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RESEARCH ARTICLE

Characterization of CNTs by SEM, XRD &TGA

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Abstract

Carbon nano tubes have remarkable properties like electrical, magnetic, thermal, mechanical and elastic properties. Due to the various applications of CNTs, it is necessary to develop new methods for the synthesis of CNTs. In this method, complexes of transition metalCr(III) with amino acid present in egg albumin have been synthesized. The amino acid metal complex so formed is decomposed at 800^0C temperature in muffle furnace to obtain metal carbon nano tubes. Then they are characterized by the scanning probe instruments such as SEM, XRD, DTG, DTA and TGA.

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Introduction

Carbon nanotubes (**CNTs**)[1] are allotropes of carbon with a cylindricalnanostructure[2]. These cylindrical carbon molecules have unusual properties[3], which are valuable for mankind. These remarkable properties motivate the scientist to investigate in different parts of technology like nanotechnology[4], electronics, optics and other fields of materials science and technology. The carbon nano tube structure has already made it appearances because it represents an entirely new form of matter[5,6]. There are two types of nanotubes:

1. One atom thick layer of graphite wrapped into a seamless cylinder is known as Single walled carbon atom tube (SWCNT) and other
2. Consist of multiple layers of graphite rolled in themselves to form a tube shape. So, they are known as Mutliwalled carbon nano tubes (MWCNT).

Synthesis by Advanced Method
Material and Method

To prepare carbon nano tube, 0.5 gm normal metal salt solution of Cr^{+3} was prepared in distilled water. It is allowed to react with egg albumin to form a complex of egg albumin with chromium ion. The metal albumin complex, so formed was decomposed in muffle furnace at 800^0C temperature.

Preparation of Amino-acid metal Complex

As we know that the proteins are macromolecules, comprising of amino acid as its monomer. Amino acid contains $-NH_2$& - COOH group. With these groups, amino acids form complexes with metals and different chains of amino acid combined together. These compounds on decomposition give carbon metal nano tube.

When aqueous solution of Cr^{+3} salt is allowed to react with amino acid present in egg albumin the lone pair present on nitrogen of $- NH_2$ and oxygen of COO^- of COOH group present in amino acid form complex with Cr^{+3} forming cross links between two amino acid chains.

The structure of egg-albumin is very complex to produce exactlymetal complex. Egg Albumin contains a number of different chemical compounds for example:-

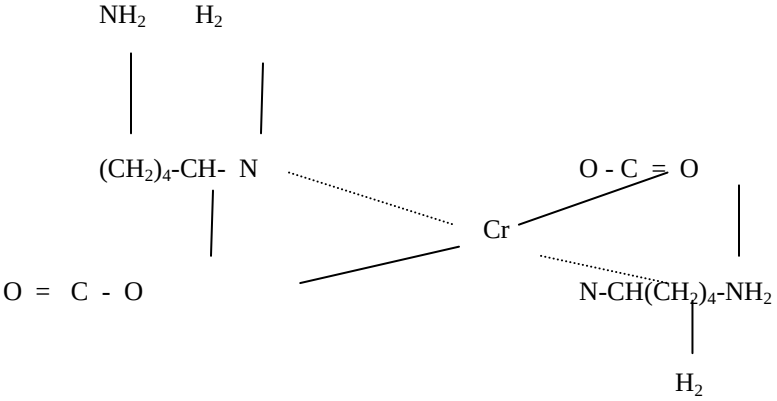
Egg albumin contain Lysine (NH_2 $(CH_2)_4$ CH (NH_2). COOH) and arginine

