



Exponent[®]
Engineering & Scientific Consulting

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Professional Profile

Dr. Kirchhofer specializes in the failure analysis, metallurgy, corrosion, materials structure-properties relationships and applying the principles to integrity assessment and management. Dr. Kirchhofer provides consulting service for industries including petrochemical, power generation, automotive, aerospace, consumer products, and microelectronics. Dr. Kirchhofer received her Ph.D. Materials Science and M.S. in Metallurgical and Materials Engineering from Colorado School of Mines. She has extensive knowledge of characterization techniques, testing procedures, and materials systems and excels at investigating the relationship between materials properties and performance. Dr. Kirchhofer has worked on materials systems ranging from ferrous alloys, high-grade steels, stainless steels, nickel alloys, polymers, and ceramic materials.

Dr. Kirchhofer applies her knowledge and experience to evaluate failure mechanisms and determine the root cause(s) of a failure, perform fitness-for-service assessments, identify material substitutions for cost reduction, and reliability testing. Her interests are in fractography, materials structure-property relationship, microstructural development, materials selection, corrosion, weld inspections and design.

Prior to joining Exponent, Dr. Kirchhofer worked as a consulting engineer for the power generation industry performing failure analysis investigations in fossil fuel and nuclear plants, and in the renewable energy sector involving solar and wind power generation. In this role she has managed investigations of steam and gas turbines, high energy piping remaining life assessment, corrosion evaluation and mitigation of pressure vessels and piping, accelerated degradation of composite structures, and welding failures in steel structures. In addition, she worked in product development, design of experiments, and product reliability testing (HALT & HASS) in fuel cell stacks and supporting assemblies. Dr. Kirchhofer has been involved in ceramic material selection, characterization, and qualification for refurbishment.

Dr. Kirchhofer graduate work at Colorado School of Mines investigated the nano-scale structure of different ceramic oxides, ferroelectric materials, piezoelectric materials, and metal alloys to explore structure-property relationships. She employed diffraction, spectroscopy, a dual-beam FIB-SEM, and other advanced techniques to develop advanced methods for materials characterization and specimen preparation. Additionally, she aided in the designed and managed the fabrication of a scientific apparatus for atomic scale characterization of materials.

Academic Credentials & Professional Honors

Ph.D., Materials Science, Colorado School of Mines, 2014

M.S., Metallurgical and Materials Engineering, Colorado School of Mines, 2011

B.S., Mechanical Engineering, University of California, Davis, 2004

B.S., Materials Science and Engineering, University of California, Davis, 2004

Licenses and Certifications

Professional Engineer License in Metallurgical and Materials, Colorado # 45977

Certified Welding Inspector, AWS # 15082711

Prior Experience

Senior Materials & Forensic Engineer, Intertek AIM, 2016-2017

Senior Engineer, Bloom Energy, 2014-2016

Materials Research Fellow (Contractor), Idaho National Laboratories, 2009-2011

Materials Engineer, Anamet Inc., 2005-2008

Professional Affiliations

American Society of Mechanical Engineers — ASME

Co-organizer ASME Pressure Vessel & Piping, Materials and Manufacturing Committee - Creep & Creep-Fatigue Interaction

ASM International

American Welding Society — AWS

The Minerals, Metals, and Materials Society — TMS

National Association of Corrosion Engineers International — NACE

Languages

Spanish

Publications

Kirchhofer R, Vaillancourt H, Garner M, Cipolla RC, "Dealloying of As-Welded Microstructures in Aluminum Bronzes in Essential Cooling Water Service". Proceedings of the ASME 2017 Pressure Vessels and Piping Conference, PVP 2017, July 16-20, 2017, Waikoloa, HI.

Kirchhofer R, Diercks DR, Gorman BP, "Near Atomic Scale Quantification of a Diffusive Phase Transformation in (Zn,Mg)O/Al₂O₃ Using Dynamic Atom Probe Tomography". Journal of Materials Research 2015, 30 (8):1137-1147.

Kirchhofer R, Diercks DR, Gorman BP, Ihlefeld JF, Kotula PG, Shelton Ct, Brennecka GL, "Quantifying Compositional Homogeneity in Pb(Zr,Ti)O₃ Using Atom Probe Tomography". Journal of the American Ceramic Society 2014, 97 (9):2677-2697.

Sanford NA, Blanchard PT, Brubaker M, Bertness KA, Roshko A, Schlager JB, Kirchhofer R, Diercks DR, Gorman BP, "Laser-Assisted Atom probe Tomography of MBE Grown GaN Nanowires Heterostructures",

Physica Status Solidi C 2014, 11(3):608-612.

Diercks DR, Gorman BP, Kirchhofer R, Sanford NA, Bertness K, Brubaker M, "Atom Probe Tomography Evaporation Behavior of C-Axis GaN Nanowires: Crystallographic, Stoichiometric, and Detection Efficiency Aspects", Journal of Applied Physics 2013, 114 (184903).

