International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.10 No.12, pp 220-225, 2017

Time effect on the red shift of surface plasmon resonance of gold nanoparticles by using hydrogen chloride solution

Abdul Kareem Al-Kazaz[1], Israa Ali Zaidan Al-Ogaidi[2], Raad M. S. Al-Haddad[3], Zakariya Yahia[4]*

[1,2]Department of Biotechnology, College of Science, University of Baghdad, Baghdad-Iraq
[3,4]Department of Physics, College of Science, University of Baghdad, Baghdad-Iraq

Abstract : The solutions of sodium chloride and hydrogen chloride have a high effect on shifting the peak of surface plasmon resonance of gold nanoparticles to the near infra-red region. The gold nanoparticles were synthesized by chemical technique. sodium chloride and hydrogen chloride solutions were added to the colloidal gold nanoparticles. sodium chloride solution has a high effect on shifting the peak absorbance of surface plasmon resonance of gold nanoparticles to the near infra-red region from 524nm to 715nm while hydrogen choride solution has much less effect on shifting the peak absorbance from 715nm to 725nm. The results showed no stability in the peak absorbance of surface plasmon resonance of gold nanoparticles when adding hydrogen chloride solution but more shifting in near infra-red region and more broadening in the absorbance when the time pass.
Keywords : Red shift, SPR, NaCl, HCl, NIR, AuNPs.

I. Introduction

Nanostructure science and technology are an area of research and development activity that has been growing in many different fields in the past few years (A. Alagarasi, 2011). Gold nanotechnology was used in many fields of life, one of them in medical field as an external source of energy such as the output power of near infrared (NIR) laser applied on Gold nanoparticles (AuNPs) where absorb the light as a source of heat to ablate tumors. (M. Marsh et al., 2009). The physical properties of gold nanoparticles show special characterestic among nanoparticles materials due to the high ratio between surface area and volume, small size, inert nature, stability, high dispersity, non-cytotoxicity and biocompatibility (AK Khan et al., 2014). The unique phenomenon known as surface plasmon resonance (SPR) is an optical property of gold nanoparticles leads to strong electromagnetic fields applied on the surface of the particle and enhance the absorption due to the collective oscillation of the electrons in the conduction band, known as the surface plasmon oscillation (Xiaohua Huang et al., 2010). Techniques for making different AuNPs can be categorized into two principles, the “bottom up” method or “top down” methods (Susie Eustis et al., 2006). The bottom up method include thermal reduction techniques (Haes et al., 2004; K. Okitsu et al., 2005). This method involves assembly of atoms (produce by reduction of ions) into desired nanostructures. (Monic Shah et al., 2014). The gold nanoparticles is synthesized by chemometric technique by using chemical reduction methods (Stephan Link et al., 1999; Soheila Honary et al., 2013; Zhao Jingyue et al., 2015). Chloroauric acid ($HAuCl_4$) the source of gold nanoparticles and trisodium citrate dihydrate ($Na_3C_6H_5O_7$) is the reducing agent (Ahlam Jameel Abdulghani et al., 2014). The optimal wavelength 800 nm in near infrared region is used in the tissue for the best penetration by gold nanoparticles where the absorption of water is increasing and the absorption of hemoglobin is decreasing predominantly by assistant of sodium chloride (NaCl) and hydrogen chloride (HCl) solutions which forming a ‘‘tissue window’’ transmission (James F. Hainfeld et al., 2014).

Experimental Method

Materials :

Sodium chloride (NaCl), 0.1N of hydrogen chloride (HCl), deionized water, chloroauric acid ($HAuCl_4$) and trisodium citrate dihydrate ($Na_3C_6H_5O_7$).

Procedure :

Heat 0.2M of chloroauric acid solution at 100°C in 50ml of deionized water without stirring until the solution start to evaporate, then 500µl from 34M of trisodium citrate dihydrate solution was added with stirring until the color of solution turned to red-wine and cool it under room temperature. Then 750µL was added from 0.8M of sodium chloride solution to 2ml of colloidal gold nanoparticles and 50µL from hydrogen chloride solution of 0.1N was added to the solution, respectively**.**

Results and Discussion

The colloid gold nanoparticles was synthesized by 0.2M of chloroauric acid solution and 500µl from 34M of trisodium citrate dihydrate solution as reducing agent. Figure1 shows the surface plasmonic resonance of gold nanoparticles where the peak of absorbance at 524nm in the visible region.

