Assessment Review.

Novenia Oerip Ariyani (BIE Year 4) and her supervising professor, A/ Prof Sierin Lim, were ranked 2nd under the “Physical and Biological Sciences” category for their poster titled: "Biodegradable gel-emulsion for pharmaceutical and cosmetic applications".

Kelvin Suriyaputra (CBE Year 3) and his supervising professor, Asst Prof Tan Meng How, have won the popularity award under the “Biomedical & Medicine” category with the most number of votes for their poster titled: “Improving CRISPR-Cas technologies for targeted genome engineering by homology-directed repair Investigating Cancer-Bone Interactions in an In Vitro Model”.

**DISCOVER URECA @ NTU POSTER EXHIBITION AND COMPETITION 2017 (UG)**

Ng wei Kai (BIE Recent Graduate – SCBE) and his supervising professor, Dr Mark Chong, were ranked 1st under the “Biomedical & Medicine” category for their poster titled: "Microfluidic Platform for Investigating Prostate Cancer Metastasis". Their poster have also won the most number of votes at the Peer Assessment Review.

Novenia Oerip Ariyani (BIE Year 4) and her supervising professor, A/ Prof Sierin Lim, were ranked 2nd under the “Physical and Biological Sciences” category for their poster titled: "Biodegradable gel-emulsion for pharmaceutical and cosmetic applications".

Kelvin Suriyaputra (CBE Year 3) and his supervising professor, Asst Prof Tan Meng How, have won the popularity award under the “Biomedical & Medicine” category with the most number of votes for their poster titled: “Improving CRISPR-Cas technologies for targeted genome engineering by homology-directed repair Investigating Cancer-Bone Interactions in an In Vitro Model”.

Ng Wei Kai (BIE Recent Graduate – SCBE) and his supervising professor, Dr Mark Chong, were ranked 1st under the “Biomedical & Medicine” category for their poster titled: "Microfluidic Platform for Investigating Prostate Cancer Metastasis". Their poster have also won the most number of votes at the Peer Assessment Review.
HIGHLIGHTS OF STUDENTS

BEST POSTER AWARD IN ICMAT 2017 (PG)

Asst Prof Ni Ran, Dr Hao Hu (research fellow) and Pablo Sampedro Ruiz (PhD Student), have won the Best Poster Award in the 9th International Conference on Materials for Advanced Technologies.

The International Conference on Materials for Advanced Technologies, or more commonly known as ICMAT, is a major biennial event organized by The Materials Research Society of Singapore (MRS-S). The focus of MRS-S has been to promote materials science not only to researchers in Singapore, but also to publicise the niche capabilities of local researchers throughout Asia and further afield.

27 SCBE STUDENTS BUILT HYDROPONIC SYSTEM AND THEIR PASSION WAS HIGHLIGHTED INTERNATIONALLY

Equipped with only basic knowledge in hydroponic, students signed up for the training to learn new skills, worked on canvassing and overcome the language barrier. Despite all the challenges during planning and execution, they become stronger and learnt the importance of service learning to the community. Their hard work has paid off when the system was successfully built and benefited the orphans. Not only that, it was highlighted during the University Scholars Leadership Symposium (USLS) 2017 in front of the 907 delegates from 78 countries to encourage others to contribute in a small way.

The Overseas Community and Involvement Programme (OCIP) was organised and participated by 27 SCBE students from 28th May – 11th Jun 2017 in Sunrise Orphanage – Cambodia. With a strong sense of social and community responsibility, they went ahead to build a sustainable hydroponics farm and wish that their footprints are able to inspire others.

SHARED FACILITIES

SCBE offers modern infrastructure, state-of-the-art research and teaching facilities.

