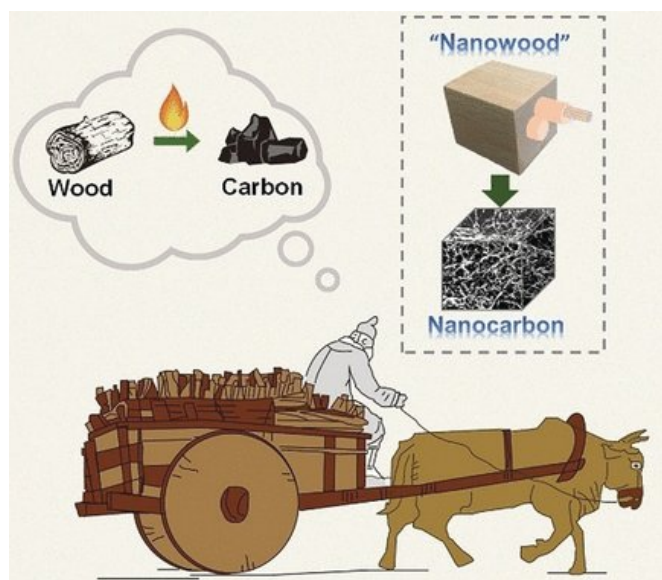


# Sustainable highly conductive electrode materials from ultrathin carbon nanofiber aerogels derived from nanofibrillated

24 May 2018



Credit: *Angewandte Chemie International Edition*

Carbon aerogels are ultralight, conductive materials, which are extensively investigated for applications in supercapacitor electrodes in electrical cars and cell phones. Chinese scientists have now found a way to make these electrodes sustainably. The aerogels can be obtained directly from cellulose nanofibrils, the abundant cell-wall material in wood, finds the study reported in the journal *Angewandte Chemie*.

Supercapacitors are capacitors that can take up and release a very large amount of energy in a very short time. Key requirements for [supercapacitor](#) electrodes are a large surface area and conductivity, combined with a simple production method. Another growing issue in supercapacitor production—mainly for smartphone and electric car technologies—is sustainability. However, sustainable and economical production

of [carbon aerogels](#) as supercapacitor [electrode](#) materials is possible, propose Shu-Hong Yu and colleagues from the University of Science and Technology of China, Hefei, China.

Carbon aerogels are ultralight conductive materials with a very [large surface area](#). They can be prepared by two production routes: the first and cheapest starts from mostly phenolic components and produces aerogels with improvable conductivity, while the second route is based on graphene- and carbon-nanotube precursors. The latter method delivers high-performance aerogels but is expensive and non-environmentally friendly. In their search for different precursors, Yu and colleagues have found an abundant, far less expensive, and sustainable source: wood pulp.

Well, not really wood pulp, but its major ingredient, nanocellulose. Plant cell walls are stabilized by fibrous nanocellulose, and this extractable material has very recently stimulated substantial research and technological development. It forms a highly porous, but very stable transparent network, and, with the help of a recent technique—oxidation with a radical scavenger called TEMPO—it forms a microporous hydrogel of highly oriented cellulose nanofibrils with a uniform width and length. As organic aerogels are produced from hydrogels by drying and pyrolysis, the authors attempted pyrolysis of supercritically or freeze-dried nanofibrillated cellulose hydrogel.

As it turns out, the method was not as straightforward as expected because ice crystal formation and insufficient dehydration hampered carbonization, according to the authors. Here, a trick helped. The scientists pyrolyzed the dried gel in the presence of the organic acid catalyst paratoluenesulfonic acid. The catalyst lowered the decomposition temperature and yielded a

"mechanically stable and porous three-dimensional nanofibrous network" featuring a "large specific surface area and [high electrical conductivity](#)," the authors reported.

The authors also demonstrated that their wood-derived carbon [aerogel](#) worked well as a binder-free electrode for supercapacitor applications. The material displayed electrochemical properties comparable to commercial electrodes. The method is an interesting and innovative way in which to fabricate sustainable [materials](#) suitable for use in high-performance electronic devices.

**More information:** Si-Cheng Li et al. Wood-Derived Ultrathin Carbon Nanofiber Aerogels, *Angewandte Chemie International Edition* (2018).  
[DOI: 10.1002/anie.201802753](https://doi.org/10.1002/anie.201802753)

Provided by Wiley

APA citation: Sustainable highly conductive electrode materials from ultrathin carbon nanofiber aerogels derived from nanofibrillated (2018, May 24) retrieved 17 September 2019 from <https://phys.org/news/2018-05-sustainable-highly-electrode-materials-ultrathin.html>

*This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.*