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RESEARCH ARTICLE

Nanoparticles Suspensions as Optical Power Limiting Synthsization and Characterization

Gofran Hadi[1*], Jassim Mohammed[2], Qussay Mohammed Salman[3]

College of Science for Women, University of Babylon, Hillah, Iraq.

***Corresponding Author: Gofran Hadi**

Abstract

In this study, the investigation of the nonlinear and optical properties of nanoparticles (AgNPs) in distilled water with gold nanoparticles (AuNps) was investigated. The non-linear absorption coefficient of nanotubes was measured by Z-scan. Nanonuclear AuNps with AgNPs under exposure to nano-laser pulses at 532 nm as well as 405 nm and 650 nm. The results showed that nonlinear diffusion can increase the performance of the optical marker. A theoretical analysis is proposed Investigate non-linear behavior observed from AgNPs with AuNPs. Shows that the dispersion of non-linear light occurs at high intensity because of the inverse refractive mismatch between silver nanoparticles with gold and water. TheZ- scan experimental data were provided with the proposed theoretical model, allowing the extraction of nonlinear absorption coefficients and linear and nonlinear propagation coefficients for AgNP suspension with AuNPs.

Introduction

The optical limit phenomenon has worked a lot of scientific research in recent years for applications in a wide range of fields such as protection from intense laser light [1]. The ideal optical selection material should sshow high transmission in normal light while showing in a low transmission Intensive light to protect human eyes and sensors. The search for effective light parameters led to the study of different materials [1, 2]. Many organic materials such as phthalocyanins [3], fullerenes [4] and carbon black [5] have been identified as good optical determinants due to their distinctive nonlinear optical properties. The mechanism of reduction of nonlinear interactions can occur especially non-linear absorption, nonlinear refraction and nonlinear diffusion. The optical boundary work is reinforced by the involvement of two or more of these mechanisms, such as self-focusing in conjunction with nonlinear absorption in semiconductors.

In recent years, many nanomaterials and semiconductors have been extensively studied for application as optical parameters of nano-laser pulses at 532 nm due to the reinforcement of nonlinear optical properties [7-14].

In particular AgnPs have been most frequently concerned by a wide range of applications in the fields of photonics [12-15], nanotechnology, [16] electronics, [17] and medicine [18]. So far, it has been Ag-NPs are successfully manufactured through a variety of methods, such as ultraviolet light chemistry, chemical minimization and laser ablation. [19-28] has been reported that laser pulse ablation of silver targets in the liquid environment is a simple and well-suited technique for aggregating Ag-NPs. Laser ablation in liquids has received much attention as an effective and simple technique for producing various nanoparticles such as metals [19-30] and metal oxides [31-32] and semiconductors [33-35]. In this study, nonlinear responses and optical properties of NP objects were studied in water. Thus, we extracted the values of linear and non-linear scattering coefficients of NP in water.

Method and Materials

Ag & Au-NPs were prepared by laser nano-pulsed laser cutting for the target of very pure silver and gold in distilled water.

Carried out using the second harmonic radiation of the laser switched Nd: YAG Q-. 15 nm pulses (FWHM) appeared at 532 nm with a frequency of 1 Hz.

The laser beam was focused on a 15 cm lens on the surface of a silver plate placed inside a 10 mm cell. A gold plate placed inside a 10 mm cell was the spatial appearance of the Gaussian laser pulse, with a wavelength of 300 µm (FW1 / e2M) on the target. The silver sample and the gold sample were irradiated at laser level About 10 c / cm 2 for two hours.

The Ag & AuNPs focus is on the manufacture of nanoparticles by the nano-pulsed lasers of the silver plate in water. The visual limit response for Ag & AuNP suspension was measured under exposure to nano-laser pulses at 532 nm. In order to understand and understand the processes leading to the work of the optical determinant, we have conducted a pilot study to measure linear absorption using a low-power CW laser (at 532 nm) and laser pulse measurements in nanoseconds for photovoltaic of visual nonlinearity including nonlinear absorption and nonlinear scattering in colloid. Our experimental results indicate that nonlinear absorption and nonlinear dispersion play important roles in performing the strong optical limit of the Ag & AuNP parts distributed in water [7, 36].

