SCELSE Quorum
Singapore Centre for Environmental Life Sciences Engineering
November 2017

New UK centre boosts international biofilm research

International biofilm research will be significantly boosted with the newly awarded £26 million (S$47 million) National Biofilms Innovation Centre (NBIC) in the United Kingdom which officially opened on 28th November 2017.

NBIC is an inter-institutional, nationwide centre established to deliver breakthrough science and technologies to control and exploit biofilms through collaborative interdisciplinary research and industry partnerships.

The centre will be based at the University of Southampton, and co-led by a core partnership with the Universities of Liverpool, Edinburgh, and Nottingham.

National Biofilms Innovation Centre

NBIC will operate on a similar interdisciplinary research model to that of SCELSE, which along with NTU, strongly supported the centre's proposal during the application process, said SCELSE centre director, Prof. Staffan Kjelleberg.

Like SCELSE, NBIC will be a comprehensive biofilm research centre, addressing biofilm biology in a broad range of natural and engineered systems through basic as well as translational research.

SCELSE and NBIC will form strategic ties from the outset by developing collaborative funding initiatives, joint PhD studentships, shared access to facilities and shared research data on biofilm analytics, Prof. Kjelleberg said.

"Establishing a biofilm centre on the scale of NBIC will greatly enhance biofilm research and technology in general.

"For SCELSE, it will add a new dimension to our international collaborative research, that will be enriched by the exchange of personnel and know-how between the two centres."

NBIC is funded for five-plus-five years by the Biotechnology and Biological Sciences Research Council (BBSRC) and Innovate UK as one of eight Innovation and Knowledge Centres created for commercialising emerging technologies.

SCELSE congratulates Prof. Jeremy Webb, the new principal investigator and co-director of NBIC, and his colleagues on the opening of the centre and wish them every success in establishing a UK national biofilms research agenda.

For more information, please visit: http://biofilms.org.uk/

Calendar

SCELSE Seminars

06 Dec: A/Prof. Eric Yap. Lee Kong Chian School of Medicine, NTU. 3:00pm - 4:00pm. SBS-TR5.

13 Dec: A/Prof. Liang Zhao-Xun. School of Biological Sciences, NTU. 3:00pm - 4:00pm. SBS-TR5.

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.

22 Dec: SCELSE Happy Hour. 5:00pm onwards. B2 Coffee Lounge.

27 Dec: SBS/SCELSE/LKCMedicine Postdoc Club. 5:00pm. SBS-CR2.

Courses

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

Conferences 2018

19 - 22 Mar: International Conference on Microbial Communication (MiCom 2018). Jena, Germany.

27 - 29 May: 8th Biofilms Conference (Biofilms 8). Aarhus, Denmark.

SCELSE congratulated for maturity and inclusiveness during annual retreat

SCELSE's 6th annual scientific retreat provided an excellent opportunity for members to be updated with each other's research work and the centre was congratulated as an exemplar of maturity and inclusiveness.

SCELSE members and guests gathering for a group photo during SCELSE's annual retreat

The speakers who presented their work were highly commended by SCELSE SAB Chairman Prof. Alexander "Sascha" Zehnder for the quality of their projects and for their well prepared talks.

"SCELSE is maturing and becoming highly integrated. In this retreat I observed more cross-referencing between clusters and more participation by everyone, including students," Prof. Zehnder said.

This year, 30 SCELSE members took to the stage and had ample time for their talks, with 30 minutes allocated to each principal investigator and 15 minutes each for project managers, research fellows and students. Research topics were very varied and ranged from chemical biology approaches for biofilm eradication, to 3D imaging technology for bacteria tracking, and to the diel cycle of the tropical air microbiome.

The event was prefaced by a talk presented by Prof. Peter Little, emphasising the importance and seriousness of new safety procedures in SCELSE. This was followed by Centre Director Prof. Staffan Kjelleberg's opening address with the latest updates about the upcoming 7th year review. He expressed special thanks to Communications Director Dr Sharon Longford, for her efforts to put the Self-Assessment Report together.

