Modification of ZnO nanostructures by multiwalled carbon nanotubes

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1. Introduction

Since the carbon nanotubes (CNT) was discovered [1], it has been paid a great deal of attention due to their novel properties. It is well known that the CNT properties can be changed by the surface modification with organic, inorganic and biological species [2-3]. Metal oxides and sulfides such as TiO_2 , SnO_2, ZnS, and CdS [4-5], have been used to modify CNT. Of particular importance is the zinc oxide semiconductor (ZnO) with a direct band gap (3.37eV) and a relatively high exiton binding energy (60meV). ZnO with its potentials as room-temperature UV lasers, light-emitting diodes, sensors, solar cells, etc. [6-7] is particularly attractive material to build CNT/ZnO composite. At present, studies indicate that CNT/ZnO composite could possess unique properties which are different from alone CNT and ZnO. To modify CNT with ZnO various methods such as plasma-assisted sputtering, chemical vapor deposition (CVD) and microwave irradiation heating , have been used [8-9]. Only two research to modify CNT with ZnO have been made: tip-decorated CNT/ZnO heterojuntions arrays have been obtained by a water-assisted chemical vapor deposition of carbon on a zinc foil [8] and attachment of ZnO nanoparticles on the sidewalls of multiwalled CNTs (MWNTs) has also been obtained [9]. Herein, we propose that hydrothermal methods can be effective for control over the size and morphology of ZnO nanoparticles for building CNT/ZnO composites.

In this work we report a simple hexametilenetetraamina (HMTA) assisted-hidrothermal method at low temperature (90^0C) for the modification of thermally functionalized MWNTs with ZnO flowerlike nanostructures obtained via zinc nitrate $Zn(NO_3)_2.6H_2O$ as source material and hexamethylenetetramine ($(CH_3)_6N_4$) 000000000000000as the surfactant and catalyst.

2. Experimental

200 mg of MWNTs were sonicated in 10ml of ethylic alcohol at room temperature. Other solution containing 3.0g of zinc nitrate and 2.8g of hexametilenetetraamina in deionized water under vigorous stirring at 50^0C for 1h to form a 0.01m equimolar solution was prepared. Then the two solutions were mixed at 90^0C for 24h. It was observed that a grey powder precipitated at the flask bottom. Finally, the grey powder was thoroughly washed with deionized water and allowed to dry in air at room temperature.

3. Results

Figure 1 shows the SEM image of the flower-like ZnO nanostructures obtained by the hidrotermal method. They consisted of nanorods emerging from a common point in all directions. The nanorods have a diameter of 200-300nm

and 1-2 μm in length. It should be noted that the addition of carbon nanotubes induces the formation of flower-like ZnO structures, in contrast, isolated nanobars of ZnO are obtained without the addition of MWNT.

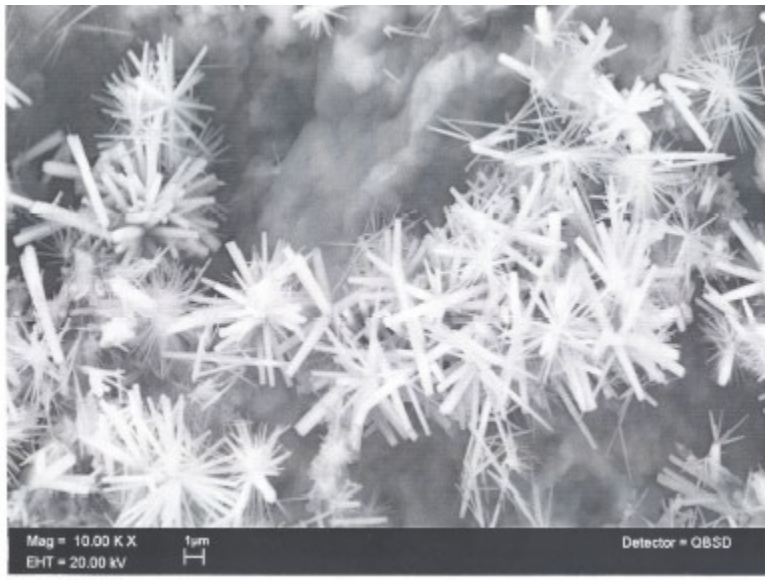

Figure 1 ZnO flower-like nanostructures.

Conclusions

In this work MWNTs/ZnO flower-like composites were synthesized by the HMTA-assisted hydrothermal method. The SEM results demonstrated that the flower-like nanostructures consisted of nanorods emerging from a common point.

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