Chemically Modified Carbon Fabric Electrodes for Asymmetric Supercapacitors

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ABSTRACT

High surface area carbon electrodes are used in electrochermical capacitors (also known as supercapacitors) due to their low cost, excellent cycle stability, high power densities and conductivity (1). They store charges primarily through an electrostatic (non Faradaic) double layer charging mechanism which limits their energy densities (2). Metal oxides on the other hand, can provide better energy densities through Faradaic redox pseudocapacitive mechanisms. However, they are either expensive (Ru oxide) (3) or highly resistive (Mn oxide) (4).

Immobilization of certain redox groups on carbon can provide redox charging in addition to the inherent double layer charging. Depending on the nature of the redox group, the chemically modified carbon electrodes can be optimized for use in an asymmetric device to maximize performance.

We reported earlier the benefit of using anthraquinone (AQ) modified carbon as a negative electrode in an asymmetric device with Ru oxide as the positive electrode (5). We reported here on a novel method for immobilization of dihydroxybenzene (DHB) onto high surface area carbon fabric and its use as a novel positive electrode to compliment an AQ-C negative electrode. It is of great importance that DHB can be used in energy storage devices since it has a lower mass to charge ratio (ca 55 $g.mol^{-1}$ of electrons) compared to AQ (ca 104 $g.mol^{-1}$ of electrons). Characterization of asymmetric AQ-C/DHB-C supercapacitors was carried out by cyclic voltammetry and constant current discharge experiments in 1M H_2SO_4. A doubling of the energy density was observed compared to a symmetric C/C device. These results demonstrate, as a proof of principle, the possibility of using DHB-C in supercapacitors.

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