

Exponent®
Engineering & Scientific Consulting

Alexander Preston, Ph.D., P.E., CWI

Senior Engineer | Metallurgical and Corrosion Engineering
Bowie
+1-301-291-2513 | apreston@exponent.com

Professional Profile

Alexander Preston, Ph.D., P.E., CWI, is a senior engineer in Exponent's Metallurgical & Corrosion Engineering practice. He has conducted numerous investigations in failure analysis, welding metallurgy, tribology, and advanced materials processing, and he has provided technical support in domestic and international litigation proceedings. He advises industrial clients and legal counsel on root-cause investigations, material degradation, and manufacturing quality, specializing in weld failure analysis, wear materials, and additive manufacturing.

Welding Metallurgy & Failure Analysis

Dr. Preston conducts root-cause failure analyses of welds and welded components across industrial, energy, and consumer product applications. His investigations address weld discontinuities, heat-affected zone (HAZ) degradation, residual stress effects, and in-service cracking mechanisms including stress corrosion cracking and fatigue. As a Certified Welding Inspector (CWI), he evaluates weld procedures, inspection records, and compliance with applicable codes and standards including AWS D1.1, ASME BPVC Section IX, and ASME B31.3.

Bearing Failure & Tribology

Dr. Preston supports clients facing premature bearing failures, surface wear, and tribological degradation in rotating machinery and industrial equipment. His analyses integrate metallographic examination, scanning electron microscopy (SEM), and surface profilometry to characterize wear mechanisms — including adhesive wear, abrasive wear, fretting, and rolling contact fatigue — and to distinguish manufacturing defects from in-service damage. This work informs maintenance strategies, design improvements, and liability assessments for manufacturers, operators, and insurers.

Pressure Vessel & Pipeline Failures

Dr. Preston investigates failures in pressure vessels, boiler piping, pipelines, and industrial process equipment, addressing mechanisms such as corrosion, fatigue, hydrogen embrittlement, and overload fracture. His experience includes gas lines, boiler piping systems, and industrial driers, with analysis methods encompassing metallography, mechanical testing, and finite element modeling (FEM). He advises clients on fitness-for-service assessments, regulatory compliance, and failure prevention strategies relevant to ASME and API standards, technical basis for liability and remediation decisions.

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Utility Infrastructure & Electrical Components

Dr. Preston investigates failures in utility infrastructure and electrical components, including overhead conductors, printed circuit boards, and solar junction boxes. His work addresses degradation mechanisms such as corrosion, thermal cycling fatigue, and electrical arcing and draws on materials characterization techniques including differential scanning calorimetry (DSC), UV aging analysis, and electron microscopy. He supports electric utilities, insurers, and legal counsel in understanding the root causes of infrastructure failures and the technical basis for liability and remediation decisions.

Additive Manufacturing & Thermal Processing

Dr. Preston brings specialized expertise in additive manufacturing (AM), powder metallurgy, and thermal processing — including field-assisted sintering technique (FAST) — that directly supports clients evaluating AM component quality, processing defects, and microstructure-property relationships. He has studied the effects of thermal and electrical gradients on microstructure evolution in stainless steels, titanium alloys, and ultra-high-temperature ceramics, and he has investigated additive manufacturing of metals, metal-metal composites, and cermets. This background enables him to assess whether AM or sintered components meet design intent and identify processing-related failure modes that may not be apparent through conventional inspection.

Academic Credentials & Professional Honors

Ph.D., Materials Science and Engineering, Colorado State University, 2022

B.S., Materials Engineering, Iowa State University, 2017

Licenses and Certifications

American Welding Society Certified Welding Inspector (CWI)

Professional Engineer Metallurgical and Materials (CA)

Red Cross - CPR/AED Certificate

Prior Experience

Prior to joining Exponent, Dr. Preston earned his Ph.D. at Colorado State University, where he studied the effects of spark plasma sintering, additive manufacturing, and pressureless sintering processes on the microstructure of pure titanium, titanium alloys, stainless steels, and ultra-high-temperature ceramics. His dissertation research focused on controlling electrical and thermal gradients within spark plasma sintering to create functionally graded porous materials in 316L stainless steel and pure titanium. This work included extensive imaging, microstructure characterization, and mechanical testing, which was used to create and validate a finite element model able to accurately predict local porous structure based on thermal history.

Professional Affiliations

ASTM International

• Voting Member, Committee F42 – Additive Manufacturing Technologies

• Member, Committee F04 – Medical and Surgical Materials and Devices

American Welding Society (AWS)

Publications

Preston AD, Ma K. Insight into the effects of pore size and distribution on mechanical properties of austenite stainless steels. Journal of Materials Science 56 (30), 17278-17295, 2021.

Preston AD, Ma K. Effect of powder morphology on the microstructure and mechanical property gradients in stainless steels induced by thermal gradients in spark plasma sintering. MRS Advances 6 (19), 482-288, 2021.

