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A short Review on Silver Nano particle Extraction Process by an Green Synthesis Approaches

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Abstract : The nano technology plays a major role in the different applications in the huge range of fields. Green synthesis is the best method for synthesizing and reduce the destructive effects of materials for nanomaterials both metal and non metal oxides, hybrid and bioinspired materials. Silver nano particle has been apparent as a safe inorganic antibacterial and antifungal agent which is also harmless and safe substance for present applications. Silver nano particles are manufactured by three different techniques such as physical, chemical and biological technique. In the present review paper discuss the different methods of silver nanoparticle extraction process.

IndexTerms **– Silver nanoparticle, Green synthesis, Physical, chemical and biological process.**

I. INTRODUCTION

A Nanotechnology (10^{-9}), this sector was combination of multiple scientific sub-branches such as physics, chemistry, engineering and biology [1]. Many interesting nano-devices are useful in biomedical field especially for the improved cancer detection, diagnosis and treatment. Nanotechnology act an important filed in research, manufacture and modifies of particle sizes from 1nm to 100nm [2]. The Richard Feynman, introduced nanoparticle in nineth century with different sectors like IT, biology, electronics etc., The micro nanoparticles has unique properties are the nanoparticles, the large surface to volume ratio it dissolves in chemicals, mechanical, chemical and electrical properties [3]. The nanoparticles are smaller in size; it can handle easily, low cost, eco-friendly, and huge production. The nanoparticles are highly usable in different applications such as medical companies, electronic, textile and chemical industries [4-6]. These in their pure or in the form of mixtures help in the formation of sensors, in batteries, in diagnostic kits, in water treatment, also helpful in curing deadly diseases such as cancer. Among all the nano materials silver material has special characteristics than other, it can be synthesized in different ways are chemical, physical and biological methods is elaborated.

II. SYNTHESIS OF SILVER NANO PARTICLES

Synthesis of Silver nanoparticles by microbes is due to their defense mechanism (resistance mechanism), and this is how the nanoparticles produced are useful to us. The resistance caused by the bacterial cell for silver ions in the environment is responsible for its nanoparticles synthesis [2]. The silver ions in nature are highly toxic for the bacterial cells. So their cellular machinery helps in the conversion of reactive silver ions into stable silver atoms. Also, temperature and pH plays an important role in their production. At room temperature, the size of nanoparticles is 50 nm; at higher temperature, i.e. at 60°C, the size of nanoparticles reduces to 15 nm [4,5]. This indicates that with the increase in temperature size decreases. Under alkaline conditions, nanoparticles synthesis by the microbe is more as compared to the acidic conditions. But, after pH 10 cell deaths occur.

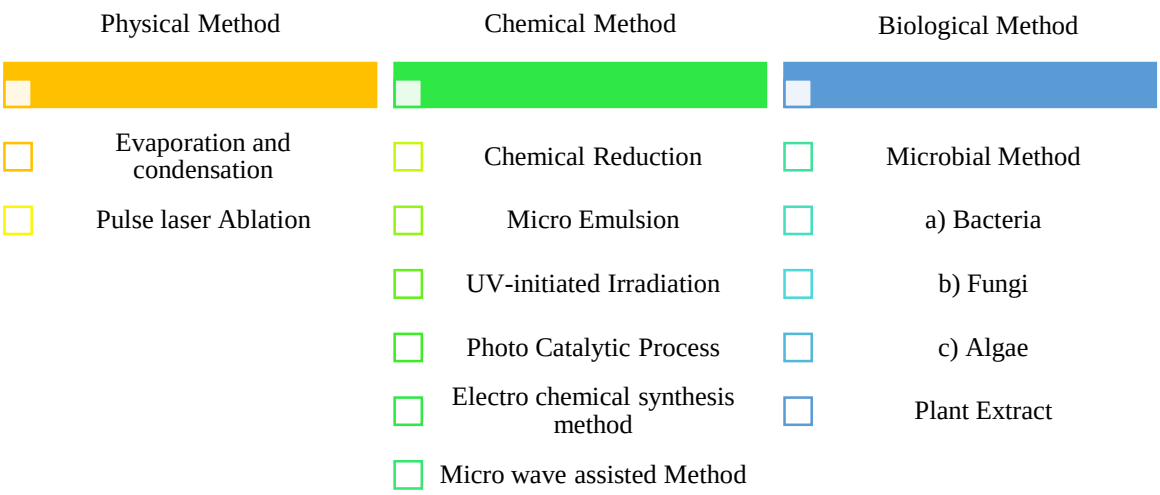
2.1 Physical Process

In the Physical extraction process broadly split into two categories such as a) evaporation and condensation, b) Laser ablation technique shown below Table 1.

