MECHANICAL ENGINEERING—ENGINEERING MECHANICS

Graduate Seminar Speaker Series

Proudly Presents:

Dr. J. G. Pharoah

Professor of Mechanical Engineering and Director

Queen's—RMC Fuel Cel Research Centre

Queen's University

J. G. Pharoah is a professor of Mechanical Engineering and Director of the Queen's—RMC fuel cell research centre, which he co-founded. Dr. Pharoah obtained his M. A. Sc and Ph D degrees in Mechanical Engineering from the University of Victoria's Institute for Integrated Energy Systems and has been working with energy systems, with an emphasis on fuel cells, for more than a decade. Dr. Pharoah has been invited to spend some time at the Norwegian Academy of Sciences and has given invited and keynote lectures at many international conferences, universities, and companies. He regularly sits on the scientific committees of international conferences and works actively with several leading fuel cell developers to help overcome the challenges necessary for the large scale commercial success of fuel cells in clean energy systems.

Thursday, February 26, 2015

4:00 pm — 103 EERC

Multi-Scale Modelling Tools for Fuel Cell Development

Fuel cells inherently involve phenomena occurring over a wide range of length scales, from the molecular scale on electro-catalyst surfaces through various scales of porous media including catalyst layers, microporous layers porous transport layers, to gas supply channels within a cell and finally to the manifolds at the stack scale. In total, length scales spanning about 10 orders of magnitude are of interest to the fuel cell developer.

This talk will discuss the various tools developed to represent phenomena occurring from the catalyst scale to the stack scale and methods for coupling information from the various scales. These tools include the ability to model arbitrary porous materials comprising multiple solid phases and to model transport phenomena and electrochemical reactions in these materials using both virtual porous media and experimentally determined geometries. At the next scale, full cell models are developed and are capable of modelling both beginning of life performance and selected degradation mechanisms. Finally, at the largest scale entire stack simulations are carried out and can be used to explore temperature distributions within a stack as well as stack manifold design. The talk will highlight and present the open source software developed for these analysie and discuss the application of the tools to the design of superior fuel cells.