Materials for Rechargeable Batteries: Which, Why and How?

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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 electrode materials with larger redox capacities that react more rapidly and reversibly with lithium or sodium cations is required.

Syntheses of advanced materials are often very complex and expensive, which limits their application in various energy storage devices. Consequently, Purdue’s experimental ViPER (Vilas Pol’s energy research) laboratory developed simple and inexpensive synthesis methods for the fabrication of electrode materials such as nanostructured TiO₂, SnO₂, nanosulfur-carbon hybrids, carbon spheres and carbon micro-compartment. The effective utilization of these newly developed electrochemically active materials as electrodes for lithium ion, lithium sulfur and Na- ion batteries will be discussed. Moreover, structural, morphological and compositional properties of these materials will be demonstrated.

Vilas G. Pol is an associate professor in the School of Chemical Engineering at Purdue University. After Ph.D., a prestigious Director’s Postdoctoral Fellowship was awarded to him at Argonne National Laboratory (ANL) to led energy storage research. Before joining Purdue, he was a Materials Scientist at ANL’s Electrochemical Energy Storage department for several years. He published 100+ articles, accomplishing an h-index of 31. Dr. Pol has four granted US patents and six patent applications. He remediated waste plastic bags into useful carbon nanotubes and carbon spheres for battery electrodes, which is highlighted in Discovery, New Scientist, ACS, RSC news and NOVA-Making Stuff Cleaner, ABC7 TV episodes. He is honored with the British Carbon Society’s Brian Kelly award, ACS grand prize, MRS science as art first prize, Argonne’s Near Hit Safety award, Intel prize and a gold medal in sports. At Purdue, his ViPER group focuses on fabricating novel nano and micro-structuring processes to make advances in the electrode materials and electrolytes for rechargeable lithium ion, lithium-sulfur, and sodium-ion batteries. https://engineering.purdue.edu/ViPER/