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Non-Linear Optical Properties of Gold Nano Particles Doped by Distilled Water (DDDW)

Dr. Raad. Sh. Alnayli, Department of Physics, University of AL-Qadisiyah, Iraq. E-mail: Raad.Anayli@qu.edu.iq

Atyaf S. Farhan Alrubaie, Department of Physics, University of AL-Qadisiyah, Iraq. E-mail: sweetsets@yahoo.com

Abstract--- In the present work, synthesis gold nanoparticle by using laser ablation by using Q-switched Nd: YaG E=80mJ, ʎ=(1064)Nanometer for gold metal target in DDDW. Z-scan technique was used to study the non-liner optical properties, represented by non-liner refractive index and non-liner optical properties in this technique used CW diode laser (50mW,650nm) the results show that non liner refractive index negative (self-defocusing) and non-liner absorption coefficients two photo absorption (TPA).

Keywords--- Gold Nanoparticle, DDDW, Z-scan, Nonlinear Refractive Index, Nonlinear Absorption Coefficients

I. Introduction

Nonlinear optical material was requiring in a wide range of important applications, like optical communication, optical computing, and optical limiting [1]. In recent year, Nano compositions and Metal nanoparticles take great attention on properties of the unique nonlinear optical, such as absorption of the reverse storable, storable absorption, absorption of the two-photon, and focusing/defocusing which start from nonlinear refraction[2,3].For the first time, The Z-scan mechanism was used before last ten years. The Z-scan is depended on all the changes that occur in profile of the Gaussian beam intensity from the far field through transfer of the sample on focal plane [4,5].Resonance of the surface plasma is results in from electronic stimulation at the interface of the metal nanoparticles with dielectric matrix. That determines phenomena of the nonlinear optical [6].The reports that related with deionized water and halides of the doping transition metal halides have great role for controlling and determining the operational feature of the different compositions [7].In our study, we are used the Au NPs by liquid medium laser by used deionized and distill water, then submitted to Z-scan for determine properties of the nonlinear optical of the nonlinear absorption coefficient and nonlinear refractive index.

II. Experimental

Materials and Methods

The Au plate laser ablation is performed by using (Nd-YAG) pulsed laser (1064nm) with energy value (80mJ)in distill and deionized water (DDDW)and pulses(200,400,600) pulsewidth10ns and 6Hz repetition .when we have AuNPs doped in DDDW.

8mL of gold nanoparticles commentary wasaddedtothe20mL aqueous DDDW solution, finally samples were left to dry onaplanesurfacefor4daysat room temperature, then use Z-scan experimental, the stimulation source was a continuous waveof650 nm laser at energy (50) mw for AuNPs/DDDW films.

Nonlinear properties of AuNPs/DDDW

Z-scan is used for magnituding of nonlinear absorption and the sign wherever, it's calculated at same time. If the laser beam (high intensity)pass through substance lead to occurring some changes in laser self- focusing or defocusing [8].

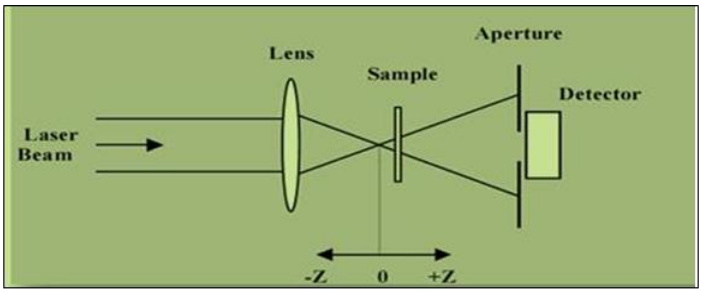

Figure 1: Z-Scan set up

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Fig (1) experiment of the Z-scan techniques provides us starting point from far distance(-z), the laser beam is reflect is low and non-significant, if the sample is become near to the focus, the laser beam increases self-lensing [1,9]

Calculation of the nonlinear refractive index is done by different from higher point to lower point as [10].

$n_2= \Delta\Phi_o/I_oL_{eff}k$... (1) Where

$\Delta\Phi_o$:nonlinear phase shift,

k= $2\pi/\lambda$

λ:isbeam wavelength.