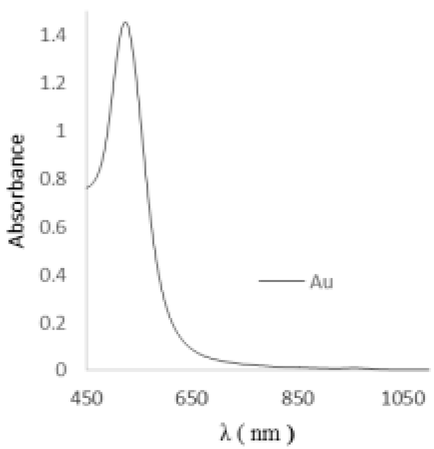

Fig.1 : The SPR of AuNPs in visible region at λ= 524nm

Figure 2 shows the absorbance of gold nanoparticles when 750µL was added from 0.8M of sodium chloride solution. The result is broadening and decreasing in the peak absorbance of surface plasmon resonance and high shift to the near infra-red region is occurred where the peak of the absorbance was shifted from λ=524nm to λ= 715nm.

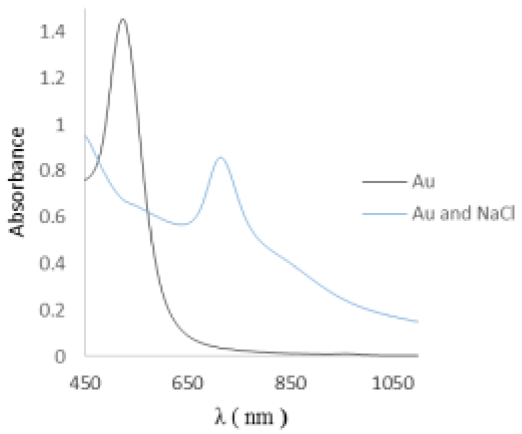

Fig.2 the effect of NaCl solution on SPR of AuNPs

Figure 3 shows a decreasing in the absorbance of surface plasmon resonance of gold nanoparticles and more broadening and shifting in the near infra-red region from λ=715nm to λ= 751nm when 50µL from hydrogen chloride solution of 0.1N was added to the mixture of sodium chloride solution and colloidal gold nanoparticles.

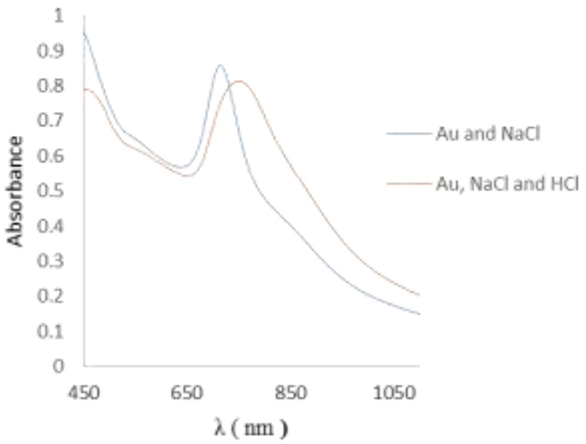

Fig. 3 the effect of HCl solution on SPR of AuNPs

Figure 4 shows the effect of time when it passed (15min, 30min. and 45min.) for HCl solution where its effect is changed the peak and the optical curve of surface plasmon resonance of gold nanoparticles. The peak of absorbance is decreased more, the optical curve of surface plasmon resonance becomes more broadening and getting more shifting toward near infra-red region from λ= 751nm to 763nm, 766nm and 768nm at time= 0min, 15min., 30min. and 45min, respectively.

