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Synthesized and Characterizing of (Au@Pt) Ultra Fine Nanoparticles Prepared by Pulsed Laser Ablation in Liquids

Abbas H. Abo Nasria **S. M. Thahab** ***Saja Hussain**

Physics Department, College of Science, University of Kufa, Najaf, Iraq.

*Corresponding Author E-mail: sajahussain2@gmail.com

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A B S T R A C T:

Gold(Au), Platium (Pt) and Gold –Coated Platinum (Au@Pt) ultra Fine(UF) nanoparticles (NPs) were preperd by Pulsed Laser Ablation in Liquids method with (Q-switched, 1064 doubled frequency-Nd: YAG). The laser ablation of Au ,Pt metal plates and (Au@Pt) has been performed by immersing these metal plates in two different liquid deionised water (DIW) and ethanol alcohol . (PLAL) process preformed with 100 pulse energy of 700 mJ and liquid depth is 2cm. The nanoparticles of the gold element were coated with platinum(Au@Pt) in two steps. The nanotubes of the gold element were first examined and the platinum metal was then immersed in the liquid from the first step. The formation efficiency of PLAL process was quantified in term of the absorption spectrum peaks. The absorption spectra (Pt) in DIW shows a sharp and single peak around 234nm,and (Au@Pt) shows a sharp and single peak for Au at 516nm and for Pt 221nm.The TEM images show that the nanoparticles are rather spherical in shape .While the average size for all the samples was in rang from(2-5)nm .There was an increase in size when using ethanol alcohol. Changing the way of the fluid environment is a simple and flexible way to control the size and strength of Au and Pt and (Au@Pt) colloidal nanoparticles.

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التركيب والخصائص لدقائق الذهب المغلف لدقائق البلاتين النانوية متناهية الصغر المحضرة بطريقة التشظي بالليزر بالوسط السائل

عباس حسن أبو ناصرية **صباح مريسن ضهاب** **سجى حسين**

قســـم الفــيزياء ، كـــلية العـــلوم ، جـــامعـــة الكـــوفـــة

الكلمات المفتاحية:

المواد النانوية
جهاز ليزر الأندياك النبظي
التشظي بالليزر
ذهب، بلاتين

الـــخُـــلاصـــة:

الدقائق النانوية للذهب والبلاتين و دقائق الذهب المغلف لدقائق البلاتين(Au@Pt) متناهية الصغر والتي تم تحضيرها بطريقة التشظي بالليزر في الوسط السائل باستخدام ليزر الأندياك النبظي مضاعف التردد بطول موجي (1064nm). تم اجراء عملية الاستضال الليزري لـ (Au) و (pt) عن طريق غمر الصفائح المعدنية لهذه المعادن في نوعين من السوائل المختلفة هما الماء المقطر و كحول الأيثانول . تمت عملية التحظير بأستخدام 100 نبظة وطاقة مقدارها(700mJ) وعمق السائل كان(2cm).تم تحظير الدقائق النانوية لـ(Au@Pt) بخطوتين حيث تم تحظير المواد النانوية لعنصر الذهب بالخطوه الاولى وبعد ذلك تم غمر معدن البلاتين بالسائل الناتج من الخطوة الاولى. تم تحديد كفأة التشكيل لعملية الأستئصال الليزري بواسطة حساب ذروة امتصاص الطيف. طيف الامتصاص لمعدن البلاتين(Pt) في الماء المقطر اظهر قمة واحده حاده عند الطول الموجي (234nm)بينما طيف الأمتصاص للمواد النانوية لـ(Au@Pt) اظهر قمة مفرده لعنصر الذهب عند طول موجي(516nm) وقمة مفرده لعنصر البلاتين عند طول موجي (221nm).بينما اظهرت فحوصات جهاز الماسح الضوئي TEM أن الجسيمات النانوية هي كروية الشكل. بينما كان متوسط حجم جميع العينات بمتوسط (2-5nm) وكانت هناك زيادة بالحجم عند استعمال كحول الأيثانول.تغير الوسط السائل المستخدم يعتبر طريقة سهلة ومرنة للتحكم بحجم وقوة الجسيمات النانوية لعنصر الذهب والبلاتين و(Au@Pt).

