

Exponent®
Engineering & Scientific Consulting

Trevor Lardinois, Ph.D., P.E., CFEI, CGE

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Professional Profile

Dr. Lardinois applies the fundamentals of chemical engineering, chemistry, mechanical engineering, and material science to investigations and analyses of safety incidents or technical issues involving chemical/mechanical processes, fires/explosions, industrial and fuel gas equipment, formulations, and consumer products. Dr. Lardinois is an active member within the American Institute of Chemical Engineers (AIChE), National Association of Fire Investigators (NAFI), National Fire Protection Association (NFPA), and American Society of Gas Engineers (ASGE) by way of participation, publications, presentations, and conference organization. Examples of Dr. Lardinois' technical consulting work includes:

Fire and Explosion Sciences

Dr. Lardinois has extensive experience investigating incidents related to fires and explosions in various industry sectors, such as agriculture, hazardous waste, residential appliances/products, and industrial chemical/utility process plants. Dr. Lardinois applies the fundamentals of engineering principles, physics, and laws of science to investigate complex incidents, often relying on calculations, modeling, laboratory testing, standards, and regulations to evaluate evidence and test hypotheses. He has investigated fires, combustion explosions, mechanical overpressure explosions, and chemical releases in a variety of settings, ranging from residential to large industrial facilities. Dr. Lardinois developed expertise with self-heating and reactive chemical hazards evidenced by numerous technical projects, research, publications, and presentations, especially for fiber materials, reactive metals, vegetable oil-containing materials, adsorbent materials (e.g., carbon), and coatings. Additionally, he offers technical services in the fuel gas industry (natural gas, LP, and propane gas) as it relates to piping, connections, regulators, materials of construction, odor fade, burners, gas-fired appliances/boilers, and carbon monoxide poisoning. Dr. Lardinois has advised clients on forced failure analyses and fire risk evaluations for consumer products and appliances from a system level down to the component level.

Mechanical Systems, Processes, and Construction

Dr. Lardinois leads investigations related to mechanical systems and processes (residential and industrial) involving water losses, fuel gas systems and components, chemicals, and process plant construction. His expertise has been leveraged to support clients on projects related to Design-Bid-Build (DBB) and Engineering Procurement Construction (EPC). Specific examples include investigations of issues related to operations, maintenance, and management of large capital assets, such as turbines, generators, dryers, and hydroelectric pumps, with evaluations focused on the performance and installation against recommended and generally accepted good engineering practices (RAGAGEP), contractual specifications, Owner requirements, design/technical specifications, and/or regulatory requirements.

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Emissions and Technologies

Another core area of Dr. Lardinois' technical consulting portfolio focuses on emissions and technologies for pollution abatement. His Ph.D. thesis work focused on automotive exhaust pollutant (NOx, COx) abatement systems and controls. This research expertise has been leveraged at Exponent to support a variety of other emission related projects, such as vehicle defeat devices, hazardous gas scrubbing/adsorption processes, carbon monoxide or flue gas releases, and decomposition of fluoropolymers (PFAS abatement). Dr. Lardinois has worked with clients to understand the failure mechanisms of problematic emission systems or formulations, and provided guidance on alternative technologies, formulations, and/or strategies to meet challenging contractual and regulatory requirements or lower risk.

Chemical Characterization, Kinetics, and Analytical Chemistry

Dr. Lardinois champions the area of chemical characterization, kinetics, and analytical chemistry. During his Ph.D. thesis, Dr. Lardinois developed novel, analytical characterization methods to address the fundamentals of complex chemicals and their formulations. He has published and presented detailed analyses of kinetics, catalyst deactivation, and catalyst regeneration to a wide variety of industries. These skills have been leveraged at Exponent to solve clients' challenges as it relates to contamination, performance, quality, and risks of a variety of formulations (catalysts, active pharmaceutical ingredients, adsorbent beds) and processes across many industries, such as pharmaceutical, automotive, hazardous waste, coatings, and chemical.

