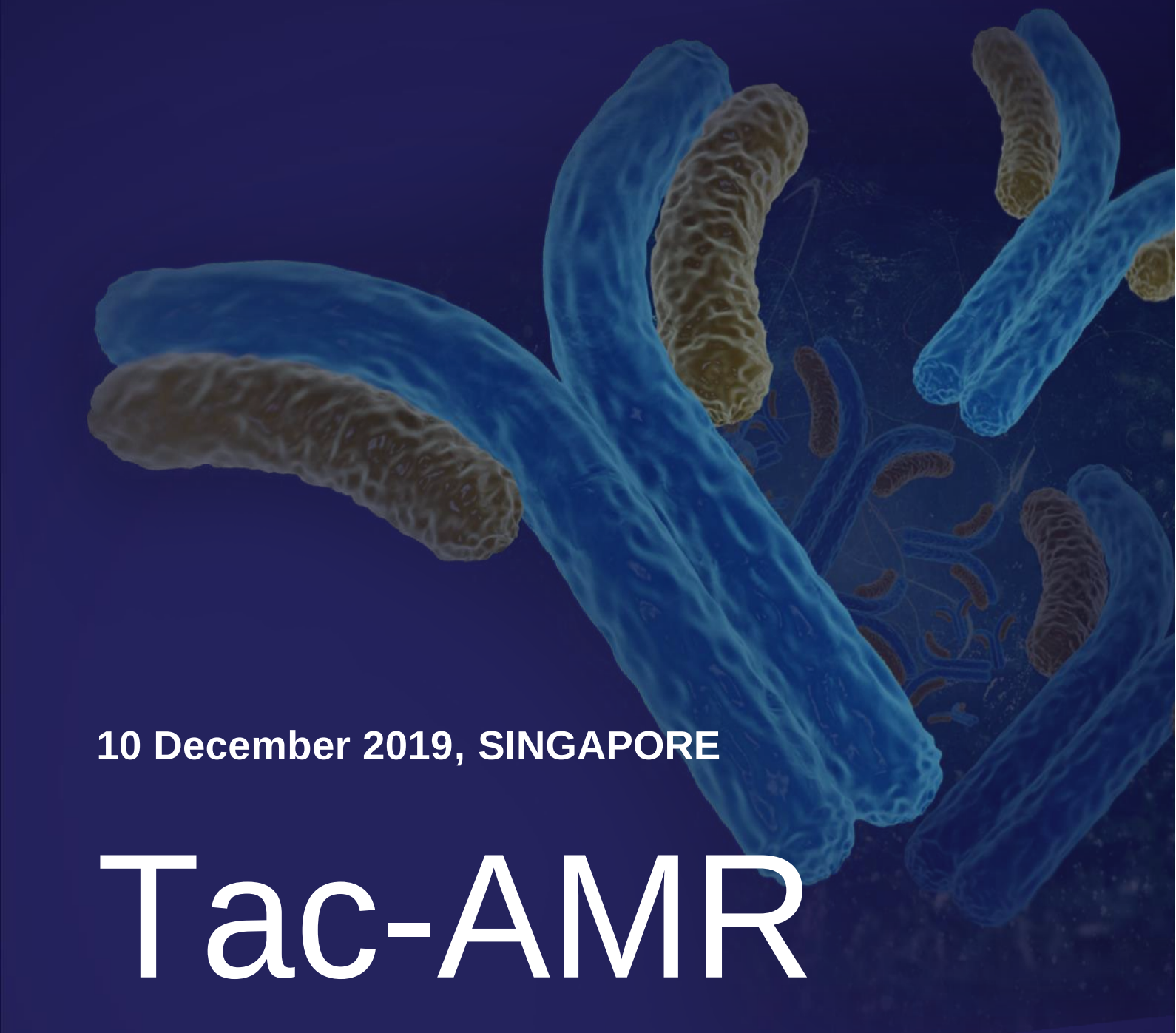
NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

Institute of Advanced Studies @ NTU
College of Engineering, Centre for Antimicrobial Bioengineering (CAMB@NTU)
Lee Kong Chian School of Medicine, NTU
National Centre for Infectious Diseases (NCID), Singapore
Singapore-MIT Alliance for Research and Technology (SMART)



10 December 2019, SINGAPORE

Tac-AMR

Tackling the Global Antimicrobial Resistance – One Health

Lecture Theatre at The Arc@NTU
Learning Hub North (LHN) LHN-B1-15
63 Nanyang Drive, 636922

