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Preparation and surface modification of PVDF-carbon felt composite bipolar plates for vanadium flow battery

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Abstract

The performance of vanadium flow batteries (VFBs) is closely related to the materials used in the bipolar plates. Carbon-based composite bipolar plates are particularly suitable for VFB applications. However, most original preparation methods cannot simultaneously achieve good electrical conductivity and mechanical performance. In this paper, we propose a novel approach to fabricating bipolar plates with carbon plastic materials, including four steps, namely coating a poly(vinylidene fluoride)(PVDF) solution onto carbon felt, solvent evaporation, hot-pressing, and surface modification. The resulting bipolar plates showed high conductivity, good mechanical strength, and corrosion resistance. Surface modification by coating with carbon nanotubes (CNTs) removed the PVDF-rich layer from the surface of the carbon fibers. The high surface area of the CNT withdrew PVDF resin from the carbon fiber surface, and promoted the formation of a conductive network. The flexibility and battery charge-discharge cycle measurements showed that the composite bipolar plates can meet requirements for VFB applications.

Keywords: Bipolar plate, Surface modification, Carbon nanotubes, PVDF

1. Introduction

Bipolar plate(BP) is an important part of vanadium flow batteries, by which single cells connected in series can generate high voltages to meet the power output needs of grid-scale energy conversion and storage [1-3]. Bipolar plate is generally required with excellent electrical conductivity, adequate mechanical stability, good corrosion resistance, and low permeability to the electrolyte [4-6]. Furthermore, bipolar plates must be amenable to rapid, low-cost processing methods if they are to be widely used in large scale electricity systems.

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