Path to Exponent

Dr. Lardinois received his B.S. in Chemical Engineering from the University of Wisconsin – Madison, where he researched the upgrading of biomass derived feed stocks to value-added chemicals. After a summer sojourn to the Technical University of Vienna in Austria, Dr. Lardinois started his Ph.D. studies at Purdue University. His dissertation focused on the influence of zeolite material properties and external gas conditions on the thermodynamics and kinetics of metal structural interconversion for the abatement of NOx pollution from automotive engine exhaust. Throughout his Ph.D. studies, Dr. Lardinois worked with many advanced catalyst/material characterization instruments and frequently consulted with automotive companies.

Academic Credentials & Professional Honors

Ph.D., Chemical Engineering, Purdue University, 2021

B.S., Chemical and Biological Engineering, University of Wisconsin, Madison, 2016

Chemical Engineering Citation Award, Purdue University, 2023

Prof. K.C. Chao and Jiun Chao Graduate Education Endowment Grant, Purdue University, 2020

Outstanding Teaching Assistant Award (Heat and Mass Transfer), Purdue University, 2018

Ross Fellowship, Purdue University, 2016–2017

Melby Scholarship, University of Wisconsin – Madison, 2015

Gensler Scholarship, University of Wisconsin – Madison, 2015

Eugene and Patricia Kreger Herscher Scholarship, University of Wisconsin – Madison, 2014 & 2015

Engineering Great People Scholarship, University of Wisconsin – Madison, 2014

Licenses and Certifications

Professional Engineer, Illinois, #062075487

Professional Engineer, Iowa, #P30707

Professional Engineer Chemical, Minnesota, #63284

Professional Engineer, Wisconsin, #102200-6

40-Hour Hazardous Waste Operation and Emergency Response Certification (HAZWOPER)

Certified Gas Engineer (CGE)

Certified Fire and Explosion Investigator (CFEI)

Prior Experience

Quality and Assurance Intern, AbbVie, 2015

Professional Affiliations

American Institute of Chemical Engineers (AIChE)

• Session Chair – Midwest Regional Conference 2022-25, Catalysis, Reaction/Green Engineering, Process Safety

• Session Chair – Spring AIChE 2022, Fuels and Petrochemical Division, Catalysis Session

National Fire Protection Association (NFPA)

• Alternate Member: Technical Committee on Ovens and Furnaces, NFPA 86 Standard for Ovens and Furnaces

National Association of Fire Investigators (NAFI)

American Society of Gas Engineers (ASGE)

Publications

Lardinois TM, Hollenbach RL, Garner S, Fecke MT. Chapter 8 - Concentrating solar power and thermal energy storage system technologies and case studies. The Sustainable Power Grid: Challenges, Applications, and Case Studies. November 2024, pp. 165-183.

Lardinois TM, Swann J, Morrison T. Investigating Spontaneous Combustion and Fire Protection Engineering at an Insulating Panel Manufacturing Facility, International Symposium On Fire Investigation Science & Technology, Conference Proceedings. September 2024, pp. 331-340.

Lardinois TM, Morrison T, Revez D. An unexpected explosion while fumigating a grain silo: It wasn't the dust. Special Issue: 9th CCPS Latin American Conference on Process Safety October 18, 2022 to October 20, 2022 Rio de Janeiro, Brazil, 2023, pp. S97-S102.

Theis JR, Ura J, Getsoian A, Prikhodko VY, Thomas CR, Pihl JA, Lardinois TM, Gounder R, Wei X, Ji Y, Pace RB, Crocker M. Effect of framework Al pairing on NO storage properties of Pd-CHA passive NOx adsorbers. Applied Catalysis B: Environmental, March 2023; 322, 12074.

Lardinois TM, Mandal K, Yadav V, Wijerathne A, Bolton BK, Lippie H, Li CW, Paolucci C, Gounder R. Kinetic and Thermodynamic Factors Influencing Palladium Nanoparticle Redispersion into Mononuclear Pd(II) Cations in Zeolite Supports. Journal Physical Chemistry C 2022, 126, 19, 8337–8353.

Kim P, Van Der Mynsbrugge J, Aljama H, Lardinois TM, Gounder R, Head-Gordon M, Bell AT. Investigation of the Modes of NO Adsorption in Pd/H-CHA. Applied Catalysis B: Environmental, May 2022; 304, 120992.

