University of Birmingham

Professor Joe Wood B.Eng, DIS, PhD, CEng, MIChemE, PGCTLHE

Chair in Chemical Reaction Engineering

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About

Professor Joe Wood leads the Catalysis and Reaction Engineering research group in the School of Chemical Engineering.

He has published 40 refereed research articles including journal papers and book chapters, plus over 30 conference papers covering a range of topics in catalysis, catalytic reactor operation and environmental engineering.

He has received major grants from EPSRC and industrial funding from Johnson Matthey, E.ON and Petrobank Energy and Resources Ltd.

Professor Wood carries out research on upgrading of heavy oil, capture of carbon dioxide from industrial sources, catalyst development and testing, reactor design and engineering.

Qualifications

- Postgraduate Certificate in Teaching and Learning in Higher Education, University of Birmingham, 2003
- CEng, MIChemE, Institution of Chemical Engineers, 2002
- PhD in Chemical Engineering, University of Cambridge, 2001
- BEng in Chemical Engineering with Environmental Protection, University of Loughborough, 1995
- Diploma in Industrial Studies, Loughborough University, 1995

Biography

Joe Wood qualified with a BEng degree in Chemical Engineering with Environmental Protection from Loughborough University in 1995. He worked at Albright and Wilson in Whitehaven from 1995-97 as a Graduate Chemical Engineer. He then studied for a PhD at the University of Cambridge, with thesis topic Transport and Reaction in Porous Catalysts under the supervision of Professor Lynn Gladden, which was awarded in 2001. Since 2001 he has worked at the University of Birmingham as Lecturer (2001-2008), Senior Lecturer (2008-2010) and Reader (2010-present).

Professor Wood held a Junior Research Fellowship at Hughes Hall Cambridge from 1998-2000 and an Exxon Mobil Teaching Fellowship from 2004-2007.

Professor Wood's research focuses on the application of catalysis and reactor engineering to solve problems of energy supply, environmental concerns and to deliver chemical products in a more sustainable way.

He teaches on Chemical Engineering programmes in the School, is Examinations Officer and IChemE Liaison Officer.

Teaching

Professor Wood is a member of the core teaching staff of the BEng/MEng degrees in Chemical Engineering and teaches the following modules:

- Process Integration and Unit Operations, Level Intermediate, Year 2
- Reactors and Catalysis, Level Intermediate, Year 2
- Advanced Reaction Systems A and B, Level Masters, Year 4
- System Modelling, Level Masters, Year 4

He also supervises MEng students in the Research and Development Project, Level Masters, Year 4.

Postgraduate supervision

- Upgrading of Heavy Oils
- Enantioselective Hydrogenation in Trickle Bed Reactors
- Catalysis in Supercritical Fluids
- Development of Adsorbents for Carbon Dioxide Capture
- Testing of BioNano Catalysts

- Catalysis for Sustainable Technologies
- Mixed Fuel Reforming
- Upgrading of Biomass Gasification Products
- Modelling of Carbon Capture at Power Plants
- DeNOX Using Monolith Catalysts

The Catalysis and Reaction Engineering group welcome speculative applications from prospective PhD students from home and overseas. For students from the European Union, grants are sometimes available (e.g. EPSRC). Overseas (non-EU) students may apply for funding from their home country or a scholarship. For further details please email Professor Joe Wood (**j.wood@bham.ac.uk (mailto:j.wood@bham.ac.uk)**). For a full list of available Doctoral Research opportunities, please visit our Doctoral Research programme listings.

Research

RESEARCH THEMES

Catalysis and chemical reaction engineering lie at the core of many chemical and biochemical processes. Research activities cover the fundamental catalyst design, through formulation and catalyst manufacture, to operational issues and reactor design.
The group aims to optimize reactor type, design and operating conditions to get the best performance and product selectivity in a particular reaction.
Application areas have recently concentrated on energy, including upgrading of heavy oils and bitumen from the Canadian oilsands, capture of carbon dioxide from power station flue gases and clean production of hydrogen.

RESEARCH ACTIVITY

Current Projects

The Next Generation of Activated Carbon Adsorbents for the Pre-Combustion Capture of Carbon Dioxide. Sponsor, EPSRC. Professor Wood is working with the Universities of Nottingham and UCL together with the Chinese Institute of Coal Chemistry and Tsinghua University, Beijing. The aims of the project are to develop activated carbon adsorbents to capture carbon dioxide from power stations and to model pre-combustion capture plants. This will reduce the amount of carbon dioxide being emitted as a greenhouse gas. Project partners include Doosan Babcock Power Systems, Emerson Process Management and Corus.

Novel Precious Metal Nanocatalyst Made by Biofabrication – Follow on Fund. Sponsor, EPSRC. As part of an ongoing EPSRC project the potential for using bacteria to biomanufacture precious metal catalysts was evaluated, while a sister BBSRC project evaluated the potential for sourcing precious metals from wastes. The purpose of the current project is to facilitate and enable the transition from benchtop demonstration to commercial prototype. Project partners include C-Tech Innovation and Roads to Riches.

