SBRC - Nottingham Newsletter Issue 11

October 2021

Foreword

by Nigel Minton

Much has changed since the last Newsletter. COVID-19 is still with us, but now most of us are all double vaccinated and most restrictions have been lifted across the UK. Most importantly the dreaded shift pattern of working in the SBRC labs is about to be confined to the scrap heap – hopefully for good – and we can all get back to personal contact and meetings in the flesh.

The BBSRC continues to support what the SBRC is doing and, following submission of a business case early this summer, awarded a 6-month costed extension that will allow us to continue until 31st March 2022 In the meantime, we submitted (Sept 22) an 'Engineering Biology Transition Award Bid' which if successful will support many parts of the SBRC for some time to come and put us in a strong position to bid for any other initiative in Engineering Biology that may materialize.

Sadly, during the last 8 months we have had to bid farewell to a number of members of the SBRC who have moved on to pastures new, with several more leaving at the end of this month (September). I am sure you will join with me in wishing them all great future success in their chosen careers, wherever they have landed, and I would personally hope that they will look back with some affection at all the good times they had in the SBRC and Nottingham in the pre-pandemic era.

Nigel

POC SUCCESS THREE TIMES OVER!!!!!

A well deserved pat on the back goes to SBRC Nottingham team leaders: Ying Zhang, Kati Kovacs and Chris Humphreys who have scooped £50,000 of POC funding in the latest round of awards from BBSRC NiBB "**The Carbon Recycling Network**". Well done to you all. Summaries of their projects follows below.

THE CARBON RECYCLING NETWORK

UKRI Biotechnology and Biological Sciences Research Council

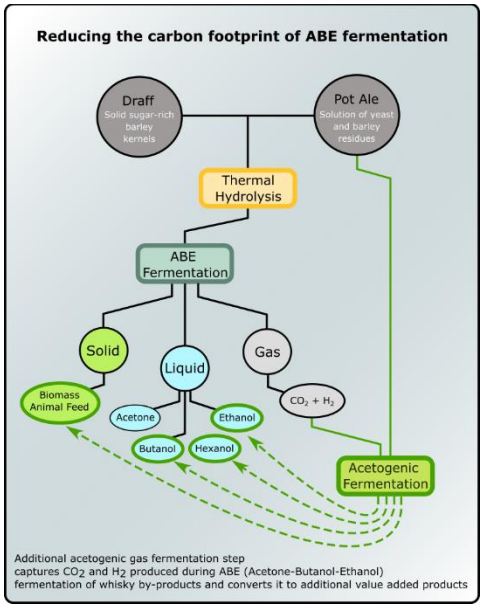
"High Value Products from Renewable Methane Feedstock"
by Dr Ying Zhang

Ectoine is a high value chemical used as moisturizer, UV protector and anti-aging ingredient in cosmetic product formulation, and as enzyme stabilizer, cell, protein and nucleic acid protectant in biomedical industry. The current process for the production of ectoine is a costly two-step batch fermentation using sugars as feedstock, which is expensive to run and there is a demand to develop alternative low-cost and renewable strategies. We propose to use alternative, low-cost and renewable feedstocks to solve the two of the greatest challenges facing industry and society - the future sustainable production of chemicals and fuels from non-food resources while at the same time reducing GHG emissions. To date, the focus has been on the use of lignocellulosic biomass feedstocks, which is reliant on an energy intensive pre-treatment step, and thereafter, the addition of costly exogenous hydrolytic enzymes. An exciting replacement is to use waste gases as the feedstock. Gas fermenting microbes can grow on C1 compounds, such as methane (CH_4) derived from non-food sources. Capturing waste methane released from landfill, anaerobic digestion, fossil fuel extraction and the stranded gas associated with shale gas, then fermentation with methane ustilising bacteria to make useful chemicals and fuels will lead to significant benefits to the environment and society. Methanotrophs oxidize methane at ambient temperatures and pressures and are therefore attractive systems for methane-based bioconversions. The concept of sustainable bioprocesses is now very much at the heart of the UK bioeconomy. In this project, we will address the scientific and technical challenges necessary to develop the initial

steps of a sustainable bioprocess to produce high value chemicals such as ectoine through the microbial fermentation of methane.