Has been reported that optical boundary performance in metallic nanoparticles is enhanced by nonlinear scattering. Theoretical analysis proposes the investigation of the laser pulse with nanosecond laser the optical limit of Ag & AuNPs response at 532 nm. Our theoretical analysis based on nonlinear absorption and nonlinear scattering will appear to be consistent with the experimental results of nanoscale scanning measurements.

The Ag & AuNP suspension was examined using TEM and UV-Vis. The use of NV32: YVO4, which operates at a 532 nm wave length, has been used in a low power wave (100 MW) working in diodes and operating at short wavelength of 532 nm. The linear absorption coefficient of Ag & AuNP suspension was measured. Nonlinear optical properties of Ag & AuNPs prepared by Z-scan permeability measurements were studied using 15 ns laser pulses at 532 nm. For the measurement of nonlinear permeability, the photometric geometry used in this work is shown in Fig. 1. A dilute and split beam is used to control the single pulse energy of the laser beam. The package was focused on the sample cell using a 15 cm focal length lens. The spot size in the focal area was 140 µm (FW1 / e2M). Two monitors were measured Energy in the incident area and energy sent from the laser beam. The diaphragm was used before the output power detector. This experimental geometry was used.

The cell containing the 5mm nanoparticles was moved using a translation system along a direction Spread (Z axis) across the focus area. At the focal point, the sample faces the maximum amount of laser radiation, which will gradually decrease in either direction of the focus. Figure 2 shows the ultraviolet absorption spectra of the solution prepared in different proportions by laser ablation in a silver dish and a golden dish submerged in water.

One can see that Ag & AuNPs show a surface Plasmon absorption tape about 400 nm in the UV-Vis region of the spectrum [12, 20]. The distribution, shape and size of AgNPs were studied by TEM and measurements performed immediately after laser ablation. Figure3, 4, 5 for scanning open slot scanning is Figure 3, 4, 5 shows, with a solid curve based on Z- scan theory including the nonlinear absorption of the reference [37].Experiments were performed with nano-laser pulse irradiation at a wavelength of 532 nm.

In addition, the laser frequency was 1 Hz to prevent the effect of thermal effects. The Ag & AuNPs show a high value of nonlinear Responses to nanoseconds [38, 39]. The scanning measurement of the open Z opening of the nanoparticle suspension is based on the non-linear absorption process using the reference procedure [37].The solid line shows convenience. The values extracted for linear and non-linear absorption coefficients are α =1.76, 1.22, 0.61cm^{-1}and β = 0.2*10^{-3}, 0.4*10$^{-3,}$ 0.7*10^{-3} cm / GW, respectively. Note that the linear absorption coefficient value is the same as the value obtained by low-energy laser measurements.

Using values obtained from linear and non-linear absorption coefficients, one can find that the input of nonlinear absorption is much greater than linear absorption.

Ag Au NPs dispersed in water were studied for optical selection properties under Exposure to nanosecond laser pulses at 532 nm. Figure 6, 7,8shows the normalized transmittance of Z-scan measurements as a function of distance from the focus of the Gaussian beam for the colloids. Applied incident laser power is about 47mW.

The Z-scan results of the Ag& AuNP colloids show an asymmetric peak followed by valley, typical of negative nonlinearity for refractive index. This asymmetric nature of Z-scan measurements along with the fact that the laser light is CW suggests that the origin of the nonlinear refractive index is thermo-optic. The pure liquid of the water does not show any closed Z-scan signal for the applied laser power up to about 50mW. - □ Figure 9, 10, 11 shows the experimental results of visual reduction of Ag &Au NPs when using different diaphragm sizes before the output detector.

The optical insulation limit is about 1.4 mJ. When the hole is 4mm wide, the power is sent to the plateau with increased input power. In the 10MJ laser energy, installed power is reduced to about 1.33MJ. This means that permeability drops to about 13 percent. It gives 4 times the attenuation of the applied laser energy. Ag & AuNPs have been found in water with strong visual limitations Behavior. Seems to be minimal visual? In fact, if we consider the diameter of the laser beam printed approximately 3 times. As shown in Figure9, 10, 11 it is clear here that the energy transferred decreases with the size of the diaphragm. This may be your role in performing his or her role in performing his or her role in achieving success.

