METALLURGICAL & MATERIALS ENGINEERING
COLORADO SCHOOL OF MINES

UNDERSTANDING STRESS CORROSION CRACKING (SCC) IN NUCLEAR REACTOR COMPONENTS THROUGH ANALYTICAL MICROSCOPY

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ABSTRACT

The fundamental basis for mechanistic understanding and modeling of stress corrosion cracking (SCC) remains in question for many nuclear reactor systems. Specific mechanisms controlling the initiation and growth of SCC can vary with changes in alloy characteristics, applied/residual stress or environmental conditions. The local crack electrochemistry, crack-tip mechanics and material metallurgy are the main factors controlling crack growth. While these localized properties are difficult or impossible to measure in active cracks, it is essential to quantitatively examine these microstructures as well as crack-tip conditions if mechanistic understanding is to be obtained. A wide variety of methods for imaging and analyses at resolutions down to the atomic level can be used to examine the crack and corrosion film characteristics, including high resolution scanning electron microscopy (SEM), transmission electron microscopy (TEM), and atom probe tomography (APT). Our research highlights a complementary approach at tackling this complex material science problem through these techniques. A general overview of the structural nuclear materials research program at PNNL will be presented, with specific examples of how unique corrosion mechanisms in Fe and Ni-based stainless steels are better understood. Our research interests span from examining how SCC initiates in commercial alloys to basic energy science in tackling how individual alloy elements affect the corrosion of Ni; all to better determine degradation mechanisms of stainless steels in reactors.

ABOUT THE SPEAKER

Dr. Olszta is a great example of how one's career path shouldn't feel limited based on a single discipline. His career models the flexibility one can have in the field of materials science, while at the same time cultivating a deep understanding in microscopy principles. As an undergrad at the University of Illinois he studied materials science with an emphasis in polymers. Subsequently, he received his masters and Ph.D. at the University of Florida in materials science while doing research on biomimetic mineralization of collagen. After finishing his graduate studies, he worked as a postdoc at Pennsylvania State University where he used analytical electron microscopy to understand microstructures and performance of electrolytic capacitors. Using the microscopy knowledge obtained as a postdoc, he was hired to do TEM/STEM at Pacific Northwest National Laboratory (PNNL) with an emphasis on understanding corrosion mechanisms in Fe and Ni-based stainless steels for the nuclear industry. At PNNL, he currently performing high resolution electron microscopy on a variety of materials, simultaneously developing teaching tools to better assist graduate students and postdocs to understand that microscopy isn't a tool but a science.