

Nimal Rajapakse “Research in Mechanics of Materials for Energy Related Applications”

Advanced materials are extensively used in energy applications including energy production, storage and distribution. This presentation reviews selected research in mechanics of advanced materials as applied to energy. We first look at flaws in zirconium alloy pressure tubes which are used in the core of nuclear reactors. A key structural integrity concern with in-service blunt flaws in pressure tubes is their susceptibility to a phenomenon known as Delayed Hydride Cracking (DHC) initiation. Extensive research carried over the past several decades have resulted in refined approaches for DHC assessment based on a "process-zone model" to simulate the hydride region ahead of a flaw tip. In this study, an analytical process-zone model is presented based on a deformation fracture criterion to improve the efficiency of modelling. Next, we examine the diffusion of hydrogen in zirconium using atomistic modelling. The objective is to get insight into the formation of denuded zones near the surface of zirconium pressure tubes in nuclear reactors. The presentation thereafter focuses on piezoelectric stack actuators used in advanced fuel injectors including hydrogen fuel technology. The interaction between hydrogen and piezoelectric materials is a topic that is still in its infancy. We propose to examine this topic through first principle calculations to provide an insight into the interaction. Finally, we look at the interaction between graphene and hydrogen to assess the mechanical behaviour of graphene with hydrogen adatoms for applications related to energy storage.



Dr. Nimal Rajapakse is currently a Professor in the School of Engineering Science at Simon Fraser University (SFU), Greater Vancouver, Canada. He was the Head of the Department of Civil Engineering at the University of Manitoba from 1997 to 2000. He joined the University of British Columbia as Head of the Department of Mechanical Engineering in 2000 and served in that capacity until 2007. He was the Director of the Institute for Computing, Information and Cognitive Systems at UBC from 2007-2009. He served as the Dean of the Faculty of Applied Sciences at SFU from 2009 to 2015. He was Vice-President (Research and International) of Carleton University from September 2015 to October 2016. Dr. Rajapakse's research interests are in Applied Mechanics, with emphasis on the computational mechanics and coupled-field problems of advanced materials. He has served on the editorial boards of six international journals and has research collaborations with universities in Brazil, China, Germany, India, Sri Lanka and Thailand. He is a Fellow of the Canadian Academy of Engineering and a Fellow of the Engineering Institute of Canada. Dr. Rajapakse is a recipient of the Horst Leipholtz Medal of the Canadian Society for Civil Engineering, in recognition of outstanding research in Engineering Mechanics.

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