At this point, one needs to consider the contribution. Nonlinear scattering that may play an important role in the non-linearity observed for suspension of nanoparticles. During nano-ray irradiation, the absorption of laser light through the nonlinear process can lead to a very high temperature rise of nanoparticles, leading to the formation of scattering centers [7].

In the following, it proposes a theoretical analysis of the investigation of nonlinear observed behavior of Ag & AuNP suspension. It has been assumed that nonlinearity results from nonlinear scattering resulting from nonlinear absorption. Absorbed laser energy creates dispersion centers induced by the change in Ag & AuNPs refractive index by thermal process.

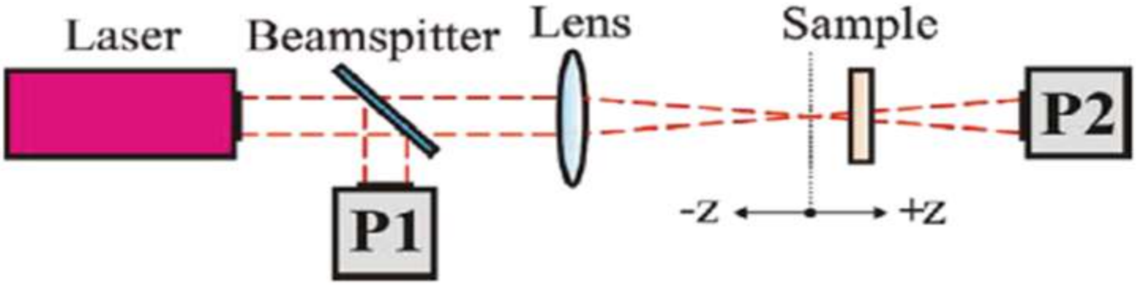

Figure 1: Optical geometry used to characterize optical limiting performance of the Ag&AuNP suspension

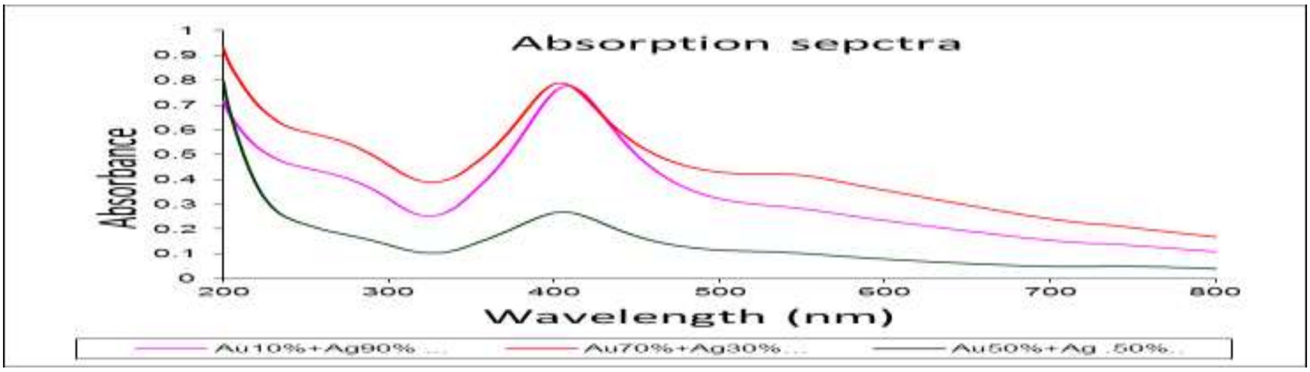

Figure 2: Absorption spectrum for suspension Ag & AuNp Obtained by laser ablation of the silver and gold plate in water