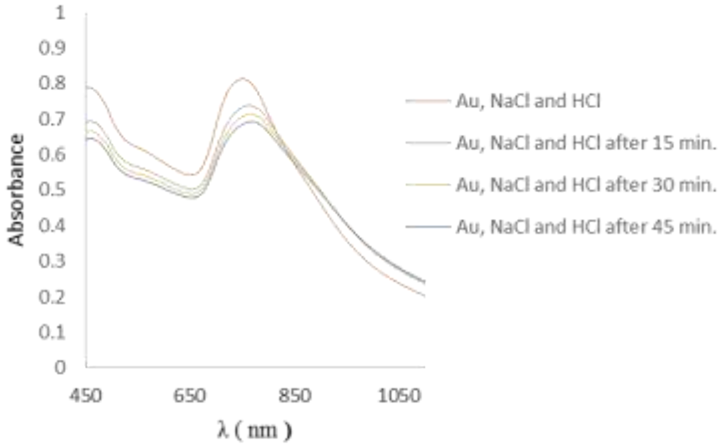

Fig 4 time effect of HCl on SPR of AuNPs

In figure 5 shows the effect of time on the peak absorbance of surface plasmon resonance for gold nanoparticles after adding 0.5μl from HCl solution of 0.1N. The curve is decreased exponentially when the time increased or the relation between time and hydrogen chloride solution is inversely proportional.

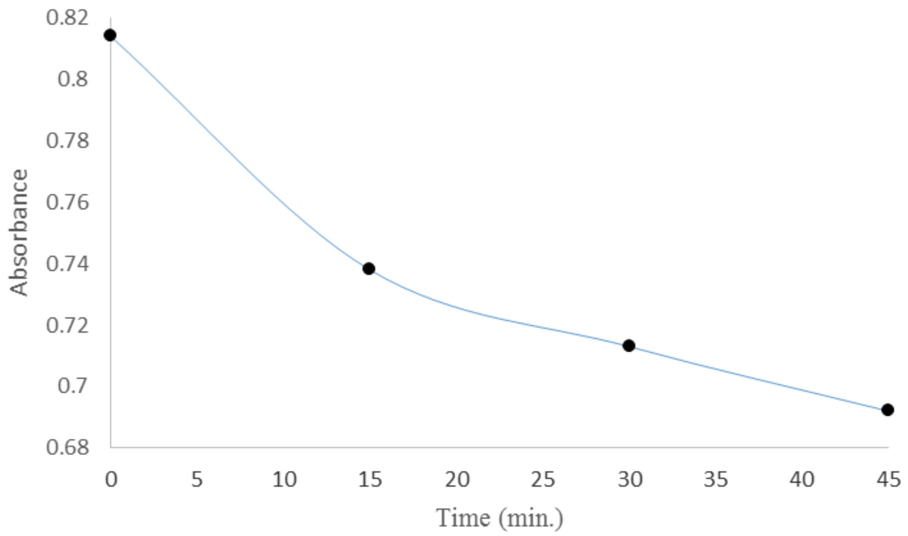

Fig. 5 the relation between time and peak absorbance for SPR of AuNPs

In figure 6 the curve is decreased exponentialy between the peak absorbance for surface plasmon resonance of gold nanoparticles and the wavelength at which the maximum value (peak) of surface plasmon resonance occurred.

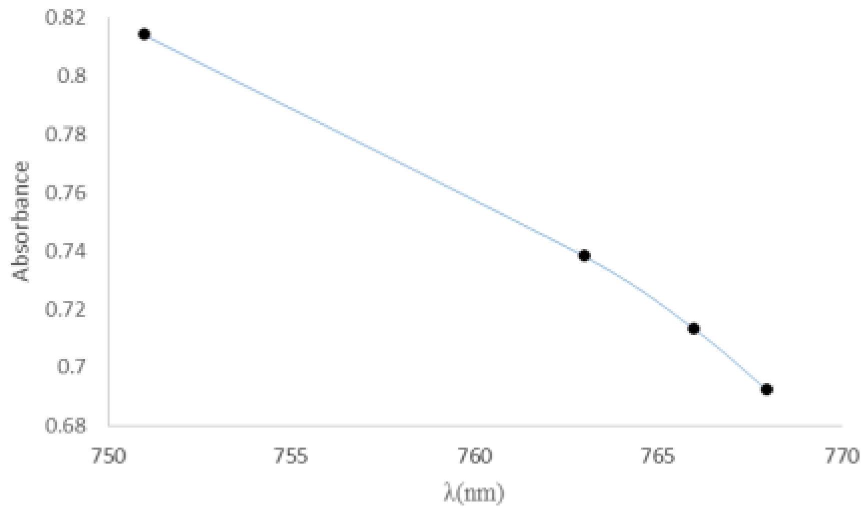

Fig. 6 the relation between peak absorbance and λ at which SPR occurred.