2.1.1. Evaporation and condensation method

In this method, bulk silver is heated at high temperature to produce silver vapours which are condensed as nanoparticles by flowing in inert gas. This method is limited because of large space occupied by the tube furnace, great amount of energy consumption by the furnace while raising the environmental temperature around the source material and a lot of time required achieving thermal stability [10].

Table 1. Different Methods of Silver Nanoparticle Synthesis are drawn



Jung H.L et al (2006), conducted a experimental investigation on silver, aluminum nano-material evaporation process by using medium tiny size ceramic heater device. The author did huge number experiments on nanomaterial condensation or extraction process using tube furnance technique. In the furnace process many drawbacks are there such as huge area was required, high temperature was required to enhance the surrounding temperature to rise the surrounding temperature around the nanomaterial. In that present technique (small evaporator) also required less time and same as huge surrounding temperature, which used heater can reach maximum surround temperature of 1500^0C. The Silver nanomaterial was used as a main source material and their inter properties, molecule size, morphology, different composition; crystallinity was tested in XRD and TEM analysis. It was concluded that geometric average diameter, deviations, number of particles in the silver nano particles was enhanced by increasing the heater surface temperature. The particle generation was constant; due to the heater temperature does not highly impact on the particle with a time period. By absorbing the both the SEM and XRD process it was clear that aluminum was spherical in size, silver was combined form and silver despite the fact that air was used as mediator gas [7].

3.1.2. Pulse Laser Ablation Technique

In this technique purest form of silver particles are extracted without chemical usage. The purity of the extracted particles are relies on the wavelength of the laser impact on the particle, time period of the laser pulses and ablation.

3.2. Chemical Extraction Process

3.2.1 Chemical Process

These processes are highly used to extract the silver particle from the silver nano materials. Two different particles are organic and inorganic particles are rapid used to maintain the quality of the silver particles in the silver nonmaterials. Some of mostly used surfactants are Poly ethylene glycol, copolymers, N-dimethylformamide (DMF), sodium borohydride ($NaBH_4$), sodium citrate, hydrogen particles etc are used to minimizing the agents on the silver particle [8].

3.2.2 Micro emulsion Technique

It is used to development of similar nanoparticles, it can be synthesized in two ways such as organic and inorganic method. The metal precursor, reducing agent was used to partial separation of silver nanoparticles. The partial separation particle was coated with stabilizer to maintain a constant silver nanoparticle.

3.2.3 UV photo reducton process

This method was easy and perfectly comfortable process to design and manufacture the silver nanoparticle, along with different types of stabilizer agents was used to manufacture the constant silver nanoparticle.

3.2.4 Photocatalytic process

Photocatalytic was another technique to design and production of different nanoparticle. This process was safe clean, easily method, and versatile technique. In the photocatalytic process few reactants was used such as styrene sulfonate, allylamine HCL, poly electrolyte capsules as micro reactors used to manufacture of silver nanoparticle [11].

3.2.5 Electrochemical Synthetic Process

Electro chemical synthesis was commonly used to extraction of silver nanoparticles. In this process includes chemical precipitation, sol-gel method, solution evaporation process, photo chemical reduction, electro chemical, templating and sonochemical process and so on. In the electro chemical process Ag+ ions from water soluble silver salt are required, and $AgNO_3$ id normally used, but pure silver metal is used as a sacrified anode [9]. In the chemical approach, chemical reduction, electro chemistry and photochemical reduction are the most common methods for synthesis of nano particles. The chemical method involves the use of toxic chemicals which can be hazardous to the person and the environment. For this process, it would be

pertinent to introduce insoluble precursors rather than soluble silver salts. Unlike typical soluble silver salts are ($AgNO_3$) commonly used to preparation of silver nanoparticles.

