

Electrochemical performance of nanodiamond/carbon fibers composites in electrical double layer capacitors

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The purpose of this work is to examine the performance of the nanodiamond growth with different CH₄ concentration on carbon fiber substrate for use as an electrochemical capacitor. The influence of the substrate carbonization temperature and the different CH₄ concentration on nanodiamond surface morphology and the electrochemical response were examined. The electrochemical characterization of the electrodes was determined by cyclic voltammetry (CV) and impedance analysis. Carbon fibers were produced from a polyacrylonitrile at three carbonization temperature: 1000, 1500 and 2000 °C. Nanodiamond films were grown by the Hot Filaments Chemical Vapor Deposition technique with a mixture of 1-0.25 vol% CH₄, 90 vol% Ar and 9 vol% de H₂.

The nanodiamonds films grown on carbon fibers substrates showed a rounded appearance, ball-like or cauliflower-like morphology as may be observed in Figure 1 and 2. Electrochemical response of electrodes was analyzed in 0.5 M of H₂SO₄ solutions. Platinum and Ag/AgCl were used as counter and reference electrodes, respectively. The results demonstrated that the electrochemical performance of the nanodiamond/carbon fiber electrodes depend of the substrate carbonization temperatures. The CV demonstrated that nanodiamond grown on carbon fiber less carbonized and with higher CH₄ concentration presented behavior more capacitive compared to the other electrode. This result was confirmed by impedance tests where the Nyquist plot presented the lowest impedance value that was consistent with the results obtained from CV tests.

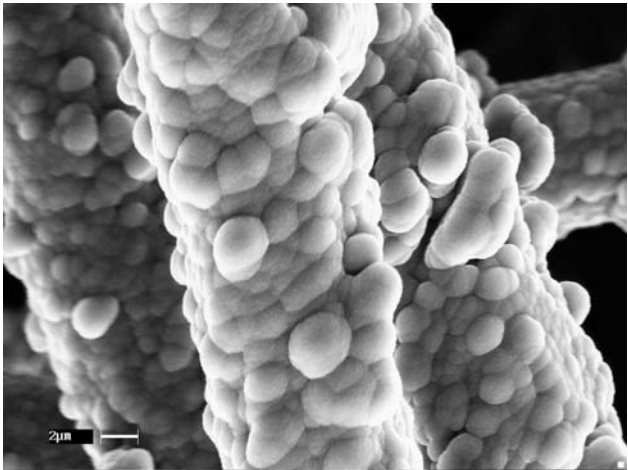


Figure 1. SEM image of nanodiamond growth on carbon fiber substrate.

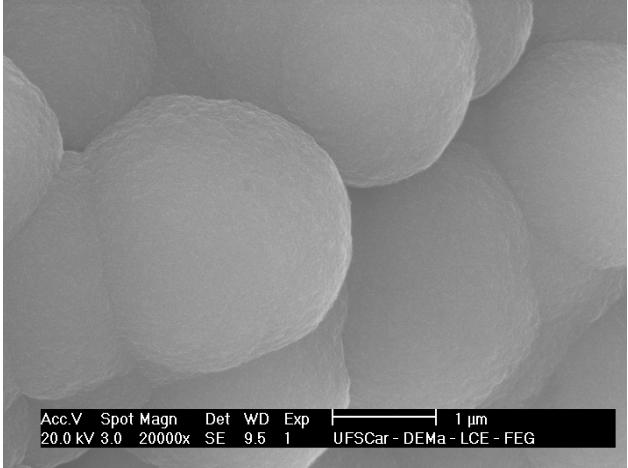


Figure 2. FEG-SEM image of nanodiamond growth on carbon fiber substrate.