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FABRICATION AND CHARACTERIZATION OF POLYANILINE/MULTI WALLED CARBON NANOTUBE CONJUGATED WITH DOXORUBICIN FOR OPTICAL AND MORPHOLOGICAL PROPERTIES

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ABSTRACT

Today nanotechnology is created a new revolution in research. Multi walled carbon nanotube (MWCNT) has multifunctional properties which can be used for different purpose. In our research, we have focused to prepare functionalized MWCNT and study potentiality of f-MWCNT based conjugating materials for biomedical application. In the present study, acid functionalized multiwalled carbon nanotube (f-MWCNT) grafted with polyaniline (PANI) then further f-MWCNT/PANI is subsequently conjugated with anticancer drug doxorubicin (DOX). We have characterized the structure of synthesized f-MWCNT/ PANI-DOX composites by UV-Visible spectrophotometer, X-ray diffraction pattern (XRD), scanning electron microscopy (SEM) and particle size analyzer. In UV-Visible spectrophotometer was given successful result of conjugation in between DOX, PANI and f-MWCNT. The shifting peak was conformed of conjugation. XRD data was suggested the strongly crystalline physical character and well conjugated with anticancer drug doxorubicin into f-MWCNT/PANI surfaces. This experiment may be very useful for drug delivery and biosensor purpose with different type of biomedical applications.

KEY WORDS: POLYANILINE , MWCNT, NANOCOMPOSITE, CONJUGATION, DOXORUBICIN, PANI; MWCNT; DOX; Nanocomposite; SEM.

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INTRODUCTION

In 21st century, the physical science is created a good image in inter disciplinary science.Multi walled carbon nanotube MWCNT and methods for their chemical modification and physical properties has been proved for different biological, physical properties and applications[1-4]. Recent study, MWCNT is one of the most studied materials in developing high performance biosensor, supercapacitor, and drug delivery applications[5-8.] MWCNT is one of the most wonderful conducting materials in developing high presentation super capacitor owning to their novel properties such as high charge transport capability, high specific surface area and high electrical conductivity properties. Process such as acid oxidation would then induce oxygenated functional groups such as carboxylic acid, ketone, alcohol and ester groups[9- 12].The most knowing method was already introduced about functionalizing of MWCNT using H_2SO_4 and HNO_3[13]. Further alteration of functional group can be achieved by reacting MWCNT-COOH with other chemicals. In recent research publications were explained about chemical modification, physical properties and bio-functionalization methods have made it possible to generate a new class of bioactive MWCNT which are conjugated with drug, proteins, carbohydrates, or nucleic acids[14]. In this experiment work, we discuss the fictionalization of MWCNT attached with PANI, and then conjugated with DOX. We also investigated its optical and morphological properties. F- MWCNT/PANI nanocomposites conjugated with DOX were confirmed by different type of characterization techniques such as UV-Visible spectrophotometer, XRD, SEM, DLS.

MATERIAL

MWCNT, PANI and Doxorubicin were purchased from sigma Aldrich. Other reagent and chemicals like HCL, HNO_3 and H_2SO_4 were of analytical grade.

Synthesis of the f-MWCNT/PANI nanocomposite

The preparation of functionalized MWCNT was followed to previous work[15]. The prepared functionalized MWCNTs were added to PANI with different concentration. Then the mixture was heated for 5 hours in the dark light. The nanocomposite (MWCNT/PANI) was first washed with acetone for 10-15 min then dry and transformed to a sheet (SS, 0.5 mm thick) for electrochemical polymerization.

Conjugation of DOX onto amid f- MWNTs

DOX was prepared by the previously reported method with some modifications[8] . DOX and succinic anhydride were dissolved in CH_2Cl_2 (15 ml) at 37^{0}C temperature. After wards, pyridine (0.001 mM) was added; the mixture was stirredfor 48 hour at 37^{0}C. The mixture was transformed to silica gel column chromatography for purification. Functionalized MWCNT/PANI were prepared by dissolving DOX-suc (100 mg, 0.1 mM) in dimethyl sulfoxide was activated by N-hydroxysuccinimide (0.1 mmol, 0.011g) and 1-ethyl-3-(3-dimethylaminopropyl carbodiimide hydrochloride) (0.1 mmol, 0.019g) for 4h at 35^{0}c . Subsequently, the produced mixture was added to f-MWCNT/PANI, amide functionalized (10 mg,) in PBS (pH 7) and the reaction proceeded at 50°C for 24 h, excesses DOX-Suc were removed by filtration and washed thoroughly with DH_2O for 10 times.

RESULT

UV–visible absorption spectrum

In figure 1, the UV–visible absorption spectrum of the f-MWCNT, PANI, DOX, f-MWCNT/PANI/DOX composites were dispersed in NMP. The characteristic absorbance peak at 437 for f-MWCNT. The major peak at about 225, 250 and 442 nm are observed for f-MWCNT/PANI/DOX , which are assigned to the excitation of the benzene and quinoid segments on the polyemeraldine chain[16-18] .The absorption peak at about 342 nm can be ascribed to π–π* transition of the benzenoid rings, whereas the peaks can be attributed to polaron–π* and π–polaron transition, respectively.

