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Synthesis and Characterization of citrate stabilized Silver nanoparticles

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Abstract
Silver nanoparticles (AgNPs) were successfully developed by a simple chemical reduction method. The particles were synthesized via the reduction of silver nitrate by trisodium citrate and citrate is used as capping agent, stabilizing agent and reducing agent. The resulting AgNPs were characterized by UV-visible spectrophotometer and transmission electron microscopy (TEM). The result of TEM shows that AuNPs with sodium citrate have particle size of 44.04 nm (diameter) and have developing stability. The Result of UV- VIS shows that AuNPs with sodium citrate gives peak at 444 nm and single peak shows monodispercity.

Key worlds*: silver nanoparticles, chemical reduction, sodium citrate, TEM, spectroscopy*

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I. Introduction

Metal particles have established great attention due to their unusual properties differ from bulk metal and also they have ultrafine size. Properties of the metal nanoparticles (chemical and physical) are dependent on their size, structure, shape and size distribution. Therefore, control over the size and size distribution is essential and is frequently achieved by varying the synthesis methods, reducing agents and stabilizers **[1]**. However, chemical reduction is simple method so it is most commonly used. In order to produce silver nanoparticles with controlled particle sizes, shapes and particle size distribution, reduction method also permits variation in the molar concentration of the reactant, dispersant and accelerate rate of reactant. The size, shape and particle size distribution powerfully depend on the nature of the reducing agent so the selection of suitable reducing agent is also a crucial factor, as. Silver nanoparticles (Ag-NPs or nanosilver) have attracted increasing interest because of their distinctive physical, chemical and biological properties compared to their macro-scaled counterparts **[2]**. Silver nanoparticles are the theme of researchers thanks to their distinctive properties (e.g. size, form and antimicrobial properties). Ag-NPs have distinctive physico-chemical properties, with a high electrical and thermal conduction, surface-enhanced Raman scattering, chemical stability, catalytic activity and nonlinear optical behavior **[3]**. Ag-NPs exhibit wide-ranging spectrum bactericidal and fungicidal activity **[4]**.

II. Experimental

2.1. Materials

Silver nitrate ($AgNO_3$) and Trisodium citrate were purchased from Sigma-Aldrich. Aqueous solutions and stock solutions were prepared by using double distilled water.

2.2. Synthesis and characterization of Ag NPs

The citrate stabilized AgNPs were prepared via chemical reduction method in which 1 mM $AgNO_3$ is reduced by 1 % trisodium citrate and citrate is act as reducing agent, capping agent also stabilizing agent. The colour of AgNPs solution is observed from colourless to yellow (figure 1). Here the citrate ions reduce the Ag^{+1} ion to neutral Ag atoms. The colour observed of solution after the procedure from colourless to yellow colour which confirm the presence of silver nanoparticles. Characterization of silver nanoparticles was done via UV-visible spectrophotometer and transition electron microscope (TEM).

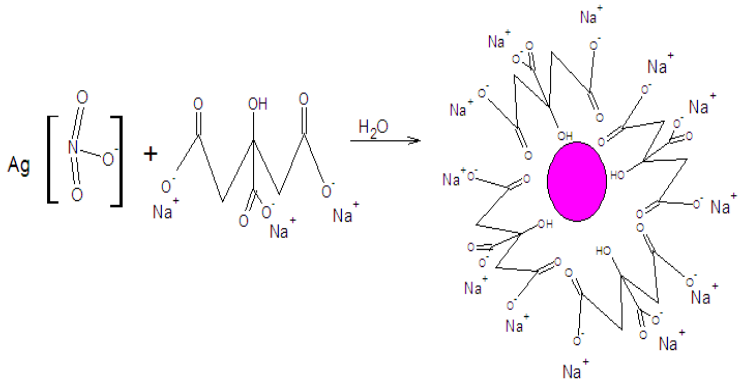

Figure 1 Synthesis of citrate capped silver nanoparticles

III. Results and Discussion

The solution of silver nanoparticles which were made by adding 1mM silver nitrate and 1% citrate was characterised by Uv-visible spectroscopy and TEM. In our work we prepared silver nanoparticles solution which is colourless at time after synthesis. Citrate containing AgNPs solution has COO^- negatively charged group on the surface of Ag. We analysed this solution by UV-visible spectroscopy and there was no peak observed so we considered there was no formation of silver nanoparticles. After 2 days we observed peak at 422 nm and colour was light yellow, then after 5 days there was a peak at 444 nm then after 8 days absorbance peak was at 439 nm and colour became more yellowish then after 14 days the absorbance peak observed at 433 nm and colour became greenish yellow then there was no change observed in absorbance after some days. So here we can see that the absorbance become higher when days go but absorbance is higher on 8^{th} days. Further we analysed the formation of silver nanoparticles. Increase in wavelength indicated that particles size also increased. TEM analysis gives the particles size and shape and from TEM analysis we considered the silver nanoparticles were in 44.04 nm in diameter (size) and spherical in shape.

