University of Birmingham

Dr Paul Anderson MA, PhD

Reader in Inorganic and Materials Chemistry

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About

Paul Anderson is a Reader in Inorganic and Materials Chemistry and leader of the Materials Chemistry Research Theme in the School of Chemistry.

Paul has published close to 100 research papers in scientific journals as well as reviews, book chapters and patents in the fields of porous framework materials, nanowires and nanoparticles, and hydrogen storage materials. He has received major research grants from the Royal Society, the Engineering and Physical Sciences Research Council, the European Union and Advantage West Midlands.

He is an enthusiastic communicator on the themes of zeolite host–guest chemistry and the chemistry of solid state hydrogen storage, and has given invited talks across the UK and worldwide. Paul has been a regular advisor to the US Department of Energy Hydrogen Program and is a founding member of the interdisciplinary RCUK Doctoral Training Centre in Hydrogen, Fuel Cells and their Applications based in Birmingham.

Personal web page (http://chemweb.bham.ac.uk/~anderspa/index.htm) s (http://chemweb.bham.ac.uk/~anderspa)

Biography

Paul Anderson qualified with a BA (Hons) in Natural Sciences from the University of Cambridge in 1987. He went on to study for a PhD in Chemistry before joining the Department of Organic, Inorganic and Theoretical Chemistry at Cambridge as a post-doctoral research fellow in 1990.

In 1993 he was awarded prestigious Ramsay Memorial and Royal Society University Research Fellowships, taking up the latter in the School of Chemistry at the University of Birmingham, becoming Lecturer in 2001, Senior Lecturer in 2006 and Reader in 2009.

Paul's contribution to zeolite science was recognized in 1996 through the award of the Royal Society of Chemistry / Society of Chemical Industry / British Zeolite Association triennial Barrer Award for the most meritorious work, pure or applied, in the field of molecular sieve zeolites.

Paul was a member of the committee of the British Zeolite Association from 2002–6, of the Royal Society of Chemistry Solid State Group from 2006–9, and serves on the Midlands Energy Graduate School Management Committee. He is currently a member of the EPSRC college, a regular participant in US Department of Energy (DOE) Hydrogen Funding Panels and was recently invited to participate in DOE's 2011 Hydrogen and Fuel Cells Program, Vehicle Technologies Program Annual Merit Review.

Paul has a longstanding interest in the popularization of science and devised practicals illustrating the potential of hydrogen as a green fuel, which he has demonstrated in local secondary schools and both as part of the University's A2B (Access to Birmingham) residential courses, and in collaboration with external agencies such as The Salters' Institute and Villiers Park Educational Trust. In 2007 he was invited to give a Frontiers in Science Lecture at the Association for Science Education Annual Conference.

Teaching

Teaching Programmes

- BSc/MSci Chemistry
- BSc/MSci Chemistry with Analytical Science
- BSc/MSci Chemistry with Bioorganic Chemistry
- BSc/MSci Chemistry with Business Management
- BSc/MSci Chemistry with Environmental Science
- MSci Chemistry with Industrial Experience
- BSc/MSci Chemistry with a Modern Language
- BSc/MSci Chemistry with Pharmacology
- BSc/MSci Chemistry with Psychology
- BSc/MSci Chemistry with Study Abroad

Postgraduate supervision

Paul is supervising doctoral research students in the following areas:

- the synthesis of new potential hydrogen storage materials, for use either in safe hydrogen delivery systems or reversible hydrogen stores (projects in this area available within the School of Chemistry, or as part of the interdisciplinary RCUK Doctoral training Centre in Hydrogen, Fuel Cells and their Applications);
- the use of porous frameworks as templates for the design of new materials that may exhibit negative thermal expansion, the ability to capture and store gases (H_2, NH_3, CO_2), or act as precursors for the production of high quality metal and semiconducting nanowires;

- the synthesis and properties of inorganic electrides and alkalide anions in zeolites.

If you are interesting in studying any of these subject areas please contact Paul on the contact details above, or for any general doctoral research enquiries, please email: **dr@contacts.bham.ac.uk (mailto:dr@contacts.bham.ac.uk)** | or call +44 (0)121 414 5005.

For a full list of available Doctoral Research opportunities, please visit our **Doctoral Research programme listings (http://www.bham.findaphd.com/?es=y&apl=y&aplt=&show)** .

Research

RESEARCH THEMES

Advanced Hydrogen Storage and Delivery Materials, Chemical Production of Metal Nanowires and Nanoparticles, Inorganic Electrides and Alkalide Anions in Zeolites, Host–Guest Chemistry of Framework Materials, Nanostructured Materials

RESEARCH ACTIVITY

Hydrogen Storage Chemistry Group (HSCG)

The HSCG has an extensive ongoing programme, dedicated to the discovery, synthesis and primary characterization of new potential hydrogen storage materials, for use either in safe hydrogen delivery systems or reversible hydrogen stores. In the last six years, the group has synthesized over two dozen new complex hydrides, contributing substantially to a rapid growth in the number of such compounds considered as candidate hydrogen storage materials.