"Reducing the Carbon Footprint of ABE fermentation".
by Dr Chris Humphreys

Current energy and chemical needs are met by the extraction and processing of the fossil fuels. Such resources are finite, and their use causes environmental pollution and greenhouse gas (GHG) emissions. The challenge facing humankind is, therefore, to identify new, sustainable, and cleaner processes for chemical and energy generation. Biological routes offer a promising alternative, and companies such as Celtic Renewables are leading the way in the UK towards implementation of sustainable fermentation processes of waste biomass to generate green biobutanol. A by-product of such ABE fermentation processes is CO2 and H2, which in the case of CO2 specifically, a GHG, presents a problem but also an opportunity. Here we propose that this waste gas could instead be captured by an acetogenic species in an additional downstream fermentation step, generating further value in the form of increased overall yields of biobutanol for the process. This would not only increase the yields of desirable products from waste biomass, but also reduce the carbon impact on the planet, helping to make the process even greener, and contributing towards the push to make the UK a net-zero carbon producer by 2050.
This project aims to assess the viability of a real-world example of this concept, replicating precise compositions and gas ratios of the waste stream at the header of a Celtic Renewables ABE production facility, and assessing the suitability of spent pot ale ABE medium for supporting growth of the acetogenic species Clostridium carboxidivorans. This species is uniquely attractive as it natively produces higher alcohols such as butanol and hexanol, and newly developed genetic tools have placed us in a prime position to exploit this organism as an industrial chassis.



"Exploring continuous, safe, and efficient production of butanediol from CO2 in an electrogenic reactor using Cupriavidus metallidurans CH34" by Dr Rajesh Bommareddy and Dr Katalin Kovacs

To tackle climate change, the UK government has passed a law in June 2019 that will require all GHGs emissions produced nationally to be brought to net-zero by 2050, including the target of 78% reduction of carbon emissions by 2035. This means that any CO2 emissions will need to be balanced out by removing the same amount of GHGs from the atmosphere. At the same time, chemicals which are currently produced from fossil fuel feedstocks will need to be made by new, sustainable methods. Using GHGs, represents a techno economically feasible feedstock. However, the flammability concerns of H2 and O2 mixtures puts constraints on O2 concentrations in gas fermentations. Lower O2 concentrations means higher mass transfer requirements are necessary for a viable fermentation process. This is a known problem in a typical industrial aerobic fermentation and the problem is only bigger in aerobic gas fermentation where O2 concentration is constrained. An alternative process design is pivotal for an economically feasible process within the capital cost context of industrial gas fermentation. In this project, we aim to solve this issue by combining bioreactor design strategy with metabolic engineering. H2 and O2 are separated in a microbial fuel cell-based strategy, where the anode acts as an intermediary electron acceptor exploiting the CO2 fixation by a chemolithoautotroph, Cupriavidus metallidurans. A valuable chemical, 2,3-butanediol, will be a case study product produced by this bacterium using CO2 as the sole carbon source, thus demonstrating a safe and efficient process. Moreover, immobilized cultures, i.e., C. metallidurans biofilm formation on the anode surface, offers greater flexibility in intensifying the process. After successful demonstration of the above, the volumetric productivities of 2,3-butanediol will be compared between conventional gas fermentation and the microbial fuel cell-based cultivation. We anticipate this novel concept creates an efficient, safe, techno economically feasible process utilizing CO2, H2 and O2 gas mixtures, aligning and addressing UN sustainable goals such as industrial decarbonization and climate action.

Responsible Research and Innovation Update by Eleanor Hadley Kershaw

European Biotechnology and Society Online Seminar, 7th July

Having delivered a talk with Carmen McLeod (Newcastle University, formerly SBRC-Nottingham) and Stevie de Saille (University of Sheffield) in the Autumn 2020 European Biotechnology and Society Seminar Series, I was invited back to speak at a special session on 'Responsible Innovation as Social Learning' in the Summer 2021 Series. The presentation 'RRI in European Biotechnology: Looking back and forward' reflected on experiences of RRI in the SBRC and several of its associated projects to consider lessons learned for future research and for funding programmes such as the European Research Area Co-Fund on Biotechnology (ERA CoBioTech), which supports two SBRC associated projects (BIOMETCHEM; SynConsor4Butanol) and convenes the seminar series. The special session also included presentations on RRI in funding policy (Rob Smith, University of Edinburgh and Thoko Kamwendo, Durham University) and stakeholder engagement in the MIPLACE project (Joanne Benton and Jose Jiménez, Imperial College London), followed by a lively panel discussion. Around 25 people attended the live session and the recording was viewed 20-40 times. The whole seminar series brought together a great range of speakers from different disciplines and sectors for thought-provoking conversations about the relationship between biotechnology and society.

