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Preparation method of Silver Nano particles

Abstract

The last few years have perceived the most important development in the field of metals nanoparticle. As they have emerged a highly demanding chemical, physical and biological properties, thereby they employed in the various chemical and pharmaceutical industry. Silver as a metal with exceptional properties, its nanoparticles have devoted significant efforts for their synthesis and utility evaluation. In this review, the most recent and important approaches for the synthesis of silver nanoparticles will be covered along with the use of Ag NPs in a various disciplines especially those that are related to human life such as medicine, drug delivery and water purification. Besides reviewing several different opinions about the risks resulting from the synthesis and use of this type of materials.

1. Introduction

Nanotechnology and nanoparticle manufacturing have entered into important and different application areas. Has become an important part of human life and developed to open wide gates areas and developed in the service of man and human development [1,2]. Nanoparticles, by definition, are structures that have one remoteness in the 1–100 nm area. Because of their common enforcement, the traditional nanotechnology manufacture is foresee to growing safely to $3 trillion by 2015[3, 4]. Ag (NP) were used widely in consumer products while Silver nanoparticles represent the elevated grade of commercialization [5]. There are extensive applications of Silver nanoparticles in medical, industrial, and other areas of life. These applications include the use of Silver nanoparticles to sterilize medical and household devices appliances. In addition of it was using in sterilization and treatment of water [6,7]. In addition to using it in biometric sensors for imaging that enhanced by the exceptional characteristics of plasmon-resonance optical scattering of nanoparticles [8-12].

2. Silver Nano particles preparations

2.1. The Chemical Preparation Methods

Chemical methods refer to the most type of Ag NPs preparation, which are widely common to most of the chemists as a polyol method by which the nanoparticles were synthesized by chemical reduction through dispersions in water or organic solvents followed by the addition of reducing agent [13]. More specifically, AgNPs particles were chemically prepared by dissolving AgNO3 in ethylene glycol with the addition of PVP polymer (poly vinylpyrrolidone) [14]. Ethylene glycol act as a solvent and reducing agent. The molar ratio between silver nitrate and the reducing agent as well as the use of precursor injectors will control the shape and size of Ag nanoparticles and this is an effective monodispersed process [13]. Silver nanoparticles should be protected against agglomeration because of the high purity of produced AgNps [15]. However, the aforementioned has a potential drawback on the environment besides it was expensive [16]. The chemical approach for the synthesis of silver nanoparticles might be detrimental according to the toxicity nature of the products in terms of the fine size of the formed particles [17].

2.2. Thermal way

The template The preparation of Nanoparticles by using the Microwave way (thermal process) is referred to as a hopeful procedure of Ag-NPs synthesis. This method is leading more than using classical oil bath because the yielding Ag NPs are smaller, narrower and giving very good crystal of nano-particles. The produced Nanoparticles will not agglomeration by using this microwave method because the time reaction is shorter, consumption energy was reduced besides getting good product yield [18]. Moreover, using a microwave in the preparation of AgNPs reduces the chemical wastes which might be produced by an oil bath [19]. Sodium carboxymethyl cellulose can be used to prepare AgNPs, where it was used as a stabilizing and reducing agent in this process. The size of the synthesized particles will depend on AgNO3 and sodium carboxymethyl cellulose concentrations. Regularity and stability of the thermal reaction products using microwave last for 2 months at room temperature and there are no visible changes [20]. Microwaves application together with polyol process were employed in the synthesis of silver nanospheroids where poly N-vinylpyrrolidone and ethylene glycol were used as stabilizing and reducing components, respectively [21]. Different kinds of nanoparticles can be prepared by using Microwave way. That by using sodium citrate with metal nitrate like AgNO3 and then divide the solution for five groups. These five groups were heated for five different times. It has been observed that the Ag nanoparticles have a negatively charged surface when they were heated for a long time. While, they have a positively charged surface when they were heated for a short time [22, 23].

2.3 Morphologies way

The second way is morphologies way. This way can be highly depending on the deposited temperature during the creation of Ag NPs. Size of Silver nano particles which were prepared by

this way about 40-80nm. For this method, Ascorbic acid represents the main factor by which play the main role at preparation method [24].

. 2.4 Polyol way

By another method, Silver Nano particles were prepared by using the polyol way. That with assistance of supercritical Carbon dioxide (SCCOS), with AgNO3 which was the last used as the main material of getting Silver nanoparticles [25]. The stabilizer compound for this method was polyvinyl pyrrolidone, used as promoter of nucleation of nanoparticles beside of its main usage as protection agent for the Silver nanoparticles size from aggregation [26]. Properties of Ag NPs were prepared by Supercritical Carbon dioxide, were smaller and more dispersion with the comparison to usual heating method at the same circumstances [27].

