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A Survey of Functionalized Carbon Nanotubes to better Dispersion

Elahe Sadat Ebrahimi*, Elham Darabi, Seyed Mohammad Elahi

Department of Physics, Faculty of Basic Sciences, Islamic Azad University, Science and research Branch, Tehran, Iran

ABSTRACT

This paper focuses attention on the functionalization of multi wall carbon nanotubes (MWCNTs). It is important to disperse carbon nanotubes in organic and inorganic solvent, otherwise; the carbon nanotubes are aggregated and lost their efficiency. Functionalization of carbon nanotubes was carried out by chemical method. The Fourier transform infrared spectroscopy (FTIR) and Raman spectrum showed the functionalization of carbon nanotubes. A new peak was observed in around 1726 cm-1 as C=O stretch vibration in the carboxyl group (COOH). Scanning electron microscope (SEM) and Transmission electron microscope (TEM) observations showed that MWCNTs were dispersed effectively in aqueous solution.

Keywords: Functionalization, Multi wall carbon nanotubes, Transmission electron microscope

INTRODUCTION

Multi wall carbon nanotubes have been extensively studied in many fields because of the many unique properties (high thermal and electrical conductivity) such as strong electrocatalyst, biological/chemical sensor, fuel cell applications and so forth [1-4]. Chemical functionalization of carbon nanotubes is an effective way to improve the processability of carbon nanotubes, which allow a better dispersion in polymer matrix and solvents. Oxidation of carbon nanotubes in nitric acid or a mixture of nitric and sulfuric acids can be functionalized by groups containing oxygen, such as -OH (hydroxyl) and -COOH (carboxyl) on the surface of the nanotubes. Since boiling, strong acid release oxygen atoms that expose with the carbon nanotubes, and the oxidation reaction may often occur [5]. The articles that have been recently published, physical methods such as sonication can enhance the solubility of SWCNT in solutions containing aromatic polymers [6].

MATERIALS AND METHODS

Acid washing is a general method for the purification and improved dispersion of carbon nanotubes in a solvent. First, 0.05 g CNTs were dispersed in 5 ml of nitric acid (65%) and 15 ml of sulfuric acid (95-98%) in a ratio of 1:3 (16 mM) and put it on an ultrasonic device for 20 minutes. Stirring operation was carried out on a magnetic stirrer with 1000 rpm and the temperature was adjusted in 90 °C. Functional groups are added to the nanotube with boiling acid. The heating was stopped after 12 hours, and the solution was cooled and CNTs were deposited. The remaining sediment was collected by centrifugation for 4 min at 4000 rpm. The washing was repeated several times, and then carbon nanotubes were dried inside a vacuum oven for 8 hours in 200°C.

Materials

Multi-walled carbon nanotubes (MWCNT, outer diameter <8 nm, average length 30 µm and specific surface area 500 $m^2\ g^{-1}$). The other chemicals were purchased from Merck. Deionized water was used in this work.

Characterization

Transmission electron microscopy (TEM, Zeiss- EM10C-80 KV) was used to characterize of the MWCNT. Aqueous suspensions of MWCNT was prepared and deposited holey carbon coated grid Cu Mesh 300. Field emission scanning electron microscopy (FESEM, Zeiss, ∑IJMA- VP) SEM was used to determine surface morphology. Dispersion of MWCNT was performed by ultrasonic (Misonix-S3000). The Raman system (Almega Thermo Nicolet Dispersive Raman Spectrometer) and Fourier transform infrared spectroscopy (FTIR, Nicolet Nexus 670 spectrometer on KBr pellets) were analyzed to characterize the carbon nanotubes.

RESULTS AND DISCUSSION

Covalent and non-covalent bonds are necessary between the external shells of carbon nanotubes with organic or inorganic solution. Also, the chemical oxidation is effective in stability and dispersity of carbon nanotubes at higher concentrations [5]. Figure 1 show MWCNT images after (Figure 1A) and before (Figure 1b) of functionalization respectively The analysis result of FTIR and Raman spectra of MWCNT is shown in Figure 2. As shown in figure 2 A, the peaks at around 1726 and 3700 cm^{-1}, are belong to C=O and O-H stretch vibration in the carboxyl (COOH) and hydroxyl (OH) groups respectively. Figure 3 shows SEM and TEM of functionalized carbon nanotube images, which are separated and dispersed in pure water.

