

## **Professor Chris Breen**

### **Professor of Materials Chemistry**

### **Head of the Polymers, Nanocomposites and Modelling Research Centre**

The Polymers, Nanocomposites and Modelling Research Centre is involved in the study of advanced polymeric systems, the application of computer simulation and mathematical modelling to materials challenges, and addresses the efficiency of energy conversion devices.



The main areas of emphasis are

- exfoliated clay-based polymeric nanocomposites, which offer enhanced mechanical, barrier and fire retardant properties to polymeric systems for use in structural, packaging and coating applications
- the application of vibrational spectroscopy to the study of controlled release from polymer matrices, polymer formation, gelation and degradation, mapping and imaging of polymer formulations, chemometric data analysis of spectra
- computer simulation and mathematical modelling of a range of materials, including state-of-the-art lattice Boltzmann computational fluid dynamics techniques for describing fluid flow and fluid-structure interaction behaviour
- modelling the energy efficiency of devices and systems which convert energy from one form to another
- applying engineering analysis and modelling techniques to support fundamental research, product development and minimising the carbon and financial cost

## **Biography**

Chris obtained his degree in chemistry and PhD at the University of Wales, Aberystwyth, in 1973 and 1980, respectively. He held the post of staff demonstrator in Physical Chemistry at the University of Exeter from 1979 to 1981 when he moved to a lectureship in Physical Chemistry at Dublin City University. Chris stayed in Dublin for six years before returning to the United Kingdom to take up a Senior Lectureship at Sheffield City Polytechnic in 1987.

Chris joined the Materials and Engineering Research Institute in 1992, was promoted to Principal Lecturer in 1999 and took up a personal Chair in 2002. He was appointed Head of Research Centre in 2004 and is currently responsible for the Polymers, Nanocomposites and Modelling Research Centre.

Professor Breen, a Fellow of the Mineralogical Society, has been an Associate Editor of Clay Minerals since 1995. He chaired the Clay Minerals Group of the Mineralogical Society (2004-2007) and in 2009 was elected as President of AIPEA, the International Association of Clay Groups ([www.aipea.net](http://www.aipea.net)), a post which he will hold until 2013.

Chris has been married to his wife, Catherine, for thirty years and has four strapping sons. When he is not devoting his time to materials research he likes to make things out of wood – much to the amusement of his family.

## **Current research interests**

Professor Breen is also leader of the Polymers, Composites and Spectroscopy (PCAS) Research Group. In addition to the work on nanocomposites and stimuli responsive polymers, this group also offers expertise in the application of vibrational spectroscopy to the study of controlled release from polymer matrices, polymer formation, gelation and degradation, to map and image polymer formulations. Chemometric data analysis of the spectral data is often used to enhance the information available. The Group also has considerable expertise in thermoanalytical methods with a particular interest in TG, DSC and evolved gas analysis using mass spectrometry.

Professor Breen has worked on clay-organic complexes for 30 years and has recently transferred this expertise into the production, characterisation and use of clay-based polymer nanocomposites. These materials offer significant changes in mechanical, barrier and fire resistant properties and the PCAS group has funding from a number of sources (including EPSRC, the European Union and industry) to investigate these systems for the automotive, construction and packaging sectors.

## **Research collaborations**

In addition to projects with UK-based industry, Professor Breen is currently engaged in a number of collaborative EU projects involving a significant number of universities, research institutes and industrial interests, including:

**NEWGENPAK** - New Generation of Functional Cellulose Fibre Based Packaging Materials for Sustainability. Marie Curie Initial Training Network. October 2011 to September 2015

**COST Action FP1003:** Impact of Renewable Materials in Packaging. December 2010 to November 2014

**POLYFIRE:** Upscaling Fire-Resistant Nano-Filled Thermosetting Polyester Resin. September 2009 to August 2012

**FLEXPARENEW:** Development of an innovative ecoefficient low-substrate flexible paper packaging from renewable resources. September 2008 to August 2011.

## **Recent publications**

FTIR-ATR Studies of the Sorption and Diffusion of Water/Acetone Mixtures in Poly(vinyl alcohol). L-M. Doeppers, C. Sammon, C. Breen and J. Yarwood. *Polymer*, 2006, 27, 2714-2722.

Bulk Mineralogical Characterisation of Reservoir Rocks and Sandstones using Diffuse Reflectance Infrared Fourier Transform Spectroscopy and Partial Least Squares Analysis. C. Breen, F. Clegg, M.M. Herron, G.P. G Hild, S. Hillier, T.L. Hughes, T.G.J. Jones, A. Matteson and J. Yarwood. *Journal of Petroleum Science and Engineering*, 2008, 60, 1-17.

Barrier material and method for making same. C. Andersson, L. Jarnstrom and C. Breen. PCT/SE2009/051469.

Steel component with intumescent coatings. C. Breen and S. Thompson, GB2448514. Granted 17 November 2010.

A new nano-TiO<sub>2</sub> immobilized biodegradable polymer with self-cleaning properties. M. Sokmen, I. Tatlidil, C. Breen, F.C. Clegg, C.K. Buruk, T. Sivlim, and S. Akkan. *Journal of Hazardous Materials*, 2011, 187, 199-205.