Iron Oxide Supercapacitors

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Supercapacitor (SC) is an unique electrochemical device designed to possess both high energy and power densities. When incorporated into a portable power source that relies on rechargeable batteries, it adds the capability for meeting the burst power demands in applications such as electric vehicles and power tools. Although pseudocapacitance arising from under-potential deposition of H is known to result in extraordinary specific capacitances for some precious metal oxides, application of these electrode materials is severely hindered by their high costs. We report here the characteristics of a low-cost and environmentally benign supercapacitor electrode material, Fe_3O_4 (magnetite), which exhibits capacitances ranging from a few tens to exceed 300 F/g, depending on the synthesis methods, in several aqueous electrolytes including alkali sulfates, sulfites and chlorides with operation voltages up to 1.2 V. Electrochemical characterizations on the oxide in different geometric forms, including thin film, bulk power, and nanocrystalline composite, will be presented.

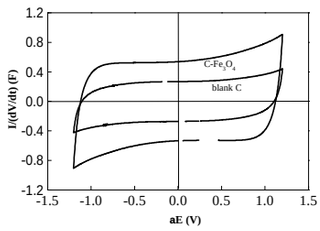

Figure 1. Voltammograms of Fe_3O_4-on-C and blank C electrodes acquired in 1 *M* $Na_2SO_{4(aq)}$ (sweep rate: 4 mV/sec). The total mass of Fe_3O_4 in each electrode is ~1.3 mg.

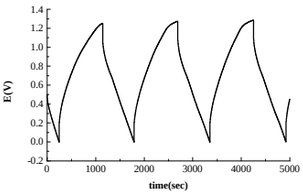

Figure 2. Charging-discharging curve of a Fe_3O_4 cell in 1M $Na_2SO_{3(aq)}$ (electrode weight: 0.11 g; C:10%; current: 3 mA/cm^2).