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Activated Maple Carbon as a Bio-Based Cathodic Material in Lithium-Sulfur Batteries for Electrochemical Energy Storage Applications

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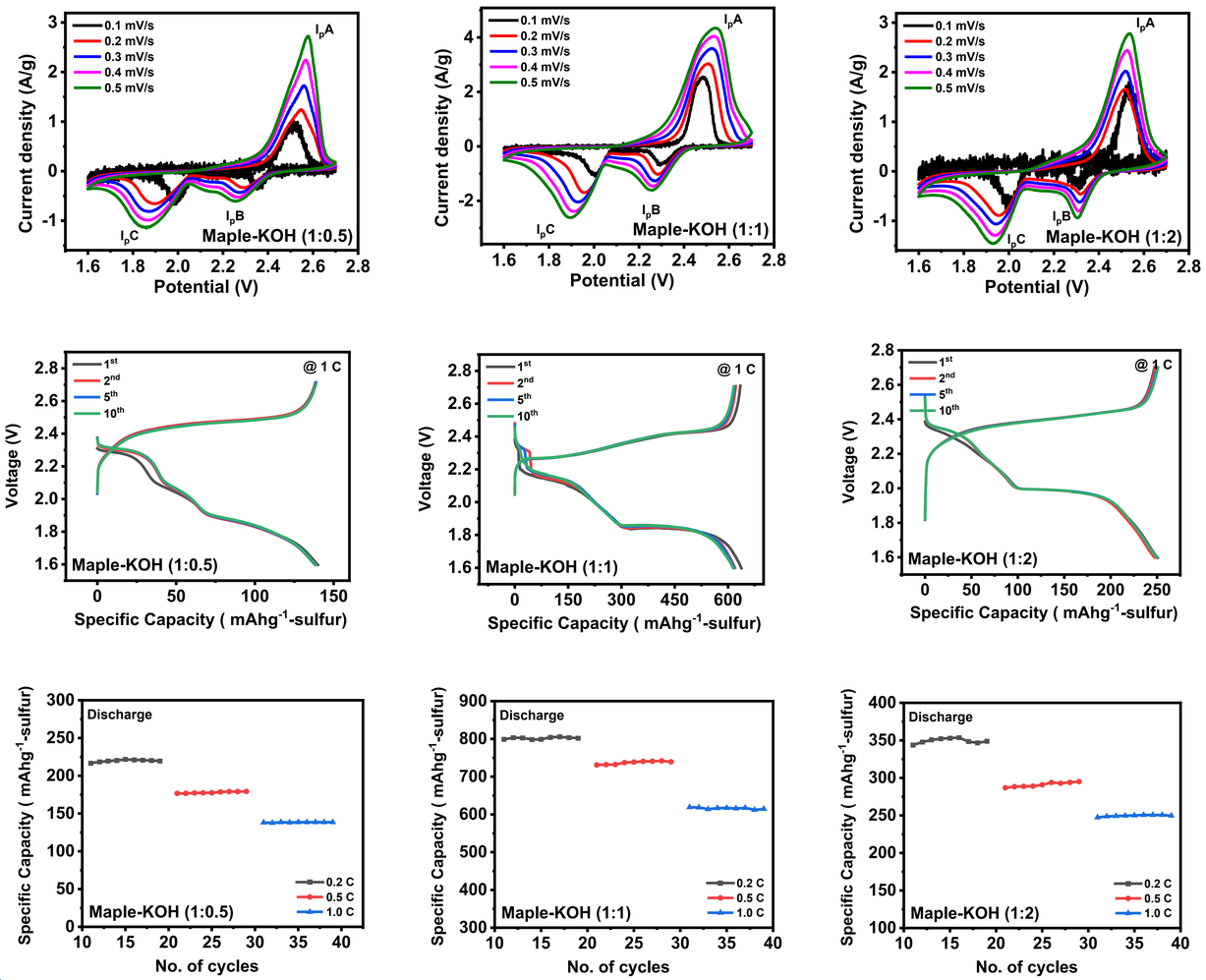
Introduction

Amid the energy crisis, scientists are looking for optimal devices to more efficiently harness and store energy. Electrochemical energy storage devices have risen in popularity, specifically batteries, capacitors, and supercapacitors. This study focuses on lithium-sulfur batteries (LSBs), because they have a high theoretical energy density of 500 Wh/kg. LSBs have a complex working principle, the conversion mechanism, that follows a 16-step redox process. However, there are limitations to these devices due to the shuttle effect and slow kinetics of the sulfur reduction reaction. To combat these limitations, this work synthesized a bio-based maple-carbon sulfur composite from maple leaves to place in coin cells as an electrode material.

Procedure

Maple leaves were pre-carbonized at 350 C for 2 hr with nitrogen gas flow. Next, they were mixed with KOH using DI water as the solvent to obtain the following sample ratios: 1:0.5, 1:1, & 1:2. Then, the samples were dried at 800 C for 2 hr. The samples were washed with dilute HCl. A slurry of 30 mg S, 24 mg sample, 3 mg PVDF, and 3 mg acetylene black was made, using 1-methylpyrrilodone as the solvent. 2 mg of this slurry was painted on carbon cloth then heated to 35 C for 1 wk. These electrodes were then used in coin cells, which were tested using cyclic voltammetry and C-rating.

Results and Discussion



Conclusion

Bio-based carbon from maple leaves has a good potential as a cathodic material. The Maple-KOH (1:1) sample had the best electrochemical activity, with the highest current density in cyclic voltammetry testing and specific capacitance in charge/discharge testing with good C-Rating performance.

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