1. INTRODUCTION

Nanoparticles of noble metals. Gold, silver, platinum and their counterparts have combined great interest from the scientific community because of their enormous properties and diverse applications [1,2]. Noble metal nanoparticles (NMNPs) can be prepared by both "top–down" and "bottom–up" approaches[3]. The exceptional properties of noble metals such as resistance to corrosion and oxidation, non-reactiveness, unusual high reduction potential, high melting point and high ionization energy have attracted huge interest of scientific community to design their functional nanoparticles for both basic as well as applied research. The physiochemical properties of noble metal nanoparticles are controlled by different attributes like size, shape, architecture, crystallinity and composition[2]. Gold also has a long history of use in the world as a nervine, a substance that could give a new lease of life for people whose suffering from neurological conditions. . In the 16th century, gold was recommended for the treatment of epilepsy. At the beginning of the 19th century, gold was used to treat syphilis. After discovering the bacteriostatic effect of gold cyanide towards the tubercle bacillus by Robert Koch, gold-based treatment was introduced for tuberculosis in the 1920s [4]. The main clinical used of gold compounds are in the treatment of rheumatic diseases including psoriasis, juvenile arthritis, planindromic rheutamitism and discoid lupus erythematosus [5,6]. Pt and alloy nanoparticles have attracted extremely interest because they are perfect catalysts for many purposes; for example, nanoparticles supported on porous alumina are used to eliminate NO generated in the combustion process [7]. PLAL produce iron-based NPs with a clean surface without toxic precursors and enhanced chemical reactivity [8]. Nanoparticles produced by PLAL technique are completely pure particles and contain no byproduct or toxic chemicals compared to other techniques used. Therefore, this process opens the door to use and apply the produced nanomaterials without the need for further purification techniques in many applications, especially medical treatments [9,10]. Several works investigated the production of iron-based NPs by PLAL in several solvents. Different oxidation or carbonization states can be achieved, because of the chemical reactions between the iron metal vapor and the liquid surrounding during the NP formation phase [11]. Thus, PLAL managed to create a variety of nanomaterials by choosing the right laser parameters and liquid solvent. Most works have been carried out on nanosecond-PLAL (ns-PLAL). In this research Iron and Platinum nanoparticles have been preperd by physical blend approach. Most vital physical methodologies incorporate dissipation buildup and laser ablation. The ablation effectiveness and the attributes of delivering nanosilver particles rely on many components, for example, the wavelength of the laser impinging the metallic focus on, the span of the laser beats, the laser fluence, the removal time term and the successful fluid medium, with or without the nearness of surfactants.

This work is to exhibit the impacts of encompassing particles on nucleation, development instruments and size conveyance. Changes in the fluid environment utilized as a part of laser removal give a basic and adaptable strategy to adjust the properties of nanoparticles and will be presented a detailed the study on the synthesis and characterization of the gold ,Platinum and gold-coated Platinum nanoparticles.

2. EXPERIMENTAL DETAILS

Gold (Au) and platinum (Pt) nanoparticles (NPs) were set up by laser ablation of the two metal target. The target with 3mm thickness and a purites of 99.99 were washed with ethanol and deionized water to remove any unwanted materials then blends in an ultrasonic cleaner. Deionised water, ethanol alcohol was used as the liquid environment for laser ablation prosses.

In the midst of laser clearing, the specimen was swing physically to ensure uniform expulsion and to keep up a basic segment from a Completing effect. The nanoparticles prepared by using ("Q- switched, 1064 or 532 nm Nd: YAG") with a single wavelength of 1064nm in various liquid media (DW , ethanol alcohol .The rest of the variables were fixed for all samples. The number of pulses used was 100 pulses, the energy value was (700) mJ, the frequency (5) HZ, the liquid depth was(2) mL, and the samples were prepared at room temperature. The nanotubes were coated with two steps. The first step was the screening of nanomaterials for gold. The second step was to immerse the platinum in the liquid containing the nanoparticles of the gold element from the first step The natures of the resulting nanoparticles were characterized and described using several UV-Visible Spectrometer, Transmission electron microscopy TEM type (Model: LEO 912 AB), (Made in Germany) The images were obtained at an accelerating voltage of 120 kV, with maximum magnification of (25000x -63000x

3. RESULTS AND DISCUSSION

3.1. Transmission electron microscopy [TEM] characterization

Au ,Pt and Au@Pt NPs size were further confirmed by TEM images. Figure 1 shows a TEM image and the size distribution of the AuNPs produced in Water. From this figure, it can be seen that the diameter of Au NPs was ranged from (0.5 to 2.5 nm). The average size of Au nanoparticles is 1.24 nm.

