Green Manufacturing of Alkali Sulfide Nanostructures

for Next Generation Batteries

Colin Wolden

Department of Chemical and Biological Engineering
Colorado School of Mines
Golden, CO 80401

Efficient energy storage technologies are critical to enable the continued expansion of renewable energy sources such as wind and solar. High capacity rechargeable batteries will be part of the solution to this issue. Anhydrous alkali sulfide (M2S, M = Li and Na) nanocrystals (NCs) are important materials central to the development of next generation cathodes and solid state electrolytes, but not commercially available at present. In this talk I will describe an innovative method for the direct synthesis of alkali sulfide nanostructures through reactive precipitation accomplished by bubbling hydrogen sulfide (H2S) through a solution containing metalorganic precursors. The synthetic steps are thermodynamically favorable ($\Delta G_{rxn} < -100$ kJ/mol), proceeding rapidly to completion at ambient temperature with ~100% atom efficiency. Cathodes fabricated from Li2S nanopowders produced by this process outperform those fabricated with commercially available micropowders. The chemistry is highly flexible, and the size and morphology of the resulting nanocrystals may be tuned through appropriate selection of solvent and co-reagents. A chemistry was developed that enables the recovery of the valuable hydrogen stored within H2S. The net result, $H_2S + 2M \rightarrow M_2S + H_2$, provides abatement of the hazardous industrial waste H2S and delivers two high value products that naturally phase separate for easy recovery. The talk concludes with an account of recent efforts to use chemical engineering principles to scale this process from the laboratory to one potentially capable of manufacturing the nanostructured materials required by emerging battery technologies.

Colin Wolden is a Professor in the Department of Chemical and Biological Engineering at the Colorado School of Mines. He received his B.S. in Chemical Engineering from the University of Minnesota and went on to obtain his MS in Chemical Engineering Practice and PhD degrees from MIT. After completing a NRC/ARO Postdoctoral Fellowship at North Carolina State University he began his academic career at CSM in 1997. His research interests are focused on the fabrication of nanostructured materials for sustainable energy applications including thin film solar cells, membranes, and solid state batteries. He has mentored 35 graduate students, co-authored >130 papers, and has 5 patents. Honors include the NSF Career award, the ETS Walton Fellowship from Science Foundation Ireland, Fellow of AVS, and he serves as an Associate Editor of the Journal of Vacuum Science and Technology.

When: Tuesday, November 7th, 2017 at 4 pm
Where: EP#252