Effect of poly hydroxyl materials on the behavior of silver nano-solution

Abstract: This work investigates the effect of poly hydroxy materials on the behavior of silver nano-particles (SNP_s) – solution produced by laser ablation technique. Different concentrations of glycerin, glucose and sucrose dissolved in double distilled water to act as carriers to (SNP_s). Laser of 20 pulses with 600 mJ, 8ns pulse duration and 532 nm are applied. Absorption spectra of SNP solution were measured by UV-VIS spectrophotometer. The rheological behavior was investigated using cone-on-plate viscometer and surface tension device. The results show that a peak of Plasmon located at 400 nm which indicate that SNP_s are present. The viscosity increases as hydroxyl groups concentration increasing and with SNP_S size decreasing. The surface tension decreases as concentration of hydroxyl materials increasing for glycerin and sucrose while increasing with glucose. A good confirming observed between optical and viscosity results.

Keywords: laser ablation, (SNP_s), glycerin, sucrose, glucose, nanosolution.

Introduction

Mostly silver has attracted much than others metals due to its unique properties which can be incorporated into antimicrobial applications, and to their surface Plasmon resonance related properties that are strongly useful for their biological applications[Hassan Korbekandi and SiavashIravani, 2012]. Silver is a safe inorganic, nontoxic, antibacterial agent used for centuries and is capable of killing about 650 types of diseases caused by microbes [Brigger et al, 2002].

Glycerol, also known as glycerin, is commonly used in the pharmacological application and its derivative used in the synthesis of

drugs [M. S. Frank et al, 1981]. Besides that it is easily biodegradable in aerobic conditions thus can be replaced by traditional reducing agent.

Few studies have been reported in the literature demonstrating the formation of silver and gold NPs using glycerol as reducing agent at low temperature. Genc *et al*. have shown low temperature method to obtain monodispersed Au NPs using glycerol-incorporated nanosized liposome, where glycerol, is incorporated on both the external and internal polar surfaces of liposome encapsulating chloroauric acid, facilitates the reduction of Au(III) to form Au(0) atoms and subsequently nanoparticles [R. Genc et al,2011]. Singh *et al*. have reported the formation of nickel nanoparticles in glycerol at 100°C by using hydrazine hydrate in alkaline medium [K. Singh et al, 2011]. Nisaratanaporn and Wongsuwan prepared silver powders of particle size more than 63 nm using silver alkoxide as silver ion precursor and glycerol as a reducing agent at high temperature [E. Nisaratanaporn and K. Wongsuwan, 2008]. Grace and Pandian reported the synthesis of spherical and prism shaped Au NPs in glycerol at both reflux and microwave conditions [N. Grace and K. Pandian, 2006].Emanuela Filippo ,et al synthesis of silver nanoparticles with sucrose and maltose through the treatment of aqueous solutions of silver nitrate with two commonly available sugars, i.e., maltose and sucrose as reducing agents. The average size, size distribution, morphology and internal crystalline structure of the nanoparticles are studied [EmanuelaFilippo, 2010]. Hidetaka Noritomi et al Silver nanoparticles were synthesized in reverse micelles consisting of sucrose fatty acid esters by dissolving reactant powder in the water pool of reverse micelles through the solid-liquid extraction method [HidetakaNoritomi et al,2011].The aim of this work is to show the effect of poly hydroxyl materials(glycrine,glucose and sucrose) on optical and rheological behavior of SNP_s prepared by laser ablation technique.

Materials and methods

Silver target 99.99 % purity with dimension (Φ20*5mm) is provided from a China Company. Silver nanoparticles were synthesized by pulsed laser ablation of silver target in each of glycerin, glucose and sucrose aqueous solutions with concentration of 0.25g, 0.5g and1g of each glycerin, glucose and sucrose dissolved in 50 ml of double distilled water with a good agitation for 1/2 hour using magnetic stirrer at room temperature. Then the silver target was fixed at bottom of the vessel containing the solution of this material and then the laser energy is applied. Ablation is carried out with laser operating at 532nm at 600 mJ pulse energy. The number of laser shots applied on the metal target is 20 pulses and pulse duration is 8ns.

