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A Review on Green Synthesis of Zinc Oxide Nanoparticles from Plant Extract

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Abstract – Nanotechnology is production and exploration of materials at nano scale. Generally Nano particles having the size range of 100 nm and are clusters of atoms, Nano scale dimensions provides Nano particles a large surface area to volume ratio. Nanotechnology is expected to play vital role in various disciplines and is becoming the most innovative scientific field. Nanotechnology plays vital role in the production food, agriculture, electronics, medicine, automotive, information and communication technologies, energy, textile, construction. Zinc oxide Nano particle had been studied and it have large wide band gap and high exaction binding energy, and its application in the field of medicine and scientific research. Nano particle can be classified according to their dimensionality, morphology. In this context, Nano particle production via biological route is more reliable, environmental-friendly Microbes or plants are also utilized while production of Nano particle they produced good surface and reduction property.

Index Terms—Nano Particles Article, Zinc oxide, Plant Extract.

I. INTRODUCTION

Nano particle is used to define the particles with small size less than 100 nm, Nano particle have at least one dimension. Nano particle of ideal size can be utilized to form an structure in nanotechnology. Nano particles can be described as Nano materials, Nano scale particles, Nano sized Particles, nanosized material, Nano-object, and Nano structured materials. Now day's production of Nano particle from the Ag, Au, Pd and Pt research study is going on the production of Nano particles. Nano materials are particles having Nano scale dimensions and Nano particles having property of thermal conductivity, chemical steadiness and large surface to volume ratio. The large fractions of surface atoms and surface energy may influence thermal stability and catalytic properties of Nano materials. Nano particles have high surface area to volume ratio, Nano particles exhibit lower melting point and have high mechanical strength due to crystal Structure of Nano particle. Nano particles have an good antimicrobial properties so they called as antibiotics. Nano particles have an wide application in the field of chemistry, health industry, food processing nanotechnology, space, cosmetic industry in which lots of green application are utilized for the production of Nano particles from green and environmental friendly materials are used for the synthesis of Nano particles [1].

II. NANO PARTICLE SYNTHESIS METHODS

The synthesis of Nano particles takes place by various methods and they are Bottom up and top down approach. Top down approaches involve the various physical methods for the production of Nano particle for large macroscopic production of particles. In physical methods laser ablation, inert gas, pulse wire discharge, mechanic milling, etc methods. It involves synthesizing large-scale patterns initially and then reducing it to Nano scale level through plastic deformation. Physical methods of Nano particles cannot utilized for large scale production of Nano particles because
it is a costly and slow process. The role of top-down approach method for the synthesis of nano particles by Interferometric Lithographic technique decide the role of top-down approach for the synthesis of Nano particles. This technique involves the synthesis of Nano particles from already miniaturized atomic components by self assembly. For the production of Nano particle the physical and chemical techniques in this chemical, thermodynamically, and kinetic equilibrium approach [2]. Different types of methods for the production of Nano particles For the production of Nano particles there are different methods they are classified as physical methods, chemical methods, green methods. In physical methods the molecular attraction forces are the part of physical forces they attracts to each other and form larger molecule which is thermally and kinetically stable Nano particles with well defined structure. Chemical Vapour Deposition method is an physical methods example for the production of Nano particle. It includes vapour deposition, Nano crystalline films, single crystalline film are formed [3]. The Nano particle synthesis is mediated by physical, chemical. Green synthesis methods. The physical methods required costly equipment for the production of Nano particles with high pressure and temperature management through the machinery which take large space and its not an cost effective for the production of Nano particles. Nano particles production by the chemical methods includes lots process for the purification and temperature management during the reaction carried out. In chemical methods lots of chemical reaction carried out for the production of Nano particles for that use of toxic chemicals which can prove dangerous and hazardous to the environment and health of person who is performing reaction under his observation. When toxic and hazardous chemicals are used in physical and chemical methods. That might be present in the Nano particles it may not give good result due toxic impurity some impurity is present and its harmful to the health industry, electronic industry. Therefore we should utilize the environmental it is a costly and slow process. The role of top-down approach method for the synthesis of nano particles by Interferometric Lithographic technique decide the role of

top-down approach for the synthesis of Nano particles. This technique involves the synthesis of Nano particles from already miniaturized atomic components by self assembly. For the production of Nano particle the physical and chemical techniques in this chemical, thermodynamical, and kinetic equilibrium approach [2].

