Synthesis of Iron Oxide, Cobalt oxide and Silver Nanoparticles by Different Techniques: A Review

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Abstract: There is a large scale work on the nanoparticles from 4th century to 2014. In this regard synthesis of nanoparticles with required properties and high potential applications are importantly required. Therefore investigation on nanoparticles by commonly used synthetic techniques from different precursors are remarked and thoroughly described in this review. Iron oxide and Cobalt Oxide nano-materials have been growing excessive importance because of their magnetic characteristics and wide applications. Iron oxide and Cobalt Oxide nanoparticles are prepared by using different methods, precursors, solvents and Temperature conditions. This review summarizes comparative and short description of the techniques for the formation ofiron oxide nanoparticles and Cobalt Oxide having controlled size, structural morphology and the magnetic and optical properties. Applications Iron Oxide and Cobalt Oxide nanoparticles are also mentioned. The particle size and morphology of the nanoparticles is characterized by XRD, TEM, UV analysis and SEM.

Keywords: Iron oxide; Cobalt oxide; Silver; Nanoparticles; Morphology

1. Introduction

Nanotechnology is the field of applied science and technology having a broader scope in the form of theoretical as well as experimental work. The terminology of the field “Nanotechnology” was first time used by a physicist Richard Feynman in 1959, [1,2] that was considered as the origin of the modern nanotechnology. The field of science in which we study matter at extremely small level which is the 10^{-9}m known as 1 nm and also the study of handlingof matter at the atomic and molecular level is known as Nanotechnology. The most basic building block of the nanotechnology for thesynthesis of a nanostructure are known as nanoparticles. Nanoparticles are extremely smaller than the world of everyday physical objects which are defined by Newton’s laws of motion but larger than an atom that are studied by quantum mechanics. It involves developing or modifying materials or devices within that size. [1,3]

The grain size of a nanoparticle are ranging from 1 to100 nm. When number of atoms combine to then they form a nanoparticle. By comparing the properties of Metallic nanoparticles and bulk metals it is concluded that there is a huge difference between the physical and chemical

properties of metallic and bulk metals were totally like lowering ofmelting points, Specific optical properties and mechanical strengths of crystal that that are used in several industrial applications. The optical property is the basic attractive property of the nanoparticles which show the color of the nanoparticles. For example, 20-nm gold nanoparticle has a characteristic wine of a red color, silver nanoparticle is yellowish gray and black color Platinum and palladium nanoparticles are black. Before the 4th century AD was the memorable time about the progress of nanotechnology, optical properties was observed in this era even in sculptures and paintings [1, 3]. Another difference in nanoparticles and the bulk material is the surface to volume ratio, as the surface to volume ratio of nanoparticles is greater than the bulk materials.

Nanotechnology is obvious in different ancient churches. A well-known application of ancient nanotechnology during middle ages is a color used for stained glass windows that color was the ruby red color. Beautiful examples of these applications can be found in glass windows of many Gothic European cathedrals, among which a unique masterpieces was represented by the Leon Cathedral, which was located in Santiago de Compostela. [3]

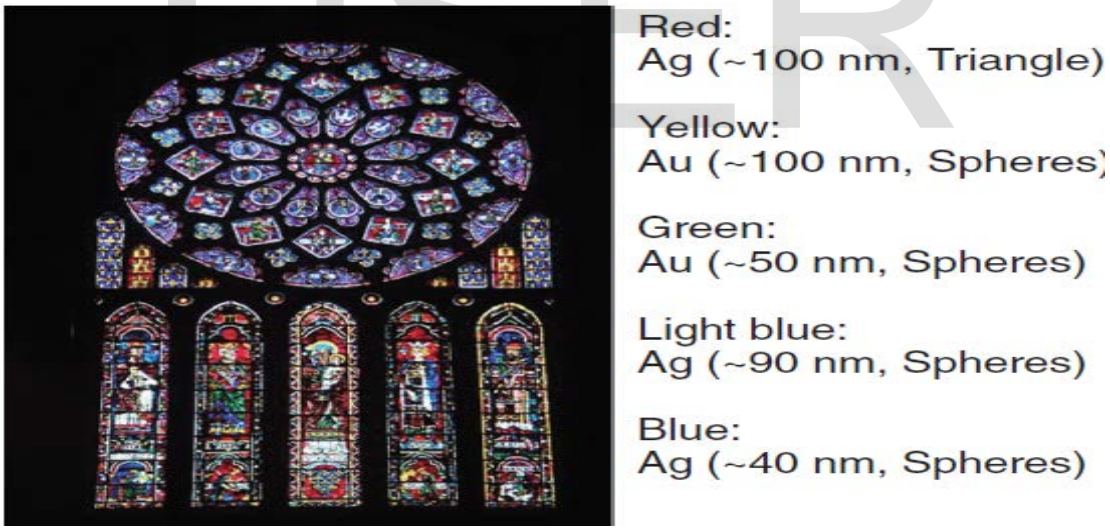

Fig 1: Rosace nord stained glass changes color depending on themorphology andsize ofSilver andGold nanoparticle. [4]

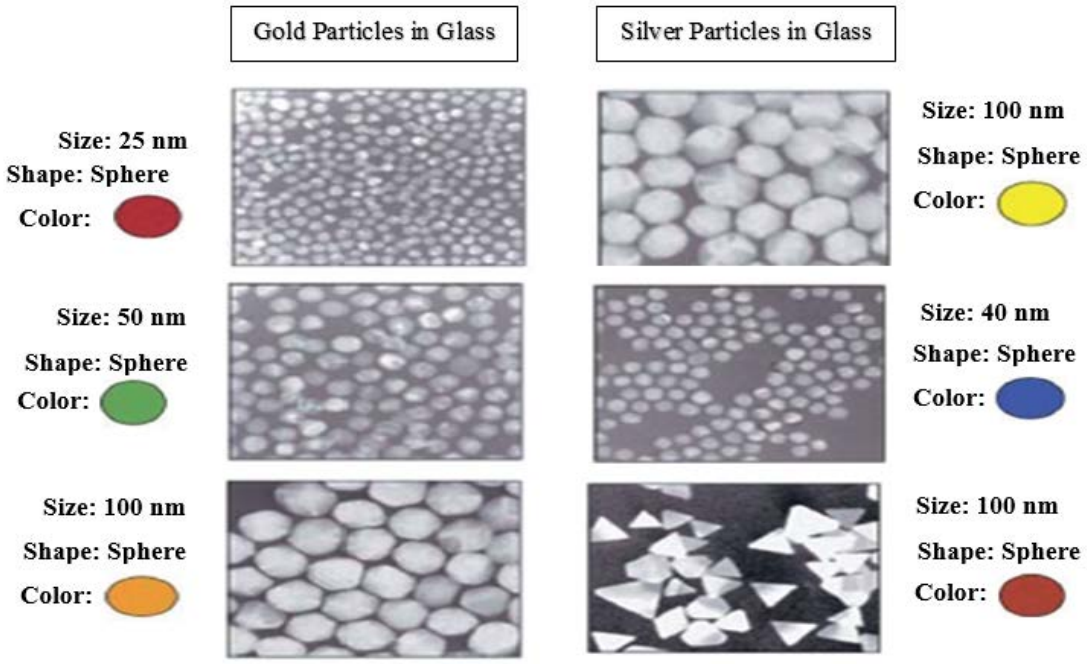

Fig 2: Coloring of stained glass and effect on morphology and grain size of nanoparticles [3]

In Fig 1 & 2, the Ancient stained-glass manufacturers saw that by changing tiny quantities of gold and silver in the glass. They could produce the red and yellow depending upon the particle size and shape of gold and silver in stained-glass windows. Drinkable gold is used for several diseases. [5]

The development take place in the field of Nano science and nanotechnology by the combined efforts in theoretical as well as experimental works in different fields like chemistry, physics other basic fields of science from 1970s [3]. The summarized ancient history of nanoparticles was given by the Daniel. [6]

Year	WORK	Reference
1200-1300 BC	Innovation Of Soluble Gold	[3]
290–325 AD	Invention of Lycurgus Cup	

1618	Concept of Colloidal Gold	
1676	Discovery of Metallic Gold In Neutral Media	
1718	Publication On Colloidal Gold	
1857	Colloidal Gold Preparation	
1902	Concept of Surface Plasmon Resonance (SPR)	[7]
1908	Electromagnetic Fields Scattering And Absorption by Nano-sphere	[8]
1928	Invention of Electron Microscope	[9]
1936	Invention of Field Emission Microscope	[10]
1937	Invention of Scanning Electron Microscope (SEM)	[5]
1947	Semiconductor Transistor	[11]
1950	Concept of Growing Monodisperse Colloidal Materials	[5]
1951	Invention of Field Ion Microscope	[12]
1956	Molecular Engineering	[5]
1958	Invention of Integrated Circuit	[13]

