CHAPTER I
INTRODUCTION

Single walled carbon nanotubes (SWNTs) have exceptional strength, stiffness and high thermal and electrical conductivity, making them excellent candidates for aerospace structural material, which can be used in a large number of potential applications. SWNT has high Young's modulus and tensile strength, which can be used as composite materials. Moreover, depending on their helicity and diameter, SWNT can show either metallic or semi-conducting electrical behavior, leading to molecular electronic devices such as nanoscale wires, electron emission sources and electrical component.

However, the carbon nanotubes are not in market since they are very expensive due to very high cost of production. Currently, they are three major ways used to produce carbon nanotubes: arc discharge of carbon electrodes technique, laser evaporation of carbon graphite technique and catalytic reaction of hydrocarbon compound technique. The main limitation of the arc discharge process is that the size of carbon nanotubes is relatively small (< 1 mm) and the low yield of the process makes the product expensive. On the other hand, the catalytic production method overcomes these difficulties. The process is simple and has a higher productivity than the arc discharge process. Moreover, the carbon nanotubes manufactured by this process are usually thicker than arc discharge process and often consists of large aggregates up to a few ten of millimeter and also containing compounds over transition metal catalyst. These processes can produce the single walled carbon nanotubes in a presence of a small transition metal. The final product consists of 50-90 % of SWNTs mixed with catalyst residues, carbon nanoparticles and amorphous carbon. These impurities have to be removed in order for one to be able to study intrinsic properties of carbon nanotubes. Therefore, the purification of the raw single walled nanotube material is a great interesting.

There are many techniques to purify SWNT. Some techniques have the negative effects such as the toxicity, high operating cost or the defecting of the SWNT particle. So the new purification method with the ultimate goal of attaining defect frees structure will focused. Therefore, this work will focus on applying froth flotation as an alternative separation process for SWNTs purification.

Froth flotation is a physicochemical property-based separation process. This process is a surface-chemistry based process for separation of fine solids that takes advantage of the differences in wettability at solid particle-surfaces. Differences of wettablitity among solid particles can be natural, or can be induced by the use of chemical adsorbates. Solid surfaces are often naturally wettable by water and termed hydrophilic. A surface that is non-wettable is water repelling and termed hydrophobic. If a surface is hydrophobic, it is also typically air attracting, termed aerophilic, and is strongly attracted to an air interface, which readily displaces water at the solid surface. In froth flotation, scparation of a binary solids mixture may be accomplished by the selective attachment of hydrophobic solid particles to gas bubbles (typically air). The other hydrophilic solid particles remain in the liquid (typically water). The difference in the density between the air bubbles and water provides buoyancy that preferentially lifts the hydrophobic solid particles to the top of the column.

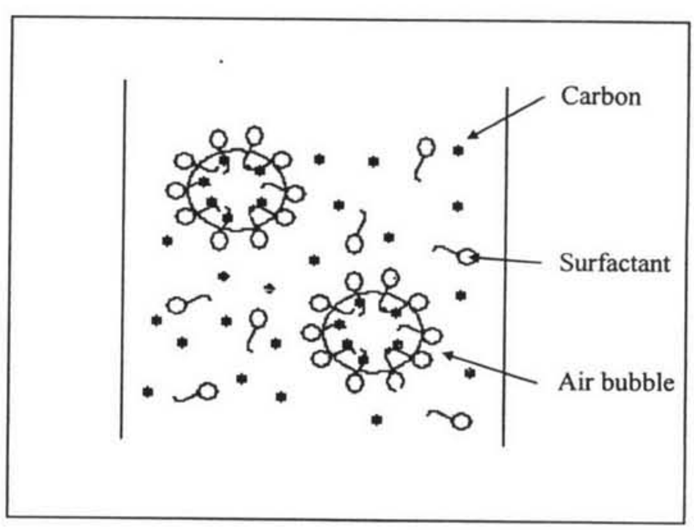

Figure 1.1 Schematic diagram of froth flotation process (Chungchamrienkit, 2004).

Recently, it was reported that the catalytic disproportion of CO over Co-Mo/SiO_2 catalysts is the most economical process to produce large quantities of SWNTs. However, SWNTs cannot be used for any applications directly, due to their high impurity. Hence, a purification step becomes important toward their commercial production. In this study, SWNT samples were obtained from the catalytic process using Co-Mo/SiO_2 catalysts. Therefore, it is imperative to remove both catalysts and silica from the as-produced SWNTs. A pretreatment step was carried out for the catalyst dissolution by HCl and the silica dissolution by NaOH. After the pretreatment step, the treated SWNTs samples were further concentrated and purified by using froth flotation in order to separate the remaining silica. Sodium dodecyl benzene sulfonate, an anionic surfactant, was used in the froth flotation experiment. Temperature programmed oxidation (TPO) was used to estimate the amounts of SWNTs and other carbon forms. Laser Raman spectroscopy was employed to confirm the structure of the SWNTs.