Preparation and Characterization of Carbon Nanotubes for Electronic and Optoelectronic Applications

Master Thesis

By

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Conclusions

Part I: - Synthesis and optimization of Fe_3O_4/MWCNTs for supercapacitor electrode.

We synthesize Fe_3O_4 using the solvothermal method studying the effect of ethylenediamine as responsible for coordination interaction on the electrochemical properties. We also use the CCVD method to synthesize the MWCNTs with four different conditions studying the effect of the molar ratio of Mo in the catalyst and the method of functionalization on the electrochemical properties. We also fabricate the Fe_3O_4/MWCNTs heterostructures using the solvothermal method to synthesize the Fe_3O_4 on the walls of the previously prepared MWCNTs by the CCVD method. The S4-FM2 heterostructure shows the best electrochemical performance in all synthesized samples with a specific capacitance of 1503 F/gm, a power density of 325 W/Kg, and an energy density of 135.68 Wh/Kg at 0.5 A/gm, and capacitance retention of 165.7% after 1000 cycles. The S4-FM2 sample shows better performance than the two pure MWCNTs and Fe_3O_4 samples due to the good interaction between the electric double-layer carbon material, MWCNTs, and the pseudocapacitor metal oxide material Fe_3O_4. The addition of the ethylenediamine resulted in decreasing the particle size of Fe_3O_4, which contribute to the improvement of the electrochemical performance. The S4 sample shows the best electrochemical performance among the MWCNTs samples. This sample is based on a catalyst with a molar ratio of Fe:Mo: MgO is 1:0.1:13 and functionalized with the two reported steps.

Part II: - Synthesis and optimization of Fe_2O_3/MWCNTs for supercapacitor electrode.

We synthesize Fe_2O_3 using the hydrothermal method. We also fabricate the Fe_2O_3/MWCNTs heterostructures using the hydrothermal method to synthesize the Fe_2O_3 nanoplatelets on the walls of the optimum previously prepared MWCNTs by

the CCVD method. The S4-FH heterostructure shows the best electrochemical performance in all synthesized samples with a specific capacitance of 323 F/gm, a power density of 325 W/Kg, and an energy density of 75.8 Wh/Kg at 0.5 A/gm. The S4-FH sample shows better performance than the two pure MWCNTs and Fe_3O_4 samples due to the good interaction between the electric double-layer carbon material, MWCNTs, and the pseudocapacitor metal oxide material Fe_2O_3.