Advanced Materials for Sustainability and Battery Efficiency

Vilas G. Pol
Associate Professor, School of Chemical Engineering
Purdue University
West Lafayette, IN 47907
Email: vpol@purdue.edu

Wednesday, February 24, 2016
221 MEC, 1:00 to 2:25pm

Abstract: Electrical energy storage is crucial for the effective proliferation of an energy economy and for the implementation of many renewable energy technologies. For the transformational changes in battery science and technology, design and discovery of *advanced materials* with larger redox capacities that react more rapidly and reversibly with lithium cations in presence of suitable electrolyte is required. Our experimental ViPER (Vilas Pol's Energy Research) laboratory at Purdue University focuses efforts on the development of high capacity electrode materials with long cycle life and improved safety. The interactions of newly developed electrode materials with electrolytes and additives are investigated. Considering the advantages and limitations of known synthesis techniques, a solvent-less, single step ViP processing technology has been developed to fabricate a variety of unique anode and cathode materials for lithium-ion, Na-ion, K-ion and Li-S batteries. The technique has particular merit for producing carbon and carbon-coated materials from inexpensive starch based precursors. This presentation will reveal selective results on the novel synthesis of 3-dimensional carbon hotels that accommodates electrochemically active, high capacity Sn, Co or Si based nanoguests. The expansion and contraction during lithiation and delithiation of Sn and Si anodes is effectively accommodated in the rooms of conducting carbon hotels avoiding pulverization effects. With the addition of electrolyte additives in Gen 2 electrolytes, high capacity and longer cycle life from these newly developed 3D electrodes are achieved. These carbon hotel rooms are also used to accommodate *in-situ* formed nanosulfur guest as a cathode of Li-S batteries in presence of fluorinated ether based electrolytes achieving longer cycle life with higher capacities. Moreover, our recent efforts on structural, morphological and electrochemical properties of various electro-chemistries will be demonstrated.

About the Speaker: Prof. Vilas Pol is Associate Professor at Purdue University's School of Chemical Engineering, USA. Before joining Purdue University, he was a materials scientist in the Chemical Sciences and Engineering Department at the Department of Energy's Argonne National Laboratory, IL, USA. He has 15 years of research experience in the fields of energy storage, materials science, chemistry, engineering and electrochemistry. He developed numerous synthetic approaches for the fabrication of various functional electrode materials including anodes and cathodes of Li-ion batteries, K-ion, Na-ion and Li-S batteries. At Argonne, he was a lead PI and Co-PI on several research projects. Currently he leads NASA, DOE and NAVY related research projects. Prof. Pol's scientific breakthroughs have been featured in various media outlets including New Scientist, Discovery, Popular Science, ACS, MRS, DOE webpages and TV (NOVA, ABC7, Asia TV, and Univision) news. He has authored or co-authored more than 110 research publications (h index 33), authored 4 book chapters and an inventor on 15 US patents/applications. He is ACS Grand Prize winner, was honored with Argonne National Laboratory's distinguished 'Directors postdoctoral fellowship', MRS science as art first prize, Intel prize, Argonne's Near Hit Safety award, 2013 British Carbon Society's Brian Kelly award and is a 'Gold Medalist' in Sports. In 2015, his sustainable materials development technology own R and D 100 award (Oscars of Invention).

For more information contact: Prof. Siva Nadimpalli, siva.p.nadimpalli@njit.edu