From trees to power: Engineers build better energy storage device

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Credit: Xuan Yang and Kevin Yager

McMaster Engineering researchers Emily Cranston and Igor Zhitomirsky are turning trees into energy storage devices capable of powering everything from a smart watch to a hybrid car.

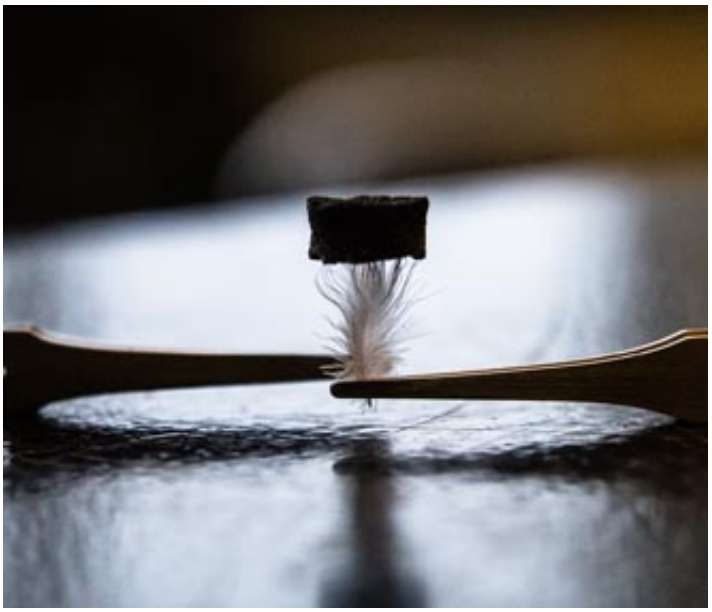
The scientists are using cellulose, an organic compound found in plants, bacteria, algae and trees, to build more efficient and longer-lasting energy storage devices or supercapacitors. This development paves the way toward the production of lightweight, flexible, and high-power

electronics, such as wearable devices, portable power supplies and hybrid and electric vehicles.

"Ultimately the goal of this research is to find ways to power current and future technology with efficiency and in a sustainable way," says Cranston, whose joint research was recently published in *Advanced Materials*. "This means anticipating future technology needs and relying on materials that are more environmentally friendly and not based on depleting resources.

Cellulose offers the advantages of high strength and flexibility for many advanced applications; of particular interest are nanocellulose-based materials. The work by Cranston, an assistant chemical engineering professor, and Zhitomirsky, a materials science and engineering professor, demonstrates an improved three-dimensional energy storage device constructed by trapping functional nanoparticles within the walls of a nanocellulose foam.

The foam is made in a simplified and fast one-step process. The type of nanocellulose used is called cellulose nanocrystals and looks like uncooked long-grain rice but with nanometer-dimensions. In these new devices, the 'rice grains' have been glued together at random points forming a mesh-like structure with lots of open space, hence the extremely lightweight nature of the material. This can be used to produce more sustainable capacitor devices with higher power density and faster charging abilities compared to rechargeable batteries.



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Lightweight and high-power density capacitors are of particular interest for the development of hybrid and electric vehicles. The fast-charging devices allow for significant energy saving, because they can accumulate energy during braking and release it during acceleration.

"I believe that the best results can be obtained when researchers combine their expertise," Zhitomirsky says. "Emily is an amazing research partner. I have been deeply impressed by her enthusiasm, remarkable ability to organize team work and generate new ideas."

More information: *Advanced Materials*, onlinelibrary.wiley.com/doi/10 … /adma.201502284/full

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