

Second Permanent Secretary of Education visits SCELSE

The Ministry of Education's (MOE) Second Permanent Secretary, Mr Lai Chung Han, visited SCELSE and gained a good impression of SCELSE's mission and the importance of biofilm and microbiome research.

"This is a rapidly expanding area that Singapore needs to do," he said.

Mr Lai, who was recently appointed as the Second Permanent Secretary of Education, was formerly a Navy Rear-Admiral who served as Singapore's Chief of Navy from August 2014 to June 2017.

Mr Lai was accompanied by NTU Chief of Staff Prof. Lam Khin Yong



Mr Lai Chung Han (left) visiting the SCELSE sequencing facility guided by Prof. Kjelleberg (3rd from right) and Mr Yap Zhei Hwee (right)

and hosted by SCELSE Centre Director Prof. Staffan Kjelleberg, who guided him through SCELSE's lab facilities and offices.

On enquiring about SCELSE's international collaborators and competitors on biofilm and microbiome

research, Prof. Kjelleberg informed Mr Lai about biofilm centres in Denmark and in Montana, USA, as well as the upcoming Biofilms Innovation Knowledge Centre in the UK.

Mr Lai was impressed by the image quality and resolution of the superresolution confocal microscope in the imaging facility. At the bioreactor facility, he examined a sample of Anammox bacteria, and was given an overview of the sequencing facility. Mr Lai was also briefed on the latest acquisition at the compute cluster, which is a compact and high performance component.

"The wonders of miniaturisation!" he said.

Before leaving, Mr Lai said that MOE's Research Centres of Excellence (RCE) review panel, which visited SCELSE earlier this year, has endorsed the good work done here at SCELSE.

Calendar

SCELSE Seminars

02 Aug: A/Prof. Daniel Blackwood, National University of Singapore. 4:00pm - 5:00pm. ASE Seminar Room.

16 Aug: A/Prof. He Jianzhong, National University of Singapore. 2:00pm - 3:00pm. SBS-CR2.

Group Meetings

Environmental Engineering meeting: Tuesdays 9am, B3 Meeting Room.

Kline Group meeting: Mondays 9:30am, B3 Meeting Room (please check with Kimberly prior to joining).

Events

Fridays: Shut Up and Write! 10:00am. Please see teamsites for location.

25 Aug: SCELSE Happy Hour. 5:00pm onwards. B2 Coffee Lounge.

30 Aug: SCELSE Open House 2017. B2 Coffee Lounge and Lab facilities.

30 Aug: SBS/SCELSE/LKCMedicine Postdoc Club. 5:00pm. SBS-CR2.

Conferences and Courses

10 - 11 Oct: Oxford Global Conferences 4th Annual Microbiology & Infectious Diseases Asia Congress 2017. Concorde Hotel, Singapore.

24 - 26 Oct: Asian Conference on Energy, Power and Transportation Electrification (ACEPT 2017). Marina Bay Sands Convention Centre, Singapore.

06 - 14 Dec: EMBO Global Exchange Lecture Course. Structural and biophysical methods for biological macromolecules in solution. NTU School of Biological Sciences, Singapore.

Confluence of diverse fields at IUMS 2017 in Singapore

SCELSE members played an integral role in the International Union of Microbiological Societies (IUMS) Congresses 2017 by showcasing SCELSE research through seminars, poster sessions and active discussions, while benefiting from the latest findings and insights at this gathering of world renowned experts.

The event was held for the first time in Singapore in the 90-year history of IUMS and comprised three congresses focusing on Bacteriology and Applied Microbiology; Mycology and Eukaryotic Microbiology; and Virology.

"This meeting is unusual and unique in its diversity. The combination of the three different fields provides an excellent opportunity for the cross-pollination of research ideas and strategies," said SCELSE Centre Director Prof. Staffan Kjelleberg.

The five-day conference was hosted at the Marina Bay Sands Expo & Convention Centre by the Singapore Society for Microbiology & Biotechnology (SSMB), with about 1,500 participants from 63 countries and more than 200 talks and 600 posters.

SCELSE presentations

SCELSE presentations at the conference covered a broad spectrum of the centre's



Asst Prof. Kimberly Kline giving a seminar at IUMS 2017

research, from quorum sensing in multispecies biofilm models, to phospholipid transport across the outer membrane in Gram-negative bacteria, and to the pathogenesis of *Enterococcus faecalis* biofilm-associated infection. SCELSE participants included Prof. Kjelleberg, A/Prof. Diane McDougald,

A/Prof. Scott Rice, Asst Prof. Chng Shu Sin, Asst Prof. Kimberly Kline, Dr Rohan Williams, Dr Sujatha Subramoni, Dr Nandini Shome, Ms Lam Ling Ning, Ms Zhu Xinyi and Mr Ezequiel Santillan.

