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Engineering & Scientific Consulting

Sam Luther, Ph.D.

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Professional Profile

Dr. Luther's expertise is in metallurgy, welding, and integrated computational and materials engineering. He has experience and knowledge with a range of alloy systems critical to petrochemical, nuclear, and renewable energy industries. He has a proven track record of conducting root cause analysis of failed metal components after suffering fracture, embrittlement, corrosion, fatigue, and thermal shock.

With extensive experience in materials characterization, Dr. Luther utilizes techniques such as metallography, visible light microscopy, and scanning electron microscopy (SEM) with energy dispersive spectroscopy (EDS) for a comprehensive approach to evaluating material failure. His analytical skills extend to the realm of data science, where he has processed large datasets using Python-based machine learning, computer vision, and artificial intelligence to produce compelling and conclusive data visualizations.

Dr. Luther's dissertation research at The Ohio State University (OSU) focused on quantification of the susceptibility to ductility-dip cracking (DDC) in nickel-based alloys for the nuclear energy industry. This self-proposed research was funded by the American Welding Society Foundation's Graduate Research Fellowship and OSU's Distinguished University Fellowship. Experimental work included automated robotic welding, high-temperature mechanical testing, and metallographic characterization via optical microscopy and SEM with EDS and EBSD. Data analysis of the mechanical testing led to his development of a new computational method involving the correlation of imposed mechanical energy to DDC in highly restrained welds. Dr. Luther also characterized thermal faceting on DDC fracture surfaces to an unprecedented level of detail, down to atomic-scale TEM imaging, and provided key steppingstones for the future of studying and mitigating a failure mechanism which has been challenging scientists and engineers for over 100 years.

Academic Credentials & Professional Honors

Ph.D., Welding Engineering, The Ohio State University, 2022

M.S., Welding Engineering, The Ohio State University, 2020

B.S., Welding Engineering, The Ohio State University, 2016

University Nuclear Leadership Program Research and Development Grant, U.S. Nuclear Regulatory Commission, 2022-2025

1st Place, International Metallographic Contest, 2019

Graduate Research Fellowship, American Welding Society Foundation, 2018-2021

Distinguished University Fellowship, The Ohio State University, 2016-2017, 2021-2022

Prior Experience

Graduate Research Fellow, The Ohio State University, 2016-2022

Professional Affiliations

American Welding Society – AWS

ASM International

The Association for Materials Protection and Performance – AMPP

Publications

Luther S, Heczko M, Mazánová V, Mills M, Alexandrov B, “Thermal faceting on the ductility-dip cracking fracture surfaces of nickel-based alloys – Occurrence, characterization, and implications for the cracking mechanism.” Materials Science and Engineering: A 2024, 890: 145994.

Luther S, Alexandrov B, McCracken S, Tatman J. “Correlation of imposed mechanical energy with ductility-dip cracking in a highly restrained weld of Alloy 52.” Journal of Manufacturing Processes 2022, 79:767–88.

Luther S, Alexandrov B. “Recreating Ductility-Dip Cracking via Gleeble-Based Welding Simulation.” Welding Journal 2021, 100:27–39.

Presentations

Luther S, Bott J, Kirchhofer R, Smith L, Templeton B. Failure Investigations of Three Unique Brittle Failure Mechanisms in Steel Timber Fasteners. Presentation, International Materials Applications and Technologies Conference, Detroit, MI, 2023.

Luther S., Alexandrov B. Thermal Faceting on the Ductility-Dip Cracking Fracture Surfaces of Nickel-Based Alloys – Occurrence, Characterization, and Implications for the Cracking Mechanism. Presentation (Invited), Fabtech Professional Program, Chicago, IL, 2023.

Luther S, Alexandrov B. Effect of Sulfur on Microstructural Evolution Prior to Ductility-Dip Crack Nucleation in Inconel Alloy 690. Presentation, Advances in Welding and Additive Manufacturing Research, Online, 2022.

Luther S, Alexandrov B. Mapping Imposed Mechanical Energy in a Multipass Weld to Correlate with Ductility-Dip Cracking. Presentation and Poster, Fabtech Professional Program, Online, 2021.

Luther S, Alexandrov B. Using Imposed Mechanical Energy as a Metric to Correlate Sysweld Model of Multipass Welding to Gleeble Simulation. Presentation and Poster, Fabtech Professional Program, Online, 2020.

Luther S, Alexandrov B. Using Fixed-Displacement Thermal Cycling to Simulate Welding Thermo-Mechanical Histories Leading to Ductility-Dip Cracking. Presentation and Poster, Fabtech Professional Program, Chicago, IL, 2019.

Luther S, Alexandrov B. Thermal Faceting in Austenitic Weld Metal During Multipass Welding.

Presentation and Poster, Fabtech Professional Program, Atlanta, GA, 2018.

Luther S, Alexandrov B. Quantification of the Susceptibility to Ductility-Dip Cracking in Welds of Ni-Based Alloys. Presentation, Materials Science & Technology, Columbus, OH, 2018.

Luther S, Alexandrov B. Quantification of the Susceptibility to Ductility-Dip Cracking in Welds of Ni-Based Alloys. Presentation, International Conference on the Strength of Materials, Columbus, OH, 2018.

Luther S, Alexandrov B. Quantification of the Susceptibility to Ductility Dip Cracking in Weld overlays of Ni-Based Alloys. Presentation, Fabtech Professional Program, Chicago, IL, 2017.

Luther S, Alexandrov B. Characterization of Cracking in Nickel-Based Alloy Overlays. Presentation, Materials Science & Technology, Pittsburgh, PA, 2017.

Luther S, Alexandrov B. Quantification of the Susceptibility to Ductility Dip Cracking in Weld overlays of Ni-Based Alloys. Presentation, EPRI Welding and Repair Technology Conference, Orlando, FL, 2017.

Project Experience

Dr. Luther played a central role in a project focused on the failure analysis of critical steelmaking components subjected to thermal shock. Utilizing advanced materials characterization techniques such as metallography, visible light microscopy, and SEM-EDS, he examined the microstructural features and chemical compositions of the materials. By conducting detailed literature investigations into the underlying mechanisms governing thermal shock-induced failures and comparison with observed material behavior, Dr. Luther provided invaluable insights into the root causes of failure and proposed effective mitigation strategies to enhance component reliability and performance in high-temperature environments.

In a series of related projects, Dr. Luther conducted three studies on separate populations of threaded steel fasteners vulnerable to temper embrittlement, stress corrosion cracking, and internal hydrogen embrittlement. Leveraging his expertise in materials science and failure analysis, he conducted thorough metallurgical examinations of the fasteners. Through systematic analysis and interpretation of microstructure, fracture surfaces, and response to metallographic etching, Dr. Luther identified the specific failure mechanisms affecting each population of fasteners. His findings contributed to the development of targeted mitigation measures to improve the durability and integrity of threaded steel fasteners in corrosive service environments and hydrogen-rich manufacturing environments.