Journal of Advances and Scholarly Researches in Allied Education
Vol. 15, Issue No. 12, December-2018, ISSN 2230-7540

Synthesis and Characterization of Carbon Nano Tubes Using Protein and Salt of Manganese

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Abstract – Nanotechnology is projected the engineering of functional systems at the molecular scale. In its true sense, 'nanotechnology' is considered as ability to construct items from the bottom up approach, using techniques and tools being developed day to day to make complete products of high performance. CNTs due to their extra ordinary properties and applications are considered as one of the high performance Nano material. Considering the importance of CNTs as Nano material a green route is developed to produce them using protein and metal salt solution. The CNTs and protein metal complex are characterized using NMR, UV, XRD and TEM.

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INTRODUCTION

CNTs are recognized as an important Nano material and are used in almost every sphere of life due to their remarkable properties in so many applications. CNTs are prepared by traditional methods need to be functionalized after synthesis. So an effort was made to develop a new method to prepare functionalized CNTs using protein and transition metal salt solution and no extra effort is required to functionalize CNTs. Actually protein have two connecting sites and it can act as a bridging legend to form chelate with metal.

The essential condition to prepare CNTs by chemical method is that the concentration of carbon at a particular point should be high so various protein chains are clubbed together using metal and are isolated from other materials, If present in the protein source.

The complex of protein and metal after separation is decomposed at various temperatures to obtain CNTs. These CNTs are purified and characterized using various scanning probe instruments.

Key Words: Nanomaterials, CNTs, TEM, NMR, XRD

Experimental Details- The synthesis of CNTs using protein and metal salt is a two-step process:

Step I- Preparation of protein –metal complex:

In this process Egg is used as the protein source. Egg yolk is separated from egg white and is taken in a beaker now 10 ml solution of Manganese Sulphate is added to it. The resultant mixture is kept in desiccator for few days for self-precipitation and drying. After drying the complex is washed with water and is kept in the folds of filter paper for drying. The weight of dried complex = 4.827gm.

Step II- Decomposition of protein metal complex: The above said complex is now taken in a crucible and kept in the muffle furnace at a temperature of 700^{o}C for 10 minutes for decomposition. After 10 minutes the crucible is taken out and is kept in desiccator for cooling. The weight of dry CNTs =2.547gm

Purification of CNTs- The purification is carried out in two steps:

Step I-At the time of decomposition in muffle furnace- At the time of decomposition of protein-metal complex in muffle furnace, so many volatile impurities are separated and CNTs become free from many impurities.

Step II- Acid treatment to separate metallic impurities:

For removal of metallic ions CNTs are kept in 12N HCl solution. For one gm of CNT 6ml HCl is taken. The CNTs are dipped in solution for 24 hours. Then they are centrifuged and washed with water till HCl is completely removed.

Characterization: Characterization is carried out in two steps:

Step I-Characterization of protein Manganese complex- Protein **–** Manganese complex is

characterized using NMR to see whether the desired compound is formed or not.

NMR graph of Protein-Manganese complex: The NMR graph of metal -protein complex is shown in Fig.1 and the results are summed up in table 1.

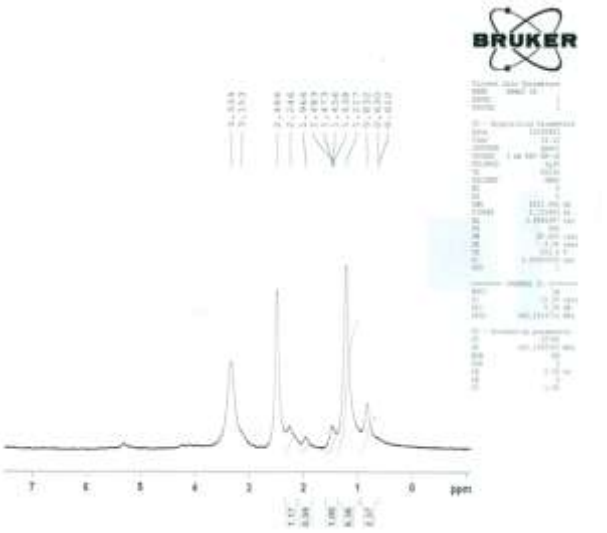


Fig.1 The NMR graph of metal-protein complex

Table of NMR:

τ Value	Functional Group
3.334 – 3.153	Alcohol
2.486	Carboxylic acid
1.483, 1.473, 1.456, 1.438	Secondary amine

Interpretation of NMR: NMR shows presence of Alcoholic group with secondary amine and carboxylic acid. So it is clear that some functional groups are present in the complex.

