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Study of Metal CNTs by TGA, DTA & DTG at Different Temperature

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Abstract: Metal carbon nano tubes due to their numerous applications, is being used very frequently, so new methods are developed to prepare CNTs. In this method, complexes of transition metal Cr^{+3} with egg protein have been synthesized[1]. The complex is characterized by spectroscopic technique like UV, NMR. The amino acid metal complex so formed is decomposed at high temperature in muffle furnace to obtain metal carbon nano tubes. Then, they are characterized by the scanning probe instruments and comparative study of thermal stability is accomplished by TGA, DTA & DTG study[2,3].

Keywords: Cr (III), albumin, Albumin-metal-complex, UV, NMR, DTA, TGA, DTG.

Introduction

Carbon nano tubes (CNTs)[4] are cylindrical nanostructure[5]. CNTs are generally of two types - one atom thick layer of graphite wrapped into a seamless cylinder is known as **Single walled carbon nano tube (SWCNT)** and of multiple layers of graphite rolled in themselves to form a tube shape. So they are known as **Multi walled carbon nano tubes (MWCNT).** These cylindrical carbon molecules have valuable properties[6] for mankind. These remarkable properties motivate the scientist to investigate in different part of technology like nanotechnology[7], 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[8,9].

Synthesis by Advanced Method

Material and Method

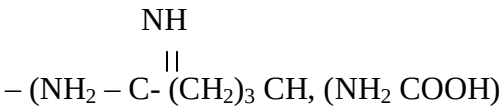
To prepare carbon nano tube, 0.5 gm normal metal salt solution of Cr^{+3} was prepared in distilled water. This solution is allowed to react with amino acid present in egg albumin to form a complex of egg albumin with chromium ion. Now, it is kept in desiccators for 30-45 days to dry. Now this, metal albumin complex, so formed, was decomposed in muffle furnace at different temperature such as 800^0C 850^0C, 900^0C.

Preparation of Amino-acid metal Complex

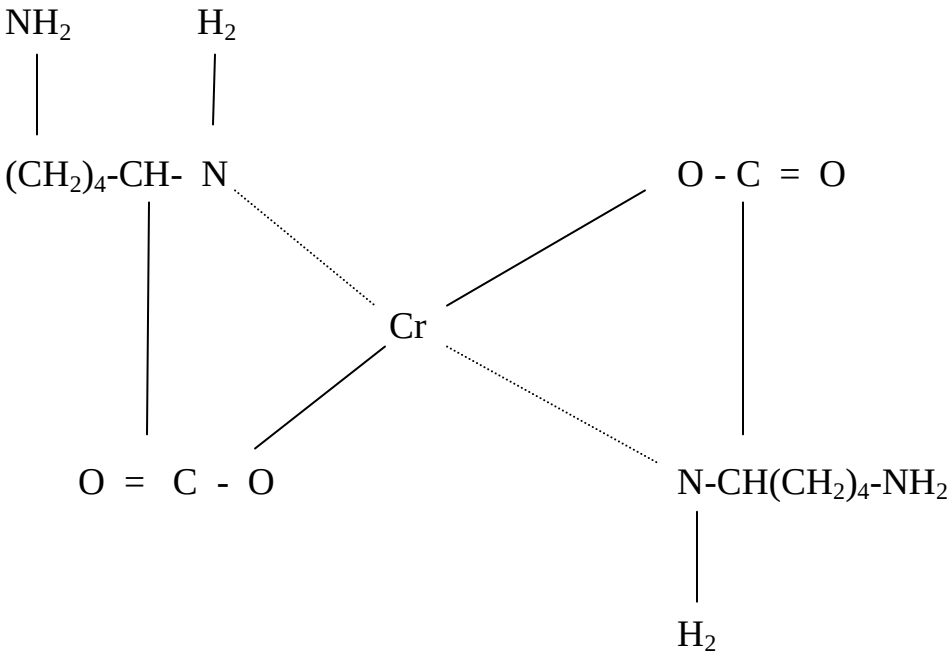
As we know that the proteins are macromolecules comprising of amino acid as monomer. Amino acid contains – NH_2 & - COOH group. With these group amino acids form complexes with metals and different chains of amino acid combined together. These compounds on decomposition give carbon metal nano tube.

