Fabrication and Characterization of Fe:Ni Nanoparticles for Carbon Nanotube Growth

Tippawan Saipin, Udom Tipparach* and Supakorn Pukid

Department of Physics, Faculty of Science, Ubon Rajathanee University, Warinchamrab, Ubon Ratchathani 34190, Thailand

**Corresponding author. E-mail: udomt@hotmail.com*

ABSTRACT

We have studied the growth of Fe:Ni nanoparticles on silicon substrates by a thermal evaporation method and surface morphology by using an Atomic Force Microscope (AFM) and Scanning Electron Microscope (SEM). The nanometer-sized particles of Fe:Ni, served as a catalyst for the growth of carbon nanotubes, were prepared under different argon atmospheres of pressures ranging from 200 mtorr to 500 mtorr. The catalyst particle sizes favorable for the chemical vapor deposition growth of carbon nanotubes are between 20 nm and 50 nm in diameters.

Key words: Metal nanoparticles, Catalyst, Carbon nanotubes

INTRODUCTION

Since being discovered by Iijima in 1991, carbon nanotubes (CNTs) have been considered as one of the most attractive nanomaterials due to their unique physical properties. The feasible potentials for technological applications of carbon nanotubes are gas sensors, battery electrodes and field-emitting devices. Several growth methods have been developed for the synthesis of carbon nanotubes such as arc discharge and thermal chemical vapor deposition (CVD). The choice of the growth process depends on the purpose of the use of carbon nanotubes. Carbon nanotubes growth by thermal CVD is both efficient and versatile (Li et al., 1996; Kong et al., 1998; Li et al., 2001; Wongwiriyapan et al., 2005) and it is promising to study an individual carbon nanotube as electron field emission devices (Chai, 2004; Saito et al., 2000), therefore, the technologically most relevant process for the synthesis of these interesting nanomaterials. Thermal CVD growth of nanotubes from hydrocarbon precursor molecules such as methane and ethanol is facilitated by nanoparticle sizes of transition metals (Campbell et al., 2002; Nerushev et al., 2003;) such as iron, cobalt and nickel at elevated temperatures. Identification and control of critical growth parameters are crucial for process optimization and development of growth models. The dimensions of carbon nanotubes have an effect on performances of carbon nanotube-based devices such as field emitters. The purpose of this work is to study the effect of nanoparticle size of an Fe:Ni catalyst on the growth of the carbon nanotubes by the thermal CVD technique.

EXPERIMENTAL PROCEDURES

Catalytic nanoparticles of iron and nickel were prepared on silicon (001) substrates by thermal evaporation. The set up apparatus are shown in Figure 1. The powder of 10 milligrams of iron and nickel metals with the ratio of 50:50 by weight was put in a tungsten boat and then placed the boat in a vacuum chamber. After the chamber vacuum was pumped down