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An Electrical Double-Layer Supercapacitor Based on a Biomass-Activated Charcoal Electrode and Ionic Liquid with Excellent Charge-Discharge Cycle Stability

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Abstract

Supercapacitors that exhibit higher power density and safety are emerging as alternative energy storage devices. The construction and performance of a supercapacitor using the ionic liquid, triethylammonium thiocyanate, as the electrolyte and biomass-activated charcoal films as the electrode are described. More interestingly, both energy and power density enhancements are observed even for 10,000 charge-discharge cycles. The fabricated supercapacitor with ionic liquid and activated charcoal-based electrodes shows impressive specific capacitance retention of 142% even after 10,000 cycles at a scan rate of 500 mv s^{-1} which is attributed to the clearing of ion conducting pathways and enhanced charge transport with the temperature rise. Impedance analysis confirms the reduction of resistive losses with increasing cycle numbers. The initial energy and power densities of the EDLC are 0.926 W h kg^{-1} and 5681 W kg^{-1} and they showed 42.2 % and 60.6 % increments after supercapacitors cycles. The study reveals low-cost biomass-based activated carbon electrodes and Trimethylamine thiocyanate can be used to prepare supercapacitors with remarkable cycling performances.