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PROCEEDINGS

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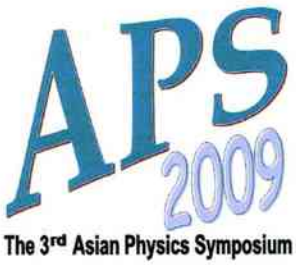

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Preface

The proceedings of The 3rd Asian Physics Symposium (APS 2009) have been completed. We thank very much to the entire member of the committee who worked hard for this completion.

In these proceedings we can find much valuable information dealing with Materials Physics, Earth and Planetary Physics, Theoretical Physics, Control and Automatization, Biophysics, Medical Physics, Nuclear Physics and Special Topics of Physics. Papers containing that information have been presented at the symposium.

On behalf of the Organizing Committee, here we want to express our thank to all participant of The 3rd Asian Physics Symposium (APS 2009). Hope we will meet again with more interesting and valuable information in the next symposium.

Thank you.

Editors,

Dr. Khairul Basar
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Contents

Proceedings of The 3rd Asian Physics Symposium (APS 2009)
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Preliminary Study on Nickel Nanoparticle growth by Sputtering Method

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Abstract
Nickel nanopartickel has been grown on Si (100) substrate by the sputtering method. The growth parameters were 4 x 10^{-1} Torr pressure, 150^{0}C temperature, 77,3 sccm Argon gas flow and 90, 30,10, 5, 1 minutes deposition time. The as deposited nickel nanoparticles were annealed for 30 minutes and 4 hours. The Nickel nanoparticles were then characterized using Scanning Electron Microscopy (SEM) and Energy Dispersive Analysis X-Ray (EDAX). The smallest size of Nickel nanoparticles found is about 50 nm.

Keywords*: nanoparticle, sputtering, anneal.*

I. Introduction

Carbon nanotubes have attracted the particular attention of researchers as a new class of materials that can become important components of nanodevices. A remarkable feature of single-walled carbon nanotubes is that the physicochemical properties of these materials depend on the atomic structure, specifically on the diameter and chirality [1, 2]. In turn, the structure of the carbon nanotubes is determined by the conditions of synthesis and subsequent treatment of the material. The synthesis of carbon nanotubes can be divided into non-catalytic and catalytic methods [9]. In the catalytic method, nickel, iron and cobalt are the only three transition metals that can be used as pure-metal catalysts for carbon-nanotubes growth. However, nickel is highly recommended as the first choice for aligned nanotube growth.

In this experiment to growth nickel nanoparticles we used the ion sputtering methods where the reactor called *dc-Unbalanced Magnetron Sputtering* (*dc*-UBMS) reactor This method had advantages from others such as simple method, clean process, and the way to control the shape and size of nanoparticle is simple. Ion sputtering methods are used ion beam to sputter the solid target. To generate ion beam a high voltage was applied between two electrodes that placed in chamber and fill it with Ar gas. The chamber pressure and sputtering voltage both influence the morphology and growth rate of resulting nanocatalyst film. The high chamber pressures made high frequent collisions of sputtered species (Ni pellets) with the chamber gas atom leads to a rapid decrease in temperature of the sputtered atoms, and the nucleation growth above substrate. The sputtering voltage affects the chemical reactions between colliding molecules before they nucleate into substrate.

II. Experiment

The substrate that we use is silicon wafer, Si(100). The substrate was cut into pieces measuring 10 mm × 10 mm and then cleaned in acetone and stirred it for 5 minutes after that we put it in DI water and stirred it for 5 minutes, and clean it again with methanol and DI water and stirred it for 5 minutes each, after that we stirred it in HF 20% for 3 minutes and dry it with N_2 gas. The cleaned pieces were mounted on the surface of a stainless steel resistive heater of the sputtering chamber (figure 1).

Fig.1dc-Unbalanced Magnetron Sputtering Reactor

The nickel pellets put on target of sputtering chamber The chamber was pumped down, with the

pressure below 3.6×10^{-1} torr before argon gas was introduced into the chamber. After the Ar gas flow we maintained a working pressure of 4.0×10^{-1} torr. The argon gas was flowed in 77.3 sccm. After all parameter stable we generated ion sputtering, with the voltage around 700 Volt. The substrate temperature was kept in 150^{o}C.The deposition time that we used was variable in 90, 30 and 10, 5 and 1 minutes. After the nickel deposition, the substrate was annealed in the furnace tube, to growth nickels islands on the substrate. The annealing temperature was 600 ^{o}C, for 90 and 30 minutes deposition time for 30 minutes long. For 10, 5 and 1 minute deposition time, the samples were annealed for 4 hour with temperature 500^{o}C.

