

Nuclear Engineering Seminar

Greg Sinclair

Ph.D. Candidate

Purdue Nuclear Engineering

Faculty Advisor: Dr. Ahmed Hassanein

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Quest for high-performance materials in future nuclear fusion reactors

Abstract

Unlimited energy, forever. That is the promise of nuclear fusion. Getting there is one of the most important challenges we face as a society in the 21st century. Part of developing commercially viable fusion energy is finding suitable materials that can withstand the harsh radiation environment present in the reactor. Tungsten is currently the leading candidate material for future plasma facing components. Comprehensive material testing has been conducted on different tungsten materials using state-of-the-art experimental facilities in the Center for Materials Under Extreme Environment (CMUXE). Exposing tungsten to multiple sources of radiation simultaneously allows for reliable predictions on material performance in a fusion environment. Contrary to current expectations, recent findings indicate that ion-induced surface structuring could lead to enhanced material erosion in the event of an off-normal, transient plasma event. Additional materials testing will be presented, highlighting potential challenges that scientists and engineers will face to maximize component lifetimes.



Greg Sinclair is a Ph.D. candidate in the School of Nuclear Engineering at Purdue University. He has conducted experimental research in the Center for Materials Under Extreme Environment (CMUXE), unraveling the complex damage mechanisms expected in fusion reactor materials. He received his Bachelor's of Science in Chemical Engineering from the University of Southern California in 2014 and his Master's of Science in Nuclear Engineering from Purdue

University in 2017. Greg is currently a member of the American Physical Society and presented his research on multi-species tungsten radiation last October at the 59th Annual Meeting of the APS Division of Plasma Physics in Milwaukee, WI. He has also presented his research internationally, at fusion materials conferences in France, Italy, and Germany. In 2015, he led a collaborative research project with scientists at Forschungszentrum Jülich in Jülich, Germany to compare differences in damage mechanisms between radiation sources. Throughout his graduate studies, Greg has served as a peer reviewer for three different materials science journals. He currently plans to defend his Ph.D. this April.