CHAPTER V
CONCLUSIONS AND FUTURE PERSPECTIVES

5.1 Conclusions

The enhanced capacitances of the composite thin films prepared by ESD indicated that nanocrystalline metal oxides improved the capacitive properties of MWNTs electrode. Electrochemical measurements including cyclic voltammetry, impedance spectroscopy and galvanostatic were used to determine the specific capacitance of functionalized MWNTs refluxed for 6 hours and that of the MWNTs refluxed for18 hours. It was found that the time of chemical treatment effect the capacitances. The higher capacitance was obtained when the time of chemical treatment, which increased the micropore volume of CNTs, was longer. Furthermore, the capacitance of TiO_2/MWNTs, FeO/MWNTs and NiO/MWNTs nanocomposites were higher than those of functionalized MWNTs because of the modification of morphological CNTs with the quantitative dispersion of nanocrystalline metal oxides which resulted in the pseudo-capacitive behavior. Electrochemical measurements of 2:8 % w/w of FeO-TiO_2/MWNTs and 4:6 % w/w of NiO-TiO_2/MWNTs nanocomposite electrode gave the capacitance of 123.01 and 180.40 F/g, respectively while the capacitance of 10 % w/w of TiO_2 composite was 177.32 F/g. The result implied that the presence of electroactive NiO-deposited TiO_2/MWNTs composites could improve the capacibility of TiO_2 composite electrodes. On the other hand, FeO in TiO_2/MWNTs composites decreased the capacitive property of the electrodes resulted from the electrochemical behavior of FeO was insulator. The impregnation of metal oxides on the functionalized MWNTs was confirmed by SEM and TEM. While XRD studies revealed that metal oxides were in crystalline state which could be responsible for significant enhancement in the specific capacitance.

5.2 Suggestion for Further Work

In this work, FeO and NiO were synthesized for improving the electrochemical capability of titanium-based oxide/MWNTs capacitor electrode. The result indicated that the capacitance of NiO-TiO_2/MWNTs composite was higher than that of TiO_2/MWNTs composite attributed to the presence of the electroactive NiO-attached to the TiO_2 composite electrode. The enhanced capacitance exhibits the advantage to use of the composite as a material for electrochemical capacitor. Therefore, the other transition metal oxides, such as MnO_2, IrO_2 and Co_3O_4 should be investigated and developed to fabricate the titanium-based oxide composite electrode.