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III. ECO FRIENDLY APPROACH FOR THE PREPARATION OF NANO PARTICLE

Nano particles by physical and chemical methods are not cost effective for the production of Nano particles as well as they are toxic in nature purification cannot give 100 percent purity so they are harmful. Eco friendly approach means they are manufactured by using biological components because they avails feasible alternative. Physical process for the production of Nano particle is slow and difficult the life of Nano particle is very short and unstable. Chemical process required the multiple purification due to impurity, toxic chemicals are harmful to the environment and explosive chemical are used in this process. High technique of instruments are required for the synthesis of Nano particle high consumption of chemicals. Harmful effects of byproduct formed during the production they are harmful to environment. After going through the disadvantages alternative methods should be evolved for the production of Nano particle with help of environmental constituent. The eco friendly methods prevents atmosphere from the pollution. Then biological components can be attempted to utilize for the production of Nano particle. They are proved to assets for the production of Nano particle in the field of nanotechnology. Biological components consist of bacteria, fungi, actinomycete, algae, plants, were utilized for the production of the Nano particle and they have capacity to produced Nano particles successfully. Nano particle have longer shelf life and stability as natural capping takes place. It is one step process for the synthesis of nano particles. The natural capping of nanoparticles available and it has great importance [5].

Biosynthesis of ZnO NPs The bio synthesis includes the biological and green synthesis method which is the option for physical and chemical methods it is environmentally benefits and have natural capping agent which restrict the agglomeration of nano particles this type of synthesis don't need an artificial capping agent. The biosynthesis of ZnO nano particle is an bottom up approach that mostly involves reduction and oxidation reaction. The synthesis reaction takes in one step, and so the molecule who have dual characteristics such as reducing and capping agent are preferred. Environmental sources are considered as resources for biosynthesis of nano particles and they are plant extract, bacteria, fungi are foremost sources [6]. The NPs are immediately coated with a protein molecule making a natural cap and so preventing formation of aggregates. Capping for nano particles by biological components increase the longer shelf life and stability [7].

Plants for ZnO NPs synthesis Plants are considered as green nano factories in the genesis of NPs. The green synthesis of ZnO NPs using plants and their application in allied field has become the favourite pursuit of all scientist including biologist, chemist and engineers. ZnO nano particles synthesis by utilizing plants extract is advantage is that there availability is so easy, safe, and nontoxic, have plenty of reduction agents that reduced metal ions. The plant extract minimize the time, and cost, waste etc. and execution of sustainable procedures for the development of ecofriendly and simple methods for production. Green nanotechnology is also known as photobilogical approach which utilizes the plant and there extract and capping agents for the synthesis of ZnO NPs [8]. The plants content are utilized for the production of Nano particle and they are seed, root, leaf, steam, bark, fruit, pulp are main sources of green nano particles. Plants contain photochemical are most important for the production of nano particles. They contain glucose, starch etc. the whole plant extract is utilized for the synthesis of nano particles. The aqueous extract is considered more environmental friendly than organic chemical compounds. They have stabilizing agents are major constituent in the formation. All plants consist of aroma latex, flavonoids, phenols, alcohols and proteins to reduce the metal ion. Flavonoids play vital role for the reduction for nanoparticles synthesis. The several factors play major role for the synthesis of nano particles and they are plant source, organic compound in the crude extract, alkaloids, polyphone, and proteins in the plant extract. The negatively charged functional group may possibly responsible for the reduction of metal ions and efficient stabilization of nano particles with capping agents present naturally [9].

ZnO nano particles synthesis by Bacteria and Actinomycetes

ZnO nanoparticles synthesis carried out by Actinomycetes and bacteria. Bacteria can be used due to gene modification it is utilized for reduction low cost production of ZnO nano particles using reproducible bacteria, Aeromona hydrophilic as a eco friendly reduction and capping agent [30] novel technique of Bacteria mediated ZnO NPs were synthesized and proved to be good antimicrobial materials. Syntheses of nano materials are carried out at room temperature. Nano particle by Actinomycetes uses an Streptomyces isolated from the rhizosphere soil in India, when metal ion get in contact enzyme reduced the metal ion.

