

Scalable Electrochemical Energy Storage R&D at UK-CAER

Ralph Brodd^{1*}, Stephen M. Lipka^{1,2,3}, Christopher Swartz², Illayathambi Kunadian², Rong Chen²,
Fon Rogers² and Raghu Mangu³

¹KY-ANL Battery Manufacturing Research and Development Center, Lexington, KY 40511

²Center for Applied Energy Research, University of Kentucky, Lexington, KY 40511

³Department of Electrical and Computer Engineering, University of Kentucky, Lexington, KY 40506

*E-mail: rbrodd@gmail.com

The integration of intermittent renewable energy technologies based on wind, solar, or tidal power into the electrical grid of the future is highly dependent on the development and assimilation of energy storage technologies into the current grid superstructure. Distributed bulk energy storage technologies currently under development include pumped hydropower, compressed air energy storage, superconducting magnetic energy storage, and flywheels. The deployment of energy storage technologies can provide numerous advantages to utilities and consumers, including improvement in power quality, reliability and efficiency, and cost-effectiveness.

The Electrochemical Power Sources Group at the University of Kentucky Center for Applied Energy Research (UK-CAER) focuses on the development of new energy storage materials for batteries, fuel cells, and electrochemical capacitors for scalable energy storage. Current research activities include the development of symmetric (carbon/carbon) and asymmetric (lithium titanate/activated carbon) capacitors based on standard lithium-ion electrolytes. New anode materials with enhanced capacities for lithium ion storage are also under investigation, including various metal oxides based on nickel and molybdenum. The development of activated carbon electrodes derived from naturally occurring precursors such as lignocellulosic biomass features carbon nanospheres synthesized hydrothermally from simple monosaccharides. New redox electrolytes based on inexpensive iron and manganese are also under investigation for non-vanadium based flow batteries for grid energy storage.

The Kentucky-Argonne (KY-ANL) Battery Manufacturing Research and Development Center is a new national laboratory currently under construction in Lexington, KY, and will focus on the development of new cell fabrication and manufacturing processes for advanced lithium ion. The KY-ANL facility will feature synergistic research activities with UK-CAER, including the manufacture of state of the art lithium ion cells used for bulk storage, as well as for the transportation sector. The KY-ANL facility seeks to re-establish the United States as a world leader in battery materials, manufacturing technology and equipment, by developing new cell designs and fabrication processes with greater reliability, higher speed, maximal output, and reduced costs.