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.

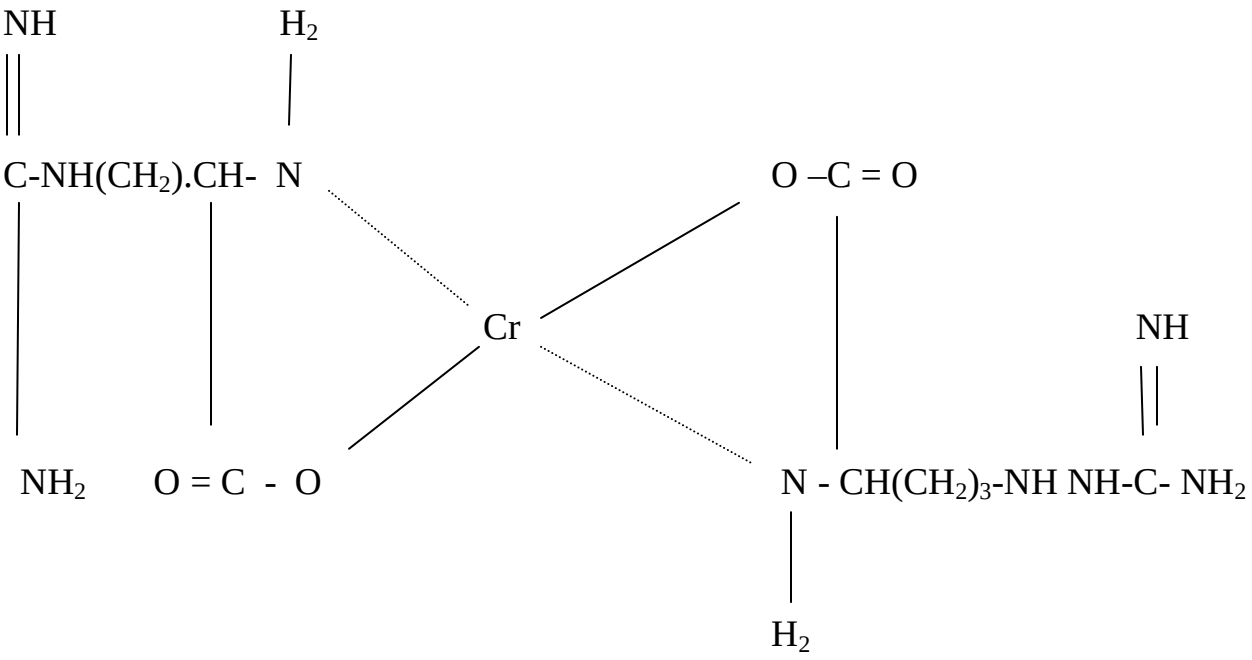
The structure of egg-albumin is very complex to produce exactly structure of amino acid metal complex. Egg albumin contain Lysine (NH_2 $(CH_2)_4$ CH (NH_2). COOH) and arginine



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



Lysine – Chromium (III) Complex



Arginine – Chromium (III) Complex

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Characterization by Scanning Electron Probe Instruments

Study of Thermal Satiability at 800^0c

TGA 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 thermograph predicts the 77 % mass decomposition of 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. (Fig. 1)

DTA Study: From DTA graph it is clear that decomposition starts at 375 Cel & 0.530 mV and again decreases as voltage decreases. There after increases on increasing voltage at 394 Cel. Stability of CNTs becomes constant after 394 Cel & 0.132 mV. (Fig. 1)

DTG Study: DTG graph indicates that decomposition is maximum at 314 Cel and 2.89 mg/min and decreases on decrease in temperature and increases further at 393 Cel at 0.46 mg/min. and becomes stable after that. (Fig. 1)

