Preparing nano silver particles (Ag NPs) by laser and studying the possibility of diagnosing cancer

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Abstract. This research aims to prepare nanosilver (AgNPs) solution by using an Nd: YAG laser and implement it in diagnosing tumors in different vitro-tissues. Various properties of nano and coated particles were studied as well as the properties of used Nd: YAG laser. Then, the various tissues were studied by different microscopes before and after treatment. This research was carried out on two stages, the first stage included preparing the nanoparticles by exposing the pure silver target (99.98%) to laser Nd: YAG of (1000 mjoule and 6 Hz), where the light was centered on the silver target by exploitation the lens of focal length (ten cm). within the second stage, silver nanoparticles were used to diagnose the infected tissues by using a laser. At first, the nano silver solution was injected into the infected tissues then exposing them to continuous laser diode of (410nm) and power of (500 m watt) and take an image by transmission microscope and reflection microscopy of the tissues before and after treatment. The optical and structural properties of nano silver solution were studied by using FTIR, XRD,(UV-VIS spectrophotometer), optical, AFM and SEM microscopes. Images of transmission and reflection microscopes show a noticeable change in tissue morphology. Where most of the tissue spaces were filled with nano solution and an outstanding glowing appeared after injection which good evidence for the possibility of using this solution in diagnosing the infected parts of the tissue.

Keywords. Cancer diagnoses, laser application in medicine, nano silver particles (Ag NPs).

1. Introduction
The difficulty of treating cancer is due to the high toxicity and non-selectivity of the drugs. In other words, they often kill the cancer cells and their healthy ones, so we notice that the patient is suffering from severe weakness and severe health disorders. The researchers focused on a mechanism to find drugs that go only to cells Cancerous cells are left intact [1]. Scientists and researchers have devised a modern method of utilizing advanced nanomaterial as well as a source of radiation (lasers). The small size of the advanced materials is very useful in oncology, especially in the field of imaging, where nanoparticles are characterized by size (sizeable light emission). When used, exceptional images of tumor sites can be obtained as the particles are shinier of organic dyes and only need a single light source for glow and excitement as an example of these tiny gold or silver minute materials. The nanostructure materials absorb the laser light that is deposited after it reaches the infected cell and turns it into a heat that dissolves the cancer cell.
It seems that the nanomaterial loses its non-interactive properties once it's dissolved into nano particles. It turns into an interactive and stimulating substance that interacts with the body of the cancerous cell, and it flashes within it whereas not interacting with the healthy cell [2].

The minutes of gold nano particles accumulate to make a bright layer on the body of the unhealthy cell to be treated at intervals minutes as they dissolve into intact cells, and don't have an effect on them in any method. The minutes of gold nano particles area unit familiar to acknowledge the cancer cells however don't see healthy cells. Because of the high mass, the gold nano particles will absorb a lot of bigger radiation than the soft tissue cells, creating them ideal for enhancing radiation doses in tumors [3]. gold particles work to prevent the cellular division of cancer cells, and is functioning to incorporate the cells of the division, that ends up in the deaths of those cells mechanically once the meeting of 2 nuclei, explaining that the treatment of those molecules far better than others, as a result of it's while not surgery, that avoids the patient Exposure to microbes that became widespread all told hospitals within the world.

He stressed that treatment of gold molecules might become ninetieth effective for carcinoma, particularly that one in each seven ladies infected, in addition as glandular carcinoma, that affects one in each vi men, declaring that it's difficult to treat tumors of the lung and brain due to the presence of bones that stop the penetration of light at intervals the cells, in addition as cancer of the liver, and so like therapy in those cases [4]. The cancer cell produces proteins over the traditional cell, and therefore the plan lies within the development of the gold items to accumulate on the cancer cells and enter them, and once they appear to the physician, and it works to focus light rays and every one the warmth generated by the disposal and destruction of cancer cells and so eliminate cancer within the body is 100%. That light used may be a light type of laser, sheds for ten minutes absorbed by gold particles. The warmth generated by the absorption of gold into light fully melts and dissolves the cell. The body then disposposes of those molecules at intervals fifteen hours, however it should stay within the liver or spleen for nearly a month [5]. New researches regarding the appliance of noble metals (nano particles, nano films, nanostructure, etc) to the medical field square measure one in every of the foremost exciting topics diagnostics, Drug Delivery, Photo-Thermal Ablation, Medical Imaging, Biomarkers, and Antimicrobial Coatings square measure samples of this new technology that the human will be reached with this acknowledge technology is that the most promising field for generating new applications in drugs. However, only nano product square measure presently in use for medical functions. A most outstanding Nano product is Nano silver [6].

