**MECHANICAL & INDUSTRIAL ENGINEERING COLLOQUIUM: ME 794 002**

**Role of mechanics in the design of durable lithium ion batteries**

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**Abstract**

Lithium-ion batteries are attractive candidates as energy storage devices for solar power, wind power, and electric vehicle applications; however, their capacities and energy densities are still not enough to meet the industry requirements. Replacing existing electrode materials with higher performance materials could address the capacity issue to some extent, but it poses other challenges. The new anode materials (such as Si, Sn, Al etc.) undergo large volume changes (~100-270%) upon reacting with lithium which induces significant amount of stresses in the electrodes during battery operation. These stresses cause fracture and mechanical damage, which also promotes chemical degradation. Both of these processes lead to rapid capacity fade. Although cathode materials do not undergo significant volume changes, mechanical degradation due to stresses is still a major issue. Hence, there is a need to understand the mechanical behavior of electrode materials and coupling between electrochemistry and mechanics to be able to design efficient, durable, and higher-energy density batteries. In this talk, I will explain the ongoing experimental and modeling efforts in understanding the deformation and fracture behavior of different electrode materials and their effect on battery performance. In addition to the work on thin film electrodes, I will talk about stress measurements in composite electrodes and explain how this data can be used to estimate pressure that the casing of a commercial (jelly roll configuration) Li-ion battery will undergo as a function of state of charge.

**About the Speaker:**

Siva Nadimpalli obtained his PhD (2011) from University of Toronto, MSc (Engg) (2005) from Indian Institute of Science, and B.E (2002) from Andhra University, all in Mechanical Engineering. After completing his study at IISc, Siva Nadimpalli joined Wind Energy group at GE, Bangalore as a Mechanical Engineer and carried out projects involving prototype testing of wind turbines and fatigue analysis of turbine components. He moved to Canada in 2006 to pursue doctoral studies at University of Toronto. During his PhD, Siva Nadimpalli developed experimental techniques to characterize fracture behavior of solder joints and printed circuit boards in commercial microelectronic packages. After finishing PhD, he worked as a postdoctoral research associate in School of Engineering at Brown University. The main focus of his research was to understand the mechanical behavior of energy storage materials primarily by using various experimental techniques. After his postdoc appointment, he returned to Canada to work for Nanowave Technologies Inc. Toronto. He is currently an Assistant Professor in the Department of MIE at NJIT, Newark, NJ. His current research focus is to understand deformation and fracture behavior of various lithium-ion battery electrode materials.

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