Flexible cellulose-based carbon fabrics for electrochemical applications

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Abstract

Carbon fabrics are usually produced by carbonizing fossil-based polymer fibers and subsequent weaving. A sustainable alternative could be direct carbonization of finished cellulose-based fabrics.
In the present study, cellulose-based fabrics were impregnated with sulfurous or phosphorous salts, dried and carbonized at 900 ∘C under nitrogen atmosphere. The resulting carbon fabrics were stable and flexible, offering various possibilities for further processing and use cases:

To prepare resistive heating elements, the carbon fabrics were pressed onto a medium-density fiberboard using an epoxy resin. They were contacted on two sides with conductive epoxy resin. When connected to a power source, they warm up very evenly, as required. By variation of the maximum carbonization temperature (tested up to 2200 ∘C), the electrical resistance of the carbon fabrics and the heating behavior of the heating elements can be tailored.
Alternatively, the carbon fabrics can be activated with CO2 to achieve very high specific surface areas of > 2000 m^2/g. These porous carbon fabrics can be used as self-standing electrodes (no binder needed) in supercapacitors. The test cells showed superior results compared to standard test cells using commercial activated carbons or cellulose-based activated carbon fibers as electrode materials.

Keywords: carbon fabrics, cellulose, sustainability, energy storage, electrical conductivity

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