CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In this study, the production of SWNTs employed the Catalytic Vapor Deposition (CVD) and CoMoCAT$^{@}$ method, which is highly selective toward SWNTs. However, the properties of SWNTs are restrained from the impurities derived from the synthesis step. Therefore, the objective of this study was to develop an effective method for purifying the SWNTs. As-prepared SWNTs synthesized from the dissproportionation of CO over a Co-Mo/SiO_2 catalyst were used in this study. The proposed method for purification of SWNTs consisted of four sequential steps: oxidative pretreatment; acid pretreatment; silica dissolution, and froth flotation.

The as-produced SWNTs had carbon purity approximately 2.55%, and composed of several types of carbonaceous species which varied from SWNTs, MWNTs and amorphous about 48%, 34%, and 18%, respectively. The as-prepared SWNTs were preliminarily oxidized with air at 250°C to convert metallic form to metal oxides, which Co metallic convert to Co_3O_4, and Mo_2C to MoO_3, resulting in increasing the exposure surface of the catalysts. After the air oxidation step, the SWNT sample was further dissolved the catalyst with hydrochloric acid, in which 90% removal of the catalysts was accomplished with the oxidative pretreatment step as compared to 10% of catalyst removal with the non-oxidative pretreatment, the optimal condition was at 5 M of HCl, 80°C and 5 h sonication time. After that, the froth flotation was employed to recover SWNTs from silica; however, the carbon purity was gradually raised to 10% by the froth flotation step. According to the SEMs images, the silica particles are mostly encapsulated by the bundle of SWNTs preventing the separation. Moreover, sodium hydroxide was applied to dissolve the silica as well as to increase the carbon purity up to 35%. Finally, the froth flotation was used to separate the SWNTs from the silica particles. The results showed that SDBS exhibited a high carbon purity up to 69.3% at

0.5 CMC and 5 pH, as compared to the 64.8% at 0.75 times the CMC and 7 pH for Surfonic L24-7.The use of mixed surfactant at anionic- to-nonionic surfactant molar ratio of 1:12 was found to offer the highest carbon purity of 76%. In addition, the use of the studied purification techniques was found not to affect the quality of SWNTs.

5.2. Recommendations

Based on this research work, the following recommendations are suggested for a future work:

1. To investigate the other type of acid for dissolution of the metal catalysts.
2. To examine an advance the separation in froth flotation process using mixed surfactant, NaCl and pH of solution.