Table 1: List of plant species, their part used and bimolecular obtained from plant extract responsible for the synthesis of metal nano particles

Sr. No.	Plant Species	Part	Size and Shape	Active Component/Functional Group	References
1	CalotropisGigantea	leaf	30-35 nm ; spherical	Calotoxin, Carboxylate, pleurone, calotropagenin	Vidya C et al., [10]
2	Citrusaurantifolia	fruit	50-200 nm ; spherical	Pinene, Limonene, terpinene,terpinolene, citral	NurulAinSamat et al., [11]
3	AstragalusGummifer	bark	50 nm ; spherical	bassorin, polysaccharide,	Majid Darroudi et al., [12]
4	Hibiscus subdariffa	leaf	16-60 nm ; spherical	Aromatic Compounds, Phenolic Compounds, Flavonoids, saponins, tannins, alkloids, amines	NiranjanBala et al., [13]
5	Trifoliumpratense	flower	60-70 nm ; spherical	alkloids, aromatic compounds, flavonoids	RenataDobrucka et al., [14]
6	Corriandrumsativum	leaf	66 nm ; spherical	alkloids, aromatic compounds, flavonoids, carbohydrates, Glycosides, steroids, fixed oils, Saponins, Tannins, Protein, Flavonoids, Terpenoids	Gnanasangeetha D. et al., [15]
7	Pongamiapinnata	leaf	100 nm ; spherical	flavonoids, terpenoids, phenols, saponins, alkaloids, vitamins. P. Pinnata	S.Ambika et al., [16]
8	OcimumTenuiflorum	leaf	13.86 nm ; spherical	linalool, alkaloids, ursolic acid, glycosides, carvacrol, tannins, rosmarinic acid, aromatic compound	SagarRaut et al., [17]
9	IxoraCoccinea	leaf	145.1 nm ; spherical	hydroxyl, carbonyl groups	SnehalYedurkar et al., [18]
10	Polygala tenuifolia	root	33.03-73.48 nm ; spherical	xanthones, saponins, oligosaccharides,linarin, isorhamnetin, kaempferol, quercetin	P.C.Nagjyothi et al., [19]
11	Cassia fistula	leaf	5-15 nm ; hexagonal	epiafezelechin, epicatechin, procynidin B2, biflavonoids, triflavonoids, rhein, rheinglocoside	D.Suresh et al., [20]

12	Plectranthusamboinicus	leaf	20-50 nm ; spherical, hexagonal	butylanisode, caryophyllene, quercetin, ursolic acid, triterpenic acids, pinene, thymol	S.Vijay kumar et al., [21]
13	Lagerstroemia Speciosa	leaf	40 nm ; hexagonal	alkaloids, glycosides, flavonoids, tannins, terpenoids, phenols, saponins, alkaloids and vitamins	V.SaiSaraswathi et al., [22]
14	Camellia Sinensis	leaves	16 nm ; hexagonal	polyphenols, flavonoids, glycosides, chlorogenic acid, gallic acid, coumarylquinic acid, theogallin	S.R.Senthil kumar et al., [23]
15	Murrayakoenigii	leaf	12 nm ; spherical	terpenoids, flavonoids, alkaloids	K.Elumalai et al., [24]
16	Laurusnobilis	leaf	47.27 nm ; hexagonal	pinene, myrcene, limonene, linalool, methyl chavicol, neral, terpineol, geranyl acetate, eugenol and chavicol	Sekar Vijaya kumar, et al., [25]
17	Ficus Hispida L	leaf	50 nm ; rod shape	carbohydrates, alkaloids, sterols, amino acids, flavonoid, coumarin, proteins, saponins	A.V.Ramesh, et al.,[26]
18	Azardirachtaindica	leaf	9.6-25.5 nm ; spherical	flavones, ketones, organic acid, aldehyde, amides	TamannaBhuyan, et al., [27]
19	Agathosmabetulina	leaf	15.8 nm ; spherical	(iso)menthone, diosphenol, pulegone, cis and trans-8-mercapto-p-menthane-3-ones	F.T. Thema et al., [28]
20	Hibiscus rosa-sinensis	leaf	30-35 nm ; spherical	cyclopropanoids, methyl sterculate, cyanidin, 3-sophoroside	R.Sharmila Devi et al., [29]

IV. CONCLUSION

Zinc oxide Nano particle has properties and they are physical, chemical properties its applicable to manufacturing methods. To increase the production of ZnO nanoparticles we have to follow the environmental methods which are non hazardous and pollution free methods for green nanotechnology. In this paper work mostly exhibit natural extract from plants.

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