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Providing sustainable catalytic solutions for a rapidly changing world

Introduction

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One contribution of 13 to a discussion meeting issue 'Providing sustainable catalytic solutions for a rapidly changing world'.

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green chemistry

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Catalysis is a key area of modern science and the recognition of its importance has been increasing in recent years. In view of this a Royal Society Discussion Meeting was held on 8–9 May 2017 bringing together many facets of the latest research in catalysis. The meeting was set out in four themes.

The first theme *Catalysis for Clean Energy* was introduced by Professor Christopher Hardacre [1] (Manchester University, UK) who discussed non-thermal plasmas that enable the activation of catalysis at low temperature operation. Dr Sara Jacob [2] (Exxon Mobil, USA) described some new exciting work relevant to alkane oxidation concerning the use of dioxiranes in solution at low temperature. Professor Gianfranco Pacchioni [3] (Milan) showed the power of contemporary computational modelling techniques with new work on biomass conversion using TiO₂ and ZrO₂ and addressed the question of why catalyst reduction aids the process. Professor Andy Beale [4] (UCL) showed how new characterization methods can be used to provide a deeper understanding of the Co-catalysed Fischer–Tropsch reaction using chemical tomography.

The second theme concerned *Catalysis for Clean Water*. Dr Jennifer Edwards [5] (Cardiff University, UK) described novel catalysts for hydrogen peroxide synthesis and described how they could be used in waste water treatment. Professor Matthew Neurock (Minnesota) continued the theme of hydrogen peroxide synthesis and showed how theory can give insights

into the design of selective catalysts for the direct synthesis of hydrogen peroxide. Professor Jim Anderson [6] (Aberdeen University, UK) described how photocatalysis can be used for the combined distraction of organic and inorganic pollutants in water.

Session three covered the topic of *Catalysis for Sustainable Materials*. Professor Matthew Davidson (University of Bath, UK) discussed the selective and robust polymerization catalysts for making sustainable bioplastics. Professor John Woodley [7] (DTU) continued this theme by addressing the integration of biocatalysts with process design. Professor Uwe Bornscheuer [8] (Greifswald) described protein engineering as a tool to create highly selective transaminases and discussed their application in cascade reactions. Professor Regina Palkovits [9] (RWTH Aachen) discussed how catalysis can be used to enable the efficient utilization of renewable feedstocks.

In the final section the topic of *Catalysis and Climate Change* was addressed. Professor Nora de Leeuw [10] (Cardiff University, UK) introduced the topic by describing the computer-aided design of novel catalysts for sustainable energy production. Professor Charlotte Williams [11] (Oxford University, UK) described catalysts for selective polymerizations from mixtures of monomers and described how the design of the catalyst can control this process. Dr Paul Collier (Johnson Matthey, UK) provided an industrial perspective and discussed the importance of innovation in process design and how catalysis lies at the heart of this.

During the meeting a very lively poster session was held in which twenty posters presented by early career scientists from the UK Catalysis Hub described their latest discoveries. The overview at the end of the meeting was provided by Professor Sir John Meurig Thomas [12] (Cambridge, UK) and Professor Ted Oyama (Tokyo University, Japan) and they described the many themes introduced in the meeting as well as indicating many recent studies that had not been covered. Many of these papers are presented in this issue of *Philosophical Transactions of the Royal Society* and we hope this will provide interesting insights into the importance of emerging catalytic science. Following the two-day discussion meeting that was attended by over 200 participants, a satellite meeting was held at Chicheley Hall and attended by over 50 invited delegates. This was a discussion meeting on the topic of *Catalysis Sustaining Society's Future*. The format of the meeting was centred on the discussion of four questions relevant to modern catalysis. These were led by four participants who each gave a different viewpoint on the question raised and this was followed by an approximately three-hour discussion. The questions addressed were:

How far can we tailor and control active sites? (Lennon, Oyama, Armstrong, Wass)

How generally applicable is the concept of single site catalysis? (Gates, Thomas, Willock, Tooze)

Where can biocatalysts be usefully applied in the future? (Baldenius, Flitsch, Davis, Woodley)

Can precious metal catalysts be replaced with earth abundant materials? (Allen, Ueda, Harth, Bedford)

The ideas generated through this discussion will no doubt form the focus of future discussion meetings which we look forward to with great interest.

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