Programme QR

THEME: GLOBAL ANTIMICROBIAL RESISTANCE

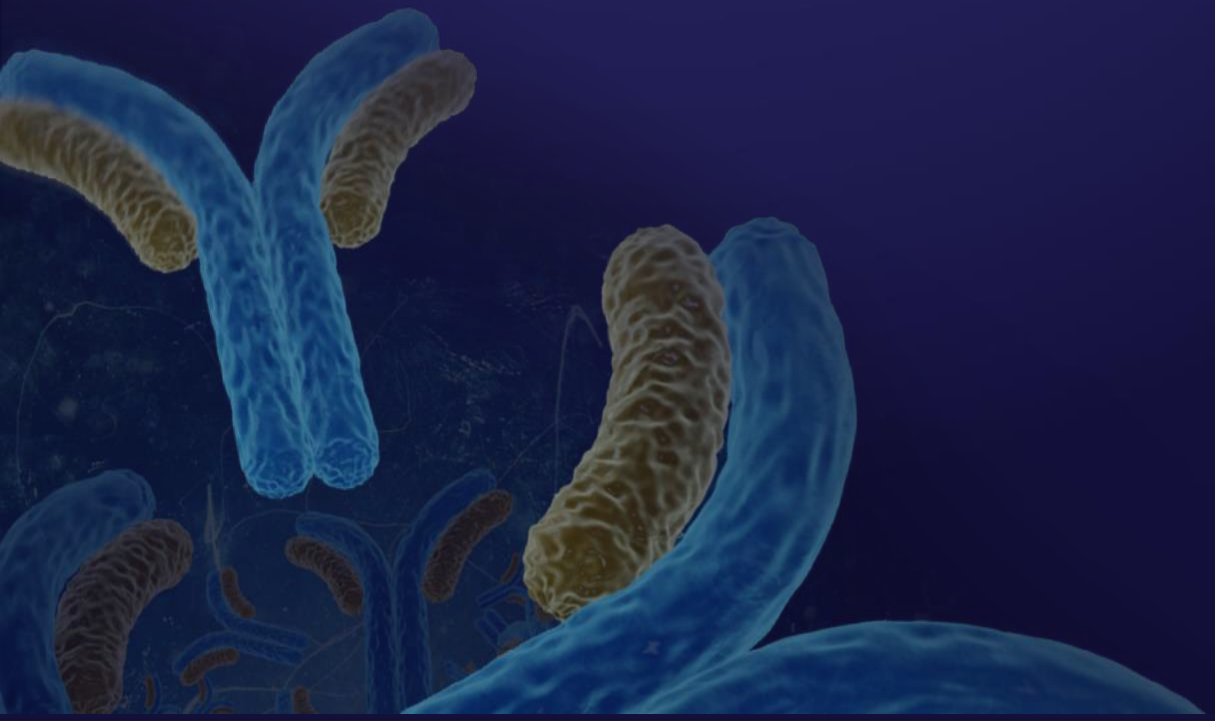
Antimicrobial resistance (**AMR**) has emerged as one of the principal public health problems that threatens the effective prevention and treatment of an ever-increasing range of infections caused by bacteria, parasites, viruses and fungi that are no longer susceptible to the common antibiotics taken for granted that can effectively treat them. The problem of AMR is especially urgent regarding antibiotic resistance in bacteria. Over several decades, to varying degrees, bacteria causing common or severe infections have developed resistance to each new antibiotic coming to market. Faced with this reality, the need for action to avert a developing global crisis in health care is imperative.

This conference on **"Tackling the Global Antimicrobial Resistance – One Health"** will address global public health needs by developing and delivering new or improved antibiotic treatments, while endeavoring to ensure their sustainable access.

The conference seeks to bring together researches in the multi-disciplinary AMR field that seeks to advance new and affordable solutions to tackle the global AMR issue relating to One Health that spans the human health to food safety. We believe that the combination of these disciplines in various related field and their frequent updates and combined approaches, will accelerate the advances in tackling the AMR global problem and would be the basis a very stimulating conference.

This conference is jointly organized by the Institute of Advanced Studies, the College of Engineering, and the Lee Kong Chian School of Medicine, all at NTU, together with the Singapore-MIT Alliance for Research and Technology (SMART) on AMR (SMART-AMR).

The one-day conference feature chemists, microbiologists, clinicians, and engineers from The Sweden, USA, Australia, and Singapore.



Programme QR

DECEMBER 10

TUESDAY

9:00 – 9:10	**Welcome by Dean of CoE, NTU** **Professor Louis Phee**
	Opening Remarks
9:10 – 9:20	**by Guest of Honor, Professor Leo Yee Sin** (Executive Director, National Centre for Infectious Diseases, Singapore)
	Session 1 (Chair: Prof Mary Chan)
9:20 – 9:50	Professor Agneta Richter-Dahlfors, Swedish Medical Nanoscience Center, Karolinska Institutet, Sweden
9:50 – 10:20	Professor Kevin Pethe, Lee Kong Chian School of Medicine, Nanyang Technological University, Singapore
10:20 – 10:30	**Tea Break**
	Session 2 (Chair: Prof Hongwei Duan)
10:30 – 11:00	Professor Guosong Chen, Department of Macromolecular Science, Fudan University, China
11:00 – 11:30	Professor Oon Tek Ng, National Centre for Infectious Diseases, Singapore
11:30 – 12:00	Dr Amit Singhal, Singapore Immunology Network (SIgN), A*STAR, Singapore
12:00 – 12:30	Dr Marimuthu Kalisvar, National Centre for Infectious Diseases, Singapore
12:30 – 13:30	**Lunch**
	Session 3 (Chair: Prof Kevin Pethe)
13:30 – 14:00	Professor Greg Qiao, Chemical Engineering, The University of Melbourne, Australia
14:00 – 14:30	Professor Hongwei Duan, School of Chemical and Biomedical Engineering, Nanyang Technological University, Singapore
14:30 – 15:00	A/Professor Mark Butler, UQ Centre for Clinical Research, University of Queensland, Australia
15:00 – 15:30	Dr Megan McBee, Scientific Director, Antimicrobial Resistance Interdisciplinary Research Group (AMR IRG), SMART, Singapore
15:30 – 16:00	**Tea Break**
	Session 4 (Chair: Dr Megan MaBee)
16:00 – 16:30	Dr Wilfried Moreira, Director, Research & Principal Investigator, Antimicrobial Resistance Interdisciplinary Research Group (AMR IRG), SMART, Singapore
16:30 – 17:00	Professor Chuanbing Tang, Department of Chemistry and Biochemistry, University of South Carolina, USA
17:00 – 17:30	Dr Susan Gibson-Kueh, James Cook University, Singapore
17:30 – 18:00	Professor Mary Chan, School of Chemical and Biomedical Engineering, Nanyang Technological University, Singapore
18:00	**Closing Remarks**

