Spectroscopic properties of gold nanoparticles by laser irradiation

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القياسات الطيفية لدقائق الذهب النانوية باستخدام تشعيع الليزر

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المستخلص

تم في هذا البحث تشعيع دقائق الذهب النانوية بأشعة الليزر .تم تحضير دقائق الذهب النانوية باستخدام ترترات البوتاسيوم كعامل مختزل او البولي اثيلين جلايكول كعامل تشتت . حجم دقائق المحلول الغروي بين (100 -50) نانو متر وقد تم امرار شعاع الليزر على المحلول الغروي المحضر ولمدة (5 و10) دقائق وتم الحصول على النتائج عن طريق قياس الامتصاصية وباستخدام جهاز المطياف ولكلا الحالتين أي قبل وبعد التشعيع . لقد اظهرت النتائج الاختلافات بين المحلولين من خلال المنحنيات المستحصلة عن طريق قياس الامتصاصية . اوضحت النتائج ومن خلال الاختبارات الطيفية ان زيادة فترة التعرض لإشعاع الليزر يؤدي الى توسيع في الحزم ووضوحها اكثر .

Abstract

In this work a gold nanoparticles solutions has been irradiated by laser beam.The gold nanoparticles are prepared by using potassium bitarate as a reducing agent and Polyethylene glycol as a dispersion factor. The particles size of prepared solutions between 50-100 nanometers. Colloidal gold nanoparticles are irradiate with laser diode at period 5 and 10 minutes then the comparisons between two solutions with and without irradiation was done. The results are obtained by measuring the absorbance and using a spectrophotometer for the both solutions before and after irradiation. The result shows the differences between the spectrum of nanoparticles at ordinary state and spectrum of nanoparticles irradiated with laser beam. It's clear that the resolution is increase when the time of radiation is increasing. When spectrophotometers testing are done, we can note that there are broadening in the beginning of the spectrum of nanoparticles and increasing when time of exposure of laser beam is increasing.

Introduction

Colloidal gold is a suspension (or colloid) of sub-micrometre-sized particles of gold in a fluid usually water. The liquid is either an intense red color (for particles less than 100 nm), or a dirty yellowish color (for larger particles).(1)(2) Due to the unique optical, electronic, and molecular-

recognition properties of gold nanoparticles, they are subjects of substantial research, with applications in a wide variety of areas, including electron microscopy, electronics, nanotechnology,(3)(4) and materials science.

Properties and applications of colloidal gold nanoparticles depend upon shape. For example, rod like particles has both transverse and longitudinal absorption peak, and anisotropy of the shape affects their self-assembly.(5)

Gold nanoparticles are useful in biomedical applications due to their distinct optical properties and high chemical stability. Reports of the biogenic formation of gold colloids from gold complexes have also led to an increased level of interest in the bio mineralization of gold. However, the mechanism responsible for biomolecule-directed gold nanoparticle formation remains unclear due to the lack of structural information about biological systems and the fast kinetics of biomimetic chemical systems in solution.(6)

Metal nanoparticles of varying sizes can be prepared by physical as well as chemical methods. They exhibit many fascinating properties, the size-dependent metal to nonmetal transition being an important one. Metal nanoparticles capped can be organized into ordered one-, two- and three-dimensional structures and these structures have potential applications in nanodevices.(7)

Experimental

Materials

Hydrogen tetrachlorourate (III) trihydrate (HAuCl4·3H2O) and poly vinyl pyrrolidone (PVP) are purchase from Aldrich. Potassium bitartrate is purchase from Merck. For the preparation of mixture solution, deionized water is use.

The methods

The colloidal form of gold nanoparticles is prepare by heating 25 ml of potassium bitartrate solution (0.5% and 1%) with stirring and 25 ml of HAuCl4 solution (1.0 Mm) containing PVP solution (1.5 wt%) was added.

Irradiations with laser diode

Solution of gold nanoparticles is radiate with Laser Diode its power max 5mW and wavelength 650 nm for 5 and 10 minutes then the comparison between solutions with and without radiation is done.

Spectrophotometers (sp-3000nano)

The absorption test for two solutions by spectrophotometer type sp-3000nano and the results were showed at fig.-1- , fig.-2- and fig.(3) of gold nanoparticles spectrum at ordinary state and at laser radiator state .

Results

The results showed the spectrum of nanoparticles at ordinary state and at the irradiated with laser beam for 5 and 10 minutes. Fig.-1- showed the ordinary state without irradiation and the spectrum of absorbance from (200-1000) nm .Fig-2- showed the spectrum of absorbance after irradiation by

laser beam (5min) .The spectrum is broadening from the beginning of spectrum and the broadening is increase when the time of irradiation increase (10 min) as in Fig.-3-.

Conclusions

In the nonmaterial, quantum mechanics behavior dominates at interaction on atomic scale and the light interaction with materials also changes significantly at nano size materials. When gold nanoparticles solution was irradiated by laser beam they were absorbed energy and become dense and an elastic scattering was occurred and when spectrophotometers 'testing were done we can note that there are broadening in the beginning of the spectrum of nanoparticles and increasing when time of exposure of laser beam is increasing.

