JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Optical Properties of Functionalized Metal (Mn^{++}) of Carbon Nano Tubes

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Abstract: Nano materials are materials with dimensions and tolerances in the range of 100nm to 0.1nm. They can be metals, Ceramics, Polymeric, materials or composite materials. CNTs are sheets of graphite rolled up that leads to the formation of tubes. They may be SWNTs or MWNTs. They have wide range of applications. In this experiment the complex of transition metal (Mn^{++}) with Amino acids in protein have been synthesized to get CNTs. Synthesized complex is characterized by NMR, IR, PL Spectroscopy and Scanning Probe Instruments (SEM).

Key words: NMR, IR, PL, SEM and Egg Protein.

1. Introduction

CNTs are allotropes of carbon having Nano structure that usually have length to diameter ratio of up to 28000000:1 which is significantly larger than any other materials. They show various properties such as Electronic, Electrical, Magnetic and Optical properties and have capacity to carry an Electric Current 1000 times better than other metal wires such as Copper (Cu). They can be insulating, semiconducting or conducting depending on the way of the graphite structure spirals around the tube. They have large surface area and are thermally stable in vacuum up to 2800^0C. They have wide range of applications and are used in Electronics, Power transmission, Tele- communications, Energy storage, Information technology, Environmental protection, Bio-Sensors and in medicine as a drug delivery system.

