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Preparation of Gold NPs Colloidal by Laser Ablation Under the Effects of Magnetic Field

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ABSTRACT

Background: Pulsed laser ablation in liquid (PLAL) has become an increasingly important technique for metals production and metal oxides nanoparticles(NPs) and others.This technique has its many advantages compered with other conventional techniques (physical and chemical). This work was devoted for production of gold (Au) nanoparticle via PLAL technique from a solid gold target with high purity(99.9%) in doubled distuled deionized water (DDDW) under the effects of magnetic field(MF)at different intensity. the produced NPs were characterized by UV-visible ,scanning electron microscope(SEM)and atomic force microscope(AFM). The absorption spectrum shows a red shift in the absorption spectra peak,as well as the NPs size were increase from(13.94)nm to (24.06)nm when the MF was on.

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INTRODUCTION

During recent years, metal and alloy nanoparticles have been more considered because of their special optical and electrical properties. These properties are completely related to the size of particles which are not seen in the bulk state(D.H. Chen *et al*.,2002, A.T. Izgaliev *et al*. 2004, M.J. Kim *et al* ,2003). Metal nanoparticles have Plasmon absorption resonance band that for different metals with different dielectric equations, their absorption peak is changed in the ultraviolet-visible region (F. Hajiesmaeilbaigi *et al*.,2012). The position of plasmon resonance peak is related to the size of particles and refraction coefficient of environment. By increasing the size of particles and the refraction coefficient,the surface plasmon resonance is desired to red wavelength (F. Hajiesmaeilbaigi *et al*.,2012).

Metal nanoparticles have attracted much attention because of their size-dependent physical and chemical properties. In this relation, size-selected nanoparticles with diameters less than 10 nm have been prepared using wet-chemistry techniques. More recently, laser-ablation method has been developed to prepare metal nanoparticles in a solution. This physical method allows us to prepare nanoparticles with ease and without contamination by a reducing agent, but the size distribution of the nanoparticles tends to be broadened because the coagulation processes of atoms can hardly be controlled(F. Mafune *et al*.,2002)

Noble metal nanoparticles such as Au NPs have been a source of great interest totheir unusual physical properties, especially due to their sharp plasmon absorptionpeak at the visible region. The resonance frequencies depend on particle shape andsize and stable for a long period of months. Moreover, exhibited absorbance, whichprovide as a powerful detection tools and shows, promise in enhancing the effectiveness of various targeted cancer treatments. Therefore it's a source of great interest of application due to their novel electrical, optical, and catalyst properties(A.S.Kupiec *et al*.,2011) This work was focused on study the effects of MF on the optical properties and size of the produced NPs.

Experiments:

Fig.1 shows the schematic diagram of the PLAL experimental set up for the synthesis colloidal solution of gold NPs. The laser used in this work is ananosecond Q- switch Nd-YAG laser. Its operates at 1064nm wavelength ,6Hz pulse repetition rate ,800mJ and the number of laser shots applied for the metal target at 500 pulse. the laser beam was focused via a 15.3mm focal length focusing lens to a minimum spot size at a solid

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gold target (purity 99.9%). The gold target (purity of 99.99%) was fixed at bottom of glass vessel containing of 2 ml of double distilled deionized water under the effects of MF with intensity range (10-60)mT.

RESULTS AND DISCUSSIONS

In the experiments of this research work, laser ablation of gold target in DDDW solution under the effects of MF was investigated. Fig.2 displays the absorption spectra of gold NPs produced in DDDW media .UV-visble. The absorbance spectra peak (SPR) of Au colloidal when MF off at 532nm which indicating the formation of Au NPs(Abdulrahman Khalaf Ali,2010) and by applying the MF absorbance peak shifted to 550nm which indicating the increase in the NPs size as shown in Tab.1 .as well as the absorbance intensity was increase when the MF is on which indicating the increase in the NPs concentration (Barcikowski Stephan *et al*.,2007) the maximum absorbance had been appeared at 40mT. Fig.3 shows AFM image of Au NPs prepared in DDDW when MF off and when MF is on, by compared between the images we can note there is an obvious agglomeration process when MF is on. The formation NPs of approximately spherical shape, as in Fig.4 shows a SEM image of gold NPs.