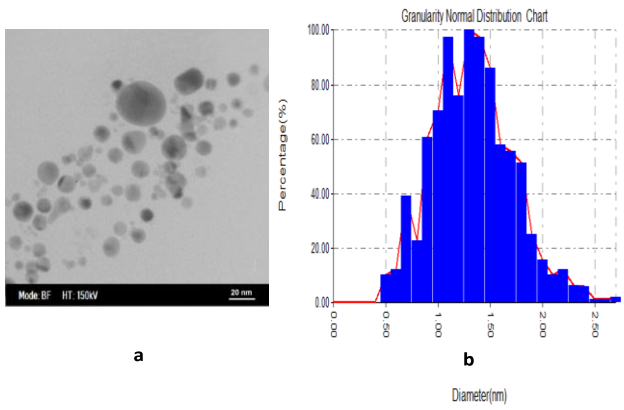
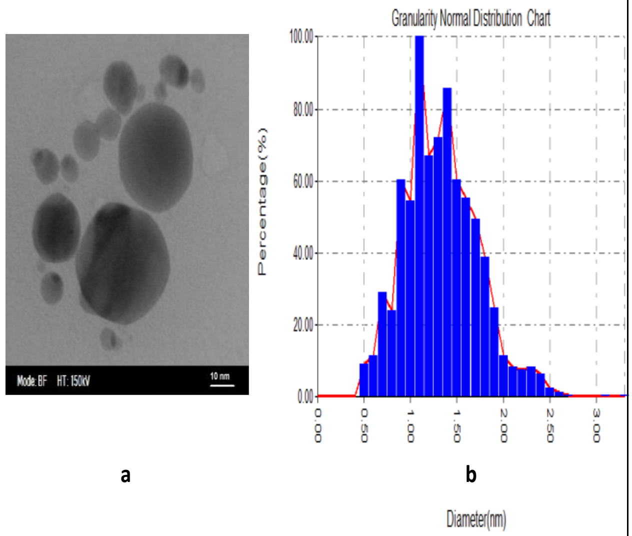


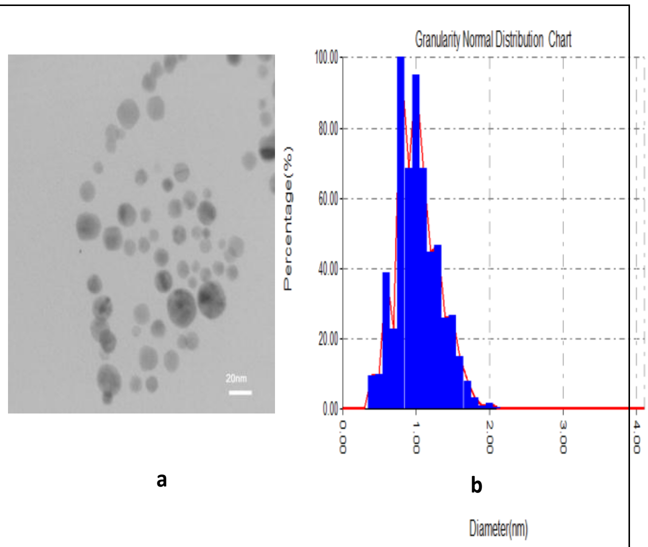
Figure 1: (a)TEM image (b) and size distribution of the Au NPs produced in Water

While the average size of the AuNPs in ethanol was range from (0.5 to 2.5 nm). The average size of Au nanoparticles is 1.27 nm as shown in Figuer 2



Figuere 2: (a)TEM image (b) and size distribution of the Au NPs produced in Ethanol alcohol

Figuer. 3 shows a TEM image and the size distribution of the PtNPs produced in Water. From this figure, it is seen that the diameter of Pt NPs was ranged from (0.5 to 2nm). The average size of Pt NPs is 0.98 nm



Figuere 3: (a) TEM image (b) and size distribution of the Pt NPs produced in water.

While the average size of the PtNPs in ethanol was range from(0.5 to 2.5nm). The average size of Pt nanoparticles is 1.30 nm. as shown in Figuer 4.

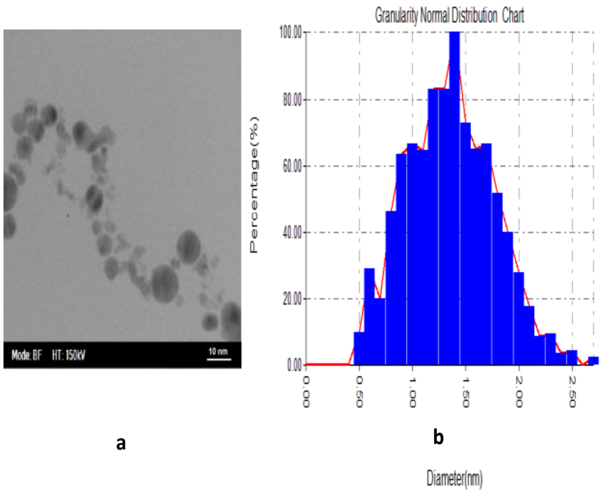


Figure 4: (a)TEM image (b) and size distribution of the Pt NPs produced in Ethanol alcohol.

