Synthesis and characterization of bi metallic nano particles by 2 thiotic acid for selective growth of SWCNT

*Dr jyotsna chauhan and sandhya yadav

* Associate professor in Physics, RGPV, Bhopal (mp)
jyotsnachauhan2006@gmail.com

Abstract: Nanoparticles (NPs) are tiny materials having size ranges from 1 to 100 nm. They can be classified into different classes based on their properties, shapes or sizes. There are different types of NPs like men made NPs and Natural NPs but we are discussing about monometallic NPs and Bimetallic NPs. We deal with bimetallic NPs. NPs possess unique physical and chemical properties due to their high surface area and nanoscale size. Some properties like optical properties, thermal properties, magnetic properties are described here. Their reactivity, toughness and other properties are also dependent on their unique size, shape and structure. Due to these characteristics, they are suitable candidates for various commercial and domestic applications, which include catalysis, imaging, medical applications, energy-based research, and environmental applications. There are many methods for synthesis of NPs, we are using Chemical reduction by Microwave irradiation. We are synthesizing on Fe CO and Fe Mn nanoparticles. EDS technique is used for the elemental analysis or chemical characterization of a sample. Transmission electron microscopy is used to determine particle size.
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Keywords: SWCNT; EDS technique; Nanoparticles (NPs); nanoscale

Introduction:

There are different types of NPs like men made NPs and Natural NPs but we are discussing about monometallic NPs and Bimetallic NPs. We deal with bimetallic NPs.

1.2.1Monometallic Nanoparticles

Monometallic nanoparticles (MNPs), as the name suggests, consist of only single metal. The constituted metal atom determines the properties of these nanoparticles. Monometallic nanoparticles are of different types depending upon the type of metal atom present such as magnetic, metallic and transition metal nanoparticles, etc. They can be prepared by different routes but the most important is the chemical method. Their structurecan be stabilized using various functional groups. Last few decades have marked the greater interest in the field of metallic nanoparticles due to their enhanced physical and chemical properties. For this reason, they are used for a number of applications such as in electronic, optical and catalysis, etc addition, they have also been used as antimicrobial agents against a number of microorganisms such as Escherichia coli [6]

1.2.2 Bimetallic Nanoparticles

Bimetallic nanoparticles, composed of two different metals have drawn a greater interest than the monometallic nanoparticles from both scientific as well as technological point of view [7]. Constituting metals and their nanometric size determine the properties of the bimetallic nanoparticles. These are synthesized by the combination of different architectures of metallic nanoparticles. They actually offer us the tendency of optimizing the energy of Plasmon absorption band of metallic mixture which offers us a multipurpose tool for biosensing. These properties may differ from those of pure elemental particles and include unique size dependent optical, electronic, thermal and catalytic effects. Extensive studies in the field of bimetallic nanoparticles started just a decade back. Different methods have been proposed for their preparation and detailed characterization. These daysresearchers are focusing on selectively preparing new bimetallic nanoparticles in different forms, such as alloys, core-shell and contact aggregate. Actually, through bimetallization, the catalytic properties of the resulting nanoparticles can be improved to great extent which may not be achievable by the use of monometallic catalysts. In bimetallic catalysts, the electronic effect plays an important role which describes the charge transfer. Alloying of the constituting elements can result in the structural changes of the bimetallic nanoparticles. From monometallic to bimetallic nanoparticles, an extra degree of freedom is introduced [8]. The catalytic activities of different bimetallic nanoparticles have been subsequently compared. Different methods and correlations have been developed with the help of physical and spectroscopic measurements. The preparation conditions determine the structure and miscibility of the two metals in bimetallic nanoparticle. Generally, bimetallic nanoparticles are prepared by simultaneous reduction of two metal ions in the presence of suitable stabilization strategy such as steric hindrance and static-electronic repulsive

force. In this method, a particle structure between core shell and homogeneous alloy depending on the reduction condition is obtained. By controlling the size, shape and structure of the nanoparticles, we can have control over the reduction rates of the two components.

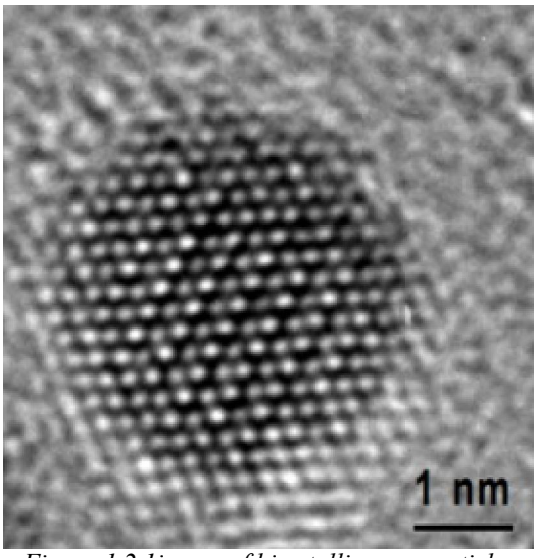

Figure 1.2.1image of bimetallic nanoparticles

Researchers are synthesizing novel bimetallic nanoparticles to get desired properties. Various types of bimetallic nanoparticles are-

