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Engineering & Scientific Consulting

Matthew Bowers, Ph.D., P.E.

Senior Managing Engineer | Metallurgical and Corrosion Engineering
Bowie
+1-301-291-2511 | mbowers@exponent.com

Professional Profile

Dr. Bowers specializes in failure analysis, failure prevention, and engineering risk assessment. His specific expertise is in metallurgy, corrosion, and welding and joining technology. He has experience in many industries including medical devices, utilities, oil and gas, automotive, engineering structures, and consumer electronics/products.

While at Exponent, Dr. Bowers has leveraged his technical skills and experience to address a wide variety of challenges in industrial consulting and dispute resolution. Specific activities include failure analysis and root cause investigations, materials selection and process development, regulatory testing and validation, failure mode and effects analysis (FMEA), reliability testing, and asset management and condition assessment. He has particular interest in assessing the fracture and fatigue behavior of metallic components and welded assemblies using techniques such as optical and scanning electron microscopy (SEM), computed tomography (CT), analytical modeling, and novel mechanical testing methods. Dr. Bowers takes full advantage of Exponent's technical breadth by assembling diverse, multidisciplinary teams to solve complex problems.

Prior to joining Exponent, Dr. Bowers worked as a postdoctoral fellow at Lawrence Berkeley National Lab, where he investigated the thermally and mechanically activated mechanisms of grain boundary migration in face-centered cubic (FCC) metals at the atomic scale. Dr. Bowers completed his Ph.D. research at The Ohio State University in 2014, where he studied the deformation mechanisms and origins of functional fatigue in NiTi-based (Nitinol) shape memory alloys (SMAs) as part of a large research effort involving multiple government agencies and industry partners.

Additionally, Dr. Bowers has authored technical publications and book chapters, has served as a metallurgy course instructor, and has presented his work at academic and industrial conferences.

Academic Credentials & Professional Honors

Ph.D., Materials Science and Engineering, The Ohio State University, 2014

M.S., Materials Science and Engineering, The Ohio State University, 2011

B.S., Engineering Physics, John Carroll University, 2009

Licenses and Certifications

Professional Engineer Metallurgical, California, #2003

Professional Engineer, Maryland, #58351

Professional Engineer, New York, #112927

Professional Affiliations

ASM International

ASTM International

The Minerals, Metals, and Materials Society—TMS

Publications

Slone CE, Kaplowitz DA, Bowers ML, Roepke C, Mazánová V, James BA, Aguiar DJ. Effects of heat treatment on vintage pipeline electric resistance welds. Metall Mater Trans A 2025; 56:3670–3680.

Georgin B, Bowers M, Hudgins A, Chy H, Luy A, Testing the Effectiveness of Covered Conductors for Wildfire Mitigation, CIGRE Conference Paper: Paris Session, August 25-30 2024, B2 PS3, Paper 10327.

Malito LG, Haghgouyan B, Bowers ML, Rosen A, Amin-Ahmadi B, Robertson SW, Ritchie RO. Fatigue and fracture of small cracks in superelastic Nitinol. International Journal of Fatigue 2024; 183:108208.

Malito, L.G., Briant, P.L., Bowers, M.L., Easley, S., Schaffer, J.E. and James, B., 2022. Fatigue, Fracture, and Crack Arrest from Bending Induced Pre-strain in Superelastic Nitinol. Shape Memory and Superelasticity, pp.1-13

Bowers ML, Ophus C, Gautam A, Lancon F, Dahmen U. Step coalescence by collective motion at an incommensurate grain boundary. Physical Review Letters 2016; 116(1):106102.

Bowers ML, Gao Y, Yang L, Gaydosh DJ, De Graef M, Noebe RD, Wang Y, Mills MJ. Austenite grain refinement during load-biased thermal cycling of a Ni49.9 Ti50.1 shape memory alloy. Acta Materialia 2015; 91:318-329.

