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A Systematic Study on Catalysed Growth of Carbon Nanotube based on Nanotechnology

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Abstract—*Carbon is a chemical element with symbol C and atomic number 6. It is nonmetallic and tetravalent making four electrons available to form covalent chemical bonds. It belongs to group fourteen of periodic table. It has three isotopes naturally being stable. Carbon is the 15th most abundant element in the universe. Carbon exhibits a unique ability to form a wide range of structures. If atmosphere be inert then it condenses to form hollow spherical fullerences. When carbon is deposited on the hot tip of the cathode of the arc discharge apparatus will form nests of graphitic tubes with polyhedral particles. When electrons irradiation used on the nanotubes and polyhedral transforms then into nearly spherical carbon onions. Now we study the co-evaporating carbon and cobalt in an arc generator leads to formation of carbon nanotube, what all these tubes having very small diameter (about 1.2nm) with wall thickness be a single atomic dimension. The tubes form a web like deposition through the fullerenes. The uniformly and single layer structure of these nanotubes should make it possible to test their properties against theoretical predictions as well as possible applications. Now we study the transmission electron micrograph of web like material showing strands of threads like fiber and cobalt cluster, higher magnification of TEM image of web like material and TEM image of produced section of single walled carbon nanotubes. Finally we find use and conclusion of our research work.*
Keywords*:Carbonnanotubes,Catalysed, Nanotechnology, Fullerenes.*

1. INTRODUCTION

Nanotechnology – In the past few years a little word with a lot of potential has been repeatedly used. That word is nano. This word has almost completely changed the concept of science and technology, Ethicks, Economics, International relations and place of living being in the universe. Many people see it as the next step in biological and chemical warfare in the extreme cases in opportunity may be created that may replace the human species [1]. The vision of nanotechnology introduced in 1989 by Novel physicist Richard P. Feynman in dinner talk said "there is plenty of room at the bottom proposed employing machine tools to make smaller machine tools, these are to be used in turn to make still smaller machine tools, and so on all the ways done to the atomic level, nothing that this is "a development which I think can not be avoided [2]. It is suggested that nanomachines, nanorobots and nanodevices ultimately could be used to develope a wide range of automatically precise microscopic instrumentation and manufacturing tools could be applied to produce a vast quantity.

Feynman's idea remained (argely undiscussed until the mid 1980s, when the MIT educated engineers K Eric Drexler published "Engines of creation "a book to popularize the potential of nanotechnology [3]. Nano comes from Greek word whose meaning is dwarf.

The prefix nano means one billionth. 1 nm is the one arabth part of a meter. To get an idea of nanoscale, a human hair has diameter 4,50,000 nm, a bacterial will measure a few hundred nanometer across the smaller chips those are commercial etched on a microchip are about 130 nm across. The smaller objects that our eyes can see without any aid are 10,000nm across. If 10 atoms of hydrogen are lined up they make 1nm [1]. Nano science is the smallest form of the study of fundamental principles of molecules and structure with the size approximately equal to 1to 100 nm. These structures are called nanostructures. Nanotechnology is the applications of these nanostructures into useful nanoscale devices. It may mentioned here that nano scale is not only small but it is a special kind of small [4]. Nanotechnology is the creation of useful material, device and systems through the manipulation of matter on this minute scale. The field of nanotechnology involves scientists, from many different disciplines including physicists' chemists, Engineers and biologists. All the natural materials and systems established their foundation at the nanoscales.

Carbon nanotabes:-Nanotechnology and nano science got started in the early 1980s with two major : the birth of cluster science and invention of scanning tunneling microscopy (STM). This development led to discovery of fullerene in 1985 and carbon nanotube is few year later. Carbon nanotubes have recent received extensive attention due to their nanoscale dimension and outstanding material properties. Such as ballistic electronic conduction, immunity from electro migration effect at high densities and transparent conduction [5]. As nanotube fabricated it bends automatically due to its nanoshape. Bending of nanotube provides bucking and this

bucking is usual way for nanotubes to reduce strain. After that relaxed configuration is obtained [6].

2. STEPS INVOLVE IN RE-SEARCH:-

- The mixture of pure powdered material of Ferrous, Nickel, Cobalt and Graphite vapourised with current of 95 to 105 A in our arc fullerene generator.
- The normal fullerene soots are obtain ted.
- The transmission electron microscopy of these particles is taken, that reveals that these particles bear web like material with strands of threads like fibers.
- A higher magnification TEM image is taken, that reveals fiber is carbon nanotube and their bare part. The vapour grown carbon nanotubes may be further used to develop a new kind of fiber.