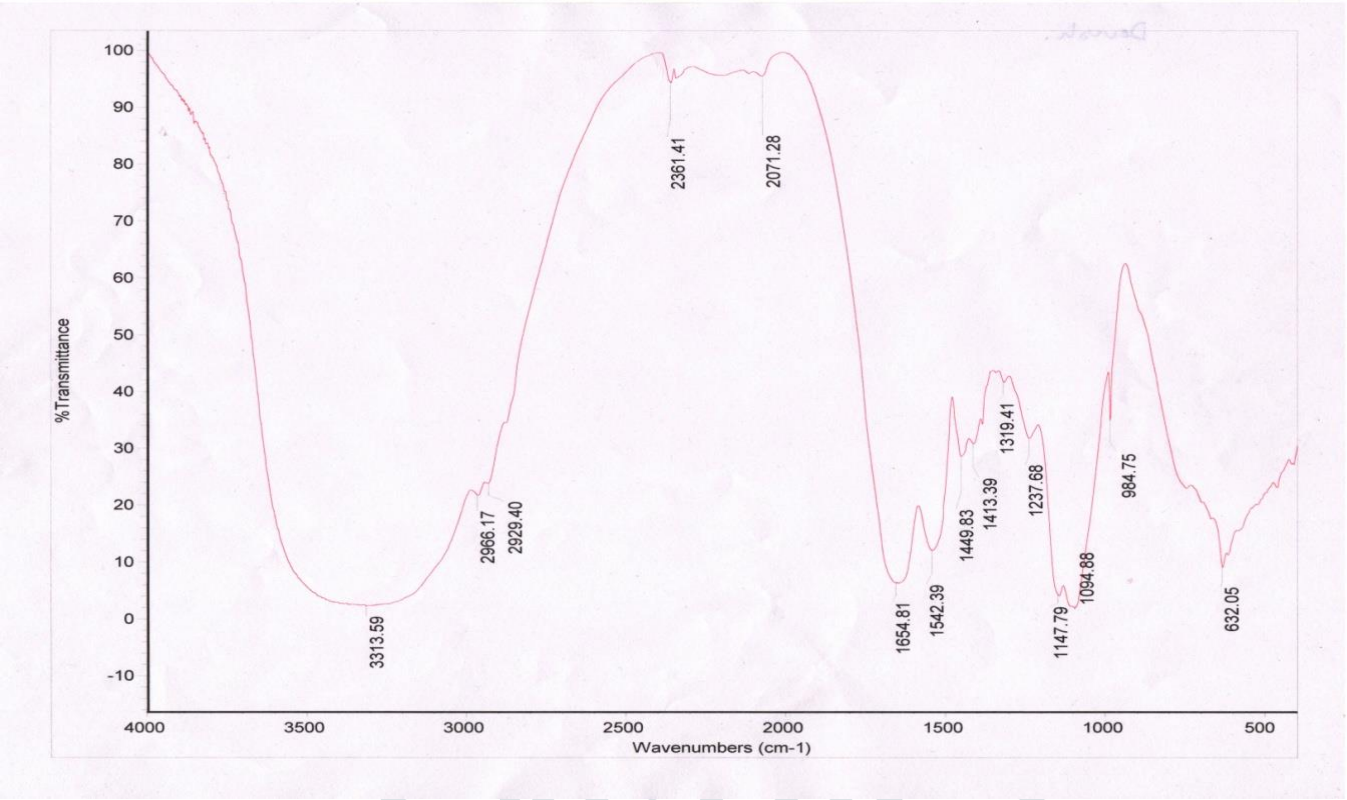
2. Chemical Experiment of Metal CNTs

In this experiment Mn^{++} salt solution of AR grade has been taken and allowed to react with Amino acids of Egg Protein to form a complex between Mn^{++} and Egg protein. The complex is characterized by spectral technique using IR, NMR and PL Spectroscopy. Complex on decomposition at high temperature in between 800^0C to 950^0C, is further characterized by scanning electron microscope (SEM).

3. Characterization

Complex & decomposed Mn^{++} Metal CNTs are characterized and result as follows by IR, NMR, PL and SEM.

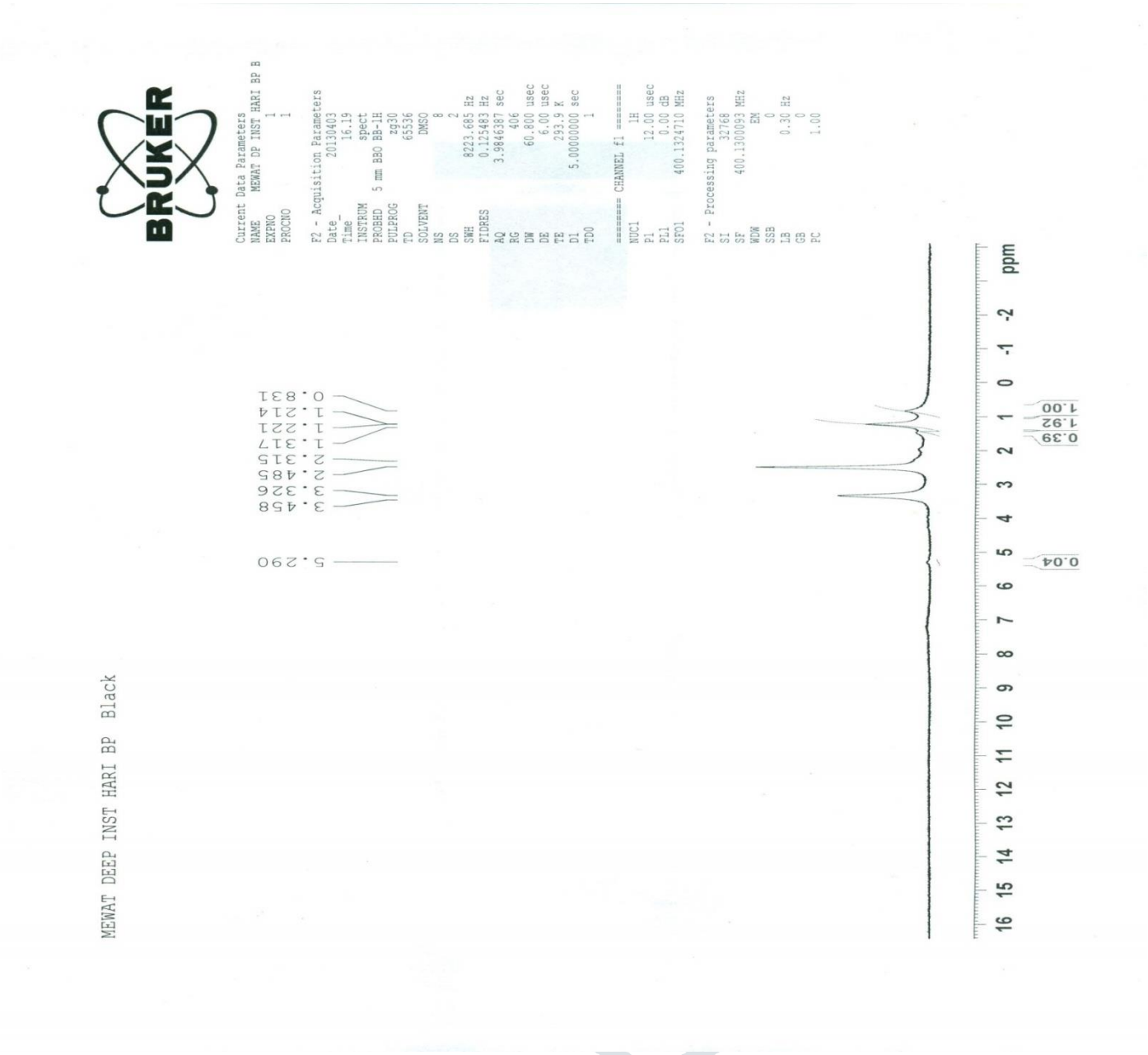
(a) IR spectroscopy deals with the infrared region of the electromagnetic spectrum. Electromagnetic radiations, having longer wavelength and lower frequency than visible light are involved. It covers a range of techniques, generally based on absorption spectroscopy. This spectroscopic techniques, is used to identify and study of chemical compounds. The IR spectra of compound prepared by the reaction of Manganese salt and Egg protein in alcoholic medium is shown below:



