Comparison of properties of graphite and carbon nanotubes treated by different oxidation agents

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INTRODUCTION

A great attention is paid to carbon nanostructures and their application in conductive materials, antistatic components and anticorrosive layers today. In this work we study different oxidation methods for graphite and carbon nanotubes (CNTs) and effects on their properties. We are able to prepare carbon materials with different degree of oxidation according to the oxidation agents. Peracetic acid or hydrogen peroxide oxidizes samples minimally. The increase of oxygen groups is more significant with persulfuric acid. Moreover if the oxidation agent is chlorate[1,2] or permanganate[3,4] the increase of oxygen groups is enormous[5].

EXPERIMENTAL

Strong oxidation

Oxidized nanomaterials were prepared by treating graphite or nanotubes with permanganate in acidic environment. In comparison to well know Tour oxidation we used smaller amount of permanganate repeatedly.

Mild oxidation

Carbon nanomaterials were modified by persulfuric acids. Firstly carbon nanoparticles were dispersed in sulfuric acid. Then the sample was separated to the three portions and hydrogen peroxide was added to form ratios H_2SO_4:H_2O_2 (1:1; 3:1; 5:1).

RESULTS AND DISCUSSION

In general the mild oxidation agents functionalize nanomaterials very slightly if ever. With the increasing force of oxidation agent the defects in the structure are more evident.

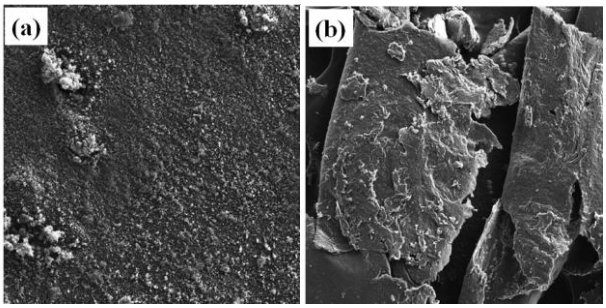

Fig 1: The SEM morphology: (a) mild oxidation of graphite (b) strong oxidation of graphite

The degree of oxidation depends not only on the strength of oxidation agent. Each of the four examined carbon nanomaterials has different reactivity.

If the ratio of sulfuric acid in persulfuric acid is low MWCNTs are slightly oxidized whereas SWCNTs are intact. With increasing ratio of sulfuric acid oxidation is stronger. The CNTs are opened or even reduced in length.

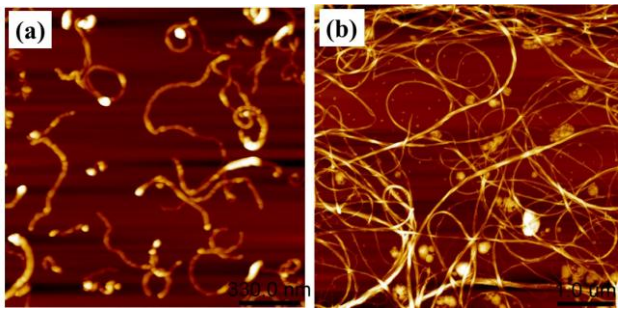

Fig 2: Images of slightly oxidized carbon nanotubes from AFM: (a) MWCNT fibres (b) SWCNT fibres

On the other hand graphite doesn´t show any signs of oxidation by persulfuric acid. To functionalize graphite with oxygen groups permanganate is needed.

CONCLUSION

We have implement increasing amount of oxygen groups into graphite as well as single and multi walled CNTs. Due to these oxygen groups the creation of chemical bonds with supporting polymer system is much easier and therefore we can prepare conducting polymers.

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