

Are microcapacitors better than electrostatic capacitors?

The properties of the resulting devices are record breaking: compared to the best electrostatic capacitors today, these microcapacitors have nine-times higher energy density and 170-times higher power density (80 mJ-cm⁻² and 300 kW-cm⁻², respectively). "The energy and power density we got are much higher than we expected," said Salahuddin.

Can micro capacitors store a lot of energy?

"We've shown that it's possible to store a lot of energy in micro capacitors made from engineered thin films, much more than what is possible with ordinary dielectrics," said Sayeed Salahuddin, the Berkeley Lab faculty senior scientist, and UC Berkeley professor who led the project.

Can thin films be used to make microcapacitors?

Berkeley Lab scientists have achieved record-high energy and power densities in microcapacitors made with engineered thin films, using materials and fabrication techniques already widespread in chip manufacturing. Their work paves the way for advanced on-chip energy storage and power delivery in next-generation electronics.

What is a 3D trench capacitor?

Microcapacitors made with engineered hafnium oxide/zirconium oxide films in 3D trench capacitor structures - the same structures used in modern microelectronics - achieve record-high energy storage and power density, paving the way for on-chip energy storage. (Credit: Nirmaan Shanker/Suraj Cheema)

How do microcapacitors achieve a negative capacitance effect?

Here, the researchers achieved their record-breaking microcapacitors by carefully engineering thin films of HfO₂ - ZrO₂ to achieve a negative capacitance effect. Normally, layering one dielectric material on top of another results in an overall lower capacitance.

Are capacitors better than batteries?

However, capacitors generally have much lower energy densities than batteries, meaning they can store less energy per unit volume or weight, and that problem only gets worse when you try to shrink them down to microcapacitor size for on-chip energy storage.

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Power-Dense Microcapacitors Pave the Way for On-Chip Energy Storage In an early look at on-chip power, researchers have demonstrated that thin-film micro-capacitors can ...

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A close up of 3D-printed Si-rich glass micro-supercapacitors (MSCs) on silicon substrates. Magnified by 4720 times. Credit: Po Han Huang/KTH Royal Institute of Technology

Researchers are focusing on reducing the use of hazardous materials and increasing the recyclability of capacitors. Innovations in solid-state capacitors, which eliminate ...

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