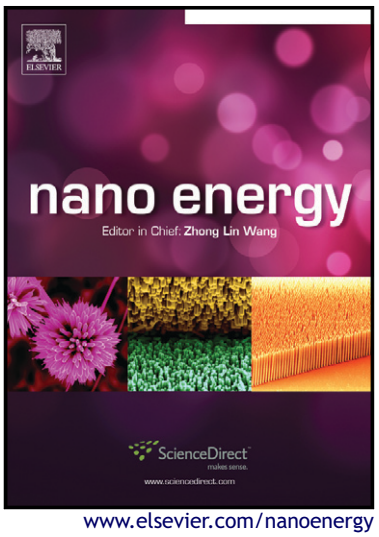

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Self-Activation of Cellulose: A New Preparation Methodology for Activated Carbon Electrodes in Electrochemical Capacitors

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Abstract

Current synthetic methods of biomass-derived activated carbon call for a high temperature pyrolysis followed by either a chemical or physical activation process. Herein, we report a simple one-step annealing synthesis yielding a high surface area cellulose-derived activated carbon. We discover that simply varying the flow rate of Argon during pyrolysis enables 'self-activation' reactions that can tune the specific surface areas of the resulting carbon, ranging from 98 m^2/g to values as high as 2600 m^2/g. Furthermore, we, for the first time, observe a direct evolution of H_2 from the pyrolysis, which gives strong evidence towards an in situ self-activation mechanism. Surprisingly, the obtained activated carbon is a crumbled graphene nanostructure composed of interconnected sheets, making it ideal for use in an electrochemical capacitor. The cellulose-derived nanoporous carbon exhibits a capacitance of 132 F g^{-1} at 1 A g^{-1}, a performance comparable to the state-of-the art activated carbons. This work presents a fundamentally new way to look at the synthesis of activated carbon, and highlights the importance of a controlled inert gas flow rate during synthesis in general, as its contributions can have a very large impact on the final material properties.

Keywords

Pyrolysis; Cellulose; flow rate; self-activation; electrochemical capacitor