Poster presenters include Dr Veronica Rajal, Dr Cecilia Cruz, Dr Joey Yam, Ms Adeline Yong, Ms Gayatri Chilambi, Ms Poh Wee Han and Mr Dan Roizman.

Opening ceremony

IUMS 2017 was officially opened by Mr Lawrence Wong, the Minister of National Development and Second Minister for Finance. In the opening address, he stressed that infectious diseases do not respect borders and expressed concern about the increasing frequency of disease outbreaks and the accelerating problem of antimicrobial resistance.

"We need the concerted effort of all stakeholders, and our ability to deal with these problems is enhanced by collaborative research. Singapore will do

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STAFF PROFILE

Nikolay Berezhnoy Research Fellow

In research, focus and determination are very important to the success of a project. Dr Nikolay Berezhnoy brings an athlete's intense drive to his scientific endeavour, which is progressing steadily.

"My research career highlights are my publications and connections which are both important in my published and to-be published works. I am grateful to my collaborators from Singapore, Sweden, Taiwan, Netherlands, Japan and USA," Nikolay said.

At SCElse, Nikolay works on the butanol tolerance project in the Microbial Biofilms cluster, which aims to improve the biofuel production process. "The area of research is lipidomics and biophysical investigation of lipids. I am in a multidisciplinary project and closely working with Jamie Hinks, Thomas Seviour and Staffan Kjelleberg in SCElse. I am grateful for the generous help from a number of SCElse colleagues," he said. In addition, Nikolay works with external collaborators including Asst Prof.



Nikolay at the MetaSprint Duathlon 2017 event

Amaury Cazenave Gassiot from NUS SLING in lipidomics, Prof. Atul Parikh from UC Davis in lipid biophysics, Prof. Guillermo Bazan from UC Santa Barbara in synthetic chemistry, and Prof. Allan Mark from University of Queensland in computer simulations.

Regarding the project, Nikolay said: "It is interesting to learn how different microorganisms adapt to butanol, how their lipids change upon butanol exposure, the limits of adaptation, and the ways our results are going to improve biobutanol production."

Nikolay started his research journey in Kazakh National University in Almaty, Kazakhstan. In 2004 he enrolled in the School of Biological Sciences (SBS) at NTU in Singapore and obtained his bachelor's degree four years later. Nikolay then embarked on his PhD training with Prof. Lars Nordenskiöld's group at NTU SBS, focusing on the biophysical characterisation of recombinant chromatin interactions with lipids. After graduating in 2013, he continued as a research fellow in

the same lab, investigating telomeric chromatin using single molecule magnetic tweezers.

"I came to SCElse because of the attractive research project," Nikolay said.

During daily work, he finds publishing research work, and balancing work and life, both rewarding and challenging.

"I enjoy understanding areas of research that are new to me, learning research techniques and getting research experiences," he said.

For new students, Nikolay advises them to focus on their work, learn from their supervisor and colleagues, and ask for help when needed. "Read the literature to continuously improve the understanding of your research area. Consistency is the key," he added.

About life in Singapore, Nikolay enjoys living in the city state where all things are within reach, and the weather is warm all year round. Outside of research, he pursues athletic interests such as triathlon training and racing.

"I participate in local races of running, swimming, cycling, and a mix of those disciplines. I will be representing NTU in a staff team in local running races. I also train with NTU aquathlon and cross country clubs," he said.

Publication profile

SCElse researchers, together with their collaborators in Nanyang Technological University (NTU) and Nanjing University, China, enhanced bacterial cells by coating them with a shell of conductive polymers which boosted their electrical properties for energy generation.

Microbial fuel cell (MFC) technology uses bacterial cells to harvest electricity from organic substrates, which has great potential for simultaneous sustainable energy production and wastewater treatment.

Despite huge improvements in recent years, MFCs are still not yet commercially practical due to their low power density. To address this issue, researchers developed a strategy of coating bacterial cells with a conductive nanomaterial to allow more efficient extracellular electron transfer (EET) between the bacteria and the anodes.