This result indicating the produced NPs in DDDW under the effects of MF tends to agglomeration, due to the confinements effect of MF.

Table 1: The effects of MF on the Nanoparticle size.

Magnetic field intensity (mT)	Nanoparticls size(nm)
0	13.94
10	22.53
40	24.06
60	23.06

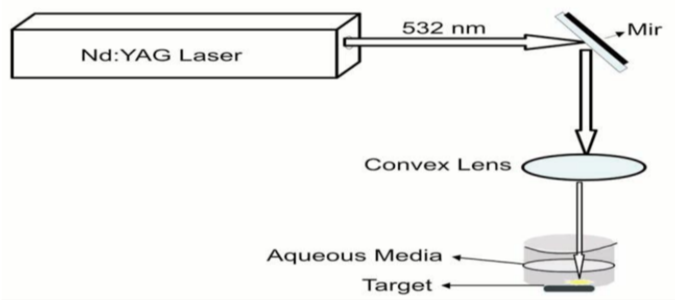

Fig. 1: Experimental arrangement.

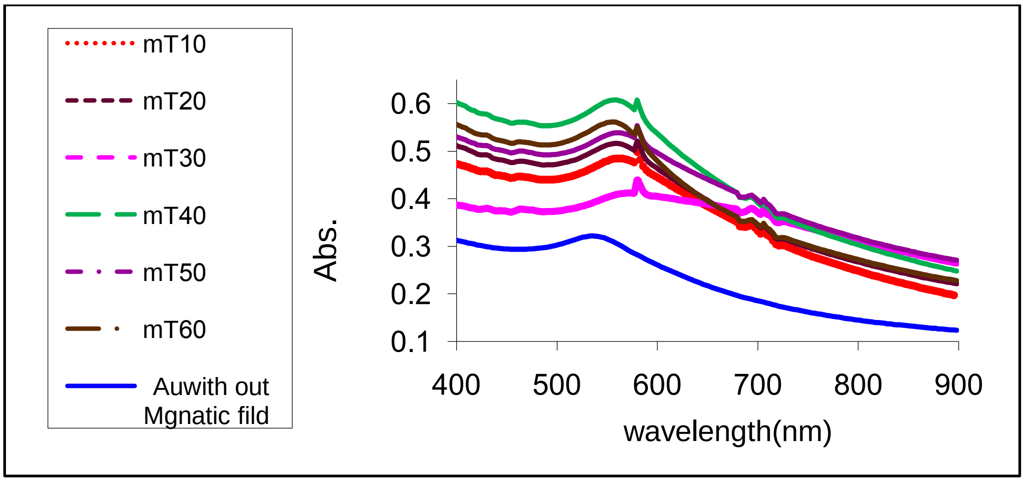

Fig. 2: Absorbance spectrum of Au NPs in DDDW, λ =1064nm, E= (800 mJ and 250 pulse.

Australian Journal of Basic and Applied Sciences, 8(18) December 2014, Pages: 159-162

