

課題番号 : F-14-UT-0011
利用形態 : 機器利用
利用課題名(日本語) : カーボンナノチューブの化学気相成長用触媒におけるアルミナの影響
Program Title (English) : Alumina as supporting material for chemical vapor deposition of carbon nanotubes
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1. 概要(Summary)

Carbon nanotubes (CNTs) can be grown by heating metal particles to a high temperature and saturate them with carbon until CNTs precipitate from the metal. The choice of metal (usually Co, Fe or Ni) and supporting material, which provides pores for the metals to occupy, strongly determine properties of the resulting CNTs.

This study was performed to determine the effects of using aluminum oxide as supporting material in combination with Fe or Co during chemical vapor deposition (CVD) growth of carbon nanotubes. The final goal is to be able to grow tubes with diameters centered around 1.3-1.5 nm. Samples were measured using four different lasers in Raman spectroscopy.

2. 実験(Experimental)

A broad selection of catalysts were prepared in different ratios of Co or Fe with aluminum oxide, purchased from Evonik as Alu C, in dehydrated 99.5 % ethanol. The catalyst were spin coated on plain silicon chips cut in 5x5 mm at 500 0rpm for 50 seconds then baked at 150 °C for 5 minutes. After another 5 minutes of 400 °C reduction the chips were placed in the CVD tube. The temperature inside the tube was risen to 800 °C during 15 minutes. A mixture of argon and hydrogen gas was then bubbled through ethanol and into the tube for 10 minutes to transfer the carbon to the metals on the samples. After a 5 minute purging in argon gas the temperature was reduced and the samples removed after cooling.

To analyze the samples Raman spectroscopy was chosen. Using lasers of wavelengths 488 nm, 532 nm, 633 nm and 785 nm a broad spectrum of CNTs were covered. The radial breathing mode, around 100-350 cm⁻¹ in Raman shift, holds information about diameter distribution and was of the most interest. G-band and D-band were used to qualify total yield of CNTs and average quality.

The gathered data was plotted for comparisons of increasing alumina + metal concentrations as well as for changing ratios between alumina and metal.

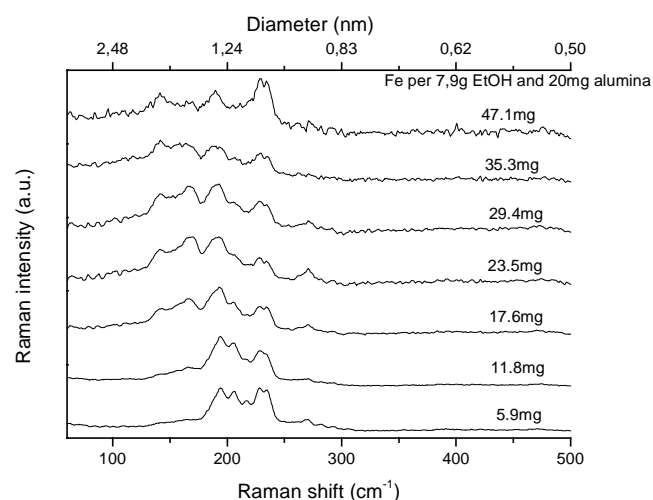


Fig. 1 The RBM gathered from samples with increasing amount of iron. This is a sum of the spectrums from all four lasers.

3. 結果と考察(Results and Discussion)

The diameter distribution of CVD grown CNTs using Fe and alumina is mainly around 1.0-1.6 nm. Changing Fe to Co produced tubes of mainly 0.8-1.2 nm. The most suitable recipe for 1.3-1.5 nm tubes was 23.5 mg Fe, 7.9 g EtOH and 20 mg alumina.

4. その他・特記事項(Others)

なし。

5. 論文・学会発表(Publication/Presentation)

なし。

6. 関連特許(Patent)

なし。