# Microstructure and Properties of Solid Oxide Fuel Cell Materials

## Abstract

Solid Oxide Fuel Cells (SOFCs) have high efficiencies for converting fuels, such as hydrogen or natural gas, to electricity. They are particularly attractive when used in combined heat and power systems in domestic, or large building, distributed generation networks. SOFC systems are now available on a limited early commercial basis, but for widespread use improvements are still needed regarding reliability, durability and cost. In the UK relevant university research is organised within a structure guided by industry called the Hydrogen and Fuel Cells Supergen Consortium. In the European Union, Industry and the European Commission are sponsoring development through a partnership called the Fuel Cells and Hydrogen Joint Undertaking (FCH-JU).

In this lecture I will describe three particular examples from my personal current research on SOFC materials that have the common theme of linking microstructure to key material properties. These have benefitted from recent advances in 3D microstructure visualisation and high resolution chemical analysis. The first concerns the relationship between the microstructure and mechanical properties of porous thin film ceramic cathodes. The second concerns the prediction of microstructure and property evolution due to coarsening processes in a porous Ni/stabilised zirconia SOFC anode. The third concerns how transition metal dopants or impurities influence the sintering and electrical properties of a doped ceria SOFC electrolyte.