Doctoral student developing next generation of batteries for improved mobile devices, electric cars

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MANHATTAN, KAN. -- Sometimes even batteries can use a boost of energy, according to the focus of a Kansas State University graduate student's research.

Steven Arnold Klankowski, a doctoral candidate in chemistry, La Crescent, Minn., is working under Jun Li, professor of chemistry, to develop new materials that could be used in future lithium-ion batteries. The materials look to improve the energy storage capacity of batteries so that laptops, cellphones, electric cars and other mobile devices will last longer between charges.

Additionally, lithium-ion batteries that can store energy and deliver power more rapidly will be a more viable alternative power source for vehicles and machines powered by alternative energy, Klankowski said. For example, solar- and wind-powered technologies could switch to the battery in the evening when there is a lack of wind or sunlight to produce energy.

"The battery market is moving very fast these days as everyone is trying to get an advantage for their electric vehicles and cellphones," said Klankowski, who also has a background in materials engineering. "As our devices get smarter, so must our methods to supply greater amounts of portable electrical energy to power these devices."

For his research, Klankowski is developing and testing a high-performance nanostructure of silicon coated onto carbon nanofibers for the use as an electrode in lithium-ion batteries. The electrodes, which look like a dense brush, give the battery greater charge capabilities and storage capacity. This is anticipated to replace current commercial electrodes that are made from simple carbon-based materials.

The material being developed and improved by Klankowski helps the electrode store roughly 10 times the amount of energy as current electrodes -- giving the batteries a 10-15 percent improvement in current battery technology.

"We're trying to go for higher energy capacity," Klankowski said. "To do that we're looking at if we can store more energy per the electrode's size or mass, and if we can use that energy more quickly to make the battery like a capacitor. Batteries and capacitors are on opposite sides of the energy storage field. We'd like to move them both closer together."

In the lab, Klankowski looks at how the characteristics of the lithium-silicon-alloy material differ with each production cycle and how those characteristics can be

improved to move lithium-ion batteries closer to capacitors.

The material is also studied for its ability to store energy. Tests, which simulate a battery's operation, repeatedly charge and discharge the material with energy.

According to U.S. Department of Energy's requirements, a battery must remain at 80 percent capacity after 300 charge-discharge cycles.

"A battery today tends to die after 400-500 cycles or three years," Klankowski said. "One of the things we'll want to improve on is that lasting performance. It won't be much of an advantage if your phone's battery can last for 36 hours for the first few months but then only two hours after that. With the progress we are seeing, I hope one day to drive from Manhattan to my folks' house in Minnesota on a single battery change."

A patent application for the material has been filed with Kansas State University Research Foundation. The foundation is a nonprofit corporation responsible for managing technology transfer activities at the university.

Klankowski was one of five doctoral students at Kansas State University to recently earn a scholarship from the research foundation to help him further develop his research.

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