

Characterization of Surface Groups on Activated Carbon
Materials and Correlation with Electrochemical
Performance in Non-Aqueous Electrolyte EDLCs

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Electrochemical double layer capacitors (EDLCs) are steadily gaining market share and are being selected over other energy storage systems for an increasing number of applications due to their high power and long cycle life (1).

The most effective way to achieve higher energy and power density for supercapacitors with non-aqueous electrolytes is to increase the operating voltage of the cell (2). As a result, the stability of the carbon electrode-electrolyte interface over the cycle life of the cell becomes a determining factor in maintaining good cycling performance (3, 4).

While pore size distribution and surface area impact the specific capacity of carbon, the presence of surface groups can have a two-fold influence on overall cell performance. First, it can lead to an increase in the capacitance of the fresh cell due to faradaic processes (3, 4), while at the same time reduce the long term performance and cycling stability (5, 6).

In the present work we investigate a range of methods for characterizing the type and concentration of functional groups on the activated carbon surface, such as Boehm titration, FTIR, XPS and elemental analysis. We look at the correlation of different surface functionalities with cycling performance, as well as identify methods to modify the surface groups to improve cell stability (e.g. post-activation treatments).

It has been shown that surface groups that form on nitrogen-containing carbon have a positive effect on stability and performance. A number of treatments for introducing nitrogen in the carbon structure have been described in the literature (7, 8). In our work we explore the effect of some of these methods (melamine treatment, ammoxidation) on the surface functionalities and the correlation with performance.

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