Combining biocatalysis, organometallic catalysis and ionic liquids for biomimetic biomass conversion

Andrew C. MARR

School of Chemistry & Chemical Engineering, Queen's University Belfast, Belfast, N. Ireland, UNITED KINGDOM
a.marr@qub.ac.uk

Nature provides great inspiration for living a more circular life, in better balance with our natural environment. It also provides great resources for synthesising chemicals. This lecture will look at some of work to harness the wisdom of nature by employing biomimicry to create catalysts that convert biomass. In this way we can find routes from a variety of cheap biomass to bio-renewable intermediates that spawn a wide variety of value-added chemicals. Whole cell biocatalysis is a powerful first step in the transition from biomass side products to valuable fine chemicals. Ionic liquids were employed as a key tool for sustainable chemistry. What sets ionic liquids apart from other solvents and bulk liquids, is the ability to strategically alter key properties by changing the ions and functional groups. For example, reducing the hydrophilicity by including alkyl groups can lead to solvents that will dissolve polar molecules, yet are immiscible with water; and changing the functional groups on either ion can yield ionic liquids ranging from strongly basic to strongly acidic. An engineered ionic liquid environment can be created around a catalytic centre by entrapping chemocatalyst or biocatalyst with an ionic liquid within a gel. These catalytic ionic liquid gels (ionogels/ iongels) have been demonstrated for organometallic, ionic liquid, and enzymatic catalysts.

References

[1] S.F. Liu, M. Rebros, G. Stephens, A.C. Marr, *Chem. Commun.* 2308 (2009)
[2] A.C. Marr and S.F. Liu, *Trends in Biotechnol.* **29** 199 (2011)
[3] Y.-M. Wang, F. Lorenzini, M. Rebros, G. C. Saunders, A. C. Marr. *Green Chem.* **18** 1751 (2016)
[4] X.-H. Liu, M. Rebros, I. Dolejš, A. C. Marr, *ACS Sustainable Chem. Eng.* **5** 8260 (2017)
[5] K.M. Bothwell, F. Lorenzini, E., Mathers, P. C. Marr, A. C. Marr. *ACS Sustainable Chem. Eng.* **7** 2686 (2019)
[6] H. T. Imam, P. C. Marr, A. C. Marr, *Green Chem.* **23**, 4980 (2021)
[7] K. Hill, A. Reid, S. Mix, P. C. Marr, A. C. Marr, *ACS Sustainable Chem. Eng.* **11** 18, 6829 (2023)

Combining biocatalysis, organometallic catalysis and ionic liquids for biomimetic biomass conversion

Andrew C. MARR

School of Chemistry & Chemical Engineering, Queen's University Belfast, Belfast, N. Ireland, UNITED KINGDOM
a.marr@qub.ac.uk

BIO

Andrew C. Marr received a PhD from the University of St Andrews in 1998, on industrial organometallic catalysis under Prof. David Cole-Hamilton. After PDRA positions on hydrogenase enzymes with Prof. Martin Schröder (University of Nottingham), and ligand synthesis with Prof. Paul Pringle (University of Bristol), he was appointed to a McClay lectureship (2001) and then a faculty position in Chemistry in Queen's University Belfast (2004), where he joined the QUILL laboratories for ionic liquids research headed by Prof. Kenneth Seddon. He is a Reader in Green & Sustainable Chemistry and Head of the Chemistry & Medicinal Chemistry programs. He is also an Associate Editor of ACS Sustainable Chemistry & Engineering.