2.5 Photochemical method

By using various types of radiation methods, Silver nano particles can be prepared successfully. A radiation laser is, a type of many types for the previous method, using watery solution of Silver salt with the surfactant to get good well silver nanoparticles with a good size and distribution. This method was not need to reduction factor [28].

3. Photochemical Synthesis

There are two different methods at photochemical techniques to prepare Silver nanoparticles:

First one is: Photochemical method which is referring to reducing of precursor or ions of Silver to produce AgNPs. This method happen in activated medium like free radical and the last prepare by using photochemical process. By UV radiation and watery solution, water solution contain Triton x-100 as stabilizing factor, Silver nanoparticles were gained. The stability of monodispersing beside uniform size for the synthesis of silver nanoparticles at the photoreaction was provided by good choosing of surfactant [28].

The second process, Silver nanoparticles were created in watery alkali solution when AgNO3 and carboxymethylated chitosan (CMCTS) were dissolved in it. This mixture was treated by UV radiation that beside of CMCTS acting as reducing agent as well as of its benefits of increasing the AGNPs preparation stability. AgNPs, were gained from this process, had diameter of less than 10nm. Stability forming of silver nanoparticles was not less than 6 months if them were prepared in alkali/CMCTS medium [29]. A research was done by Ballan and his colleagues, AgNPs particles were prepared by applying direct photoreduction on Silver nitrate solution. The photo radiation was supplied from laser source. This source has the ability to emit the radiation of the range from the near infrared region. The photoactive agents that were used at this research was being dyes [30]. Photo chemical preparation of nanoparticles generally and Silver nanoparticles especially, showed high quality according to:

1- The purity of prepared nanoparticles: High purity and easy method to prepare silver nanoparticles.

2- These nanoparticles were prepared by using UV light radiation and with the occurring of reducing factor.

3- Different types of medium reaction can be used at this process like polymer, glass, micelles and emulsion [31].

At this way a good shape, size and distribution of nanoparticles were gained without using reducing compounds or stabilizer. Also, the heat that ivolve at this method have faster rate of heating with the comparison to classical or traditional heating[25].

4. Electrochemical method

The word As it was known, electrolysis [32] were used in the past to reduce metal ions. Now,

it was used to prepare nanoparticles mostly Silver nanoparticles. So it was recorded as a type of silver nanoparticles preparation methods. Size can be gotten by this way approximately to 11nm and particles grown at room temperature. Preparation of nanoparticles relys on the presence of AgNO3 in polyol solution which was reduced by using electrochemical way. All the process achieved by presence of PVP and KNO3[33].

5. Spray pyrolysis method

Spray pyrolysis is another method of Ag NPs preparation by which the size of prepared nanoparticles about 100nm as average. A solution of Silver nitrate, was used to fabricate as Silver nanoparticles by using spray pyrolysis method [34]. At ○○Ag nanoparticles preparation study, Kalyana and et al were prepared by using the flash pyrolysis method. flash pyrolysis designing is shown in Fig.1. Aqueous solution of Ag nitrate was prepared and injected in burette. The solution was follow into atomizer from this burette and the spray method was achieved by atomizer. The atomized spray injected throw the reaction chamber at temperature more than 650°C at tube furnace. A vacuum pump was used for ventilation of water vapor and other gases. The axial profile of temperature within the reaction chamber is recorded by thermocouples placed close to the surface of atomizer and the sample holder.

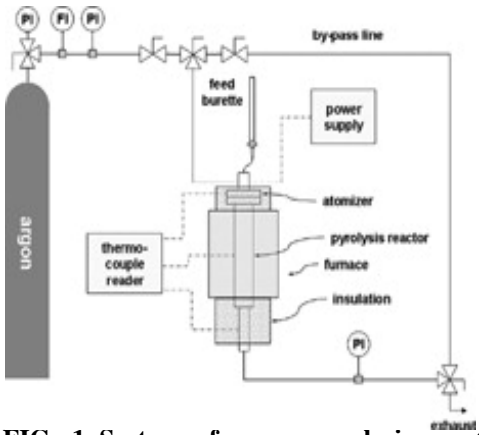

FIG. 1 System of spray pyrolysis reactor and supportive equipment [35].

At Fig. 2, an ultrasonic generator was attached to the spray atomizer by way make the atomizer emptying tube swayed in a certain frequency to Control the size of the drops that are sprayed. The atomizer was inserted into a flanged pipe by welding a flange on the atomizer unit, to provide the pyrolysis reactor chamber..