Subsequently, speakers presented highlights of their research results and outlined the numerous inter-cluster and

cont. p. 4

SCELSE STAFF PROFILE

Stephen Summers
Research Fellow

The boundless ocean holds many mysteries and delights for the intrepid explorer. Dr Stephen Summers is no stranger to diving into the waters both for work and for leisure.

"I have worked on several academic projects over the years, ranging from the monitoring of biofouling organisms on a sunken warship, to determining the potential for life in a deep sub-surface salt mine with an environment similar to the sub-surface of planet Mars," Stephen said. In addition, he has undertaken governmental contractor projects, for example to monitor microbial aerosols originating from poultry or swine farms, and an assessment of biodegradable plastics which are currently available in the European Union.

Stephen on a field trip in Skorradalur, Iceland

At SCELSE, Stephen works directly with A/Prof. Scott Rice in the Microbial Biofilms cluster, and also with A/Prof. Diane McDougald and her team.

"My role here is to investigate the formation of biofilms on the artificial seawalls which dominate Singapore's coastal areas. Many of these seawalls are either concrete or granite and almost always smooth and sloping steeply. Therefore, our group is looking to see if we can spice up the seawalls by altering materials, shape and complexity with the aim of altering the settlement of higher organisms onto the seawalls," he explained.

As this project is part of a larger investigation led by A/Prof. Peter Todd at NUS, Stephen also works closely with Dr Lynette Loke, and partners at A*STAR such as Dr William Birch and Dr Shona Yuki. In addition, as the project matures, collaborators from St John's Island National Marine Laboratory will be joining in the effort.

Stephen started out as a marine biologist studying starfish, obtaining his BSc in 2005. He then did an MSc in biological diversity in 2006 before embarking on his PhD project at the Centre for Ecology and Hydrology, UK focusing on sub-surface bacterial ecology and graduating in 2013. For his postdoctoral research, he initially worked on biofilms on volcanic rock, and later on marine plastic debris and the microbial associations.

"When I discovered a position at SCELSE investigating a geological structure of a marine environment and the associated biofilms, it was almost as if it were written for me," Stephen said. He joined SCELSE in August this year.

During daily work, Stephen considers challenges in learning and understanding new technologies as the means to obtain the rewards.

"You get a real sense of achievement as well as the knowledge that you can still train your mind," he said. For students who are just beginning their research careers, Stephen advises them to seek variety, volunteer for any project and keep writing.

"Writing is a skill that very few of us have mastered and therefore the more practice you can get early on, the easier you will find it to publish on the diverse projects you have been working on," he said.

About life in Singapore, Stephen said that the best thing he found is the difference in culture.

"I get to explore a whole new way of life such as the food courts, apartment living and having to walk everywhere with an umbrella surgically attached to my arm," he laughed.

Outside of science, Stephen is very passionate about scuba diving. "I have been splashing about like a flounder now for 15 years and got to dive in regions from the Caribbean and Mediterranean Seas to the Arctic Circle," he said.

Publication profile

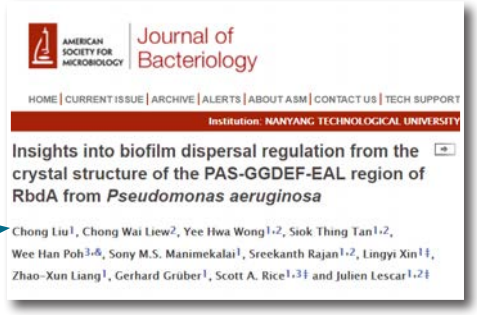
Crystal structure of RbdA reveals how biofilm dispersal can be unlocked

SCELSE researchers determined the crystal structure of a region of the RbdA (Regulator of biofilm dispersal) protein, and this knowledge can help the development of small molecules to promote biofilm dispersal.