Ecological Reparation YouTube Channel & Book

The SBRC Interdisciplinary RRI Group has contributed to a book and video project on Ecological Reparation. The project, led by Dimitris Papadopoulos (University of Nottingham) and Maria Puig de la Bellacasa (University of Warwick), explores how ecological thinking and practice can enable reparation, and how reparation for damages done can be ecological. My contribution to this project explores microbial mending of damaged ecologies across scales, from the human microbiome (helminth therapy and faecal microbiota transplantation) to industrial ecosystems and the carbon cycle (microbial gas fermentation for carbon recycling). This work will feature in: Papadopoulos D., Puig de la Bellacasa, M., & Tacchetti, M., (Eds.). (2022). Ecological Reparation. Repair, Remediation and Resurgence in Social and Environmental Conflict. Bristol: Bristol University Press.

Dimitris visited the SBRC on 8th July with a video team to capture footage of the labs and interview me for the Ecological Reparation YouTube Channel, launched this autumn. You can watch a preview of the video here!

Special thanks to Shelly Kelly, Victor Irorere, Swapnika Challa, Ruth Cornock, Margaux Poulalier Delavelle and Abubakar Madika for their help and participation, to Nigel Minton, Alan Burbidge, Jacque Minton, Louise Dynes, Loretta Waddon, James Millard, Kati Kovacs, and Carl Winfield (BDI) for their support, and to all members of the SBRC for accommodating the filming!

The Carbon Recycling Network Contributes to BEIS "Net Zero" Project
by Louise Dynes

The Carbon Recycling Network contributed to a joint response to the recent Department for Business Energy and Industrial Strategy (BEIS) Call for Evidence on the role of biomass in achieving net zero. The evidence submission was developed in collaboration with the Supergen Bioenergy Hub, Biomass Biorefinery Network, and the High Value Biorenewables Network.

The joint evidence submission considered the supply and use of biomass and highlighted the essential role we believe biomass will play in the transition to net zero, through bioenergy systems, the production of carbon-based

chemicals and materials, and as a feedstock in negative emission technologies. The response touched on the benefits of industrial biotechnology for biomass utilisation and the potential of C1 gases (for example from biomass gasification or fermentation) as manufacturing feedstocks, as well as emphasising need for further investment in research, innovation, and scale up facilities.

The responses to the BEIS Call for Evidence will support the development of the upcoming UK Biomass Strategy. It is crucial that this strategy lays out a pathway for the sustainable production and use of biomass and positions the UK as a global leader in this area (a sentiment which echoes that expressed by the CCC in their latest progress report) and to enable this, we must harness the academic expertise within the research community. To this end, the evidence submission was collated by the newly appointed Biomass Policy Fellow, Joanna Sparks, who is working with the Carbon Recycling Network, the Supergen Bioenergy Hub, the Biomass Biorefinery Network, and the High Value Biorenewables Network. Joanna will provide an important connection with government policy makers, and her position provides a unique opportunity to bring together the wealth of expertise within our community and present it in a consolidated way. We believe that this collaborative approach will afford impactful policy engagement, as well as developing capacity and capability for future policy engagement by the research community. Joanna will be continuing to engage with development of the Biomass Strategy over the coming months, so keep an eye out for further opportunities to get involved in this work!
The submission can be found here


Joanna Sparks

Upcoming Events

THE CARBON RECYCLING NETWORK - Policy Engagement Workshop
27 October 2021

The Carbon Recycling Network recently worked with Supergen Bioenergy Hub, the Biomass Biorefinery Network, and the High Value Biorenewables Network to submit a joint response to a Department of Business, Energy and Industrial Strategy call for evidence on The Role of Biomass in Achieving Net Zero. Together we are continuing to engage with policy makers as they develop the upcoming UK Biomass strategy, and this event is an opportunity for members of the Carbon Recycling Network to get involved in this work and with future policy engagement! You will be encouraged to think about the policy implications of your work and the work of your sector, and what the key

barriers to success might be. We will work together to come up with a list of key things the Carbon Recycling Network wants to communicate to government.

Register Here

SYNTHETIC BIOLOGY UK 2021
22-23 November 2021

This year SBRC Nottingham is proud to host the long-awaited Biochemical Society's "Synthetic Biology 2021" at East Midlands Conference Centre, Nottingham, 22-23 November 2021.
This meeting represents the convergence of multiple fields that generate improved understanding of biological systems and cutting-edge biotechnology. The meeting will explore the unique opportunities of research in this area, providing an excellent framework for scientists and engineers to learn about new areas of activity.
Topics include:

- engineering of microbial communities
- microbial-plant interactions
- applications for sustainable manufacture of materials
- the circular economy
- climate mitigation strategies

Submit your abstract by 22 September 2021 for your chance to be included in the event programme. We're welcoming the submission of abstracts for consideration as oral communications at Synthetic Biology UK 2021. Attracting an international audience, scheduled speakers include:

- Paul Hudson, SciLifeLab, Sweden
- Karen Polizzi, Imperial College London, UK
- Helene Steiner, OpenCell, UK
- Liz Sockett, University of Nottingham, UK

For more information and to register please go to Synthetic Biology UK 2021

Public Engagement and Outreach

Outreach and Public Engagement have been challenging with lockdown and social distancing but have begun to pick-up as we develop new skills and acquire new tools.

