Flexible and transparent supercapacitor: For energy-storage devices, thin is in (w/ Video)

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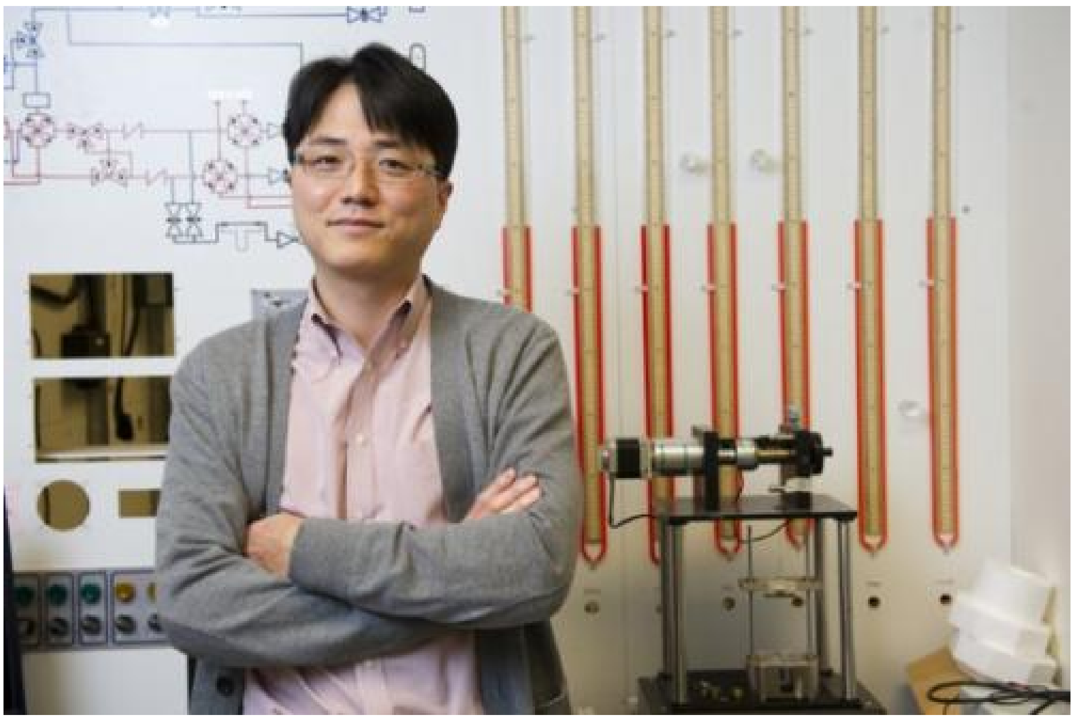

Using their novel carbon nanocup material, Yung Joon Jung and Hyunyoung Jung have developed a supercapacitor that is both flexible and transparent. Credit: Brooks Canaday

(Phys.org)—Cell phones as thin and flexible as a sheet of paper. Energy-storing house paint. Roll-up touch screen displays. These are the sorts of devices that the engineering industry is preparing for and expecting. But if any of them is to work, said Northeastern University mechanical and industrial engineering professor Yung Joon Jung, experts also need to create a thin and flexible energy-storage system. His lab has developed such a system.

In a recently published article in the journal Scientific Reports, Jung and colleagues from Northeastern and Rice University presented their design of a flexible and transparent supercapacitor, a device that stores energy as an electrical field instead of a chemical reaction, as batteries do. As such, it is a prime energy-storage candidate for the thin, flexible devices of the future.

The technology is based on a nanomaterial developed in Jung's lab two years ago, which they call a nanocup. One of the perceived advantages of nanotubes, Jung explained, is the potential to fill them with other materials, such as electrolyte in the case of a supercapacitor. The inner capacity of nanotubes has turned out to be too small to achieve this capability, "but if you have a cup," Jung said, pointing to his own coffee mug, "you can put anything in it you want."

The first step to making a nanocup is etching nanoscopic divots into an aluminum film through oxidation. By tweaking the voltage and time of this process, researchers can tailor the size of the cups. The second step is to layer carbon atoms onto the aluminum mold using standard carbon nanotube technology.

Hyunyoung Jung, the first author on the paper and a postdoctoral researcher in Professor Jung's lab, has a background in polymer chemistry. He emphasized that the new supercapacitor's novelty derives from the large surface area and the open textured surface of the nanocups. This morphology allows them to come into greater contact with the electrolyte, which drives the formation of an electrical field and thus the energy storage functionality.

The supercapacitor, which has not yet been optimized, is able to store energy and provide power at levels comparable to other devices. The difference, however, is its ability to be incorporated into thin film devices. "If we give up transparency and mechanical flexibility," Jung said, "we can easily go to that level of commercially available devices. But my goal is not to lose these two qualities and simultaneously develop high-performance energy devices."

The research team has already used a flexible and transparent prototype to power a light. The group plans to make continued improvements in power generation and energy storage.

Provided by Northeastern University

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