UK STEM LECTURE TOUR 2016

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# University of Manchester

## **Institutional Profile**

The University of Manchester is a truly global institution, with a reputation for education and innovation that resonates across the world.

International businesses, charities, governments and universities turn to Manchester for our expertise.

Our research engages with the world’s biggest questions – that’s why we bring together the best people in these fields to help us to find the answers. We’ve a history of attracting world-leading minds to work with us, from Niels Bohr and Arthur Lewis to our latest Nobel laureates Andre Geim and Kostya Novoselov, whose pioneering work with the one-atom thick wonder material graphene has established Manchester not just as the centre of research but also as a leader in its application.

More international students study with us than at any other UK university, with 160 nationalities coming together on campus. We work closely with overseas agents and foundation course providers, and tour the world to meet prospective students face to face. Offering outstanding English language support and orientation programmes, as well as courses and careers advice designed with employability in mind, we’re a springboard for tomorrow’s leaders.

We’re at the heart of Manchester, a world-class city that shares our pioneering, boundless spirit – indeed, Manchester is the current European City of Science, and hosted the EuroScience Open Forum in summer 2016.

Manchester’s industrial and cultural heritage is mirrored by the achievements of some of the University’s most celebrated names: Rutherford, Turing and Burgess to name but a few. Today, we’re making the largest investment in facilities ever seen at a UK university, with £750 million spent so far and a further £1 billion to follow by 2022.

## **Faculty Profile**

The School of Chemical Engineering and Analytical Science is one of the largest chemical engineering departments in the UK and with traditional strengths in process integration, crystallisation, industrial sustainability, and bioprocessing we aim to extend the boundaries of the chemical engineering discipline.

The overall vision of the School is to develop and promote chemical engineering as a discipline that creates practical and sustainable advances for the overall benefit of society.

Research is organised around a matrix of 6 themes:

* Biochemical engineering
* Multi-scale Modelling
* Process Integration and Development
* Sustainable Industrial Systems
* Catalysis
* Advanced Functional Materials

Expertise in these groupings enables us to address key multi-disciplinary societal challenges related to energy, water, food and nutrition, and health and well-being.

We benefit from a range of new research facilities including the new £16M James Chadwick Building for large-scale chemical engineering research as well as involvement in multi-disciplinary University research institutes.

We also aspire to develop an exemplary record of knowledge transfer and to harness our research capability to produce the best environment for student education.

## **Lecturer’s Bios**

Prof. Theodoropoulos received his BSc in Mathematics from the Aristotle University of Thessaloniki in Greece and his MSc and PhD in Chemical Engineering from the State university of New York at Buffalo, USA. He then worked as a post-doctoral associate in the Department of Chemical Engineering at Princeton University.

He is currently Professor of Chemical and Biochemical Systems Engineering, in the School of Chemical Engineering and Analytical Science (SCEAS).

He is also the Director of Postgraduate Research for SCEAS.

His research group develops state-of-the-art computational algorithms for the dynamics, optimisation and controller design of complex large- and multi-scale (bio)chemical systems and follows this through to implementation for a range of applications from fuel cells to micro and nano-catalytic systems and to the experimental bio-catalytic conversion of bio-refinery by-products to added value chemicals.

For his novel experimental and computational biotechnology applications he has a PCT patent granted.

He has over 100 publications including articles in scientific journals, and in conference proceedings as well as book contributions. He has given a number of invited seminars all over the world. He has served as member of editorial boards and of international scientific committees and also as session chair for a number of International Conferences and Workshops.

He has organised and taught Continuing Professional Development courses to industrial delegates, intensive post-graduate course programmes to Universities around the world as well as in-house training workshops for the Industrial Sector.

## **University Lecture Abstract**

**Title:** Industrial Biotechnology for the sustainable co-production of fuels and chemicals: An integrated approach.

Integrated bio-refineries for the co-production of fuels and added-value chemicals from various renewable biomass sources are emerging as a potential sustainable alternative to petroleum-based refineries. Vegetable oil from agricultural sources is extensively used for the production of biodiesel as well as waste oils from various sources including used cooking oils and fats.

Lignocellulosic biomass on the other hand seems to be a more viable source since it does not compete with the production of food, although some controversy on land use and societal issues remains. Micro-algal biomass is considered to be a sustainable and renewable feedstock for biofuel production. These photosynthetic organisms naturally accumulate lipids that can be used for the production of biodiesel and carbohydrates - mainly in the form of starch - that can be used as raw substrates for sugar-based biofuels like bioethanol or bio-butanol.

Furthermore, for biodiesel production, lipids are converted into methylated fatty acid, meanwhile generating a discernible amount of glycerol as the main by-product, which accounts for approximately 10% weight of lipids consumed. Hence, in recent years we have developed the integrated bio-refinery paradigm through a combination of experimental and computational studies for the co-production of various-biofuels, including biodiesel, bioethanol and bio-butanol, and the bio-production of added-value chemicals, such as succinic acid and PHB, as well as microbial oil from residual glycerol. We utilize the Chlamydomonas reinhardtii algal strain, grown from the lab-scale to large open raceway ponds.

Furthermore, we study the bio-production of added value products from glycerol at a variety of scale, from flasks to industrial-scale bioreactors. An efficient approach towards improving the performance of the various bioprocesses involved, including yields and productivities is the development of robust, predictive dynamic computer-based process models that able to describe the main phenomena that take place. Such unstructured process models should include all relevant process parameters (agitation, liquid and gas flow rates) as well as environmental conditions, extracellular nutrient availability, multiple substrates and scaling parameters. We develop a number of such experimentally validated models for bioprocess design optimisation and process mode selection purposes.

Furthermore, we develop a number of metabolic-level models in order to decipher the intracellular behaviour of the various bio-systems and to gain insights on the optimal performance of the utilised microorganisms.

**Target audience:** Chemical Engineering, Biochemical Engineering, Industrial Biotechnology, Bioenergy