1.2.2.1 Platinum based bimetallic nanoparticles

Platinum nanoparticles are now being used in the upcoming generation for automotive catalytic converters due to high surface area, thus the amount of platinum required for their fabrication is less. To enhance the effectiveness of Pt-based electrodes, the Pt based bimetallic nanoparticle catalysts have been synthesized [9]. The Pt-X (X = Cu, Au, or Ag, etc.) alloys are very important due to their high catalytic efficiency. In the recent years, polymer-protected colloidal Pt–Cu particles have been prepared and these can be used for the catalytic hydrogenation of solution, where the bimetallic clusters are used as active and selective agents for the hydration of acrylonitrile to acrylamide as well as for hydrogenation of 1,3-cyclooctadiene to cyclooctene. It has also been found that Pt-Cu bimetallic catalysts are effective in the reduction of NOx. Studies about Pt-Cu based bimetallic nanoparticles have revealed their heterogeneous catalytic activities for reduction of gas phase NO with hydrogen as the reducing agent. In Pt-based catalyst studies, the addition of other metals to Pt catalyst decreases the amount of need of noble metal, Pt. It also helps in improving its catalytic ability [10]. For example, Hu et al. have concluded that bimetallic Pt–Au nanocatalyst shows better catalytic capability as compared to single metal catalyst of Au or Pt.

1.2.2.2 Nickel based bimetallic nanoparticles

Metal nanoparticles such as nickel nanoparticles have been intensively used for its catalytic and the magnetic properties. However, Nickel on combination with other metals shows fascinating properties [11]. Catalysts containing nickel are commonly used due to their low cost, high stability and fast turnover rate. In the past few years, Ni-Sn based bimetallic nanoparticles have been prepared with controlled size and composition. By varying the stoichiometric ratios of Ni and Sn, bimetallic nanoparticles with different composition such as Ni100, Ni74-Sn41, Ni75-Sn25, Ni40-Sn40 and Ni50-Sn50 have been synthesized. The Cu-Ni based bimetallic catalyst has been used as an effective method for improving the efficiency of various reactions. Cu–Ni/Al2O3 catalysts and Ni–Cu/samaria-doped ceria catalysts have been used which are used for the hydrogenation of carbon dioxide and for steam reforming of methane.

1.2.2.3 Palladium based bimetallic nanoparticles

Now-a-days, palladium nanoparticles are being used for various applications due to their low cost and easy availability. The palladium based bimetallic nanoparticles are stable in the acidic medium and are suitable for the oxidation of alcohol in alkaline medium. Palladium coupled gold nanoparticles has a tendency of acting as a catalyst which is used mainly for the ligand-free Suzuki coupling reactions. These nanoparticles reside their catalytic efficiency even after repeated number of cycles. The Pd/Fe bimetallic nanoparticles have great economic importance because they have the tendency of transforming the chlorinated compounds. It has been recently reported that Pd/Ag nanoparticles acts as a sensor which can be used for the electrochemical detection of L-Cysteine [12].

1.2.2.4 Gold based bimetallic nanoparticles

Gold NPs act as an efficient catalyst and biosensors. It is believed that gold containing nanoparticles can be used for increasing the catalytic activity and selectivity. Au/Pd based bimetallic nanoparticles have been recently prepared and they show interesting catalytic, electrochemical and structural properties [13]. In addition to this, bimetallic nanoparticles of gold/copper have also been prepared. These have many applications but are mainly used in medical sensors and biomedicine. Au/Ni based bimetallic nanoparticles in different shapes and forms are prepared and systematically investigated. Extensive studies have been done for synthesizing Au/Ag BNPs. These bimetallic nanoparticles have extensive applications such that they are used in the detection of glucose and it also exhibits property of chemiluminescence [14].

1.2.2.5 Magnetic Nanoparticles

We are making magnetic nanoparticles and we specially focus on iron based nanoparticles. Magnetic nanoparticles are a class of nanoparticle that can be manipulated using magnetic fields. Such particles commonly consist of two components, a magnetic material, often iron, nickel and cobalt, and a chemical component that has functionality. While nanoparticles are smaller than 1 micrometer in diameter (typically 1–100 nanometers), the larger microbeads are 0.5–500 micrometer in diameter. Magnetic nanoparticle clusters that are composed of a number of individual magnetic nanoparticles are known as magnetic nanobeads with a diameter of 50–200 nanometers [15]. Magnetic nanoparticle clusters are a basis for their further magnetic assembly into magnetic nanochains. The magnetic nanoparticles have been the focus of much research recently because they possess attractive properties which could see potential use in catalysis including nanomaterial-based catalysts,biomedicine and tissue specific targeting, magnetically tunable colloidal photonic crystals,microfluidics,magnetic resonance imaging,magnetic particle imaging, data storage,environmental remediation, nanofluids, and optical filters, defect sensor and cation sensors.