Pace R, Lardinois TM, Ji Ya, Gounder R, Heintz O, Crocker M. Effects of treatment conditions on Pd speciation in CHA and Beta zeolites for passive NOx adsorption. ACS Omega, 2021; 6, 29471−29482

Crocker, M, Bell, AT, Van der Mynsbrugge, J, Kim, P, Gounder, R, Lardinois, T, Bates, J, Pace, R, Ji, Y, Lambert, C, Theis, JR, Getsoian, A, Ura, J, Lupescu, J, Prikhodko, V, Wei, X. Development of Passive HC/NOx Trap Catalysts for Low Temperature Gasoline Applications, Report Number: DOE-UKY-EE0008213, 2021.

Lardinois TM, Bates JS, Lippie HH, Russell CK, Miller JT, Meyer HM, Unocic KA, Prikhodko VY, Wei X, Lambert CK, Getsoian A, Gounder R. Structural Interconversion Between Agglomerated Palladium Domains and Mononuclear Pd(II) Cations in Chabazite Zeolites. Chemistry of Materials, January 2021; 33(5):1698−1713.

Shih A, Khurana I, Li H, González JM, Kumar A, Paolucci C, Lardinois TM, Jones CB, Albarracin Caballero JD, Kamasamudram K, Yezerets A, Delgass WN, Miller JT, Luz Villa A, Schneider WF, Gounder R, Ribeiro FH. Spectroscopic and kinetic responses of Cu-SSZ-13 to SO2 exposure and implications for NOx selective catalytic reduction. Applied Catalysis A, March 2019; 574(25):122−131.

Presentations

Lardinois TM, Carlton A, Schroeder E, Morrison T. Process Safety Lessons Learned from an Aluminum Casting Steam Explosion, AIChE Global Congress on Process Safety. April 2026.

Lardinois TM, Hetrick T, Morse T, Lindahl P. Failure Analysis of Fuel Gas Systems. American Society of Gas Engineers National Conference, June 2025.

Lardinois TM, Schroeder E, Morrison T. Hazards and Fundamentals of Handling and Transferring Flammable, Caustic, and Toxic Liquid Chemicals in Non-Steady-State Operations, AIChE Midwest Regional Conference. April 2025.

Schroeder E, Lardinois TM, Morrison T. Steam Explosion: Process Safety in Molten Metal Processes, AIChE Global Congress on Process Safety. April 2025.

Lardinois TM, Swann J, Morrison T. Investigating Spontaneous Combustion and Fire Protection Engineering at an Insulating Panel Manufacturing Facility. International Symposium On Fire Investigation Science & Technology, September 2024.

Lardinois TM, Cox BL. Hazardous Waste Generators and Treatment Facilities: Hazardous Waste Characteristics, RCRA and Treatment Technologies. AIChE Midwest Regional Conference, March 2024.

Lardinois TM, Hietala DC, Cox BL, Dee SJ, Ogle RA, Walters MS. Learnings in Material Flash Point Characterization from the Lac-Mégantic Rail Disaster. AIChE Midwest Regional Conference (virtual), March 2022.

Lardinois TM, Lippie HH, Yadav V, Li CW, Gounder R. Effects of Pd particle size and water pressure on the structural transformation of Pd nanoparticles to mononuclear Pd(II) cations in CHA zeolites. Chicago Catalysis Club Conference (virtual), May 2021.

Lardinois TM, Bates JS, Lippie HH, Gounder R. Interconversion of agglomerated Pd domains and mononuclear Pd(II) cations in CHA zeolites. North East Corridor Zeolite Association Annual Meeting (virtual), December 2020.

Lardinois TM, Bates JS, Getsoian A, Miller JT, Gounder R. Interconversion of agglomerated Pd domains and mononuclear Pd(II) in CHA zeolites. American Institute of Chemical Engineers Annual Meeting (virtual), November 2020.

Lardinois TM, Bates JS, Getsoian A, Miller JT, Gounder R. Structural Interconversion Between Agglomerated Pd Domains and Isolated Pd2+ Cations in Chabazite Zeolites. Cross-Cut Lean Exhaust Emissions Reduction Simulations (virtual), September 2020.

