

MSE-Colloquium@NTU

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3D Mesostructured Electrode Concepts for High Energy and Power Density Rechargeable Batteries

Professor Paul Braun

*Department of Materials Science and Engineering
University of Illinois at Urbana-Champaign*

About the Talk

Through mesoscale design of a 3D current collector, both large format and microscale high power density and high energy density primary and secondary (rechargeable) batteries were fabricated. At the most fundamental level, mesostructuring enables optimization of the trade-off between energy and power density in energy storage systems due to unavoidable ohmic losses and other losses that occur during charging/discharging. Of course, it is at fast charging and discharging, where these effects are most important. By efficient design of the ion and electron transport pathways, we and others have shown it is possible to significantly improve the power-energy relationship. A particularly effective way to provide these pathways is to use a colloidal-based template to form a mesostructured 3D current collector. The electrochemically active material is then deposited on this current collector. Using this approach, Li-ion batteries which could be discharged at up to 300C with 75% capacity retention were formed. The combination of high surface area and short solid-state diffusion lengths of a mesostructured electrode design also offers a number of unique opportunities for both high energy and high power chemistries. As examples, we have formed conventional form-factor and microbattery high power cells based on a lithiated manganese oxide cathode and carbon or NiSn anodes, and high energy cells based on a silicon anode.

About the Speaker

Professor Paul Braun is the Ivan Racheff Professor of Materials Science and Engineering and Professor of Chemistry at the University of Illinois at Urbana-Champaign (UIUC). He received his B.S. degree with distinction from Cornell University, and his Ph.D. in Materials Science and Engineering from UIUC. Following a postdoctoral appointment at Bell Labs, Lucent Technologies, he joined the faculty at UIUC. Professor Braun has co-authored a book, over 200 papers, and multiple patents, and has co-founded two companies. He is the recipient of the Young Alumnus Award (2011), the Friedrich Wilhelm Bessel Research Award (2010), the Stanley H. Pierce Faculty Award (2010), the Beckman Young Investigator Award (2001), the 3M Nontenured Faculty Award, the 2002 Robert Lansing Hardy Award from TMS, the Xerox Award for Faculty Research (2004, 2009) and multiple teaching awards. In 2006, he was named a University Scholar by UIUC, and in 2011 was named the Ivan Racheff Professor of Materials Science and Engineering.