Effect of Heat-Treatment of Manganese Oxide Deposited on Stainless Steel 316L Current Collector Surface towards Carbon Based Supercapacitor Performance

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Manganese oxide was deposited on the surface of stainless steel (SS) foil current collector (CC) using a simple immersion method followed by heat-treatment at three different temperatures (70, 200 and 400 °C) for 3 h. The CC deposited with manganese oxide without and with heat treatment were used in symmetrical supercapacitor cells using highly porous activated carbon electrodes and LiCl electrolyte. The heat-treatment changes the structure (from amorphous to crystalline phase) and surface morphology of manganese oxide deposited on the CC surface as evidenced by X-ray diffraction and field emission scanning electron microscopy studies. The electrochemical impedance spectroscopy, cyclic voltammetry and galvanic charge-discharge characterization results of the supercapacitor cells demonstrate that the heat-treatment temperature of 70 °C results in a maximum increase of ~70 % in specific capacitance, ~140 % in specific power and ~280 % in specific energy compared to the cell using CC deposited with manganese oxide at room temperature. Further, a 10-fold decrement in response time (from ~ 14 to ~ 1.4 s) is achieved for a heat-treatment at 70 °C which implies a ten times faster delivery of energy. These results show the superiority of CC deposited with manganese oxide heat-treated at 70 °C over the manganese oxide deposited at other temperatures.

Keywords: Wet chemical deposition, Activated carbon; Supercapacitors; Manganese oxide; Electrochemical properties.

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