



Composite Electrodes For Electrochemical Energy Storage

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SUMMARY

Researchers at the UCLA Department of Physics & Astronomy have designed supercapacitors with enhanced energy density and power density properties.

BACKGROUND

Supercapacitors provide instantaneously high-power density and energy density compared to batteries and conventional dielectric capacitors, making them excellent candidates for applications in hybrid electric vehicles, computers, mobile electric devices and other technologies. An electrochemical capacitor is typically operated based on the electrochemical double-layer capacitance (EDLC) formed along an electrode/electrolyte interface, or a pseudocapacitance resulted from a fast reversible Faradaic process of material that undergoes Faradaic reactions. For a double-layer supercapacitor, the rapid charge/discharge process provides the capacitor with a high-power density, yet the energy density is limited by its effective double layer area. Activated carbon has large surface area, and is the most commonly used material, but it suffers from dramatic capacitance drop at high scanning rate because of its porous structure. On the other hand, psuedocapacitance-based capacitors use metal oxides or conducting polymers and may provide high specific capacitances. However, their application is limited by high cost, low operation voltage, and poor rate capability because of inefficient mass transport or slow Faradaic redox kinetics.

INNOVATION

Researchers at UCLA have designed supercapacitors with both high energy and high-power density, by using composite electrodes that incorporate multiple types of electrode materials. With this design, a supercapacitor’s electrode is formed from electrode materials used for double-layer capacitors and pseudocapacitors coated onto the same charge collector. When the desired material properties are combined, the electrode made is highly conductive, capacitive, and cost-effective.

APPLICATIONS

- ▶ Electrochemical capacitor

ADVANTAGES

- ▶ High power density
- ▶ High energy density
- ▶ Relatively low manufacturing cost

STATE OF DEVELOPMENT

The performance of the composite electrodes has been tested experimentally.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	8,520,365	08/27/2013	2014-285

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

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OTHER INFORMATION

KEYWORDS

supercapacitor, ultracapacitor,

electrode, capacitance

CATEGORIZED AS

- ▶ [Energy](#)
- ▶ [Storage/Battery](#)

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