Figuer. 5 shows a TEM image and the size distribution of the (Au@Pt)PtNPs produced in Water. From this figure, it is seen that the diameter of Au/Pt core–shell nanoparticles ranges from (0.4 to 2.5nm). The average size of Au/Pt nanoparticles is 1.09 nm and are core –shell.

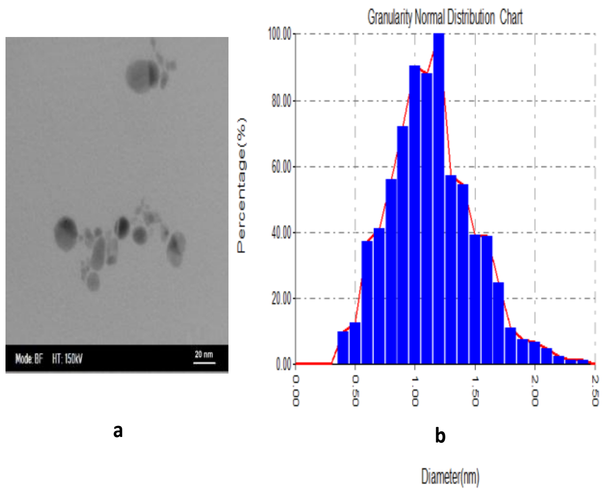


Figure 5: TEM image (a) and size distribution (b) of the Au@Pt NPs produced in Water.

While the average size of the (Au@Pt) NPs in ethanol was ranging from F (0.5 to 3.5mm). The average size of Au/Pt nanoparticles is 1.23 nm and are core –shell as shown in Figuer 6.

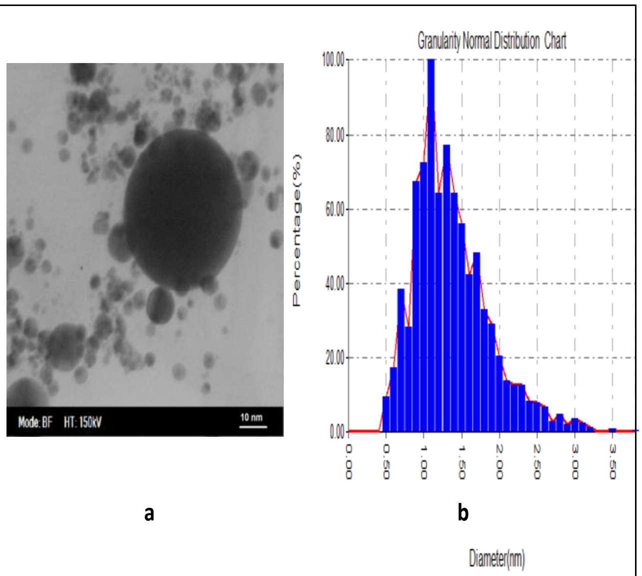


Figure 6: (b)TEM image (b) and size distribution of theAu@ Pt NPs produced in Ethanol alcohol.

3-2 UV–vis spectroscopy characterization

The Fig 7 shows the UV–visible spectra of Pt NPs (in DW and in ethanol alcohol). In Fig 7 the peak presented at 234 nm indicating the formation of Pt NPs in water with Absorption value1.08 . While ,the peak located at 224 nm indicating the formation of NPs in ethanol with Absorption value 0.44 . From the result of the UV-vis spectrum, it can be seen that a wavelength shift to the shorter wavelength (blue shift) in ethanol alcohol due to high polarity of alcohol ,while the absorption value was higher to that in a water medium.