Using a laser ablation method to synthesize silver nanoparticles in the liquid was successful to produce nano that able to inhibit glioblastoma cancer cell line proliferation as well as induction of apoptosis in these cancer cells when used in 60μg/ml concentration [7]. The UV-Vis absorption results at different periods which have been revealed the formation of surface Plasmon absorption for silver nanoparticles at 405 nm distinguished peaks. Spherical nano particles are shaped with varied sizes as characterized by TEM pictures [8].The absorbance of the solution at 400 nm obtained with 1064 nm laser light was under that at 400 nm obtained with 532 nm laser light within the entire pulses, and therefore the efficiency of the inter-pulse self-absorption ought to be lower for 1064 nm laser light than that for 532 nm laser light, that is inconsistent with ablation efficiencies observed. Preparation of Silver Nanoparticles and Study the Optical and Antibacterial Properties[9]. Q-switched Nd-YAG laser of wavelengths (1060, 532 and 322 nm) wit energy within the vary 200 to 1000 MJ and one Hertz repetition rate was used to synthesis silver nanoparticles using pulsed laser ablation in liquid.

The effect of laser wavelength has been studied for the basic, second and third harmonic generation. The experimental UV-Vis absorbance information were fitted with the theoretical Mie-Gans model. it's found that the smaller silver nanoparticle of 12 nm capable to terminate each staphylococcus and streptococcus} bacteria [10]. GNPs have synthesized by many techniques, PLA is easier, cheaper, soft and green. The size and concentration of NPs in this method are controlled by many conditions as the laser energy, number of pulses and the nature of the surrounding
medium. The synthesis of GNPs in DMEM gives a large, relatively (sometimes over 100 nm). Although the spherical GNPs have PSR peaks in the visible region, a redshift achieved when they were synthesized in DMEM. Two peaks have been observed when GNPs penetrated the cell that refers to ellipse formations that were found inside the cell. This behavior has given IR an ability to use in the treatment of the cancer field for the closed area of skin [11]. Silver nanoparticles were obtained by pulse laser using 100 mJ and 600 mJ for 400 and 4000 pulses. X-ray diffraction for produced nanoparticles showed that the samples have a small crystalline size (about 9.8 nm). SEM image showed the resulting nanoparticles ranging from too small (less than 50 nm) spherical shape [12]. Highly pure silver nanoparticles have been prepared with pulsed laser ablation in liquid using 532nm Nd: YAG laser in 5mM SDS solution. The results proved that the preparation of silver nanoparticles is affected by SDS concentration as confirmed by UV-visible analysis with peak wavelengths of 415nm, due to SPR of silver nanoparticles [13]. HRTEM images proved the nanosize for these pure noble metals NPs and core-shell metals NPs with a spherical shape. From ZF results show that the colloidal of Ag NPs is the most stabilizing than other noble metals, While Ag/Au core/shell is the most stabilizing than other core/shell metals NPs and Cu/Au core/shell is the most aggregation. Coating these nanoparticles with gold nanoparticles as a shell makes them useful in medical applications for getting high heat capacity that enables them to absorb CO2 laser that used in the field of cancer therapy [14].

2. The goal of the research
This research aims to study the possibility of using laser and nanoparticles in diagnosis and treatment of cancer. Low-power diode laser parameters and their effect on tissues are evaluated as well as the specifications of the nanoparticles that support the laser beam and its impact on the infected tissues.

3. The Theoretical Part

3.1. Laser working methods
This depends mainly on the photon absorption by the "Chromophore" or the target tissue such as melanin pigment, water or hemoglobin. The photon concentrates its power and ability on the distinctive target "Chromophore" and then turns the power and turns to the heat that is distributed to adjacent tissue, by transmission or radiation, In cells and thus begin cell proteins infusion as well as DNA, RNA and cell walls and their contents at a temperature of 400. The amount of effect depends on the intensity of the laser and the area of the area exposed to the laser light [15].