Prof Agneta Richter-Dahlfors

AIMES - Center for the Advancement of Integrated Medical & Engineering Sciences, Karolinska Institutet, Stockholm, Sweden

Professor Agneta Richter-Dahlfors is the director of AIMES – Center for Integrated Medical and Engineering Sciences, an interdisciplinary research center shared between the Karolinska Institutet (KI) and KTH Royal Institute of Technology (KTH) in Stockholm, Sweden. Richter-Dahlfors' multidisciplinary competence is witnessed from her holding a Professor position in Cellular Microbiology at KI, as well as in Chemistry and Biotechnology at KTH. She heads a multidisciplinary research group which aims to bridge a gap between medicine and engineering by innovating and publishing equally in both fields. Her broad research interest include bacterial infection, tissue microbiology, organic bioelectronics, opto-electronic sensors for bacterial detection, and anti-fouling surface coatings to mention a few. Richter-Dahlfors is co-inventor on several patents, and is engaged in entrepreneurial activities as founder and co-founder of companies in the biotech and med-tech field.

Opto-electronically active oligomers and polymers for bacterial sensing, infection diagnostics, and antimicrobial coatings

Abstract

When growing in a biofilm lifestyle, bacteria become tolerant to antibiotics and the host's immune response. This may have severe consequences for patients suffering biofilm-related infections. Yet, the biofilm parameter is overlooked in current infection diagnostics, which are designed to detect, isolate and grow planktonic bacteria. To develop novel materials and strategies to control biofilm formation and diagnose biofilm infections, we take advantage of the dual organic-conductive nature of electrically conducting oligomers and polymers. Based on the conducting polymer poly(3,4-ethylenedioxythiophene (PEDOT), we show how PEDOT acts as an electron mediator for bacterial metabolism. This demonstrates that growth of Salmonella biofilm can be modulated by the electrochemical state of the polymer. By functionalizing PEDOT with biocide agents, the material showed efficient antimicrobial activity as a surface coating. This was illustrated in PEDOT functionalized with silver nanoparticles (AgNP), where a synergistic effect of AgNP and the electrical input nearly completely prevented growth of Staphylococcus aureus. The biofilm research field is however hampered by the fact that tools that specifically report the biofilm life style is lacking. We hypothesized that methods for specific detection of ECM components, which constitutes the extracellular matrix that defines the biofilm lifestyle, would serve as excellent tools for improved biofilm research, and for diagnostics of biofilm infections. Taking advantage of the opto-electronic nature of conjugated oligothiophenes, we developed 'optotracing' as a non-toxic, fluorescence-based method for identification of ECM components, initially amyloid curli fibers and the cellulose polysaccharide. By optotracing, we study the development of biofilms on the air-solid interface in real-time. Based on cellulose detection, we further developed optotracing to a culture-independent diagnostic assay for biofilm-related urinary tract infection (UTI) caused by uropathogenic E. coli (UPEC). We currently extend the applicability of optotracing technology for diagnostics of clinically important Staphylococci using spectral analysis based on machine learning.

Prof Kevin Pethe

Lee Kong Chian School of Medicine,
Nanyang Technological University, Singapore

Before joining the Nanyang Technological University, Kevin Pethe gained expertise in Research & Development in the private sector as research investigator and project manager at the Novartis Institute for Tropical Disease (Singapore) from 2004 to 2011. In 2011, he took a position of principal investigator at Institut Pasteur Korea to pursue his interest on host-pathogen interactions and chemical biology applied to tuberculosis and multidrug resistant bacteria. He became head of the departments of disease biology & chemical genomics in 2013, and nominated acting CEO of Institut Pasteur Korea the same year. He is interested in the pathogenesis of Mycobacterium tuberculosis, microbial bioenergetics, and on strategies to discover novel antibacterial agents. Notably, he led interdisciplinary teams that developed clinical-stage drug candidates for tuberculosis and related mycobacteria.
Kevin Pethe is teaching microbiology, antibiotic drug development, infectious diseases and pharmacokinetics to undergraduate and graduate students in the Lee Kong Chian School of Medicine, the College of Science, and the College of Engineering of the Nanyang Technological University.

