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Maximizing Energy Density of Nanostructured Electrochemical Capacitors: from Proof of Concept to Reliable Manufacturing

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14. ABSTRACT
Currently, portable energy storage devices are lacking in the performance characteristics needed to meet desired energy and power density demands. Electrochemically-based double-layer capacitors (EDLCs) or ultracapacitors offer a promising solution to bridging the gap between maintaining the high-power density capability of electrostatic capacitors while providing a path to improving the energy density to be comparable to batteries. However, current EDLC technologies still provide significantly lower energy density than is available from batteries. Our approach to increasing the energy density of EDLCs is to increase the surface area using carbon nanotube-based electrode structures with highly controlled and ordered nanostructured porosity in conjunction with a high voltage window ionic liquid electrolyte to increase the operation voltage. In this talk, we will discuss scaling up the fabrication and testing of reproducible, nanostructured electrodes from 3.14 cm^2 to 200 cm^2 electrodes on both sides of an aluminum current collector. We will discuss performance validation from small coin cells to larger area sealed pouch cells. The challenges of optimizing the practical tradeoff of electrode active depth and minimizing the current collector thickness as we move the electrode and overall cell design to a fully packaged cell while maintaining the optimized performance characteristics will be discussed.

15. SUBJECT TERMS
Electrochemical double layer capacitor(EDLC), ultracapacitor, carbon nanotubes, ionic liquids, anodized aluminum oxide(AAO)

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