8th ICGC 2018 Session:

Biomass conversion to sustainable solvents for industry

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Abstract:

Solvent use is ubiquitous throughout industry and plays a crucial role in chemical synthesis, however, many have inherent drawbacks of toxicity and environmental hazards. Thailand 4.0 is driving the move towards safer chemicals and innovative production processes. Bio-based solvents which are renewable, sustainable and potentially safer alternatives to traditional petrochemical derived analogues could be a key tool for delivery of innovative production processes. The production and use of bio-based solvents can be a key part of a biorefinery. It has been demonstrated that waste agricultural biomass can be used in combination with $scCO_2$ extraction to generate valuable bio-derived products (including waxes) and also enhance the production of 2nd generation biofuels as part of an integrated holistic biorefinery. Thus gives rise to higher yields of glucose, which resulted in a 40% increase in ethanol production on fermentation, as compared to non-$scCO_2$ extracted biomass.[1]

In addition, the utilisation of bio-platform molecules has now led to a range of greener non-polar, and polar diprotic solvents, which are functionally proficient, and importantly, safer. The combination of silico modelling, property measurements and lab scale testing are a powerful tool for bio-solvent development. Herein, examples of replacements solvents that can be potentially synthesised from waste biomass as part of a biorefinery will be discussed, including dipolar aprotic and low polarity replacements for hydrocarbon or aromatics solvents. 2,2,5,5-tetramethyloxolane (TMO) is one such low polarity replacements for toluene.[2] This unconventional ether has an absence of protons alpha to the oxygen eliminates peroxide formation, and also leads to lower basicity compared with many traditional ethers. Such case studies demonstrate how green chemistry can be employed as a powerful tool for the development of safer bio-based solvents for use in sustainable circular economy.

References:

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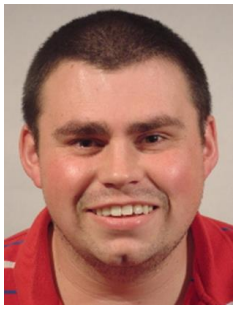

Dr. Andrew J. Hunt gain a BSc (Hons) in chemistry with computer science from the University of Wales (Swansea) in 2001, follow this he obtained an MRes (with Distinction) in Clean Chemical Technology in 2002 from the University of York. Dr Hunt continued his studies in York by obtaining a PhD focused on "the extraction of high value chemicals from British upland plants" under the supervision of Professor James Clark in 2007.

From 2009-2017, Dr. Hunt was the scientific leader of the alternative solvent technology platform at the Green Chemistry Centre of Excellence within the University of York. Dr Hunt joined the department of chemistry at Khon Kaen University in 2017, where he will continue his research in Green Chemistry. His research interests include bio-based solvents, supercritical fluids, waste utilisation, biorefineries and elemental sustainability.

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