High-performance energy storage

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North Carolina State University physicists have recently deduced a way to improve high-energy-density capacitors so that they can store up to seven times as much energy per unit volume than the common capacitor.

High performance capacitors would enable hybrid and electric cars with much greater acceleration, better and faster steering of rockets and spacecraft, better regeneration of electricity when using brakes in electric cars, and improved lasers, among many other electrical applications.

A capacitor is an energy storage device. Electrical energy is stored by a difference in charge between two metal surfaces. Unlike a battery, capacitors are designed to release their energy very quickly. They are used in electric power systems, hybrid cars, and all kinds of electronics.

The amount of energy that a capacitor can store depends on the insulating material in between the metal surfaces, called a dielectric. A polymer called PVDF has interested physicists as a possible high-performance dielectric. It exists in two forms, polarized or unpolarized. In either case, its structure is mostly frozen-in and changes only slightly when a capacitor is charged up. Mixing a second polymer called CTFE with PVDF results in a material with regions that can change their structure, enabling it to store and release unprecedented amounts of energy.

The team, led by Vivek Ranjan, concluded that a more ordered arrangement of the material inside the capacitor could further increase

the energy storage of new high-performance capacitors, which already store energy four times more densely than capacitors used in industry. Their predictions of higher energy density capacitors are encouraging, but have yet to be experimentally tested.

Citation: Vivek Ranjan, L. Yu, M. Nardelli and J. Bernholc, *Physical Review Letters* (forthcoming article)

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