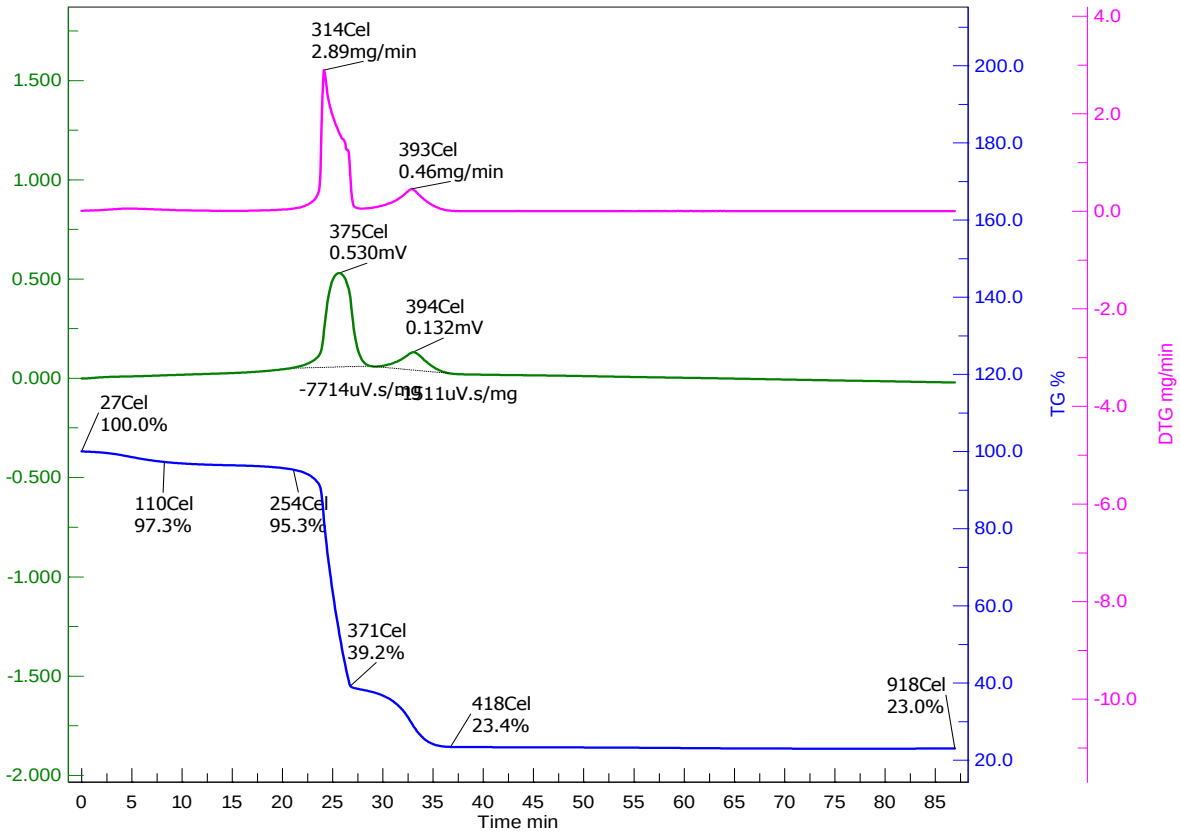

Fig.1. TGA, DTA, & DTG Image of CNTs synthesized at decomposition of Cr^{+3} complex at 800^0c

Study of Thermal Satiability at 850^0c

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TGA Study: The TGA thermograph predicts that 79.9 % mass decomposition of CNTs from 26-917 Cel. It becomes stable at 917 Cel & stable amount of CNTs is 20.1%. After this, decomposition does not occur. It proves the thermal stability of CNTs. (Fig. 2)

DTA Study: From DTA graph it is clear that, first decomposition stats at 321 Cel & 0.112m V and after this, increases up to 419 Cel. and again decreases as voltage decreases. Thereafter increases on increasing voltage at 411 Cel. Stability of CNTs becomes constant after 411 Cel & 0.058 mV. (Fig. 2)