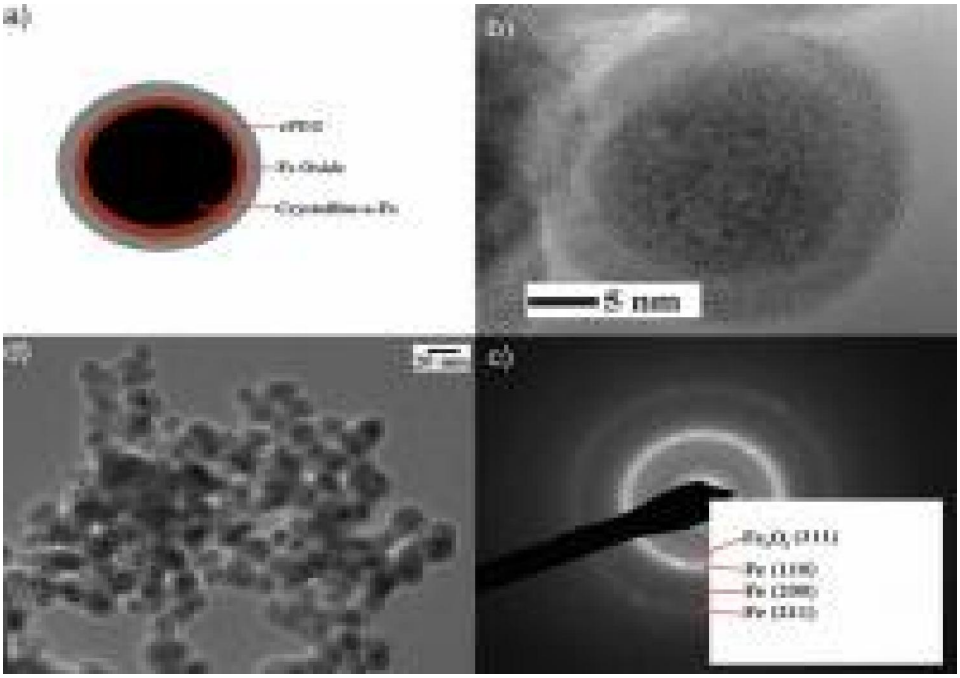

Figure 1.2.2 images of magnetic nanoparticles

1.2.2.6 Iron based bimetallic nanoparticles

From the recent studies, it has been found that the Fe-Cu bimetallic catalyst system has attracted tremendous attention [16]. It has been reported that this catalyst when supported on MCM-41 showed higher catalytic activity as compared to Cu or Fe when singly supported on MCM-41. It shows high catalytic activity even after 10 consecutive runs. Other class of iron based bimetallic nanoparticles includes Pd/Fe nanoparticles which have been prepared by chemical precipitation method in liquid phase. With diameters in the range of 30–50 nm, these nanoparticles exhibit excellent catalytic activity for dechlorination of chlorinated methane such as dichloromethane (DCM), chloroform (CF) and carbon tetrachloride (CT) For the treatment of chlorinated organic pollutants, nanoscale bimetallic particles (Pd/Fe, Pd/Zn, Pt/Fe, Ni/Fe) have been synthesized in the laboratory.

3. Properties Of Nanoparticles

There are different types of properties exhibited by nanoaprticles, some of which are discribed below.

1.3.1 Electronic and optical properties

The optical and electronic properties of NPs are interdependent to greater extent. For instance, noble metals NPs have size dependent optical properties and exhibit a strong UV–visible extinction band that is not present in the spectrum of the bulk metal. This excitation band results when the incident photon frequency is constant with the collective excitation of the conduction electrons and is known as the localized surface plasma resonance (LSPR). LSPR excitation results in the wavelength selection absorption with extremely large molar excitation coefficient resonance Ray light scattering with efficiency equivalent to that of ten fluorophores and enhanced local electromagnetic fields near the surface of NPs that

enhanced spectroscopies. It is well established that the peak wavelength of the LSPR spectrum is dependent upon the size, shape and spacing of the NPs as well as its own dielectric properties and those of its local environment including the substrate, solvents and adsorbates [17]. Gold colloidal NPs are accountable for the rusty colors seen in blemished glass door/windows, while Ag NPs are typically yellow. Actually, the free electrons on the surface in these NPs (d electrons in Ag and gold) are freely transportable through the nanomaterial. The mean free path for Ag and gold is 50 nm, which is more than the NPs size of these materials. Thus, no scattering is expected from the bulk, upon light interaction, instead they set into a standing resonance conditions, which is responsible for LSPR in these NPs.

1.3.2 Mechanical properties

The distinct mechanical properties of NPs allow researchers to look for novel applications in many important fields such as tribology, surface engineering, nanofabrication and nanomanufacturing. Different mechanical parameters such as elastic modulus, hardness, stress and strain, adhesion and friction can be surveyed to know the exact mechanical nature of

NPs. Beside these parameters surface coating, coagulation, and lubrication also aid to mechanical properties of NPs [18]. NPs show dissimilar mechanical properties as compared to microparticles and their bulk materials. Moreover, in a lubricated or greased contact, the contrast in the stiffness between NPs and the contacting

external surface controls whether the NPs are indented into the plan surface or deformed when the pressure at contact is significantly large. This important information could divulge

how the NPs perform in the contact situation. Decent controls over mechanical features of NPs and their interactions with any kind of surface are vital for enlightening the surface quality

and elevating material removal. Fruitful outcomes in these fields generally need a deep insight into the basics of the mechanical properties of NPs, such as elastic modulus and hardness, movement law, friction and interfacial adhesion and their size dependent characteristics

1.3.3 Thermal properties

It is well-known fact that metals NPs have thermal conductivities higher than those of fluids in solid form. For example, the thermal conductivity of copper at room temperature is about

700 times greater than that of water and about 3000 times greater than that of engine oil. Even oxides such as alumina (Al_2O_3) have thermal conductivity higher than that of water.

Therefore, the fluids containing suspended solid particles are expected to display significantly enhanced thermal conductivities relative to those of conventional heat transfer fluids.

Nanofluids are produced by dispersing the nanometric scales solid particles into liquid such as water, ethylene glycol or oils. Nanofluids are expected to exhibit superior properties relative to those of conventional heat transfer fluids and fluids containing microscopic sized particles. Because the heat transfer takes place at the surface of the particles, it is desirable to use the

particles with large total surface area. The large total surface area also increases the stability suspension [19]. Recently it has been demonstrated that the nanofluids consisting of CuO or Al_2O_3 NPs in water or ethylene exhibit advance thermal conductivity.

