

Transition from Biomass to Sustainable Green Energy Storage Devices

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Energy as a commodity is facing a global crisis due to its high demand and consumption in all areas, overuse of fossil fuels is also causing environmental problems such as global warming and depletion of the ozone layer. To solve this problem, researchers have been interested on developing efficient, sustainable, and clean energy storage systems to boost the use of renewable energy. We report on green and ecofriendly biomass derived devices for energy storage applications. From our results on activated carbon nanostructures from peanut shell waste using different porosity-enhancing agents, an asymmetric supercapacitor device was assembled in a neutral electrolyte (2.5 M KNO₃) at a cell voltage of 1.8 V, which yielded 224.3 F g⁻¹ specific capacitance at a specific current of 1 A g⁻¹ with a corresponding specific energy of 25.2 W h kg⁻¹ and 0.9 kW kg⁻¹ of specific power. To enhance the performance of the device, ex-situ nitrogen-doped porous carbon was synthesized and investigated in the same electrolyte. The fabricated device exhibited a 251.2 F g⁻¹ of specific capacitance at a gravimetric current of 1 A g⁻¹ at a wide cell voltage of 2.0 V. A specific energy of 35 Wh kg⁻¹ with a corresponding specific power of 1 kW kg⁻¹ at 1 A g⁻¹ was obtained. For future development of environmentally friendly and sustainable electrode materials, we developed sustainable binary vanadium pentoxide carbon graphene foam composites (V₂O₅@C-R2HS/GF) using a green method. The device showed high specific energy and specific power values of 55 W h kg⁻¹ and 707 W kg⁻¹, respectively, at a specific current of 1 A g⁻¹. The device presented a good stability test showing 99% capacity retention up to 10000 cycles confirmed by the floating time up to 150 h with specific energy an increase of 23.6% after the first 10 h.

Keywords: Biomass, Energy Storage, Supercapacitors, Energy and Power densities

Abstract Category

Energy

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