Characterization

UV – VIS double beam spectrophotometer:

SHIM ADZU spectrophotometer UV-1800is used to checks the absorbance of the Nano solutions.

Cone– on- plate viscometer:

The rheological measurements are performed with a cone on plate geometry with the cone diameter of 25mm and its angle 0.8^0 .All experiments are conducted at a constant gap of 0.5mm and an initial stabilization period of 2 minutes is given for achieving constant temperature.

Surface tension

Measurements obtained by using JZYW-200B Automatic Interface Tensiometer supply by BEING UNITED TEST CO., LTD.

Results and discussion

UV – VIS spectrophotometer

Fig. 1, shows the absorbance spectra of SNP_s solutions, the laser pulse struck the metal surface which immersed in the solution. It created a spark plume with a strong shock wave that propagated in all directions. The spark emitted light which were followed by a visible cloud of metal particles oozing out of the silver surface and dispersed slowly in all directions floating in the solution, easily noticed by naked eye. The color of solution was changed. The Absorption peaks in visible region are the characteristic of metals NPs formation. The concentration of glycerin increases from 0.25 to 0.5g results in increasing the absorption intensity, at 1g glycerin the absorption intensity decreasing due to the viscosity increasing. Change in the wave length which is around 400nm indicated that SNP_s are generated [Alireza HOJABR, 2014, Halimah Mohamed, 2014]. Abs. for all glycerin concentration 2g>3g may be due to the dimer or trimer of glycrine as its concentration increases .

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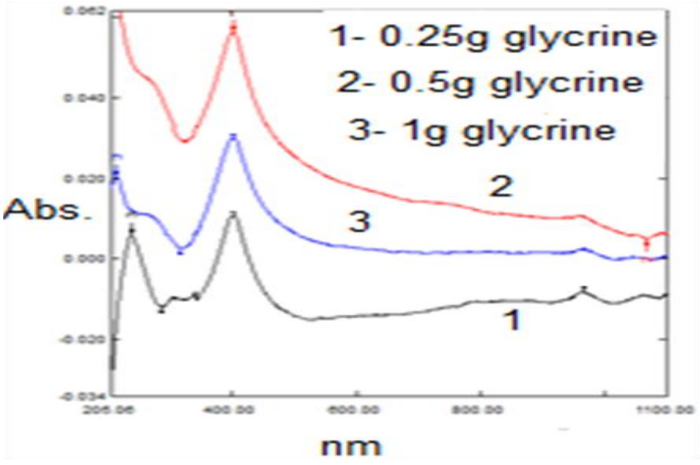

Fig 1:- UV-vis spectra of (0.25g, 0.5gand 1g/50ml) of glycerin solutions

Figs .2 and 3show that the UV-vis spectra of silver nanofluid with different concentrations of glucose and sucrose respectively. When concentration varied from 0.25g to 1g, the position of SPR shifted from 402nmto 405nm for glucose and unchangedfor sucrose.

