



ELIZABETH C. BUC, PhD, PE, IAAI-CFI

Dr. Elizabeth Buc, a recognized leader in Failure Analysis and Forensic Fire Investigation, has a Bachelor's Degree in Chemistry from Rochester Institute of Technology, a Master's Degree in Chemistry from McMaster University, a Master's Degree and PhD in Materials Science and Engineering from Wayne State University and is a licensed Professional Engineer in Metallurgical Engineering in the States of Texas and Michigan. In 2006, she founded Fire and Materials Research Laboratory (FMRL), a forensic engineering consulting firm with burn facility, in Livonia, Michigan. She is a voting principal member on six National Fire Protection Association (NFPA) technical committees. She is a former panel member of the Fire Protection Research Foundation's Research Advisory Committee. She has performed original scientific research for the NFPA as well as the United States Department of Transportation on fire related topics. She has authored and presented papers on improving forensic fire investigation. She speaks at local, state and national conferences on the topic of scientific fire investigation. Her laboratory has state-of-the-art analytical equipment for the examination of failures and fire debris as well as a burn facility for fire and hypothesis testing. She is a current member of the Texas Department of Insurance's Science Advisory Workgroup—as a subject matter expert in Fire Investigation. She has processed hundreds of small and large fires and explosions in Michigan and across the United States. She has testified over 100 times in deposition and trial on matters related to failures, fires and explosions—qualifying as an expert in Chemistry, Fire Investigation and Failure Analysis. She reviewed the chapter on Conductors for the new book *Electrical Fires and Explosions* and authored a new chapter on Oxidizers for the latest edition of the Fire Protection Handbook. Dr. Buc peer reviews fire-related technical papers for the journals *Fire Technology*, *Fire and Materials* and *Fire and Arson Investigator*. In 2022, she received a Professional Excellence Award from the Michigan State Police for her work on and testimony in a murder trial that led to a successful conviction.

EDUCATION & LICENSURE

Ph.D. Materials Science & Engineering	Wayne State University, Detroit, MI (2004)
M.S. Materials Science & Engineering	Wayne State University, Detroit, MI (2002)
M.S. Chemistry	McMaster University, Hamilton, Ontario (1996)
B.S. Chemistry	Rochester Institute of Technology, Rochester, NY (1993)
P.E. Metallurgical Engineering	State of Michigan (#52290, expires 4/21/2026)
	State of Texas (#129620, expires 12/31/2025)
IAAI Certified Fire Investigator	05-020236 (expires 2029)
Michigan Chapter IAAI	Member ID#148 (expires 12/31/2025)

SUMMARY OF RESEARCH & ENGINEERING ACTIVITIES

1. Influence of radiant heat and fire on the performance of and damage to line cords, fuses, electronic devices, lithium-based cells and batteries, and appliances
2. Custom and standard, property and full-scale burn testing of chemicals, plastics, oxidizers, residential products, cells, batteries, modules, packs and electronic devices, and appliances
3. Heat and fire-related failure and forensic examination and analyses of metal and plastic



products, pyrotechnics and composites

4. Hazard assessment of thermal decomposition and combustion of organic and inorganic materials, powder metals, oxidizers, composites and industrial waste
5. Vehicle fire investigations including flammability, fire performance, and flame spread of interior materials and engine components. Evaluation of post-collision and/or post fire damage including electrical faults
6. Plastics and metallurgical failure analysis including fracture, corrosion, high temperature corrosion, welded components, and mechanical damage
7. Materials characterization of oxidizers, plastics, composite, ferrous and non-ferrous products including gaseous products of combustion and/or decomposition
8. Assessment of release and ignition of flammable fuels, vapors, particulate and mists
9. Hazard analysis of new and existing products and processes involving chemicals
10. Evaluation of fabric flammability

PROFESSIONAL EMPLOYMENT & RESEARCH EXPERIENCE

8/06-Present	Materials Engineer/Fire Investigator <i>Fire and Materials Research Laboratory, LLC</i>	
10/96–8/06	Materials Engineer <i>Safety Engineering Laboratories, Inc.</i>	<i>Warren, MI</i>
5/02–9/04	NSF-IGERT Fellow <i>Department of Physics and Astronomy</i> <i>Wayne State University</i>	<i>Detroit, MI</i>
6/01–12/03	Research Intern <i>Williams International</i>	<i>Walled Lake, MI</i>
10/94	Research Assistant <i>Brookhaven National Laboratory</i>	<i>Upton, NY</i>
5/93–7/94	Research Intern <i>Xerox Corporation</i>	<i>Webster, NY</i>

PROFESSIONAL AWARDS

Michigan State Police Professional Excellence Award (Jan. 2022)

PROJECT MANAGEMENT/SCIENCE ADVISORY COMMITTEE APPOINTMENTS

Texas State Fire Marshal's Office Science Advisory Workgroup	September 2016-present
US Navy Contract Project Leader w/ RTI Laboratories, Inc.	January 2016- present



JOURNAL ARTICLES / PUBLISHED REPORTS

Dubay Christian *et al.* Fire Protection Handbook. 21st ed. *Oxidizers, Solids and Liquids*, National Fire Protection Association 2023.

