
Jacob D. Fuerst, Ph.D., P.E.
15 Nantucket Ct, Dover, New Hampshire 03820
Jacob@fuerstmetallurgy.com • (812) 841-6639

MATERIALS ENGINEER

QUALIFICATION SUMMARY

Analytical Materials Engineer with over 16 years of experience in root cause failure analysis and forensics, fractography, and materials characterization. Adept at using of laboratory tools, including scanning electron microscopy (SEM) with energy dispersive x-ray spectroscopy (EDS), x-ray fluorescence (XRF), light microscopes, and preparing metallography samples. Proficient in identifying features in low and high cycle fatigue failure. Experienced in heat treating, induction hardening, furnace and induction brazing, laser additive manufacturing, MIM/powder metallurgy, plasma spray, electroform deposition, and friction stir welding in research, manufacturing, and production environments. Extensive experience in the design and testing of firearms, ammunition, and related components. Competitive shooter in Steel Challenge, IDPA, IPSC/USPSA, ISSF 25-meter rapid fire pistol. NRA certified Range Safety Officer (RSO) and Instructor (pistol).

Technical Skills/Core Competencies:

- Fractography: identifying ductile failure, brittle failure, fatigue, overload, rupture, buckling, creep, fretting, stress-corrosion cracking, and causes and origins of metal fracture
- Metallography: polishing and etching of metal samples to identify microstructure and composition
- Servohydraulic tensile, compression, and low and high cycle fatigue testing
- Magnetic particle inspection and dye liquid penetrate inspection non-destructive testing (MPI LPI NDT)
- Hardness testing including Rockwell, Brinell, Knoop, Vickers micro-hardness
- Scanning electron microscopy (SEM) with energy dispersive x-ray spectroscopy (EDS)
- X-ray fluorescence spectroscopy (XRF), optical emissions spectroscopy (OES)
- Laser additive manufacturing, Laser powder deposition (LPD), selective laser sintering (SLS), selective laser melting (SLM), laser additive manufacturing (LAM), laser engineered net shaping (LENS)
- Materials characterization and processing of metal injection molding (MIM) and powder metallurgy (PM)
- Heat treating, quenching and tempering, aging, case hardening and carburizing, nitriding, nitrocarburizing

EDUCATION/CERTIFICATION

Professional Engineer, Metallurgy and Materials, Alabama, North Carolina, South Carolina, Florida, Oklahoma

Graduate Certificate in Explosives Engineering November 2021
New Mexico Institute of Mining and Technology; *Socorro, NM*

Ph.D. in Materials Engineering and Science May 2012
South Dakota School of Mines and Technology; *Rapid City, SD*
Concentrations: Failure Analysis, Biomedical/Biomaterials Engineering, Physical Metallurgy and Corrosion

Master of Science in Materials Engineering and Science May 2011
South Dakota School of Mines and Technology; *Rapid City, SD*
Concentration: Metallurgical Engineering

Bachelor of Science in Chemical Engineering May 2006
Rose-Hulman Institute of Technology; *Terre Haute, Indiana*

PROFESSIONAL EXPERIENCE

Senior Metallurgist | Sig Sauer

October 2022 – Present

- Metallurgist for Sig Sauer research and development.

Senior Materials Engineer | Rimkus Consulting Group

July 2021 – August 2022

- Performed root cause failure analyses on cast iron, steel, titanium, aluminum, copper, and brass components.
 - Performed SEM and EDS analysis, OES, metallography, fractography, and optical microscopy in the course of root cause failure analyses.
- Investigated the mechanical operation of a pistol involved in an accident resulting in an injury.
- Investigated the cause of failure of a shotgun that resulted in an injury.
- Analyzed over 100 firearms involved in a fire for serviceability.
- Consulted in the use of SEM and EDS to identify the origin of bullet fragments.
- Have performed root cause failure analysis on automotive components, plumbing components, industrial equipment, and consumer products.

Principal Consultant | Fuerst Metallurgy, LLC

January 2019 – July 2021

- Consulting in failure analysis and forensics, industrial support, and litigation support.