3.2. Human skin and laser
The nature of interference in all types of laser with live tissue can be summarized as follows:-
Reflection: There is always a degree of laser light reflection on the skin. Moving or crossing: The laser light crosses and penetrates the skin and deep tissue. This absorption occurs by the target tissue by special types of laser. Absorbed laser light occurs in the fabric cutting or evaporating in it. Distinctively, the laser light reaches its own target, such as pigment, pigment, and water. Coagulation: relates to the thermal effect, conversion of laser capacity to heat causing clotting and vascular occlusion or coagulation with less coagulation occurring at temperatures above 45 ° C. Fabric evaporation: Occurs when the temperature is higher than 100 ° C especially with rapid heat transfer from the laser light to the fabric, this may lead to boiling in the cellular fluid and complete rupture of the cellular protein and the cell itself. The damage of the fabric depends mainly on the rate of radiation interference with the target, the extent of heat absorption or dispersion. The heat is absorbed by the chromophore, which is either melanin pigment, water or blood vessels, each of which has a specific elective length, affecting the particular type of Objectives. Absorption depends on the concentration of the target material (Chromophore) found in the tissue applied to the laser light Figure (1).
Figure 1. Absorption of materials within the fabric [16]

Melanin: It is the first pigment that a laser light encounters when it penetrates the skin. Melanin protects the skin from extreme sun, especially UV, by absorbing harmful wavelengths. These physical properties of melanin make it either helpful or in combination with laser surgery depending on the type of tumor being treated. Melanin is found especially in the skin and at the root of the hair. Hemoglobin: The pigment-containing iron that makes blood red, stores a large amount of light into the tissue. Scattering: is the third important factor in tissue interferometry during laser therapy. Most of the inner beam of the tissue is completely dissolved in water, fat, cellular membranes and absorbed and thus generates heat in the tissue. This is why heat is lost from the treated tumor and may reach nearby tissue or tissue. These three factors: melanin hemoglobin and dispersion are the basis for the use of laser in the treatment of skin diseases and cosmetic.

3.2.1. Practical part
- A pure silver target with purity (99.98%).
- Glass lens with focal length (f = 10cm).

3.2.2. Equipment used
1. Pulsed Nd: YAG with basic pattern and frequency (6 Hz), wavelength (1064 nm) and card (1J).
2. Continuous laser diode (410 nm) and 500 mW card.
3. Spectra Academy (K-MAC) spectrometer.
4. UV-Vis-LABOMED spectrometer (190-1100 nm).
5. Inverter microscope type (Metallurgical microscope - MT7100).
6. Light Microscope with a magnifying force (28) times.

4. Results and Discussions
In this research, gold nanoparticles solution was prepared by using laser and studying the possibility of using it to diagnosis and treat cancer cells from different tissues outside the living body, then study various properties of nanomaterial and coated materials, the laser used, and the different tissue under the transparent and reflector microscope before and after treatment.

4.1. Preparation of nanomaterial

4.1.1. Preparation of nanosilver solution
In this stage, the nanosilver solution was prepared by using a pulsed laser ablation method. pulsed Nd:YAG laser with basic mode, wavelength, and energy (6Hz, 1064 nm, 1J) was used, glass lens (f = 10 cm) used for focusing laser beams on silver target (99.98%) as shown in figure (2).

Figure 2. Laboratory set up for preparation of nanosilver solution by using laser

The silver is cleaned with ethanol and distilled water and placed in a glass container with non-ionic water depth (1 cm). The laser beam is then centered at 360 mJ and a (100) stroke for 10 min to obtain a light yellowish solution as shown in Figure (3). The sample was weighed before and after the ablation to obtain the number of gold nanoparticles that are attached to the solution at a weight (0.0003 gm).

Figure 3. Light yellowish solution

4.1.2. Study of optimal laser parameters for treatment

At this stage, the optimal laser parameters for the treatment and diagnosis of tissues containing cancer cells are studied. The choice of laser depends mainly on the degree of absorption of all tissues and nanoparticles. In this study, a continuous diode laser (410nm, 500 mW, and a 2.1mm spot size) is used as shown in Figure (4).
Figure 4. Laser system used for treatment

The laser emission spectrum was measured using Spectra Academy (K-MAC) spectrometer as shown in Figure (5).

