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New composite materials based on carbon nanostructures combined with conductive polymers

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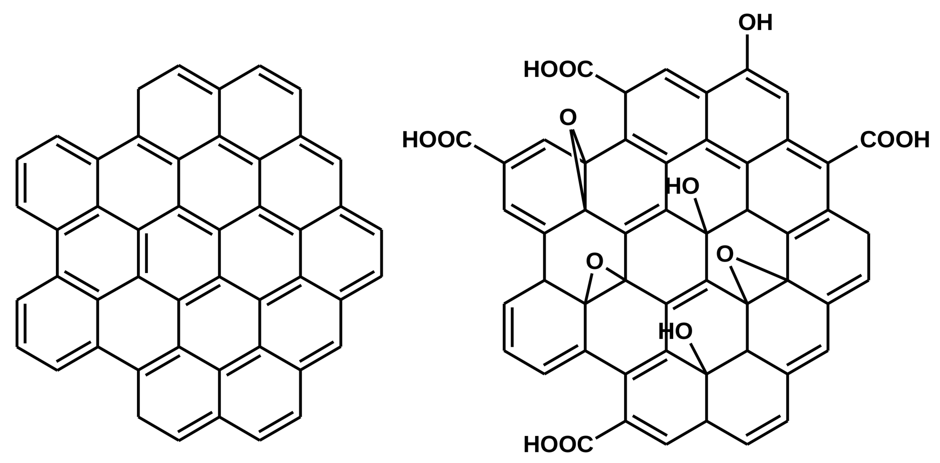
Introduction

A great attention is paid to carbon nanostructures and their application in conductive structures, antistatic components and anticorrosive layers today. In this work we study different oxidation methods of graphite and carbon nanotube (CNT) 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 oxidized samples minimally. The increase of oxygen groups is more significant with persulfuric acid. Moreover if the oxidation agent is permanganate or chlorate the increase of oxygen groups is enormous[1-7].

Tour oxidation

Graphite oxide was prepared by treating graphite with permanganate in acidic environment. This strong oxidation causes destruction of CNT.



Oxidation by persulfuric acid

Two different graphite, single and multi walled carbon nanotubes (swcnt; mwcnt) were modified by persulfuric acids. Firstly carbon nanoparticles were dispersed in sulfuric acid. Then the sample was separated in three portions and hydrogen peroxide was added to form ratios $H_2SO_4 : H_2O_2$ (1:1; 3:1; 5:1).
There are very slight destructions and defects in comparison with strong oxidation agents.

