2008-2009

Graduate Seminar Series

The Department of Mechanical Engineering – Engineering Mechanics

Proudly Presents

Professor Nigel Sammes

Colorado School of Mines

Received my PhD from Imperial College, London University, UK, in 1987 and my MBA in 2000. I worked at ICI Chemicals and Polymers, as a Senior Research Scientist, investigating new materials for use in electrochemical applications. While serving as a Professor and Department Head at the University of Waikato in Hamilton, New Zealand, I founded their Materials and Process Engineering Department and formed a solid oxide fuel cells research group. In 2000, as the Director of Fuel Cell Development, at Acumentrics in Massachusetts, I set up the solid oxide fuel cell commercialization program. In 2002, I became the UTC Chair Professor in Fuel Cell Technology, Professor of Mechanical Engineering, and director of the Connecticut Global Fuel Cell Center at the University of Connecticut. My current position as H.F. Coors Distinguished Professor in Ceramic Engineering at the Colorado School of Mines, Department of Metallurgical and Materials Engineering began in 2007.

I am a Fellow of the Institute of Materials, Minerals and Mining (UK), and a Chartered Engineer. I have chaired the ASME Fuel Cell Conference series. I serve on the editorial board for the Journal of Power Sources, Fuel Cells: From Fundamentals to Systems and the International Journal of Hydrogen Energy. I am the Editor-in-chief of the ASME Journal of Fuel Cell Science and Technology. I published over 200 papers, patents and book chapters, and am the author of a textbook on Ionic Materials.

I enjoy long distance running and watching my soccer team in the UK Premier Division.

Thursday, Dec. 4, 2008 3:00 – 4:00 p.m. Room 112, ME-EM Bldg.

Why Micro-Tubular Solid Oxide Fuel Cells?

Solid oxide fuel cells (SOFC) have been considered as an alternative source of energy due to their high electrical conversion efficiency, superior environmental performance, and fuel flexibility. In comparison to conventional tubular-SOFC's, micro tubular (MT-SOFC) SOFC's have many advantages such as high resistance to thermal shock, higher volumetric power densities, and relative ease of fabrication and stacking. In this paper, I shall discuss the route to fabrication, the properties (electrochemical and mechanical) and finally the reasons for choosing intermediate temperature MT-SOFC's for certain applications. The MT-SOFC examined in this work consisted of a NiO and $Gd_{0.2}Ce_{0.8}O_{2-x}$ (GDC) cermet anode support, thin GDC electrolyte, and a $La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_{3-y}$ (LSCF) and GDC cermet cathode. The methodology for fabricating, via extrusion of the anode, the MT-SOFC will be examined, and the techniques for scale-up will be discussed. Individual 0.8 mm diameter, 1.2 cm length MT- SOFCs were, thus, obtained for the intermediate temperature range of 450~550°C. The electrochemical information (EIS and electrochemical performance) gained at cell operating temperatures of 450, 500, and 550°C yielded power density losses of 0.8, 2.0, and 4.6% respectively. Within the operating temperature range of 450~550°C, the cells were found to have power densities ranging between 350~1050 mW cm^{-2}. The data for the single cells (short term data, long term data, and cycling) will be discussed in relation to the materials. Some preliminary data on small stacks will also be examined. For the mechanical testing of the cell, an in-house designed burst testing method, using pressurized water was applied, in parallel to other techniques to give data that can allow the fabrication to be optimized.

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