Abstract

Lithium-ion batteries are widely used in electric vehicles and energy-storage systems, with their performance strongly influenced by chemistry, cell design, temperature, and operating conditions. This seminar introduces the fundamentals of lithium-ion batteries, key terminology, and common cell chemistries, including why different chemistries are selected for different applications.

After the fundamentals have been explained, it will be followed by a research section that examines how cell chemistry, size, and temperature affect battery performance. Cells with different capacities and chemistries are compared using internal resistance and coulombic efficiency, with particular emphasis on their behavior at low temperatures and whether different cells respond similarly to cold conditions.

The seminar then transitions to battery modeling, introducing equivalent-circuit models, their governing electrical and thermal equations, and their state-space representation. The relationship between experimentally observed battery behavior and the mathematical models used to describe and predict that behavior will also be discussed.

BIO

Ahmed Abdelrahman is a Ph.D. candidate in Mechanical Engineering at Carleton University, specializing in lithium-ion battery characterization, modeling, degradation analysis, and advanced charging control. He holds a B.Eng. in Mechatronics and Automation from Ain Shams University and an M.Eng. in Mechanical Engineering from the University of Ottawa.

His experience includes work in energy-storage systems at Portable Electric, battery research at the National Research Council Canada, and lithium-ion cell testing and characterization at Stellantis Canada, where he currently works as a Battery Test Engineer. His research interests include battery diagnostics, internal resistance and degradation analysis, equivalent-circuit modeling, state-of-health estimation, and model predictive charging.