Antibiotics development for mycobacterial diseases

Abstract

The rapid emergence and spread of multi-drug resistant *Mycobacterium tuberculosis* and other pathogenic bacteria is a serious concern worldwide that advocates for the development of new classes of antibacterials with a novel mode of action. Current antibiotics derive mainly from natural sources and inhibit a narrow spectrum of cellular processes such as DNA replication, protein synthesis and cell wall biosynthesis. With the spread of drug resistance, there is a renewed interest in the investigation of alternate essential cellular processes, including central metabolic and bioenergetics pathways, as a drug target space for the next generation of antibiotics. Oxidative phosphorylation as recently emerged as a relevant target space for the development of new drug for tuberculosis. In this context, I will discuss the relevance of targeting the terminal respiratory oxidases for the development of a rational drug combination for tuberculosis and other mycobacterial diseases.

Prof Guosong Chen

Department of Macromolecular Science, Fudan University, China

Research interests:
Glycopolymer self-assembly, protein self-assembly, immunological functions

Biographic description:
Prof. Guosong Chen studied chemistry at Nankai University, where she obtained her B.Sc. in 2001. In 2006 she received her Ph.D with the same university in supramolecular chemistry. After her postdoctoral studies in carbohydrate chemistry at Iowa State University, she moved to Fudan University in Dec. 2008, where she joined the research group of Prof. Ming Jiang in macromolecular self-assembly as a lecturer, working on the interface of macromolecular self-assembly and supramolecular chemistry. Then she was promoted to associate professor in 2011, professor in 2014. Recently, her research focus has been reoriented to carbohydrate-based macromolecular self-assembly and its biological functions. She received Excellent Youth Foundation from NSFC in 2013. As a corresponding author, she published more than 50 papers in J. Am. Chem. Soc., Nature Communications, Angew. Chem. Int. Ed., Adv. Materials and other journals. She was elected as Fellow of Royal Chemical Society (FRSC) and serves as Associate Editor of ACS Macro Letters and international board member for Polymer Chemistry, Bioconjugate Chemistry, Polymer International and etc.

Deprotection-induced Glypopolymer Self-Assembly (DISA) for nanostructure construction and immunological applications

Abstract

Key Words: deprotection chemistry; glycopolymer

We proposed the deprotection-induced block copolymer self-assembly, that is, the deprotection of hydroxyl groups resulted in in situ self-assembly of glycopolymers. In the previous studies, block copolymers soluble in common organic solvents were employed as the starting material. In this paper, by using the protected glyco-block containing pre-assembled glyco-vesicles in water as the starting materials, we moved forward and made two exceeding achievements. Firstly, we have observed a deprotection-induced morphology transition trigged by alkali in water. The carbohydrate-carbohydrate interaction was considered to contribute to such a morphology transition during deprotection. Secondly, lipase was found to be an efficient enzymatic trigger in the sugar deprotection, which motivates the immune-application of this morphology transition process. When lipase and a model antigen, ovalbumin (OVA), were encapsulated inside the glyco-vesicles, the deprotection of sugars by lipase induced the transition of vesicles to micelles and the lipase and OVA were released accordingly. When glyco-vesicles were internalized by dentritic cells (DCs), the lipase from lysosomes efficiently induced the release of OVA and presentation of antigen to T cells. During the process, lysosomal lipase performed as a trigger on the deprotection of sugars and the release of protein without any other reagents.

A/Prof Ng Oon Tek is an Infectious Disease Senior Consultant with interest in research integrating public health, laboratory medicine and clinical medicine to improve patient outcomes. He works in the CaPES network on understanding how to stop spread of CPE. He was recently funded by the Singapore Medical Research Council for a study using FMT for CPE gut eradication. His research interest include antimicrobial resistance, emerging infectious diseases and HIV.

Prof Oon Tek Ng

National Centre for Infectious Diseases, Singapore

Whole-Genome Sequencing Reveals Plasmid-mediated Transmission and Persistent Reservoirs of Carbapenemase-Producing Enterobacteriaceae

Abstract

Carbapenemase-producing Enterobacteriaceae (CPE) is a global, antibiotic-resistant “superbug” threat with 40 to 80% mortality. Infection control, the main intervention to prevent CPE disease spread, is hindered by inability to accurately determine transmission pathways. Recent evidence strongly suggests the inanimate environment as having a major role in CPE spread. We share WGS data over 5 years in Singapore hospitals examining this issue. Additionally we will also discuss results from an international collaboration examining transmission of NDM-positive bacteria.

Dr Amit Singhal

Singapore Immunology Network, A*STAR, Singapore

Dr. Amit Singhal is an infectious disease immunologist. After postdoctoral stints at Pasteur Institute, Brussels and Novartis Institute of Tropical Diseases, Singapore; he joined SIgN in 2011 as a Research Scientist to establish BSL3 lab and initiate TB work. In 2014 he was promoted to Project Leader position to start his own independent group. He is now a Principal Investigator and conducts fundamental and modern translational immunological research at both population and single cell level. The information gained from this work is being currently exploited to establish clinically relevant therapeutic interventions in infectious diseases.

Host-directed therapies: The next frontier against AMR

Abstract

The global burden of morbidity and mortality due to drug-resistant microbes, including *Mycobacterium tuberculosis* (*Mtb*), remains immense. To manage this there is a resurgence in efforts to identify novel anti-microbial avenues. A new paradigm in drug discovery has emerged that involves therapeutic modulation of host cell responses in order to improve pathogen eradication. These ‘host-directed’ adjunct therapeutic strategies are less likely to engender microbial resistance than direct targeting of the pathogen with conventional drugs. Using chemical genetics approach we have demonstrated that activating AMP-activated protein kinase (AMPK) and Sirtuin 1 (SIRT1), regulators of whole-body energy metabolism, by FDA approved drugs / supplements could control inflammation and infection by drug-resistant *Mtb*. We are currently utilizing single cell high-dimensional approaches to (i) understand the dynamics of host-pathogen interaction, and (ii) identify druggable host-pathways that are rewired during infection and therefore could have therapeutic implications. The data related to this effort will be presented and discussed.

