

The effects of electrode geometry on electrical double layer capacitors with ionic liquids as an electrolyte

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Conventional capacitors have high power density, while batteries have high energy density. Electrical double layer capacitors (EDLC) have high power density and moderate energy density, thus are expected to make up for the gap between the conventional capacitors and the batteries. The nanostructured electrodes are proposed in order to enhance the energy density of EDLC by increasing the interfacial area. Room temperature ionic liquids (RTILs) are used as electrolytes of EDLC owing to their unique electrochemical properties. However, RTIL has thick electrical double layer (EDL) and EDL overlapping may occur inside the nanostructured electrodes. Therefore the interrelations between EDL of RTIL and the nanostructured electrode must be studied in order to design proper RTIL-electrode systems. In this study, the EDLC system with nanostructured electrode and RTIL is simulated by solving the modified Poisson-Boltzmann equation with COMSOL Multiphysics. Several geometries such as cylindrical and spherical shapes with different length scales are simulated as the electrode shapes. The capacitance per unit area and the charge distribution in the normal direction to the electrodes are also analyzed.