The cytoplasmic second messenger c-di-GMP is a key regulator of the transition between biofilm and planktonic modes of life in many bacterial species. High c-di-GMP concentrations is associated with biofilm formation while low concentrations correlate with biofilm dispersal. The cellular concentration of c-di-GMP is controlled by two types of enzymatic domains with opposing activities: GGDEF domain proteins with diguanylate cyclase (DGC) activity catalyses the synthesis of c-di-GMP, while EAL/HD-GYP domain proteins with phosphodiesterase (PDE) activity catalyses the breakdown of c-di-GMP.

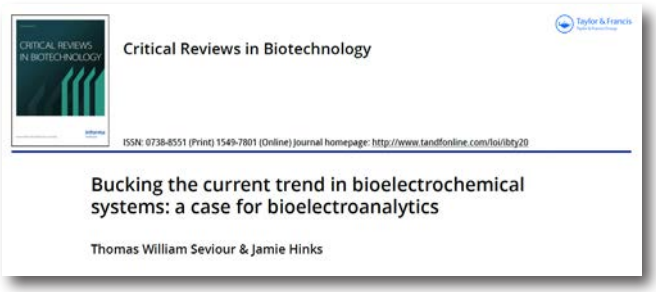
Interestingly, there are a number of proteins that contain both GGDEF and EAL domains. In *Pseudomonas aeruginosa*, there is a dual domain protein called RbdA that regulates biofilm dispersal. Researchers solved the crystal structures of the cytoplasmic region of RbdA (cRbdA) in its free form, and two binary complexes by soaking cRbdA native crystals with GTP bound to the GGDEF domain and c-di-GMP bound to the EAL domain. Conformational changes induced by GTP binding were also studied using small angle X-ray scattering.

By evaluating the activity of loss-of-function mutants via enzymatic assays, researchers found that cRbdA has both DGC activity and intrinsic GTP-stimulated PDE activity. The GGDEF and EAL domains are linked by an α-helix (H-helix) that likely functions as a hinge. Crystallography results revealed that the cRbdA protein forms a stable dimer, locked in an auto-inhibited conformation where the EAL domain and GGDEF of the same monomer face each other. When GTP binds to the A site of the GGDEF domain, cRbdA changes shape and the two domains are unlocked and move apart, transforming cRbdA into a functional dimer capable of breaking down c-di-GMP.



RbdA can be used as model to study common mechanisms for controlling c-di-GMP metabolism because several structural elements, such as the H-helix, are conserved across various bacterial proteins. This is important because there are many such dual proteins in the genomes of major human pathogens, and this study helps to identify potential target sites for the design of molecules that promote biofilm dispersal.

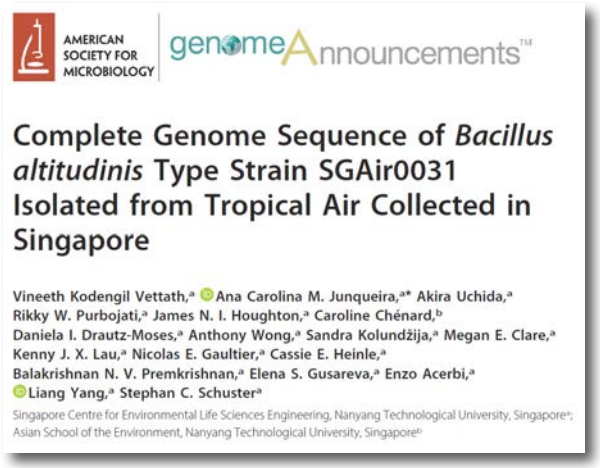
Latest SCELSE publications


Critical Reviews in Biotechnology

ISSN: 0738-8551 (Print) 1549-7801 (Online) Journal homepage: http://www.tandfonline.com/loi/ibty20

Bucking the current trend in bioelectrochemical systems: a case for bioelectroanalytics

