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RICHARD CHU ITHERM AWARD FOR EXCELLENCE

THERMAL MANAGEMENT OF LITHIUM-ION BATTERIES FOR ELECTRIC VEHICLES: A MULTISCALE CELL-TO-VEHICLE HIERARCHICAL PERSPECTIVE

Presented by the 2021 Awardee Cristina Amon

Friday June 4, 10:30 AM – 11:30 AM EDT

Alumni Distinguished Professor in Bioengineering
Advanced Thermofluid Optimization, Modeling, and Simulation (ATOMS) Laboratory
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Abstract: Electric Vehicles are expanding at a rapid pace, enabled by technological advances in lithium-ion batteries, fast chargers, and charging infrastructures. Further advances in lithium-ion battery (LIB) performance and lifetime relies on enhanced thermal management strategies and packaging architectures, realized as intelligent battery thermal management systems, which can optimally control the thermo-electrochemical phenomena occurring inside the batteries to maximize LIB performance, minimize degradation, enable fast-charging protocols, and permit a seamless transition of degraded electric vehicle (EV) batteries into less-demanding second-life stationary systems. This presentation will describe current engineering challenges and opportunities on EV thermal management, with a focus on our research on multiscale hierarchical design, modelling, and optimization approaches to overcome cooling and heating challenges across multiple physical domains and length scales; from battery electrodes, to battery cells, modules, and packs, to vehicle-level thermal management systems. We will provide a scale-bridging perspective across the following subjects: (i) sub-continuum modelling and thermal engineering of electrode materials for metal-ion batteries, (ii) characterization of anisotropic thermophysical properties and spatially distributed heat generation rates in battery cells, (iii) high-fidelity thermo-electrochemical modelling and simulations of battery cells and modules, (iv) reduced-order thermal models, scalable to different battery sizes and cooling architectures at the battery pack level, (iv) performance-degradation models of LIB packs, (v) vehicle-level model validated with experiments in a concept EV, and (vi) thermal management systems to enable thermally-safe fast charging and temperature-modulated battery life extension.

Cristina Amon is Alumni Distinguished Professor and Dean Emerita of the Faculty of Applied Science and Engineering at the University of Toronto. Prior to joining U of T in 2006, she was the Raymond J. Lane Distinguished Professor and Director of the Institute for Complex Engineered at Carnegie Mellon University. She has pioneered the development of computational fluids dynamics, multidisciplinary multiscale hierarchical modelling, concurrent design and optimization methodologies for thermo-fluid transport phenomena, with applications to thermal management of electronics and electric vehicles, renewable energy and biomedical devices.

Professor Amon is a fellow of ASEE, ASME, IEEE and other major professional societies in her field and has contributed over 400 refereed articles to the education and research literature. She was appointed to the Order of

Canada and inducted into the Canadian Academy of Engineering, Hispanic Engineer Hall of Fame, Royal Society of Canada, Spanish Royal Academy and US National Academy of Engineering.

Among her many accolades, she received the ASEE Westinghouse Medal, ASEE Ralph Coats Roe Award, ASME Heat Transfer Memorial Award, ASME InterPACK Achievement Award, EIC Sir John Kennedy Medal, and CSME Robert W. Angus Medal. She was recognized as one of Canada's Most Influential Women in 2012, the Powerful Women Trailblazers & Trendsetters in 2019, and received the highest honor for Engineers in Canada (2020 Engineers Canada Gold Medal) and in Ontario (2015 PEO Gold Medal) for outstanding engineering public service, technical excellence and professional leadership.

Cristina Amon is the founding chair of the Global Engineering Deans Council and has served on numerous advisory and review boards in North America and abroad, editorial and technical conference roles, including ITherm General Chair in 2002. She received her Mechanical Engineering degree from Simon Bolivar University in Venezuela, and her M.S. and Sc.D. from the Massachusetts Institute of Technology.