Icove, David, Elizabeth C. **Buc**, Mark E. Goodson, PE, and Thomas R. May. 2021. "State of the Arc (Mapping)." *Journal of the National Academy of Forensic Engineers* 38 (1).

Buc, E.C., *Improved Reaction-to-Fire Test for Particulate Metals and Method to Evaluate the Efficacy and Limitations of Liquid Suppressant Agents for Metals Fires and Waste Hazard Reduction*, U.S Department of Transportation, Project BAA#78, March 2021.

Buc, E.C., *Hazardous Waste Treatment, Storage, and Disposal Facility Fire Code Gap Analysis*, NFPA Fire Protection Research Foundation, 1 Batterymarch, Quincy, MA, 2015.

Buc, E.C., *Assessing the List of Typical Oxidizers*, NFPA Fire Protection Research Foundation, 1 Batterymarch, Quincy, MA, 2013.

Buc, E.C., *Oxidizer Classification Research Project: Tests and Criteria*, NFPA Fire Protection Research Foundation, 1 Batterymarch, Quincy, MA, 2009.

Buc, E.C., *Fire Technology*; Book Review: Fire Debris Analysis by E. Stauffer, et al; 44(2), June 2008, 199-201.

Buc, E.C., Hoffmann, D.J; *Development of Enhanced Hazard Classification System for Oxidizers*, NFPA Fire Protection Research Foundation, 1 Batterymarch, Quincy, MA, 2006.

Hoffmann, J., Hoffmann, D., **Kroll, E.C.**, and Kroll, M.; "Full Scale Burn Tests of Television Sets and Electronic Appliances", *Fire Technology*, 39, 2003, 207–224.

Hoffmann, J., Hoffmann, D., **Kroll, E.C.**, Kroll, M., Fowler, J., and Logan, L.; "Effectiveness of Gas Fired Water Heater Elevation in the Reduction of Ignition of Vapors from Flammable Liquid Spills", *Fire Technology*, 39, 2003, 119-132.

Hoffmann, J., Hoffmann, D., **Kroll, E.C.**, Kroll, M., and Wallace, J.; "Electrical Power Cord Damage from Radiant Heat and Fire Exposure", *Fire Technology*, 37, 2001, 129–141.

CONFERENCE PROCEEDINGS & PRESENTATIONS

Buc, E.C., Burning Down the House: Fires from Self-Heating Ignition Scenarios, *Proceedings 2024 International Symposium on Fire Investigation Science and Technology*

Buc, E.C., Reactive Particulate Solids and Dusts, *Proceedings 2024 International Symposium on Fire Investigation Science and Technology*

Buc, E.C., w/ L. Green and A. Marronne, IAAI International Training Conference: *Status of CSST Fire Investigation, Lab Analysis and Litigation*, Las Vegas, NV, April 2024



Buc, E.C (Instructor)., IAAI Michigan Chapter, Michigan Arson School, *Marijuana Fires and Explosion Hazards*, Lansing, MI, May 2023

Buc, E.C (Instructor)., IAAI Michigan Chapter, Michigan Arson School, *CSST Failures*, Lansing, MI, May 2022

Buc, E.C., w/ Geer, D., Colwell, K., and Spruiell, J.; A Case Study of a Radiant Barrier System Roof Subject to a Lightning Event: From Scene Examination to Metallurgical Analysis, *Proceedings 2018 International Symposium on Fire Investigation Science and Technology*, p 139-153

Buc, E.C., Oakland County Association of Arson and Fire Investigators Quarterly Training Session: Failure Analysis and Analytical Tools, April 17, 2018

Buc, E.C. w/ L. Green and M. Shuttlesworth; Loss Investigations Involving Heating Element Failures: Fire, Water and Personal Injury, *Proceedings 2016 International Symposium on Fire Investigation Science and Technology*, p 179-188

Buc, E.C. w/ D. Icove; Never say Never: Black Swan Fire Investigation Statements and Hypothesis Development in the Real World, *Proceedings 2016 International Symposium on Fire Investigation Science and Technology*, p 105-110

Buc, E.C. Hazardous Waste TSD Fire Problem and Gap Analysis, *NFPA Conference and Expo*, Chicago IL, June 22-24, 2015

Buc, E.C. w/ K. Kreitman, Inspecting Facilities with Combustible Particulate Solids, *NFPA Conference and Expo*, Chicago IL, June 22-24, 2015

Buc, E.C. Fire Investigation and Hazardous Materials, IAAI Michigan Arson School, Instructor, May 21, 2015

Buc, E. C. Breaking Bad: Investigation Fires from Chemical and Chemical Reactions, *NAFI ISFI 2014 Conference*, College Park, MD, September 22-24, 2014

Buc, E.C., Combustible Metal Fires and Explosions-Survey and Case Study, *NFPA Conference and Expo*, Chicago IL, June 10-13, 2013

Buc, E.C., Reiter, D., Battley, J., Sing, T.B., Sing T.M.; Method to Evaluate Damage to Conductors from Fire Scenes, *Fire and Materials International Conference*, San Francisco, CA (January 28-30, 2013)

Buc, E.C., Metallurgy and Fire Investigation, *Proceedings 2012 International Symposium on Fire Investigation Science and Technology*.