Atomic Force Microscopy (AFM)
Circular dichroism (CD)
Field Emission Scanning Electron Microscope (FESEM)
Raman Spectrometer
Scanning Electron Microscope (SEM)
TGA-FTIR Integrated
Transmission electron microscopy (TEM)
RESEARCH CENTERS

ANTIMICROBIAL BIOENGINEERING

The Centre for Antimicrobial Bioengineering studies new antimicrobial biomacromolecules to combat resistant Gram-negative and Gram-positive bacteria. We are an interdisciplinary group of polymer chemists, sugar chemists, microbiologists, and molecular cell biologists assembled for this noble purpose. Centre for Antimicrobial Bioengineering is helmed by Director Professor Mary Chan-Park.

BONE TISSUE ENGINEERING

The Centre for Bone Tissue Engineering is set up with the aim of creating a stimulating and dynamic research environment for the incubation of ideas in relation to bone regeneration. Headed by Professor Teoh Swee-Hin, our group has made significant contributions both to the scientific and clinical community due to our close connections with the surgical/clinical community.

NTU FOOD TECHNOLOGY CENTRE (NAFTEC)

NAFTEC is a newly formed centre aimed at the integration of new scientific developments as a basis for more efficient, safe and sustainable food production in South-East Asia. NAFTEC is developing expertise to enable science-based policy planning by industry and regulatory agencies, ultimately in support of safer, better food for the consumer.

SCHOOL OF CHEMICAL AND BIOMEDICAL ENGINEERING (SCBE)

NANYANG TECHNOLOGICAL UNIVERSITY, SINGAPORE

Tenure and Tenure-track Faculty Positions at Full/Associate/Assistant Professor Levels

The School of Chemical and Biomedical Engineering (SCBE) invites applicants to apply for tenure and tenure-track faculty positions at the Full/Associate/Assistant Professor levels. Applicants should hold a PhD in Chemical Engineering, Bioengineering, Biomedical Engineering, Food Science Technology and Engineering or a related field by the beginning of the appointment period. Candidates with post-doctoral training would be preferred.

The School is particularly interested in candidates with research interests in one of the following research areas:

i. Chemical Engineering
   Especially in the area of heterogeneous catalysis, reaction engineering, colloids and interface sciences, energy technologies, carbon capture, continuous manufacturing, etc.

ii. Biotechnology & Synthetic Biology
   Especially in the areas of bioprocess, biocatalysis, bacteriology, protein engineering, genome engineering, combinational genetics and systems biology.

iii. Biosensors and Bioinstrumentation
   Especially in the areas that utilize recent advances in materials, fabrication, electronics, optics, biomimetics, omics and biochemistry to develop novel diagnostic, therapeutic, and prosthetic devices or tools.

iv. Translational Healthcare Technology
   Especially in the areas of high clinical relevance that utilize state of the art biomedical device, imaging, and monitoring technologies for surgery, disease diagnosis / treatment, rehabilitation, or home based healthcare management.

v. Food Science & Technology
   Especially in the area of sustainable food production and processing technology, food fermentation technology, food analytics, food formulation, functional food, food waste management.

The candidate should have a demonstrated excellence in original research, with good publication records and the ability to teach core Chemical/Food Engineering and Bioengineering courses. Entrepreneurial qualities are also sought after.

Emoluments and General Terms & Conditions of Service

The commencing salary will depend on the candidate’s qualifications, experience and the level of appointment offered.

Application Procedure:

Qualified candidates are invited to submit an application. Guidelines for Submitting an Application for Faculty Appointment are available at the link: http://www.ntu.edu.sg/oehr/career/submit-an-application/Pages/Faculty-Positions.aspx

Electronic submission of application is encouraged and can be forwarded to:

Chairman,
Search Committee
School of Chemical and Biomedical Engineering
NANYANG TECHNOLOGICAL UNIVERSITY
E-mail: scbe_recruit@ntu.edu.sg
Website: www.scbe.ntu.edu.sg

Please indicate clearly the post applied for when submitting an application, or inquiring about this job announcement. Only shortlisted candidates will be notified.