NH

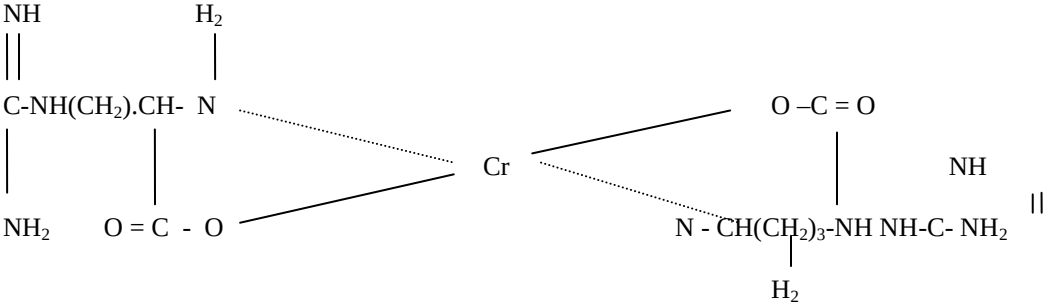
||

– (NH_2 – C- $(CH_2)_3$ CH, (NH_2 COOH)

They react with Cr^{+3} metal ion solution to give the following complex.



Lysine – Chromium (III) Complex



Arginine – Chromium (III) Complex

Characterizationby Scanning Electron Probe Instruments

SEM: Morphology & Size of CNTs can be determined by Scanning Electron Microscope (SEM) with 12 and 15 A accelerating voltage. The sample which is shown in fig. 1 was analyzed at IIT Roorkee. It gave the thickness of CNTs 10000 nm with magnification of 100x. The spot represents Cr^{+3} metal ion on the surface of CNTs. These ion play the important role in electron transportation.

XRD: The XRD pattern were recorded with Cu Ka radiation (1.54056 λ =A) in 2θ range from 15 to 80. From analysis of the XRD report, we find different peak, at different value of 2θ & d. for Example (2θ & d = 15.87055, 5.564, 8.12372, 10.882, 2.52883, 35.469,1.91759, 47.369), which show that the given sample is Multi-walled carbon nano tubes. The report was analyzed at IIT Roorkee (fig. 2).

TGA, DTA& DTG Study: Thermo gravimetric analysis of TGA is a type of testing performed on samples to determine changes in weight in relation to change in temperature. Such analysis tells that on a high degree of precision in three measurements. i. e. weight, temperature, and temperature change.

The TGA (fig.3)thermograph predicts the 77 % mass decomposition of metal ion is CNTs from 27-918 Cel. It becomes stable at 918 Cel& stable amount of CNTs is 23%. After this, decomposition does not occur. It proves the thermal stability of CNTs.

From DTA graph (fig.3) it is clear that decomposition starts at 375 Cel& 0.530 m V and again decreases as voltage decreases. Thereafter increases on increasing voltage at 394 Cel. Stability of CNTs increases after 394 Cel& 0.132 m V.

DTG graph(fig.3)indicates that decomposition is maximum at 314 Cel and 2.89 mg/min and decreases on decreasing in temperature and increases further at 393 Cel at 0.46 mg/min. and becomes stable after that.

Result and Discussion

The Carbon metal nanotubes formed, is thermally stable even on increase in temperature and voltage. This also exhibits conductivity[7], which shows the presence of unpaired electron[8]. It is found to exhibit thermal conductivity also.

