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Preparation of flexible phenolic resin-based porous carbon fabrics by electrospinning

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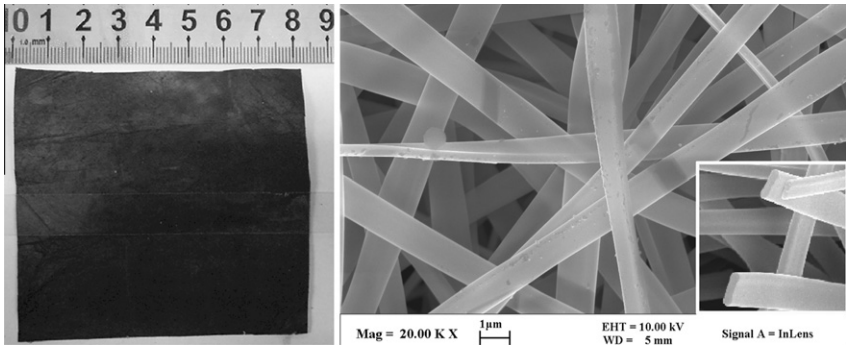
HIGHLIGHTS

- We prepared uniform resol fibers with flat cross-section by electrospinning.
- High-molecular-weight linear polymers facilitates the fabrication of resol fabrics.
- The resol fabrics could be simply cured with specially designed ramp rate.
- Resol-based flexible porous carbon ribbon fabrics were obtained.

GRAPHICAL ABSTRACT

Left: photograph of free-standing phenolic resin-based carbon fabrics. Right: SEM images of electrospun phenolic resin ribbons (inset: cross-section)



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ABSTRACT

In the present study, we prepared flexible phenolic resin fabrics and corresponding porous carbon fabrics through electrospinning and successive curing and carbonization of resol/ethanol solutions. The addition of high-molecular-weight polyvinyl butyral (PVB) is essential for the stable fabrication of bead-free resol fabrics. Due to a high evaporation rate of ethanol and non-linear molecule structure of resol, the electrospun fabrics consist of entangled high aspect ratio ribbons instead of round fibers. The resol fabrics can be simply cured by heating at low temperature in air. Further carbonization at different temperatures resulted in flexible porous carbon fabrics with different specific surface area, which reached a maximum value of 855 m^2/g after heat treatment at 1000 °C. These phenolic resin-based free-standing porous carbon fabrics would be promising in adsorption and electrochemical applications.

1. Introduction

Due to their developed pore structures and high specific surface areas, porous carbons have versatile applications in gas adsorption, water treatment, energy storage and capacitive deionization, etc. [1,2]. There is an extraordinary superiority for free-standing bulk carbon materials in practical application [3–5]. Among all of the techniques for preparation of carbon materials, electrospinning is a preferred method for fabrication of carbon fabrics with free-standing structure [6–8]. In terms of phenolic resin-based carbon materials, they demonstrate very large microporous surface area due to pyrolysis during carbonization [9–13], which is beneficial for adsorption and electrochemical applications. Accordingly, phenolic resin-based carbon fabrics prepared by electrospinning method tend to show great potential in various applications.

Up to now, only a few literatures [14–17] reported the preparation of electrospun phenolic resin fibers and corresponding carbon

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