

Morphological, Structural and Electrochemical Characterization of PAni/BDND/CF Ternary Composite

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The development of alternative sources for storage and energy conversion has been of great worldwide interest. Therefore, supercapacitors, also known as electrochemical capacitors, play an important role in energy storage systems, with significant advantages, including high power density, long lifecycle and operational safety. In this context, boron doped nanocrystalline diamond (BDND) films grown on carbon fibers (CF) has shown to be an excellent material for obtaining porous diamond electrodes with high surface area. In addition, conductive polymers, such as polyaniline (PAni), have also been used in energy devices, due to their great electrical properties and rapid electrochemical reversibility. Thus, this work presents the production and characterization of PAni/BDND/CF ternary composite. BDND films were grown on CF, by Hot Filament CVD technique, using CH_4 , H_2 and Ar. The doping process consisted of an additional H_2 line, passing through a bubbler containing B_2O_3 dissolved in methanol. For PAni synthesis, the BDND/CF samples were immersed in a NaCl/HCl solution with distilled aniline, keeping the temperature at -10°C . It was used as oxidant an aqueous solution of $(\text{NH}_4)_2\text{S}_2\text{O}_8$ in NaCl/HCl. Samples were obtained at deposition time of 60 min. Both the binary and ternary composites were characterized by scanning electron microscopy (SEM), Raman spectroscopy and cyclic voltammetry. SEM images showed that BDND and PAni coatings covered and enwrapped the fibers, forming a homogeneous film that may enhance the electrode surface area. Raman spectra confirmed the quality of the composites, presenting both BDND and PAni features. Cyclic voltammetry indicated that the ternary composite has a high current density with a capacitance response higher than those for the binary composites of PAni/CF or BDND/CF. They also presented a more reversible oxidation and reduction processes as well as greater charge storage capacity and good electrochemical reversibility observed from charge-discharge curves.