Aqueous EDLC-Type Capacitor Using Activated-Carbon-Coated Aluminum Current Collectors

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Abstract. The global demand for environmentally friendly energy-storage devices has grown rapidly as part of ongoing efforts to reduce carbon emissions and transition toward sustainable technologies. Among these devices, aqueous EDLC-type capacitors have drawn significant attention due to their safety, low cost, and reduced environmental impact compared to organic-electrolyte counterparts. In this study, an aqueous electric double-layer capacitor (EDLC) was fabricated using activated-carbon-coated aluminum plates as both the anode and cathode electrodes, while phosphoric acid served as the electrolyte. The assembled capacitor possessed a total mass of 96.29 g and a total volume of 7.50×10^{-5} m³. When charged to full capacity using an external power supply, the device exhibited a terminal voltage of 1.35 V between the electrodes. Discharge testing yielded a capacitance of 5.15 mF. The calculated mass energy density was 1.35×10^{-5} J/kg, while the volumetric energy density reached 62.45 J/m^3. To evaluate its practical capability, the capacitor was directly connected to a small DC motor, successfully sustaining continuous motor operation for approximately one hour. These results demonstrate the potential of aqueous EDLC-type capacitors as low-impact, carbon-reducing alternatives for future green energy applications.

References

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