Careers Talk to English Martyrs' Catholic School, Leicester "Careering into Science"
by Dr Andrew Dempster

I was asked by a former colleague of ours at the SBRC, Nimit Joshi (now assistant head of science at a secondary school in Leicester), to give a 20 minute presentation on my career in science so far. I was to be talking to the whole of Year 9 at English Martyrs' Catholic School - approximately 160 students in total, split over two sessions.

The talks were conducted on 23 and 25 June 2021 via Teams. I spoke about my unconventional career route from computer science to microbiology and everything in between - pharmacy, semi-professional rugby and more recently covid lab volunteer. I also gave a brief introduction to microbiology – prokaryotes vs eukaryotes and DNA aimed at the level at which they were currently or due to be learning, through pictures and videos of lab techniques to keep it engaging. Relating these concepts to the (non-confidential) activities we perform at the SBRC, I gave a visual example of how we study gene function in bacteria with a motility mutant and plate assay (thanks to Alex for that) and spoke about how we can apply these principles in health and industrial biotechnology.

As we've all learnt over the last year, talking to a screen for 20 minutes, it is quite difficult to judge your audience, but I was told that the Year 9 students were all engaged and responded enthusiastically to the talk – asking even more questions once my session had ended. Overall a very positive and humbling experience talking about science careers and teaching molecular biology to a young and impressionable audience.

SBRC PhD Student Talks to U3A about "Biofuels"
by Francois Seys

On the 16th of June I had the pleasure to introduce the topics of Bioenergy, biofuels and Carbon Capture and Storage to an avid audience from the University of the Third Age (U3A) of Edwalton and Gamston. Speaking at an U3A is always an extremely rewarding and inspiring experience: it is rare to find a public more invested and more curious than senior citizens brought together by their desire to learn. I was happily surprised that they specifically requested talk on Bioenergy, as it is a concept of capital importance which is often used in the context of sustainability and Net-zero emissions targets, but very rarely explained properly. Improving the literacy of the U3A group of Edwalton and Gamston in these very important topics felt like a privilege. Indeed, I hope that my explanations will help them feel more confident in their consumption choices and their voting preferences.
Preparing this talk gave me the opportunity to update my knowledge of global and national energy consumption patterns, and of the UK strategy to reach net-zero CO_2 emissions. Even though it was done by videoconference, it also constituted a welcome human interaction in these times of social distancing, as well as a convenient break from writing up my thesis. All in all: amazing experience, 10/10 would do again.

STOP PRESS

DONT MISS "NEW SCIENTIST" MAGAZINE SBRC ARTICLES!!!

To coincide with the run-up to COP26 which is taking place in Glasgow 1-12 November, 6 of our very own SBRC researchers have written three articles which will appear in New Scientist Magazine in issues 30 October, 6 November and 13 November. The Outreach articles will promote the work of the SBRC in three exciting areas: Biofuels, Bioplastics and Biotherapy. Thanks go to the contributors, Chris Humphries, Francois Seys, Callum McGregor, Victor Irorere, Patrick Ingle and Raquel Rodrigues and to enablers as ever, Loretta and Louise..

NewScientist

AND FINALLY
ITS GOODBYE FROM ME
by Jacque Minton

It is with mixed emotions that I say farewell to you all, as I leave the SBRC on 30 September. We have been through a lot together since Nigel first asked me to organise a conference (ClostPath) for him back in 2006... little did I know... I then went on to project manage several of Nigel's projects (Marie Curie, Clostnet, LoLa, Hyperdif, C1net). In these roles I was privileged to meet, mentor and manage many lovely people and to travel to and coordinate events all over the world. More recently I have returned to my teaching roots by helping with the SBRC Outreach and Communication. I wish to thank Loretta, Alan and Louise for sharing their energy and expertise with me in these SBRC days and every one of you for your enthusiasm; making Outreach fun. It is sad that Covid prevents a proper farewell, but I think you all know you have not seen the last of me.. I will be there, helping Nigel out whenever I am needed, so it's just goodbye until then.....

Our new baby “Evening Star”!!!