CHAPTER I
INTRODUCTION

Carbon nanotubes have shown their outstanding mechanical and electrical properties, which can be used in a wide range of applications. Carbon nanotubes are predicted to have very high Young's modulus, which can be over 1 Tera Pascal that is as stiff as a diamond (Cassel, 1999). Carbon nanotubes also show the extraordinary electronic properties. Single wall carbon nanotubes (SWNTs) can be either electrical conductor or semiconductor depending on their helicity and diameter. Carbon nanotubes have been demonstrated many promising practical applications which are composite materials, advanced scanning probes for scanning probe microscope, electron field emission sources and nanoelectronic devices (Cassel, 1999). However, the carbon nanotubes are not in market since they are very expensive due to very high cost of production. Currently, there are three major ways used to produce carbon nanotubes: (i) Arc discharge of carbon electrodes technique, (ii) Laser evaporation of carbon graphite technique and (iii) Catalytic reaction of hydrocarbon compounds technique. The arc discharge and laser vaporization of carbon techniques are difficult to scale up the production capacity. In order to produce carbon nanotubes as today plastic, the catalytic reaction of hydrocarbon compounds has been proposed. This technique has proved to commercially produce other carbon materials, *e.g.*, carbon fibers and filaments. Similarly, carbon nanobues should be produced by the decomposition of carbon-containing gases. Therefore, it is necessary to find a selective catalyst, feed gas, and reaction condition that preferentially produces high quantity and quality of carbon nanotubes.

Recently, many researchers (Kitiyanan *et al.*, 2000) have focused on the catalytic production of single-wall carbon nanotubes (SWNTs) by using Co-Mo on silica support as a bimetallic catalyst and carbon monoxide as a feed gas. These conditions seem to favor for producing high yield and quality of SWNTs, especially with low Co-Mo mole ratio. However, there are many hydrocarbon gases, *e.g.* methane that potentially can be used for carbon nanotube production.

Methane consists of only one carbon in its molecule, and has high stability as carbon monoxide. Furthermore, methane is not only cheaper but also less poisonous than carbon monoxide. Methane also has high stability at the high temperature, which possibly eliminate self-pyrolysis that may lead to the generation of amorphous carbon (Hernadi *et al.*, 1998). In this work, Co-Mo and Fe-Mo on the silica support and magnesium oxide catalysts was systematically studied by varying catalyst compositions in order to find the best catalyst for carbon nanotube production with methane. The effect of reaction temperature on the production of carbon nanotube was further investigated by varied the operating temperatures in the range of 700 to 1000 °C.