Department of Engineering Physics
UNIVERSITY OF WISCONSIN–MADISON

Department of Materials Science and Engineering
UNIVERSITY OF WISCONSIN–MADISON

Presents:

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Materials Research and Development for the Harsh Environments of Nuclear Energy Systems

Abstract: Materials in nuclear energy systems experience extreme environments of high temperatures, corrosion, irradiation, and stresses that often act synergistically, and for long periods of time. Understanding the fundamental mechanisms of materials degradation in these environments is crucial to predicting the long-term in-service performance of components, and for developing materials with superior properties through appropriate compositional modifications and micro/nano-structural control. The accelerated materials research towards the development of accident tolerant fuel (ATF) for LWRs in the wake of the 2011 Fukushima-Daichii accident and the increasing materials' performance demands of the Generation IV Advanced Reactor Technologies (ART) are spurring innovations in materials and manufacturing processes. The Department of Energy's (DOE) Gateway to Innovation in Nuclear (GAIN) program formed in reaction to these needs is further incentivizing these developments. In all these areas UW-Madison has been at the fore-front of materials research and development. The talk will cover our research on corrosion in Gen IV reactor-relevant environments with emphasis on the molten salt reactor which is receiving considerable attention from DOE and the private sector. Examples will be provided of irradiation studies of materials systems that "self-heal" under radiation. I will then discuss the development of the cold spray powder-based coating process for improving the accident tolerance of Zr-alloy fuel cladding in LWRs, that is being performed in collaboration with Westinghouse Electric Company. The process has become an integral part of Westinghouse's EnCore® ATF program with coated lead test rods (LTR) scheduled to be introduced in a reactor in early 2019. Three international patents have been filed for this work. Finally, I will highlight the work on developing the cold spray process as a solid-state additive manufacturing process for making radiation damage resistant nanostructured oxide dispersion strengthened (ODS) steel fuel cladding tubes in a rapid and cost-effective manner.

Biography: Dr. Kumar Sridharan's expertise spans a broad spectrum of areas in materials science, including nuclear reactor materials, corrosion, physical metallurgy, surface modification and coatings processes, ion implantation, plasma-based synthesis and deposition of materials, characterization and testing of materials, interfaces of materials and manufacturing, and industrial applications. He has over 250 publications in these areas including eight invited book chapters, journal articles, reviewed conference proceedings, published abstracts, and industry/national laboratory reports. Dr. Sridharan has provided research mentorship to over 100 graduate and undergraduate students, and post-doctoral research associates. He serves on the editorial committee of the journal, Advanced Materials & Processes which specializes in reports on cutting-edge, applications-driven materials research and associated manufacturing processes. In 2008, Dr. Sridharan was elected Fellow of American Society for Materials for distinguished contributions in the field of materials science & engineering, and in 2013 he received the University of Wisconsin, Madison's Chancellor's Award for Excellence in Research. In 2015, he was inducted as Fellow of Institute of Materials, Minerals, and Mining, United Kingdom, in recognition of his contributions to materials science and applications, and education. In 2016, he received the Faculty Recognition Award given for enriching and inspiring collegiate experience of undergraduate students by Leaders in Engineering Excellence and Diversity in the University of Wisconsin, Madison's College of Engineering.

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