1959	Study on 'There's Plenty Of Room At The Bottom"	[2]
1960	Concept of Successful Oscillation Of a Laser	
1962	Concept of Kubo Effect	[14]
1965	Moore'S Law	[15]
1969	Concept of ' Honda–Fujishima Effect'	[16]
1976	Discovery of 'Amorphous Silicon Solar Cells'	[3]
1980	Concept of 'Quantum Hall Effect'	[17]
1981	Discovery of 'Quantum Dots In a Glass Matrix'	[18]
1982	Invention of Scanning Tunneling Microscope (STM)	[19]
1985	Discovery of Buckybal	[3]
1986	Invention of Atomic Force Microscope (AFM)	[20]

1987	Chemical Catalysis of Gold Nanoparticle	[3]
1989	35 Xenon Atoms Manipulation	[21]
1991	Discovery of Carbon Nanotubes	[22]
1993	Controlled Synthesis of NanocrystalsMethods	
1995	Fabrication of Nano-Imprinting	[23]
1996	Formation of Nano Sheets	[3]
1999	Invention of Dip-Pen Nanolithography	[24]
2000	Establishment of National Nanotechnology Initiative (NNI)	[3]
2003	Establishment of 21St Century Nanotechnology Research And Development.	
2005	Theory for DNA-based computation	[18]
2006	Discovery nanoscale car	[6]
2007	Non-harmful Lithium-Ion Battery	
2008	First Strategy of NNI For Nanotechnology Retlated to Healt	[18]
2009	Invention of Robotic Nano-Scale Assembly Devices	

2010	Patterns and Structures at Nanoscale	[6]
2011	Merging of both the NNI Strategic Plan and The NNI Environmental, Health, and Safety Research Strategies	
2012	Lounching of Two More Nanotechnology Signature Initiatives (NSIS)	
2013	Strategic Planning for the Development of Carbon Nanotube Computer	
2014	Implementation of the Research Strategies by NNI 2011	

Table 1: History of Nanotechnalogy

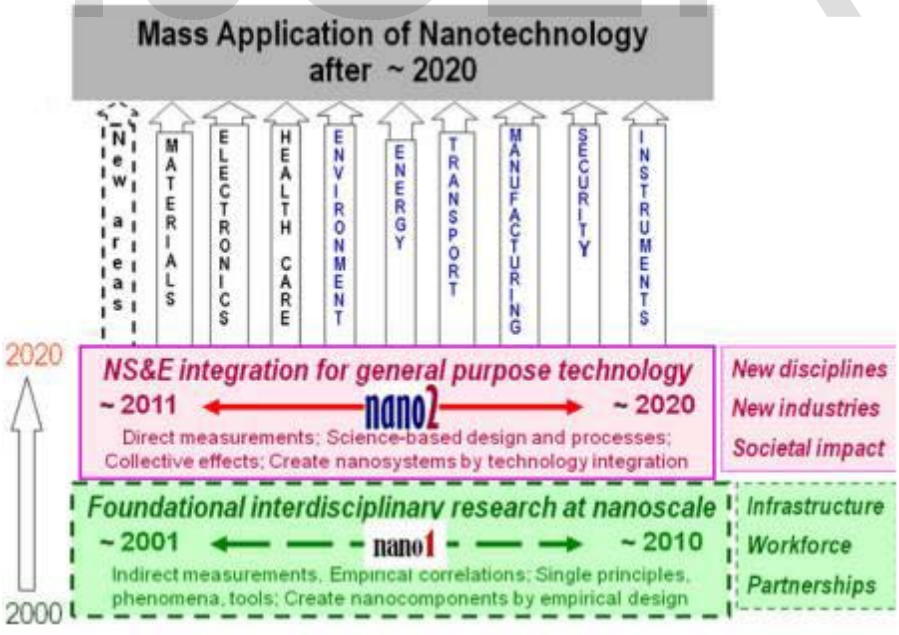

Fig 3: Overall review from 2000 to 2020. [25]

The Fig 3 shows that in 2000 it was an overall idea that nanotechnology will appear in two basic phases one is passive structural phase and other is complex structural phase. The first phase is in the duration 2001-2010.

1.1. Approaches for the Synthesis of Nanoparticles

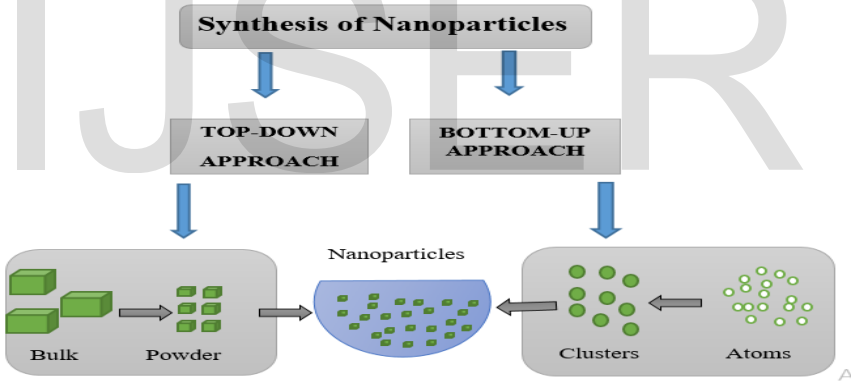

Fig 4: Approaches for the Synthesis of Nanoparticles.[26]

Fig 4 shows that there are two approaches have been used for the synthesis of thenanoparticle in early ages. The first approach is named as Top-Down approach. According to this approach bulk solids are breakdown into their slighter nanoparticles beneath the action of external forces. This is also known as break-up approach. The second approach is named as Bottom-Up approach. According to this approach the nanoparticles are synthesized from the atoms, atomic transformations or molecular condensations. This approach is also known as Build up approach.

1.2. Types of synthesis methods of nanoparticle

There are three basic methods for the synthesis of nanoparticles named as physical method, chemical method and biological method.[27] The further classification of the synthesis methods of nanoparticles as given in the following Table 2.

Physical Method	Biological Method	Chemical Method
Arc discharge method	By Plant extract	Co-Precipitation Method
Electron beam lithography	By Microorganisms	Sono-chemical Method
Ion implantation	By Algae	Electrolysis
Inert gas condensation	By Biomolecules or Enzymes	Microemulsion Method
Mechanical grinding	By Agricultural and Industrial Waste	Chemical reduction Method
Milling		Phytochemical Method
Spray pyrolysis		Sol-gel Method
Vapour phase Synthesis		Pyrolysis
		Solvothermal Method

Table 2: Approaches for the Synthesis of Nanoparticles.[21]

Physical method is a method in which precursor is used in gaseous form to synthesize the nanoparticles. It is an expensive and harmful method.[28, 29] Second method is Biological or Green method which is according to the Bottom-Up approach. It is not expensive method. Another method is Chemical method which is the combination of Top-Down and Bottom-Up approach. The major method which is used to preparethe nanoparticles is liquid phase methods. It is classified into different methods like Co-Precipitation, Chemical reduction, Microemulsion, Solvothermal, Hydrothermal, Sol-Gel. Every method has its own advantages and disadvantages. Advantages of the chemical reduction method is the easy formation of particles of different morphologies such as Nano prisms, Nano rods, nameplates and nanowires. In this method the size and the morphology of the nanoparticles depend on the different factors such as time and temperature of the reaction, dispersing agent and reducing agent. This method origionally on the

basis of the reduction of the ions of the metals to their zero oxidation states. Nanoparticles can be synthesized in this method by using non-complicated equipment or instruments, low cost and in the short time. We get pure nanoparticles by this method.[22]Some methods are commonly used to synthesis the nanoparticles which are given below.

