Comparison of Electrochemical Properties and EDLC Performance of Activated Carbon Electrodes According to Pore Structure

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Abstract:

Electrical double-layer capacitors (EDLCs) play a crucial role in energy storage systems due to their high power density and long lifespan. The performance of EDLCs largely depends on the properties of the activated carbon used as the electrode material. Activated carbon, with its developed pore structure and high specific surface area, enhances the capacitance of EDLCs. The pore structure significantly impacts the electrochemical stability and ion transport characteristics.

There are two main activation methods for producing activated carbon: steam activation (physical activation) and alkali activation (chemical activation). Steam activation increases the pore structure, resulting in a cylindrical form, while alkali activation increases the specific surface area, producing a slit-like form.

To investigate the electrochemical properties according to the pore structure, we used YP50F and YP80F as cylindrical structured activated carbons, and CEP21KSN and MSP20 as slit-structured activated carbons. For the electrolyte, we prepared pouch cells using 1.5M SBPBF4 salt, with acetonitrile (AN) and propylene carbonate (PC) as solvents. Electrochemical tests, including formation, EIS, and C-rate, were conducted. The results showed that cylindrical structured activated carbons exhibited higher power output, while slit-structured activated carbons provided higher capacity, indicating the necessity of selecting activated carbon based on specific applications.