Boulder Fluid and Thermal Sciences Seminar Series

Tuesday, March 6, 2018
3:30pm-4:30pm (refreshments at 3:15pm)
Bechtel Collaboratory in the Discovery Learning Center
University of Colorado, Boulder

Computational Design of Lithium-Ion Batteries for Next Generation Electric Vehicles

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Batteries are ubiquitous in our modern lives, enabling everything from untethered viewing of cat videos to 'ludicrous' 2.8-second 0-to-60 mph acceleration in a family sedan. But as battery users, we are all familiar with their shortcomings as well. An exceedingly complex electrochemical system, batteries typically improve in energy density just 5-8% per year, a far cry from Moore's law. Nonetheless, with near term improvements in lithium ion chemistry, battery electric vehicles (BEVs) may soon become cheaper than their conventional internal combustion engine counterparts.

But to truly compete with the status quo, these BEV batteries don't just need to be inexpensive. They must be capable of >200 mile range, 10 minute fast charging, and 15 year lifetime. Thus enters the challenge for battery scientists and engineers. For the past 8 years, the U.S. Department of Energy's (DOE's) Computer Aided Engineering for Batteries (CAEBAT) program has worked to develop and proliferate computational models to help enable the design of safe, long lasting batteries for electric-drive vehicles. Based on these successes, battery manufacturers and automotive integrators have largely adopted computer-aided engineering tools for design of large format cells and battery pack systems. Active research is increasingly turning towards the microstructure length scale, to understand and quantify the role of electrode microstructure on performance and lifetime.

After introducing batteries and developments at U.S. DOE, this presentation outlines ongoing studies at NREL under the CAEBAT program designed to address gaps and enable next generation battery architectures and chemistries. Electrical, chemical, electrochemical, mechanical and thermal physics are all at play across disparate time- and length-scales.

Biography: Kandler Smith is a senior researcher and principal investigator in the Transportation & Hydrogen Systems Center, Energy Storage Group at the U.S. Department of Energy's National Renewable Energy Laboratory in Golden, CO. He leads projects in Li-ion battery-lifetime prediction, multi-physics modeling and computational design. Kandler holds a Ph.D. in mechanical engineering from the Pennsylvania State University in electrochemical modeling and control of Li-ion batteries and recently co-authored a textbook on design and analysis of large Li-ion battery systems.