Matrimid/MOP-18 Composite Material for High-energy Hybrid Supercapacitor Electrodes

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Introduction

Hybrid Supercapacitors (HSCs) are considered to be promising candidates for electrical energy storage in the future. They are expected to be utilized in many applications in transportation and electrical energy distribution sectors. For supercapacitors to realize their promise, their energy densities need to be maximized without harming their superior power density and cyclability. To address this issue, in this work, a composite derived from MOP-18 and Matrimid is utilized to fabricate HSC electrodes.

HSC electrodes are generally composites of two types of materials: Carbon or similar materials to form electrochemical double layer capacitance and redox active materials to offer pseudocapacitance. Depending on symmetry, both electrodes may or may not have both components. Electrodes are separated by a separator and soaked with electrolyte solution.

Methodology

Electrospinning Matrimid and MOP-18 gives a composite fiber with uniform dispersion. When carbonized in the furnace at 800 °C under N₂, MOP-18 decomposes to form Cu and Cu₂O. Activation under CO₂ increases the surface area and porosity.

Activated carbon fiber composites are then punched out into the required dimensions to be used as electrodes in electrochemical testing.

Results and Discussion

• C/Cu/Cu₂O nanofiber composites were synthesized by electrospinning and carbonizing Matrimid/MOP-18 solutions
• MOP-18 helps to ensure uniform dispersion of nanoparticles with small dimensions
• MOP-18 helps to improve the surface area of the composite
• CO₂ activation was used to improve the surface area of synthesized electrode materials
• Energy density of 25.4 Wh/kg at a current density of 1 A/g was achieved in a 6 M KOH electrolyte

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