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Development and advanced manufacturing of materials for extreme environments

Abstract

There are critical societal needs to have clean energy, improve energy efficiency, and enhance the safety and reliability of energy systems. Nuclear energy is an important form of clean energy and plays a notable role in decarbonizing the economy and combating the climate change. Materials used in nuclear reactors are subjected to severe damages by the extremely harsh environments, including intense irradiation, high temperature, high mechanical stress, and corrosive atmosphere. Life extension of current nuclear reactors and development of next-generation nuclear reactors require advanced manufacturing of more robust materials with enhanced properties and performance. There are two approaches to enhancing irradiation resistance: 1) engineering microstructure of existing materials, and 2) developing new materials with new compositions. These eventually need to be enabled by advanced manufacturing. In this seminar, research projects will be discussed involving advanced manufacturing of nanostructured steels with enhanced mechanical properties and irradiation resistance, as well as of novel high-entropy alloys. The manufactured materials were assessed for mechanical properties, high temperature stability and irradiation performance. Additive manufacturing of silicon carbide and its composites will also be showcased.

Bio

Dr. Haiming Wen is an Associate Professor and Associate Chair for Research and Graduate Programs in Department of Materials Science and Engineering, with a courtesy appointment in Department of Nuclear Engineering and Radiation Science at Missouri University of Science and Technology (Missouri S&T). He obtained his PhD from University of California – Davis in 2012, and subsequently held postdoctoral appointments at Northwestern University and Idaho National Laboratory. Prior to joining Missouri S&T, he was a Research Assistant Professor at Idaho State University and a staff scientist at Idaho National Laboratory. Dr. Wen has extensive experience in development and advanced manufacturing of materials, especially those for extreme environments including nuclear and aerospace. He has been leading multiple research projects funded by Department of Energy, National Science Foundation, and Nuclear Regulatory Commission. Dr. Wen has authored or coauthored 95 peer-reviewed journal publications, with citations ~4,900 and an h-index of 29. He serves on the Editorial Board of the journal *Materials Science and Engineering A*, and has served as the lead guest-editor of special issues in *Journal of Metals* and *AIMS Materials Science*. He was named CEC Dean's Scholar, and received an Outstanding Teaching Award from Missouri S&T in Dec. 2022. He also received a Faculty Research Award from Missouri S&T in Dec. 2023.