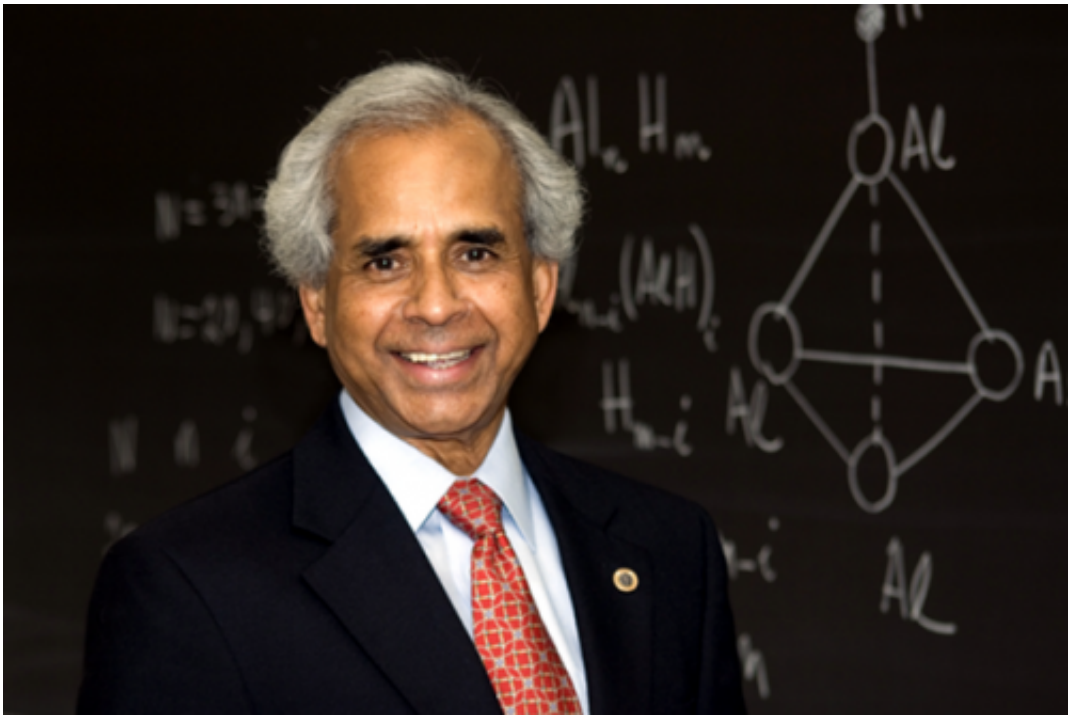
Li-ion batteries contain toxic halogens, but environmentally friendly alternatives exist

October 24 2014, by Brian Mcneill



Physics researchers at Virginia Commonwealth University have discovered that most of the electrolytes used in lithium-ion batteries—commonly found in consumer electronic devices—are superhalogens, and that the vast majority of these electrolytes contain toxic halogens.

At the same time, the researchers also found that the electrolytes in lithium-ion batteries (also known as Li-ion batteries) could be replaced with halogen-free electrolytes that are both nontoxic and environmentally friendly.

"The significance [of our findings] is that one can have a safer battery without compromising its performance," said lead author Puru Jena, Ph.D., distinguished professor in the Department of Physics of the College of Humanities and Sciences. "The implication of our research is that similar strategies can also be used to design cathode materials in Li-ion batteries."

The article, "Superhalogens as Building Blocks of Halogen-free Electrolytes in Li-ion Batteries," by Jena, postdoctoral researcher Santanab Giri, Ph.D., and then-graduate student Swayamprabha Behera, Ph.D., will appear in a forthcoming issue of the chemistry journal *Angewandte Chemie* International Edition, which has posted the study online.

Jena said he hopes that the article's findings will lead to production of safer, less toxic batteries.

"We hope that our theoretical prediction will stimulate experimentalists to synthesize halogen-free salts which will then lead manufacturers to use such salts in commercial applications," he said.

The researchers also found that the procedure outlined for Li-ion batteries is equally valid for other metal-ion batteries, such as sodium-ion or magnesium-ion batteries.

Jena became interested in the topic several months ago when he saw a flyer on Li-ion batteries that mentioned the need for halogen-free electrolytes.

"I had not done any work on Li-ion batteries at the time, but I was curious to see what the current electrolytes are," he said. "I found that the negative ions that make up the electrolytes are large and complex in nature and they contain one less electron than what is needed for electronic shell closure."

Jena had already been working for more than five years on superhalogens, a class of molecules that mimic the chemistry of halogens but have electron affinities that are much larger than that of the halogen atoms.

"I knew of many superhalogen molecules that do not contain a single halogen atom," he said. "My immediate thought was first to see if the anionic components of the current electrolytes are indeed superhalogens. And, if so, do the halogen-free superhalogens that we knew serve the purpose as halogen-free electrolytes? Our research proved that to be the case."

Provided by Virginia Commonwealth University

Citation: Li-ion batteries contain toxic halogens, but environmentally friendly alternatives exist (2014, October 24) retrieved 3 May 2024 from https://phys.org/news/2014-10-li-ion-batteries-toxic-halogens-environmentally.html