Renewable and Sustainable Energy Review

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Although a wide range of technologies are used in making a functional supercapacitor, carbon—specifically activated carbon, is a common thread among most SC’s. Activated carbon is chosen because of its remarkably porous structure and high surface area. Activated carbon means carbon that has been inoculated with different functional groups at its surface. These functional groups can greatly enhance the capacitance per unit area of carbon, which alone is in the range of 10~30 mF cm^-2. The use of these kinds of carbon technologies is an environmentally friendly, high longevity, and high power way to make SC’s.

Another technology being explored further for electrode production is SC’s is what is called “pseudocapacitance”. Pseudo-capacitance relies on activated carbon electrodes layered with transition oxides, transition metal nitrides, and conducting polymers. The crux of this technology are the fast reversible Faradaic reactions that occur between the boundary of the activated carbon and the electrolyte dielectric. The terminology that is used to describe the advantages of layering the electrodes with oxygen groups is that it is capable of increasing the wettability of the electrode, making the interaction between electrode and water molecules in the dielectric. Another way oxygen groups are capable of changing the properties of the SC is that oxygen groups can cause faradic reactions at the boundary, which in turn increase the capacitance and self-discharge rate. Ways in which to activate the carbon with pseudo-capacitance properties are wet impregnation, plasma reduction, pulse laser, sputtering, electrodeposition, and thermal evaporation, and electroless deposition. These authors are in favor of the electroless deposition, as it is low cost, high reproducibility, and the requirement of only very simple equipment.

There is a lot of information in this paper, including very detailed figures and comparative data. It seems to me that there are many, many options at the disposal of developers who are searching for SC technology that can make a major impact.