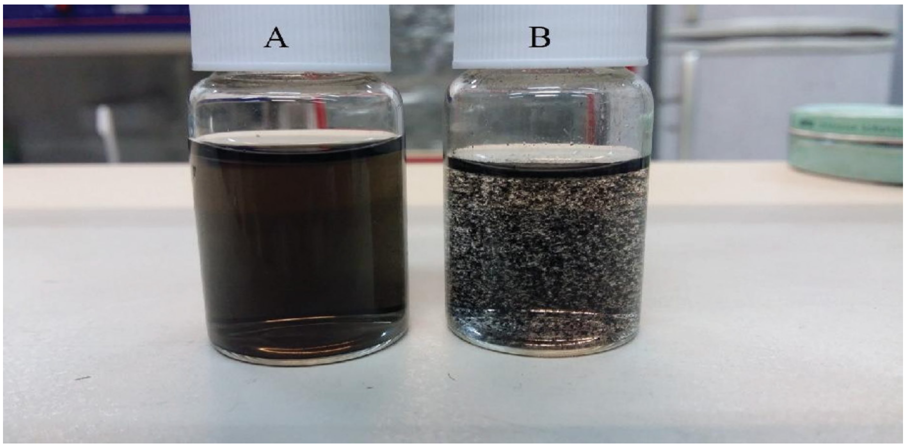

Figure 1: MWCNTs before (A) and after (B) functionalization in pure water

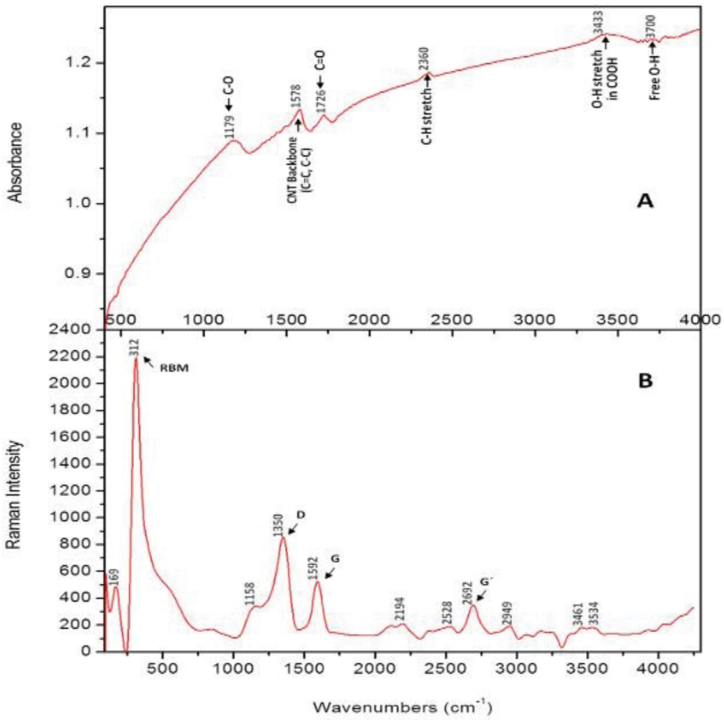

Figure 2: FTIR (A) and Raman (B) spectrum of functionalized MWCNTs.

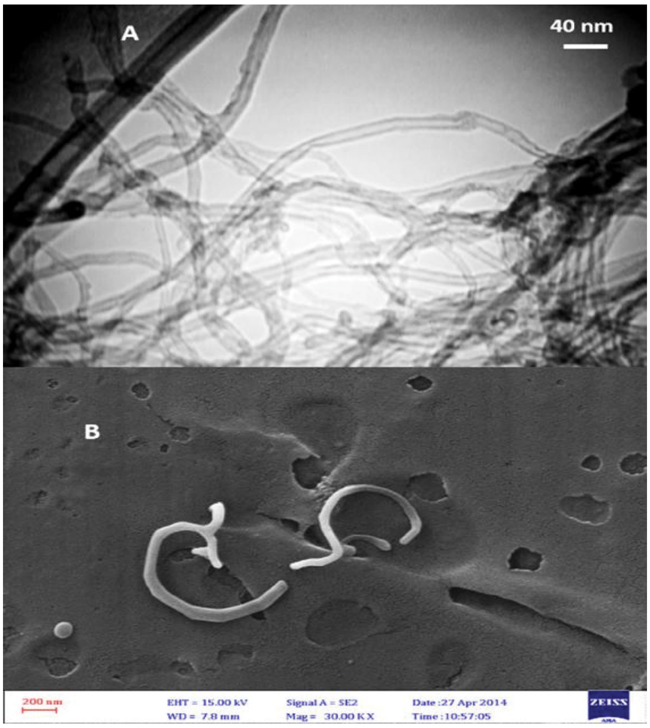

Figure 3: SEM and TEM of functionalized carbon nanotube images, which are separated and dispersed in pure water.

CONCLUSION

The nanotubes are attracted to each other by weak van der Waals force and do not dispersed in solvent. We can greatly improve the performance of MWCNTs by separation. Chemical treatment is one of the most useful approaches to improve the dispersion of CNTs.

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REFERENCES

[1] Pierini F, Lanzi M, Lesci IG, Roveri N. Comparison between inorganic geomimetic chrysotile and multiwalled carbon nanotubes in the preparation of one-dimensional conducting polymer nanocomposites. Fib & Poly, 2015, 16: 426-433.

[2] Matsumoto K, Fujigaya T, Sasaki K, Nakashima N. Bottom-up design of carbon nanotube- based electrocatalysts and their application in high temperature operating polymer electrolyte fuel cells. J Mat Chem, 2017, 21: 1187.

[3] Paul DR, Koros WJ, Liu RYF, Hu YS, Baer E, et al. Nitrogen-Doped Carbon Nanotube Arrays with High Electrocatalytic Activity for Oxygen Reduction. Sci, 2009, 323.

[4] Dai H, Gong L, Xu G, Li X, Zhang S, et al. An electrochemical impedimetric sensor based on biomimetic electrospun nanofibers for formaldehyde, Analyst, 2015, 140: 582-589.

[5] Zhang J, Zou H, Qing Q, Yang Y, Li Q, et al. Effect of chemical oxidation on the structure of single-walled carbon nanotubes. J Phy Chem B, 2018, 107: 3712-3718.

[6] Okamoto M, Fujigaya T, Nakashima N. Design of an assembly of poly(benzimidazole), carbon nanotubes, and Pt nanoparticles for a fuel-cell electrocatalyst with an ideal interfacial nanostructure. Small, 2009, 5: 735-740.