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SYNTHESIS AND CHARACTERIZATION OF DENDRIMER HYBRID CARBON NANOTUBES

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ABSTRACT

Multiwalled CNT dendrimer hybrid nano-material was synthesized by chemical vapor deposition procedure in the presence of Mo as a catalyst at 900°C. The AFM images of hybrid nanomaterial confirm that linear dendrite Co-polymers are assembled on to the surface of CNT whereas the length and thickness are around 500 and 50 nm by SEM analysis.

Key words: Dendrimer, Carbon nanotubes, AFM, SEM, XRD, TGA etc.

INTRODUCTION

The combination of carbon nanotubes with inorganic nanostructure is believed to be a powerful tool for constructing novel organic-inorganic hybrid architecture with desirable functionalities and application in many fields ranging from energy storage and conversion, to catalysis, sensing and medical diagnosis and treatment.

Due to the chemically inert graphitic surface of the carbon nanotube, different assembly protocols for building functional carbon nanotube inorganic hybrid, including covalent and non-covalent routes, have been designed and demonstrated. A better understanding of the chemically associated with the hybrid assembly hold key to rational manipulation of the hybrid properties. This critical review discusses nano destructive nano-covalent assembly methodologies for constructing diverse carbon nano tube-inorganic hybrid materials and provides the latest advances in this field. Particular focus is given to the non-covalent assembly via functional linking molecules, which play pivotal roles in the control of morphology, composition, structure, interface and thus properties of the hybrid materials.

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EXPERIMENTAL

Material and methods

Preparation of CNT/ 2 3 γ - Fe O NP Hybrid Material

CNT/ 2 3 γ - Fe O NP hybrid materials were prepared by a simple and effective chemistry precipitation method. The MW plasma torch (2.45 GHZ) in the mixture of $CH_4/H_2/Ar$ (42/430/1540 sccm) with added vapors was used for the synthesis of iron oxide nanoparticle and nanotubes. The particle well defined facets consisting of Fe_3O_4 and γ 2 3 - Fe O self assembled in to long chains were produced at the power of 360 W[1].

Preparation of PCA-PEG-PCA Co-polymer

Linear dendritic ABA tri-block Co-polymers containing Poly (Ethylene glycol) (PEG) as a B-block and hyper branch poly (Citric acid) (PCA) as A block were synthesized through polycondensation the molecular self-assembly of synthesize PCA–PEG–PCA copolymers in water led to formation of nanoparticies and fibers in different sizes and shapes depending on the time and size of PCA blocks. Ten days after dissolving PCA–PEG–PCA Co-polymers in water, the fibers had reached several milliliters[2-3].

Preparation of PCA–PEG–PCA/CNT/ 2 3 γ - Fe O NP

Typically, 2 3 Fe O NP (0.001g) was dispersed in 5 mL water and mixture was added to a water solution of PCA–PEG–PCA linear dendritic co-polymer (0.0024 g in 5 mL) drop wise at room temperature and upon vigorous stirring. Then mixture was sonicated for 30 min at room temperature and it was filtrated to obtain a clear brown solution. Yield of reactions for preparation of PCA–PEG–PCA/CNT/ 2 3 γ - Fe O NP hybrid material was obtained[4].

Characterization technologies

Nanostructure or material characterization is necessary to establish, understanding and control of nanostructure synthesis and application characterization is done by using a variety of technique. Common technique that we had used in characterization of PCA–PEG–PCA/CNT/ 2 3 γ - Fe O NP hybrid nano material are as follows:-

AFM analysis

Surface imaging studies were performed using Atomic force microscopy (AFM) to estimates surface morphology and particle size distribution. The samples were imagined with the aid of Dualscope/Rastrescope C26, DME, Denmark, using DS 95–50 E Scanner with vertical z axis resolution of 0.1 nm. AFM images at PCA–PEG–PCA/CNT/ 2 3 γ - Fe O

NP confirm that linear dendritic Co-polymers are assembled on to the surface of CNTs. Non-continues molecular self-assemblies of linear dendritic co-polymers and CNTs surface change regionally (Fig. 1a and 1b). While hydrogen bonding between dendritic blocks of linear dendritic co-polymers and hydroxyl functional group of iron oxide nanoparticle cause assembling of these co-polymers on to the surface of CNT/2 3 γ - Fe O NP hybrid nanomaterial.

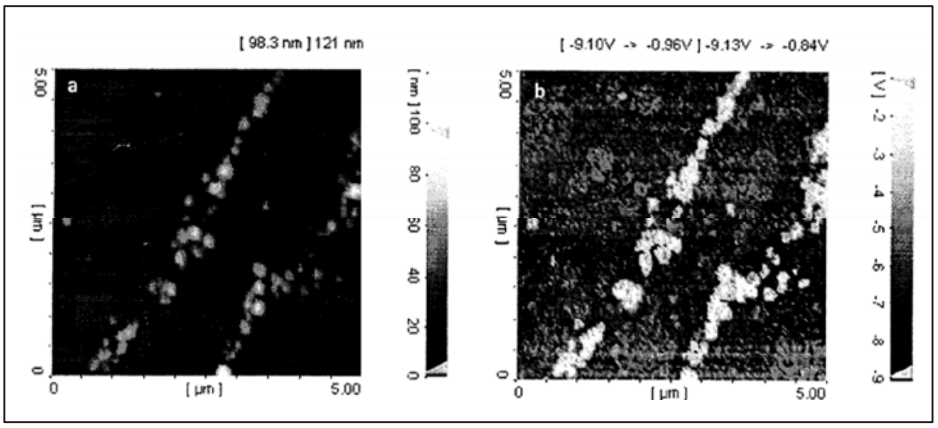

Fig. 1: AFM images of PCA-PEG-PCA/CNT/ 2 3 γ - Fe O NP hybrid nanomaterials (a) topographic and (b) contrast phase images