Tang X, Kuehster AE, DeBoer BA, Preston AD, Ma K. Enhanced thermionic emission of mayenite electride composites in an AR glow discharge plasma. Ceramics International 47 (12), 16614-16631, 2021.

Evans RC, Austin R, Miller RC, Preston AD, Nilsson ZN, Ma K, Sambur JB. Surface-Facet-Dependent Electrochromic Properties of WO3 Nanorod Thin Films: Implications for Smart Windows. ACS Applied Nano Materials 4 (4), 3750-3759, 2021.

Cramer CL, Preston AD, Ma K, Nandwana P. In-Situ metal binder-phase formation to make WC-FeNi Cermets with spark plasma sintering from WC, Fe, Ni, and carbon powders. International Journal of Refractory Metals and Hard Materials 88, 105204, 2020.

Cramer CL, Preston AD, Elliott AM, Lowden RA. Highly dense, inexpensive composites via melt infiltration of Ni into WC/Fe preforms. International Journal of Refractory Metals and Hard Materials 82, 255-258, 2019.

Presentations

Alexander Preston, Kaka Ma. Microstructure and Mechanical Property Gradients induced by Thermal Gradients in Spark Plasma Sintering. Materials Research Society, Boston, MA, 2021.

Alexander Preston, Kaka Ma. Heterogenous Pore Architecture Achieved by Spark Plasma Sintering. The Minerals, Metals & Materials Society, San Diego, CA, 2020.

Alexander Preston, Yuchen Lin, Kaka Ma. Titanium Alloys with Radially Distributed Porosity and Structural Hierarchy. Materials Science & Technology, Portland, OR, 2019.

Alexander Preston, Kaka Ma. Nanoporous Stainless Steel with Structural Hierarchy. Materials Science & Technology, Columbus, OH, 2018.

Project Experience

Energy and Utilities

- Electric Power Transmission Conductors: Investigated failures of multiple electric power transmission conductors involving aeolian vibration, mechanical overload, creep, and annealing.
- Natural Gas Transmission Pipeline: Investigated the rupture of an in-service natural gas transmission pipeline resulting from third-party damage and subsequent pressure cycling. Evaluated the failure mechanisms through finite element analysis (FEA), location specific pressure calculations, and fitness-for-service assessments in accordance with API 579.
- Boilers and Associated Piping: Conducted failure investigations of boilers, boiler tubes, and associated piping to evaluate metallurgical and mechanical contributors to component failures.

- Water Treatment Infrastructure: Performed fitness-for-service assessments of welded pipelines in water treatment facility, incorporating nondestructive examination results, pressure calculations, and weld geometry evaluations to assess structural integrity and continued serviceability.

Wind Energy

- Pitch Bearings: Investigated wind turbine pitch bearing failures involving lubrication deficiencies, nonmetallic inclusions, and improper material processing. Evaluated the metallurgical and tribological factors contributing to premature bearing degradation and failure.
- Main Bearings: Investigated wind turbine main bearing failures involving inadequate maintenance practices and associated bearing damage. Evaluated the contributing failure mechanisms and their effects on bearing performance and service life.

Biomedical Materials

- Implantable Medical Devices: Investigated failures of implantable medical devices involving implantation-related damage, fatigue, and corrosion. Evaluated the metallurgical and mechanical factors contributing to component degradation and failure.
- Nitinol Shape Memory Alloys: Investigated the effects of manufacturing processes, material composition, and thermal treatments on the functional performance of nitinol shape memory alloys, including changes in phase transformation behavior and shape memory response.

Electronics

- Electrically Conductive Epoxies: Investigated the aging behavior and electrical stability of silver-filled conductive epoxies, evaluating the effects of material degradation and aging on electrical performance and long-term reliability.
- Solder Joint Failures: Investigated cracking and failure of solder ball interconnections involving embrittlement, coefficient of thermal expansion (CTE) mismatch, thermal stresses, and intermetallic compound formation. Evaluated the metallurgical and thermomechanical factors contributing to joint degradation and failure.

Additive Manufacturing & 3D Printing

- Additively Manufactured Components: Conducted failure investigations of additively manufactured components involving incomplete sintering, microstructural segregation, embrittlement, and secondary processing. Evaluated the effects of manufacturing defects and processing-related metallurgical conditions on material performance and component integrity.

Fire Protection

- Fire Protection Systems: Investigated leaks and ruptures in fire protection piping systems involving welding discontinuities, pitting corrosion, grooving corrosion, freezing, and other material degradation mechanisms. Evaluated the metallurgical and mechanical factors contributing to piping failures and loss of system integrity.
- Pipe Fittings and Valves: Conducted failure investigations of pipe couplings, fittings, and valves, evaluating material-related and mechanical contributors to component failures.

Automotive

- Automotive Weld Failures: Investigated fractured spot welds and projection welds in automotive assemblies following vehicle accidents, evaluating weld integrity and the metallurgical and mechanical factors contributing to weld failure.