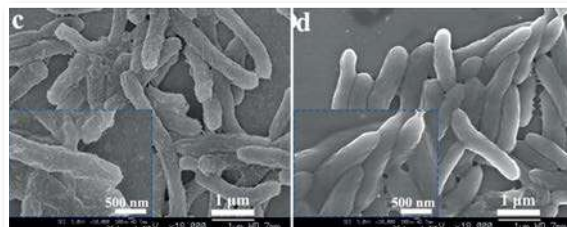
Polypyrrole (PPy) was selected because it is a biocompatible material with excellent conductive properties, and *Shewanella oneidensis* MR-1 was chosen as the model exoelectrogenic bacteria. The researchers fabricated the conductive coatings by *in situ* polymerisation of pyrrole

monomers on the surface of individual cells.

They tested the viability of the coated bacteria using confocal scanning laser microscopy (CLSM) and found that the percentage of viable cells was very high and nearly the same as untreated cells. The coated cells could still proliferate, as confirmed by cell culture experiments.

The morphology of coated cells was investigated using scanning electron microscopy (SEM) and transmission electron microscopy (TEM), revealing that the coated cells had a rough surface compared to the smooth exterior of native cells.

Since the cells appear to be alive and well, the researchers used electrochemical impedance spectroscopy (EIS) to test their electrochemical activity. The conductive coating reduced charge transfer



SEM images of *S. oneidensis* MR-1 bacteria coated with PPy (left) compared to native bacteria (right)

resistance by 23-fold, suggesting that it facilitates EET from bacteria to electrode. They constructed a classical double-chamber MFC using PPy-coated cells as anodes and found a 4.8-fold increase in electricity generation and 14.1-fold increase in maximum power density compared to untreated cells. These results clearly show the superiority of the coated cells in MFCs.

The researchers were also able to coat PPy onto the surfaces of *E. coli* K-12, *O. anthracis* N058 and *S. thermophilus* LMD-9 without affecting their viability, showing the applicability to other bacterial species.

Findings from this study can be further used to explore high-performance anodes for MFCs and other applications of cell-surface modifications in microbial electrochemical systems.



Latest SCELSE publications



SCELSE social

New SCELSE PhD



Congratulations to SCELSE student Tan Shi Ming who successfully completed his PhD oral defence in July!

SCELSE 2017 Graduates



It is graduation season again and SCELSE has many graduates this year! Prof. Kjelleberg presented a graduation mug to each PhD graduate during a Thursday communal morning tea session. Above photo (from left): Joey Yam, Ding Yuanzhao, Tan Shi Ming, Chew Su Chuen, Calvin Ng, Li Yingying, Cai Zhao, Zhang Yingdan, Nandini Shome, Prof. Kjelleberg, Lucinda Elizabeth Doyle and Anuradha Vajjala.



Congratulations to all and best wishes in your future endeavours!

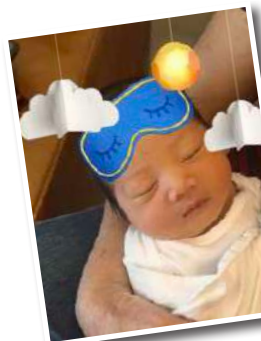
SCELSE 7th Summer Course



SCELSE's 7th Summer Course took place over three highly intensive weeks in July. Students interacted with world-renowned instructors in lectures, discussions, demo sessions and student presentations. We hope that it was a great learning experience for the participants!

New SCELSE Baby

Congratulations to Dr Grace Chong on the birth of her beautiful daughter Sarah this month!



SCELSE Real-time PCR Course



SCELSE's real-time PCR course from 24-28th July provided strong fundamental training with a focus on applications in environmental microbiology. Dr Cecilia Cruz (left photo) conducted the laboratory exercises at an NTU SBS teaching laboratory where participants gained hands-on experiences in preparing samples and running qPCR (right photo).

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STUDENT PROFILE

Tay Wei Hong PhD Student

This month's student profile features Tay Wei Hong!

Tell us a bit about your work in SCElse.

I work with Asst Prof. Kimberly Kline. My research focuses on understanding the intracellular lifestyle of *Enterococcus faecalis*, an otherwise extracellular opportunistic pathogen. Research aside, I also help to manage the Tissue Culture facility in SCElse together with the users and lab support personnel.

Any interesting findings or experiences so far?