The sol-gel method was established in the 1960s typically due to the necessity of new preparation methods in the nuclear industry. Sol is a stable spreading of colloidal suspended particles or polymers in a solvent. The particles may be amorphous or crystalline. Sol and Gel are two different terminologies having different properties. As sol is the combination of particles and liquid and gel is the liquid phase3-D system. There are different types of gel like colloidal gel containing colloidal particles and polymer gel having sub-colloidal particles.[25] In the sol-gel synthesismethod is the mixing of the compound in a liquid and then back it as a solid after the excellent procedure. It minimize the problems facing in co-precipitation in which solution may be Inhomogeneous. Results in minor particles which are simply sinter able. The disadvantage of this method is that it produces 3-D networks made by the oxides and having imperfect efficiency regarding the preparation of freelymoving nanoparticles. [30]

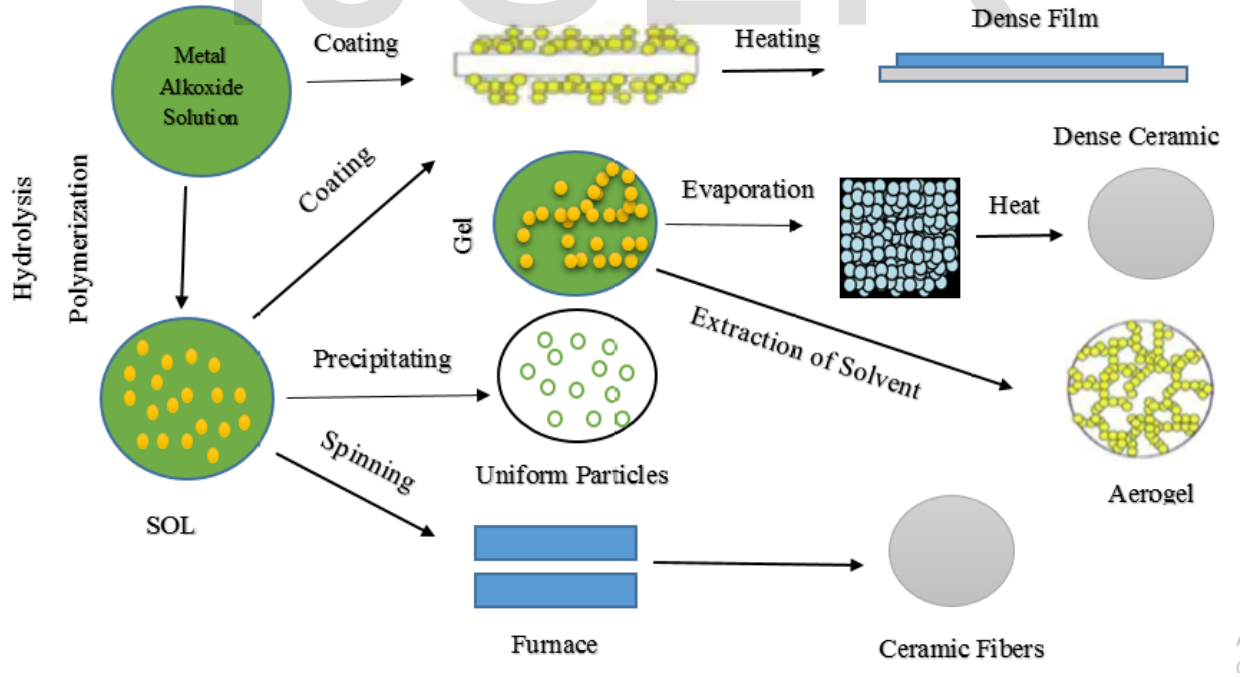

Fig 5: Systematic Diagram of Sol-Gel Method.[31]

Fig 5 shows the systematic diagram of the sol-gel method in which step by step mentioned the hydrolysis process of sol and precursor ten formation of gel and uniform particles, dense film, aerogel and dense ceramics.

Hydrothermal is a combination of two Greek words one is ‘Hydros’ meaning water and second is ‘Thermos’ meaning heat. [32] Single crystal nanoparticles synthesis is the hydrothermal synthesis which is effected by the particles solubility under high pressure in hot water. A steel container is used by the formation of the crystals that container is known as autoclave in which a sample is fill with water. The temperature for the reaction in this process is less than 300 ^{0}C. [33]A temperature is maintained at the other portion of the container to liquefy the sample and the other end is the cooler portion to take extra growth of sample. The diameter of nanoparticle ranges from 15 to 30 nm by altering the concentration of the reactants or the reaction solvent composition. This method involving to create a phase in the form of crystalline phases and even their melting pointcannot be effected on this phase. [34]

Microemulsion[35] is a thermodynamically unchanged isotropic distribution of two immiscible phases. These phases can be water and oil beneath the surfactant existing the surfactant molecules may procedure a monolayer at the border between the oil and water with the hydrophobic ends of the surfactant mixed in the oil phase and in the aqueous phase. Water-in-oil microemulsions are made by distinct nanodroplets of the aqueous phase disseminated by the gathering of surfactant molecules in an oil phase.[36]

Microemulsion is the process in which we can control over the size of the particles. Physicochemical featuresof the system chose the type of surfactant for the reaction. There are different classifications of the surfactants likeanionic, cationic or non-ionic are some types of used surfactants.

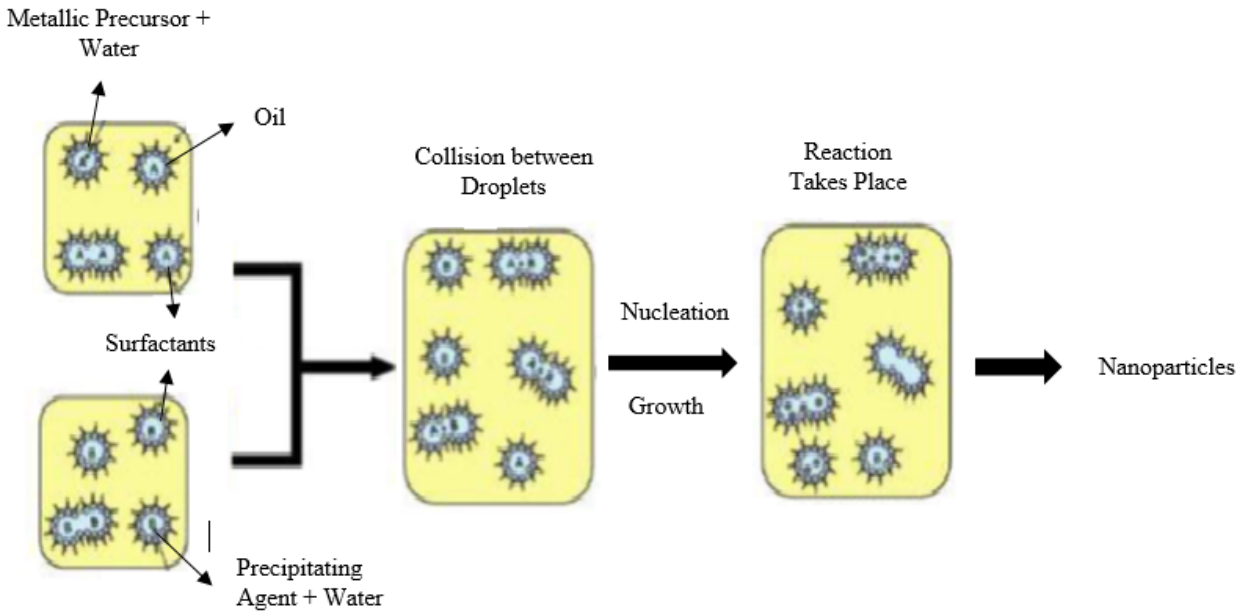

Fig 6: Systematic Diagram of Microemulsion Method. [37]

The particles gained with the co-precipitation method have a comprehensive size dissemination. Water-in-oil micro-emulsion containing of nanosized water droplets isolated in an oil phase and stabilized by surfactant molecules at the water-oil interface.[31]

Fig 6 shows the systematic diagram of the micro-emulsion method to control the reaction kinetics which is strongly connected to the oxidation speed of the iron species.The synthesis of particles necessity be carried out in an oxygen free environment by passing nitrogen gas. The Micro-emulsion method is slightly complicated with difficulties such as the creation of micelles the difficulty in eliminating surfactants from nanoparticles and only minor amounts of iron oxide particles can be synthesized.

Chemical co-precipitation may be the most capable method because of its effortlessness[38], high yield and little budget in the synthesis process. The controller of the size shape and configuration of magnetic nanoparticles depends on the kinds of magnetic salts used company or lack of oxygen gas.Co-Precipitation methodology is that the contamination of a precipitate by substances that area unit commonly soluble beneath the conditions of precipitation. Co-precipitation is that the concurrent precipitation of

compound that's commonly soluble beneath the conditions of precipitation with one or lot of alternative compounds that type a precipitate beneath identical conditions. The morphology and properties of the nanoparticles changing by changing some some factors like pH of the solution, Temperature, Preparation Cost, Time. [39]

There is no need of high temperature precipitates are made at less than 100^0C. Fe_3O_4 particles composed of small particle. We can see that the diameter size 5-20 nm. It is a simple magnetic separation process. Synthesis is rapid and high yield. The control in size and shape in a simple way. It is a controlled process and itcan be easily done with the success rate of 96 to 99.9%.

In fig 7: green synthesis (which is also called biosynthesis)is the preparation method of nanoparticles is a method of bottom up approach in which the oxidation and reduction of the ions are take place within the reaction.There are toxic chemical involved in chemical synthesis method that may have applications in the medical field.