Kirchhofer R, Teague MC, Gorman BP, "Thermal Effects on Mass and Spatial Resolution During Laser Pulse Atom Probe Tomography of Cerium Oxide", Journal of Nuclear Materials 2013, 436 (1-3):23-28.

Kirchhofer R, Hunn JD, Demkowicz PA, Cole JI, Gorman BP, "Microstructure of TRISO Coated Particles from the AGR-1 Experiment: SiC Grain Size and Grain Boundary Character", Journal of Nuclear Materials 2013, 432 (1-3):127-134.

Presentations

Kirchhofer R, Vaillancourt H, Garner M, Cipolla RC. Dealloying of As-Welded Microstructures in Aluminum Bronzes in Essential Cooling Water Service. Presentation, ASME Pressure Vessels and Piping Conference, PVP, Waikoloa, HI, 2017.

Kirchhofer R, Lanthorn G, Vaillancourt H, Lee C. Special Consideration for dissimilar metal welds: design, fabrication, and repair for power plants in flexible operation. Presentation, EPRI Workshop on Dissimilar Welds in High Temperature Applications, ASME Pressure Vessel and Piping, Waikoloa Village, HI, 2017.

R Kirchhofer R, Diercks DR, Gorman BP, Brennecke G. Atomic Scale Composition Profiling of Ferroelectrics via Laser-Pulsed Atom Probe Tomography and Cross-correlative Transmission Electron Microscopy. Presentation, Microscopy and Microanalysis, Indianapolis, IN, 2013.

Kirchhofer R, Diercks DR, Gorman BP. Atomic Scale Composition Profiling of Ferroelectrics via Laser-Pulsed Atom Probe Tomography and Cross-correlative Transmission Electron Microscopy. Poster Presentation, Materials Research Society, San Francisco, CA, 2013.

Diercks DR, Kirchhofer R, Brubaker M, Bertness K, Sanford NA, Gorman BP. Characterization of GaN Nanowires via Laser Pulsed Atom Probe Tomography and Transmission Electron Microscopy. Presentation, Electronic Materials Conference, Electronic Materials Conference, State College, PA, 2012.

Kirchhofer R, Diercks DR, Teague MC, Gorman BP. Lateral Thermal Transport in Laser-Assisted APT of Oxides. Presentation, International Field Emission Symposium, International Field Emission Symposium, Tuscaloosa, AL, 2012.

Kirchhofer R, Diercks DR, Gorman BP. Development of a Dynamic Atom Probe Tomography System at the Colorado School of Mines. Poster Presentation, American Vacuum Society, AVS-Rocky Mountain Chapter, Westminister, CO, 2012.

Kirchhofer R, Reimanis IE, Demkowicz PA, Cole JI, Hunn JD, Gorman BP. Microstructural Characterization of the Silicon Carbide Layer in AGR-1 Fuel Variants. Presentation, Second Workshop on HTGR SiC Materials Properties, Idaho Falls, ID, 2012.

Kirchhofer R, Teague MC, Gorman BP. Laser-Assisted Atom Probe Analysis of Ceria as Surrogate Materials for Ceramic Nuclear Fuels. Poster Presentation, Microscopy and Microanalysis, Nashville, TN, 2011.

Kirchhofer R, Hansford B, Reimanis IE, Gorman BP. Characterization of Stresses in the SiC Layer of TRISO Particles. Presentation, Microscopy & Microanalysis, Portland, OR. 2010.

Kirchhofer R, Gorman BP. EBSD Characterization of the Silicon Carbide Layer of TRISO Particles

Prepared in a FIB. Poster Presentation, Microbeam Analysis Society on Electron Backscattered Diffraction, Madison, WI, 2010.

Project Experience

Failure Analysis

Evaluated mechanisms contributing to failure of components to determine the root cause. Analyzed laboratory testing data and compared to models to determine degradation rates and for remaining life assessment. Evaluated historical operation data, maintenance and operation records, and manufacturing information for root cause analysis. Investigations include gas and steam turbines components, high energy piping, piping in petrochemical service, pressure vessels, welded structures, and composite materials in wind energy convertors among others.

Asset Integrity Management

Carried out asset integrity management evaluation based on inspection data and performed risk based inspection ranking in accordance to API 580 / API 581. Risk based inspection assessment applied to high energy piping, petrochemical and explosive manufacturing industries. Performed metallurgical evaluation of buried and above ground piping to determine active damage mechanisms and risk of failure to perform fitness-for-service assessment (ASME FFS-1).

Product Development

Developed failure modes and effect analysis (FMEA) diagrams for product risk assessment of components and to determine appropriate test methods for component validation. Performed materials selection and validation for new designs and for material improvement on existing components, as well as refurbished components for cost saving measures.

Reliability Testing

Develop testing protocols, HALT and HASS, for components and assemblies in high temperature applications. Applied reliability testing methodologies to benchmark design changes and quantify improvements and to assess refurbish components.

Peer Reviewer

Journal of the American Ceramic Society — JACerS

The International Research and Review Journal for Microscopy — Micron

Journal of Nuclear Materials

Journal of Materials Research