IR Spectra of Manganese salt and egg protein in alcoholic medium.

Functional Groups	**Prominent absorption band (cm^{-1})**
C-H (alkanes)	1147.79
Alcohol (hydrogen bonded)	3313.59
C-H	2966.17
Carboxylic acid (hydrogen bonded)	2929.40
Carboxylic acid	1654.81
Amide	1542.39
C-O Carboxylic acid	1094.88

(b.) Nuclear magnetic resonance spectroscopy (NMR) is a technique that exploits the magnetic properties of certain atomic nuclei and determines physical and chemical properties of atoms or the molecules in which

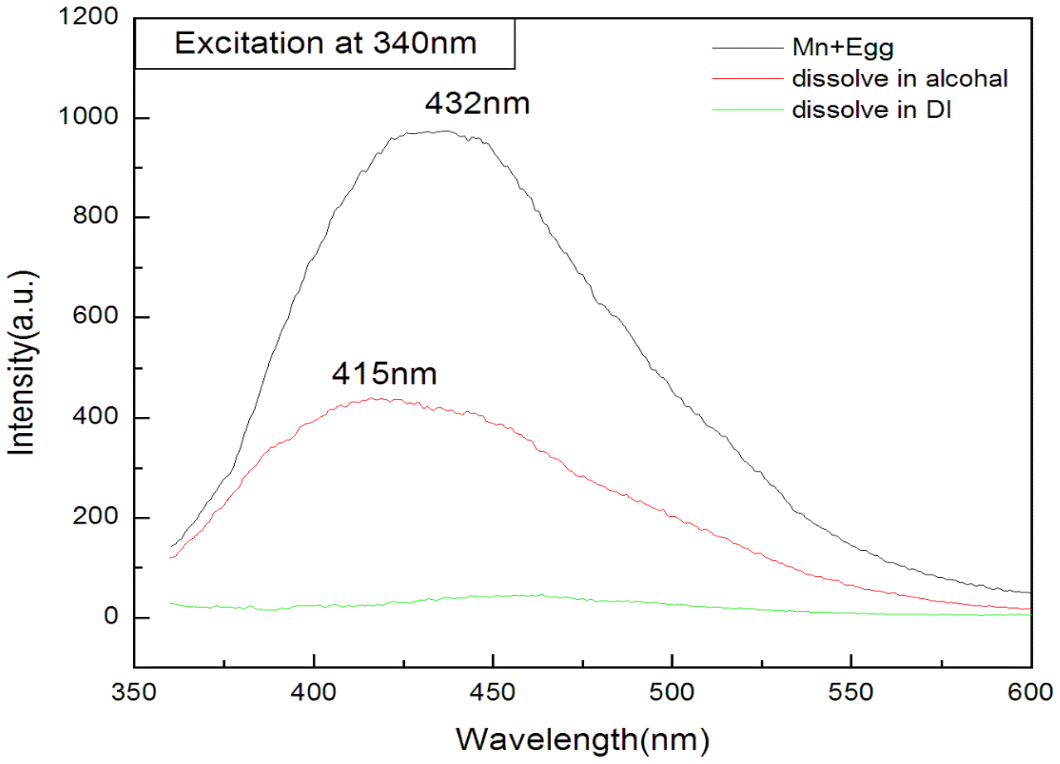


they are contained in complex compound. Nuclear magnetic resonance provides information in detail about the structure, dynamics, reaction state, and chemical environment of molecules.