1.3.4Magnetic properties

The physical and chemical properties of magnetic nanoparticles largely depend on the synthesis method and chemical structure. In most cases, the particles range from 1 to 100 nm in size and may display superparamagnetic.

Magnetic nanoparticles are those which can be affected using magnetic field. These particles usually contain magnetic elements like iron, nickel, cobalt etc. Magnetic nanoparticles show a variety of unusual magnetic behavior when compared to the bulk materials, mostly due to surface or interface effects, including symmetry breaking, electronic environment or charge transfer and magnetic interactions. Let us discuss some other magnetic properties of nanomaterials with examples:

- The physical and chemical properties of magnetic nanoparticles mainly depend upon the chemical structure and method of synthesis. For example, nano scale particles of magnetite show superparamagnetism at a transition temperature, which is smaller than the transition temperature of bulk material.
- Nanocomposite magnets consisting of uniform mixture of magnetically hard and soft phases have been extensively investigated in recent years due to their useful hard magnetic properties.
- High energy products and relatively high coercivities can be developed in these nanocomposite magnets. These magnets are high value of remanence and low cost.
- Magnetic studies in nanostructured materials have focused on the interaction between electron charges and magnetic spins and these studies have led to discoveries of new and unique phenomena that are neither observable in traditional bulk materials, nor explainable using classical theories. For examples:

Giant Magnetoresistance (GMR) in multilayers and metallic granular solids, spin valves, spin injection etc.

- Magnetostrictive materials are of great scientific importance to us. Magnetostriction is the process in which magnetic material deformed due to presence of magnetic field.
- **Synthesis of Nanoparticles**
- There are two techniques for synthesis of nanoparticles-
- **2.1 Top down synthesis**-In this type of synthesis techniques we take a bulk material and from that we obtain nanoparticles by different synthesis techniques.
- **2.2 Bottom up synthesis-** In this type of synthesis techniques we take atoms and from those atoms we obtain nanoparticles by different synthesis techniques.

In this research **Chemical reduction by Microwave irradiation method is used**

Chemical reduction by Microwave irradiation

- Microwave irradiation of organic compounds is a rapid and low-cost method to synthesize NPs. Using sucrose as the carbon source and diethylene glycol (DEG) as the reaction media, green luminescent NPs were obtained within one minute under microwave irradiation [26]. These DEG-stabilized NPs (DEG-CQDs) could be well-dispersed in water with a transparent appearance. With an increase in the excitation wavelength, the intensity of the PL first increased to a maximum (360 nm excitation) and then decreased.
- In a domestic microwave oven, microwaves are produced by an electronic valve called magnetron, which emit microwave on 2.45 GHz frequency. These waves reflect in the walls of the oven and hit the substance placed inside it on many angles. The waves pass through glass and plastic without appreciable effect. However, they have considerable effects on polar molecules: a polar molecule turns, trying to align itself with the electromagnetic wave. The friction between molecules produces heat.
- For this phenomenon, submitting samples to microwave besides reducing reaction time, fewer materials are needed. In addition, the use of microwave promotes the controlling of reaction processes.
- The closer to the spherical form and more uniformity between the forms, greater will be the efficiency of nanoparticles with bigger applicability, either as ferrofluid, as separating of cells or removal of pollutants.
- In this present work, the objective is to demonstrate simple and rapid methods for producing magnetite nanoparticles. Influence of heating time in preparation of magnetite nanoparticles by microwave radiation using a domestic microwave oven and water bath was investigated, and their characterization by Scanning Electron Microscopy, X-ray Diffractometry and Fourier Transform Infrared Spectroscopy was done.

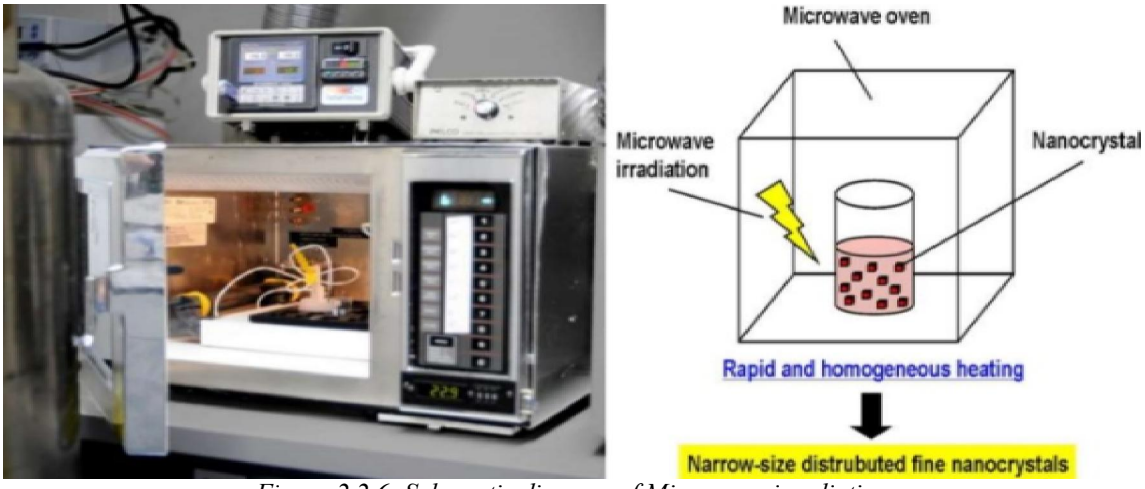

Figure 2.2.6- Schematic diagram of Microwave irradiation

Experimental Procedure-: four nanoparticles are synthesized

For sample 1, Measure required amount of ferric nitrate, cobalt nitrate and 2thiotic acid on electronic weighing machine.