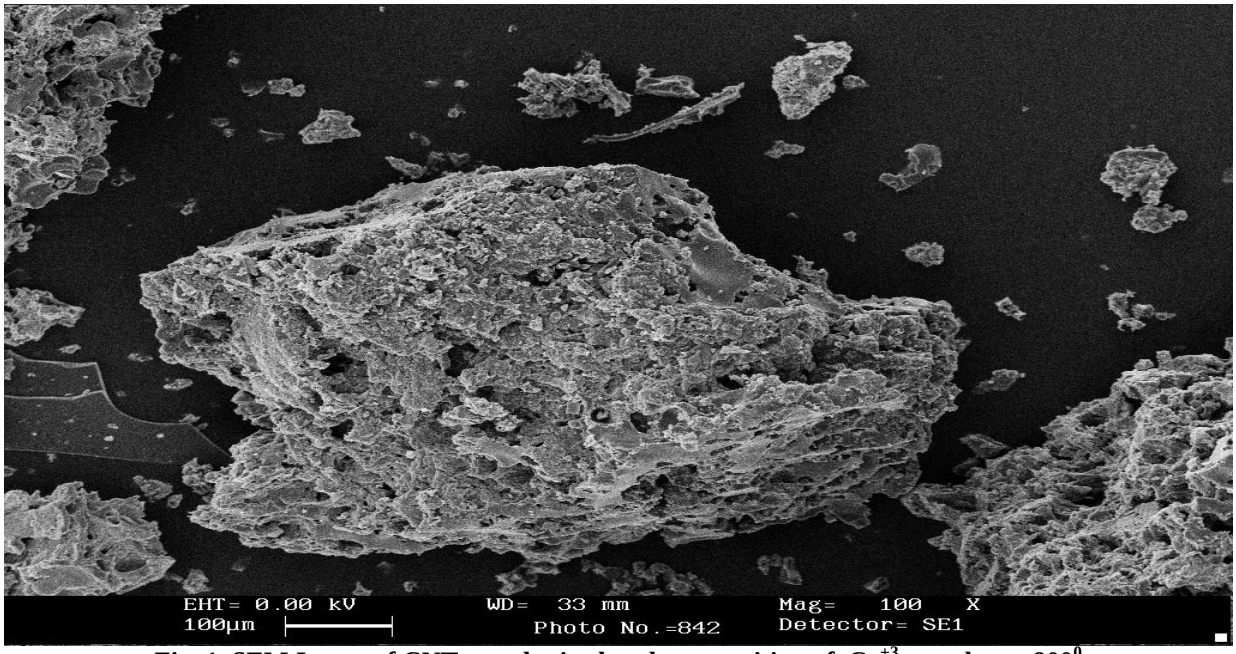


Fig. 1. SEM Image of CNTs synthesized at decomposition of Cr^{+3} complex at 800^0c

