Seminar Announcement

Thermal Transport in Li-ion Cells: Materials, Processes and Metrology

Presenter: Dr. Ankur Jain, Assistant Professor, Mechanical and Aerospace Engineering, University of Texas at Arlington

Location: Microelectronics and Engineering Research Center (MER 160), Room 2.114, 10100 Burnet Road, Austin TX 78758

Time: Friday, November 11th, 2016, at 3:30 PM CDT.

Abstract: Li-ion batteries offer excellent energy conversion rate and high energy storage density in electric vehicles, aircraft, consumer electronics and renewable energy storage. However, these batteries suffer from several safety related problems, as evidenced by recent product recalls and incidents of fires in electric cars and aircraft. Overheating due to poor thermal transport is at the heart of several of these challenges, and therefore, a fundamental understanding of heat transfer in Li-ion cells is critically needed.

This talk will summarize ongoing research that integrates experimental measurements with robust analytical modelling to better understand and optimize heat transfer in batteries. We have reported, for the first time, measurement of orthotropic thermal transport properties of a Li-ion cell. We have carried out material-level measurements that show that poor thermal transport across the cathode-separator interface is the fundamental root cause of the low thermal conductivity of Li-ion cells. We have also experimentally demonstrated a molecular bridging approach that reduces this rate-limiting thermal contact resistance by 4X, which is expected to dramatically reduce operating temperature rise in a Li-ion cell. Recent experiments have demonstrated the capability to non-invasively measure the temperature at the core of a Li-ion cell through surface temperature measurements using an analytical thermal transport model. We have also shown that the occurrence of thermal runaway is governed by the value of a single, non-dimensional number, which we call the Thermal Runaway Number (TRN), that combines the effects of multiple thermal processes within the cell. These efforts not only improve the fundamental understanding of thermal transport in electrochemical energy systems, but also provide the technological basis for high-performance batteries that do not suffer from an overwhelming risk of thermal runaway and fire.

Ankur Jain is an Assistant Professor in the Mechanical and Aerospace Engineering Department at the University of Texas, Arlington. His research interests include heat transfer in Li-ion batteries, microscale thermal transport, bioheat transfer, microelectromechanical systems, etc. He received the NSF CAREER Award (2016) and the ASME EPP Division Young Engineer of the Year Award (2013). He received his Ph.D. (2007) and M.S. (2003) in Mechanical Engineering from Stanford University, and his B.Tech. (2001) in Mechanical Engineering from the Indian Institute of Technology (IIT), Delhi with top honors. His research has been supported by National Science Foundation, Department of Energy, Office of Naval Research, Indo-US Science & Technology Forum, etc.