"Understanding and Design of Materials of High Energy Density Batteries"

Wednesday
February 26, 2020
3:00 pm
Wu and Chen Auditorium
Levine Hall

Jeffrey Lopez
Postdoctoral Fellow
Massachusetts Institute of Technology

Abstract

Environmental challenges and economic forces are reshaping the way we generate and consume energy on a global scale. To keep up with the accelerating adoption of electric vehicles, allow for grid scale energy storage, and meet the demands of future technological advances, new materials for high energy density batteries must be developed. High costs have prevented widespread deployment of lithium-ion batteries beyond portable electronics, and the safety hazards of exothermic reactions associated with traditional materials during cell failure remain to be fully addressed. Therefore, strategies to enhance the mechanical and chemical stability of next-generation electrode materials are key to the successful integration of batteries into our future energy systems. In this presentation, I will discuss new materials designed to address issues of stability in Li-ion batteries and fundamental insight into the mechanisms of this stabilization. The first portion of my talk will describe how a supramolecular, hydrogen-bonding, self-healing polymer is used to stabilize high capacity anode materials. Next, I will describe further investigation toward a general understanding of how polymer coatings affect the electrodeposition of metallic lithium anodes. Third, I will discuss the use of in situ characterization techniques to study the mechanisms of electrolyte decomposition reactions at the lithium metal interface. Overall, the work presented here contributes new materials to be used in electric vehicles, grid scale storage, and new electronic devices, and uses these materials to develop a fundamental understanding about how materials properties affect the stability of lithium ion batteries in each application. This understanding provides direction for the design and synthesis of new polymer materials to better stabilize advanced battery chemistries.

Bio

Jeffrey Lopez earned his Ph.D. in 2018 from Stanford University under the supervision of Prof. Zhenan Bao. He was awarded a NSF Graduate Research Fellowship and a NDSEG Fellowship to fund his graduate work, which focused on molecular design new self-healing polymers and elastomers with novel mechanical properties for improving the stability of lithium ion batteries. Jeffrey is currently an Intelligence Community Postdoctoral Fellow at the Massachusetts Institute of Technology working with Prof. Yang Shao-Horn where he is studying fundamental mechanisms of electrochemical instability and ion transport in polymer electrolyte materials. Jeffrey has received multiple awards for his research including the ACS Eastman Chemical Student Award in Applied Polymer Science in 2018 and the AIChE Excellence in Graduate Polymer Research Award 1st Prize in 2016. Jeffrey was involved with the Stanford Polymer Collective as president from 2013-2016, supporting the polymer research community on Stanford's campus, and has worked with various programs at Stanford and MIT to promote improved access to higher education among students from underrepresented minority groups.

Spring 2020 CBE Seminar Series

Penn Engineering