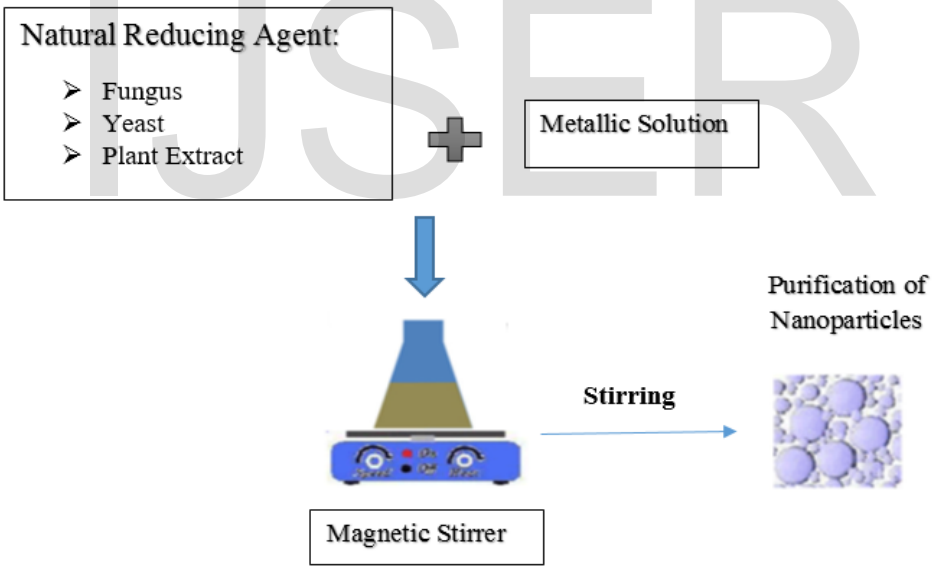

Fig 7: Overview of Green Synthesis.[40]

Biosynthesis is the inexpensive, faster [41]ecofriendly [42,43]and nontoxic method for the preparation of the nanoparticles by using plant extract or microbial enzymes.[44, 45] When this process is being proceed then there will be the reduction of metal take place during the reaction of the formation of the nanoparticle. [46] This method give good developments in engineered

materials. [47]There are many biological resources for the synthesis of nanoparticles like plant extract, fungus bacteria and algae etc. plant extracts are preferable for the synthesis of the nanoparticles than other microorganisms because they are good reducing agents.[48]Procedure of biological method depends on the follow factors like pH[49] of the solution, physiological temperatures,[50] pressure during preparation,[51] cast of the experiments and time of the experiments. [52]

2. Synthesis of Iron Oxide Nanoparticles

The broad family of useful materials metal oxides show a very significant role in many fields of science and technology. The magnetic colloids were studied first time in 1965. [53] Iron oxide is a transition metal which can be exist in different forms. [54]Iron oxide and cobalt oxide nanoparticles have a wide range applications depending upon their physical as well as chemical properties. Metal oxides are the rare existing oxides on the earth and these oxides are very useful for the fabrication of the new invention of the materials. These materials have different structures and bonding of electrons due to they show the different properties like magnetic and electronic. Moreover metal oxides having multivalent oxidation states have attracted much care among specialists because they often exhibit better catalytic reaction performance. In recent years there has been a cumulative interest in the synthesis of nanosized crystalline metal oxides because of their large surface areas, unusual adsorptive properties, surface defects and fast diffusivities. Different methods are used for the fabrication of the metal oxide nanoparticles such as Green Synthesis, Co-Precipitation, hydrothermal, Microemulsion, Solvothermal and sol-gel.[55] Iron oxide nanoparticles was prepared first time by co-precipitation method in 1852. [56] There are many factors affecting the synthesis of the nanoparticles such as concentration of the precursor, pH of the solution,Time of reaction, Temperature, environment etc. Iron oxides nanoparticles have an excellent importance different field of science like chemistry, materials science and physics. It is one of the basic and important nanoparticle having magnetic nature. There are several ways for the preparation of the nanosized iron oxide particles. Iron Oxide can be used for different applications like magnetic resonance imaging agent [57], hyperthermia[58], giant Magnetoresistance [59,60]for drug delivery [61],radionuclides[62]wastewater purification, such as to adsorb arsenate, chromium, cadmium, nickel. It can be used to alkalinity and hardness elimination, desalination, decolonization of tissue mill waste and removal of natural organic

compounds. Iron particles have very wide range applicational scope in the field of medical. [63,64]Iron Oxide will be recycled to adsorb dye. Elimination of dyes from wastewater is a major environmental problem because dyes are observable even at low concentration.[52]

Fig 8: Applications of Iron Oxide Nanoparticles [65]

Method	Precursor	Temperature ^{0}C	Size (nm)	Reference
Green Synthesis	Iron chloride and Green Tea extract	Room temp	Spherical 5-15 nm	[52]
	Iron chloride and Black tea	Room Temp	Irregular 40-50 nm	
	Iron chloride and Oolong Tea	Room Temp	Spherical 40-50 nm	
	Iron chloride and Banana Peel	Room Temp	10-25 nm	

	Iron chloride and Coffee seeds	70-80	UV: 216-265 nm SEM: 100nm	[66]
	Iron chloride and Neem Leaves	70-80	UV: 216-265 nm SEM: 100nm	[67]
	Iron chloride and Mango Leaves	50-60	UV: 216-268 nm SEM: 5-100nm	[68]
	Iron chloride and Clove Buds	50-60	UV: 216-268 nm SEM: 5-100nm	
	Iron chloride and Rose Leaves	50-60	UV: 216-268 nm SEM: 5-100nm	
	Iron chloride and Carom seeds	50-60	UV: 216-268 nm SEM: 5-100nm	
	Iron chloride and Joy Perfume Leaves	50-60	UV: 216-268 nm SEM: 5-100nm	
	Iron chloride and Curry Leaves	50-60	UV: 216-268 nm SEM: 5-100nm	
	Iron chloride and Centella asiatica herb	Room Temp-80	XRD: 30-80nm SEM: 30 nm	[69]
	Iron Sulphate	80-100	XRD: 35-60 nm	[70]

	and Ocimum sanctum		TEM: 20 nm	
	Iron ammonium sulphate with Cuminum cyminum and Ocimum Tenuiflorum	Room Temp	UV: 239.7 nm	[71]

Method	Precursor	Temperature ^{0}C	Size (nm)	Reference
Co-Precipitation	Iron chloride and NaOH	60- 70	TEM: 5-20 nm	[72]
	Iron Sulphate, Iron chloride Urea and NaOH	90-100	XRD: Cubic 35 nm	[73]
	$FeCl_3.6H_2O$, $FeCl_2.4H_2O$ and Sodium carbonate	70	Depends upon pH	[31]
	Iron chloride, Deionized water, Ethanol	90-650	smallest grain size (63.20 ± 0.928 nm	[74]
	Iron Chloride and Ammonium Hydroxide	90-700	TEM:20-22 nm	[75]

			VSM:10-25 nm	

Method	Precursor	Temperature ^{0}C	Size (nm)	Reference
Sol-Gel	Iron Chloride, Ethanol	80	SEM: 200 nm TEM: 180 nm	[76]
	Iron Nitrate, Double distilled water and Gelatin	60-800	XRD, EMA and UV: 30–40 nm	[77]
	Iron Chloride, NaOH	100	0.1 – 0.5 µm	[78]

Method	Precursor	Temperature ^{0}C	Size (nm)	Reference
Microemulsion	Iron chloride, AOT, deionized water and NaOH	25-30	colloidal nanoparticle 45-50 nm	[79]
	Acetyl Acetonate, Distiled Water	High Temp	12-16 nm	[78]

Method	Precursor	Temperature ^{0}C	Size (nm)	Reference

Hydrother	Iron chloride, Urea and ammonia solution	150	TEM: 50-90 nm	[33]
	Iron Nitrate and Ethanol	60-160	SEM & TEM: 33.3 nm	[80]

2.1. Green Synthesis Method

Mihir *et al.*(2014) had been used the green synthesis method to prepare the iron oxide nanoparticles from different leaf extract like green tea, black tea, Oolong Tea and banana peel with iron chloride at room temperature. The synthesized sample were characterized by X-Ray Diffraction (XRD),Fourier transform infrared spectroscopy(FTIR) and Transmission electron microscopy (TEM). The characterization of the sample showed that the morphology of the synthesized sample was changed by varying the leaf extract. They were reported as by above characterization the average size of the iron oxide nanoparticles was ranging 40-60 nm with cubic, irregular and spherical shape depended upon the leaf extract. Coercivity of the prepared sample of the iron oxide nanoparticles was changed with the change in the morphology of the particles. [52]