i. Measured amount of above components is mixed in 10 ml of ethylene glycol.

ii. After mixing, put measured amount of 2 thiotic (polymer) acid in our solution.

iii. Now put ammonia as reducing agent.

iv. Doing centrifugal stirring for 3-4 hours.
v. Now take this solution in a clean beaker and cover beaker with aluminum foil.
vi. Steer the solution by keeping beaker on magnetic stirring machine for 2 hours. And provide hot plate heating for 30 minutes.
vii. Perform microwave heating for 1 min on temperature 180°C.
viii. Now filtering the solution and we get NPs

For sample 2

measure required amount of ferric nitrate, cobalt nitrate,2 thiotic acid and sodium bromide on electronic weighing machine.
i. Measured amount of above components is mixed in 10 ml of ethylene glycol.
ii. After mixing, put measured amount of 2 thiotic (polymer) acid in our solution.
iii. Now put measured amount of sodium bromide as reducing agent.
iv. On putting sodium bromide color of solution changes to **brown.**
v. Doing centrifugal stirring for 3-4 hours.
vi. Now take this solution in a clean beaker and cover beaker with aluminum foil.
vii. Steer the solution by keeping beaker on magnetic stirring machine for 2 hours. And provide hot plate heating for 30 minutes.
viii. Perform microwave heating for 3 min on temperature 200°C.
ix. Now filtering the solution and we get NPs.

For sample 3

After calculation, measure required amount of ferric nitrate, cobalt nitrate,2 thiotic acid and sodium bromide on electronic weighing machine.
i. Measured amount of above components is mixed in 10 ml of ethylene glycol.
ii. After mixing, put measured amount of 2 thiotic (polymer) acid in our solution.
iii. Now put measured amount of sodium bromide as reducing agent.
iv. On putting sodium bromide color of solution changes to **lemon green.**
v. Doing centrifugal stirring for 3-4 hours.
vi. Now take this solution in a clean beaker and cover beaker with aluminum foil.
vii. Steer the solution by keeping beaker on magnetic stirring machine for 2 hours. And provide hot plate heating for 30 minutes.
viii. Perform microwave heating for 3 min on temperature 200°C.
ix. Now filtering the solution and we get NPs.

For sample4

After calculation, measure required amount of ferric nitrate, cobalt nitrate and 2 thiotic acid and sodium bromide on electronic weighing machine.
x. Measured amount of above components is mixed in 10 ml of DI water.
xi. After mixing, put measured amount of 2 thiotic (polymer) acid in our solution.
xii. Now put measured amount of sodium bromide as reducing agent.
xiii. On putting sodium bromide color of solution changes to **dark brown.**
xiv. Doing centrifugal stirring for 3-4 hours.
xv. Now take this solution in a clean beaker and cover beaker with aluminum foil.
xvi. Steer the solution by keeping beaker on magnetic stirring machine for 2 hours. And provide hot plate heating for 30 minutes.
xvii. Now filtering the solution and we get NPs.

Characterization methods

Different characterization techniques have been practiced for the analysis of various physicochemical properties of NPs. These include techniques such as Energy-dispersive X-ray spectroscopy (EDS), Transmission electron microscopy (TEM), UV – Visible Spectroscopy etc.

UV/Vis spectroscopy is routinely used in analytical chemistry for the quantitative determination of different analytes, such as transition metal ions, highly conjugatedorganic compounds, and biological macromolecules. Spectroscopic analysis is commonly carried out in solutions but solids and gases may also be studied.

- Solutions of transition metal ions can be colored (i.e., absorb visible light) because d electrons within the metal atoms can be excited from one electronic state to another. The colour of metal ion solutions is strongly affected by the presence of other species, such as certain anions or ligands. For instance, the colour of a dilute solution of copper sulfate is a very light blue; adding ammonia intensifies the colour and changes the wavelength of maximum absorption (λ_{max}).
- Organic compounds, especially those with a high degree of conjugation, also absorb light in the UV or visible regions of the electromagnetic spectrum. The solvents for these determinations are often water for water-soluble compounds, or ethanol for organic-soluble compounds. (Organic solvents may have significant UV absorption; not all solvents are suitable for use in UV spectroscopy. Ethanol absorbs very weakly at most wavelengths.) Solvent polarity and pH can affect the absorption spectrum of an organic compound. Tyrosine, for example, increases in absorption maxima and molar extinction coefficient when pH increases from 6 to 13 or when solvent polarity decreases.
- While charge transfer complexes also give rise to colours, the colours are often too intense to be used for quantitative measurement.