3. RESULT AND DISCUSSION:-

Preparation of nanomaterials:-The main aim of our experiments is to produce nano crystals of magnetic atoms. Electrodes are prepared by boring 3nm diameter hols in 6 mm diameter of graphite's rod and filling them with uniform mixture of pure powdered materials ferros, nickel or cobalt and graphite. This system is vaporized with a current of 100 to 105 A in 200 to 600 torr of Helium in arc fullerene generator. After that a blunder result is obtained with cobalt. It is found that construction like spider web formed in the chamber. The soot on the Chamber walls is rubbery. Normal fullerene soots made with ferrous or nickel containing are mostly crumply nature[7].

Transmission Electron Microscopy (TEM):-Transmission electron microscopy (TEM) is a microscopic technique, where by a beam of electrons is transmitted through an ultra thin specimen, interacting with the specimen as it pass through. An image is formed from the interaction of the electron transmitted through the specimen; the image is magnified and focussed onto an imaging device such as fluorescent screen on a layer of photographic film or to be detected by sensor such as CCD camera [8].

A transmission electron microscopy (STM) is demonstrated in fig-1. This figure reveals that the web consists of rounded soot particles with a few tens of nanometer, linked together by a finite fibers. Individual threads can be traced for several micrometers and coverage on soot particles. Fibers embedded within the soot particles are rounded cobalt cluster whose range of diameter be from a few nm to roughly 20 nm. Both electron and X-ray diffraction pattern showed that these cluster s are face centred cubic lattice. That figure indicates that the cluster were rapidly quenched as cobalt as generally hexagonally closed placed below 500 degree centigrade [9].

Scanning electron microscopy (SEM) image show that the rubber soot deposits from the chamber walls contain thin fibers and soot particles similar to those in the web materials, but the particles greater relative abundance. The carbon around the cobalt cluster consists partly of fullerene which can be extracted from the soot [10].

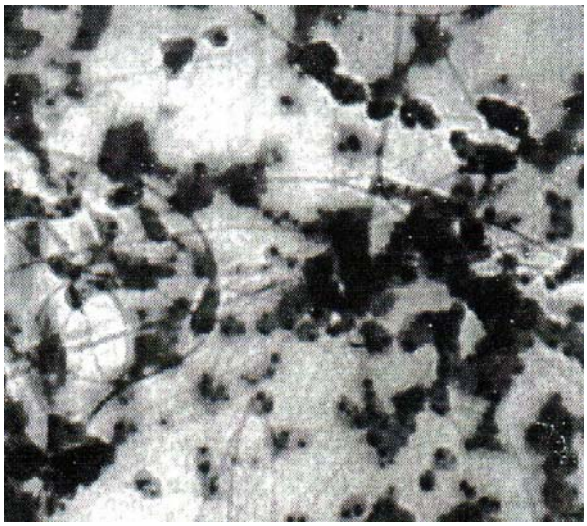

Fig. 1: A TEM image of web like materials

Higher magnification of TEM image of web materials: A higher magnification of TEM image of web material is demonstrated in fig. 2. This reveals the structure underlying the fiber and web formation. It is also found that carbon nanotubes with single atomic layer walls and diameter of (1.2 to 1) nm are universal. These tubes apparently crossed, aggregated and tangled before being encased. The tubes mostly coated with non graphitic carbon bare sections are s also evident [11].