Using both the mouse wound model and the tissue culture model, we have shown that *E. faecalis* can become internalised within non-immune cells and survive for prolonged periods. Moreover, at late timepoints, we also observed infected cells with large numbers of bacteria in them, suggesting intracellular replication. We proposed that this intracellular lifestyle contributes to persistent wound infections, resulting in a state of recurrence.

Being an interdisciplinary project that spans across the fields of microbiology and cell biology, it comes with several challenges, such as communicating our research to our cell biology collaborators. It was like learning a new language! Having to present and communicate my work to cell biologists clearly, without all the usual technical jargon that we are used to was an interesting experience.

To improve on this, I started reading columns and blogs by science writers. I highly recommend Ed Yong's blog to all other interdisciplinary students out there!



Wei Hong at the Micropia museum in Amsterdam, the Netherlands

What excites you and what makes you go zzzzz?

It excites me when I get to do "science photography". Basically, anything imaging related! Advancements in electronics, chemistry and optics meant that we could now observe the micro world with greater detail and clarity in their native state, opening whole new avenues of research. I am currently

exploring the possibility of combining both fluorescence and electron microscopy for my research work.

It makes me go zzzzzz when personal emotions and conflicts affect the research work. When such situations arise, take the initiative to solve the problem in a calm and rational manner. The ability to overcome conflicts is a soft skill, that can be applied in any other job setting.

If you were stranded on a deserted island, what would you want to bring with you?

Is this a trick question? A speedboat, compass and a map to sail back to mainland!

Fill in the blanks: When _____, I _____.

When I am out of the lab, I decompress by baking or managing my investment portfolio. Both activities necessitate focus and concentration, preventing me from ruminating over my failed experiments. Nothing beats the smell of a freshly baked cake/pastry. The smell just makes you forget everything!

Anything you would like to say to fellow students?

"Don't fear failure so much that you refuse to try new things. The saddest summary of life contains three descriptions: could have, might have and should have." - Louis E. Boone

Be fearless!

Confluence of diverse fields at IUMS 2017 (from p. 1)

our part by hosting platforms such as this, and with our investments in R&D. The government commitment to research is S\$19 billion for 2016 to 2020, and a key area of focus is infectious disease," Mr Wong said.

Keynote lectures

The keynote lectures were delivered by Prof. Zhao Liping from Shanghai Jiaotong University, China;

A/Prof. Cynthia He from NUS and Prof. Grant McFadden from Arizona State University, USA.

Prof. Zhao studies the effect of diet on the gut microbiome to fight human obesity and diabetes, and is well known in his field for being the first volunteer of his own diet plan based on traditional Chinese medicine. He successfully lost 20kg and was featured on Science magazine in 2012. Prof. Zhao presented his group's research on dietary intervention to deal with childhood obesity and the molecular characterisation of the gut microbiome.



Prof. Zhao Liping delivering his keynote lecture

"This is the best time for microbiology. Not only for work on infectious diseases but also chronic diseases. We have the training and tools, so take the lead and work with our colleagues at the clinical side for a chance to make a contribution to mankind," he said.

A/Prof. He works on the single-celled eukaryote parasite *Trypanosoma brucei* that causes African Sleeping Sickness which is fatal if untreated. Her research focuses on the biophysics of *T. brucei* flagellum, which is important for its movement and invasive behaviour.

"The sequential constriction of the flagellum helps *T. brucei* penetration through size-limiting channels. Interestingly, spirochete bacteria also use a similar strategy, which couples motility and cell shape changes for a highly invasive lifestyle," she said.

Prof. McFadden studies the myxoma virus, which is highly pathogenic in European rabbits but harmless in people and has potential to fight cancer.

"We can conscript immune cells such as T-lymphocytes and neutrophils to take up the viruses and deliver them to tumour sites where they kill residual

cancer cells. This work is heading towards clinical trials," he explained.

Comments and insights

The IUMS 2017 conference format was an intermix of separate plenary talks, workshops and combined bridging sessions. The proximity of these three programmes allowed participants to choose the talks that interest them, even across different fields.

"I found the virology talk about the history of bacteriophage research very interesting and I'm thinking about how it applies to my work," said SCElse researcher Ezequiel Santillan.

SCElse PhD student Adeline Yong said that she liked the talk about manuka honey by Prof. Liz Harry, who studied the antibacterial and antibiofilm properties of manuka honey metabolites.

Both Adeline and Joey were awarded with travel grants from SSMB to attend this conference.

"It's very interesting to see so many pioneers of their fields here, and we not only get to see their work but also understand their thought processes," said SCElse PhD student Lam Ling Ning.

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