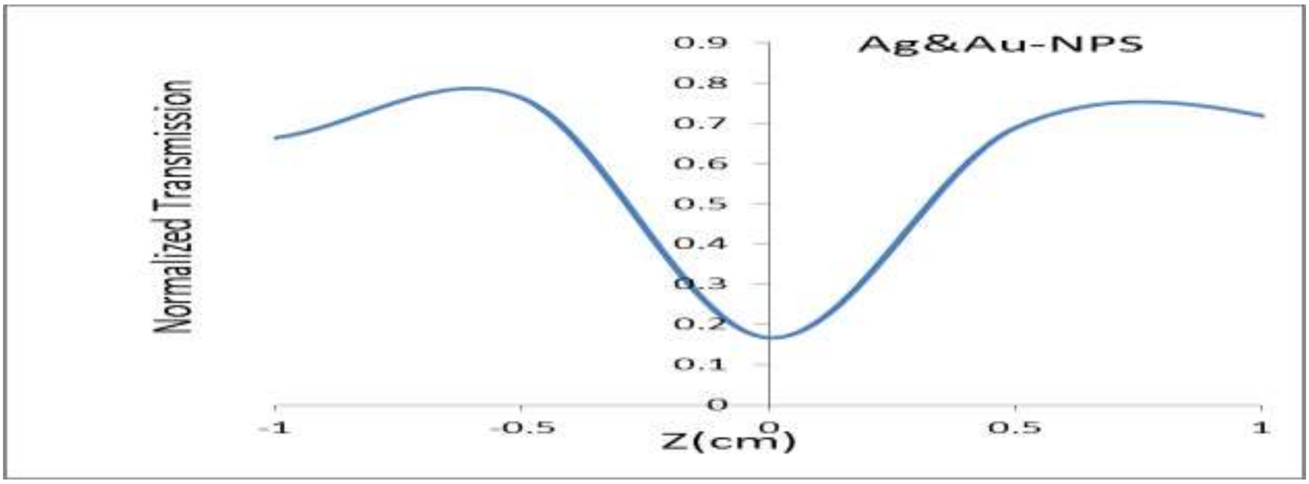

Figure 3: Open the scanning Z slot for Ag & Au-NPs in the remote water (Liquid medium) at different energy pulses (20 mW) at 405 nm

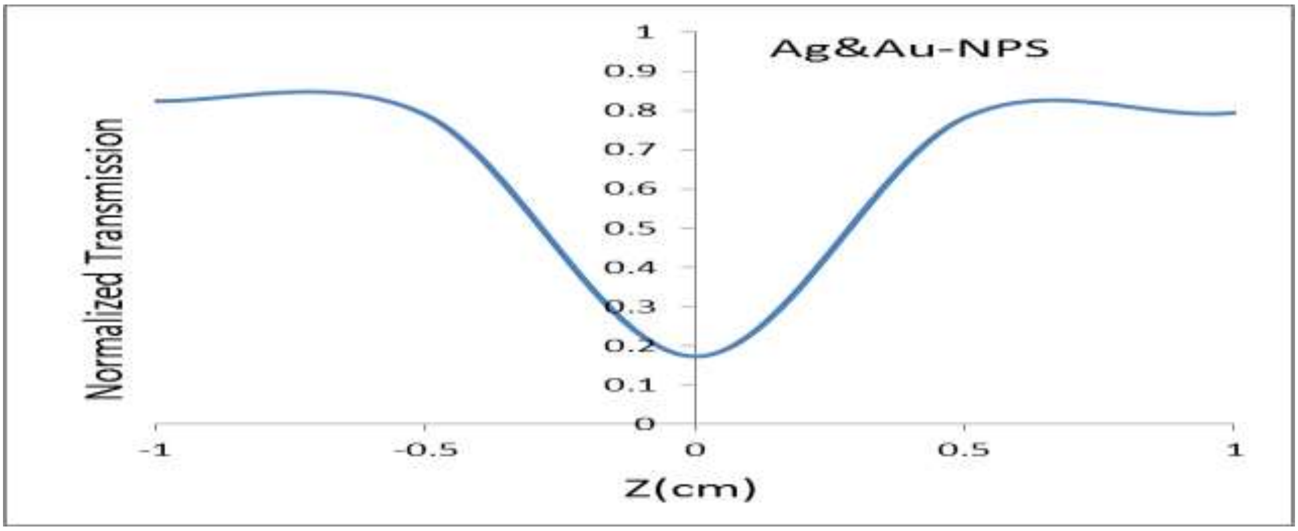

Figure 4: Open the scanning Z slot for Ag & Au-NPs in the remote water (Liquid medium) at different energy pulses (20 mW) at 532 nm