Dr Marimuthu Kalisvar

National Centre for Infectious Diseases, Singapore

Dr Kalisvar Marimuthu completed his advanced specialty training in Internal Medicine and Infectious Diseases in Singapore in 2010 and 2013 respectively. Subsequently, Dr Marimuthu trained in infection prevention and control (IPC) as a Senior Research Fellow in the Infection Prevention and Control Unit of Geneva University Hospital. Dr Marimuthu is currently a senior consultant in Infectious Diseases and IPC at National Centre for Infectious Diseases (NCID) and Tan Tock Seng Hospital. He heads the HAI surveillance unit at NCID. He is a member of the National Infection Prevention and Control Committee (NIPC) of Singapore. He is also a consultant in the technical advisory committee for World Health Organisation (WHO)'s carbapenem-resistant Enterobacteriaceae (CRE) guideline and Healthcare associated infections guideline.
Dr Marimuthu's main research focus is applied genomics in IPC.

Trans-oceanic collaboration for AMR control in the healthcare facilities

Abstract

Singapore's role as the international hub for travel and business means easier entry for multidrug-resistant organisms (MDRO) with epidemic potential. In this talk, Dr Marimuthu will describe the potential role for Singapore in the regional research on AMR control.

Prof Greg Qiao

Chemical Engineering, The University of Melbourne, Australia

Professor Greg Qiao received his B.Eng in Donghua University in 1982 and Ph.D. at the University of Queensland in 1996. He joined the University of Melbourne in 1996 and became a full Professor in 2009. He was an Australian Research Council's professorial Future Fellow (2012-2015). He is a Fellow of RACI and RSC. Prof Qiao was the Chair of Polymer Division of the RACI (2015-2016) and a member of ARC College of Experts (2016-2018). Prof Qiao received RACI Applied Research Award in 2017, ExxonMobil Award of Excellence for Chemical Engineering in 2015, RACI's Polymer Division Citations in 2011 and 2019 as well as Freehills Award in 2010. He has published > 250 journal papers and > 20 patents. His key research interests are in novel macromolecular architectures, new activation methods for RAFT process, structurally nanoengineered, antibacterial peptide polymers (SNAPPs), Peptide eco polymers as alternative plastics, soft tissue engineering scaffolds, polymeric gas membranes, and chemical engineering products.

Learning from Nature: SNAPPs vs Superbugs, RAFT in Blood, Redox-reaction in Cancer Cells

Abstract

This talk will introduce our recently developed new platform technologies based on mordent polymer chemistry. The first example will be structurally nanoengineered antibacterial peptide polymers (SNAPPs) we developed, which possess specific secondary structures and can kill multi-drug resistant gram-negative superbugs without using any antibiotics and without causing toxicity to healthy cells (*Nature Microbiol.* 2016*, 1*, 16162, *Adv. Healthcare Mater.* 2018, *7, 1800627*). The 2nd example will introduce new methods in activating reversible addition–fragmentation chain transfer (RAFT) polymerization process, including photo-RAFT (*Macromolecules* 2015, *48*, 3864), Sono-RAFT (*Angew. Chem. Int. Ed*. 2017, *56*, 12302), and Fenton-RAFT (*Chem. Eur. J.* 2017, *23*, 7221), leading to a blood catalyzed RAFT (*Angew. Chem. Int. Ed*. 2018, *57*, 10288). RAFT in blood was facilitated by red blood cells using a Fenton chemistry. The same reaction has now been also used into a concept of a recent strategy in killing cancer cells via targeting the conditions of rich reactive oxygen species inside the cancel cells (*Nanoscales*, 2019, 5705). These examples demonstrate learning form nature provide new pathways in future polymeric biomedicine.

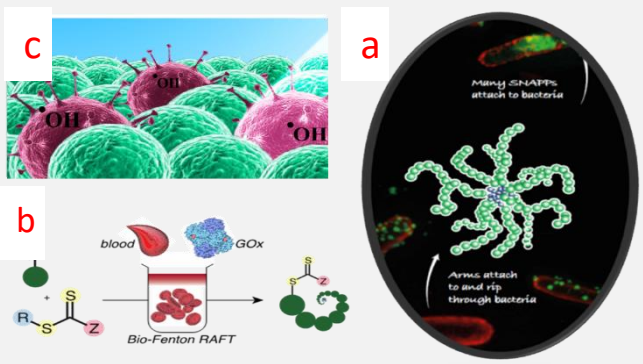
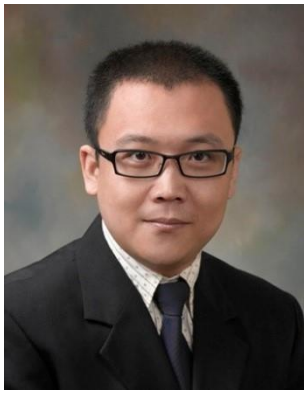


Figure 1. (a) Image showing peptide star polymers interacting with bacteria surface under fluorescent microscopy; (b) Red blood cell catalyzed Fenton-RAFT process; and (c) cancel cell with increased hydroxyl radicals for targeting treatment.