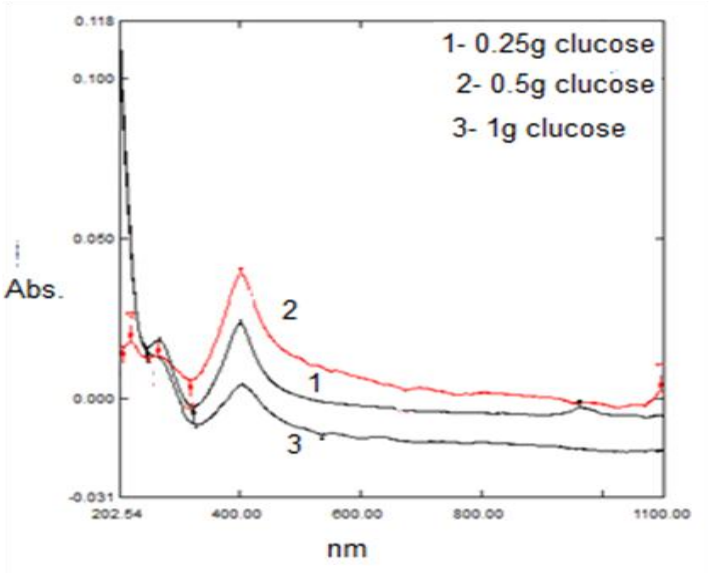

Fig 2:- UV-vis spectra of (0.25g,0.5g and 1g/50ml) of glucose solutions

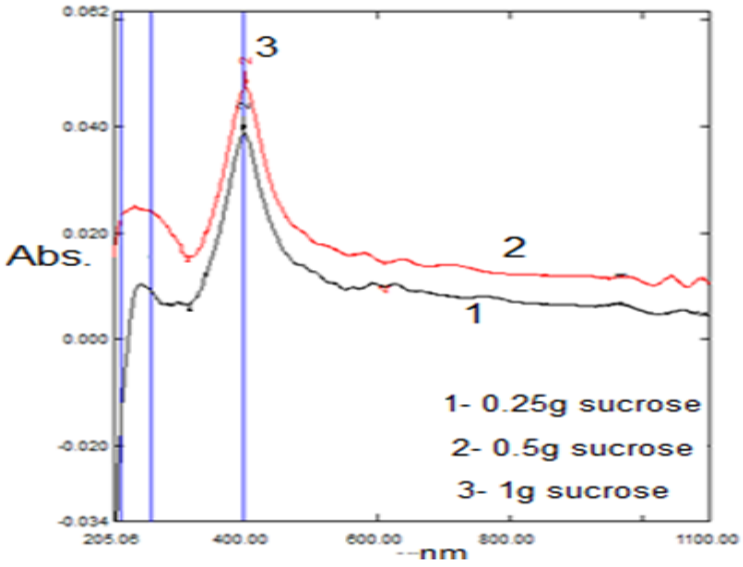

Fig 3:- UV-vis spectra of (0.25g, 0.5gand 1g/50ml) of sucrose solutions

Viscosity and surface tension tests:-

Fig. 4 shows the viscosity against aqueous concentration of glycerin (g/50ml water).The maximum viscosity obtained at 0.55 g/50ml. While at this concentration minimum surface tension obtained as in (Fig.5). This indicated that as the viscosity increases due to the agglomeration, the surface tension decreases. When the concentration increases the particles becomes more closely packed together and the particle – particle interaction increases so that it's difficult to move freely and the resistance to flow increases .Also the viscosity increases due to the SNP distributed in the solution.

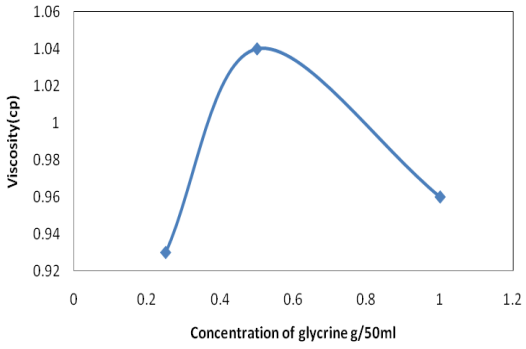

Fig 4:- viscosity behavior of SNP with different concentrations of glycerin

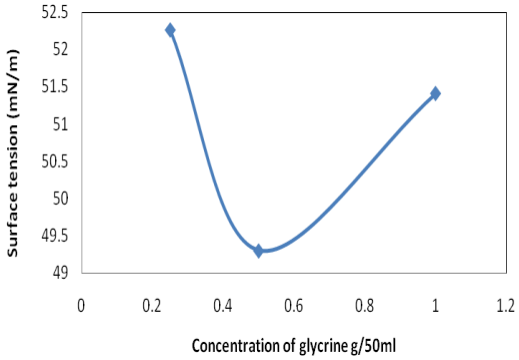

Fig 5:- Surface tension behavior of SNP with different concentrations of glycerin

Fig. 6 shows that the viscosity against concentration of glucose (g/50ml).The viscosity increases with concentration of glucose and maximum viscosity obtained at 1 g/50ml. While Fig. 7shows the surface tension increases as concentration increases due to the cyclic form. This indicated that as the viscosity increases the surface tension increase.