M. Pattanayak *et al.*(2013) had been synthesized zero valent iron oxide nanoparticles from the seeds of plant extract which was coffee with iron chloride by using green synthesis method at 50-60^0 C. It was rapid formation of iron oxide nanoparticles during the reaction. The color and the morphology of the particles was changed by the change in the temperature, time and the pH of the solution. They were reported as the pH of the solution was changed from high acidic to low acidic. The size of the particles of prepared sample of iron oxide nanoparticles was ranging 216-265 by Ultraviolet visible Spectroscopy (UV) characterization and 100 nm with spherical structure by Scanning Electron Microscope (SEM). [66]

M. Pattanayak *et al.*(2013) had been synthesized zero valent iron oxide nanoparticles from Azadirachta indica(Neem) Plant Leaves extractwith iron chlorideat 50-60^0 C by using green

synthesis method. They were reported as the iron oxide nanoparticles formed with very good rate in the reaction therefore synthesis of iron oxide nanoparticles from leave extract is preferable than other methods. The color and the morphology of the particles was depended on the temperature, time and the pH of the solution. The pH of solution was changed from high acidic to low acidic. The prepared samples of iron oxide nanoparticles were characterized by UV and SEM. They were reported as the average size of the nanoparticles was in the rage of was 216-265 nm by UV and 50-100 nm by SEM with spherical morphology. [67]

M. Pattanayak*et al.* (2013) had been synthesized iron oxide nanoparticles by green synthesis using iron chloride with different leaf extract like mango leaves, Clove Buds, Rose Leaves, Carom seeds,Joy Perfume Leaves, Curry Leaves and coffee at room temperature with the variation of reaction time. The morphology waschangedwith the change of pH of the solution, reaction time and the leaf extract used. The pH of the solution was moved towards acidic range. The prepared samples were characterized by UV and SEM which reported as the size of the particles was in the range of 216-265 and 50-100 nm respectively. [68]

Lakshmi *et al.*(2015) were used Centella asiatica herb to prepare the iron oxide nanoparticle by green synthesis. They were used iron chlorides and Centella asiatica herb with sodium hydroxide at room temperature to 7000 C. The size of the particles was vary by the change in the applied temperature. The synthesized iron oxide nanoparticles were characterized by TEM, XRD,SEM and FTIR. The size of the particles ranging 30-80 nm by above mentioned characterization with having aggregated state. [69]

Balamurughan *et al.* were used green synthesis to prepare the iron oxide nanoparticles from Ocimum sanctum (Tulsi) with iron sulphate at room temperature to 800 C. By changing the pH of the solution the morphology of the particles was changed. The average particle size of the synthesized sample of iron oxide nanoparticles was 47 nm and 20 nm which is showed by the XRD, TEM and SEM characterization. [70]

C.Narendhar *et al.*(2014)had been synthesized iron oxide nanoparticles from ferrous ammonium sulphate and iron chloride with Cuminum cyminum and Ocimum tenuiflorum by using green synthesis and co-precipitation method.The optical properties of the prepared iron oxides nanoparticles was depended on the antimicrobial time and chitosan which acted as antimicrobial

agent. The particle size were 239.7 nm and 269.1 nm from green synthesis and co-precipitation method respectively investigated by UV characterization. [71]

Different researchers do their best to study the iron oxide nanoparticles at nano level. They studie the properties of the iron oxide nano particles by prepare with green synthesis by using different plant extract. They were characterized the samples by XRD, SEM, TEM UV-Vis etc. They reported as the morphology and the color of the iron oxide nano particles were dependent on the temperature of preparation, time and specially extract used and pH of the solution in which iron oxide nanoparticles are formed. Coercivity of the iron oxide nanoparticles also vary with the change of extract and pH of the solution.

2.2. Co-Precipitation Method

Poedji *et al.*(2013) were prepared the iron oxide nanoparticles by co-precipitation method by using chlorides of iron with sodium hydroxide and N_2 gas at 60-70^{0}C with the pH value 8-14. The morphology and color of the particles prepared was changed by changing the temperature and reaction time. They reported as the prepared iron oxide nanoparticles showed paramagnetic properties with the size of the particles ranging 5-20 nm characterized by XRD, SEM and TEM. The magnetic properties of the synthesized iron oxide nanoparticles vary with the morphology of the particles measured by Vibrating Sample Magnetometers (VSM).[72]

W. Myat *et al.*(2013) had been prepared iron oxide nanoparticles used for ferrofluids, catalysts andmagnetic materials from Iron sulphate and iron chloride with Urea and NaOH by co-precipitation method. Iron oxide nanoparticles were synthesized after the removal of arsenic for the solution. The structural and magnetic properties of the prepared sample of iron oxide were depended on the given temperature time. By XRD and SEM it was characterized which showedthat the particle size of iron oxide was ranging 19-25 nm. These characterization also showed the structure of the particles that was cubic structure.They were reported as the morphology of the particles was also changed with differentAgeing time of the reaction. [73]

Cristina *et al.*(2012) had been used the co-precipitation method for the preparation of the iron oxide nanoparticles from chlorides of the iron with sodium carbonate used as precipitating agent. The particle size, morphology and magnetic properties of the prepared particles was depended on

the variation of the pH value from 6-10 and temperature of the reaction. They were reported as the prepared sample was characterized by XRD and TEM which showed the average particle size 50-70 nm with inverse spinal crystal structure and square shaped particles depending upon the pH value.Coercivityof the particles was increases with the increase with the increase in the size of the particles of the iron oxide prepared by this reaction. [31]

Zuolian *et al.*(2012) had been synthesized iron oxide nanoparticles by a useful method which is co-precipitation method using iron chlorides with urea at different calcination temperature and ageing time. The iron oxide nanoparticles were synthesized after the removal of Pb^{2+}which effected the morphology of the particles.They were reported as the structural and magnetic properties of the prepared iron oxide nanoparticles were depended on the concentration of precursor, ageing time and pH value, investigated by XRD and SEM having smallest particle size 63.20 ± 0.928 nm. [74]

N.D Kandpal *et al.*were used co-precipitation method to synthesize the iron oxide nanoparticles from hydrated iron chloride with ammonium hydroxide at different temperature from 100 to 700^0C. The synthesized samples of the iron oxide nanoparticles were characterized by XRD, VSM and TEM which showed the average particle size was ranging 15-22 nm. Theses nanoparticles were have spinal structure characterized by above mention characterization. The magnetic properties of the prepared sample were studied by VSM which showed that the saturation magnetization was increases with the decrease in the particle size of the prepared iron oxide nanoparticles. They were reported as the saturation magnetization of bulk magnetite was high. [75]

Co-precipitation is the very common and easy method to prepare iron oxide nanoparticles. Different researchers prepared iron oxide nanoparticles. They were reported as the morphology of the iron oxide nanoparticle were dependent of the reaction time and the structural and the magnetic properties were dependent on the temperature applied to the sample and the pH of the solution.

2.3. Sol-Gel Method

Anand *et al.*had been synthesized iron oxide nanoparticles from iron chloride with 1, 2-epoxybutane and ethanol used as precursor and complexing agent by sol-gel method in aerosol reactor at 80^0 C. They were reported as the particle size of the prepared iron oxide nanoparticles was controlled by varying the concentration of the solution and reaction time. The particle size was ranging 100-250 nm characterized by SEM and TEM characterization. [76]

Samira *et al.*(2013) were synthesized iron oxide nanoparticles by sol gel method using iron nitrate as precursor with gelatin as a polymerizing agent at calcination temperature 600^0 C. gelatin was used to give which give the stability to the particles under preparation. XRD, SEM, TEM and UV characterization was taken to study the morphology of the prepared sample of iron oxide nanoparticles which showed that particles were in spherical structure with average size ranging 30-40 nm. [77]

Sol-Gel method is high temperature method to prepare iron oxide nanoparticles. The morphology and structural properties were changed by changing the reaction time and the concentration of the solution.

2.4. Microemulsion Method

Nashaat *et al.*(2006) were synthesized iron oxide nanoparticles by using microemulsion method from iron chlorides with AOT and sodium hydroxide at room temperature. The morphology of the iron oxide nanoparticles was depended on the concentration of the AOT which was used as surfactant. They were investigated as the size of these particlesdirectly increased by increasing the concentration of the AOT. The samples were characterized which showed that the particles were colloidal with average particle size ranging 45-50 nm by UV and TEM characterization. [79]

Iron oxide nanoparticles were prepared by Nashaat *et al.* and they reported as morphology of the iron oxide nanoparticles were totally dependent on the concentration of the surfactants used in this method.