DTG Study: DTG graph indicates that decomposition starts at 314 Cel and 0.32 mg/min and maximum at 371 Cel and 3.46 mg/min. Decomposition decreases on decrease in temperature and increases further at 409 Cel at 0.16 mg/min. and becomes stable after that. (Fig. 2)

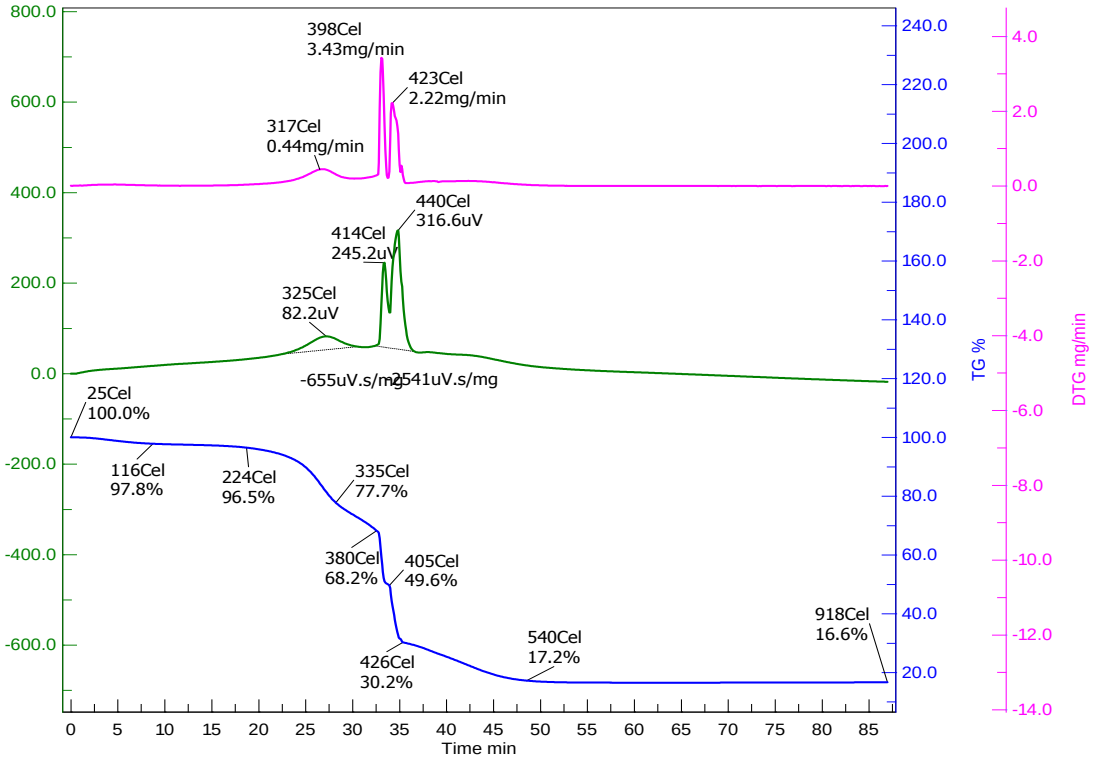

Fig.2. TGA, DTG, & DTA Image of CNTs synthesized at decomposition of Cr^{+3} complex at 850^0C

Study of Thermal Satiability at 900^0c

TGA Study: The TGA thermograph predicts that 83.6 % mass decomposition of CNTs from 25-918 Cel. It becomes stable at 918 Cel & stable amount of CNTs is 16.6%. After this, decomposition does not occur. It proves the thermal stability of CNTs. (Fig. 3)

DTA Study: From DTA graph it is clear that, first decomposition starts at 325 Cel & 82.2 µV and after this increases upto 414 Cel. Now decomposed at 414 Cel & 245.2 µV and again decreases as voltage decreases. There after increases on increasing voltage at 440 Cel. Stability of CNTs increases after 440 Cel & 316.6 µV. (Fig. 3)