III. Result and Discussion

The characterization of nickel nanoparticles that we used was Scanning Electron Microscopy (SEM) to analyze the effect of time deposition parameters on surface morphology of nanoparticles. In addition energy dispersive analysis X-ray (EDAX) was used to characterized the Ni composition. The SEM results can be seen in figures 2-6. From the figure 2 and 3, with its time deposition are 90 minutes and 30 minutes the surface morphology are still as thin film. The surface morphology of sample with deposition time 10 minutes is already found nickel nanoparticle (Fig. 4), but the islands of nickel nanoparticle are still combined. In figure 5-6 , shows the nickel nanoparticle islands with the size around 50-80 nm. The islands of nickel nanoparticle in fig.5 are still bigger than sample in fig.6, but the islands of nickel nanoparticle size had tendency to the smaller islands. According to the growth parameter of 90 minutes and 30 minutes samples, the annealing time was 30 minutes. It can be explained that the sample needs much time to form islands.

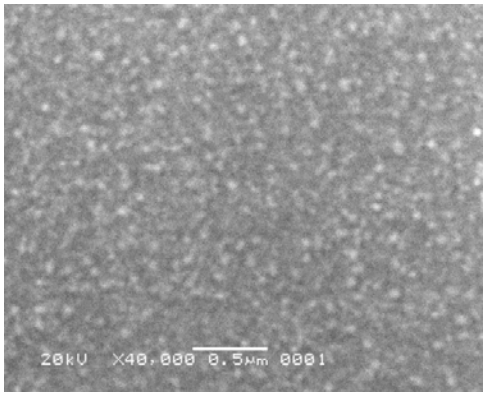

Fig.2 Sample with deposition time 90 minutes

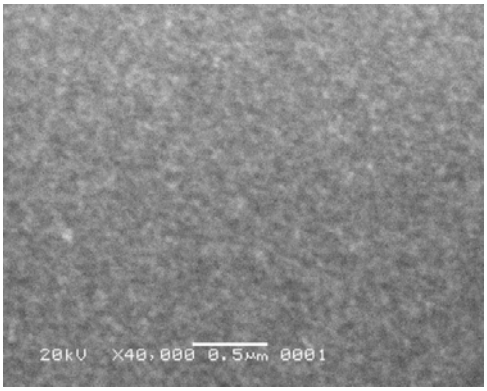

Fig.3 Sample with deposition time 30 minutes

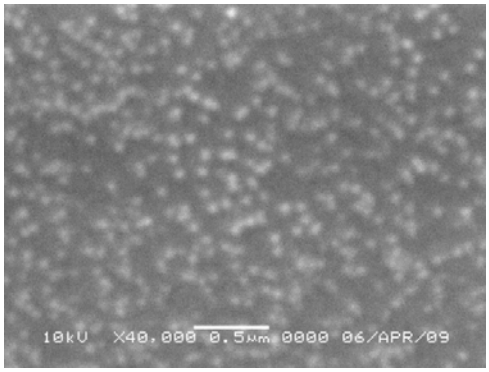

Fig.4 Sample with deposition time 10 minutes

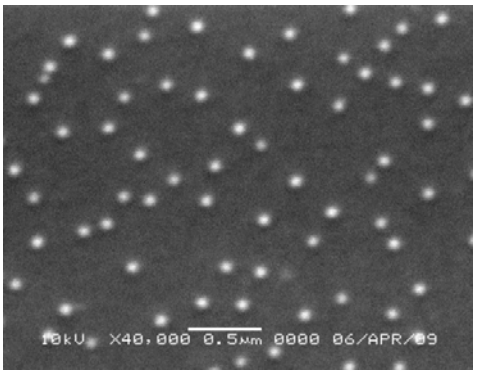

Fig.5 Sample with deposition time 5 minutes

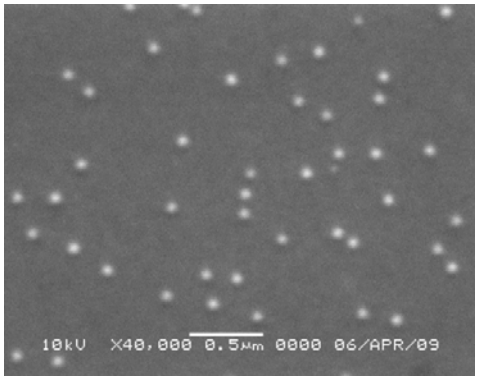

Fig.6 Sample with deposition time 1 minute

From the EDAX (Table 1), we found that atomic composition percentage of nickel nanoparticle had tendency to increase with the decreased of deposition time. As we see in 1 minute deposition time, the percentage of nickel composition around 7.10%.

Table 1

Deposition Time (minutes)	Atomic Composition (%)	
	Si	Ni
90	98.81	1.19
30	97.52	2.48
10	96,73	0.28
5	92,86	3,89
1	92,37	7,10

IV. Conclusion

Nickel nanoparticles had been growth by DC-Unbalanced Magnetron Sputtering on silicon substrates with deposition time variants 10, 5, 1 minutes and 15 seconds. The decreases of deposition time tend to decrease nickel nanoparticle diameter until around 25 nm. However, the homogeneity nickel nanoparticle deposition time is 1 minute with diameter around 50-80 nm.

Annealing process is a very important process to consider, because it's play an important role to growth nickel nanoparticle islands, optimum time to annealed was 4 hour in temperature 500^{o}C.

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