2.5. Hydrothermal Method

M. M. Rahman*et al.*(2011) were synthesized the iron oxide nanoparticles from the iron chloride and urea with ammonia solution by using hydrothermal. They were reported as the morphology of the prepared iron oxide nanoparticles was ranging 50-90 nm with spherical structure characterized by TEM and SEM. Different properties of samples were studied by using different techniques like optical properties were studied by UV and FTIR, chemical properties were studied by using Energy-dispersive X-ray spectroscopy (EDX) and physical or structural properties were studied by using XRD. They were studied different applications of prepared iron oxide nanoparticles like chemical sensor and Photo-degradation. [33]

Eman*et al.*(2015) had been synthesized iron oxide and cobalt doped iron oxide nanoparticles from iron nitrate with ethanol by using eco-friendly hydrothermal method. They were reported as the properties of prepared nanoparticles were characterized by SEM, TEM, FTIR, UV and EDX. The morphology of the iron oxide nanoparticles was depended on the doping concentration. The average particle size of the pure iron oxide particles was 33.3 nm with cubic structure characterized by SEM and TEM. They were investigated that the prepared iron oxide particles can be used for dyes research and for the removal of harmful metals from the solution. [80]

Hydrothermal method is high temperature method to prepare iron oxide nanoparticles by different researchers. They were characterized the samples by XRD, SEM, TEM, FT-IR, UV-Vis. They were reported as the morphology of the iron oxide were dependent on the temperature applied and the doping concentration. Applications of the iron oxide nanoparticles were changing with the change in the particle size.

3. Synthesis of Cobalt Oxide Nanoparticles

Cobalt compound could be a promising material to be used as a gas sensing element and catalyst increasingprocesses of crude fuels, pigment for glasses and ceramic. Extremely distributednanostructured mineral atomic number 27 compound is predicted to show higher performancewithin the on top of mentioned application aspects. Specific morphologies and crystallographic phases of nanostructures materials are accountable for their optical, magneticandelectrical properties. Cobalt Oxide belongs to the traditional mineral structure that relies on a cuboid shutpacking array of compound ions.[81] Cobalt Oxide could be an important magnetic material having several applications in different

proposes like in chemical process, sensing of gas, in Electro chromic films, Heterogeneous chemical change materials, as cathodes in batteries, lepton Transfer supporter. They are little sized nanoparticles exhibit novel material properties which are totally different from their bulk counterparts.Some of the on top of ways suffer from the issue in size-homogeneity and well dispersion of Co_3O_4 nanoparticles. [82]

Method	Precursor	Temperature ^{0}C	Size (nm)	Reference
Co-Precipitation	Cobalt chloride, Sodium carbonate, oxalic acid and ammonia	various temp	Size varies by changing temperature.	[83]
	Cobalt Nitrate and Potassium Hydroxide	300-700	XRD, SEM: 2-80 NM	[84]
Sol-Gel	Cobalt chloride and Sodium hydroxide	70-100	TEM: 10-50 nm XRD: 14 nm	[85]
	Cobalt Nitrate and oxalic acid.	100-600	XRD, TEM: 44.89 nm	[86]
Solvothermal	Cobalt chloride, Hydrazine, TEA	60-120	XRD:face-centered TEM: Spherical 2nm	[82]
Thermal Decomposition	Cobalt chloride, Nitrobenzen, Ammonium hydroxide and	50-450	XRD: 49 nm	[87]

	glycerol			
	Carbonatotetra ammine cobalt nitrate complex	Start from 175	XRD, TEM: 11 nm	[88]
Chemical Reduction	Cobalt Sulphate with $NaBH_4$	Room Temp and pressure	Amorphous and Crystalline	[89]
Green Synthesis	Cobalt Nitrate,pomegranate peel and fungus with sodium hydroxide	500	XRD and SEM: 49 nm	[90]
Hydrothermal	Cobalt Chloride and Ammonium Hydroxide	2-300 K	SEM: 16.4±3.1 nm	[81]
Microemulsion	Cobalt Nitrate and PVP	300-700	XRD, SEM : 2-80 nm	[60]

3.1. Precipitation Method

Katalin *et al.*(2011) were compared two preparation methods of cobalt oxide nanoparticles which were co-precipitation and sol-gel method. They were used nitrates and chlorides with different surfactants at different temperatures. Nitrates of cobalt ware much soluble than chlorides. They were reported as the structural and magnetic properties were depended on the surfactants and applied temperature in both methods. They were reported as in co-precipitation method the size of the particle decreased till 700^0C and increased above this temperature. The average particle size of prepared cobalt oxide nanoparticle was 100-150 and 70-100 nm in co-precipitation and sol-gel method respectively characterized by XRD and SEM. [83]

S. L. Sharifi1 *et al.*(2013) had been used three synthesis methods i.e co-precipitation, Thermal

decomposition method and Micro-emulsion method to synthesis cobalt oxide nanoparticles from cobalt nitrate with different solvents and surfactants at different calcination temperature ranging 300-700 ^{0}C. They were reported as the prepared samples of particles were characterized by XRD, SEM and showed that the particles morphology was depended on the calcination temperature. The particle size of cobalt oxide nanoparticles was ranging 2-80 nm. They compare three synthesis methods reported as the co-precipitation method was the best method for the synthesis of cobalt oxide nanoparticles. [84]

Selection of Method used for the preparation of the cobalt oxide is very important. Co-Precipitation method is very eco-friendly method for the synthesis of the cobalt oxide nanoparticles. The particle size of the cobalt oxide nanoparticles increased by the increase in the temperature of the reaction. Structural and magnetic properties were totally dependent on the amount of the surfactants added in the solution.

3.2. Sol-Gel Method

B. I. Nandapure *et al.*(2012) had been used cobalt chloride with starch solution and sodium hydroxide to synthesized cobalt oxide nanoparticles by sol-gel method at temperature varying 100-750^0 C. They were reported as the magnetic properties the cobalt oxide nanoparticles was depended on the morphology of the particles and particles showed ferromagnetic and paramagnetic behavior studied by VSM and PANI respectively. The color of the cobalt oxide particles was changed from green to black when temperature was increased from 100 ^{0}C to 750 ^{0}C. The average particle size of synthesized sample of cobalt oxide nanoparticles was 14 nm characterized by XRD and 10-50 nm with irregular structure by TEM. They were reported as the cobalt oxide nanoparticles are used as soft magnetic materials [85]

Harish*et al.*were synthesized cobalt oxide nanoparticles by using cobalt nitrate as precursor with oxalic acid by sol-gel method at 600 ^{0}C. They were reported as the prepared sample of cobalt oxide particles were characterized by XRD, UV, TEM and FTIR. The results about the morphology of the particles by XRD and TEM were nearly same with the average particle size of particles was 45 nm. The optical and magnetic properties of the particles were studied by UV and FTIR respectively. They were mentioned that cobalt oxide nanoparticles can be used as

magnetic materials, battery cathodes, electrochromic films, and heterogeneous catalytic materials. [86]

When cobalt oxide were synthesized by the sol-gel method at different temperaturesthen the color and morphology of the cobalt oxide nanoparticles were dependent on the change in temperature of the reaction. The color of the cobalt oxide particles was changed from green to black when temperature was increased from 100 ^{0}C to 750 ^{0}C.

3.3. Solvothermal Method

M. Alagiri*et al.*(2013) had been used solvothermal method to synthesize the cobalt nanoparticles from hydrated cobalt chloride in ethanol as solvent with hydrazine and TEA at 50-120^{0}C in stainless steel autoclave. The time required for the synthesis of cobalt particles by this method was 12 h. They are reports as the synthesized cobalt nanoparticles showed super magnetic behavior.The magnetic behavior of prepared cobalt particles was depended on the applied temperature. The magnetic anisotropy constant value of cobalt nanoparticles was increased with the decrease in the morphology of the particles so magnetic anisotropy constant value of cobalt nanoparticles is greater than the bulk material. The particle size of prepared sample was 2 nm averagely having FCC and spherical structure characterized by XRD and TEM characterization respectively. [82]

In the solvothermal method the amount of surfactant used in this reaction. The magnetic properties effect of the cobalt oxide nanoparticles were changed by changing the temperature. Magnetic anisotropy constant increase with the decrease in the morphology of the particles.

3.4. Thermal Decomposition Method

R. Manigandan*et al.*(2013) were synthesized the cobalt oxide nanoparticles by thermal decomposition method from cobalt chloride used as precursor with ammonium hydroxide and glycerol at calcination temperature 450^{0}C. FTIR was used for the confirmation of the synthesis of cobalt oxide nanoparticles. They were reported as the cobalt oxide nanoparticles were non-electroactive with higher activity for the detection of nitrobenzene.The optical properties of

cobalt oxide particles was studied by UV. The prepared sample was characterized by XRD which showed that the average particle size of cobalt oxide was 49nm and having cubic morphology. SEM characterization showed that the cobalt oxide nanoparticles having spherical irregular rod like structure. [87]

Saeed*et al.*(2013) were synthesized cobalt oxide nanoparticles from carbonatotetra ammine cobalt nitrate complex used as precursor by thermal decomposition method at various temperature starting from 175 ^{0}C. They characterized the prepared samples by XRD, TEM, FTIR, EDX and UV. They were reported as the morphology of the particles was depended on the applied temperature, size of particles was increased by increasing the temperature of preparation of sample. The average particle size of synthesized cobalt oxide nanoparticles was 11 nm by XRD and TEM with spherical structure. The saturation magnetization and magnetization of cobalt oxide was also depended on the applied temperature. Synthesized cobalt oxide particles can be used as electrochemical device, gas sensor etc. [88]

Thermal decomposition is temperature dependent method which is used for the synthesis of the cobalt oxide nanoparticles. Morphology and the magnetic properties of the cobalt oxide nanoparticles synthesized by the thermal decomposition method were changed by changing the temperature of the reaction.