Lardinois TM, Bates JS, Getsoian A, Miller JT, Gounder R. Interconversion of agglomerated Pd domains ion-exchanged Pd2+ in CHA zeolites." Chicago Catalysis Club Conference (virtual), August 2020.

Lardinois TM, Gounder R. Structural interconversion between agglomerated Pd domains and isolated Pd cations in chabazite zeolites. Purdue Graduate Student Symposium (virtual), August 2020.

Lardinois TM, Bates JS, Unocic KA, Choi JS, Prikhodko VY, Getsoian A, Miller JT, Gounder R. Palladium Speciation in Beta and Chabazite Zeolites for Passive NOx Adsorption. North American Catalysis Society Meeting, Chicago, IL, June 2019.

Lardinois TM, Bates JS, Unocic KA, Prikhodko VY, Getsoian A, Theis J, Lambert CK, Miller JT, Gounder R. Palladium Speciation in Zeolites for Passive NOx Adsorption. Cross-Cut Lean Exhaust Emissions Reduction Simulations, Ann Arbor, MI, September 2018.

Lardinois TM, Motagamwala AH, Dumesic J. Conversion of Ligno-cellulosic Biomass to Sugars Using Gamma-Valeroactone. Chemical and Biological Undergraduate Research Poster Session, Madison, WI, December 2015.

Project Experience

Fire and Explosion Sciences

· Spontaneous combustion and basket testing

· Self-heating of fibers, carbon materials, vegetable-derived oils, wood finishing products, metal fines

· Residential, commercial, and industrial fire/explosion investigation

· Corn/grain processing facilities and combustible dust

· Hot work incidents

· Leak testing of fuel gas systems and appliances

· Hospital fires involving oxygen enriched atmospheres and electrocautery

· Explosions, fires, and incidents caused by chemical reactivity hazards

· Fuel gas systems, components, and equipment in residential and industrial settings

· Flue or combustion gas releases (e.g., carbon monoxide poisoning)

Hazardous Waste Chemistry, Releases, and Management

· Chemical treatment of hazardous waste

· Representative sampling of hazardous waste

· Chemical releases (recent or historical), especially trichloroethylene (TCE)

· Unknown reactive chemistries and hazards

· Sulfur chemistry (H2S, SO2)

· Hazardous waste management and regulations for generators and TSDFs

Product Safety and Failures

· Aerosolized spray – slip and fall hazards, flammability testing following SOR/2001-269 Schedule 1 (Canada) and 16 CFR § 1500.45 (United States)

· AV carts – tipping (UL 1678)

· Blenders – motor locking, smoking

· Candles – flashing/flash over, container integrity, ASTM standards for fire safety, manufacturing, adhesion material compatibility

· Clothing storage tip-over – testing, ASTM F2057-23

· Electric Kettles – container integrity, burns

· Flame arresters – certification

· Heated massagers – skin burns, process parameters

· Laminators – safety features, smoking

· Shredders – smoking, locking motors

· Space Heaters – failures, melting

· Water heaters – control valves, thermal cutoffs, flame arrestors

Engineering and Construction

· Operations, equipment, maintenance, systems, capital assets management

· Engineering Procurement Construction, Design Bid Build, turn-key, engineering contracts

· Power and Utility Plants with steam turbines, supercritical boilers, hydroelectric pumps

· Piping support following MSS SP-58, ASME B31.1, ASME B31.3

Emissions and Vehicles

· Pollution abatement in mobile engine exhausts (especially SCR and NOx traps)

· 40 CFR Part 86

· Defeat devices

· Hazardous gas abatement and adsorption with packed beds

· Technologies for plastic decomposition and PFAS abatement

Chemical Characterization, Kinetics, and Analytical Chemistry

· Synthesis, characterization, and kinetics (especially zeolites) of catalysts and formulations

· Deactivation and regeneration of catalysts

· Chemical characterization of formulations and contaminants

· Technical requirements and compliance of chemical converting processes

· Experience with a suite of analytical chemistry equipment

Peer Reviews

Process Safety Progress (AIChE)

Applied Catalysis B: Environment and Energy