Senior Materials Engineer | Plasma Processes, LLC

March 2020 – June 2021

- Developed parameters for plasma spray of thermal barrier coatings (TBC) and high emissivity coatings for aerospace applications.
- Developed parameters for suspension plasma spray (SPS) coatings for satellite radiation and thermal shielding.
- Developed thermal spray wear resistant coatings for lunar applications.
 - Tested wear resistant coatings with simulated lunar regolith.
- Developed parameters for electroform deposition of high temperature and refractory materials.
- Contributed to an SBIR for the development of additively manufactured high density shaped charge liners and bi-metal shaped charge liners.
- Developed and tested high temperature oxygen resistant coatings for the AGM-183 ARRW hypersonic missile system.
- Managed development and production of components for NASA and DOD projects.

Senior Metallurgist & Materials Test Engineer | Remington Arms Company

July 2015 – December 2019

- Responsible for all materials and metallurgical related issues in research and development, and manufacturing in Huntsville, AL.
- Remington is America's oldest firearms manufacturer, responsible for over \$700 million in annual sales.
- Provided materials and metallurgical support to firearms manufacturing in Ilion, NY, and ammunition research and development, and manufacturing for Remington Ammunition in Lonoke, AR, and Barnes Ammunition in Mona, UT.
- Provided material related assistance to research and development for firearms and ammunition for retail sale and military and defense applications.
- Managed the Remington Arms Company materials laboratory in Huntsville, AL, research and development.
 - Performed failure analysis on firearms and ammunition failures for both customer returns, manufacturing, and litigation.
 - Tested and recommended materials, alloys, heat treatments, and coatings, for firearms and ammunition, including powder metallurgy (PM) and metal injection molding (MIM) components.

- Primary operator of Scanning Electron Microscope (Zeiss systems)
- Performed optical microscopy, metallography, Knoop and Vickers microhardness testing, Rockwell hardness testing, tensile/compression/fatigue testing of prototypes and production samples, ASTM B117 Salt Fog testing, high and low temperature environmental testing, chemical and solvent resistance testing for compliance with various military specifications (MIL-SPEC).
- Performed materials characterization with X-ray spectrometry, optical emissions spectrometry (OES), X-ray fluorescence (XRF), energy dispersive x-ray spectrometry (EDS).
- Developed vacuum, molten salt bath, and induction heat treating regimens for firearms manufacturing.
- Developed cost savings programs for manufacturing.
- Developed quality control programs for manufacturing.
- Full compliance with ITAR regulations and ISO-9001.

Staff Consultant/Engineer in Training | Engineering Systems Inc.

July 2012 – July 2015

- Performed failure analysis on components from crashed and impact damaged fixed and rotary wing aircraft.
 - Involved in aircraft crash investigations of commercial general aviation and rotor-wing aircraft (helicopters)
 - Involved in accident analysis of military helicopter incident.
 - Performed failure analysis of general aviation and helicopter components.
 - Primary operator of Scanning Electron Microscope (Tescan system).
 - Performed failure analysis, including metallographic analysis and electron microscopy, on orthopedic implants and medical devices.
 - Devices and incidents analyzed include:
 - Total hip prosthesis femoral neck fracture, femoral neck fretting, and acetabular cup/femoral ball wear
 - Fracture of internal fixation plates and screws including dynamic and locking compression plates
 - Failure of spinal fusion rods and pedicle screws
 - Provided failure analysis assistance to DePuy Orthopaedics Inc., Synthes, Inc., Medtronic Inc., Stryker Corp., Phygen, LLC.
 - Evaluation of particulate release from drug eluting cardiovascular stents.
 - Assisted in product development of acetabular cup components and surgical equipment for a biomedical startup, Pipeline Orthopedics.
 - Provided 510(k) compliance testing and assistance to Pipeline Orthopedics prior to acquisition by Mako Surgical Corp
 - Involved in forensic engineering for multidistrict litigation (MDL) on medical devices
 - Assistant to the expert for the defense in litigation against DePuy Orthopaedics, Inc., regarding the DePuy ASR XL acetabular system recall.
 - Assistant to the expert for the defense in litigation against DePuy Orthopaedics, Inc., regarding the DePuy Pinnacle multi-district litigation.
 - Assistant to the expert for the defense in litigation against Stryker Corporation, regarding the Stryker Rejuvenate and ABG II recall and litigation.
 - Performed corrosion, wear, and fretting evaluations on the Zimmer Trilogy Acetabular Hip System.
 - Performed failure analysis on firearms and ammunition for signs of material or manufacturing defects, misuse, and evidence of overpressure ammunition including:
 - Failed shotguns on behalf of US Customs & Border Protection
 - Failed civilian sporting shotguns for litigation
 - Failed muzzle loaders for litigation

- Corrosion of ferritic nitrocarburized handgun slides due to improper nitrocarburizing procedure.

