# ABSTRACT


Author: Rian Tucci

Title: CHARACTERIZATION OF THE $MnO_2$-MWCNT NANOCOMPOSITE FOR SUPERCAPACITOR APPLICATIONS

Thesis Advisor: Christine Broadbridge

Department: Department of Physics and Honors College

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Supercapacitors, with long cycle lives and long-term efficiency, have potential to become an appealing alternative to the lithium-ion battery; however, the specific energy of these devices lags well behind current state-of-the-art lithium-ion batteries. Nevertheless, numerous opportunities exist to optimize supercapacitors through the rational manipulation of the structure and morphology of novel materials. The material of interest for the current study is a composite of manganese dioxide ($MnO_2$) and multi walled carbon nanotubes (MWCNT). Three concentrations of MWCNT, 5%, 16%, and 33% percent mass MWCNT relative to a constant concentration of $MnO_2$, were synthesized. Changes in nanostructure morphology of these samples were observed via transmission electron microscopy. A complex microstructure was observed that included a crystalline $MnO_2$ adsorption onto the MWCNT wall surfaces (termed aggregation). MWCNT agglomeration was also noted as a dominant morphology. It is proposed that the aggregation ultimately gives rise to interfacial phenomena that effects MWCNT agglomeration. Aggregation width was studied as a function of concentration of MWCNT. Above 16% mass MWCNT, self-agglomeration of pristine carbon nanotubes is preferential over $MnO_2$ aggregation. Preliminary results indicate that, as MWCNT concentration increases, there is a decline in average $MnO_2$ aggregation thickness. $MnO_2$ aggregation thickness may contribute directly to the specific capacitance of the composite material.