Understanding Bio-Induced Selectivity in Nanoparticle Catalyst Manufacture. Sponsor, EPSRC. This project proposes to make highly selective nano-particulate catalysts using a novel method ('biocasting') for a set of defined catalytic reactions and to develop understanding of how to control the catalyst manufacturing process to achieve the desired selectivity which is not readily achieved using chemical manufacturing alone. Controlled growth of metal nanoparticles in various naturally occurring and modified bacteria will be used to produce the required catalysts supported on cell surfaces. Professor Wood is collaborating with Professor Lynne Macaskie in Birmingham, Professor Gary Attard at the University of Cardiff and Johnson Matthey Technology Centre is a project partner.

Step Change Adsorbents and Processes for CO2 Capture. Sponsors EPSRC and E.ON. To overcome the problems associated with current capture technologies, advanced CO2 capture technologies are required. This research project involves the development one such technology. Adsorbents, porous solids that can selectively 'soak up' CO2, have the potential to significantly reduce the energy penalty, by 30 -50%, and subsequent cost of CO2 capture. Specifically amine modified hydrotalcite adsorbents are being developed and tested. Professor Wood is collaborating with the Universities of Nottingham, UCL and Liverpool.

Previous EPSRC Research Projects

- In-Situ Catalytic Upgrading of Heavy Crude and Bitumen: Optimisation of Novel CAPRI Reactor
- C-Cycle
- Heterogeneous Catalysis in Supercritical Fluids: The Enhancement of Catalytic Stability to Coking
- Discipline Hopping Award: Interfacing Novel Reactor Technologies with Molecular Discovery
- Infrared Spectroscopy Applied to the Characterization of Catalysts and Online Analysis of Reactors

Other activities

- Treasurer of the IChemE Catalysis Subject Group
- Member of EPSRC review college
- Invited staff member of the Midlands Energy Group Summer School in Guwahati, India, 2011
- Marker and moderator of the Postgraduate Certificate in Teaching and Learning in Higher Education, Centre for Learning and Academic Development, University of Birmingham, 2007-present

Publications

Wang J., Chigada P.I., Rigby S.P., Al-Duri B. and Wood J. (2009), Prolonging catalyst lifetime in supercritical isomerization of 1-hexene over a platinum/alumina catalyst, Chemical Engineering Science 64: 3427 – 3426.

Mikheenko, I.P., Bennett, J.A., Shannon, I.J., Wood, J., Macaskie, L.E. (2009), Biomineralised palladium is an effective hydrogenation catalyst, Advanced Materials Research 71-73: 725-728.

Bennett, J. A., Fishwick, R. P., Spence, R., Wood, J., Winterbottom, J. M., Jackson, S. D., Stitt, E. H. (2009), Hydrogenation of 2-Pentyne over Pd/Al2O3 Catalysts: Effect of Operating Variables and Solvent Selection, Applied Catalysis A: General 364: 57 – 64.

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Bennett, J. A., Creamer, N. J., Deplanche, K., Macaskie, L.E., Shannon, I., Wood, J. (2010), Palladium Supported on Bacterial Biomass as a Novel Heterogeneous Catalyst: A Comparison of Pd/Alumina and bio-Pd in the Hydrogenation of 2-pentyne, Chemical Engineering Science 65: 282 – 290.

Wood, J., Bodenes, L., Bennett, J.A., Deplanche, K., Macaskie, L.E. (2010), Hydrogenation of 2-Butyne-1,4-diol Using Novel Bio-Palladium Catalysts, Industrial and Engineering Chemistry Research 49: 980 – 988.

Shah, A., Fishwick, R., Wood, J., Leeke, G., Rigby, S., Greaves, M. (2010), A review of novel techniques for heavy oil and bitumen extraction and upgrading, Energy and Environmental Science 3: 700 – 714.

Coker, V.S., Bennett, J.A., Telling, N.D., Henkel, T., Charnock, J.M., van der Laan, G.,. Pattrick, R.A.D, Pearce, C.I., Cutting, R.S., Shannon, I.J., Wood, J., Arenholz, E., Lyon, I.C., Lloyd, J.R. (2010), Microbial Engineering of Nanoheterostructures: Biological Synthesis of a Magnetically Recoverable Palladium Nanocatalyst, ACS Nano 4: 2577–2584.

Chigada, P.I., Wang, J., Al-Duri, B., Wood, J., Rigby, S.P. (2010), Modelling of pore structure evolution during catalyst deactivation and comparison with experiment, Chemical Engineering Science 65: 5550-5558.

Aschenbrenner, O., McGuire, P., Al-Samaq, S., Wang, J., Supasitmongkol, S., Al-Duri, B., Styring, P., Wood, J., (2011), Adsorption of carbon dioxide and nitrogen on hydrotalcite-like compounds of different compositions, Chemical Engineering Research and Design. In Press, available online: doi:10.1016/j.cherd.2010.09.019.

Al-Herz, M.A., Tsoligkas, A.N., Simmons, M.J.H, Wood, J. (2011), Enantioselective hydrogenation of dimethyl itaconate with immobilized rhodium-duphose complex in a recirculating fixed bed reactor, Applied Catalysis A: General. In Press, available online: doi:10.1016/j.apcata.2011.02.009.

Expertise

Catalysis and reaction engineering; upgrading of heavy oil and bitumen; capture of carbon dioxide from power stations; various aspects of industrial catalysis