Thomas William Seviour & Jamie Hinks


AMERICAN SOCIETY FOR MICROBIOLOGY | genomeAnnouncements™

Complete Genome Sequence of *Bacillus altitudinis* Type Strain SGAir0031 Isolated from Tropical Air Collected in Singapore

Vineeth Kodengil Vettath,[a] Ana Carolina M. Junqueira,[a]* Akira Uchida,[a] Rikky W. Purbojati,[a] James N. I. Houghton,[a] Caroline Chénard,[b] Daniela I. Drautz-Moses,[a] Anthony Wong,[a] Sandra Kolundžija,[a] Megan E. Clare,[a] Kenny J. X. Lau,[a] Nicolas E. Gaultier,[a] Cassie E. Heinle,[a] Balakrishnan N. V. Premkrishnan,[a] Elena S. Gusareva,[a] Enzo Acerbi,[a] Liang Yang,[a] Stephan C. Schuster[a]

Singapore Centre for Environmental Life Sciences Engineering, Nanyang Technological University, Singapore[a]; Asian School of the Environment, Nanyang Technological University, Singapore[b]

SCELSE social

SCELSE annual retreat

After a long day of scientific presentations, SCELSE members relaxed over good food and drinks and great company at the Raffles Marina clubhouse. Some ventured out to the pier to enjoy the cool evening air, the scenic harbour view and the beautiful sunset!

Left photo (from left): Dr Qiu Guanglei, Dr Law Yingyu, Dr Jimmy Ding, Dr Nirakar Pradhan, Mr Rogelio Zuniga and Mr Ezequiel Santillan.

NTU football tournament

SCELSE members formed a combined team with NTU SBS, SPMS and EOS, and achieved second place during this year's NTU Staff Football Tournament. Team members from SCELSE include Mr Ezequiel Santillan (first from left), Dr Thomas Seviour (second from left) and Mr Talgat Sailov (fifth from left).

Congratulations to the team for their great effort!

Seminar report

World Harbour Project aims for more engagement

The World Harbour Project (WHP) which was launched three years ago has doubled in size to 14 partnerships, growing into an international consortium of about 100 people, and the time is right for more engagement and new ideas, said Prof. Peter Steinberg, Director of the WHP and the Sydney Institute of Marine Science.

Prof. Steinberg, who is also a visiting professor at SCELSE, came to NTU on 3rd November to give a talk about the latest project results and developments of the WHP, together with Dr Serena Teo, Deputy Director of the Tropical Marine Science Institute in Singapore.

Prof. Steinberg said that most people living in cities see the marine environment in an urban context, and stressed the importance of understanding both ecological and human aspects. He also outlined recent results and ongoing work of the four main working groups of the WHP: water and sediment quality, green engineering, multiple users, and education and outreach.

Prof. Peter Steinberg giving a talk on the World Harbour Project

Dr Teo said that the WHP provides a network and platform that can tapped for local research activities.

"We should start thinking about projects in Singapore. The WHP platform will aim for more marine science education and youth outreach. We invite everyone here to contribute," said Dr Teo.

Prof. Steinberg noted that the WHP is not a trivial endeavour and it is a good time to look for new ideas.

"In 30 years I have seen many coastal environments degrade, and we want to make a positive impact. We can potentially change how people measure water quality globally, in a very practical way," he added.

SCELSE STUDENT PROFILE

Muhammed Hafiz Ismail
PhD Student

This month's student profile features Muhammed Hafiz Ismail!

Tell us a bit about your work in SCELSE.

My work focuses on the role of filamentous bacteriophages in development and modulation of biofilms, in the context of both complex community (aerobic granules in water reclamation) and single species *Pseudomonas aeruginosa* PAO1 biofilms. I am working in A/Prof. Scott Rice's group.

On holiday in Seoul, South Korea. From left: Kelvin Chong, Muhammed Hafiz Ismail, Adeline Yong and Dr Sharon Goh

Any interesting findings or experiences so far?