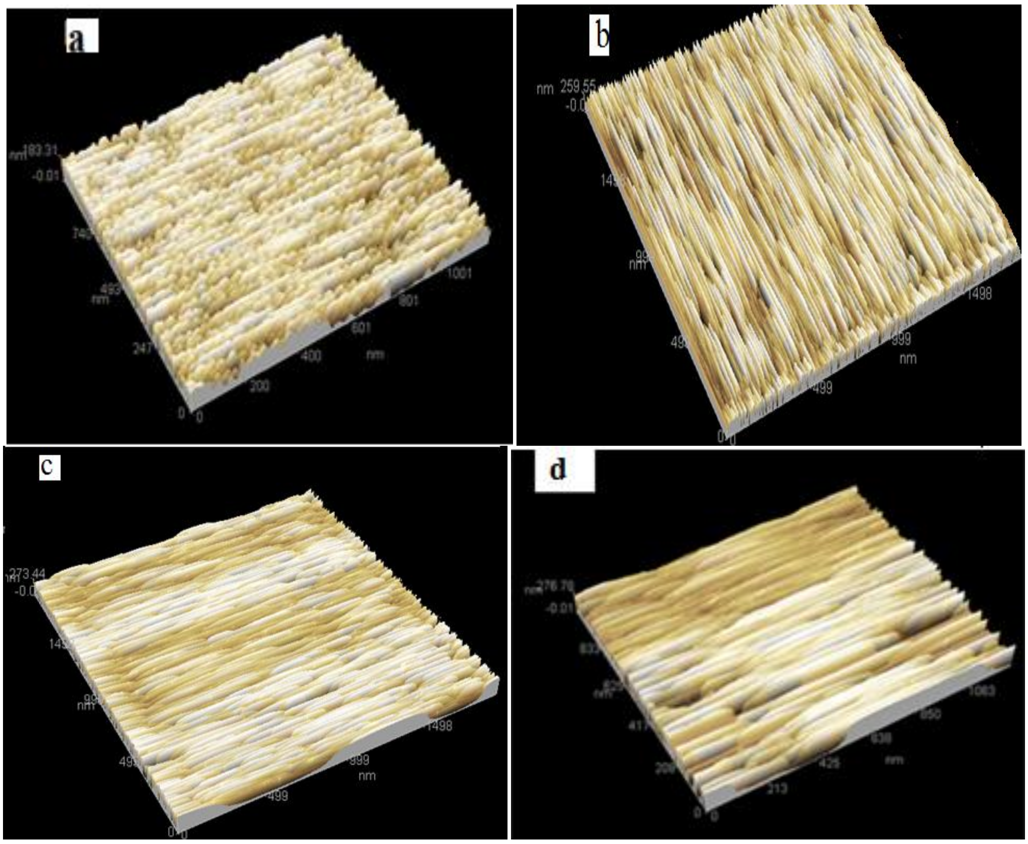

Fig. 3: AFM image of Au NPs ,(a) MF off, (b)10mT, (c)40mT and(d)60mT.

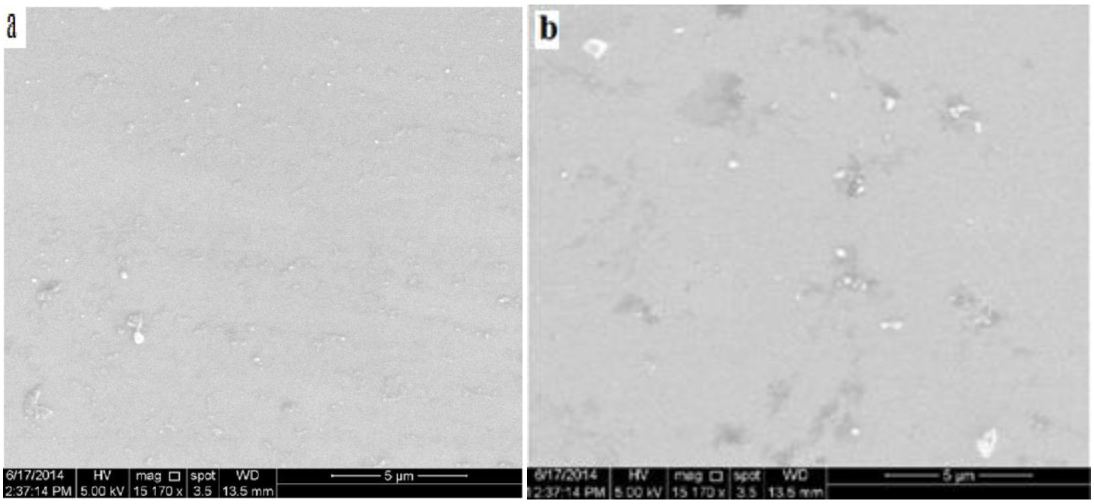

Fig. 4: SEM of Au , (a) MF off (b)40mT.

Conclusions:

In summary, this research work has successfully produced pure gold NPs by using a simple method of nanosecond pulsed laser ablation in DDDW under the effects of MF. the average energy gap of produced NPs is 3.85eV. The average size of gold NPs increased with the applied MF due to the agglomeration effect .scenes the MF act as confinement to the produced plasma.

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Australian Journal of Basic and Applied Sciences, 8(18) December 2014, Pages: 159-162

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