Conclusion

A red shift can be achieved to the near infrared region for the surface plasmon resonance of gold nanoparticles by adding sodium chloride solution and hydrogen chloride solution as an assistant factor (Zakariya et al., 2017). Unfortunately, no stability in the optical curve of gold nanoparticles especially for the absorbance of surface plasmon resonance when hydrogen chloride solution is added to colloidal gold nanoparticles and sodium chloride solutions under time effect.

References

1. Alagarasi, Introduction to nanomaterials, Indian Institute of Technology Madras, book , ch. 1, 2013.
2. Ahlam Jameel Abdulghani, Rasha K. Hussain, Synthesis of Gold Nanoparticles Via Chemical Reduction of Au (III) Ions by Isatin in Aqueous solutions Ligand Concentrations and pH Effect, Baghdad Science Journal, 11(3), 2014, 1201-1216.
3. AK Khan, R Rashid, G Murtaza, A Zahra, Gold Nanoparticles Synthesis and Applications in Drug Delivery, Tropical Journal of Pharmaceutical Research, 13(7), 2014, 1169-1177.
4. Haes, A.J. Hall, W.P Chang, L. Klein, W.L. Van Duyne, A localized surface plasmon resonance biosensor: First steps toward an assay for alzheimer's disease, Nano Lett., 2004, 4, 1029-1034
5. James F. Hainfeld, Michael J. O'Connor, Ping Lin, Infrared-Transparent Gold Nanoparticles Converted by Tumors to Infrared Absorbers Cure Tumors in Mice by Photothermal Therapy, PLOS ONE, 9(2), 2014.
6. K. Okitsu, M. Ashokkumar, F. Grieser, Sonochemical synthesis of gold nanoparticles: Effects of Ultrasound frequency, J. Phys. Chem. B, 109, 2005, 20673-20675.
7. M. Marsh, E. Schelew, S. Wolf & T. Skippon, Gold Nanoparticles for Cancer Treatment , PHYS 483 - Queen's University, Kingston, 2009
8. .Monic Shah, Vivek Badwaik, Yogesh Kherde, Gold nanoparticles various methods of synthesis and antibacterial applications, Frontiers in Bioscience, 19, 2014, 1320-1344.
9. Soheila Honary, Pouneh Ebrahimi, Maedeh Ghasemitabar, Preparation of Gold Nanoparticles for Biomedical Applications Using Chemometric Technique, Tropical Journal of Pharmaceutical Research, 12(3), 2013, 295-298.
10. Stephan Link, Mostafa A. El-Sayed, Size and Temperature Dependence of the Plasmon Absorption of Colloidal Gold Nanoparticles, J. Phys. Chem. B, 103, 1999, 4212-4217.
11. Susie Eustis, Mostafa A. El-Sayed, Why gold nanoparticles are more precious than pretty gold Noble metal surface plasmon resonance and its enhancement of the radiative and nonradiative properties of nanocrystals of different shapes, Chem. Soc. Rev., 35, 2006, 209-217.

12. Xiaohua Huang, Mostafa A. El-Sayed, Gold nanoparticles Optical properties and implementations in cancer diagnosis and photothermal therapy, Journal of Advanced Research, 1, 2010, 13–28.
13. Zakariya Yahia, Raad M. S. Al-Haddad, Abdul Kareem Al-Kazaz, Red shift in the Surface Plasmon Resonance of the Gold nanoparticles by using Sodium Chloride and hydrogen chloride solutions, Journal of Chemical and Pharmaceutical Sciences, 10, 3, July-September 2017.
14. Zhao Jingyue, Friedrich Bernd, Synthesis of Gold Nanaoparticles via Chemical Reduction Methods, nanocon, 2015.

*****