Abstracts of Lectures

Applied Catalysis and Reaction Engineering

University of Cambridge, UK

17-18 September 2014

Invited Lectures

- Professor Freek Kaptejin, TU Delft
- Dr Adeana Bishop, ExxonMobil
- Professor David Cole-Hamilton, University of St Andrews

IChemE
Catalysis Special Interest Group

ROYAL SOCIETY OF CHEMISTRY

IChemE

Catalysis Special Interest Group

Applied Catalysis and Reaction Engineering

17-18 September 2014

University of Cambridge, Cambridge, UK

Programme – Wednesday 17 September 2014

12:00	**Registration and lunch**
13:00	**Opening Remarks**
13:10	***Invited Lecture One – Title TBC.*** Professor Freek Kapteijn, TU Delft
13:50	***Using Active Site Confinement and Organic Ligand Approaches to Control Catalysis*** Michael M Nigra, A. Katz, M.O. Coppens, University College London
14:15	***New Opportunities for AU Catalysts in Hydrogen Mediated Reactions*** Fernando Cardenas-Lizana, M.A. Keane, Heriot-Watt University
14:40	***Interdependence Between Reactor Design and Catalyst Development: An Innovative Reactor Design Opens Opportunities to Enhance Catalyst's Activity*** Paolo Brunengo, T.D. Gamlin, B.B. Miller, G. Headdock, J. Clarkson, Davy Process Technology
15:05	**Coffee/Tea Break/Poster Session**
15:30	***The Role of the Platinum-Support Interface in Catalysis: a Model Catalyst Kinetic Study*** Evangelos I. Papaioannou, C. Bachmann, J.J. Neumeier, D. Frankel, J. Janek, I.S. Metcalf, Newcastle University
15:55	***The Effect of Promoters on Iron Carbon Nanotubes Catalysts for the Conversion of Carbon Dioxide to Hydrocarbons*** Emma Sackville, D. Mattia, M. Jones, Bath University
16:20	***Unitisation of CO2 in the Process of Propane Oxidative Dehydrogenation*** Ewa Nowicka, C. Reece, D. Willock, S. Golunski, G. Hutchings, Cardiff University
16:45	***Confinement Protection Effects of Mesoporous Silica, Inspired by Chaperonin Complexes*** Michele M. Lynch, M.-O. Coppens, University College London
17:10	***Invited Lecture Two: Invention to Application, the Role of Basic Science in Industrial Research*** Dr Adeana Bishop, ExxonMobil
17:50	**Poster Session and Networking**
19:30	**Dinner at Jesus College (optional)**

Programme – Thursday 18 September 2014

9:00	***Invited Lecture Three: Chemicals from Waste Bio-Oils*** Prof. David Cole-Hamilton, St Andrews University
9:40	***Highly Active and Recyclable Metal Oxide Catalysts for Prins Condensation of Bio-Renewable Feedstocks*** H. Bayahia, Vincius V. Costa, E.F. Kozhevnikova, E.V. Gusevskaya, I. Kozhevnikov, Liverpool University
10:15	***Cofactor (NADH) Regeneration by Selective Hydrogenation of NAD+ over Heterogeneous Catalysis*** Xiaodong Wang, H.H.P. Yiu, F. Cardenas-Lizana, M.A. Keane, Heriot-Watt University
10.40	***How Accurate are Mercury Porosimetry Pore-Size Distributions for Supported-Metal Catalysts?*** Paul E Dim, S. P. Rigby, Nottingham University
11.05	**Coffee/Tea Break/Poster Session**
11:30	***Multiwalled Carbon Nanotubes (MWCNTs) Catalysed Ozonation: Mechanistic Study and Kinetic Modelling*** Xiaolei Fan, M.F.R. Pereira, M. Chappel, A. Lapkin, Manchester University
11:55	***Expansion of Temporal Analysis of Products (TAP) Pulse Responses for More Accurate Data Analysis*** K. Morgan, A. Goguet, C. Hardacre, E.V. Kondratenko, Colin McManus, S.O. Shekhtman, Queen's University Belfast
12:20	**Closing Remarks**

How Accurate are Mercury Porosimetry Pore-size Distributions for Supported-Metal Catalysts?

Paul E. Dim,[a] Sean P. Rigby,[b]

[a,b] Manufacturing and Process Technology Research Division
Department of Chemical and Environmental Engineering
University of Nottingham, United Kingdom
[c]Corresponding or presenting author:enxpd@nottingham.ac.uk

Abstract

The accurate determination of pore size distributions (PSDs) is critical for understanding the performance of porous, heterogeneous catalysts, such as resistance to coking. Catalysts containing heavy metals, such as nickel, molybdenum, cobalt and copper, are used for heavy oil upgrading. In particular, such catalysts are used in the in-situ combustion, oil recovery method known as Toe-to-Heel Air Injection (THAI) used for extracting bitumen deposits like the Athabasca tar sands. The catalysts are used to obtain upgrading of the heavy oil down-hole, and, thus, improve flow properties and oil quality. However, this application is subject to very heavy coking and a coking-resistant catalyst must be sought. Pore size distributions are a key parameter used to select the optimum catalyst. Given many of the catalysts are macro-porous, mercury porosimetry seems the obvious tool to use to obtain the PSDs for fresh and coked materials. However, mercury porosimetry relies upon mercury being a non-wetting fluid for the material under study, but this may not be the case for catalysts containing heavy metals.

In this work we have used novel characterisation methods, such as mercury thermoporometry, and more sophisticated mercury porosimetry experiments than are conventionally used, to address the issue of potentially unreliable PSDs for the samples of interest to oil upgrading. The more sophisticated porosimetry experiments employ scanning loops techniques and complementary information from computerised x-ray tomography. These techniques have been used to assess the accuracy of the standard mercury porosimetry PSDs for catalysts containing heavy metals. Previous work in this area has relied upon the also potentially unreliable gas sorption PSDs, while the new techniques used here do not suffer the drawbacks of previous approaches. The new methods have been able to assess the degree of error in the PSDs introduced by the chemically heterogeneous surface, with spatially varying wetting properties, that was found in the heavy metal catalysts.

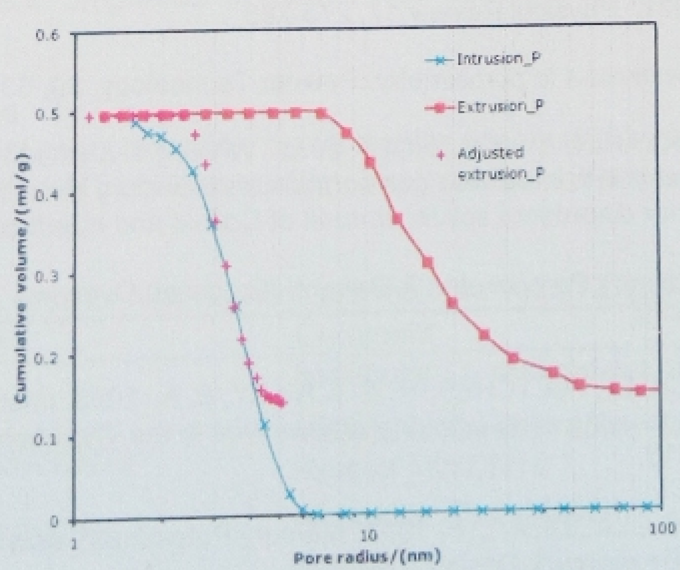

Fig. 5. Mercury porosimetry data for fragmented (P) pellet sample of CoMo analysed using Kloubek (1981) correlation, and adjusted version to remove hysteresis