NANOMATERIALS FOR GREEN ENERGY

Imagine charging your cell phone outside using only a tiny sticker on the back — no cord or pad needed. Thanks in part to Dr. Hemali Rathnayake, solar-powered cell phones could be the wave of the future.

Alongside collaborators from University of Louisville, Rathnayake is developing smaller, more energy-efficient, environmentally-friendly, inexpensive solar panels.

Her research has received $1.5 million in grant support from the National Aeronautics & Space Administration, National Science Foundation, and other funders. In July 2016, the associate professor came to UNCG and the Joint School of Nanoscience and Nanoengineering.

"Our goal is for you to be able to go to Walmart, buy your solar panel, pull off the sticker, and put it on your window," she says. "That's the dream. It needs to be plug and play."

To meet this goal, she's using carbon-based nanoparticles, roughly one-millionth of a millimeter in size, to build flexible solar panels. They're bendable, making them useful in more places than existing rigid silicon panels. The unique structure of the particles, which incorporate many void spaces, also makes the panels lightweight.

In addition to being small — roughly 4 cm by 8 cm — they use less sunlight energy to create the same amount of electricity as a silicon panel, she says. They produce voltage equivalent to a small battery, and, while they don't outlast silicon panels, they do cut production costs by 25 percent. Carbon-based panels are also more environmentally friendly because they don't include heavy metals that become toxic when processed.

Ultimately, she envisions being able to use a spray can, much like an airbrush used to paint a car, to coat the carbon solar cell solution on any surface.

And that includes surfaces in space. Currently, astronauts at the International Space Station are using a high-definition electron microscope monthly to monitor how well the nanoparticles, suspended in solution, align themselves under microgravity.

One hypothesis, Rathnayake says, is that the particles will organize in a more stable pattern under less gravity and can be returned to Earth for even more energy-efficient solar cell production.

NASA is also testing Rathnayake's carbon particles to see whether the nanotechnology could improve how satellites are powered for expanded space exploration. Even in space, solar panels don't have access to constant sunlight. By reducing the sunlight needed to produce energy, carbon solar panels could make it easier to power satellites for long time periods.

But her research doesn't stop there. Rathnayake's also interested in harnessing waste energy — energy produced, but not captured — for electricity production. In particular, she's investigating thermoelectrics, the direct conversion of temperature differences into electric voltages.

She's working on a device that uses body heat to power electronic devices. For example, the body heat you produce while jogging could be used to run — and recharge — the mp3 player playing your music.

Overall, she says, the impetus behind her research is bringing electricity to the public in a more effective, affordable form.

"I come from a country where sunlight is abundant, but electricity isn't," she says. "Electricity isn't affordable for all families. That's the reason we're thinking about doing this in an environmentally-friendly, cheaper way."

By Whitney J. Palmer • Photography by Mike Dickens • Learn more at http://jsnn.ncat.uncg.edu