Figure 5. Emission spectrum of the laser diode

4.1.3. Studying the Synthetic and Optical Properties of Nanoparticles

The properties of optical nanoparticles and composition are studied as follows

1. Absorption and Fluorescence Spectrometry: The absorbance spectra of the silver solution and the bonding material are analyzed using a UV-Vis-LABOMED spectrometer for the range (190-1100) nm and measured by vertical fall on a quartz cell. The absorption spectrum of the solution is due to the ratio of peaks of Plasmon absorption to the gold nanoparticles as shown in figure (6). It is observed that the highest absorption peak (410 nm), which corresponds to the maximum peak of flora, which corresponds to the emission of laser diode used for treatment and diagnosis, that the fluorescent spectrum depends on the shape and size of the silver nanoparticles.
2. **Infrared spectroscopy:** In this test, emission spectra for the range (400-4000) cm\(^{-1}\) were recorded using Bruker spectrometer. The results of the FTIR analysis showed the main vibration patterns of silver nanotubes and their main peaks as shown in Fig. (7).

3. **X-ray diffraction:** X-ray diffraction results showed the nanoscale structure of the random-phase silver nanoparticles as shown in figure (8). The particle size was measured about (42) nm calculated using the Scharr equation.

4.2. **Atomic Force Microscope and Electronic Scanner**
To study the topography of the surface, shape and grains size of nanoparticles, an atomic force microscope (AFM) and a scanning electron microscope are used for this purpose. The results of the images of the atomic forces of the silver grains in 2D and 3D dimensions showed a homogeneous distribution and surface roughness of (1.025 nm) and a ripple of (0.122nm) as shown in Fig(9).

Figure 9. Images of atomic force microscopy of nanoparticles in two dimensions (2D) and three dimensions (3D)

For quantitative information on the morphology of the model, the surface height distribution plot is analyzed, showing that the diameter was about (27 nm), which approximates the results of the scanning electron microscope. Figure (10).

Figure 10. Distribution plot of different heights for silver nanoparticles

The results of the scanning electron microscopy images of nanoparticles were observed on nanoparticles with different dimensions and shape Fig. (11).

Figure 11. Scanning microscope images with different magnification for silver nanoparticles

4.3. Metallurgical microscope images
In this test, images were taken with the metallurgical microscope (MT7100) for the solution of the gold nanoparticles before it was used for treatment with laser and diagnosis. The images showed glitter and apparent luminance with a magnification capacity of the microscope (100 times) and showed its distribution as clusters within the sample on a glass slide, as shown in figure (12).

![Image](image12.png)

**Figure 12.** Image of the reflection microscope for the silver nanoparticles on the glass slide

4.4. Study of different infected tissues stage

At this stage, three samples were taken for different tissues (1, 2, 3) infected (breast cancer) as shown in Figure (13).

![Image](image13.png)

**Figure 13.** Three breast cancer tissues

Silver nanoparticles solution was injected on the infected sample as in Fig. (14), then tested in a microscope before and after exposure to the laser light. Diode laser used was (410) nm with a capacity of (500 MW) for 5 min and a distance of (2 cm) from the sample.

![Image](image14.png)

**Figure 14.** Three breast cancer tissues injected with silver nanoparticles
4.4.1. Reflective microscope images
Images were taken to different infected tissues and for three samples of the metallurgical microscope (MT7100) with a magnification capacity (100x). In each test, a microscope image is taken for all tissues areas before and after laser treatment, as in Figure (15). The targeted cells can be visualized through adding exogenous contrast agents, such as silver nanoparticles (AgNPs).

(1) before treatment
(1) after treatment

(2) before treatment
(2) after treatment

(3) before treatment
(3) after treatment

Figure 15. Reflection microscope images for tissues before and after treatment with laser

4.4.2. Images of the light microscope
Tissue Light microscope images were taken before and after laser treatment with silver nanoparticles solution. The images showed its susceptibility to the nanoparticles and the laser. The samples of different tissues were examined before and after laser treatment with the presence of nanoparticle. Light microscopy images showed that treated cells with 42 nm AgNPs for 24 h (Figure 16) show profound morphological changes characteristic of cytotoxicity; shrinkage, granulation and irregular shape aggregation of cells.
5. Conclusions
   1. In a simple physical way, AgNPs solution was prepared with a homogeneous distribution grain and uniform surface roughness.
   2. Clarified the features of the tissue after injecting the silver Ag NPs solution, which confirms the possibility of successful use of the diagnosis of tumors.
   3. Change tissue after injection with a solution of silver particles and the laser beam explained the ability of the laser to destroy infected tissue and ability to show profound morphological changes.

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