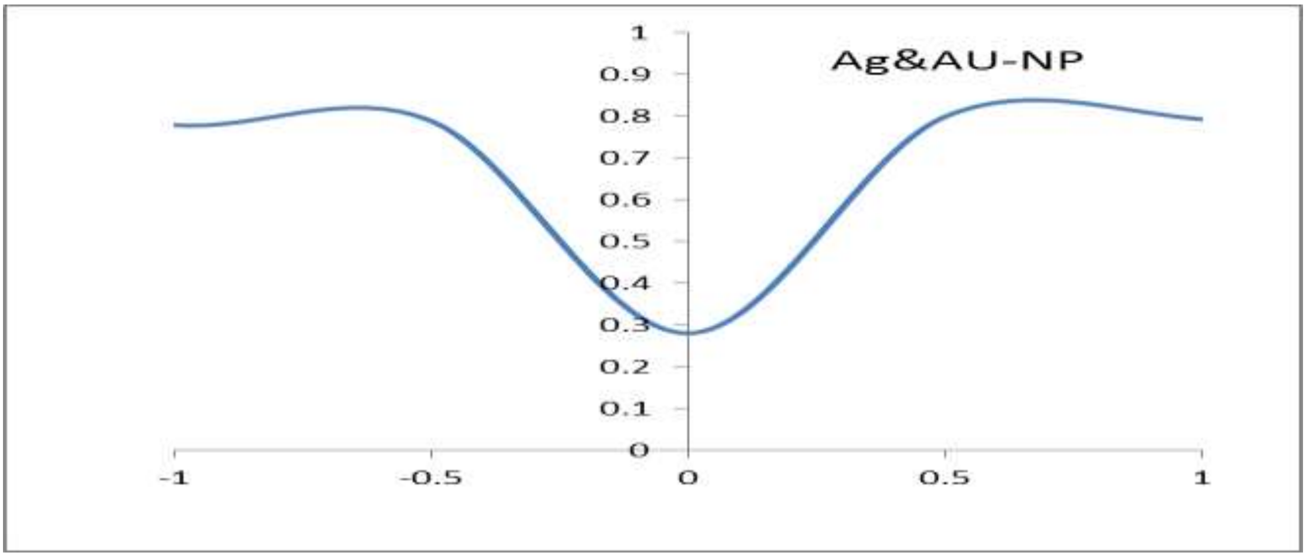

Figure 5: Open the scanning Z slot for Ag & Au-NPs in the remote water (Liquid medium) at different energy pulses (20 mW) at 650nm

Table 1: Nonlinear properties of gold and silver mix with different pulses in the case of open aperture

β(cm/w)	$^{2)}I_0\ (w/cm$	ΔT_{p-v}	$L_{eff(cm)}$	Number of pulses
$0.2*10^{-3}$	3710.57	0.789	2.758	405
$0.4*10^{-3}$	2210.48	0.903	2.758	532
0.7*10-3	151.515	0.999	0.237	650