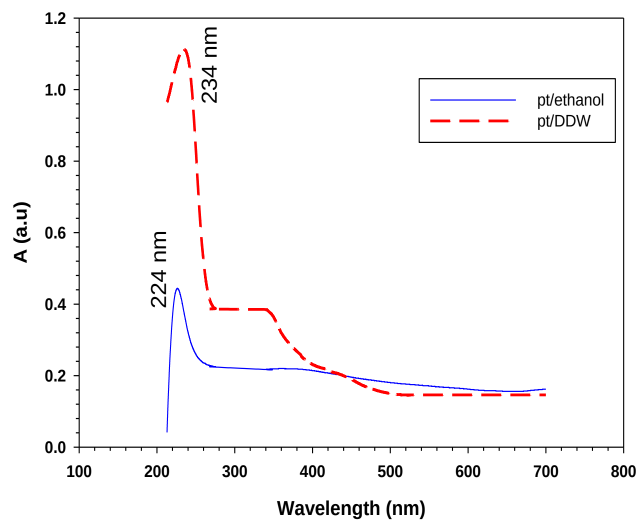


Figure 7: UV-Vis absorption spectra of Pt NPs prepared in different solutions.

Figure8 shows the UV–visible spectra of Au@Pt NPs prepared in wate.The Au/PtNP in DW colloid exhibits an absorption band with a sharp peak for AuNP located in the wavelength of (516)nm and absorption value of (0.24), while the PtNP colloid shows an absorption band with a sharp peak located in the wavelength of (221)nm with Absorption value(1.11).

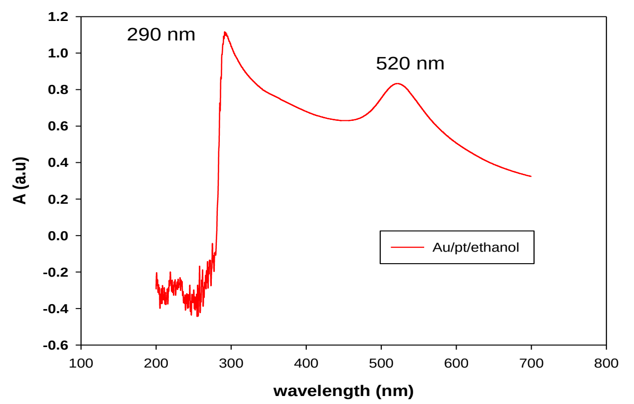


Figure 8: UV-Vis absorption spectra of Au@Pt Ps prepared in Water.

Figure 9 shows the UV–visible spectra of Au@Pt NPs prepared in ethanol alcohol . In ethanol the Au/PtNP colloid exhibits an absorption band with a sharp peak for AuNP located in the wavelength of (520)nm and absorption value of (0.84), while the PtNP colloid shows an absorption band with a sharp peak located in the wavelength of (290)nm with Absorption value(1.05).

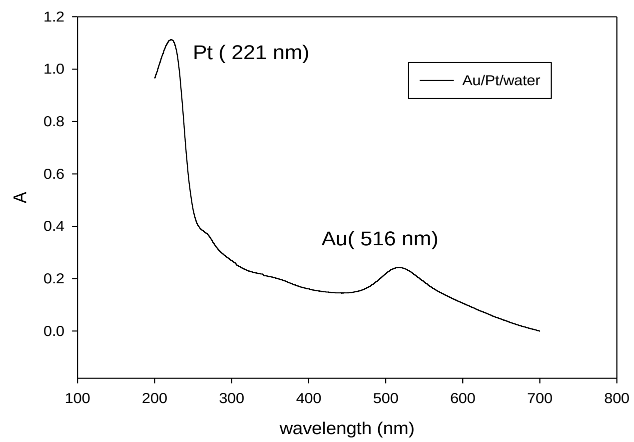


Figure 9: UV-Vis absorption spectra of Au@Pt NPs prepared in Ethanol.

4. CONCLUSION

The effectiveness of Laser Ablation in Liquid method to preparation of Au,Pt and Au/Pt nanoparticles of different metals in different solutions has been used . Pt NPs in a DIW showed a slim size scattering and a wavelength of most prominent optical demolition at 234nm, While in ethanol gave a single sharp peak of the iron in 224nm. The Au/PtNP in DIW colloid exhibits an absorption band with a sharp peak for AuNP located in the wavelength of (516)nm and absorption value of (0.24), while the PtNP colloid showed an absorption band with a sharp peak located in the wavelength of (221)nm. In ethanol the Au/PtNP colloid exhibits an absorption band with a sharp peak for AuNP located in the wavelength of (520)nm and absorption value of (0.84), while the PtNP colloid shows an absorption band with a sharp peak located in the wavelength of (290)nm. TEM images show that the nanoparticles are rather spherical in shape .While the average size for all the samples was in rang from(2-5)nm .There was an increase in size when using ethanol alcohol.

5. ACKNOWLEDGMENT

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