UV Graph of protein -Metal complex: The UV graph of metal -protein Complex is shown in Fig.2 and the results are summed up in table 2

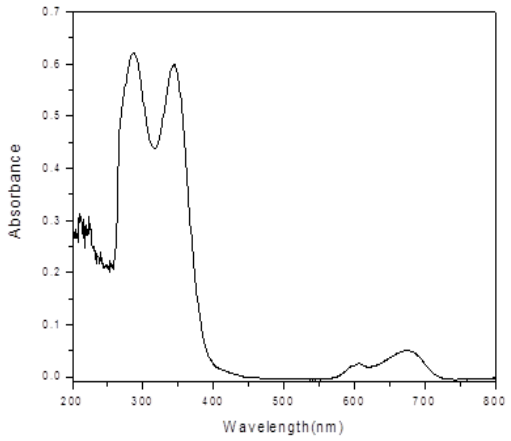


Fig.2 UV graph of metal -protein Complex

Table of UV:

λ max	Functional group
280 nm	Carbonyl group
340 nm	Peptide linkage
350 nm	Glutamic carboxylic acid

Interpretation of UV: UV graph of protein-metal complex shows the presence of carbonyl group with Glutamic Carboxylic Acid. A peptide linkage is also found in the complex.

Step II Characterization of CNTs: CNTs formed are characterized using XRD & TEM.

Characterization using XRD: The XRD graph of CNTs is shown in Fig.3

Graph of XRD

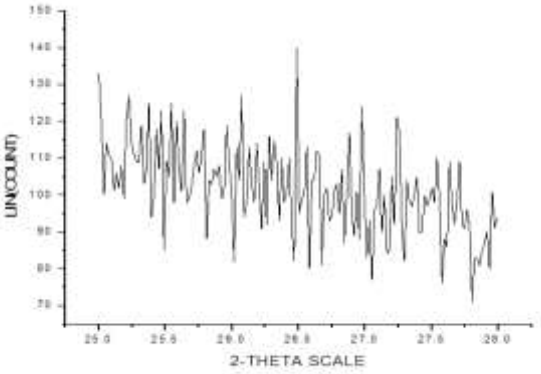
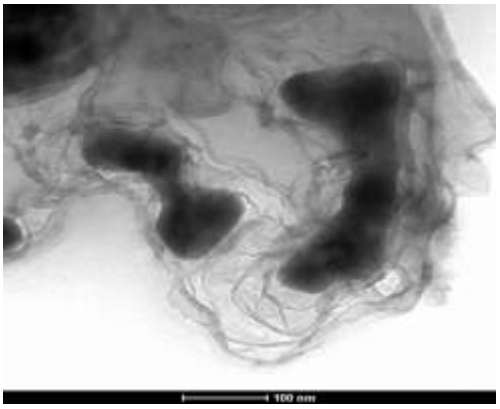


Fig.3 XRD graph of CNTs

Interpretation of XRD: XRD Graphs shows the presence of CNTs. The peak of graph is at 26.4.Which is quiet close to the standard value of 25. The results were found to be almost similar to the results reported by for multi walled CNTs prepared by C.R.Bhattacharjij[3] by pyrolysis of turpentine oil (2θ=25.6) and with Ioan Stalin etal[4],who prepared CNTs by catalytic pyrolysis of phenol formaldehyde resin(2θ =26.2).



Characterization using TEM: The TEM images of CNTs formed is shown in Fig.3

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

Conclusion: CNTs are formed by the decomposition of Protein-Metal complex.. The Size of CNTs formed is 100nm.

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