DTG Study: DTG graph indicates that decomposition is stated at 317 Cel and 0.44 mg/min and maximum at 398 Cel and 3.43 mg/min decreases on decreasing in temperature and increases further at 423 Cel at 2.22 mg/min. and becomes stable after that. (Fig. 3)

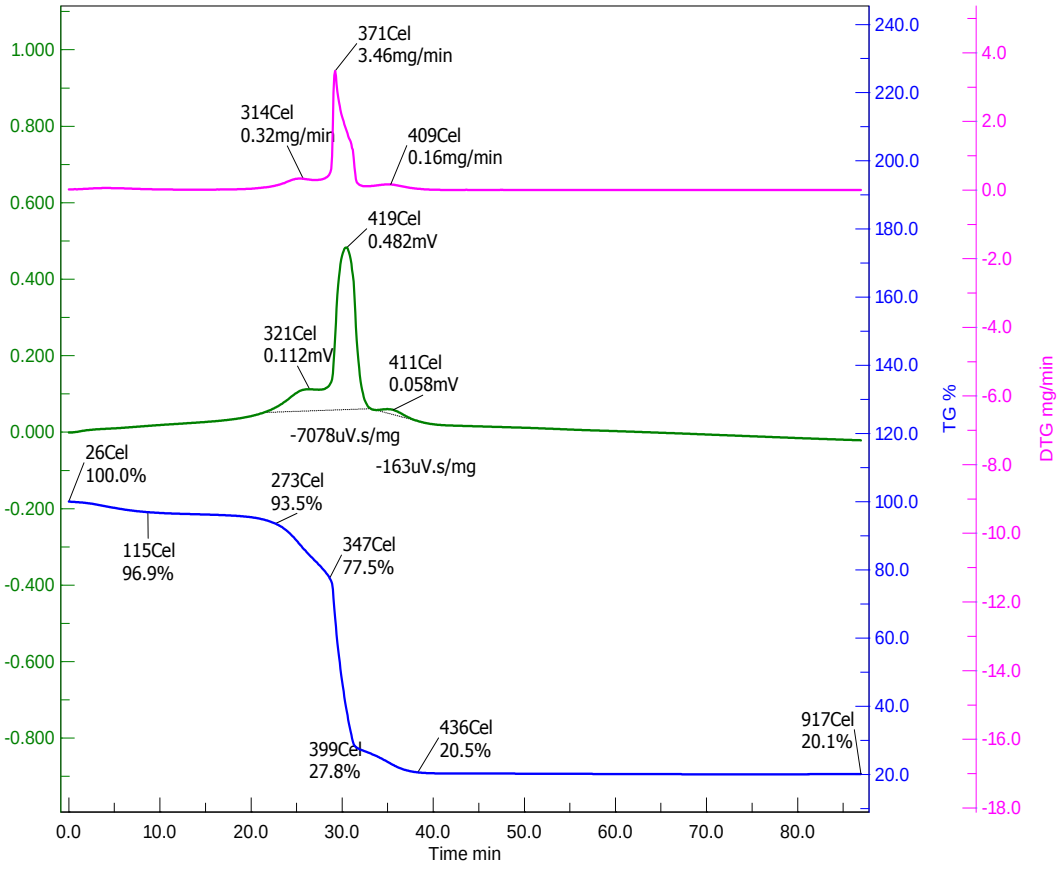

Fig. 3. TGA, DTG, & DTA Image of CNTs synthesized at decomposition of Cr^{+3} complex at 900^0c

Result and Discussion

The Carbon metal nano tube is found to be thermally stable even on increase in temperature and voltage. At 8**00^0c,** stable amount of CNTs is 23%, at 850^0c, stable amount of CNTs is 20.1%. and at 900^0c stable amount of CNTs is 16.6%. This also exhibits conductivity[7], which shows, the presence of unpaired electron[8]. It is found to exhibit thermal conductivity also.

Conclusion

From, Comparative study of thermal stability of carbon nano tube at three different temperatures. It is clear that as temperature increases, thermal stability of Carbon nano tube decreases.

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