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Rational design of nanoengineered catalysts for biofuels production

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Concerns over the economics of proven fossil fuel reserves, in concert with government and public acceptance of the anthropogenic origin of rising CO_2 emissions and associated climate change from such combustible carbon, is driving academic and commercial research into new sustainable routes to fuel and chemicals. Catalysis has a rich history of facilitating energy efficient, selective molecular transformations, and in a post-petroleum era will play a pivotal role in overcoming the scientific and engineering barriers to economically viable, and sustainable, biofuels derived from renewable resources. Biodiesel is one of the most readily implemented and low cost, alternative source of transportation fuels to meet future societal demands. However, current practices to produce biodiesel via transesterification employ soluble acids and bases, resulting in costly fuel purification processes and undesired pollution. Heterogeneous acid and base catalysts, able to transform undesired free fatty acid (FFA) impurities and naturally-occurring triglycerides within algal or plant oils into clean biodiesel, can dramatically improve process efficiency. The microporous nature of conventional catalysts hinders their application to converting bulky and viscous plant/algal bio-oil feed streams. We show how advances in the rational design of nanoporous solid acid and base catalysts, and their utilization in novel continuous reactors, can deliver superior performance in the energy-efficient esterification and transesterification of bio-oil components into biodiesel.

Biography

Adam F Lee holds a BA in Natural Sciences and PhD in surface science and catalysis from the University of Cambridge, and was appointed a Lecturer in Physical Chemistry at the University of Hull in 1997. After moving to the University of York and promotion to Senior Lecturer, he was appointed Professor of Physical Chemistry within the Cardiff Catalysis Institute at Cardiff University in 2009, and subsequently joint Chair of Sustainable Chemical Synthesis at the University of Warwick and Monash University. He was recently appointed Professor of Sustainable Chemistry in the European Bioenergy Research Institute, Aston University, where he holds an EPSRC Leadership Fellowship in "Nanoengineered Materials for Clean Catalytic Technologies". He was awarded the 2000 CR Burch Prize by the British Vacuum Council, the 2004 Fonda-Fasella Prize of the Elettra synchrotron, the 2011 McBain Medal of the Royal Society of Chemistry and Society of Chemical Industry, and 2012 Beilby Medal of the Royal Society of Chemistry, IOM3 and Society of Chemical Industry for outstanding contributions in the field of heterogeneous catalysis and surface science. His research spans heterogeneous catalysis, green chemistry and synchrotron science, in which he has authored over 140 articles (h-index = 33), with particular focus on the rational design of functional materials for sustainable chemical processes and energy production.

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