3.3 Biological Techniques

Green synthesis of nanoparticle with biological resources containing plant extract and microorganisms can be a suitable replace for the physical and chemical routes in synthesis of nanoparticles. Few advantages of biological synthesis when compare with both physical and chemical conversion process are A) Eco-friendly and clean process because of there is no use on toxic chemicals. B) The micro enzyme presence in the active biological component which helps to minimizing the capping agent causes reduce the production cost. C) Small nanoparticles can be produced even during mass-scale production. D). Huge energy, high pressure is not required to manufacture which causes significantly energy saving. Because of this causes, they are highly used in commercial parts due to the herbal nature, enzymatic reactions, and photochemical characteristics. Different investigations have been done on the synthesis of nanoparticles from a biological system. Biological nanoparticles are used in the field of pharmaceuticals, cosmetics, biomedical and environmental use. Mother nature has contributed to the development of a freshly unexplored area of biosynthesis of nanomaterials.

3.3.1 Microbial synthesis Process

3.3.1.1. Bacteria

The silver nanoparticles are developed using fungus (Aspergillus flavus) in the process of microbial reduction or evaporation process [12]. Silver and Gold can synthesize nanoparticles due to their distinct properties but silver is normally used rather than gold. One of the most accepted mechanisms for the synthesis of silver nanoparticles using bacteria is Nitrate reductase. It is a cycle in which the enzyme converts nitrate into nitrite with the presence of NADPH (nicotinamide adenine dinucleotide phosphate) causing the silver ion to be reduced to silver. The fungus, Aspergillums flavours when challenged with silver nitrate solution mixed with silver nanoparticles on the top layer of its cell wall in 4-5 days. The Ultraviolent spectroscopy was used to evaluate or judge the characteristics of the silver nanoparticles. The silver nanoparticle appears the 420-440mm of peak point on the UV-spectrum with respect to the Plasmon resonance. The protein and stabilizing particles was covered around the silver particles, it was confirmed by FTIR spectroscopy [13].

3.3.1.2 Fungi

Fungi have excellent potential for the production of many compounds that can be used in different applications. Around 6,400 bioactive substances are known to be produced by microscopic filamentous fungi (ascomycetes and imperfect fungi) and other fungal species These organisms are widely used as reducing and stabilizing agents, due to their heavy metal tolerance and capacity to internalize and bioaccumulate metals. Furthermore, fungi can be easily cultivated on a large scale (“nanofactories”) and can produce nanoparticles with controlled size and morphology. Fungi have advantages over other microorganisms, in that they produce large quantities of proteins and enzymes, some of which can be used for the fast and sustainable synthesis of nanoparticles [14].

3.3.1.3 Algae

The antifungal activity of green synthesized silver nanoparticles against various fungal strains was assayed by Agar well diffusion method. The fungicidal effect of the silver nanoparticles could be assessed by the formation of zone around the well. 100mL of sterilized Sabouraud Dextrose Agar medium was poured into three sterilized Petri dishes. The fungal strains were grown in Rose Bengal agar and their spores were mixed into the 10mL sterile distilled water and swapped on the agar [15].

3.3.2 Plant Extraction Process

By utilization of plants fro nanomaterials extraction process can gives wide range of advantages other than chemical synthesis process. Due to it does not require cell cultures and intercorporate additions for the mass production of silver nanoparticles [16]. In the plant extraction process the plants metabolites such as phenolic acid, flavonoids, alkaloids, and terpenoids, which are mainly responsible for the reduction of ionic metal into bulk metallic nanoparticles. Primary and secondary metabolites are constantly involved in redox reactions required to synthesize eco-friendly nanoparticles. The green synthesis of AgNPs is highly useful for different medical application with prescribed permission [17]. The shape, size, and size distribution of AgNPs can be controlled by modifying synthesis conditions, such as with specialists, stabilizers, or distinct engineering techniques. The productive translation of silver into nanotechnology applications requires safe, creative, and eco-conscious strategies and greater control over their bio-distribution and pharmacokinetics in clinical applications.

III. CONCLUSIONS

The silver nanoparticle are synthesized using different techniques are physical, chemical and biological methods and its sub branch wide. By comparing all the technique it’s have its own merits and demerits few are discussed. In the biological process, the silver nanoparticle extraction process is safe, eco-friendly, simple rapid, less cost and less energy consumption. In the chemical process, is the best one when comparing all the process but it has few drawbacks are it is toxic and against to the nature and human beings also.

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