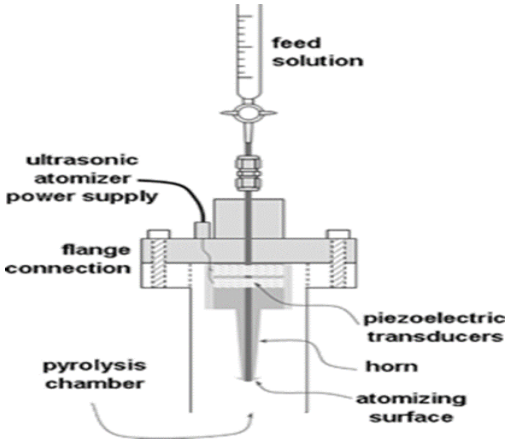

FIG. 2 System of Spray pyrolysis reactor system, showing feeding unit details and ultrasonic atomizer location in pyrolysis chamber [35].

Samples of particles were designed to be fit with the normal distribution, which lead to characterized by using size of mean particles and standard deviation .The calculating of nanoparticles size were achieved manually and then characterized from the gained images from scanning electron microscopy (SEM) or the transmission electron microscopy(TEM) with a JEOL 200CX using a Hitachi S-3200N. The substrates were a Formvar-glazy 200-mesh nickel lattices. The SEM was used to image sample particles of greater than 100nm while the TEM technique was used to image the smaller particles, which were less than 100 nm. At this, the researcher studied the efficiency of this reactor by studying the influence of feeding samples concentrations beside effect of atomizer

power on prepared AgNPs properties. The concentration of samples were studied via different types of amounts, from 10-1kmole/m3 to 10-7kmole/m3, to obtain the influenced concentration of AgNPs concentration. Aerosol size is proportional to the inverse of the ultrasonic frequency applied to the atomizer (0.79 power as mentioned previously). A power range was between 4 to 11 W or a frequency of 50 to 100 kHz [35].

6. Physical method

Physical methods, to prepare Nanoparticles, by don`t emission a toxicity compounds if it is compared to chemical method as well as it was easy and fast although it is from the old classical methods. Physical way branched to physical vapor condensation (PVC) method and Arc-discharge method[25,36].

6.1 Physical vapor condensation (PVC) method

Nanoparticles prepared by used target materials. Target compound was vaporized by heat source and after vaporized, it was condensed falsely. These steps is repeated frequently to vapor the target and then fabricated as nanoparticles. There is tow ways for vaporization process, first one is physical method itself and the other one is chemical method [37].

6.2 Arc-discharge method

Positioning This method was studied in a new technique to synthesis AgNPs as watery nano suspension which was achieved without using stabilizer or surfactants material that was by using arc-discharge way(the second method of physical method. Silver compound as wires(with 1mm diameter) were used as two electrodes put in deionized water. A pulse voltage(70-100V) was supplied by the DC arc-discharge system to ionize the watery media between the two the silver electrodes. This voltage continued for 2-3msec. Then a voltage of a pulse 20-40-V stays for 10 sec. The two Ag wires electrodes were steaming and condensing in the water through the arc-discharge process. The transparent solution converts to a characteristic pale yellow color and then a silver suspension is created[25].

7. Biological Methods

Recently, Scientist discovered that plants and microorganism can be as a manufacture of metal nanoparticles [38, 39]. Because of this ability, they take advantage of the microorganisms' ability to prepare nanoparticles and use it as possible factories of the same purpose. Some types of metal that microorganism can synthesis it, are gold, Silver, Zirconium and Ni/Ti. [40,41].Prepared Nanoparticles by using microorganism can be classified according to environmental friendly [42]. The cause that push scientists to using bacteria or fungi to prepare nanoparticles is the well and good control on distribution size of prepared nanoparticles [43] By using a base of Lennox L agar (LB) or bacteria, which contain 50mmole of AgNO3, Silver nanoparticles of 200 nm were prepared at 30 C and for two days at dark [44]. By reducing aqueous Silver ions with biomass of B. licheniformis, were used as a preparation method for Ag NPs. Diagnosis of Ag Nps conformation was characterized by changing with the color (white-yellow) to brown [45-48].

The biological process is the very good way of NPs preparation because it is using friendly technques in the AgNPs preparation. AgNPs were prepared out of the cell wall by using the fungi type which are called (Geotricum sp). The simple effective and eco-friendly process was used to synthesize Ag Nano particles with size of 30-50nm.

The cause of using this method return to circumstances of NPs preparation. that is beside of the absent of harmful reducing agents, the low cost, environment friendly good high percent

amount yield. Also, AgNPs extract from the living cells by this method by supplementary handling to dismiss AgNPs. These particles were prepared with a very good stability and a very good high production that beside of the anti-(bacterial, fungal, cancer and viral). All these causes make the biological method to be the preferred method using by the researchers and scientists to prepare NPs[49].

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