

# Concrete Electrolyte-Based Structural Supercapacitor Reinforced With Carbon-Modified Steel Mesh

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Structural Supercapacitors (SCs) are electrochemical energy storage devices that utilize the abundance of cement as an electrolyte by employing its high porosity as ion transport channels toward achieving zero-energy buildings. Nonetheless, three major challenges prevent the realization of these devices, which are: 1. the contradiction between compressive strength and ionic conductivity, 2. the use of corrosive agents, and 3. the high cost of used electrode materials. Herein, steel mesh is configured as both a reinforcing agent and a current collector as an innovative approach to optimizing the mechanical and electrochemical properties. Moreover, local biomass *Corchorus Olitorius*-derived activated carbon is utilized as a cost-effective electrode material prepared through pyrolysis and chemical activation. The as-synthesized electrode material was characterized via FE-SEM, EDX, XRD, Raman, FTIR, and BET. The characterization confirmed successful synthesis with a 3D-hierarchical interconnected nanosheet-like structure. The cement electrolyte was constructed with only 3 wt% KOH using a designed 3D-printed mold. Afterward, the SC was fabricated and tested through CV, GCD, and EIS. The SC exhibited a high areal capacitance of 12mF/cm<sup>2</sup>, a power density of 260mW/cm<sup>2</sup>, and an energy density of 1.4mWh/cm<sup>2</sup>, which concurs with the aforementioned modifications. Simultaneously, a benchmarking compressive strength of 51.25MPa surpassing previous literature was achieved, and the cost was decreased by 13 times. The SC showed excellent durability by obtaining a capacitance retention of 83% after 1000 cycles. Lastly, a real-world application was demonstrated where the SC operated a LED paving the way for its immediate implementation to fulfill emerging demands for net-zero energy structures.

## Awards Won:

Third Award of \$1,000