ABSTRACT BOOK

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High Capacitance of Coarse-grained Carbide-Derived Carbon Particles

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Most conventional supercapacitor electrode materials implement micrometer (1-10 μm) or nanometer (5 – 100 nm) sized carbon particles with finely tuned porosities and high accessible specific surface areas. We present a novel internal surface area electrode with 50 – 100 μm diameter particles, a finely tuned microporosity, a specific surface area in excess of 1800 m^2/g, and high capacitive performance. We obtained these carbide-derived carbon (CDC) materials *via* Cl_2 etching of large titanium carbide particles at 800 °C and subsequently annealing them with H_2 at 600 °C. The carbon particles, which retained their coarse grained structure, exhibited a narrow pore size distribution (d_{av} = 0.67 nm) that allowed for electrosorption of organic electrolytes and room temperature ionic liquids. Electrochemical testing using tetraethylammonium tetrafluoroborate ($[NEt_4^+][BF_4^-]$) solvated in acetonitrile showcased low ionic resistance, capacitance exceeding 120 F/g (at 10 mV/s), and high rate handling capability that allowed the material to store 60 F/g at a 1 V/s charge/discharge rate. We evaluated the performance of this carbon material using 1-ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide ($[EMIm^+][TFSI^-]$) in neat and solvated configurations. Despite the viscous nature of the electrolyte, the material showcased over 110 F/g charge storage densities in a solvent-free state and 140 F/g while solvated in acetonirile at a 10 mV/s sweep rate. Furthermore, neat RTIL electrolyte extended the voltage window of the material above 3.0 V, showcasing little electrochemical breakdown and improving the material's operational capabily and energy density. In addition to showcasing high capacitance, dense, coare-grained carbon electrodes offer a less expensive supercapacitor fabrication approach and maximize the electrodes' mass loading. We further explore the fundamental properties of this novel model system by mechanically milling or vacuum annealing the material to explore the influence of pore length and surface defects on fundamental properties of ion electrosorption in supercapacitors.

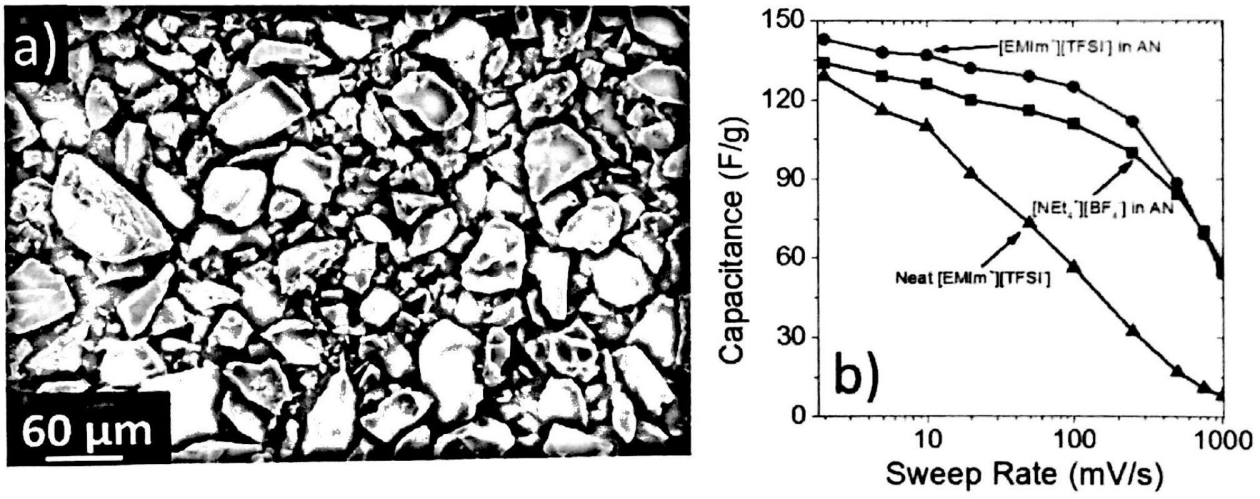

***Figure 1:** a) Scanning Electron Microscopy image of coarse-grained particles with an average diameter of 75 μm. b) Rate handling capability of the coarse-grained CDC with different electrolytes.*