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Integrable Redox-Active Polymer Batteries

Background

Some conventional battery design approaches target volumetric energy density through a compartmentalized approach (i.e. the battery and the device powered by it considered as separate entities) which results in limited form factors (e.g. cylindrical, prismatic). While this rationale has produced compact electrochemical cells and enables the packaging optimization of batteries, the devices in which those batteries are disposed can be constrained in design and limited in form factor. In contrast to some conventional battery design approaches, design approaches that can allow a battery to be accommodated into or become the structure of the device itself can dramatically open up the design possibilities and potential capabilities of various technologies that employ batteries, especially in non-stationary applications (e.g. electric vehicles, personal electronics etc.). Unconventional battery designs have been proposed such as flexible batteries, textile batteries and microbatteries; however, adequate integration of batteries providing high energy densities has yet to be accomplished as challenges in design, manufacturing and battery chemistry and stability remain.

Invention Description

Research at Arizona State University has led to the development of electrochemical cells for storing energy and delivering power, in the form of solid-state batteries comprising electrically conductive, redox-active polymers as active materials.

The disclosed technology relates generally to apparatuses and methods of fabricating solid-state electrochemical cells having redox-active polymers. In one aspect, an electrochemical cell comprises a negative electrode including a first redox-active polymer and configured to be reversibly oxidized during a discharging operation and further configured to be reversibly reduced during a charging operation. The electrochemical cell additionally comprises a positive electrode including a second redox-active polymer and configured to be reversibly reduced during the discharging operation and further configured to be reversibly oxidized during the charging operation. The electrochemical cell further comprises an electrolyte including a solid ion-exchange polymer, the electrolyte interposed between positive and negative electrodes and configured to conduct ions therebetween. The electrochemical cell is configured to store energy for an associated device or apparatus and further configured to provide structural features of the associated device or apparatus. The electrochemical cell may constitute a part of the casing, packaging or containment of the device.

This innovation is covered by U.S. Pat. No. 10,256,460 and U.S. Pat. No. 10,892,474.