Characterising the bacteriophage population dynamics in bioreactors is one of the major parts of my work. To facilitate that, I started on my arduous journey in studying bioinformatics and data analysis. Eventually, I got more involved in more kinds of analyses, and in different kind of projects, which has been quite challenging and yet also rather enjoyable.

In my PAO1 work, I identified a protein that is the immunity factor in preventing PAO1 from being reinfected by the Pf4 filamentous phage. We also think that this protein might play a role in the gene expression of virulence-related genes, so work has been done to test that idea. I am looking forward to analyse this new set of data.

What excites you and what makes you go zzzzzz?

I have been slowly scuba diving more since I started. So it makes me really excited when I get to go on a dive trip and experience the beautiful underwater world. It makes me go zzzzzz when I have no idea why the script I wrote or any of my analysis pipelines doesn't work as well as I hoped.

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

How about with whom instead? I definitely will want to bring my good buddies along. As they say, the more the merrier. Time for an adventure! Though of course, if the island comes with my very own high-tech lair it'd be even more fun.

Fill in the blanks: When _____ , I _____.

When I have the chance to take a break from work, I want to travel the world! Especially to visit and scuba dive at as many dive sites around the world as possible. Oh, and also to take many captivating photos both on land and underwater too!

Anything you would like to say to fellow students?

Don't be too afraid to try and learn new things. At first, when it's unfamiliar, it will be natural for it to feel suffocating. However, once you get through that, more often than not, you'll find that the process was worth it and now you're equipped with one more skill in your arsenal. Don't have too many regretful "what if" questions for yourself!

Workshop report

Practice makes perfect at ASM writing workshop

The scientific writing workshop organised by the American Society for Microbiology (ASM) Singapore Student Chapter attracted about 20 participants from SCELSE and NTU and provided a good overview of the best practices for writing in the scientific and wider contexts.

The virtual workshop was presented as a series of video lectures by Prof. Roberto Kolter from Harvard Medical School, augmented by hands-on practice and personal insights from the trainers:

Participants and trainers at the ASM scientific writing workshop

Dr Daphne Ng, Ms Kaylie Lam and Dr Ivor Russel Lee. The video presentations emphasised the importance of writing as a communication tool and how setting aside dedicated time for writing practice will lead to improvements in the long run.

SCELSE researcher Ms Saw Nay Min Min Thaw found the workshop to be excellent.

"The lectures are very engaging and explanations are extremely clear. The most interesting part of the course is how to prepare concise and informative figures and tables of your manuscript," Nay Min said. She added that the most important lesson from the workshop was the importance of daily writing practice.

"Even if the material I am writing is not well written at first, I must write every day in order to get better," she said.

SCELSE congratulated for maturity and inclusiveness during annual retreat *(from p. 1)*

inter-institutional collaborations that made the projects possible. Prof. Little said that he was especially impressed by the work from the Air Microbiome group, which had risen to prominence on the world stage.

Prof. Kjelleberg thanked everyone for their hard work in the past year.

"SCELSE has become more inclusive and collegial, and the research more integral," he said.

SCELSE PhD student Mr Kenny Lau, who works in the Air Microbiome group, enjoyed a number of the talks including Asst Prof. Chng Shu Sin's talk about outer membrane lipid transport and Prof. Stephan Schuster's talk about air as an ecosystem.

"Outside of my group's talks, I especially like Dr Viduthalai's talk about the skin microbiome. I see interesting applications to his work and managed to talk to him about the artificial skin model. I swab plant surfaces and of course asked him about swabbing skin surfaces. He replied that there are existing studies that has looked at skin swabs," he said.

Kenny added that he found the retreat to be an excellent learning experience and great opportunity to discuss potential projects with Prof. Schuster's collaborators Profs. Victor A. Albert and Charlotte Lindqvist.

A big thanks goes out to all those who helped make the event a success, especially lead organisers A/Prof. Scott Rice, Dr Rohan Williams, Mr Allen Chow, Ms Nathasha Oberoi-Lee and Ms Loh Ying Ting.

Newsletter contacts

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