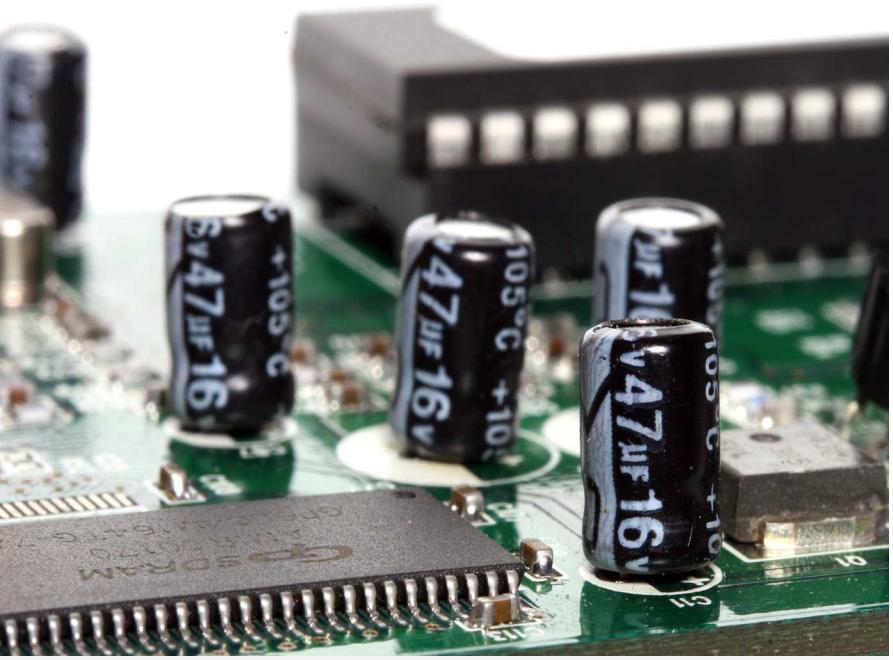


National Aeronautics and Space Administration

technology solution

Electrical and Electronics

Metal Oxide-Vertical Graphene Hybrid Supercapacitors

Hybrid supercapacitor system utilizing vertical graphene

NASA has developed a novel hybrid supercapacitor system utilizing vertical graphene as an electrode material grown directly on collector metals using a plasma enhanced chemical vapor deposition. Supercapacitors are an alternative to batteries for energy storage, offering high power density and rapid charging time. Nanomaterials such as carbon nanotubes and graphene offer high surface area and porosity to construct the electrodes. Vertical graphene grown directly on a collector metal substrate enables construction of a supercapacitor. The key to the hybrid supercapacitor technology is the growth of vertical graphene directly on to an inexpensive metal substrate without the use of bulk graphene, catalysts, or binders, resulting in increased power density. Adding the metal oxide or electrically conducting polymer to the vertical graphene adds redox (reduction and oxidation) capacitance, thus increasing the overall performance of the device.

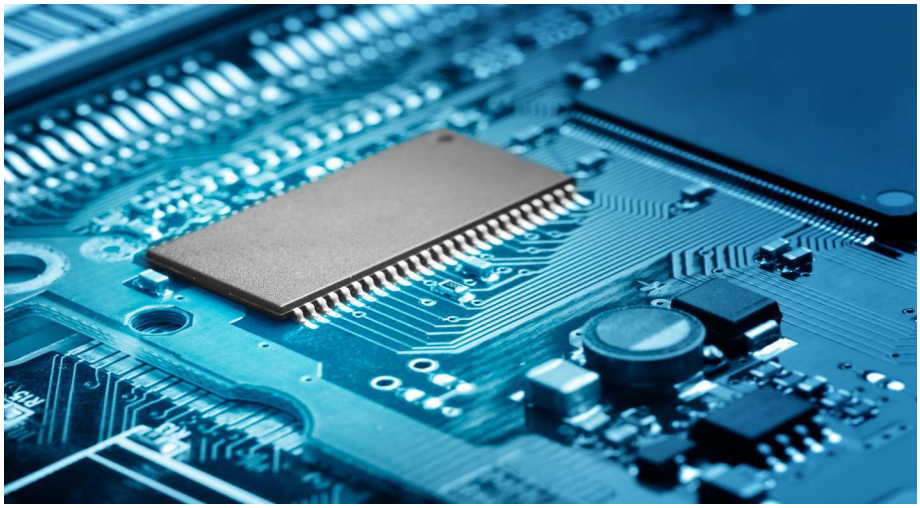
BENEFITS

- High power density
- Rapid charging time
- No catalyst or binders, thus reduced interfacial resistance
- Long life cycle
- Hybrid supercapacitor by adding metal oxide or electrically conducting polymer to vertical graphene

THE TECHNOLOGY

The electrodes are soaked in electrolyte, separated by a separator membrane and packaged into a cell assembly to form an electrochemical double layer supercapacitor. Its capacitance can be enhanced by a redox capacitance contribution through additional metal oxide to the porous structure of vertical graphene or coating the vertical graphene with an electrically conducting polymer. Vertical graphene offers high surface area and porosity and does not necessarily have to be grown in a single layer and can consist of two to ten layers. A variety of collector metals can be used, such as silicon, nickel, titanium, copper, germanium, tungsten, tantalum, molybdenum, & stainless steel.

Supercapacitors are superior to batteries in that they can provide high power density (in units of kw/kg) and the ability to charge and discharge in a matter of seconds. Aside from its excellent power density, a supercapacitor also has a longer life cycle and can undergo many more charging sequences in its lifespan than batteries. This long life cycle means that supercapacitors last for longer periods of times, which alleviates environmental concerns associated with the disposal of batteries.



Applications for supercapacitors include memory back-up in computers, portable electronics etc.

APPLICATIONS

The technology has several potential applications:

- Electric Automobile power sources
- Renewable energy storage
- Energy and Environmental Design
- Consumer electronic products
- Power delivery solutions for forklifts, robots, buses, trolleys, light rail
- Computer memory back-up devices

PUBLICATIONS

Patent Pending

More Information

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