Prof Hongwei Duan

School of Chemical and Biomedical Engineering, Nanyang Technological University, Singapore

Hongwei Duan is an associate professor in the School of Chemical and Biomedical Engineering at Nanyang Technological University (NTU). He received his B.S. in applied chemistry and M.S. in polymer chemistry & physics at Fudan University. After completing his Ph.D. at the Max Planck Institute of Colloids and Interfaces, he had his postdoctoral training in the joint Department of Biomedical Engineering at Emory University and Georgia Institute of Technology. He joined NTU as a Nanyang Assistant Professor in 2009. His current research focuses on understanding surface/interface properties of micro- and nano-structures to achieve tailored optical, electronic, magnetic, catalytic, and structural properties, for their biomedical and environmental applications.

Surface-Engineered Plasmonic Nanostructures for Diagnostic and Therapeutic Applications

Abstract

The optical properties of plasmonic nanomaterials, originating from localized surface plasmon resonance (LSPR), are of tremendous potential across many disciplines spanning chemistry, materials science, photonics, and medicine. The development of plasmonic nanostructures with precisely controlled spectroscopic properties and/or multifunctional characteristics is key to their use in diverse applications. In particular, tailored LSPR of plasmonic nanostructures allows for spatially confining photons at sub-wavelength scales and controlling light-molecule interactions at specific wavelengths. Excited LSPR dissipates energy of incident light by the combination of Mie scattering and absorption-mediated thermal conversion, making plasmonic nanostructures compelling photoabsorbers and imaging agents. This talk summarizes our recent work in developing tailored plasmonic nanostructures and well-defined assemblies that were not easily accessible by traditional colloidal chemistry. We have shown that our strategies based on the use of reactive polymers offers new opportunities in addressing some fundamental challenges in surface enhanced spectroscopy, diagnostic microfluidic biochips, and antimicrobial applications.

Prof Mark S. Butler

Centre for Clinical Research, Faculty of Medicine
The University of Queensland, Australia

A/Prof Mark S. Butler has a B.Sc. (Hons, 1st Class) in 1988 and a PhD in natural product chemistry in 1993 from The University of Melbourne, and an MBA from The University of Queensland in 2017. After postdoctoral work at Arizona State University (1993-1994), he has led teams focusing on natural product-derived drug development at Universities, Research Institutes and a Biotech company: Griffith University/Astra Zeneca (1994-1999), Centre for Natural Product Research (CNPR)/GSK (Singapore, 1999-2002) and MerLion Pharmaceuticals (Singapore, 2002-2009). From 2009-2017, he worked at Institute for Molecular Bioscience, The University of Queensland (UQ), predominantly working on anti-infective and inflammation drug development projects and since 2018 has worked in the antibiotics area with Professor David Paterson at UQCCR.

He has published over 112 papers and was a Clarivate Analytics Highly Cited Researcher in Pharmacology & Toxicology in 2016 and 2017. He is currently a member of the World Health Organisation's (WHO) antibiotic pipeline analysis team and is an Editorial Board member for Planta Medica, The Journal of Antibiotics, Natural Products and Bioprospecting and Biomolecules. He was awarded the 2017 "Journal of Antibiotics Ōmura Award for Reviews" Medal and Matt Suffness (Young Investigator) Award from the American Society of Pharmacognosy in 2002. Research interests include the discovery and development of drug leads to clinical candidates, antibiotics, natural products and drug development pipeline analysis.

Lessons Learnt in Antibiotics Drug Development and Future Outlook

Abstract

Antibiotics are one of the miracles of the 20th Century, which along with sanitation, has helped extend the average Human lifespan to over 70 years old today from 40 years in the pre-antibiotics 1930s. However, antibiotic drug resistance has started to take hold around the World and physicians are now routinely encountering bacterial infections that are no longer able to be easily treated, especially infections derived from Gram-negative bacteria. This lecture will describe our recent efforts to develop new antibiotics and probes, which have been used to explore mode of action and resistance. In addition, the current state of the antibiotic clinical pipeline will be reviewed, and future priority research areas outlined.

Dr Megan McBee

Interdisciplinary Research Group (AMR IRG), SMART, Singapore

Originally from the mountains outside of Seattle, Washington, USA, she holds an S.B in Chemical Engineering and a Ph.D. in Molecular and Systems Bacterial Pathogenesis from the Department of Biological Engineering both from Massachusetts Institute of Technology. During her research career she worked on a diverse array of projects from mucosal immunology to bacterial persistence and translational control. Her research projects utilized several in vitro culture as well as animal models with the ultimate goal of identifying disease- or pathogen-specific cellular or molecular markers of inflammation and bacterial persistence. Prior to becoming the Scientific Director at AMR IRG in SMART, she was the first employee and Associate Director at Tychan Pte Ltd, a local Singapore biotechnology company focused on rapid development of antibody therapeutics to emerging infectious diseases. Making an impact in global health, particularly related to infectious diseases, has been the driving motivation in Dr. McBee's career and research over the past 15+ years. As such, her primary aim as AMR Scientific Director is to promote and facilitate the research into translational and entrepreneurial projects and ultimately start-ups.