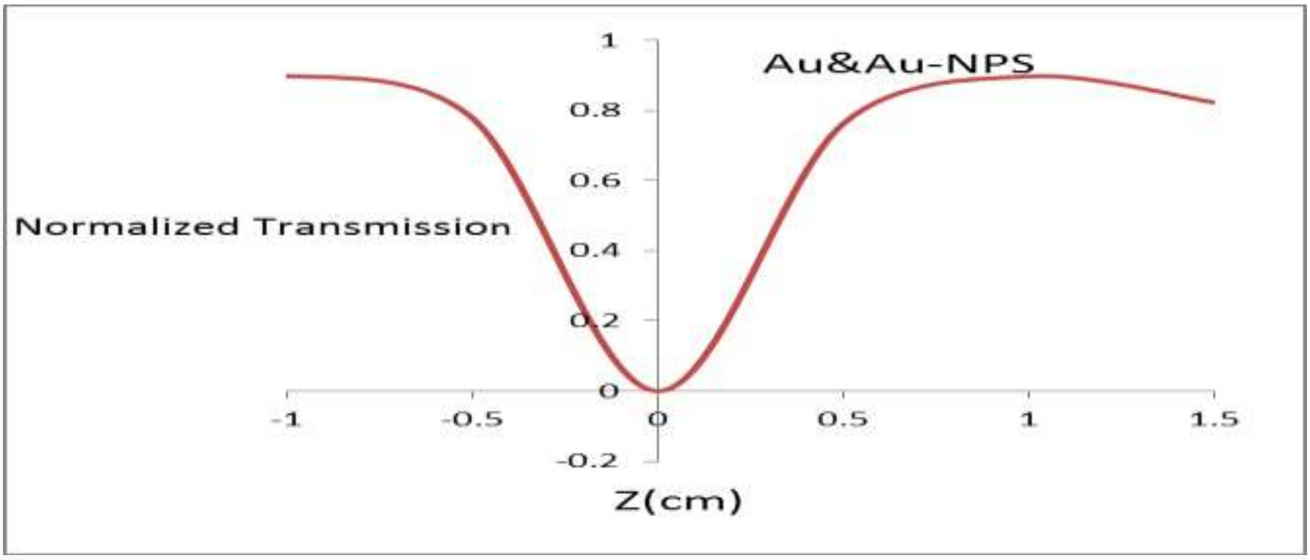

Figure 6: close aperture Z-Scan for Ag&Au-NPs in distal water (liquid media) at different pulses for power 20(mW) at 405nm

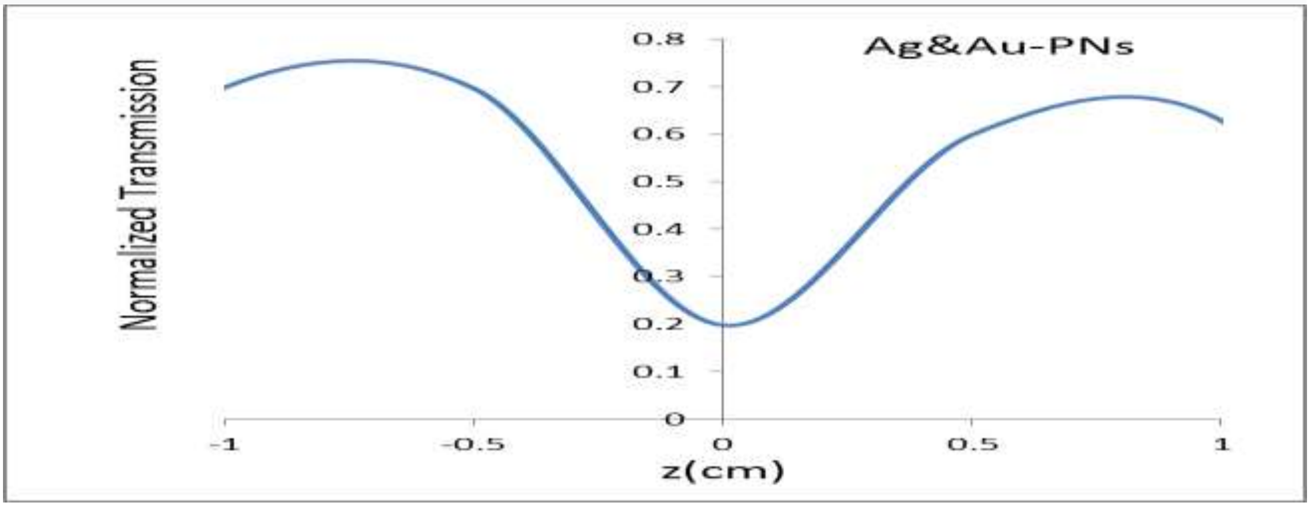

Figure 7: close aperture Z-Scan for Ag&Au-NPs in distal water (liquid media) at different pulses for power 20(mW) at 532nm