Engineering Consultant | Law Office of Fuerst Ittleman, PL

August 2006 – May 2012

- Performed chemical research for the California Office of Environmental Health Hazard Assessment on cosmetics approval
- Evaluated material failure and manufacturing processes for civil suit on behalf of the FDA

PROJECT HISTORY

South Dakota School of Mines and Technology

August 2006 – May 2012

- Additive Manufacturing Laboratory
 - Developed components for biomedical applications using LASER Engineered Net Shaping (LENS) of Titanium, and Ti-6Al-4V
 - Developed components for biomedical applications using Micro LASER Additive Manufacturing (M-LAM) Ti-6Al-4V, Ti-15Mo, and Ti-Ta alloys
 - Developed wear resistant surfaces using LASER Engineered Net Shaping (LENS) of AlMgB₁₄/TiB₂ BAM
 - Research into developing long life orthopedic implants using LASER deposition of micro powders
 - 3-D LASER Powder Deposition for cladding with titanium carbide (TiC) for creating wear resistant Surfaces
 - Armament Research, Development & Engineering Center (ARDEC) Contract W15QKN-09-C-2000: *Laser Additive Manufacturing (LAM) For Powder Consolidation, Surface Modification and Low Volume Production*
- Metallurgical evaluation of samples produced by the Quad City Manufacturing Laboratory
- Testing VDK 4000 Direct Write 3-D printing system for Wright Patterson AFB
 - CAD driven system for of six degree of freedom printing capable of sub millimeter resolution
- Direct Write, micro-dispensing non-contact printing (*n*Script) of secondary explosives for producing smart fuses for military applications
- Developed suspensions for nanoscale iron and barium titanate (BaTiO₃) for non-contact printing ink

August 2006 – July 2009
- South Dakota School of Mines and Technology: Previous Research Projects
 - Arbogast Materials Processing and Joining Laboratory (AMP)
 - Friction stir welding of alpha-beta titanium alloys
 - Friction stir welding of aluminum-lithium alloys.
 - U.S. Army Medical Research and Materiel Command Contract W81XWH-08-1-0315: Bio-Medical Materials Initiative
 - Micro-LASER Additive Manufacturing (M-LAM) for creating micro-scale surface features on titanium alloys
 - U.S. Army Research Laboratory Cooperative Agreement DAAD19-02-2-0011 -Project 9 - Advanced Materials & Processes for Future Combat Systems: *Cold Spray Deposition of Titanium Alloys*
 - National Science Foundation NSF 05-515 Award ID CTS 0520985 Major Research Instrumentation Program (MRI): *Development of an Extended Wavelength Pulsed Laser System for Vibrational Sum-Frequency Generation Spectroscopy*
 - Designed and manufactured opto-mechanical components for the second harmonic generator and assembled and tested the performance of the SHG for the Leopard Nd:YAG LASER

ADDITIONAL EDUCATION/TRAINING

- Technical Studies in Manufacturing & Industrial Technology and Welding Technology at Ivy Tech Community College (Wabash Valley Campus, Terre Haute, Indiana)
- ASM International Principles of Failure Analysis Course (4-day). April, 2014
- ASM International Chicago Regional Chapter Introduction to Failure Analysis Short Course (2014)
- ASM International Interpretation of Microstructures Course (4-day). April, 2015