Exploration and Innovation for Solutions to AMR

Abstract

A Singapore-MIT initiative creating solutions to address AMR, the AMR Interdisciplinary Research Group (AMR-IRG) is a translational research and entrepreneurship program that tackles the growing threat of antimicrobial resistance. By leveraging talent and convergent technologies across Singapore and MIT, together, the program aims to tackle AMR head-on by developing multiple innovative and disruptive approaches to identify, respond to, and treat drug-resistant microbial infections. Through scientific and clinical collaborations, the program's goal is to provide transformative, holistic solutions for Singapore and the world.

Dr Wilfried Moreira

Antimicrobial Resistance Interdisciplinary Research Group (AMR IRG), SMART, Singapore

Wilfried obtained his PhD in Microbiology & Immunology from University Laval in Canada. In 2012, he moved to Singapore in the department of Microbiology and Immunology at NUS where he headed drug discovery projects targeting *M. tuberculosis* as part of the SPRINT-TB program. In 2016 he joined the Singapore-MIT Alliance for Research and Technology (SMART) and was appointed Director for Research of the Antimicrobial Resistance program in 2018. The research areas in his group include i) novel antibiotic resistance mechanisms and vulnerable pathways in pathogenic bacteria, and ii) bacteriophage isolation and engineering for antimicrobial applications.

A smelly proposal: hydrogen sulphide role in antibiotic resistance

Abstract

Antimicrobial resistance (AMR) is rising globally and will constitute one of the biggest public health crises moving forward this century. AMR is currently responsible for nearly one million deaths annually and this number could reach ten million by 2050. Our comprehension of antibiotic-resistance mechanisms has significantly changed over the last decade. Beyond the canonical antibiotic-specific resistance mechanisms (*e.g.* target mutation, antibiotic inactivation), novel cellular pathways play a pervasive role in resistance. Identifying and characterizing these pathways has the potential to deliver new targets for antibiotic discovery. For example, our findings show that the production of hydrogen sulfide (H_2S) by pathogenic bacteria contributes to resistance to antibiotics with different mechanisms of action. We used reverse and chemical genetic tools to tweak the H_2S biosynthetic pathway and showed that H_2S modulate antibiotic-resistance as well as biofilm formation in *Mycobacteria spp.* and Gram-negatives like *A. baumannii*. These results suggest that resistance-reversion or antibiotic-potentiation could be achieved by targeting the bacteria at the system's level.

Prof Chuanbing Tang

Department of Chemistry and Biochemistry, University of South Carolina, USA

Dr. Chuanbing Tang received B.S. from Nanjing University, M.S. and Ph.D. from Carnegie Mellon University, and worked as a postdoctoral scholar at the University of California Santa Barbara. He joined the University of South Carolina in August 2009. Currently he is a Distinguished Professor at the College of Arts and Sciences, Department of Chemistry and Biochemistry. His research interests focus on organic polymer synthesis, sustainable polymers and biomaterials from biomass, metal-containing polymers, and polymers for advanced applications. He is a recipient of Presidential Early Career Award for Scientists and Engineers (PECASE). He is a Fellow of Royal Society of Chemistry, a POLY Fellow of American Chemical Society, and a Kavli Fellow of National Academy of Sciences. He also won South Carolina Governor's Young Scientist Award for Excellence in Scientific Research, National Science Foundation Career Award, ACS Local Section Outreach Volunteer of the Year Award, and USC Distinguished Undergraduate Research Mentor Award. He is currently an Editor for Polymer, and serves or have served on editors or editorial advisory boards of major polymer journals including Polymer Reviews, Macromolecules, ACS Macro Letters, Macromolecular Rapid Communications, Macromolecular Chemistry and Physics, and Green Materials. He has edited one book, published over 140 papers and garnered 14 patents.

Attacking Gram-Negative Bacteria by Designing Robust Polyelectrolyte Compositions

Abstract

Gram-negative bacteria are among the most dangerous microbials that need revolutionary therapeutic reagents and methods. We have taken two major approaches to tackling the challenges. Inspired by facial amphiphilicity that many antimicrobial peptides possess to disrupt bacterial membranes, we design a new class of cationic antimicrobial polymers containing local facial amphiphilicity on individual monomeric units that are clustered together via macromolecular backbones. This new topology circumvents typical high entropy loss associated with many reported polymeric compositions that are aimed for global facial amphiphilicity. The key is to utilize multicyclic natural products such as terpenoids and steroids. These macromolecular compositions have strong affinity with double membranes in Gram-negative bacteria. On the other hand, we have taken efforts on repurposing traditional beta-lactam antibiotics for treating multidrug-resistant bacteria. Our approach is to conjugate these anionic antibiotics with cationic metallopolymers. In comparison with quaternary ammonium-based polymers, cobaltocenium-containing metallopolymers have high efficacy in complexation with these antibiotics. By integrating with nanoparticles, these new bioconjugates exhibit enhanced efficiency in killing MDR bacteria.

References:

(1) Rahman M. A.; Bam M.; Luat E.; Jui M. S.; Shokfai T.; Nagarkatti M.; Decho A.; Tang C. Macromolecular-Clustered Facial Amphiphilic Antimicrobials. *Nat. Commun.* 2018, 9, 5231.