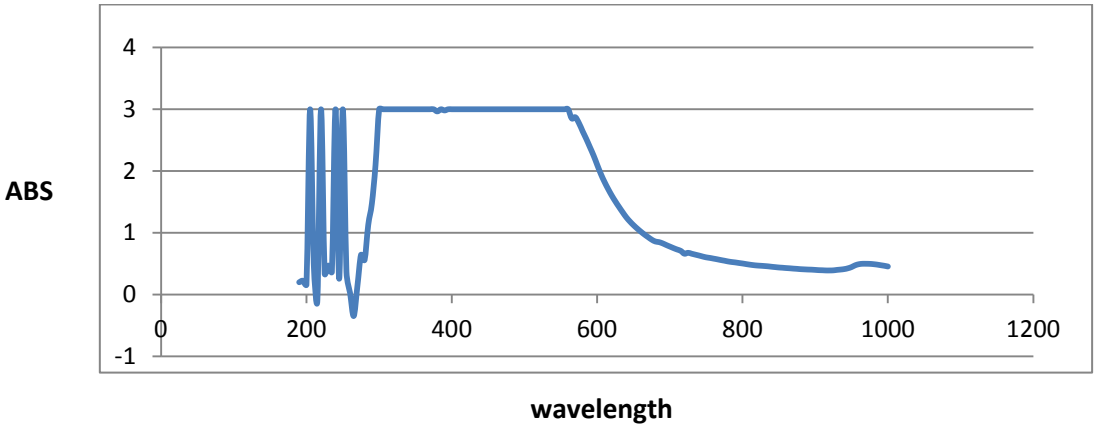

Figure (1): spectrum of nanoparticles at ordinary state

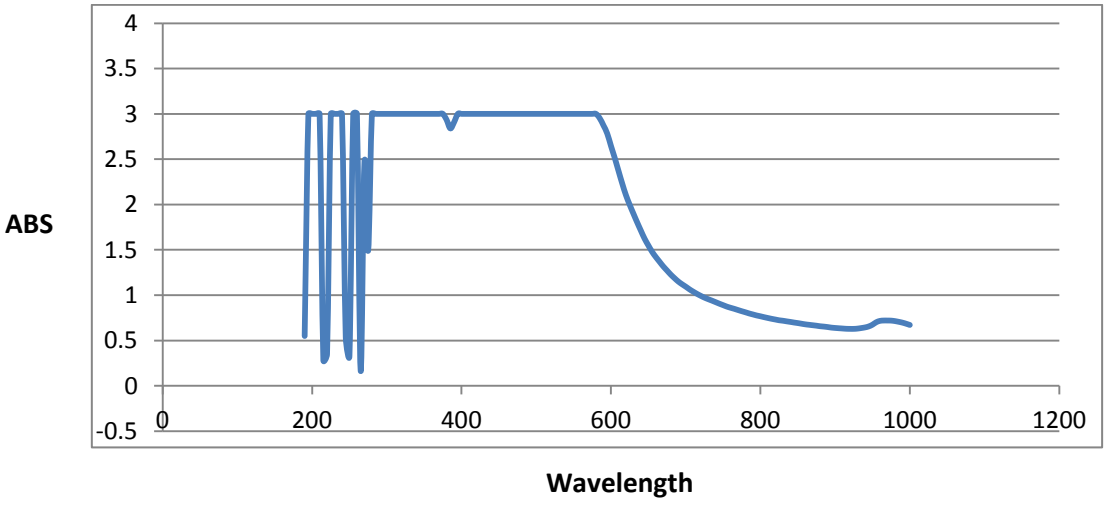

Figure (2): Spectrum of nanoparticles irradiated with laser beam (5 min.)

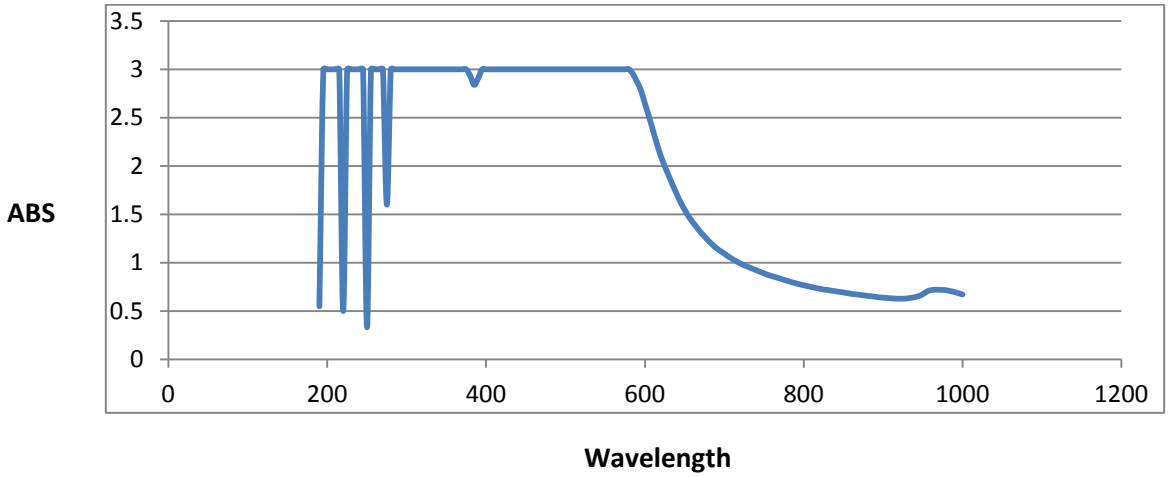

Figure (3): Spectrum of nanoparticles irradiated with laser beam (10 min.)

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