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Growth of Carbon Nanotubes over Ni Nano-particles Prepared *in Situ* by Reduction of La_2NiO_4 Oxides

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Abstract: A novel catalyst precursor, La_2NiO_4, was investigated to synthesize carbon nanotubes, obtained from catalytic disproportionation of CO. The morphology of carbon nanotubes has been examined by TEM (transmission electron micrograph) and SEM (scaning electron micrograph). It was observed that the Ni nano-particle size formed at different reducing temperatures was a key factor to the yield and diameter of carbon nanotubes.

Keywords: Carbon nanotubes, synthesis, La_2NiO_4 precursor, CO.

Carbon nanotubes (CNTs), the allotrope of carbon, have attracted much speculation for their extraordinary properties and potential applications since they were discovered[1]. Now the synthesis of CNTs is one of the challenging issues in the new carbon materials field.

The catalytic production of CNTs is simpler and more reproducible than other methods[2,3]. In the present work, we obtained growth of CNTs by catalytic disproportionation of CO over Ni nano-particles prepared by reducing La_2NiO_4. The rare earth oxides can prevent transition metal from agglomerating and promote dispersion of nano-scale Ni particles, which is advantageous for CNTs growth. With the present catalytic method, the yield of product is higher and the reaction temperature is lower. Especially, average diameter of CNTs can be controlled to some extent. The purification and separation are easy from the support-free catalyst.

The catalyst precursor (50mg) in quartz boat was put into the horizontal quartz glass reactor and reduced in a flow of H_2 from room temperature to predetermined temperature. And then the reactor was controlled to 600℃ for reaction. In this condition, CO was introduced into the reactor, passing over the catalyst with 20mL/min for 60 minutes. After cooled naturally, the products were gathered and purified.

The disproportionation of CO for growth of CNTs has been investigated at different reducing temperatures. The collected CNTs has been examined by SEM and TEM.A characteristic SEM image of CNTs, obtained over catalyst reduced at 800℃ (**Figure 1**) shows a bulk growth of entangled ropes. A typical TEM image of CNTs (**Figure 2**) shows many rope-like structures of CNTs and their diameter ranges from 25 to 35 nm. The selected area electron diffraction pattern (SAED, inset to **Figure 2**) exhibits a better

degree of graphitization. It was observed that CNTs show different yield and average diameter according to various reducing temperature (**Figure 3** and **4**). It can be proposed that the diameter of CNTs is affected greatly by the size of Ni particles prepared during reduction.

Figure 1 SEM image of CNTs

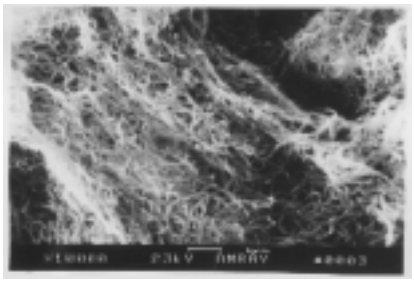


Figure 2 TEM and SAED image of CNTs

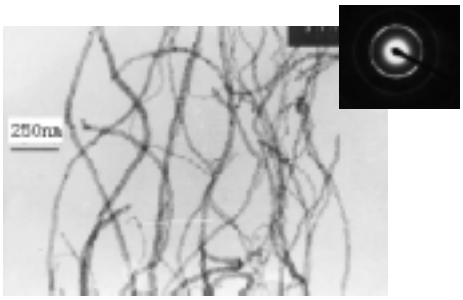


Figure 3 Amount of CNTs at different reducing temperature

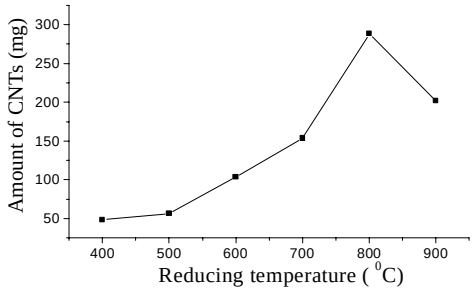
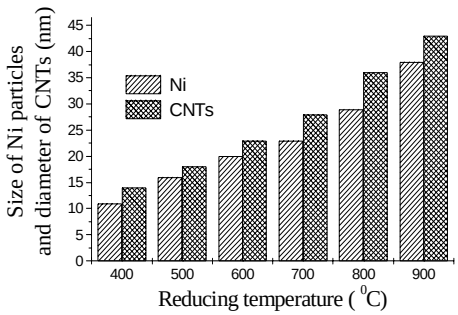


Figure 4 Ni particle size and diameter of CNTs



Acknowledgments

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References

1. S. Iijima, *Nature*, **1991**,*354*,56.
2. T. W. Ebbesen, P. M. Ajayan, *Nature*, **1992**,*358*,220.
3. J. Kong, A. M. Cassel, H. J. Dai, *Chem.Phys.Lett.*, **1998**,*292*,567.

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