The group maintains a strong focus on achieving a better understanding of fundamental aspects of the interaction of hydrogen with solids, and of the chemistry of hydrogen desorption and reabsorption. Examples of approaches employed include: the modification of the decomposition pathway of lithium amide in favour of hydrogen rather than ammonia, through the substitution of borohydride anions for one quarter of the amide anions to produce the first example of a new class of amide–borohydride compounds; and.the chemical activation of magnesium hydride to achieve fast absorption–desorption kinetics, without recourse either to mechanical milling or the addition of a precious metal catalyst.

Current work is focused on enhancing the ionic conductivity of lithium containing complex hydrides as an alternative or complementary approach to precious metal catalysis in improving absorption–desorption kinetics, on new ultra-high hydrogen capacity complex hydrides, and also on attempts to improve the binding strength of molecular hydrogen in porous framework materials to achieve usable hydrogen storage capacities at or near room temperature. The group is an active partner in the AWM Science City Hydrogen Energy Project and the EPSRC-funded UK Sustainable Hydrogen Energy Consortium (UKSHEC 2).

Host–Guest Chemistry in Framework Materials

The second major strand in Paul's research for many years has been the chemical manipulation of the nanoscale pore space of porous crystalline materials. Zeolites and related framework structures may be used as both precursors and templates in the synthesis of materials with controlled morphologies at the nanoscale and sub-nanoscale level.

Performing a 'molecular scaffolding' function, they facilitate the assembly of advanced materials with finely tuned electronic, magnetic and optical properties. Examples include atomically fine chains of metal atoms (atomic wires), ordered arrays of interacting metal or semiconductor clusters (cluster crystals), and the first zeolite-based material to show evidence of metallic conductivity. Other host–guest materials are of interest on account of negative and zero thermal expansion behaviour and the ability to capture and store gases such as H_2, NH_3 and CO_2.

Paul has also demonstrated the use of zeolites as precursor materials for the growth of high quality single-crystal metal and semiconducting nanowires, encapsulated nanoparticles, and as hosts for inorganic electrides and rare alkalide anions. Current work is focussed on the develoment of light hybrid organic–inorganic frameworks with zeolite-like ion exchange properties, suitable for host–guest chemistry

Publications

Anderson, P.A., Chater, P.A., Hewett, D.R. and Slater, P.R. (2011) Hydrogen Storage and Ionic Mobility in Amide–Halide Systems., **Faraday Discussions**, 151/15.

Mayoral, A., Sakamoto, Y. and Anderson, P.A. (2010) Synthesis of Copper Chloride Nanowires by Thermal Treatment in the Presence of Zeolite X., **CrystEngComm**, 12:3012–3018.

Anderson, P.A., Chater, P.A., David, W.I.F., Evans, I.C. and Kersting, A.L. (2009) New B,N-hydrides: Characterization and Chemistry., **Materials Research Society Symposium Proceedings**, 1219:W09-05.

Reinhold, C.J., Anderson, P.A., Edwards P.P., Terskikh, V.V., Ratcliffe, C.I. and Ripmeester J.A. (2008) ESR Studies of Cesium-Loaded LiX and LiA Zeolites., **Journal of Physical Chemistry C**, 112: 17796–17803.

Anderson, P.A. (2008), "Storage of Hydrogen in Zeolites"., In: Walker, G. (ed.) Solid-State Hydrogen Storage—Materials and Chemistry. Cambridge: Woodhead, pp. 223–260.

Chater, P.A., David, W.I.F. and Anderson, P.A. (2007) Synthesis and Structure of the New Complex Hydride $Li_2BH_4NH_2$., **Chemical Communications**:4770–4772.

Chater, P.A., Anderson, P.A., Prendergast, J.W., Walton, A., Mann, V.S.J., Book, D., David, W.I.F., Johnson S.R. and Edwards P.P. (2007) Synthesis and Characterization of Amide Borohydrides: New Complex Light Hydrides for Potential Hydrogen Storage., **Journal of Alloys and Compounds**, 446–447:350–354.

Ramirez-Cuesta, A.J., Mitchell, P.C.H., Ross, D.K., Georgiev, P.A., Anderson, P.A., Langmi, H.W.L and Book, D.(2007) Dihydrogen in Cation-Substituted zeolites X—An Inelastic Neutron Scattering Study., **Journal of Materials Chemistry**, 17: 2533–2539.

Mayoral, A. and Anderson, P.A. (2007) Production of Bimetallic Nanowires through Electron Beam Irradiation of Copper- and Silver-Containing Zeolite A.,**Nanotechnology**, 18, art. no: 165708.

Readman, J.E., Gameson, I., Hriljac, J.A. and Anderson, P.A. (2007) Cationic Zinc–Cadmium Alloy Clusters in Zeolite A., **Microporous and Mesoporous Materials** 104: 83–88