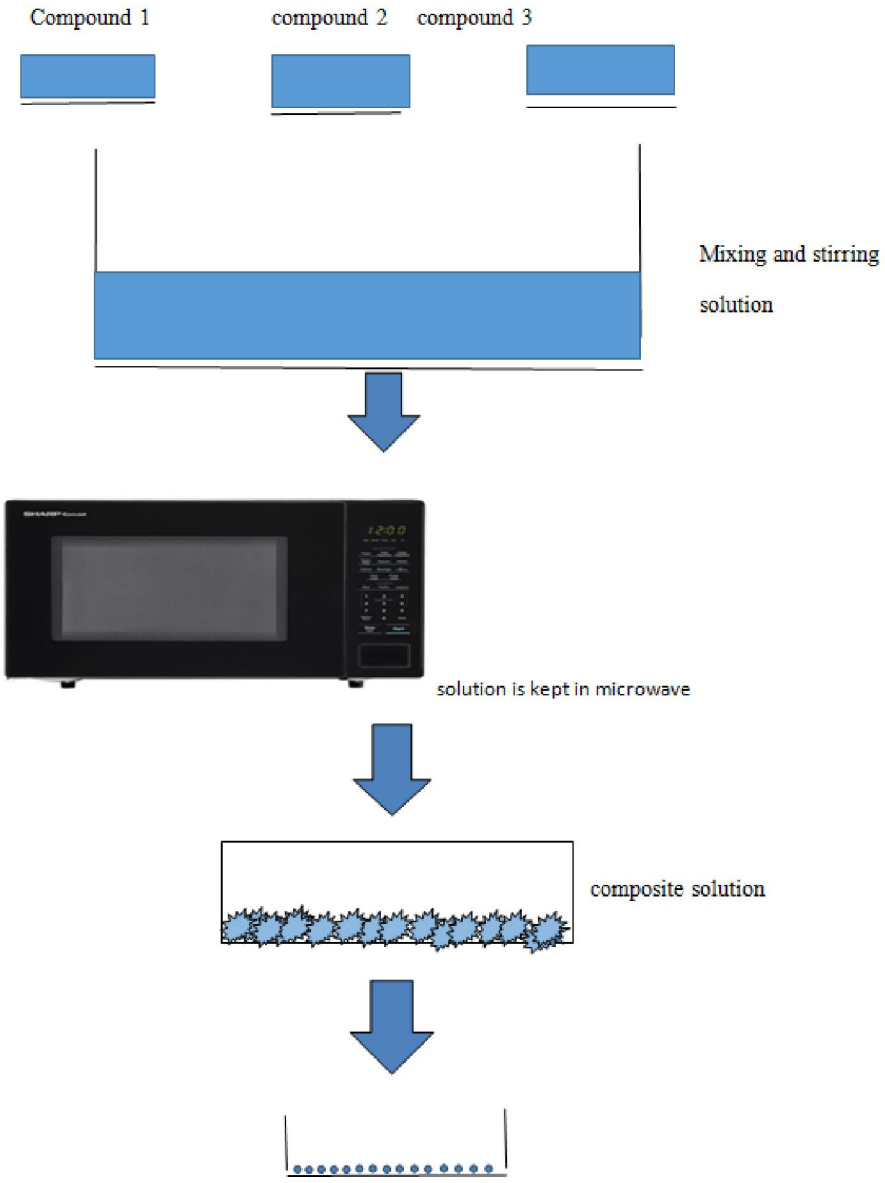

figure 2.2.7 schematic diagram process of synthesis of nanoparticles.

The Beer–Lambert law states that the absorbance of a solution is directly proportional to the concentration of the absorbing species in the solution and the path length. Thus, for a fixed path length, UV/Vis spectroscopy can be used to determine the concentration of the absorber in a solution. It is necessary to know how quickly the absorbance changes with concentration. This can be taken from references (tables of molar extinction coefficients), or more accurately, determined from a calibration curve.

A UV/Vis spectrophotometer may be used as a detector for HPLC. The presence of an analyte gives a response assumed to be proportional to the concentration. For accurate results, the instrument's response to the analyte in the unknown should be compared with the response to a standard; this is very similar to the use of calibration curves. The response (e.g., peak height) for a particular concentration is known as the response factor.

The wavelengths of absorption peaks can be correlated with the types of bonds in a given molecule and are valuable in determining the functional groups within a molecule. The Woodward–Fieser rules, for instance, are a set of empirical observations used to predict λ_{max}, the wavelength of the most intense UV/Vis absorption, for conjugated organic compounds

such as dienes and ketones. The spectrum alone is not, however, a specific test for any given sample. The nature of the solvent, the pH of the solution, temperature, high electrolyte concentrations, and the presence of interfering substances can influence the absorption spectrum. Experimental variations such as the slit width (effective bandwidth) of the spectrophotometer will also alter the spectrum. To apply UV/Vis spectroscopy to analysis, these variables must be controlled or accounted for in order to identify the substances present.

Result and Discussion:

The TEM images and particle size distribution in shown in images below. TEM is used for detection of surface morphology of particles.

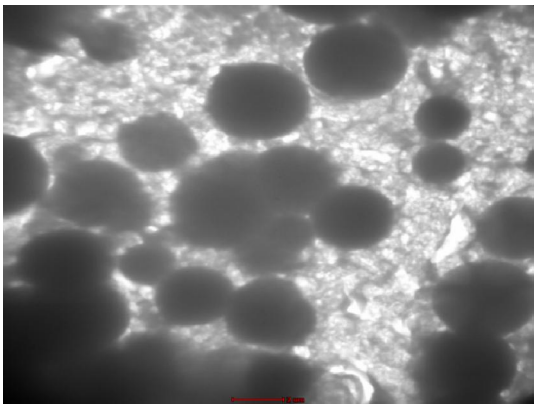

Figure 4.1 TEM image for Fe Co (in 1 um scale)

Figure 4.1 shows TEM image for the sample of FeCo. TEM is used for detection of surface morphology of particles. Here we can see that FeCo nanoparticles are in the size of 100-150 nmand we can see the uniform distribution of particles on the surface. The sample have spherical shape due to nature of surfactant used. Nanoparticles of FeCo arenon homogeneous.