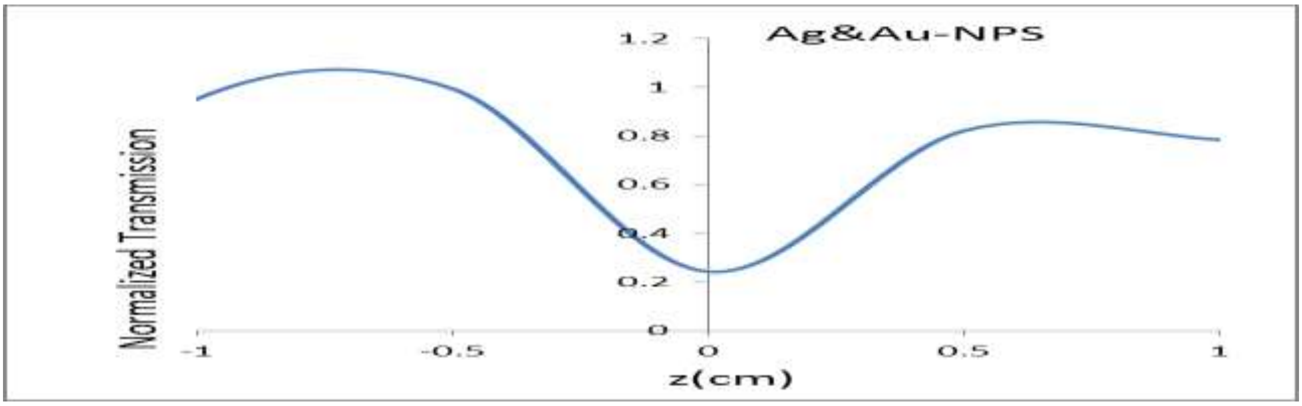

Figure 8: close aperture Z-Scan for Ag&Au-NPs in distal water (liquid media) at different pulses for power 20(mW) at 650nm

Table 2: Shows the nonlinear properties of the gold and silver mix with different pulses in the case of aperture close

$n_2(cm^2/w)$	${}^{2)}I_0\,(w/cm$	ΔT_{p-v}	$L_{eff(cm)}$	S	Number of pulses
$0.1*10^{-8}$	3710.57	1.195	2.758	0.1	405
$0.09*10^{-8}$	2210.48	0.27	2.762	0.1	532
$7.08*10^{-7}$	151.515	0.972	0.237	0.1	650

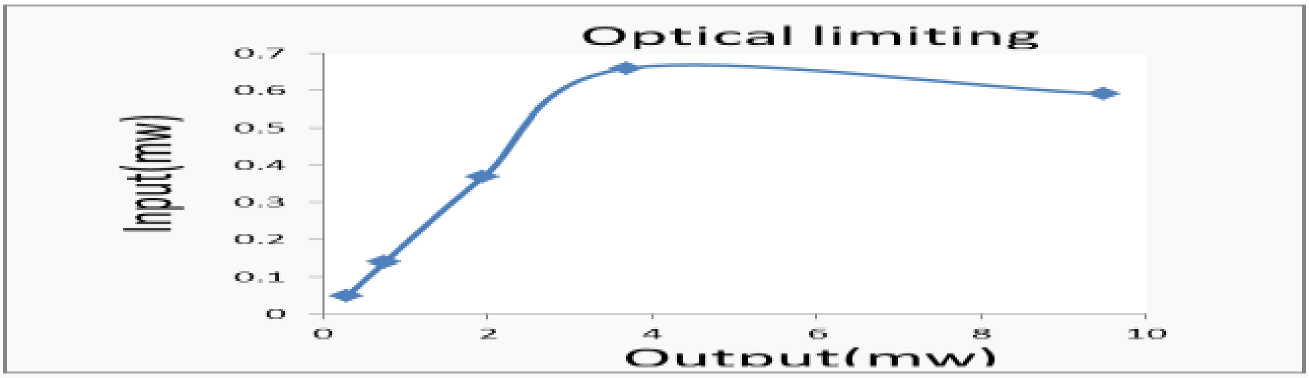

Figure 9: threshold and limiting power different pulses and different ratios of gold and silver at 405nm

