# "New Inorganic Materials from Solution Chemistry: Understanding Crystallisation and Reactivity"

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The discovery of new functional materials for various applications in energy and environmental fields requires exploration of a wide range of chemical reaction conditions and also an understanding of crystallisation pathways to allow some prediction in synthesis. We have been exploring solvothermal chemistry for the preparation of a wide variety of materials, from porous framework solids to ceramic oxides. We use *in situ* X-ray synchrotron methods at the UK's Diamond Light Source to follow crystallisation and understand materials' reactivity. I will describe some recent examples of our work, including (1) new metal organic frameworks, including some rare-earth materials whose crystallisation we have followed in laboratory-scale reactors using high energy X-rays to allow fine detail of the kinetics and structural evolution, (2) the solvothermal formation of nanocrystalline spinel photocatalysts based on gallium oxide where *in situ* XRD shows the unexpected formation of transient layered hydroxides, and (3) the crystallisation of iridium oxide pyrochlores that have use as acid-resilient electrocatalysts for water splitting and where *in situ* XAFS allows us to examine the mechanism of catalysis by following changes in metal oxidation state under realistic conditions on applied potential in a electrochemical cell.

"Exchange of Coordinated Solvent During Crystallisation of a Metal-Organic Framework Observed by *In Situ* High Energy X-ray Diffraction" Y. Wu, M.I. Breeze, G.J. Clarkson, F. Millange, D. O'Hare and **R.I. Walton**, *Angew. Chem. Int. Ed.* **55** (2016) 4992–4996.

"Controlling the Crystallisation of Oxide Materials by Solvothermal Chemistry: Tuning Composition, Substitution and Morphology of Functional Solids" C.I. Hiley, and **R.I. Walton**, *CrystEngCommun* **18** (2016) 7656-7670.

"Time-Resolved Powder X-ray Diffraction of the Solvothermal Crystallisation of Cobalt Gallate Spinel Photocatalyst Reveals Transient Layered Double Hydroxides" D.S. Cook, Y. Wu, K. Lienau, R. Moré, R.J. Kashtiban, O.V. Magdysyuk, G.R. Patzke and **R.I. Walton**, *Chem. Mater.* **29** (2017) 5053−5057.

Richard Walton was educated at the University of Oxford (BA 1994) and the University of Reading (PhD 1997) and undertook postdoctoral work in the Inorganic Chemistry Laboratory, Oxford with Dermot O'Hare working on *in situ* methods for following crystallisation. Following a Lecturer position at the University of Exeter (2000-2005) he was appointed at the University of Warwick as Senior Lecturer in 2006 and promoted to full Professor of Chemistry in 2011. His research focusses on the synthesis and characterisation (particularly using synchrotron X-rays and neutron scattering) of a range of inorganic materials, including tranistion-metal oxides, zeolites and MOFs. His work involves several industrial collaboration to examine applications in areas such as heterogeneous catalysis and electrochemistry. He is co-editor (with Bruce and O'Hare) of the *Inorganic Materials Series*, published previously by Wiley and currently the Royal Society of Chemistry, he recently held a CNPq visiting researcher position at USP Ribeirão Preto, and is the holder of a Royal Society Industry Fellowship working with Johnson Matthey plc for 4 years to explore scale-up and new applications the materials produced in Warwick.