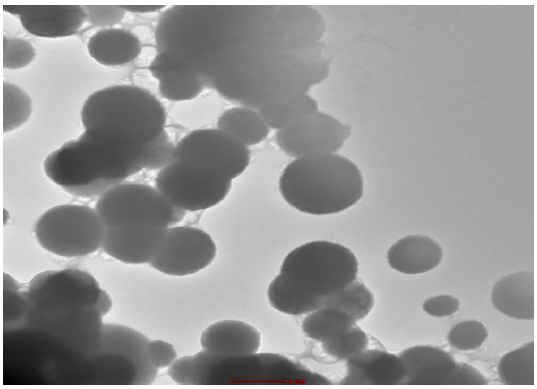

Figure 4.2 TEM image for Fe Co (in 2 um scale)

Figure 4.2 shows TEM image for the sample of FeCo. Here we can see that FeCo nanoparticles are in the size of 200-300 nm and we can see the uniform distribution of particles on the surface. NPs are spherical in shape due to nature of surfactant used. Nanoparticles of FeCo arenon homogeneous.

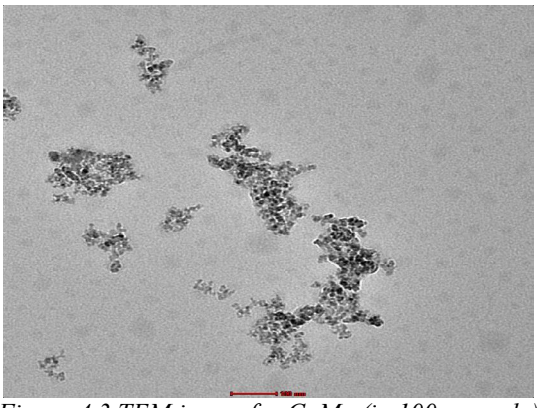

Figure 4.3 TEM image for CoMn (in 100 nmscale)

Figure 4.2 shows TEM image for the sample of CoMn. Here we can see that CoMn nanoparticles are in the size of 60-80 nm and we can see the non-uniform distribution of particles on the surface. Here nanoparticles of CoMn are non-homogeneous.

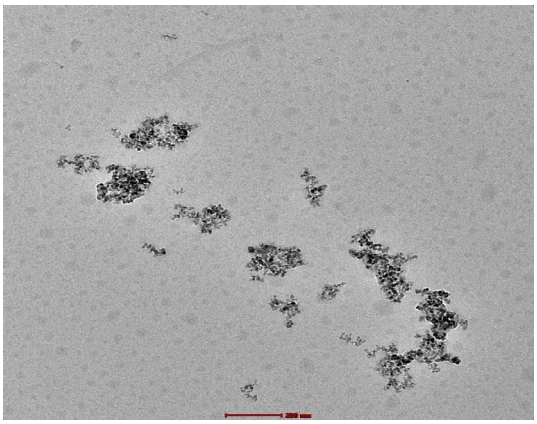

Figure 4.4 TEM image for CoMn (in 200nm scale)

Figure 4.2 shows TEM image for the sample of CoMn. Here we can see that CoMn nanoparticles are in the size of 100-120 nm and we can see the non-uniform distribution of particles on the surface. Here nanoparticles of CoMn are non-homogeneous.

Figure 4.5 shows UV graph of CoMn. red curve represents CoMn in 10 ul of 2 thiotic acid. Black cure represents CoMn in 5 ul of 2 thiotic acid. We can see that absorbance is both cases is decreasing exponentially with increase in wavelength. But after the wavelength of 210 nm absorbance don't show much change's and it is almost constant. From wavelength of 550 nm absorbance curves for both

samples are becoming same and overlapping each other. There is blue shift in this UV graph. Here our UV results are non-supporting SPR.

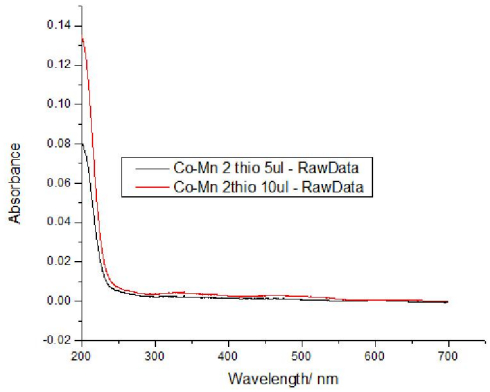

Figure 4.5 UV graph of CoMn

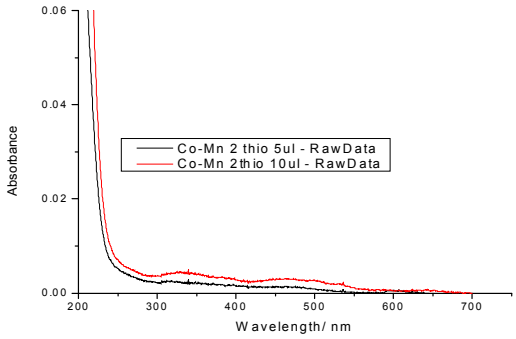

Figure 4.6 UV graph of CoMn

Figure 4.5 shows UV graph of CoMn. red curve represents CoMn in 10 ul of 2 thiotic acid. Black cure represents CoMn in 5 ul of 2 thiotic acid. We can see that absorbance is both cases is decreasing with increase in wavelength. But after the wavelength of 240 nm absorbance is showing a sudden decrease and between 300nm to 350nm it shows an increment and then again showing a less decrease from 350nm to 400nm. this increase and decrease goes up to 650 nm for black cure and upto 700nm for red curve. There is blue shift in this UV graph. Here our UV results are non-supporting SPR.

