FAST CHARGING BATTERIES TO ENABLE CLEAN ENERGY SOLUTIONS

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Abstract: Fast charging batteries are key to many promising energy technologies, including regenerative energy storage and ubiquitous access to electric vehicles (EVs). While a lack of fast charging stations is often cited as the key reason for long EV charging times, the reality is that it is damaging to most conventional batteries to repeatedly charge them quickly due to high over-potentials and resistive heating. To fully address this problem, new electrode materials are also needed. In this talk, we thus examine ways to use nanostructured electrode materials to enable fast charging. We specifically focus on nanoporous materials, because the combination of nanoscale structure and porosity can produce a very desirable combination of electrical connectivity, electrolyte access to the interior of the material, and short solid-state diffusion lengths for lithium ions, all of which facilitate fast charge/discharge kinetics. Using *operando* diffraction collected during electrochemical cycling, we further find that many nanoscale materials show suppression of intercalation induced phase transition that can cause kinetic limitations in bulk materials. This leads us to explore in more detail the question of 'what limits charging speed in faradaic systems like batteries and pseudocapacitors?' Our results indicate that size and disorder interplay to control phase stability and rate capabilities. Importantly, by understanding these phenomena on a fundamental level, we are able to impact the practical problem of creating fast charging energy storage devices.

Bio: Sarah H. Tolbert is a professor in the Departments of Chemistry and Biochemistry and Materials Science and Engineering at UCLA. Her research focuses on controlling nanometer-scale architecture in solution-processed nanomaterials to generate unique optical, electronic, magnetic, structural, and electrochemical properties. She has published over 200 scholarly research article and has 20 patents focusing on electrochemical energy storage, organic electronics, nanomagnetics, nanoscale control of thermal conductivity, and new ultra-hard materials. She also serves as the faculty direct for a program aimed at bringing nano-concepts to schools, students, and the general public throughout the greater LA area. Professor Tolbert is the recipient of a number of awards including the American Chemical Society Henry H. Storch Award in Energy Chemistry, Fellow of the Royal Society of Chemistry, an NSF Special Creativity Award, the ACS R.A. Glen Award, and the UCLA Diversity, Equity, and Inclusion Award. She directs the DOE Energy Frontier Research Center on Synthetic Control Across Length-scales for Advancing Rechargeables (SCALAR).