3.5. Chemical Reduction Method

I. Markova*et al.*(2007) had been synthesized cobalt nanoparticles by chemical reduction method from iron sulphate with $NaBH_4$ at room temperature and pressure using two hydrodynamic conditions one is ideal mixing condition known as T-Method and other is ideal displacement regime known as A-Method. The morphology and color of the prepared cobalt nanoparticles were depended on these mixing conditions. They were characterized the samples of particles by SEM which showed that the particles having black color with amorphous structure prepared by T-method and particles having gray color with crystalline anisotropic structure which were prepared by A-method. They were reported as the conductivity, density and the morphology of the cobalt nanoparticles were also depended on the heating temperature of the reaction.[89]

Chemical reduction method is the simple method to prepare the cobalt oxide nanoparticles. The

color and morphology of the cobalt oxide changed with the change in the mixing condition. Conductivity and density of the particles are dependent on the heating temperature of the reaction.

3.6. Green Synthesis Method

M. Ullah*et al.*(2014) had been used a cost effective green synthesis method to synthesize the cobalt oxide nanoparticles by using cobalt nitrate and pomegranate peel and a microorganism that was fungus with sodium hydroxide which was used as precipitating agent. The temperature required for this propos was room temperature to 500 ^{0}C. They were reported as in this synthesis cobalt oxide nanoparticles were characterized by SEM and XRD. The average size of the cobalt oxide particles was 49 nm with crystalline morphology and spherical structure by XRD and SEM characterization respectively. The morphology of the prepared cobalt oxide particles was depended on the temperature applied in the reaction. [90]

Cobalt oxide nanoparticles were prepare with green synthesis by using different plant extract. The morphology and the color of the iron oxide nanoparticles were dependent on the temperature of preparation, time and specially extract used of the solution in which iron oxide nanoparticles are formed.

3.7. Hydrothermal Method

A. Fernandez*et al.*(2009) had been used hydrothermal method to synthesize the cobalt oxide nanoparticles from cobalt chloride with ammonium hydroxide. They were prepared samples at different temperatures varies from 2-33 K. They characterized the prepared samples of cobalt oxide particles by XRD, UV, TEM and SEM. They were reported as the particles of cobalt oxide showed antiferromagnetic behavior at 33k which was Neel temperature and just after this temperature particles showed super magnetic behavior and for above this Neel temperature particles showed para magnetic behavior. The average size of the prepared cobalt oxide nanoparticles was about 16.4±3.1 nm with octahedral structure. This cobalt oxide can be used as gas sensor, pigment and as a catalyst. [81]

Cobalt oxide nanoparticles synthesized by the hydrothermal method were totally dependent on

the temperature applied to the solution. As the magnetic behavior of the cobalt oxide nanoparticle changes with the increase in the temperature applied to the solution.

4. Synthesis of Silver Nanoparticles

Silver is a noble metal[91]. It has a good attention in the field of nanoscience and nanotechnology due to its extra-ordinary properties like electrical conductivity, catalytic, stability and especially anti-microbility [92].The metallic nanoparticles in both forms which are pure as well as composite [93] form have their unique properties like electronic, magnetic, mechanical as well as optical properties.[94] These properties vary with the size and surface area of the silver nanoparticles so properties of silver at nano scale are different as compare to the bulk material [95]. The spherical shaped silver nanoparticles are thermodynamically stable [96]the silver nanoparticles are metallic particles but their genotoxicity and cytotoxicity is not clearly defined. [97,98, 99]There are different applications noble metallic silver in the different fields of science on the basis of above mentioned properties. The major application of the silver particles in the medical field of science as good resistive for bacteria (Anti-Bacterial agent)[100].Its second major use is water treatment [101]. Silver nanoparticles also used in chemical sensing [102], catalysis [103],photography [104], photonics [105].As ethanol is the reduced form of salts of noble metals by a solvent which is in the form of organic solvents, which has been long used by Toshima and coworkers [106]

The basic applications of silver nanoparticles in the medical science as shown in fig 9.

Different methods can be used for the preparation of the noble metallic nanoparticles [107,108] like chemical precipitation method, chemical reduction, thermal decomposition method, sol–gel method, solvothermal method and microemulsion method. [109,110].

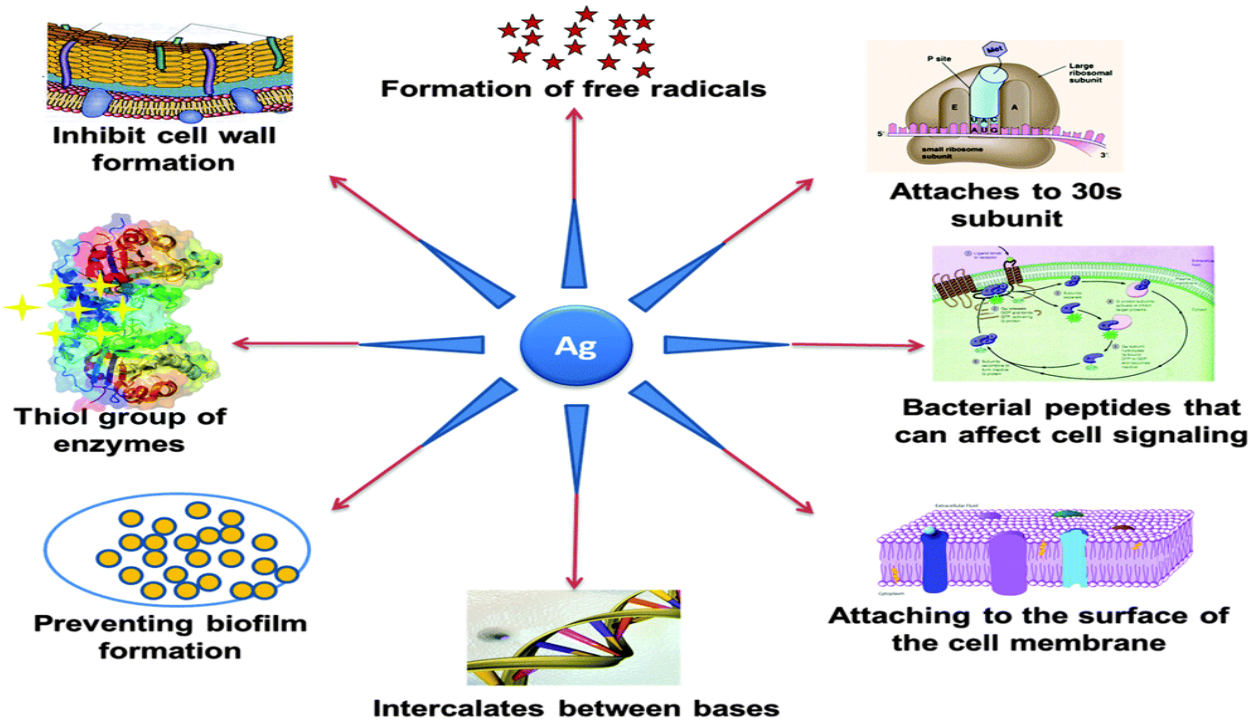

Fig 9: Medical Applications of Silver Nanoparticles[111]

Method	Precursor	Temperature ^{0}C	Size (nm)	Reference
Co-Precipitation	Silver Nitrate Sodium borohydride	Room Temperature	Change with color	[112]
	Silver Nitrate, Sodium chloride and CTAB		TEM: 25 nm	[113]
Sol-Gel	Silver Nitrate, Silver Perchlorate	Room Temperature	UV-Vis:14 nm TEM: 5-30 nm	[114]
Solvothermal	Silver Nitrate Octadecane and octane thiols	180-200 ^{0}C	TEM: 4±0.5 nm	[115]
Chemical	Silver Nitrate,	Room	XRD: 22-43	[116]

