

Study of Thermal Stability of Metal Carbon Nanotubes by SEM, XRD & TGA

Rajeev Kumar Sharma¹, B. Tiwari², J. S. Tomar³

Research Scholar, Mewar University, Chittorgarh, India¹

Director, D.S.I.T.M. Ghazibad, India²

Rtd. H.O.D., D.A.V. (P.G.) College, Muzaffarnaga, India³

Abstract: In this present study a complex of transition metal Cr^{+3} with amino acid present in egg albumin have been synthesized. To obtain metal carbon nanotube, this amino acid metal complex is decomposed at $800^{\circ}C$ in muffle furnace to give metal carbon nanotube. These metal carbon nanotubes are characterized by the scanning probe instruments such as SEM, XRD. The thermal stability has been studied using DTA, TGA, DTG.

Keywords: Cr (III), albumin, Albumin-metal-complex, SEM, XRD, DTA, TGA, DTG

I. INTRODUCTION

Carbon nanotubes¹ are molecular scale tubes of graphite carbon². They are among the stiffest & strongest fibre known and having outstanding properties³. These outstanding properties³ motivate the scientist to develop new techniques to produce carbon nanotube⁴.

To produce CNTs, a large no of carbon atom is required⁴. For this, proteins are used as key material, because proteins are the bio-polymers of amino acid⁵. Amino acid containing $-NH_2$ & $-COOH$ group. These group play important role to form metal complex. When these metal complex are decomposed at $800^{\circ}C$ then CNTs are formed⁶.

II. SYNTHESIS BY ADVANCED METHOD

To prepare carbon nano tube, 1 gm normal metal salt solution of Cr^{+3} was prepared in alcohol. When this solution is mixed with egg albumin, a complex of egg albumin with chromium ion is formed. The metal albumin complex is decomposed in muffle furnace at $800^{\circ}C$.

III. CHARACTERIZATION BY SCANNING ELECTRON PROBE INSTRUMENTS

A. SEM: scanning electron microscope is used to determine morphology & Size of material. Result of SEM is shown in fig. 1. From fig.1 it is clear that the thickness of CNTs 10000 nm with magnification of 100x. Fig.1 shows some white spots. These spot represents Cr^{+3} metal ion on the surface of CNTs. Which are responsible for electron transportation.

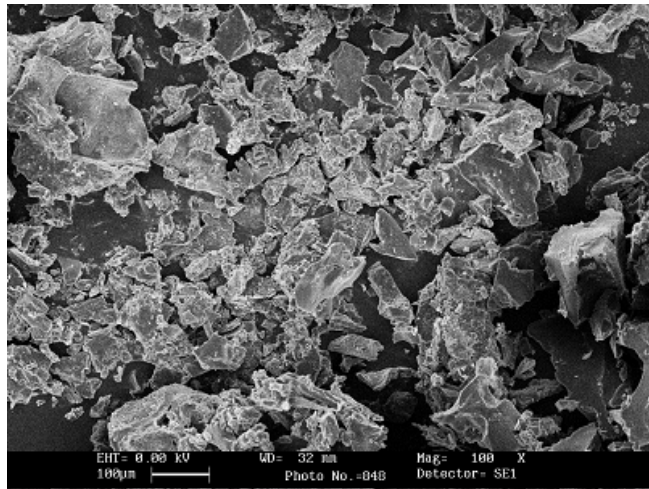


Fig.1. SEM image of CNTs (decomposed of Cr⁺³ complex at 800⁰C)

B. XRD : The X-Ray Diffraction pattern is used to determine the structure of carbon nanotube. XRD patterns were recorded with Cu K α radiation ($1.54056 \lambda = \text{Å}$) in 2θ range from 15 to 80. From analysis of the XRD report, we find different peak values, at different values of 2θ & d . For example (2θ & $d = 9.34282, 9.459, 2.26639, 39.739, 2.01150, 45.033, 1.43137, 65.117, 1.24872, 76.176, 1.11162, 87.729, 0.93996, 110.071$), which show that the given sample is Multi-walled carbon nanotubes. The XRD report, as shown in fig. 2 was analyzed at IIT Roorkee.

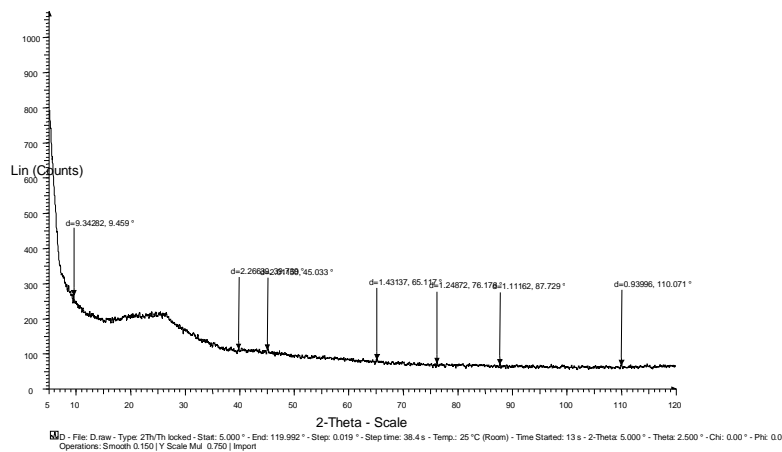


Fig.2. XRD image of CNTs (decomposed of Cr⁺³ complex at 800⁰C)

C. DTA, TGA & DTG : 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 thermograph (from Fig. 1) predicts 72.4 % mass decomposed from 100% - 27.6%, when temperature increase from 24-917 Cel. It becomes stable at 917 cel & stable amount of CNTs is 27.6%. After this decomposition does not occur. It proves the thermal stability of CNTs.