SEM Analysis

Morphology and size of material were investigated using the Philips XL30 Scanning electron microscope (SEM) with 12 and 15 A accelerating voltages. The PCA–PEG–PCA/CNT/ 2 3 γ - Fe O NP hybrid nanomaterials are in their extended conformation and appear as short worm-like objects. Their length and thickness are around 500 and 50 nm, respectively. Increasing the thickness of PCA–PEG–PCA/CNT/2 3 γ - Fe O NP is related to the self-assembling of linear dendritic copolymer on their surface but decreased length is due to the changing conformation of CNTs from extended towards closed upon noncovalent interaction with linear-dendritic Co-polymers (Fig. 2)[5] .

X-Ray diffraction

The X-Ray power diffraction pattern of product were recorded on Siemens D-500 diffractometer with Cu K*a* radiation (1.54056 λ = A°) in 2 θ range from 15° to 80°. Fig. 3 shows the XRD pattern of the opened MWNTs and a% 2 3 FO decorated MWNTs. The XRD pattern of the opened MWNTs seen that the diffraction peaks at 2e = 26.4°, 42.58° are assigned to (002), (101) planes of MWNTs. The XRD pattern of the decorated MWNTs seen

that diffraction angle at 2e = 35.52°, 43.22°, 57.87° can be assigned to (311), (400), (511) crystal planes at a% – 2 3 F*e*O, respectively.

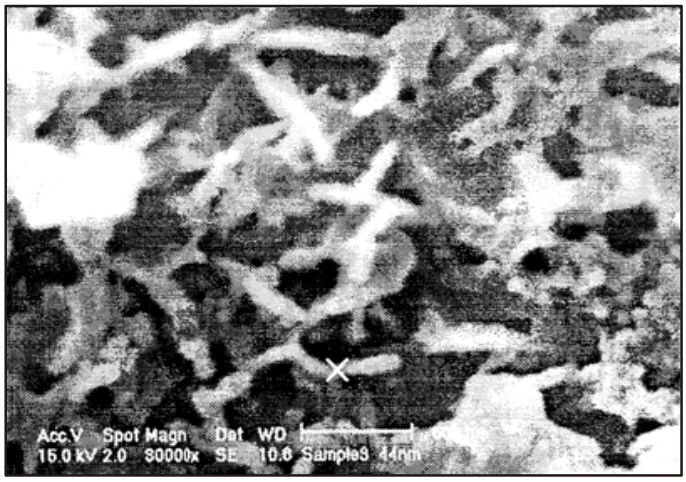

Fig. 2: SEM images of PCA-PEG-PCA/CNT/ 2 3 γ - Fe O NP hybrid nanomaterials

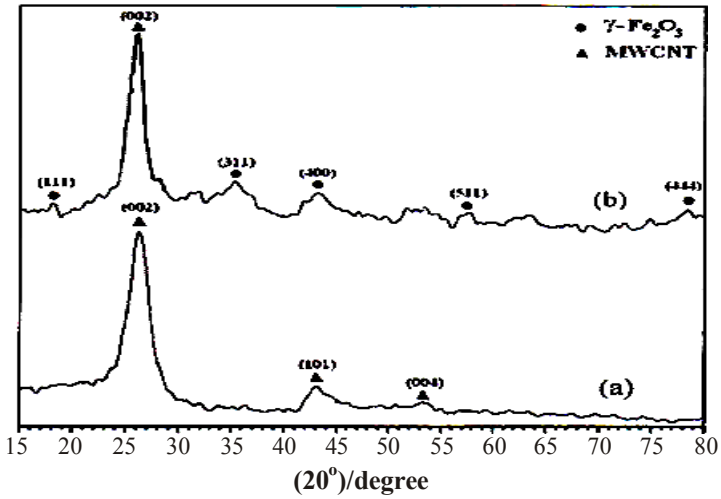

Fig. 3: XRD pattern of (a) opened MWCNTs, (b) CNT/ 2 3 γ - Fe O NP hybrid nanomaterials

TGA Thermogram

Thermogravimetric analysis or TGA is a type of testing that is performed on samples to performed on samples to determine changes in weight in relation to change in

temperature. Such analysis relies on a high degree of precision in three measurements: weight, temperature and temperature change.

Thermogravimetric analysis was performed on a PL – STA 1500 thermal analyzer set up under dynamic atmosphere of an inert gas (i.e. Ar) at 10 mL/min. The TGA thermogram of PCA-PEG-PCA shows weight loss in two stages at 171-249 and 366-416ºC, which are attributed to decomposition at PCA blocks (51%) and the decomposition of the PEG block (43%), respectively.

CONCLUSION

Multi-walled hybrid dendrimer PCA–PEG–PCA/CNT/2 3 γ - Fe O NP has been prepared by the chemical vapor deposition procedure. The AFM images of PCA–PEG–PCA/CNT/ 2 3 γ - Fe O NP confirm that linear dendritic Co-polymers are assembled on to the surface of CNTs. The IR spectra of compound proving the preparation of hybrid nanomaterial and covalent interaction between CNT/ 2 3 γ - Fe O NP and PCA-PEG-PCA. The SEM study shows the short worm like objects distribution.

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