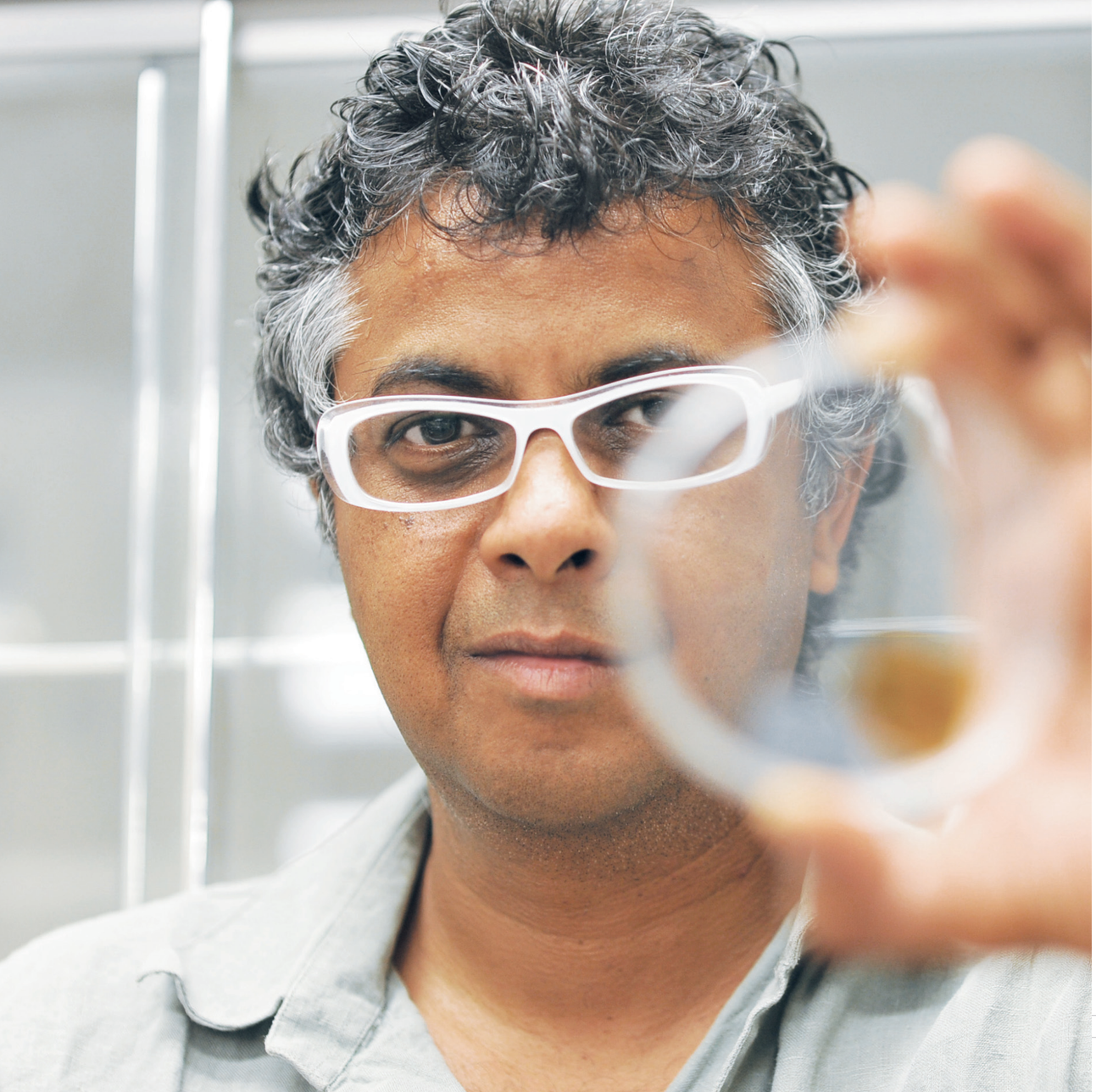

Storing Energy More Efficiently

SANAT KUMAR

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The battery has long been the energy storage device of choice, but limitations persist in life span, storage capacity, and weight. A growing number of researchers—including Sanat Kumar, chair of the Department of Chemical Engineering—are working to make high-energy capacitors (energy storage devices) become a viable replacement in electronics, hybrid cars, and electric power systems.

"Electrical energy is stored by a difference in charge between two metal surfaces, but unlike a battery, capacitors are designed to release their energy very quickly," he said. Kumar said the objective is to design high-energy capacitors, which would have big impact in industry and the military.

"Such an improvement in the state-of-the-art would have a substantial impact on the Department of Defense, making the move to electrified systems much more practical, for example, for aircraft launchers on ships," added Kumar. "Further, since we want to use plastics to make these capacitors, it will provide considerable savings in weight, which is highly desirable from a fuel consumption point of view."

Technological advancements would have an impact on transportation, as well.

"Advanced low-voltage capacitors are needed to facilitate more power-efficient and compact, portable electronic devices for communications, medical applications, and high-power electronics," he said. Applications include implantable defibrillators and power electronics for power conversion and distribution in hybrid electric propulsion systems."

The present and future needs do not stop there.

"Advanced high-voltage capacitors are needed for reactive compensation of electric power systems, energy storage, and distribution related to the interfacing of renewable energy sources to the power grid," said Kumar, "and for energy storage for pulsed power applications such as electromagnetic-based pulse power systems."

To meet the present and future demand, substantial advances beyond the present state-of-the-art in dielectric materials and capacitor technology are required. At the same time, new technologies will be developed for fabricating compact, high-voltage, high-current, high-repetition-rate capacitors that deliver energy in sub-microseconds.

"We will help to model the behavior of new materials that the group will propose as new capacitors," he said. "The goal is to design better capacitors from the ground up."

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