Sing, T.B., Sing, T.M, Buc, E.C.; *NFPA-1033 The Forgotten Standard*, Central Texas Fire Investigator Association, Inc., Shertz Civic Center, Shertz, Texas (July 12-13, 2011).

Brannigan, V., **Buc, E.C.**, Forensic Fire Investigation: Creating and Critiquing the Abductive Inference, *Fire and Materials International Conference*, San Francisco, CA (January 31-February 3, 2011).



Brannigan, V., **Buc, E.C.**, The Admissibility of Forensic Fire Investigation Testimony: Justifying a Methodology Based on Abductive Inference Under NFPA 921, *Proceedings 2010 International Symposium on Fire Investigation Science and Technology*, p 105-117.

Brannigan, V., **Buc, E.C.**, Forensic Fire Investigation: An Interface of Science, Technology and Law, *Fire and Materials International Conference*, San Francisco, CA (January 26-28, 2009).

Buc, E.C., Fire Testing Materials and Reality, *FIRESEAT Seminar*, Edinburgh Royal Society, Edinburgh, Scotland (November 12, 2008).

Buc, E.C., Hoffmann, D.J., Finch, J., Forensic Examination of Flexible Gas Connectors from Fire Scenes, *International Symposium on Fire Investigation 2006*, University of Cincinnati (June 26–28, 2006).

U.S. PATENTS

McConnell, P.N., **Buc, E.**, Lindhagen, C.H., Karlsson, A., Reite, F., US Patent Application Publication No. US 2008/0198524 A1, Absorption Gas Arrestor System, August 21, 2008

Ziolo R., Palacios, J.T., **Kroll, E.C.**, Zhang, X., Pieczynski R.; US Patent No. 6,451,220 B1, High Density Recording Compositions and Processes Thereof, September 7, 2002.

Ziolo R., **Kroll, E.C.**, Pieczynski R.; US Patent No. 5, 667, 716, High Magnetization Aqueous Ferrofluids and Process for Preparation and Use Thereof, September 16, 1997.

Ziolo R., **Kroll, E.C.**, Tejada J., Zhang X.; US Patent No. 5, 641, 424, Magnetic Refrigerant Compositions and Processes for Making and Using, June 24, 1997.

TRAINING

11/2024	Constructing Competence in Failure Analysis: A Holistic Approach, Grand Rapids, MI
4/2024	IAAI International Training Conference: Status of CSST Fire Investigation, Lab Analysis and Litigation, Las Vegas, NV
1/2024	CFI Trainer.net: Electric and Hybrid Vehicles; Understanding Undetermined.
4/2023	OCAAFI, Arson and Fire Investigation: 921, 1033, 1321, Oakland, MI
6/2022	National Association of Forensic Engineers, Tucson, AZ
2/2013	Electrical Fires and Explosions by V. Babrauskas, Hyatt Fisherman's Wharf, San Francisco, CA
10/2012	HAZOP Studies and Other PHA Techniques for Process Safety and Risk Management; Advanced Concepts for Process Hazard Analysis, AIChE, Las Vegas NV
2/2011	Regulatory Fire Testing, Hyatt Fisherman's Wharf, San Francisco, CA



4/2008

Residential Electricity for Fire Investigators, Fire Findings Laboratories, Benton Harbor, MI

PROFESSIONAL ASSOCIATIONS

- National Fire Protection Association (NFPA)
- American Chemical Society (ACS)
- American Society of Materials (ASM)
- International Association of Arson Investigators (IAAI)

ADVISORY COMMITTEES, TECHNICAL COMMITTEES, TECHNICAL PANELS

- NFPA Fire Protection Research Foundation Research Advisory Committee (2007-2011)
- NFPA Technical Committee Voting Principal:
 - Hazards and Risks of Furnishings and Contents (HAR-AAA)
 - Fundamentals of Combustible Dusts (CMD-FUN)
 - Combustible Metals (CMD-CMM)
 - Hazardous Chemicals Technical Committee (HCS-AAA)
 - Hazardous Waste Technical Committee (HDW-AAA)
 - Fire Protection for Cannabis Growing and Processing Facilities (CGP-AAA)
- International Group of Experts on Energetic and Oxidizing Substances (IGUS OES)
- NFPA FPRF Technical Panel Member
 - Dust Hazard Assessment Methodology
 - Antifreeze Solutions in Home Fire Sprinkler Systems (Phase I & Phase II)
 - Fire Safety in Consumer Fireworks Storage and Rental Facilities
- SAE 2008 World Congress Fire Safety Session Co-organizer
- Peer-review manuscripts for *Fire Technology*, *Fire Safety Journal*, *Fire and Materials* and *Fire and Arson Investigator Journal*

SERVICE WORK

Ladies Burn and Learn:

@FMRL-July 2022

@FMRL-October 12-14, 2023

Girl Scouts Burn and Learn, Chino Valley Fire Department, CA- December 3, 2023

@Leland Fire Department, Leland, MI-December 9, 2023

CONTACT INFORMATION

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