

Applications of Natural Protein for Sustainable Energy Storage

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Abstract:

Ever-increasing energy needs demand for sustainable energy from natural materials. An abundant natural material, protein possesses significant functional groups and great potential for various energy storage applications. Firstly, the complex compositions and structures of protein enabling the interaction with ions, along with the excellent mechanical properties make it promising for fabricating solid electrolytes. Via manipulating protein configuration, we fabricated an advanced protein-based solid electrolyte showing good performances in ionic conductivity, modulus and transference number (0.94). Secondly, unique protein-coated ceramic nanofillers were created to enable faster ion-conduction to enhance the poly(ethylene oxide)-based solid electrolyte. The resulting composite electrolyte shows further improvement in ionic conductivity and mechanical properties. Additionally, eco-efficient electrodes for advanced batteries, such as Li-S battery, were studied. Simulation results prove that the rich functional groups and unique spatial configuration of protein offer strong polysulfide-trapping capability. Based on this, we developed a robust and multifunctional protein-based binder for high-loading sulfur cathodes, which deliver high areal capacity and stable cycling performance. Moreover, a protein-functionalized conductive interlayer with assembled porous structure was fabricated to effectively alleviate the shuttle effect and promote the ion-transport. Consequently, the electrochemical performances of the Li-S battery are notably improved.

Biography:

Dr. Zhong currently is an endowed chair professor, Westinghouse Distinguished Professor, in the School of Mechanical and Materials Engineering at Washington State University in the US. Her research interests include polymers, nanocomposites for energy and environment applications. Dr. Zhong received numerous awards/honors including the Dow Chemical Composites Educator of the Year by SPE and an honored Fellow of American Association for the Advancement of Science (AAAS). Dr. Zhong has had over 300 publications in polymer composites and energy materials, including 213 peer-reviewed papers, 2 books and 5 book chapters, more than 90 conference papers, and a number of US patents.