$\Delta\Phi_o=\Delta T/0.406$ … (2)

I_o:Symbolizes to focal spot intensity as:

$I_o=2P_{peak}/\pi\omega^2{}_o$… (3)

ω_o: Symbolizes to focal point of the beam radius

P: power of the peak point.

$L_{eff}= (1-e^{-\alpha oL})/\alpha_o$...(4)

L: is length sample

αo: is mean coefficient of the linear absorption

The material absorption:

(α)is intensity dependent as [11]

$\alpha=\alpha_o+\beta I$ … (5)

β:is coefficient of the nonlinear absorption.

While α_o: coefficient of the linear absorption

Nonlinear Refractive and Nonlinear Absorption Coefficient

Fig (2): The nonlinear refractive index negative (self-defocusing: that mean the peak followed by a valley), and the nonlinear absorption coefficient two photon absorption then the degree of nonlinear absorption coefficient and nonlinear refractive indices aresummarized in Table (1).

Table 1: Values of nonlinear parameters for prepared AuNPs /DDDW.

pulses	$\beta * 10^{-8}$(cm/W)	$n_2 * 10^{-12}(\frac{cm^2}{W})$	$\Delta\emptyset(rad)$	$I_0(\frac{mw}{cm^2})$
200	21.1	8.4757	1.110837438	14154282
400	7.9	3.05018	0.967980296	
600	7.64	4.27882	0.980295567	

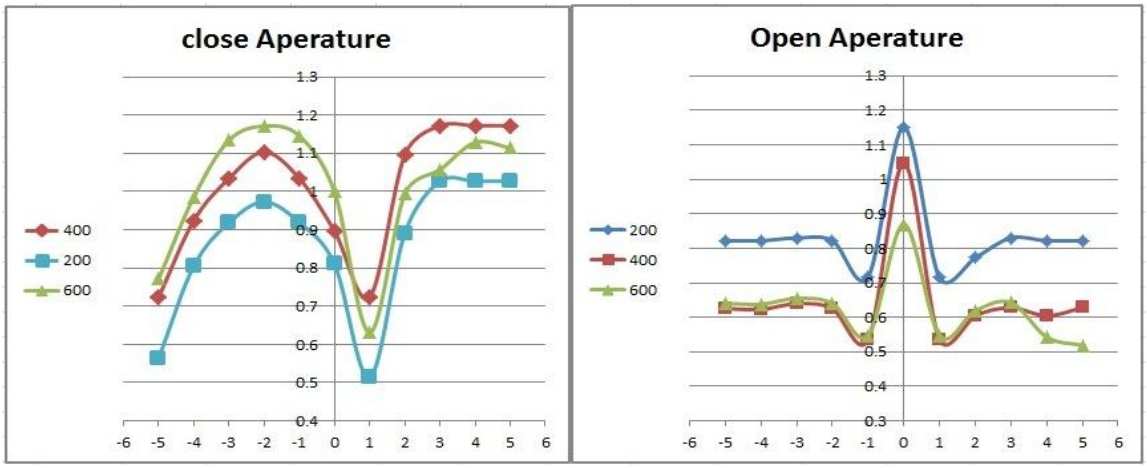

Fig. 2: Data of Z-scan experimental stimulation open and close aperture curve, for AuNps/DDDW.

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III. Conclusion

Nonlinear refractive of different composites containing AuNPs/DDDW was studied using Z-scan techniques. Index of the nonlinear refractive and nonlinear absorption wear measured and sign of the nonlinear refractive index was positive. The nonlinear refractive index increase when increase pulse from 200 to 400 pulse then few decrease in 600 pulse. The closed aperture of the z-scan method results was measured the nonlinear refractive index. It is measure from the curve of normalize transmission from the linear absorption. The figure (2) show the relation between (Tz)and poison Z of the sample by closed aperture z-scan method at (650) nm in (50) mw nonlinear. Effected region was extend from (-5) to(5) cm the valley–peak configuration indicated the positive sign of refractive index nonlinearity (+n) self –focusing. The nonlinear absorption (β) was measured by the result of the open z-scan method measured the curve of the normalize transmission from linear absorption measured by spectrophotometer figure (2) illustrate the relation between the normalize transmission and the positive sample by open aperture z-scan method for sample at laser wavelength 650nm and power 50mW. It is seem the peak of the normalize transmission curve indicates the AuNPs exhibited saturation absorption.

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