Kwon J, Bowers ML, Brandes MC, McCreary V, Robertson IM, Sudaharshan Phani P, Bei H, Gao YF, Pharr GM, George EP, Mills MJ. Characterization of dislocation structures and deformation mechanisms in as-grown and deformed directionally solidified NiAl-Mo composites. Acta Materiala 2015; 89:315-326.

Bowers ML, Chen X, De Graef M, Anderson PM, Mills MJ. Characterization and modeling of defects generated in pseudoelastically deformed NiTi microcrystals. Scripta Materialia 2014; 78:69-72.

Selected Presentations

M.L. Bowers, B. James, ‘Case Studies on Sterilization-Induced Embrittlement in Metallic Medical Devices,' MS&T Annual Meeting, Columbus, OH, 2018.

M.L. Bowers, P. Briant, B. James, P. Adler, ‘Nitinol fatigue life prediction based on inclusion content and stressed volume,' ASTM Fourth Symposium on Fatigue and Fracture of Metallic Medical Materials and Devices, San Diego, CA, 2018.

Bowers ML, Gautam A, Ophus C, Lançon F, Dahmen U. Dynamic observation of step nucleation and propagation at grain boundaries. TMS Annual Meeting, Nashville, TN, 2016.

Bowers ML, Chen X, Anderson PM, Mills MJ. Characterization and modeling of transformation-induced defects in pseudoelastically-deformed NiTi microcrystals. Shape Memory and Superelastic Technologies (SMST) Annual Meeting, Pacific Grove, CA, 2014.

Bowers ML. Insights into transformation-induced defect generation in NiTi shape memory alloys. Invited seminar, Los Alamos National Laboratory, Los Alamos, NM, 2014.

Bowers ML. Insights into transformation-induced defect generation in NiTi shape memory alloys. Invited seminar, Lawrence Berkeley National Laboratory, Berkeley, CA, 2014.

Bowers ML, Yang L, De Graef M, Anderson PM, Mills MJ. Microstructural evolution in NiTi polycrystals strained by load biased thermal cycling. TMS Annual Meeting, San Diego, CA, 2014.

Bowers ML, Yang L, T. Nuhfer, De Graef M, and Mills MJ. In-situ and post-mortem observations of microstructural evolution in NiTi polycrystals strained by load-biased thermal cycling. Microscopy and Microanalysis Annual Meeting, Indianapolis, IN, 2013.

Bowers M, Chen X, Yang L, Manchiraju S, Sarosi P, Noebe RD, Anderson PM, Mills MJ. STEM characterization of defects generated during the martensitic transformation in NiTi shape memory alloys. Microscopy and Microanalysis Annual Meeting, Phoenix, AZ, 2012.

Bowers M, Manchiraju S, Uchic M, Sarosi P, Anderson PM, Mills MJ. Characterization of defects generated during the martensitic transformation in pseudoelastically-deformed NiTi microcrystals. MS&T Annual Meeting, Columbus, OH, 2011.

Bowers M, Norfleet D, Uchic M, Manchiraju S, Sarosi P, Anderson PM, Mills MJ. Size effects in the pseudoelastic deformation in NiTi microcrystals. TMS Annual Meeting, San Diego, CA, 2011.

Book Chapters

Malito LG, Bowers ML, Briant P, Ganot GS, James B. Fractography of Nitinol. ASM Metals Handbook Volume 12. 2024; 430-440

Bowers, M, Ganot, G, Malito, L, Kondori, B, Anyanwu, E, Svedlund, F, James, B, “Failure Analysis of Medical Devices,” Analysis and Prevention of Component and Equipment Failures. ASM Handbook, Volume 11A, ASM International, 2021, p. 736 – 753

Project Experience

Medical Devices

Dr. Bowers has performed failure analyses of medical devices and instruments and has provided guidance to clients in the development of specifications and process parameters for the manufacturing of device components. He has also assisted clients with fatigue and corrosion performance testing to support research and development efforts and to satisfy regulatory requirements. Examples include:

- Vascular implants: performance testing and failure analysis of stents, artificial heart valves, occluder devices, aneurysm treatment devices, and mitral valve repair devices.
- Orthopedic implants: failure analysis of bone fixation devices, modular hip implants, limb salvage systems, and pedicle screws.
- Needles: surface roughness and cleanliness analysis of stainless-steel and Nitinol hypotubes.
- Surgical devices and instruments: testing and analysis of instrumented catheters, pulsed-field ablation devices, clot retrieval devices, guidewires, and robotic surgical end-effectors (grippers, cutters, etc.).

