CAMBRIDGE CARES

CAMBRIDGE CENTRE FOR ADVANCED RESEARCH AND EDUCATION IN SINGAPORE LTD.

CARES Visiting Scientist Seminar Series:

Role of genome-scale modelling for improving methanogenesis in M. maripaludis

Dr Nishu Goyal, University of Petroleum and Energy Studies, India

Thursday 24 May, 11.30am - 12.30pm

CREATE Theatrette, Level 2, CREATE Tower

CAM.CREATE C4T Cambridge Centre for Carbon Reduction in Chemical Technology

Abstract: Exhaust flue gas generated during combustion of fossil fuels such as coal accounts for about 11 % of CO_2 emissions worldwide. To reduce these carbon emissions, cost-effective, clean and efficient approaches are needed to capture the CO_2 from flue gas and convert it into a relatively cleaner and sustainable fuel such as methane. M. maripaludis is a fast growing, mesophilic, hydrogenotrophic methanogen which reduces CO_2 (an electron acceptor) with the help of H_2 (an electron donor) for growth and methanogenesis. Despite several decades of research on M. maripaludis, a consolidated review on its metabolic processes and applications was lacking in the literature. In addition, efforts to generate a systems biology model for M. maripaludis have not been successful. We initiated the system level analysis and successfully reconstructed the first genome-scale metabolic model (iMM518) of M. maripaludis. For model validation, we performed batch culture experiments and quantified three key extracellular fluxes (CO_2, H_2, and CH_4) along with specific growth rates of M. maripaludis. A novel process simulation approach was used to accurately estimate these fluxes. Exceptionally high consumption and production rates were observed in M. maripaludis with a growth yield of 3.549±0.149 gDCW/mol CH_4. The experimental results indicated that M. maripaludis was capable of reducing 70-95% of CO_2 to CH_4 during the exponential phase. We further explored the nitrogen-fixing ability of M. maripaludis and performed batch culture studies on M. maripaludis to compare the impact of NH_4+ or N_2 on methane production. Our results show that with the same amount of nutrients in both the reactors, N_2-fixation allows methane production for more than 30 days and hence provides an ideal scenario for dual capture of carbon and nitrogen from flue gas.

Biography: Dr Nishu Goyal is an Assistant Professor in the Department of Chemical Engineering at University of Petroleum and Energy Studies (UPES) in India. From July 2011-2015, she was a President Graduate Fellow in the Department of Chemical and Biomolecular Engineering at National University of Singapore (NUS) and later worked as the Research Engineer in the same department. She was awarded a Springer thesis award for her outstanding PhD research work. She began her PhD after securing an M.Tech (Biomedical Engineering) from Indian Institute of Technology Bombay (IITB), India and gaining some valuable work experience in Strand Life Sciences Pvt Ltd., a leading bioinformatics company in India. Her research interests include genome-scale modelling of microbes, parameter estimation and model optimisation, genomics data analysis, drug delivery, wastewater treatment and enzymatic / microbial degradation of plastic.

CREATE
Campus for Research Excellence And Technological Enterprise

University of Cambridge
Nanyang Technological University
National University of Singapore