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CAPACITANCE IMPROVEMENT IN THE PRESENCE OF FRACTAL GRAPHENE: ACTIVATED CARBON COMPOSITE BY IMPROVING THE ELECTROLYTE WETTABILITY

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Supercapacitors are gaining attention as energy storage devices due to their rapid charge and discharge capabilities, bridging the gap between traditional capacitors and batteries. A significant challenge in optimizing activated carbon-based supercapacitors is the limited wettability of the carbon material by electrolytes, which is crucial for efficient ion transport and charge storage. This study investigated the integration of Fractal Graphene Aggregate (FGA-1) into Activated Carbon (AC) to enhance wettability and supercapacitor performance. Experimental methods involved preparing two test tubes: one with activated carbon alone and the other with a composite of activated carbon and FGA-1. The electrolyte used was a 1M solution of tetraethylammonium tetrafluoroborate dissolved in acetonitrile. The experiment was conducted at room conditions, with the distance travelled by the electrolyte measured using a ruler (least count of 1 mm) and capacitance measured using Metrohm Autolab PGSTAT 128 N. The experiment was repeated five times, and the average distance travelled was recorded. Results indicated that the incorporation of FGA-1 improved the average distance travelled by the electrolyte, leading to a capacitance increase from 1 F for activated carbon alone to 3.96 F for the AC:FGA-1 composite. Quantitative analysis using the Washburn equation revealed that the effective diffusion constant of the electrolyte increased by a factor of four with FGA-1, confirming enhanced wettability. Scanning electron microscope images showed that AC pores and jagged edges were covered with FGA-1, indicating improved wettability due to size differences and the formation of new paths for electrolyte flow. These findings suggest that FGA-1 enhances activated carbon's wetting behaviour, offering the potential for developing more efficient supercapacitor materials and advancing energy storage technologies.

Keywords: Activated carbon, Energy storage devices, Fractal graphene, Supercapacitors, Wettability