

Title:

Recent advancements in synthesis, properties, and applications of conductive polymers for electrochemical energy storage devices: A review

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Abstract:

Conductive polymer (CP) research has exploded in popularity over the years, with applications ranging from nanoelectronics to material science. CPs are, for all sorts of purposes, Nobel Prize-winning compounds, as their inventors received the Nobel Prize in Chemistry in 2000. Conducting polymers have sparked a lot of interest in academic and industrial sectors because they combine the electrical characteristics of semiconductors and metals with the typical benefits of ordinary polymers, such as ease of preparation and low cost production. Conducting polymers have also received a lot of attention because of their unique characteristics, which include customizable electrical properties, excellent optical and mechanical capabilities, ease of synthesis and manufacturing, and superior environmental durability to traditional inorganic materials. In this study, the molecular structures and behaviors of the most common forms of CPs, namely, polyacetylene, polyaniline, polypyrrole, and polythiophene and derivatives of polythiophene are discussed. The transport phenomenon that allow to understand the conduction process, are also described in this review. An in-depth investigation of conducting polymer-based binary, ternary, and quaternary composites with carbon-based materials, metal oxides, transition metals, and inorganic particles is utilized to analyze their applications as supercapacitors and batteries. There are also explanations of recent advancements in their applications in the areas of energy storage systems including batteries and supercapacitors. The development of their applications in the energy storage devices such as supercapacitors, lithium, and other -ions batteries, as well as their current issues and future prospect to advance energy storage systems are broadly discussed. This review is intended to contribute to a better understanding of this conducting polymer and, as a result, to the development of new research areas.