BIG energy seminar series

Addressing the scale and complexity of the global energy challenge.

Material and System Approaches to Electrochemical Energy Storage

Dr. Ping Liu

ARPA-E Program Director

Date: Tuesday, April 29, 2014 at 3:15pm
Location: ECCR 1B40

Abstract:

Energy storage is an enabling technology for both vehicle electrification and grid storage. Driven by the desire to increase specific energy, recent battery material research has focused on "beyond lithium ion" systems with very high capacities but also extensive structural changes during operation. In the 1st half of the presentation, we use Li/FeF3 as an example to show that the extensive structural change accelerates charge losses at the interface, leading to large hysteresis and poor cycle life. These observations are consistent with known issues that had plagued historical battery chemistries such as lead-acid and nickel-cadmium. We next present approaches to address the stability issues of these reactions which include system designs to replenish lost active materials, nanoengineering to mitigate mechanical failure of electrode materials, and use of solid separators to isolate individual electrode reactions.

In the 2nd half of the presentation, we discuss how my research experience helps shape the vision of an ARPA-E program. The RANGE program supports long-life, robust battery chemistries and multifunctional designs where batteries also serve structural functions when used on an electric vehicle. This approach contrasts with the pursuit of high specific energy batteries and opens the possibility of using batteries of lower specific energies without system-level weight penalty. Advantages of the RANGE approach will be illustrated by innovative examples. We conclude by pointing out promising new directions and research needs in energy storage, where extremely long-life systems can simultaneously serve the storage need for the electric grid, distributed generation, and electric vehicle. This synergy can greatly reduce the overall life-cycle cost and enable energy storage as a cornerstone for a sustainable future.

Bio:

Dr. Ping Liu currently serves as a Program Director at the Advanced Research Projects Agency – Energy (ARPA-E), where he initiated and manages the RANGE program aimed at developing innovative energy storage solutions for electric vehicles. In addition, he has broad interests in advanced materials for energy efficiency and manages the REACT program which develops rare-earth free permanent magnetic materials. Dr. Liu was previously Manager of Energy Technology at HRL Laboratories, an industrial research company jointly owned by the Boeing Company and General Motors. At HRL, Dr. Liu led a broad range of research activities in energy conversion and storage for owner companies as well as government and commercial customers. Prior to joining HRL in 2003, Dr. Liu was a member of the technical staff at the National Renewable Energy Laboratory (NREL). At NREL, Dr. Liu conducted research in thin film batteries, electrochromics, and optical hydrogen sensors. He contributed to several inventions that have been transitioned to industry for commercialization and received an R&D 100 Award from R&D Magazine for a solid-state battery technology. Dr. Liu has published more than 60 archival journal papers and has more than 40 issued or pending patents. He received his B.S., M.S. and Ph.D., all in chemistry, from Fudan University in China.

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