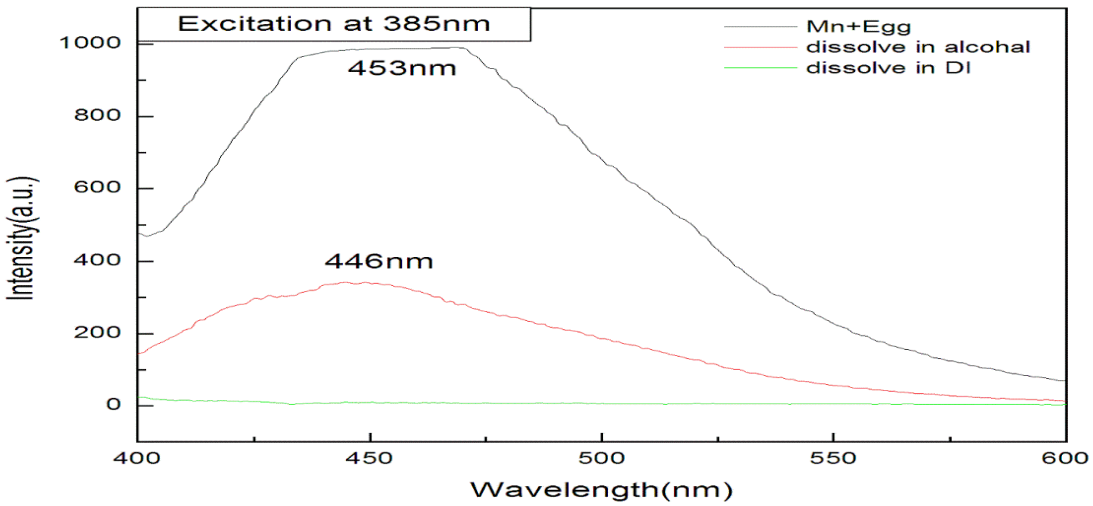
The information from above figure which we get by NMR spectra is summed and the Characteristics Proton Shift in the given table is as follows.

Types of protons	Chemical Shift (ppm) Black
$(CH_2)_3CH$	1.31
CH_2-	2.48
-CH-	3.45
-CH-COOH-	5.29

(c.) Photo Luminescence (PL) Light is directed onto a sample, where it is absorbed and imparts excess energy into the material/ CNTs. Photoluminescence excitation spectroscopy can be used to identify the chirality of carbon nanotubes.



From above figure if Excitation at 340 nm, the Intensity picks are 432 nm of Mn+Egg albumin and Intensity is 415nm when CNTs dissolve in alcohol.



From above figure if Excitation at 385 nm, the Intensity picks are 453 nm of Mn++ and Egg albumin and Intensity is 446 nm when CNTs dissolve in alcohol.

(d.) Characterisation by TEM : The TEM images of CNTs formed is shown in Fig.4.In TEM figors CNTs are clearly visible.

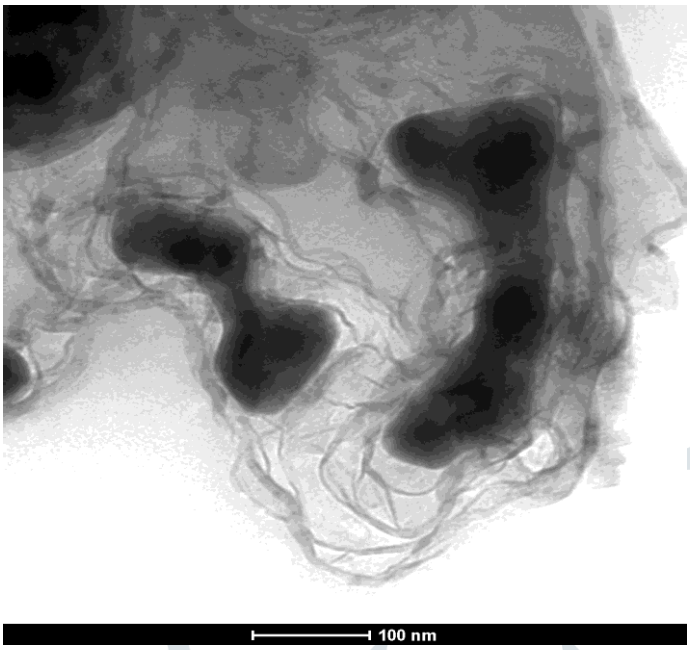


Fig.4TEM image of CNT

Interpretation of TEM: TEM image clearly shows the formation of CNTs. The Size of CNTs formed is 100nm.

4. Conclusion

Manganese Carbon nano tubes can be obtained by the reaction of aqueous solution of Manganese Salt with amino acids which are present in egg albumin after decomposing on high temperature of about 800^0C to 950^0C.These CNTs possess chiral carbon atom and show optical properties.

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