

Spring 2016 Joint Colloquium

Materials Department & Materials Research Laboratory

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Materials Science and Engineering Center
Sandia National Laboratories

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11:00 am, ESB 1001



Born Qualified? The Challenge of Qualifying Additively Manufactured Metals for High-Reliability Applications

Additive Manufacturing offers the opportunity to rapidly produce custom, complex, topologically optimized parts in hours. This presents both a challenge and an opportunity for material qualification. To complement the rapid nature and geometrically complex capabilities of additive manufacturing, a rapid high-throughput tensile test method has been developed. This method permits ~100 tensile tests in a few hours of test time and for the same cost as a few conventional tensile tests, allowing for robust statistical assessments of the extreme-value tails of property distributions. As a proof of concept, the method was applied to the evaluation of an additively manufactured precipitation-hardened stainless steel produced by two commercial vendors. The method revealed rare, statistically anomalous failures associated with sporadic manufacturing defects. These rare statistical outliers would have been missed by a few conventional tests. Through this rapid property assessment, it is possible to shorten the process-structure-properties feedback cycle and more quickly converge on reliable solutions. Moreover, the high-throughput methodology is amenable to combinatorial parametric studies to optimize process parameters. Building from the success in high-throughput mechanical properties assessment, Sandia is now exploring ways to accelerate many aspects of structure and property measurement.

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BIO Dr. Boyce is a Distinguished Member of the Technical Staff at Sandia National Laboratories. Dr. Boyce received the B.S. degree from Michigan Technological University in 1996 in Metallurgical Engineering and the M.S. and Ph.D. degrees in 1998 and 2001 from the University of California at Berkeley. Dr. Boyce joined the technical staff at Sandia in 2001 where his research interests lie in micromechanisms of deformation and failure. He was promoted to Principal Member of the Technical Staff in 2005, and received the Distinguished appointment in 2015. At Sandia, Dr. Boyce leads several large-team research projects, totaling ~\$4M/yr. He has over 80 peer reviewed archival publications (H-index=27) in areas such as microsystems reliability, nanoindentation, fracture in structural alloys, weld metallurgy, ocular tissue viscoelasticity, and fatigue mechanisms. Dr. Boyce has served as a Key Reader for Metallurgical and Materials Transactions. He has also served as a guest editor for Thin Solid Films, Experimental Mechanics, International Journal of Fatigue, and International Journal of Fracture as well as MRS proceedings books. He has organized 11 technical symposia at international conferences and has chaired the Rio Grande Symposium on Advanced Materials. Dr. Boyce is a past recipient of the Hertz Foundation fellowship, TMS Young Leader award, and ASM's Marcus A. Grossman Young Author award.