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PROFESSOR WINS NAVAL YOUNG INVESTIGATOR AWARD FOR BATTERY DEVELOPMENT

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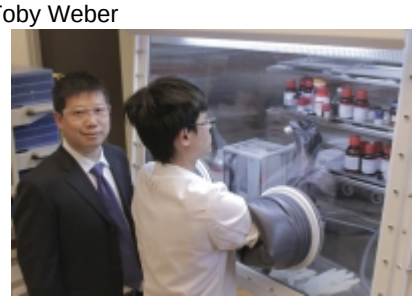

A professor with the University of Houston Cullen College of Engineering is working to make safer and longer-lasting batteries for everything from electric vehicles to Navy vessels.

Yan Yao, assistant professor in the Cullen College?s electrical and computer engineering department and Robert A. Welch Professor at the Texas Center for Superconductivity at the University of Houston (TcSUH), is developing alternatives to popular lithium-ion batteries, which are used to power much of the modern world. To carry out this work, he recently received grant worth nearly $660,000 from the U.S. Navy?s Office of Naval Research Young Investigator Program (YIP), which is interested in new batteries as a distributed power source for marine vessels.

The Young Investigator Program seeks to identify and support academic scientists and engineers who are in their first or second full-time tenure-track (or tenure-track-equivalent) academic appointment and who show exceptional promise for conducting creative research. The program seeks to attract outstanding faculty to the Navy?s research program, to support their research, and to encourage their teaching and research careers.

In a letter to University of Houston President and UH System Chancellor Renu Khator, Rear Admiral Matthew Klunder, the Chief of Naval Research, outlined how difficult this grant competition was. ?Dr. Yao is one of 16 investigators selected for award from an outstanding group of 310 applicants?He emerged successfully from a very competitive pool because of his academic achievements, his ability to contribute to the strength of the Nation?s research and development, and the commitment to him expressed by university administrators.?

?I am extremely honored to be selected as an ONR YIP recipient since I started my independent career at UH less than a year ago,? Yao said. ?I am grateful to ONR for their invaluable support on developing safer and more powerful battery technology, which is critical to energy security and independence,? " I am also proud of being part of the UH Energy research. I am indebted to the strong support from Cullen College, the ECE department, and TcSUH.?

Lithium ions are commonly used in batteries because they are light and have a high energy density, which allows them to hold large amounts of energy in a small space, said Yao. Lithium, though, is expensive. Even worse, lithium-ion batteries often develop dendrite growth problems ? essentially breaches in their internal structural integrity ? that cause them to catch fire and even explode under certain conditions.

Yao, then, is developing batteries that use with magnesium ions and aluminum ions, which are safer and potentially cheaper than lithium-based batteries. In addition, these two ions are also both multivalent, meaning they have multiple extra electrons and thus greater potential energy density than lithium ions.

The problem lies in how these ions actually behave in batteries, where they must move through dense crystal structures in order to reach the devices they power. Due to Coulomb?s Law, which governs how electrically charged particles interact, magnesium ions and aluminum ions move much more slowly through these crystals than lithium ions. As a result, real-world batteries that use these ions are larger, heavier and store less energy than their lithium ion counterparts.

Yao?s solution for this problem is a novel one. ?We want to modify the existing battery materials to increase the mobility of the magnesium or aluminum ions so they can diffuse [either during charging or discharging] faster than they did before modification,? he said.

This work, said Yao, has both basic and applied science aspects. He and his research team will collaborate with experts in conducting atomic-scale simulations to predict how the multivalent ions move inside different crystal structures. They will verify their findings using in situ transmission electron microscopy experiments, where they will be able to view actual ion movement. They will then turn their attention to the practical applications of their research, building, testing and optimizing new batteries.

While it will probably take years for shoppers to find devices that use Yao?s research on store shelves, the potential for such multivalent ion batteries is undeniable. ?The energy density of these batteries is potentially four times higher than state-of-the-art lithium ion batteries,? said Yao. ?This would mean cell phones that hold a charge for days and electric vehicles that cost less and can go much farther on a single charge. There?s great potential here.?

As one of the college?s newer professors, Yao added that he is currently looking to add to his research team, including students at all levels. In fact, this summer Yao mentored a student through a National Science Foundation Research Experience for Undergraduates grant; a UH student through the university?s Summer Undergraduate Research Fellowship program, and three high school students.

?I am looking for bright UH students motivated in energy research to join my group,? said Yao, ?It doesn?t matter if he or she has a background chemistry, physics, or engineering, or if he or she is a graduate or an undergraduate. All are invited to join my team to address the grand energy challenge together.?