Engineers improving safety, reliability of batteries

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The next big step forward in the quest for sustainable, more efficient energy is tantalizingly within reach thanks to research being led by UT's Joshua Sangoro.

Sangoro, an assistant professor of chemical and biomolecular engineering, heads a group devoted to the study of soft materials—substances that can be manipulated while at room temperature, including liquids, polymers, and foams.

While such materials have obvious use in fields like medicine or cosmetics, it's their potential to reshape our use of energy that has the team's focus.

"By changing the design of batteries and the substances used in them we can improve safety, performance, and reliability," said Sangoro. "If you think about everything we use that needs power, we can affect practically everything in a big, big way."

In the simplest terms, batteries rely on electrolytes within them to carry their charge from one electrode to another and in the process provide electric energy to the device they are powering. The most commonly used electrolytes are based on lithium salts combined with organic additives.

While lithium ion batteries are becoming more efficient, they also produce great amounts of heat, which can trigger unwanted chemical reactions within the batteries. These reactions yield toxic and highly flammable substances such as hydrofluoric acid gas.

That resulting stress from such gases has led to fires and damaged cell phones, laptops, and other electrical devices and was even thought to be the cause of some high-profile fires on airliners.

Sangoro's team is developing a new kind of electrolyte that cuts down on many of those problems.

"We are developing ionic liquid systems to take the place of traditional electrolytes in batteries," said Sangoro. "Not only are they nonflammable, but they are also much more stable in wide temperature ranges, and they have very low vapor pressure.

"They are more reliable and safer—without sacrificing the power requirements of the batteries."

The other big advantage of the breakthrough is its adaptability.

By molding the substances into ultrathin films, the team has found a way to make power sources with more flexible structures.

Doing so increases the opportunity for their use not just in portable devices but also in solar cells, transistors, or anything that needs a portable power source.

"Based on the ionic liquids we now know, we calculate that there are ten quintillion possible combinations that could be used," said Sangoro. "We haven't even scratched the surface yet."

The National Science Foundation took notice of the work and recently awarded Sangoro's team a $348,000 grant to continue the study.

Sangoro says that while the work so far is very promising, it will likely be four to five years before any such product becomes available for widespread use.

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