

Carbon Nanotubes Grown on Sepiolite as Catalyst Carrier

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Abstract: Multi-walled carbon nanotubes were synthesized by the catalytic decomposition of acetylene at 750°C over sepiolite powder, which was treated with aqueous cobalt nitrate. It is expected that the composite with high specific area will have high capacity of hydrogen storage.

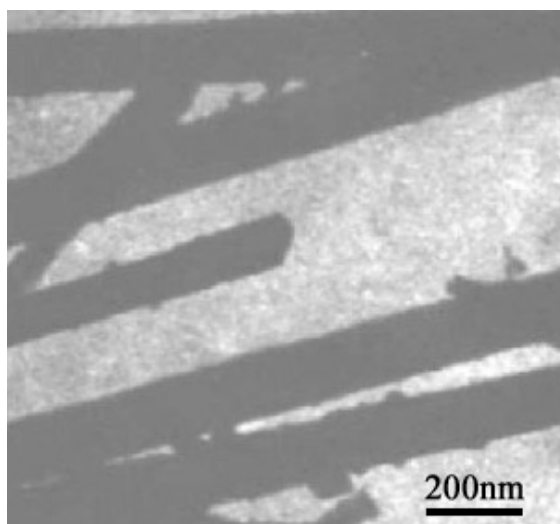
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Since the discovery of carbon nanotubes (CNTs)¹, they are considered as one of the most promising candidates being able to be used in many hi-tech fields. They have unique geometric microstructure, leading to their unique physical and chemical properties. Recently, carbon nanotubes were reported to be very fascinating material for H₂ uptake due to the super-high surface area²⁻⁴, which gave people feasibility on utilizing this attractive energy. Chemical vapor deposition (CVD) is one of the most important methods to synthesize CNTs⁵⁻⁶. In this work, carbon nanotubes were prepared by CVD method.

The microstructure and morphology of sepiolite, a kind of nonmetallic mineral, are much similar to those of carbon nanotubes and carbon nanofibers (**Figure 1**). It has high specific area, which make it able to be used to absorb gaseous hydrogen. If carbon nanotubes can grow on sepiolite, the surface area of the composite will increase greatly. For this purpose, we applied sepiolite powder as catalyst carrier to prepare carbon nanotubes.

Sepiolite clump was milled for 3 hours and screened through the screen with 400 mesh. The powder was dipped into the 33% (v/v) hydrochloric acid solution for 2 hours. The filtered slurry was heated to 100°C in vacuum for 2 hours. The dry mineral was then ground and the catalyst carrier had been prepared.

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Figure 1 TEM image of sepiolite

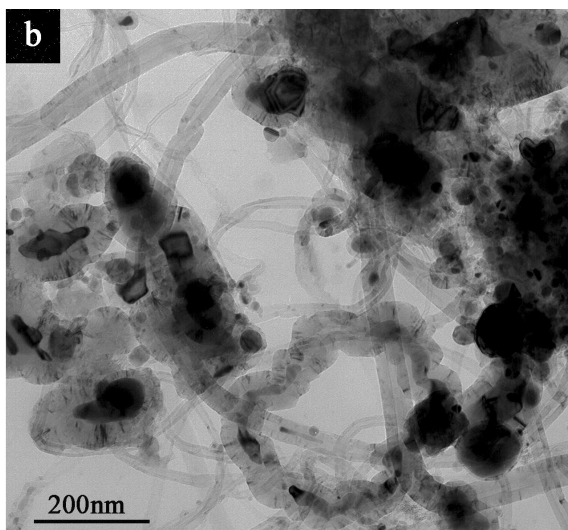
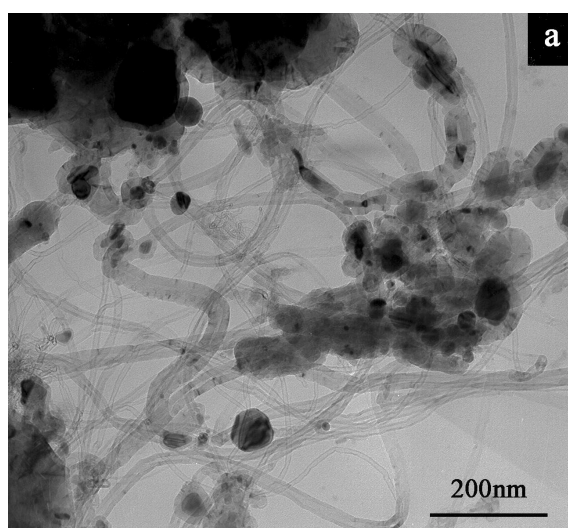
The sepiolite powder was put into the deionized water to make suspension (5 wt%). The same volume of cobalt nitrate solution (25 wt%) and a little polyethyleneglycol 200 were added into the suspension. Then the suspension was stirred for 6 hours by magnetic force and the colloid was formed. The ammonia solution (2 wt%) was slowly dripped into the colloid until the pH value of the colloid reaches to 11 and the cobalt hydroxide was formed. After filtration with filter paper, the powder was heated to 100°C in vacuum and the cobalt hydroxide coated on the sepiolite powder would change to cobalt oxide. Finally, the powder was ground and the catalyst for synthesis of carbon nanotubes had been prepared.

A molybdenum boat charged with catalyst was pushed into the constant temperature region in the quartz chamber and the acetylene was introduced into the chamber at a flow rate of 200 sccm at 750°C for 15 minutes. Then carbon nanotubes were formed on the catalyst substrate.

Transmission electron microscopy was applied to observe the quality and diameters of the grown CNTs. **Figures 2(a) (b)** are the TEM images of the carbon nanotubes grown on sepiolite.

The diameters of carbon nanotubes grown on sepiolite are in the range of 20 nm to 60 nm. The length of CNT is about several micrometers. But the CNT rate of yield grown on sepiolite is about 30%, lower than that grown on nano-quartz. Whether the composite of sepiolite with carbon nanotubes would have high capacity of hydrogen storage, further investigation on the composite is needed.

Figure 2 TEM images of carbon nanotubes prepared by CVD



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