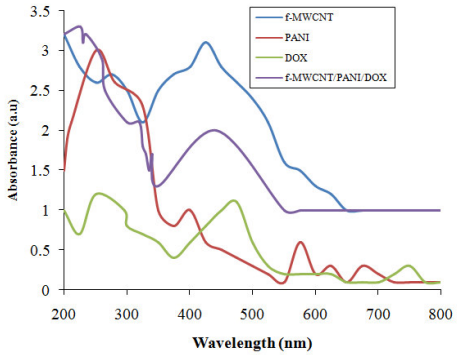

Figure 1
UV–visible absorption spectrum of the DOX, f-MWCNT, f-MWCNTs/PANI and f-MWCNT/PANI/DOX nanocomposite

XRD

In figure 2 shows XRD measurements of f-MWCNT, PANI, DOX, f-MWCNT/PANI/DOX nanocomposites. The XRD patterns of f-MWCNT shows peaks ~16^o, ~38^{o,} ~74^o for f-MWCNT respectively. But in f-MWCNT/PANI/DOX shows peak at ~19^o, ~28^o, ~46^o,~58 ^{o}.It was concluded that, f-MWCNT/PANI/DOX was crystallinity nature[19-21].

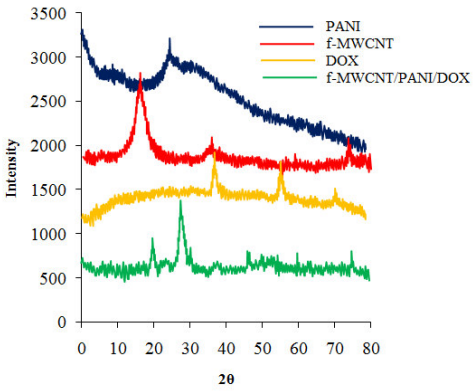

Figure 2
X-ray diffraction spectra of the neat DOX, f-MWCNT and f-MWCNT/PANI/DOX.

SEM

In figure 3, SEM image was identified that f-MWCNT/PANI conjugated with DOX, a layer of uniform organic compound at side wall of the f-MWCNT and the diameter of figure-3b is slightly increased comparing to without conjugated sample f-MWCNT/PANI. These structures are quite different from f-MWCNT/PANI, in which the tube surface is relatively smooth and clean as depicted.

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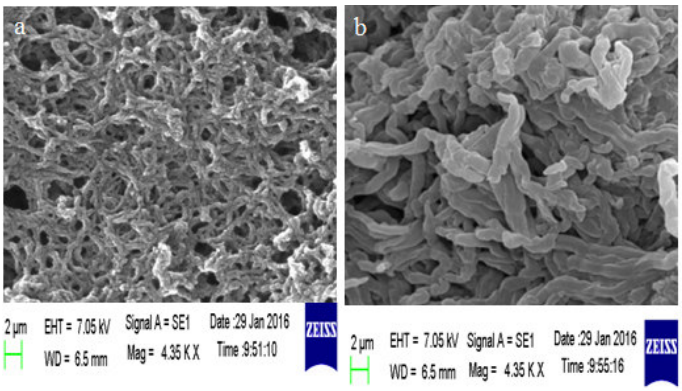

Figure 3
SEM of -MWCNT/PANI and f-MWCNT/PANI/DOX

DLS

The size of the produced particles was analyzed with DLS with sonicated in aqueous dispersions method. An increase in the particle size of f-MWCNT/PANI from primary sample during the modification with the drug is readily observed and is consistent with our claim regarding preparation of complex. The average cluster size of f-MWCNT/PANI is around 30 nm and this size for f-MWCNT/PANI/DOX is about 160 nm in figure.4.

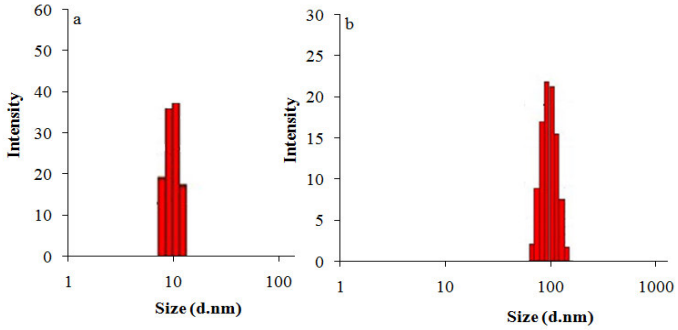

Figure 4
DLS of f-MWCNT/PANI (a)and f-MWCNT/PANI/DOX(b)
DLS of f-MWCNT/PANI (a)and f-MWCNT/PANI/DOX

DISCUSSION

According to latest literature survey , the inner and outer surface of MWCNT have various characters, In published result offering the possibility of loading capability of in inner and outer surface for biological activities for improving biological properties. Furthermore, bioactive agents can be conjugated to

carbon nanotubes through functionalization, as a result of which they can serve as a suitable carrier for drugs, antigens and gene delivery. Our research was done preliminary study to improved biological potentiality of MWCNT for drug delivery applications. Also, through functionalization method of MWCNT, bioactive agents can diminish the toxicity of MCNTs[22-23] .To investigate MWCNT loaded with DOX , It is used covalent method for drug loading or bonding in figure-1. Here the optical absorbance data (UV-Vis-NIR spectra) of DOX and MWCNTs the quantity of DOX was measured, for the same batches of samples. In this study, DOX / MWCNTs/PANI complex was obtained using chemical methods. The very good crystalline character was obtained in figure-2. Microscopic analyses showed MWCNT without physical changes after the conjugation process in figure-3 and figure-4. Conjugation of organic combination with MWCNT was confirmed using the data obtained from elemental analysis.

CONCLUSION

F-MWCNTs/PANI and f-MWCNT/PANI/DOX were successfully prepared via in situ polymerization. The preparations of nanocomposite with copolymer chain were confirmed by UV–visible spectrophotometer. The nanocomposites were indicated that filament-like features and disruption of outer and near-surface shell structure by SEM analysis. The crystallinity of nanocomposite was confirmed by XRD and also conformed well conjugation with DOX. We hope this study can be useful for further research on biosensor application of MWCNT for enhancement of anticancer properties.

CONFLICT OF INTEREST

Conflict of interest declared none.

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