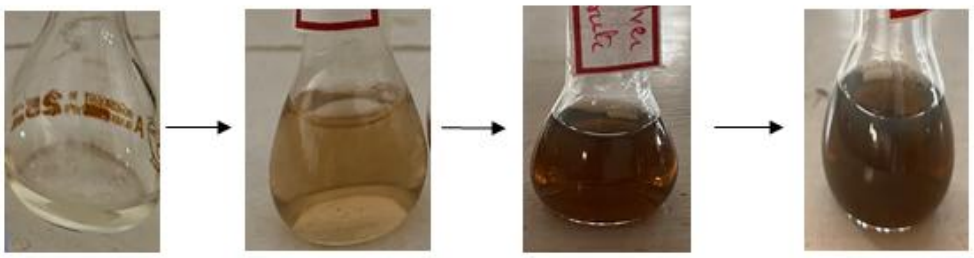

Figure 2 Colour changes of citrate capped silver nanoparticles

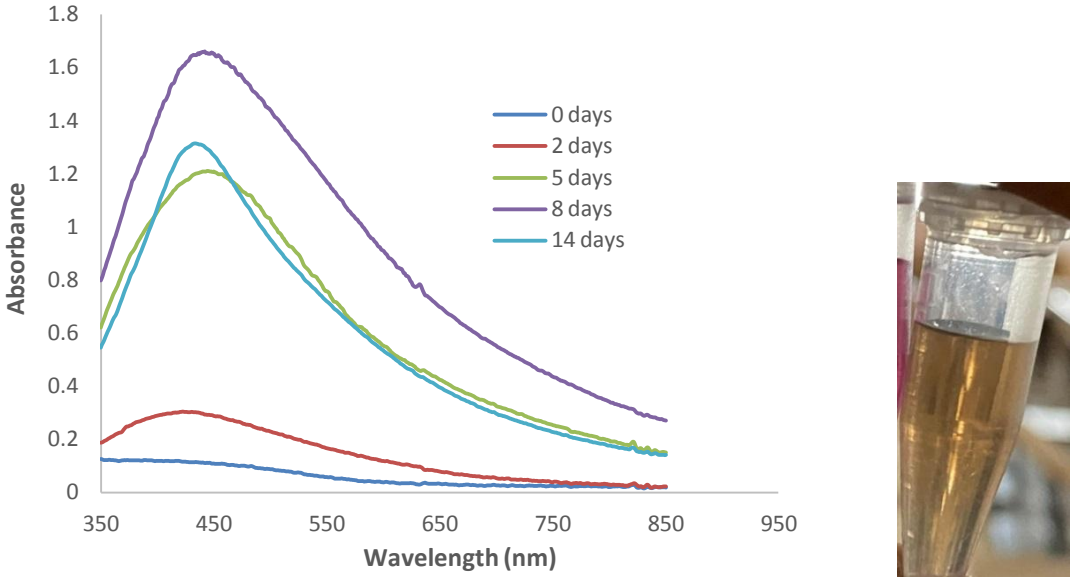

Figure 2 Absorbance peak of citrate capped silver nanoparticles with time

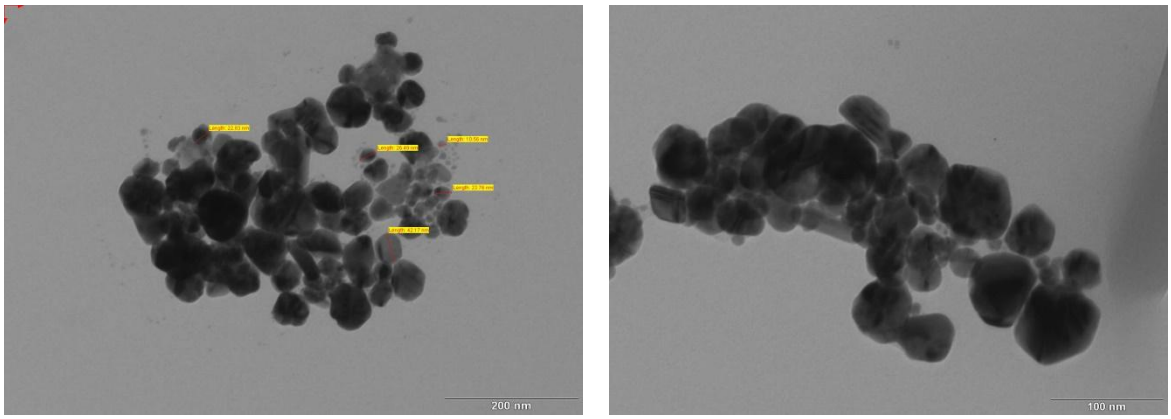

Figure 3 TEM images of citrate capped silver nanoparticles made by adding 1mM silver nitrate and 1 % citrate.

IV. Conclusions

Silver nanoparticles in were synthesized by the citrate reduction method. Preparing Silver nanoparticles takes more time to develop. In our work it was 15 days to prepared silver nanoparticles. The morphology, size and shape of citrate capped AgNPs were characterised using TEM and UV-visible spectrophotometer. The TEM shows diameter 44.04 nm and Uv-visible give maximum absorbance at 444 nm of 1mM gold and 1 % citrate. This data was used in our further study. Such environmental- responsive synthesis method for AgNPs has excessive potential in huge scale manufacturing to match the increasing marketable and industrial demand.

Acknowledgement

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