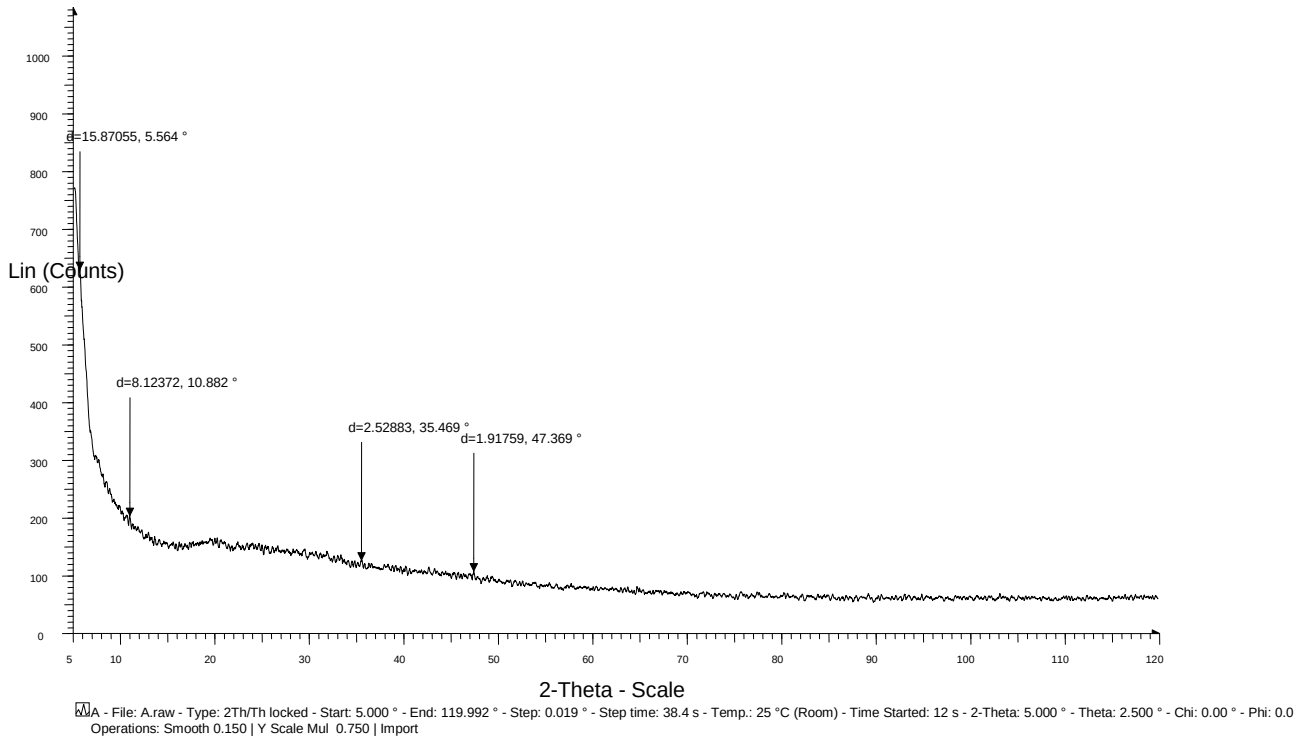
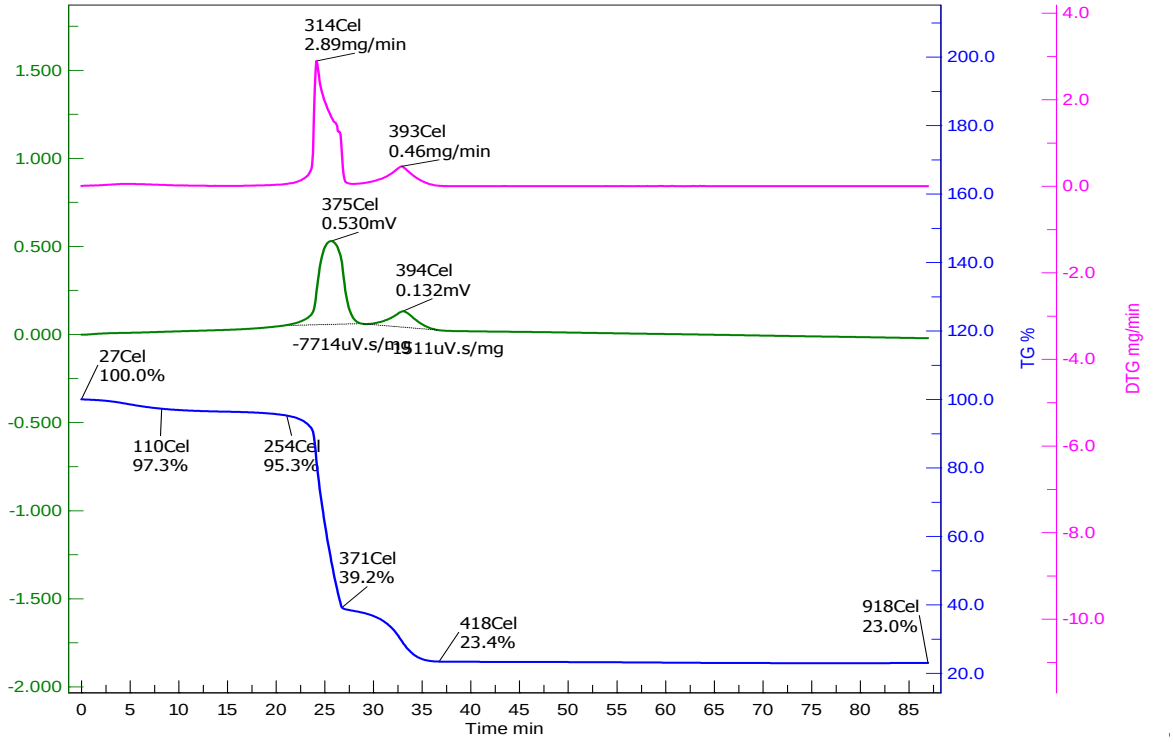


Fig. 2. XRD Image of CNTs synthesized by decomposition of Cr^{+3} egg albumin complex at 800^0c



Conclusion

Multi-walled carbon nano tubes have been prepared by advanced Chemical method. From SEM image metal ion presence is predicted on the surface of CNTs. The XRD studies confirm the Multi-walled structure of CNTs.

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