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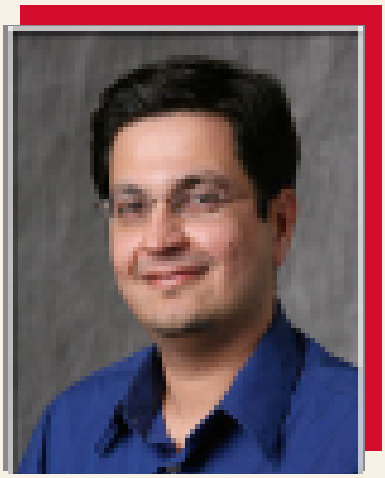
Graphene Electrodes for Next Generation Lithium-Ion Batteries



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ABSTRACT:

Conventional graphitic anodes in lithium-ion batteries provide a maximum specific charge storage capacity of ~372 mAh/g. Moreover graphitic anodes cannot provide high power densities due to slow diffusivity of lithium ions in the bulk electrode material. In my talk, I will describe novel thermal and photo-thermally reduced free-standing graphene paper as high-energy and high-power density capable electrodes for lithium-ion batteries. These materials are also structurally robust and deliver stable performance for thousands of cycles of charge and discharge. I will explain the fundamental mechanisms that enable the superior performance of graphene electrodes over their graphitic counterparts. I will also discuss how defects in the graphene lattice can be used to attract Li and initiate the plating of lithium metal in the interior of porous graphene networks. I will show how the nano-porous nature of the graphene electrode prevents dendrites from forming in such structures. Using this principle, I will demonstrate an ultra-high energy density full-cell configuration with stable performance where graphene based electrodes are utilized as the anode and the cathode is lithium cobalt oxide. I will also demonstrate how the pore and defect structure of the graphene electrodes can be optimized to maximize both the gravimetric as well as volumetric energy density of the full-cell configuration.

BIOGRAPHY:

Nikhil Koratkar is the John A. Clark and Edward T. Crossan Endowed Chair Professor of Engineering at the Rensselaer Polytechnic Institute. Koratkar's research has focused on the synthesis, characterization, and application of nanoscale material systems. This includes graphene, carbon nanotubes, hexagonal boron nitride, transition metal dichalcogenides as well as metal and silicon nanostructures produced by a variety of techniques such as exfoliation of graphite, chemical vapor deposition, and oblique angle sputter and e-beam deposition. He is the author or co-author of over 140 archival journal papers (7000+ citations, H-Index = 48) and is presently serving as an editor of the Elsevier journal CARBON. He is a winner of the NSF CAREER Award (2003), RPI Early Career Award (2005), the Electrochemical Society's SES Young investigator Award (2009) and the American Society of Mechanical Engineering (ASME) Gustus L. Larson Memorial Award (2015).