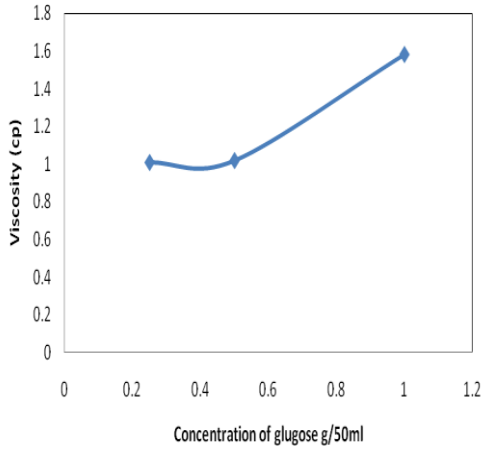

Fig 6:- Viscosity behavior of SNP with different concentrations of glucos

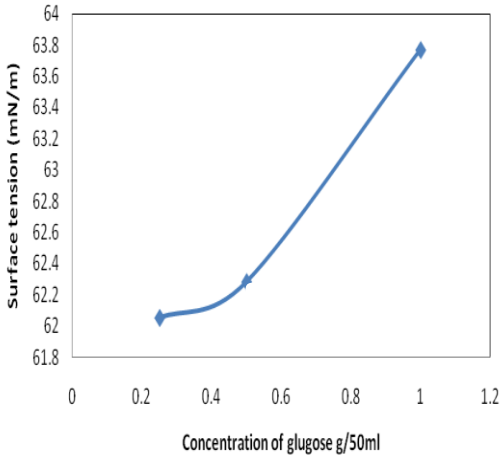

Fig 7:- Surface tension behavior of SNP with different concentrations of glucose

Fig. 8 shows that the viscosity against concentration of sucrose (g/50ml).The viscosity increases with concentration of sucrose increases and highest viscosity value obtained at 1 g/50ml.This concentration shows the lowest surface tension value (Fig.9).

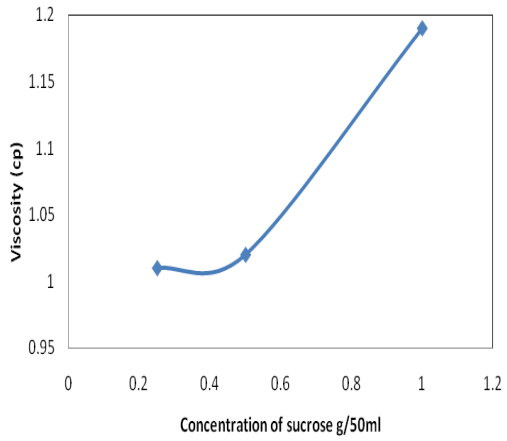

Fig 8:- Viscosity behavior of SNP with different concentrations of sucrose

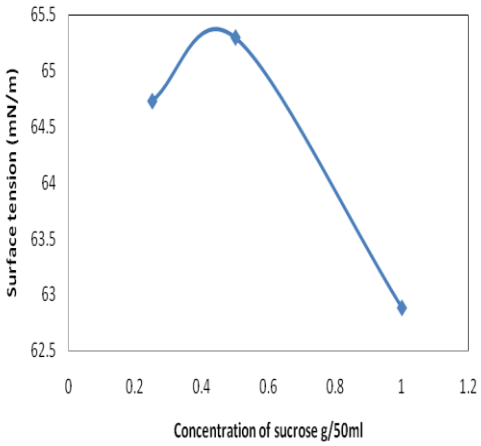

Fig 9:- Surface tension behavior of SNP with different concentrations of sucrose

Conclusion

In this study SNP-polyhydroxyl materials with different aqueous concentrations prepared by laser ablation technique.The applied method is simple, safe and gives high stability. The results show that the absorption peak around 400nm indicated silver nanoparticle is generated with spherical shape. The viscosity and surface tension give an indication whether the nanosolution is stable or not. The viscosity increases with concentration increasing.The surface tension decreases as concentration increases for glycerin and sucrose while surface tension increases with increasing concentration for glucose due to the cyclic form. The six – membered ring of glucose has the chair conformation. In an isomer β-glucose, all of the hydroxyl groups and the – CH_2OH group are equatorial.

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