Utilities

Dr. Bowers has extensive experience assisting both gas and electric utilities with failure and risk analyses. This work has included root cause investigations of asset failures, failure prediction and modeling of time-dependent failure mechanisms, and evaluation of new technologies for risk mitigation. Select examples of this work include the following:

- Mechanical/electrical testing of electric transmission/distribution conductors, insulators, hot- and cold-end hardware, and related components.
- Evaluation of the effectiveness of covered conductors for wildfire mitigation.
- First-principles based modeling of atmospheric and below-grade corrosion of transmission electric assets.
- Evaluation and review of asset inspection methodologies and repair/replacement criteria.
- Failure mode and effects analysis (FMEA) and quantitative risk assessment for utility assets.

Oil and Gas

Dr. Bowers has performed numerous failure investigations and extent-of-condition assessments for gas pipelines and petrochemical processing equipment. Examples include:

- Root cause analysis of hydrotest-related pipeline ruptures.
- Investigation of weld-related failures of pipelines due to selective seam-weld corrosion, hydrogen embrittlement, fatigue, weld defects, etc.
- Analysis of pipeline leaks and ruptures due to pitting corrosion, microbiologically influenced corrosion (MIC), and stress corrosion cracking (SCC).
- Fracture mechanics crack analysis and fitness-for-service assessment of gas transmission pipeline.
- Evaluation of corrosion mitigation and remediation measures for pipe spools and heat exchangers in an oil refinery.
- Risk assessment for an exposed span of gas transmission piping in a California community.
- Failure analysis of compressor station piping and valves that failed due to vibration-induced fatigue.

Vehicles and Personal Transportation

Dr. Bowers has applied his metallurgical expertise to investigate failures of automotive vehicles, related equipment, and various transportation platforms. Examples include:

- Fractured spot welds and projection welds following a vehicle accident.
- Fracture of a welded towing wheel lift L-arm.
- Collapse of an automotive transmission jack related to a prior weld repair.
- Cast-aluminum truck failures in an electric skateboard.
- Electric scooter handlebar stem fatigue failures.
- Hydrogen embrittlement and fatigue failures in bicycle frame components.
- Investigation of systemic bearing wear and fatigue in a fleet of large marine vessels.

Fire Protection

Dr. Bowers has conducted numerous failure analysis investigations of fire protection system components including sprinklers, piping, and pipe fitting failures. Select examples are as follows:

- Investigation of the cause of unintended activation for both glass-bulb and fusible-link sprinkler designs.
- Analysis of fire protection piping leaks or ruptures that occurred due to welding discontinuities, pitting corrosion, grooving corrosion, freezing, etc.
- Failure analysis of pipe couplings, fittings, and valves.

Electronics

Dr. Bowers has leveraged his metallurgical and corrosion expertise to assist clients with a variety of electronics-related materials issues. Select examples include:

- Aging behavior and electrical stability of silver-loaded conductive epoxy.
- Analysis of solder ball cracking due to gold embrittlement, coefficient of thermal expansion (CTE) mismatch, thermal stresses, and intermetallic formation.
- Fatigue failures of pins, connectors, and contacts.
- Corrosion investigation for point-of-sale electronic devices exposed to various liquids and disinfectants.
- Analysis of microstructure and mechanical properties of copper foils for battery applications.
- Analysis of seam weld integrity for flexible battery pouches.
- Evaluation of brazes and friction-stir welds for a radar antenna device.