Discovery could open the door to cellphone and car batteries that last five times longer

May 23 2016

A University of Texas at Dallas researcher has made a discovery that could open the door to cellphone and car batteries that last five times longer than current ones.

Dr. Kyeongjae Cho, professor of materials science and engineering in the Erik Jonsson School of Engineering and Computer Science, has discovered new catalyst materials for lithium-air batteries that jumpstart efforts at expanding battery capacity. The research was published in *Nature Energy*.

"There's huge promise in lithium-air batteries. However, despite the aggressive research being done by groups all over the world, those promises are not being delivered in real life," Cho said. "So this is very exciting progress. (UT Dallas graduate student) Yongping Zheng and our collaboration team have demonstrated that this problem can be solved. Hopefully, this discovery will revitalize research in this area and create momentum for further development."

Lithium-air (or lithium-oxygen) batteries "breathe" oxygen from the air to power the chemical reactions that release electricity, rather than storing an oxidizer internally like lithium-ion batteries do. Because of this, lithium-air batteries boast an energy density comparable to gasoline—with theoretical energy densities as much as 10 times that of current lithium-ion batteries, giving them tremendous potential for storage of renewable energy, particularly in applications such as mobile devices and electric cars.

For example, at one-fifth the cost and weight of those presently on the market, a lithium-air battery would allow an electric car to drive 400 miles on a single charge and a mobile phone to last a week without recharging.

Practical attempts to increase lithium-air battery capacity so far have not yielded great results, Cho said, despite efforts from major corporations and universities. Until now, these attempts have resulted in low efficiency and poor rate performance, instability and unwanted chemical reactions.

Cho and Zheng have introduced new research that focuses on the electrolyte catalysts inside the battery, which, when combined with oxygen, create chemical reactions that create battery capacity. They said soluble-type catalysts possess significant advantages over conventional solid catalysts, generally exhibiting much higher efficiency. In particular, they found that only certain organic materials can be utilized as a soluble catalyst.

Based on that background, Cho and Zheng have collaborated with researchers at Seoul National University to create a new catalyst for the lithium-air battery called dimethylphenazine, which possesses higher stability and increased voltage efficiency.

"The catalyst should enable the lithium-air battery to become a more practical energy storage solution," Zheng said.

According to Cho, his catalyst research should open the door to additional advances in technology. But he said it could take five to 10 years before the research translates into new batteries that can be used in consumer devices and electric vehicles.

Cho said he has been providing research updates to car manufacturers and telecommunications companies, and said there has been interest in his studies.

"Automobile and mobile device batteries are facing serious challenges because they need higher capacity," he said.

"This is a major step," Cho said. "Hopefully it will revitalize the interest in lithium-air battery research, creating momentum that can make this practical, rather than just an academic research study."

More information: Rational design of redox mediators for advanced Li-O2 batteries, *Nature Energy*, DOI: 10.1038/nenergy.2016.66

Provided by University of Texas at Dallas