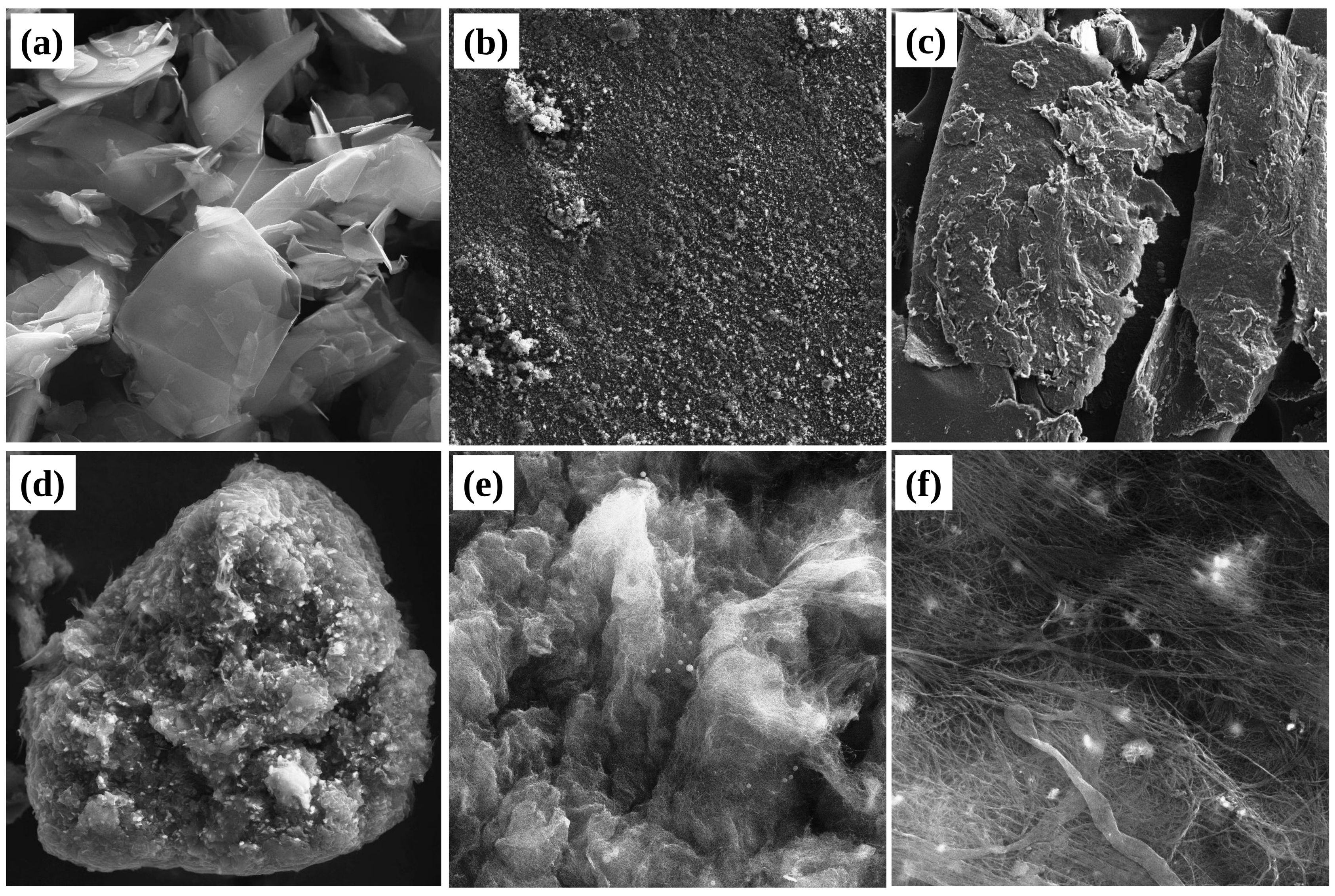


Fig 2: The SEM (scanning electron microscope) morphology: (a) Non modified graphite (b) slight oxidation of graphite (c) strong oxidation of graphite by Tour, slight oxidation by persulfuric acid (d)(e) mwcnt (f) swcnt

Raman spectra demonstrate defects (or oxidation) by ratio D/G band. Strong oxidation causes significant increase of D band. Treatment with persulfuric acid influences D and G bands very little. Furthermore some materials show defects even in non oxidized form.

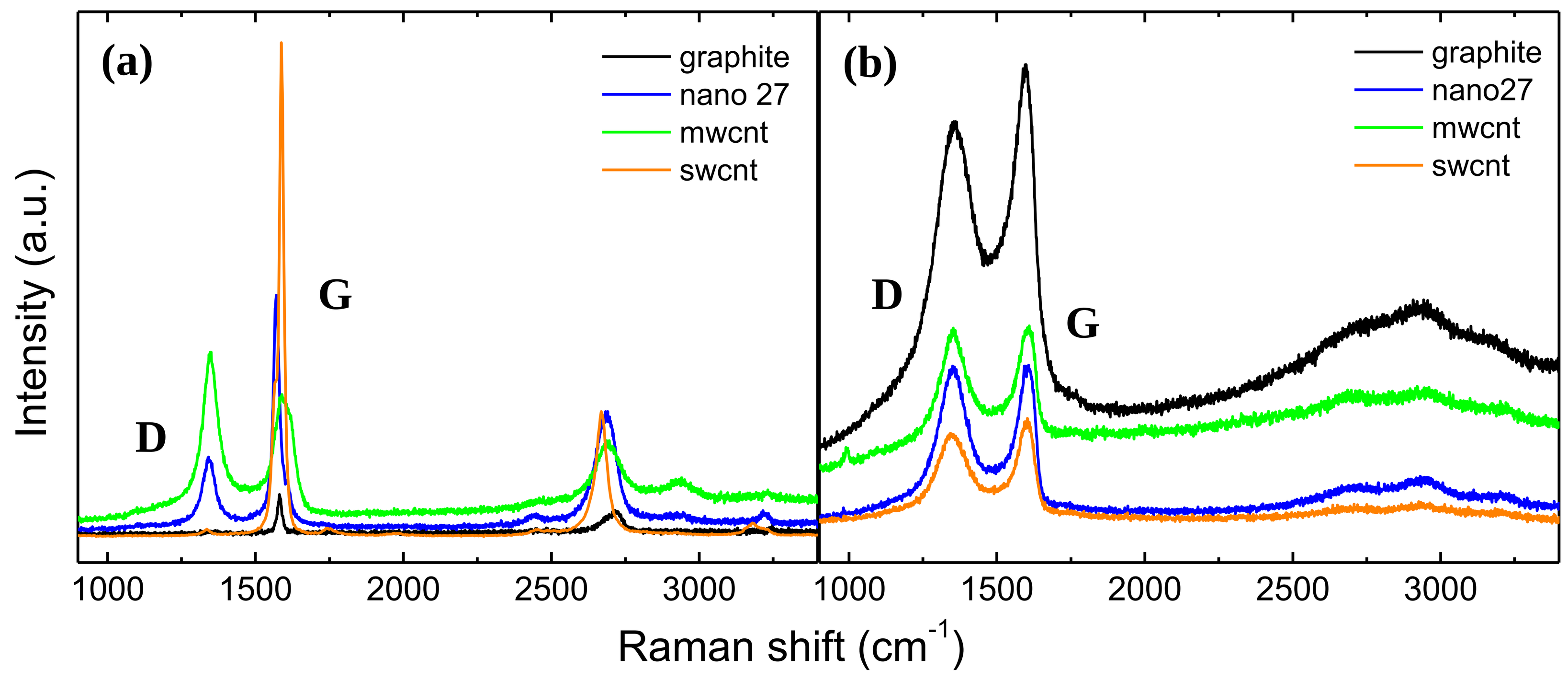


Fig 1: Raman spectra (a) unmodified carbon nanoparticles (b) oxidized carbon nanoparticles

Atomic force microscopy (AFM) is able to survey surface of CNT. Graphite creates too big agglomerates. 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.