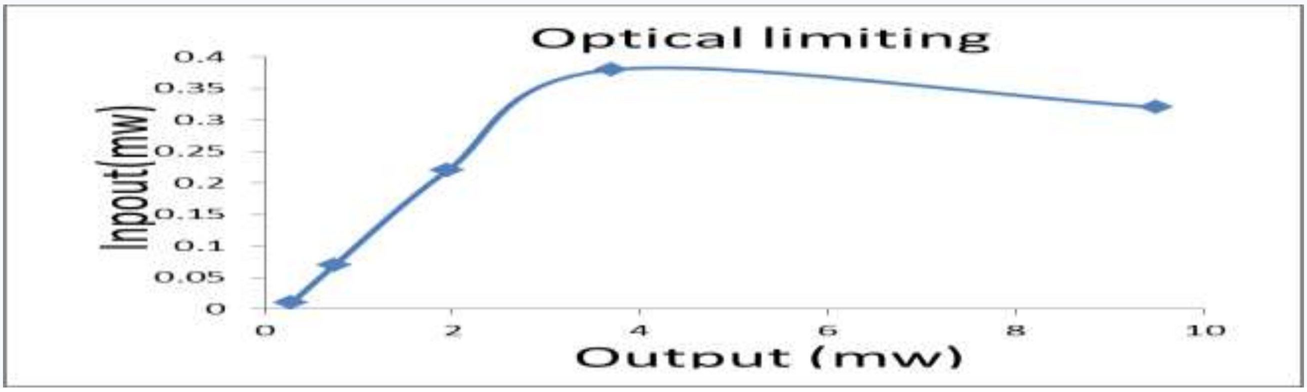

Figure 10: threshold and limiting power different pulses and different ratios of gold and silver at 532nm

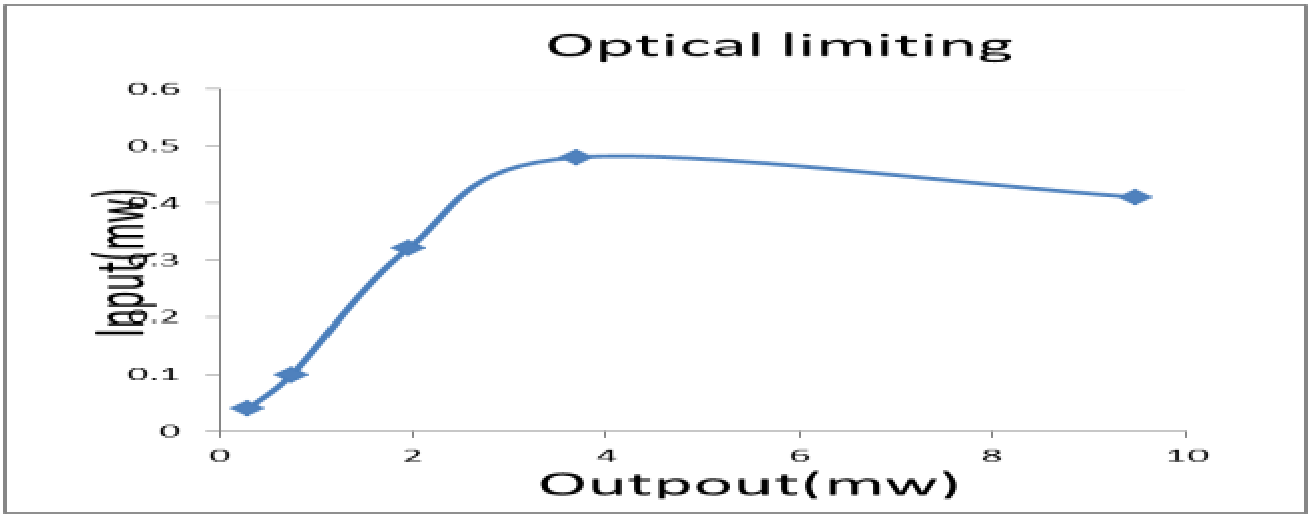

Figure 11: threshold and limiting power different pulses and different ratios of gold and silver at 650nm

Table Power and optical determinant of gold and silver mix with different number of pulses

(mW)P_L	(mW)P_{th}	p/s
0.66	3.4	405
0.37	3	532
0.45	3	650

Conclusions

- Silver nanoparticle solution has positive nonlinear absorption coefficient values, confirming that the material exhibits RSA behavior.

- A silver nanoparticle solution has negative nonlinear absorption (n2) values, confirming that the material exhibits defocusing behavior.

- Concerning the combination of gold and silver nanoparticles, we observed that the nonlinear absorption coefficient increases with the wavelength used.

- Input power values at which the saturation state (pth) starts are the same for all linear permeability values (s) and for the sample prepared with a certain number of pulses

- The values (pth) are the same for all samples prepared with different pulses and for different wavelengths
- The nonlinear refractive index (n2) values are higher for samples prepared with more pulses than for samples prepared with fewer pulses.
- Nonlinear refractive index (n2) increases with increasing linear permeability values (s)
- Note that the nonlinear absorption coefficient (n2) of silver is higher than that of the nonlinear absorption coefficient n2)) of gold.

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