Exponent®
Engineering & Scientific Consulting

Alex Preston, Ph.D., P.E.

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Professional Profile

Dr. Preston specializes in failure analysis and failure prevention of engineering materials, components, and systems. His primary expertise includes powder metallurgy, microstructure evolution, additive manufacturing, and thermal-electrical processes.

Dr. Preston assists clients in understanding the underlying factors that have resulted in failed, fractured, and corroded components and systems, and provides strategies for preventing future failures. His project experience has consisted of root-cause failure analyses, regulatory testing, material degradation modeling, lifetime prediction, and interdisciplinary investigations of engineering systems. Some of Dr. Preston's work has included nitinol medical devices, crankshafts, overhead conductors, boiler piping, corrugated stainless steel tubing, printed circuit boards, solar panel junction boxes, and insulated glass units. He regularly supports industrial clients as well as those involved in domestic litigation and international arbitration disputes. Dr. Preston also regularly supports clients with their quality assurance needs related to manufacturing support, material processing, equipment implementation, and test plan development.

Dr. Preston has an extensive background in materials characterization using a variety of analytical tools and techniques including metallography, electron microscopy, mechanical testing, profilometry, differential scanning calorimetry, and UV aging.

Prior to joining Exponent, Dr. Preston was a Graduate Researcher at Colorado State University, where he received his Ph.D. in 2022. While there, he studied closed-foam nanoporous metals, specifically stainless steels, titanium alloys, and CP titanium. Dr. Preston synthesized these porous materials via powder metallurgy and identified the impact of powder morphology on macroscopic mechanical properties and mechanical property gradients. During his studies, he sintered powders using the field-assisted sintering technique, modeled the thermal-electric gradients, and predicted the relevant microstructure to create tuned functionally graded materials. This work involved grain-scale microstructural evaluation, powder characterization, macro- and micro-mechanical testing, and thermal-electric-microstructure finite element modeling. Dr. Preston also participated in the ASTRO (Advanced Short-Term Research Opportunity) program at Oak Ridge National Lab, where he studied additive manufacturing of WC/Fe composites and field-assisted sintering of WC-FeNi cermets.

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

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.

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.