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High-performance Supercapacitors Enabled by Highly-porous Date Stone-derived Activated Carbon and Organic Redox Gel Electrolyte

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Abstract : Construction of eco-benign, cost effective, and high-performance supercapacitors with improved electrolytes and hierarchical porous electrodes is necessary for effective energy storage. In this study, a gel type organic redox electrolyte made of polyvinyl alcohol (PVA)-H2SO4 and an organic redox molecule, anthraquinone (PVA-H2SO4-AQ), was prepared by simple solution casting method and was used to construct a symmetric supercapacitor (SSC) with a high BET surface area (1612 m^2/g) using activated carbon made from date stones (DSAC). The DSAC was synthesized by simple carbonization method followed by activation with potassium hydroxide. The SSC exhibit a high specific capacitance of 126.5 F/g at 0.5 A/g, as well as a high energy density of 17.5 Wh/kg at a power density of 250 W/kg with high capacitance retention (87%) after 1000 GCD cycles. The present research suggests that adding anthraquinone to a PVA-H2SO4 gel electrolyte improves the performance of the fabricated device significantly as compared to using pristine PVA-H_2SO_4 or 1M H_2SO_4 electrolytes. The research also presents a promising approach for the development of sustainable and eco-benign materials for energy storage applications. The use of date stone waste as a precursor material for activated carbon electrodes presents an opportunity for cost-effective and sustainable energy storage. Overall, the findings of this research have important implications for the future design and fabrication of high-performance and cost-effective supercapacitors

Keywords : date stone, activated carbon, anthraquinone, redox gel-electrolyte, supercapacitor
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