COMMITTEE AND PROFESSIONAL MEMBERSHIPS

- Contributing member of ASTM Committee F15 on Consumer Products

PUBLICATIONS

- J. Fuerst, J. Sears, D.J. Medlin, D. Neufeld, T. Yescas; **LASER Deposited Engineered Surfaces for Orthopedic Implants for Increased Device Longevity.** Medical Device Materials V: Proceedings of the Materials & Processes for Medical Devices Conference, August 10-12, 2009, Minneapolis, MN, USA.
- J. Fuerst, M. Carter, M. Huber, J. Sears, D.J. Medlin, G.F. Vander Voort; **Laser Powder Deposition of Titanium - Tantalum Alloys Structured Interfaces for Use in Orthopedic Devices.** Medical Device Materials VI: Proceedings of the Materials & Processes for Medical Devices Conference, August 8-10, 2011, Minneapolis, MN, USA.
- J. Fuerst, K. Kennedy, M. Carter, J. Sears, D.J. Medlin; **The Functionality of Ti-15Mo in Creating 3-D Porous Surfaces via Laser Powder Deposition for the Use in Dental Prosthetics.** Medical Device Materials VI: Proceedings of the Materials & Processes for Medical Devices Conference, August 8-10, 2011, Minneapolis, MN, USA.
- J. Fuerst, M. Carter, J. Sears. **LASER Powder Deposition of AlMgB₁₄-TiB₂ Ultra-Hard Coatings on Titanium, and Steel Substrates.** Randall M. German Honorary Symposium on Sintering and Powder-Based Materials.
- J. Fuerst, D.J. Medlin, M. Carter, J. Sears, G.F. Vander Voort. **LASER Additive Manufacturing of Titanium-Tantalum Alloy Structured Interfaces for Modular Orthopedic Devices.** Journal of Materials, April 2015, Volume 67, Issue 4, pp 775-780

PRESENTATIONS

- The Minerals, Metals & Materials Society (TMS) 138th Annual Meeting and Exhibition, February 17, 2009: *High Performance Titanium Osteoconductive Coatings for Medical Implant Applications*
- ASM International Materials and Processes for Medical Devices (MPMD) Conference and Exposition, August 12, 2009: *Laser Formed Porous Coatings for Osteointegration*
- ASM International Materials and Processes for Medical Devices (MPMD) Conference and Exposition, August 9, 2011: *Laser Powder Deposition of Titanium - Tantalum Alloys Structured Interfaces for Use In Orthopedic Devices*
- ASM International Materials and Processes for Medical Devices (MPMD) Conference and Exposition, August 10, 2011: *The Functionality of Ti-15Mo in Creating 3-D Porous Surfaces via Laser Powder Deposition for the Use in Dental Prosthetics*
- Session Chair: Fabrication Processes for Medical Devices Session III and IV, ASM International Materials and Processes for Medical Devices (MPMD) Conference and Exposition, August 9, 2011
- The Minerals, Metals & Materials Society (TMS) 141st Annual Meeting & Exhibition, Orlando, FL, March 11-15, 2012. Randall M. German Honorary Symposium on Sintering and Powder-Based

Materials: *LASER Powder Deposition of AlMgB14-TiB2 Ultra-Hard Coatings on Titanium, Steel, and Cast Iron Substrates*

- The Minerals, Metals & Materials Society (TMS) 141st Annual Meeting & Exhibition, Orlando, FL, March 11-15, 2012. Biological Materials Science Symposium: *LASER Powder Deposition of Titanium - Tantalum Alloys Surfaces for Use in Biomedical and Corrosion Resistant Applications*
- Session Chair: Materials Science & Technology 2014 (MS&T' 14) Failure Analysis session on Biomaterials and Medical Devices
- *LASER Powder Deposition OF ALMGB14-TIB2 Wear Resistant Coatings for Biomedical Applications* (MS&T' 14), Symposium: Boron, Boron Compounds, and Boron Nanomaterials: Structure, Properties, Processing, and Applications
- *Evaluation of the Failure of Two Grade IV CP Ti Spinal Fusions Rods* (MS&T' 14), Session: Corrosion - Biomaterials and Medical Devices
- *Tibial Non-Union as a Cause for Fracture Fixation Screw Failure* (MS&T' 14), Session: Corrosion - Biomaterials and Medical Devices
- *Metallographic Preparation and Microstructural Characterization of Additive Manufactured Tantalum and Titanium Alloy Porous Coatings for Biomedical Applications*. ASTM International Symposium Commemorating 100 Years of E04 Development of Metallographic Standards, Session 2: Physical Metallurgy and Failure Analysis, November. 12, 2017.