Reduction	Tetrabutyl titanate (TNBT)	Temperature	nm SEM: 19±2 nm TEM: 17±0.6 nm	
	Silver Nitrate Trisodium	90 ^{0}C	STM: 5-10 nm	[117]
	Silver Nitrate trisodium citrate	60-120 ^{0}C	XRD, TEM, SEM: 50 nm	[118]
Green Synthesis	Silver Nitrate and Roots of R. Hymenosepalus	25-40 ^{0}C	UV-Vis, TEM: 2-40 nm	[119]
Hydrothermal	Silver Nitrate, Arabic Gum	160-180 ^{0}C	XRD, SEM, TEM: 15-25 nm	[120]
Microemulsion	Silver Nitrate. (NaBH4), Sodium dodecyl sulfate (SDS)	30-40 ^{0}C	UV-Vis, SEM: Dependent on water to surfactant ratio	[121]

4.1. Precipitation Method

S. D. Solomon *et al.*(2011) were synthesized silver nanoparticles by using silver nitrate and sodium borohydride as precursor by precipitation method at room temperature. They were characterized the prepared silver nanoparticles by UV-Vis and TEM. They were reported as the properties of the silver nanoparticles changes with the change in the color of the particle from silver to yellow. It was concluded that the properties of the nanoparticles depends upon the color of the particles. They were also reported as the size of the silver nanoparticles increases with the increase in the plasmon peak shift with greater wavelength. [112]

J. I. Hussain *et al.*(2015) were synthesized the silver nanoparticles from silver nitrate and sodium chloride with CTAB by using precipitation method. They were characterized the prepared nanoparticle by UV-Vis and TEM. They were reported as the size and morphology of the silver nanoparticle were controlled by controlling the pH value of the solution. They were studied the optical avsorption of the silver particles by UV-Vis which were observed in the range of 350 – 600 nm. They were also reported as the morphology of the prepared silver nanoparticles was roughly spherical with the particle size 25 nm characterized by the TEM. [113]

Synthesis of silver nanoparticles by precipitation method is very ecofriendly process. This was concluded that the properties of the silver nanoparticles were totally dependent on the color and size of the particles while the size of the particles increases with the increase in the plasmon peak shift with greater wavelength.

4.2. Sol-Gel Method

P. W. Wu *et al.*(2000) were synthesized silver nanoparticles by sol-gel method by using silver nitrate and silver perchlorate as precursor with and without acids. They were characterized the prepared nanoparticles by XRD, TEM and UV-Vis. They were reported as the absorption band were dependent on the amount of the acid as absorption band increases by the addition of acid in the solution so size of the silver nanoparticles changes. They were also reported as the silver nanoparticle size was 5-30 nm characterized by TEM. [114]

Synthesis of silver nanoparticles by sol-gel method is not temperature dependent but the amount of the surfactant will affect the morphology and the size of the particles. Absorption band of the particles increases with the increase in the amount of the surfactants present in the solution.

4.3. Solvothermal Method

M.J. Rosemary *et al.*(2007) were synthesized silver nanoparticle from silver nitrate, octadecane and octane thiols using solvothermal method at temperature 180-200 ^{0}C in hydrothermal bomb which is coated by Teflon. They characterized the prepared silver nanoparticles by UV-Vis and TEM.They were studied the optical properties of the prepared silver nanoparticles by UV-Vis

and noted the absorption peak at 420 nm. They were reported as the particle size of prepared nanoparticle was 4±0.5 nm characterized by TEM. [115]

4.4. Chemical Reduction Method

M. Farasat *et al.*(2012) were prepared silver nanoparticles by using chemical reduction method with the precursor silver nitrate in the presence as well as in the absence of the tetrabutyl titanate (TNBT). They used metallic tin powder as a reducing agent. They characterized the samples by XRD, SEM, and TEM. They were reported as the silver nanoparticles in the absence of the TNBT have greater particle size as compare to the presence of the TNBT in the chemical reduction reaction characterized by XRD. As in the absence of the TNBT the particle size was 43 nm but in the presence of TNBT the particle size of silver nanoparticle reduces to 22nm with the cubic morphology. They were also reported as the particle size of silver nanoparticle were 17±0.6 nm and 19±2 characterized by TEM and SEM respectively. They were also reported as the prepared nanoparticle can be applicable in the biological labelling and in photography. [116]

S. Balu *et al.*(2003) were prepared silver nanoparticles by using chemical reduction method with Silver nitrate and Trisodium citrate as precursor at 90 ^{0}C. They were characterized the prepared silver nanoparticles by UV-Visible Spectroscopy Vis and ScanningTunneling Microscope (STM). They studied the absorption of the silver nanoparticles by UV-Vis was observed at 420 nm. They were reported as the morphology of the silver nanoparticle was spherical with the particle size 5-10 nm characterized by STM. [117]

S. Ghazali *et al.*(2013) were used silver nitrate and trisodium citrate to synthesis the silver nanoparticles by chemical reduction method at temperature 60-125 ^{0}C.They were used a reducing agent which was Ascorbic acid.They were characterized the prepared silver nanoparticles by XRD, TEM and SEM. They were reported as the average particle size of the prepared silver nanoparticle was 50 nm with the quasi-spherical morphology. They were also reported as the electric conductivity of the silver nanoparticles was dependent on the epoxy matrix.[118]

In the chemical reduction method the size of the silver nanoparticles were dependent on the amount of surfactants present in the solution and the epoxy matrix.

4.5. Hydrothermal Method

Y. F. LI *et al.*(2011) were used silver nitrate with Arabic Gum (AG) to synthesize the silver nanoparticles by hydrothermal method at different temperatures in stainless steel autoclave. They were characterized the prepared nanoparticle by XRD, SEM, TEM, UV-Vis and FT-IR. They were reported as the blue shift of the prepared nanoparticles increases with the increase in the temperature applied during preparation which is studied by the UV-Vis spectroscopy. As intensity of absorption increases first and then decreases with the increase in the temperature. They were concluded as the particle size of the silver nanoparticle decreases with the increase in temperature. They were reported as the morphology of the silver nanoparticles was face-centered cubic (FCC). [119]

Hydrothermal method is temperature dependent method so in case of silver nanoparticles the band shift of the absorption increases then decreases by the increase in the thermal energy applied to the solution. Hence particle size of the silver nanoparticles were totally dependent on the increase in the temperature.

4.6. Microemulsion Method

S. Hossain*et al.*(2012) were synthesized silver nanoparticles by using microemulsion method from silver nitrate (AgNO3) and sodium borohydride (NaBH4) with Sodium dodecyl sulfate (SDS) with different compositions. They were characterized the prepared nanoparticles by UV-Vis, SEM. They were reported as the size of the prepared nanoparticles was directly controlled by the Water tosurfactant molar ratio. The grain size of the silver particles increases with the increase in the Water to surfactant molar ratio with the spherical morphology. The silver nanoparticles are good Antibacterial particles. [120]

In microemulsion method presence of the water concentration and the amount of surfactant are very important to control the morphology and the size of the particles. In the case of silver nanoparticles the grain size of the particles prepared by microemulsion method increases with the increase in the water to surfactant molar ratio.

4.7. Green Synthesis Method

E. R.Leon *et al.*(2013) were synthesized silver nanoparticles by using green synthesis method from the silver nitrate and roots of R. hymenosepalus by varying the reaction time and the concentration of the silver nitrate. They characterized the prepared samples by UV-Vis and TEM. They compared the results of the silver nanoparticles prepared at different reaction time and concentration of the silver nitrate. They were reported as the number of particles prepared during reaction increases with the increase in the concentration of the precursor (Silver Nitrate). The particle size of the prepared silver nanoparticles was 2-40 nm with the mixture of hexagonal and FCC morphology. [121]

Green synthesis is the biological method to prepare the silver nanoparticles in which the morphology and the structural properties of the silver nanoparticles were dependent on the time of the reaction and the reaction and the concentration of the precursor used for the reaction

5. Conclusion

Nanoparticles are used in a wide range of devices such as photonic, electronic, and spin-based devices. In this review paper overall study and comparison of different experimental techniques such as Hydrothermal, Solvothermal, Micro emulsion, Co-Precipitation, Sol-Gel and Green synthesis of nanoparticles by using different precursors. Selection of accurate experimental method to synthesize nanoparticles according to environmental conditions is very important. After a critical review of all synthesis methods used to prepare nanoparticles, it is concluded that high temperature and pressure is required for the synthesis of nanoparticles using solvothermal and hydrothermal method. Normal temperature and atmospheric pressure is require for the synthesis of nanoparticles by using Co-Precipitation and Sol-Gel method. We can synthesis nanoparticles of good morphology by using Co-Precipitation Method so the preferable method of synthesis of nanoparticles is Co-Precipitation method. By changing the precursor, solvent or Temperature conditions we can prepare iron and Cobalt oxide nanoparticles of different size and morphology. As Co-Precipitation Method is more suitable than Sol-Gel method because Sol-Gel is preferable for Nitrates only.

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