From DTA graph (from Fig. 1), it is clear that decomposition starts at 396 Cel & 369.5 μV and again decreases as voltage decreases. There after increases on increasing voltage at 471 Cel. Stability of CNTs increases after 471 Cel & 72.5 μV .

DTG graph (from Fig. 1) indicates that decomposition is maximum at 362 Cel and 2.79 mg/min and further at 476 Cel at 0.30 mg/min. and becomes stable after that.

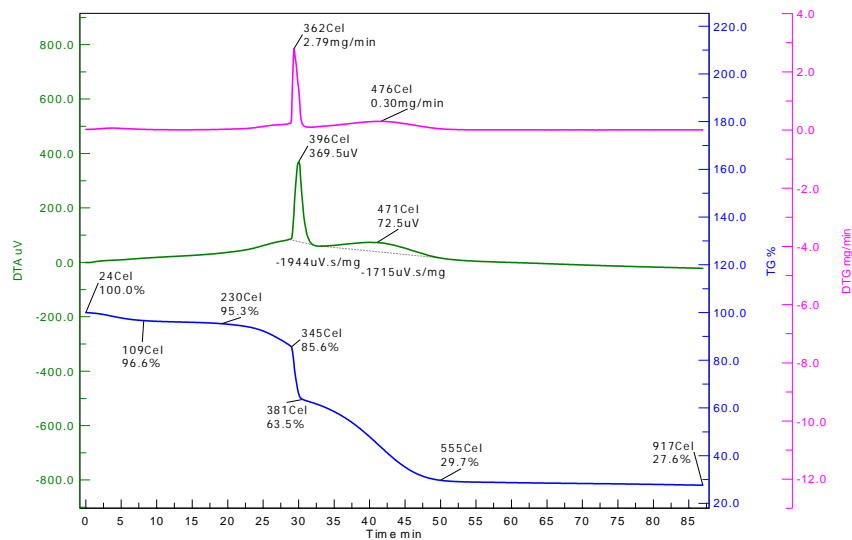


Fig.3. TGA, DTG & DTA image of CNTs (decomposed of Cr^{+3} complex at 800°C)

III. RESULT AND DISCUSSION

The Carbon metal nanotube is formed which is found to be thermally stable⁷ even on increase in temperature and voltage. This also exhibits conductivity⁸, which shows the presence of unpaired electron. It is found to exhibit thermal conductivity also.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 1, January 2014

V. 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.

REFERENCES

- [1]. Kaustav Banerjee (2006-11-150). "what are carbon Nanotubes /?". ACM/SIGDA E- Newsletter, Vol. No. 22.
- [2]. S. Iijima, "helical Micro tubes of Graphite Carbon," Nature, Vol. 354, pp. 56-58, 1991.
- [3]. "Nanotechnology Information Center: properties, Applications, Research and Safety Guidelines". American Elements Retrieved 13 May 2011
- [4]. Royal Society and Royal Academy of Engineering, "Nanoscience and nanotechnologies: opportunities and uncertainties." July 2004. Retrieved 13 May 2011.
- [5]. Nanostructures and Nonmaterial's; Synthesis, Properties and Application" Crit. Rev. Solid State Mater. Sci. 26(3): 145-249 : 145
- [6]. M. S. Dresselhaus, G. Dresselhaus and Ph. Avouris, Editors, Carbon Nanotubes: Synthesis, Structure, Properties and applications, Springer-verlag, 2000.
- [7]. Meo, SB.: Andrews R., "Carbon Nanotubes: Synthesis, Structure, Properties and applications." Crit. Rev. Solid State Mater. Sci. 26(3) : 145-249 : 145., 2001.
- [8]. Nanostructures and Nanomaterials; Synthesis, Properties and Application G. Cao, Imperial College Press.
- [9]. Y. Kumar and B. Tiwari, "Synthesis and characterization of carbon metal nano tubes using Zn^{++} and egg albumin", Nanoscience and Nanotechnology: An International Journal, 3(1): pp 12-15, 2013.

BIOGRAPHY



Rajeev Kumar Sharma completed his B.Sc. and M.Sc. degrees from Chaudhary Charan Singh University Meerut, India in year 1998 and 2000 respectively. He is pursuing his Ph.D. degree in Physics from Mewar University Chittorgarh, Rajasthan, India. Presently Mr. Rajeev Kumar Sharma is working as a Research Scholar in Department of Physics, Mewar University Chittorgarh, Rajasthan, India. His research field is Nanotechnology. He has also published some papers in reputed national and international journals and presented their work in conferences also.



B. Tiwari is currently working as a director in DSITM Gaziabad. He has completed his D.phil. degree from B. R. Ambedkar Bihar university on coordination chemistry and M.tech. from MVU. Currently his 3 students awarded D.phil. degree and two M.phil. degree and 15 students are pursuing Ph.D. under his supervision. His research area is on carbon nanotubes, composite materials, organic light emitting diode and quantum dot. He has published 35 research papers in international journals and attended 13 national and international conferences.



Dr. J. S. Tomar is retired From DAV (PG) College as a HOD. He has completed his P.hd. Degree from CCS University on Studies on Molecular Interaction in Binary Liquid Mixtures in Presence of Micelles in 1987. He has published a large no. of Paper in International & National Journal. Five Candidates was awarded P.hd. Degree under his supervision.