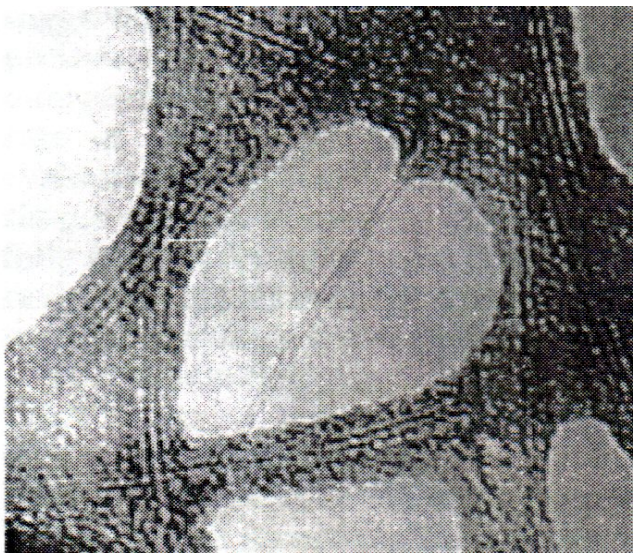

Fig. 2: A higher magnification of TEM image of web materials

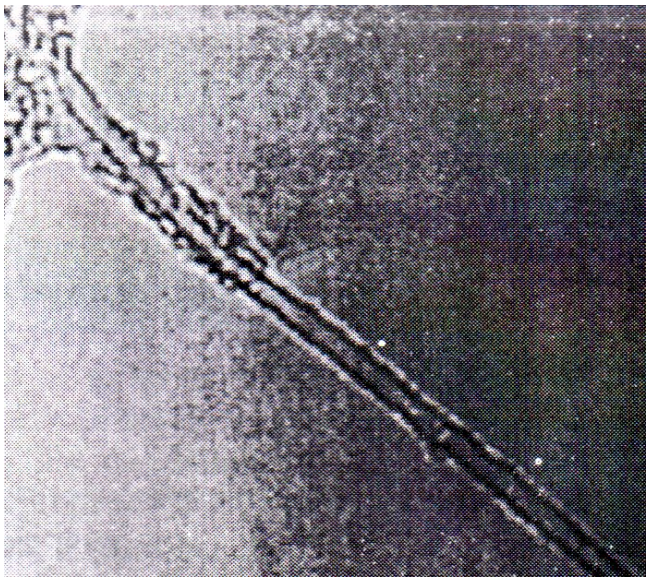

Fig. 3: TEM image of bare section of SWCNT

TEM image of bare section of single walled carbon nanotubes: This is demonstrated in figure.3.It also related at still higher magnification. This shows that a bare nanotube with several round object comparable in size of fullerene with 60 to100 carbons. The circumference of nanotube would correspond to a belt of 15 or 16 edge-sharing hexagons with 0.142nm side [12].

Carbon nanotubes grow under diverse condition: Carbon fibers fabricated under diverse condition. Graphitic whiskers with 1to **5micrometer** in diameter and centimeters in length can be grown on extremely hot cathode of carbon arc run in high pressure argon [13]. In under similar condition but at lower pressure graphite tube structure having diameter 2 to 30nm and length in uniform micrometer formed on the cathode deposition in an are fullerene generator [14]. The walls of nanotube with 2 to 50 atoms layers thick. But on the other hand in the presence of transition metal catalyst particle vapour grown carbon fiber can be fabricated by pydrolysis of hydrocarbon at the temperature between 500°c to 1200°c [15].

Yacaman et all reported that some fibers produced by this method gives the hollow graphitic tubes as seen in fullerene generator cathode deposits[16].In other hand these multilayer's fibers and tubes, our cobalt catalysed nanotubes having single atomic layer walls and common diameter equal to 1.2nm. They grew from carbon vapour at helium pressure in range of 100 to 500torr. No fiber growth was observed when using Fe, Ni, Cu mixtures, all of which are catalys fibers. Hence we believe, that the cobalt plays a special role in catalysing the formation of these single walled carbon nanotubes (SWCNT). Here a specific nucleon process may be responsible for their highly uniform diameter. The idea of relationship between carbon and cobalt cluster is observed by covering the carbon layers [17]. .Mostly nanotubes are found in cold regions of chambers and Co-condensed by fullerene soot.

Method for control the carbon form on the nanotubes: It is possible to control the amount of carbon, those forms on the nanotubes by modification of growth conditions with crystallinity of this carbon by post annealing the coated nanotubes at higher temperatures. Such measure is used to modify this vapour grown carbon nanotubes to develope a new kind of carbon nanotubes [18].

4. CONCLUSIONS

The result of this re-search reveal that the deposition of cobalt particles inside the carbon nanotubes pores improve the catalytic behaviour of cobalt carbon nanotubes. Likely due to difference in electronic properties of inner and outer surface of carbon nanotubes (CNT).Our cobalt catalyst nanotubes having single atomic layer walls and a common diameter (1.2 nm). It is possible to isolate the bulk quantities of bare single walled carbon nanotubes. This structure constitute a new type of all carbon polymer. Theoretical calculation predict that carbon nanotubes may be metallic or semiconducting depending on their helical pitch. Cobalt in catalyst provides the uniform diameter of carbon nanotubes. The uniformity of vapour grown nanotubes further may be used to develop a new types of carbon fibers. The availablility of single walled carbon nanotube should be permit to characterisation of further experiment [19]. When carbon is deposited on the hot tip of the cathode of the arc discharge apparatus will form nests of polyhedral particles. Their measure have been used to modify vapour grown carbon fibers. These vapour grown carbon nanotubes may be further used to develop new kinds of carbon nanotubes for further use [20].

5. FUTURE DIRECTIONS

As it stands now the majority of commercial nanoparticles applications in devices fabrication, are geared towards the revolution in small nanoscale devices production industries. Their are some developments in the direction and remotely controlling the function of nanoprobe and other kind of strange nanoparticles. The major trend in further development of nanomaterials to make them multifunctional and controlled by external signal or by local environment. Thus essentially turning them into nanodevices. If nano technology gave less potential with respect to other kind of technology. That may be Pico technology. We have to work on this new technology for finding the more potential and facilities.

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