Imperial College London

Centre for Process Systems Engineering
2017 Seminar Series

UCL

Elucidating and Engineering Microbial Communities: Systems and Synthetic Biology Approaches

Dr. Xiaoxia "Nina" Lin
(University of Michigan—Ann Arbor)

Abstract:

Microorganisms live in synergistic communities in nature and play key roles in numerous natural or engineered systems. For example, there are increasing evidences that microbes in our gut assist in digesting food, help prevent the invasion of pathogens, and stimulate the immune system. However, the basic physiological and ecological mechanisms governing these complex microbial communities remain largely unclear. My laboratory has been developing and applying new systems biology approaches to elucidate the microbe-microbe and microbe-environment interactions of these communities. In particular, we have been exploiting droplet microfluidics in the co-cultivation and characterization of symbiotic microbial communities. Our devices encapsulate subsets of a synthetic microbial community in nano-liter droplets, provide highly parallel localized environments for co-growth, and are capable of detecting microbial interactions effectively. The technology is being applied to the study of natural microbial communities, including the human gut, oral, and vaginal microbiome.

Inspired by the metabolic capability and robustness of synergistic microbial communities in nature, we have also been developing a promising alternative approach for microbial engineering and biochemical production - design and construction of synthetic microbial consortia consisting of different specialists to accomplish a complicated task. Our initial application focus is synthesis of fuels and chemicals from lignocellulosic biomass. Our designed consortium includes a cellulolytic member responsible for hydrolyzing hemicellulose and cellulose (main components of lignocellulosic biomass) into mono and oligosaccharides and a fermenting member for converting mono and oligosaccharides into desired molecules such as isobutanol, an advanced biofuel. Such a synthetic microbial consortium integrating saccharification and fermentation capabilities will enable one-step "consolidated" bioprocessing (CBP), a potential breakthrough technology that can lead to large-scale and cost-effective production of lignocellulosic biochemicals. Furthermore, the general framework of engineering defined co-cultures of coordinated specialists could offer exciting new opportunities for the efficient and flexible production of many valuable chemicals from non-conventional bio-feedstocks.

Bio:

Dr. Xiaoxia "Nina" Lin got her bachelor's degree in chemical engineering and a minor in computer science from Tsinghua University of China. She came to US in 1997 and did her PhD in process systems engineering with Chris Floudas at Princeton University. Afterwards, Nina went to do a postdoc in the emerging field of systems and synthetic biology with George Church at Harvard Medical School. Since 2006, Nina has been directing her own research group in the Chemical Engineering Department at the University of Michigan - Ann Arbor. She is also affiliated with UM's Biomedical Engineering Department.

Nina's laboratory focuses on investigating microbial systems, particularly microbial communities, using systems biology and synthetic biology approaches. One part of her research aims to advance fundamental understanding of natural microbial communities closely associated with health or environmental issues, most notably the human microbiome, by exploiting tools and methods from engineering fields, such as microfluidics and network modeling. In parallel, another major part of her laboratory aims to engineer microorganisms, most importantly synthetic microbial consortia, to address critical biotechnology applications, such as sustainable biofuel and chemical production. Her group's research has been funded by the NSF, NIH, and USDA; and Nina is the recipient of a 2011 NSF CAREER Award, a University of Michigan Elizabeth C. Crosby Research Award in 2007 and 2011, and an Ohio State University REACH for Commercialization Conference Fellowship in 2012.

5 April 2017, 11am
Lecture Theatre 3, RODH C333

Lecture Theatre 3, RODH C333, Roderic Hill Bldg, Chemical Engineering department, Imperial College London, SW7 2AZ;
Refreshments before the seminar in RODH C336 (opposite Lecture Theatre 3).
This event is free and open to the public. No registration is required.

Organisers & Contacts: Dr. Gonzalo Guillen Gosalbez (g.guillen05@imperial.ac.uk), Dr. Alex Kiparissides (alex.kiparissides@ucl.ac.uk), Ms. Cristina Romano (c.romano@imperial.ac.uk)