(2) Zhu T.; Sha Y.; Yan J.; Pageni P.; Rahman M. A.; Yan Y.; Tang C. Metallo-Polyelectrolytes as a Class of Ionic Polymers for Functional Materials. *Nat. Commun.* 2018, 9, 4329.

Dr Susan Gibson-Kueh

Aquaculture,
James Cook University,
Singapore

Dr Susan Gibson-Kueh has extensive experience in aquatic animal health from roles in government and academia. She has a veterinary degree from Sydney University, an MSc in aquatic veterinary studies from Institute of Aquaculture, Stirling University and a PhD in fish pathology from Murdoch University. Her career spans 12 years in AVA, 12 years at Murdoch University, and a brief 2 years as senior fish pathologist in DPIRD, WA before her current position at JCUS. Her research is based on an in-depth understanding of complex diseases in aquaculture species, to support the development of sustainable and effective approaches to disease management. Dr Kueh's expertise in diagnostic fish pathology encompasses both finfish (marine and freshwater, food and ornamental species) and shellfish (shrimps, oysters, mussels, abalone). Dr Kueh was the first researcher to study the causative agent of scale-drop in barramundi and big belly disease, with 25 publications mainly on diseases in Asian aquaculture.

She has special interests in development of sustainable livelihoods based on aquaculture in remote communities.

Neobenedenia: can we innovate to successfully manage this parasite in sea cages?

Abstract

Neobenedenia is a monogenean skin fluke that can cause severe production losses in sea cage cultured food fish species such as barramundi and snapper. Newly stocked juvenile fish are most susceptible to Neobenedenia. Control is difficult because the parasite produces large numbers of eggs that stick steadfastly to net cages. Treatment is often met with low success as fish gets re-infected soon after freshwater baths. Freshwater baths are labour intensive. Various studies using oral anti-parasitic drugs have met with variable success due to re-infection after treatment. There is some difficulty in getting fish to eat medicated feed with praziquantel due to poor palatability.

There is some work on looking at control of parasites such as sea lice using vaccines that target the gut wall. Other studies explored the possible disruption of parasites finding the fish hosts or novel compounds that could be administered orally or as baths to control these parasites. Can some of these methods be adapted to control Neobenedenia in cage cultured fish?

Prof Mary Chan

School of Chemical and Biomedical Engineering
Nanyang Technological University, Singapore

Dr Mary Chan-Park is the 2019 Board of Trustees Chaired Professor of Chemical and Biomedical Engineering at the Nanyang Technological University Singapore (NTU Singapore). She also holds a joint appointment at the Lee Kong Chian School of Medicine at NTU. She is the Director of the Centre for Antimicrobial Bioengineering and the Director of the Nanyang Food Technology Centre (NAFTEC). She is a Fellow of the America Institute of Medical and Biological Engineering. She is also an associate editor of the American Chemical Society (ACS) Applied Materials & Interfaces.

Her main research interests are in polymers in nanoscience and biotechnology. She has published extensively, with more than 230 papers in top-tier journals such as Nature Materials, Nature Communications, Nano Letters, Advanced Materials, Advanced Functional Materials, JACS, Small, Biomaterials, *etc.* She is a leader in the field of antibacterial and antibiofilm polymers. Her group has invented a new class of potent cationic antimicrobial polymers which are non-toxic and biocompatible. These new antimicrobial polymers have been reported in Nature Communications (2019), Nano Letters (2018), ACS Nano (2015), Advanced Materials (2012) and Nature Materials (2011). Her patents have been used by/licensed to companies. Professor Mary Chan contributes actively to the industry through industry cooperation projects, consultancy and licensing of her technologies.

Professor Mary Chan was also a pioneer of the Chemical and Biomolecular Engineering degree program at NTU. She was the founding Associate Chair (Research & Graduate Studies) and Associate Chair (Research and External Relations) of the new NTU School of Chemical and Biomedical Engineering from 2005-2010 and 2010-2011, respectively, and the Acting Chair from 2011-2013. She has graduated and trained 30 PhD students and 12 Masters students.

She obtained her BEng (Chemical) and PhD (Polymers) from the National University of Singapore and MIT in 1986 and 1993, respectively.

Cationic polymers and associated coatings as antimicrobial agents

Abstract

The rise of multi-drug resistant (MDR) bacteria together with the decrease of useful antibiotics has been a mounting problem. Especially for Gram-negative bacteria, no new family of drug was found in the last past 50 years. Also, recently, the United States Food and Drug Administration (FDA) has prohibited the use of 19 active ingredients (including triclocarban, triclosan, iodophors, *etc.*) in over-the-counter consumer antiseptic wash products, including hand soap. Alternative active antiseptic which can replace the banned agents and which exhibit comparable or superior efficacy agents and better disinfective coatings for biomedical devices are urgently needed. In this talk, I shall describe antibacterial coatings some of which are also antibiofilm for contact lens coatings[1], wound dressings[2], catheter coatings[3] and water purification[4]. I shall also describe antibacterial alpha-peptides[5] and beta peptides; the beta-peptides can be designed so that it can eradicate various sub-populations of MRSA[6], or selectively target the pathogenic Gram-negative bacteria, but not the Gram-positive. I shall also describe nanoparticles that are anti-biofilms[7].

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