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Designing Durable Metals Resistant to Simultaneous Chemical and Mechanical Attack

Dr. Wenjun (Rebecca) Cai
Assistant Professor, Materials Science and Engineering
Virginia Tech

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Zoom Link here

ABSTRACT The increasing complexity and severity of service conditions in areas such as aerospace and marine industries, nuclear systems, microelectronics, batteries, and biomedical devices etc., imposes great challenges on the reliable performance of metal subjected to simultaneous surface stress and corrosion. However, the design of strong and corrosion-resistant alloys, especially those containing lightweight elements such as Al are challenged by the tradeoff between strength and corrosion resistance. Solute tends to have a small equilibrium solubility limit in Al due to the relatively large negative enthalpy of mixing with Al. As a result, the formed precipitates strengthen the alloys, but compromises corrosion resistance due to their micro-galvanic coupling with the metal matrix. Towards this end, this talk will focus on the development of novel microstructure design strategies for metals to mitigate the combined attack of wear and corrosion (i.e. tribocorrosion) under harsh conditions. Two design strategies will be discussed to overcome this long-standing dilemma: by forming solid solution alloys and nanostructured multilayers. These studies provide insights for general design guidelines to engineer more robust, high-performance metals for use under harsh conditions.

BIO Dr. Wenjun (Rebecca) Cai is an Assistant Professor in the Department of Materials Science and Engineering (MSE) at Virginia Tech. Prior to joining VT in Aug 2018, Dr. Cai was a faculty member of the Mechanical Engineering department at the University of South Florida (2012-2018). Her current research focuses on understanding the processing-structure-property relationships of metals and coatings under extreme conditions (e.g., corrosion and tribocorrosion) using experiments, analytical theory, and computer simulations. She received her BS from Fudan University in 2005 and her Ph.D. from UIUC in 2010, both in Materials Science and Engineering. She was a postdoc research associate at MIT from 2010-2012. She received the Racheff-Intel award for outstanding graduate research at UIUC in 2010, the National Science Foundation CAREER award in 2015, outstanding faculty award from USF in 2016, and the TMS young leaders professional development award in 2017.

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