

Scale-up and Sustainability Evaluation of Biopolymer Production from Citrus Waste Offering Carbon Capture and Utilisation Pathway



Group photo Imperial College

Imperial College
London

Invited for this month's cover picture is the group of Dr Miao Guo from Department of Chemical Engineering at the Imperial College London (UK). The cover picture shows modelling research on the co-polymerisation of waste-sourced limonene oxide with CO₂ to produce poly(limonene carbonate), which offers a sustainable pathway to achieve carbon capture and utilisation. A computational approach to process design was integrated with sustainability evaluation to model this synthetic pathway and identify the environmental-damaging and performance-limiting steps for further improvement. Our research highlights the potential of closed-loop manufacturing systems with waste recovery, which is instrumental in building a sustainable circular economy. Read the full text of their Full Paper at 10.1002/open.201900015.

What are the main challenges in the broad area of your research?

Despite the empirical advances in green chemistry and biopolymers, the research challenges remain open on whole systems design to achieve sustainable resource-manufacturing-waste life-cycles. Design challenges range from the conflicting decision criteria (e.g. economic and environmental sustainability) to the system complexity with interlinked manufacturing processes and waste resources. Such complexity and challenges can be tackled by integrative modelling research underpinned by Process Systems Engineering approaches.

What future opportunities do you see (in the light of the results presented in this paper)?

Our modelling results suggest economic and environmental advantages to maximising waste utilisation, in this case by coupling biopolymer production with carbon capture and integrated heat and power generation. This realises the opportunity for more integrative technology solutions to resource recovery from waste, whereby a spectrum of value-added products can be recovered on the journey to achieving circular economy. Our research also highlights the engineering insights derived from computer aided process design and optimisation, which can inform the decision-making in the field of green chemistry and deployment of chemical processes and technologies.

What other topics are you working on at the moment?

We are working actively in the fundamental modelling research and applications in the field of Process Systems Engineering. This include multi-scale process design, modelling and mathematical optimisation to analyse and optimise the low-carbon, sustainable chemical processes and systems such as bioplastic, bio-chemicals, and renewable energy production.

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