An Advanced Supercapacitor From 3D-Silicon Carbide Nanospheres Synthesized Using Locally Sourced Corn Cob-Based Activated Carbon

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Kenya produces a substantial amount of maize annually. According to IPAD (International Product Assessment Division) in 2023, Kenya produced over 3.2 million tons of maize, with cobs being a major waste product. Corn cobs are often utilized as animal feed or burnt, leading to CO2 emissions. Supercapacitors are expensive as they average a cost of $2500 per kWh compared to a conventional lithium-ion battery that averages a cost of $50 per kWh. (InnoEnergy, 2020) A major challenge affecting energy management in Kenya is the high cost of power storage and frequent power outages (Business Daily, 2023). By utilizing maize cobs grown in Kenya we aim to create an efficient 3C-SiC nanosphere supercapacitor utilized as an energy storage reserve. Pyrolysis of dried maize cobs is performed in an argon atmosphere at 290°C for 1 hour to produce porous carbon that is activated using KOH, HCl, and ZNCl2, which is subsequently used to synthesize 3D-SiC nanospheres through carburization. The 3D-SiC nanospheres were dispersed onto a nickel foam current collector using the spin coating technique, Na2SO4 is used as the electrolyte, and polyolefin membrane is the separator. The characteristics of the Na2SO4 electrolyte and polypropylene membrane were investigated and the results evidenced c compatibility for their use in supercapacitors. Several performance evaluation tests of the supercapacitor were performed, including cyclic voltammetry, specific capacitance, and leakage current. The supercapacitor demonstrated remarkably higher energy and power density as SiC nanospheres provide a large surface area for electrode material compared to activated carbon-based supercapacitors.