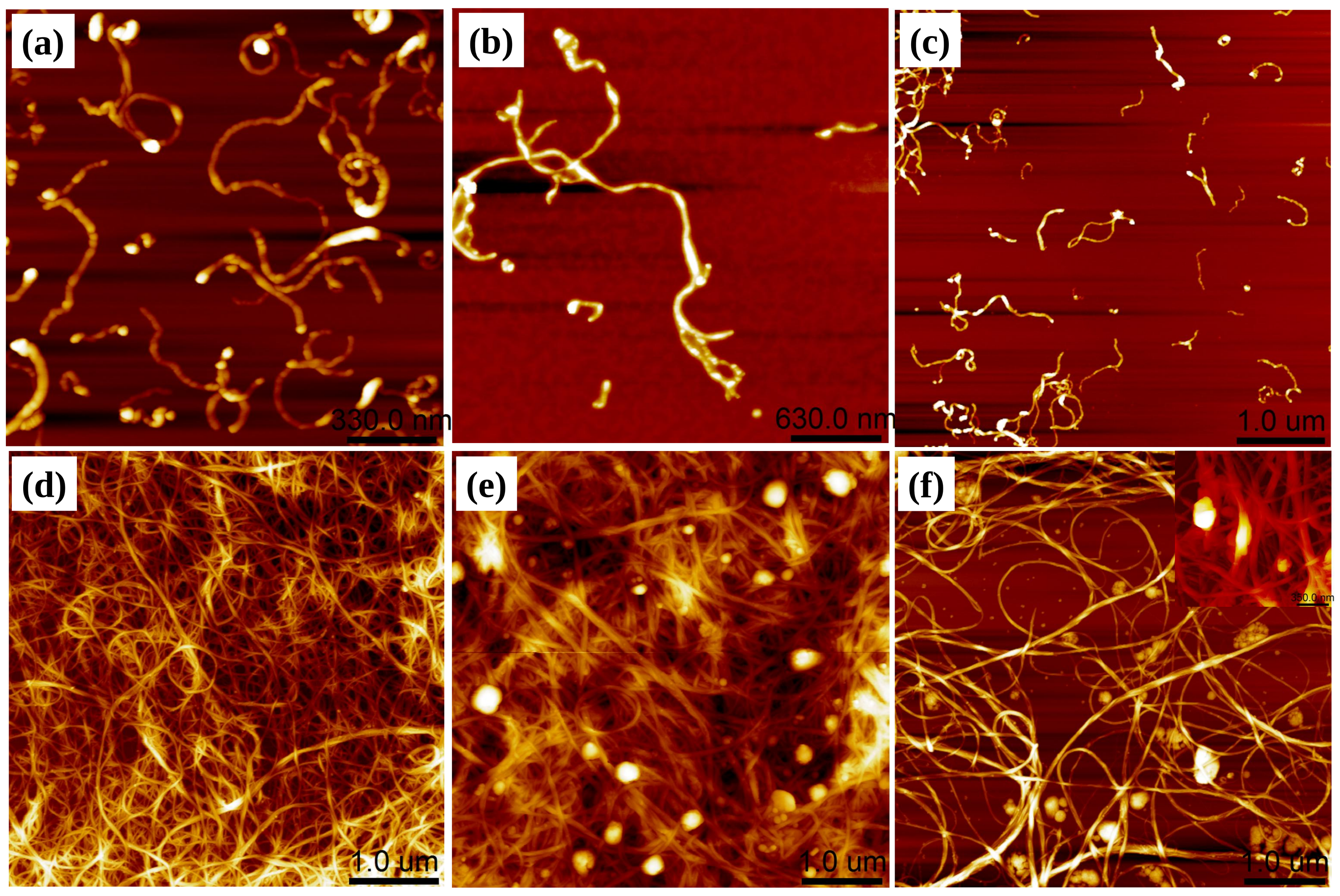


Fig 3: Images of slightly oxidized carbon nanotubes from AFM: mwcnt fibres (a) open in the ends (b) open in the middles (c) reduced in length; swcnt fibres (d) unopened (e) broaden (f) open in the ends

Conclusion

We have prepared slightly oxidized graphite oxides as well as single and multi walled CNTs. Due to these oxygen groups electrical compatibility is better and the creation of chemical bond with supporting polymer system is much easier.
We expect to use these properties for:
- functional fabrics equipped with electronic systems
- marking conductive inks
- pultrusion composite profiles
- conductive flooring
- anticorrosive thin films

Acknowledgements

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