4.2 discussion

We have synthesized four samples with different compounds in the ratio of 4:1. We are synthesizing FeMn because Mn is highly magnetized in bulk size. There we are trying to observe magnetization of Mn in bulk particles.

For characterization we have used two techniques TEM and UV visible spectroscopy.

TEM gives surface morphology and particle size. UV visible spectroscopy is used for analysis of absorption property of nanoparticles. EDX is used for elemental analysis.

Size of nanoaprticles of CoMn is 60-80 nm size of nanoparticles of FeCo is 100-150 nm.

Our nanoparticles are in bulk form and non-homogeneous.

In UV results we can see blue shift. Blue shift in graph represents formation of nanoparticles. There for we can say that we have obtained nanoparticles.

The result indicates that samples prepared are uniform in both morphology and particle size distribution.

Out of the above four results we can say that nanoparticles of CoMnare better than other three results because in this result (figure 4.3) nanoparticles formed are of size 60-80nm and are homogeneous in nature, uniformly distributed on the surface.

Conclusion

Nanoparticles (NPs) are the nanometer-sized solid particles engineered at atomic or molecular scale so to form either novel or superior physical properties that are not attainable by conventional bulk solids. These Nano sized particles; nanoparticles act like a complete unit in relation to properties. All materials have some critical range or value below which their properties changes drastically. Particles below 100 nm in diameter show properties that are different from those of conventional solids. When all the dimensions of the particle are in nanometer range, it is known as iso dimensional nanoparticles, for example spherical nanoparticles of silica. **Nanoparticle**, ultrafine unit with dimensions measured in nanometres (1 nm = 10^{-9} metre).

Bimetallic nanoparticles, composed of two different metals have drawn a greater interest than the monometallic nanoparticles from both scientific as well as technological point of view. Constituting metals and their nanometric size determine the properties of the bimetallic nanoparticles We are making magnetic nanoparticles and we specially focus on iron based nanoparticles. Magnetic nanoparticles are a class of nanoparticle that can be manipulated using magnetic fields. Such particles commonly consist of two components, a magnetic material, often iron, nickel and cobalt, and a chemical component that has functionality. We are using cobalt and ferrite as two componets and using 2 thiotic acid as a polymer because it is a protective agent and it helps in forming nanoparticles of good size.

In this present work, we are making catalytic NPS for development of CNT. We have synthesized FeCo and CoMn nanoparticles at different ratios by the method called chemical reduction by microwave irradiation.

We have characterized our sample by Transmission electron microscopy technique (TEM) and by ultraviolet (UV) visible spectroscopy. From TEM images of samples we determine the particle size and particle distribution on the surface, we observe that spherical nanoparticles of FeCo of size 1 um and 2um are obtained. Form the TEM image of sample of CoMn we can observe that nanoparticles of size 100nm and 200nm are obtained.

We have also obtained wavelength verses absorption graph for the sample of CoMn with different ratios of 2 thiotic acid (polymer).

6.2 future work

These nanoparticles are chirality control so help for CNT development. we are making CNT with nanoparticles because nanoparticles control diameter because of small size.

We are planning to make CNT using chemical vapor deposition method and these NPs will be used as precursor.

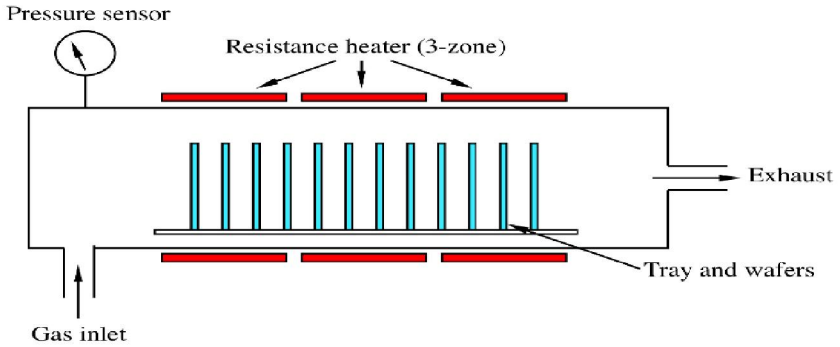

Figure 6.2.1 Schematic diagram of CVD for preparation of CNT.

Individual CNT walls can be metallic or semiconducting depending on the orientation of the lattice with respect to the tube axis, which is called chirality.

carbon nanotube are used for applications in energy storage, automotive parts, boat hulls, sporting goods, water filters, thin-film electronics, coatings, actuators and electromagnetic shields.

These CNTsmay be used for the fabrication of the next generation of energy storage, supercapacitors, field emission transistors, high-performance catalysis, photovoltaics, and biomedical devices and implants.

CNTs exhibit dimensional and chemical compatibility with biomolecules, such as DNA and proteins. CNTs enable fluorescent and photoacoustic imaging, as well as localized heating using near-infrared radiation.

We can also use these NPs for device fabrication (FET, MOSFET etc). In FET we can use CNT as channel between source and drain.

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