Cheaper, greener, alternative energy storage at Stevens

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Every year, the world consumes 15 Terrawatts of power. Since the amount of annual harvestable solar energy has been estimated at 50 Terrawatts, students at Stevens Institute of Technology are working on a supercapacitor that will allow us to harness more of this renewable energy through biochar electrodes for supercapacitors, resulting in a cleaner, greener planet.

Supercapacitors are common today in solar panels and hydrogen fuel cell car batteries, but the material they use to store energy, activated carbon, is unsustainable and expensive. Biochar, on the other hand, represents a cheap, green alternative. The Chemical Engineering Senior Design team of Rachel Kenion, Liana Vaccari, and Katie Van Strander has designed biochar electrodes for supercapacitors, and is looking to eventually bring their solution to market. The group is advised by Dr. Woo Lee, the George Meade Bond Professor of Chemical Engineering and Materials Science.

For their project, the team designed, fabricated, and tested a prototype supercapacitor electrode. The group demonstrated biochar's feasibility as an alternative to activated carbon for electrodes, which can be used in hybrid electric automobile batteries or home energy storage in solar panels.

"While the team's findings are preliminary, the approach taken by us represents a small, but potentially very important step in realizing sustainable energy future over the next few decades," says Dr. Lee.

Biochar is viewed as a green solution to the activated carbon currently used in supercapacitor electrodes. Unlike activated carbon, biochar is the byproduct of the pyrolysis process used to produce biofuels. That is, biochar comes from the burning of organic matter. As the use of biofuels increases, biochar production increases as well. "With our process, we are able to take that biochar and put it to good use in supercapacitors. Our supply comes from goldenrod crop, and through an IP-protected process, most organics, metals, and other impurities are removed. It is a more sustainable method of production than activated carbon," Liana says. Another significant advantage: biochar is nontoxic and will not pollute the soil when it is tossed out. The team estimates that biochar costs almost half as much as activated carbon, and is more sustainable because it reuses the waste from biofuel production, a process with sustainable intentions to begin with.

One of the largest concerns for solar panel production today is the sheer cost of manufacturing supercapacitors. Current photovoltaic arrays rely on supercapacitors to store the energy that is harnessed from the sun. And while the growth rate of supercapacitors is advancing at 20 percent a year, their cost is still very high, in part because they require activated carbon. Biochar, on the other hand, is cheaper and readily available as a byproduct of a process already used in energy production.

"My favorite part of this project was seeing the creation of the prototype," Katie says. "It was cool to be able to hold it in my hand and test it and say that I made this."

"Using this technology, we can reduce the cost of manufacturing supercapacitors by lowering the cost of the electrodes," Katie says. "Our goal is eventually to manufacture these electrodes and sell them to a company that already makes supercapacitors. Once supercapacitors become cheaper, they will become more common and be integrated into more and more devices."

Provided by Stevens Institute of Technology