CB101: Experiment 10 : Synthesis of silver nanoparticles

I- INTRODUCTION

Nanotechnology is the study of materials on the nanometer scale for the purpose of developing practical applications. Materials at nanoscale dimensions exhibit unusual properties compared to their behaviour in bulk. For example, bulk silver metal which is silver grey in colour, when synthesized as nanoparticles can exhibit a wide range of colour depending on the size and shape of the nanoparticles. Silver nanoparticles have anti-bacterial properties and used in wound-healing bandages.

Table for determining the diameter (D) and molar concentration of spherical citrate-capped silver nanoparticles:

D (nm)	λ_{max} (nm)	$\varepsilon \times 10^8$ ($M^{-1}.cm^{-1}$)
16	398.5	22.7
18	399.7	31.3
20	400.8	41.8
22	401.6	54.8
24	402.5	70.8
26	403.5	90.5
28	404.5	115
30	405.6	145
32	406.8	181

D (nm)	λ_{max} (nm)	$\varepsilon \times 10^8$ ($M^{-1}.cm^{-1}$)
34	408.1	215
36	409.4	255
38	410.8	295
40	412.3	336
42	413.9	376
44	415.5	416
46	417.3	457
48	419.1	497
50	420.9	537

The value of ε (molar absorption coefficient) can be used to calculate the molar concentration of the particles (*c*) from the maximum absorption A, using Beer-Lambert law: $A = \varepsilon\, c\, l$, where *l* is the path length of the cuvette (= 1 cm).

Objective: Study the synthesis of silver nanoparticles by reduction of Silver (I) using glucose as reducing agent.

II- PREMILINARY WORK

- Read carefully the procedure

III- PROCEDURE

Chemicals required:

- 3 x 10^{-3} M silver nitrate solution 
- 1 x 10^{-2} M D-glucose solution
- 2 x 10^{-2} M trisodium citrate solution 
- 12g/L soluble starch solution
- 100g/L NaCl solution

Apparatus and laboratory glassware required: See appended.

CB101: Experiment 10 : Synthesis of silver nanoparticles

<u>IMPORTANT:</u> Carefully wash all the glassware with tap water, and rinse it carefully with minimum amount of deionized water provided (NOT distilled water).

- In two large test tubes with magnetic stir-bars, prepare mixture A and B using the following volumes of the supplied solution

Solution	Silver nitrate	Glucose	Citrate	Starch	Water
A	1mL	5mL	1mL	2mL	1mL
B	2mL	5mL	1mL	2mL	0mL
C	1mL	5mL	0 mL	2mL	2mL
D	1mL	5mL	1mL	0mL	2mL
E (no stirring)	1mL	5mL	1mL	2mL	1mL

- The hot bath should be already at high temperature before starting with the experiment.
- The mixture is stirred for 30s and taken it into the hot bath for 3min.
- Alternative stirring and heating is repeated during 30min in total
- The spectra of mixture A and B are obtained. The maxima of absorption and the corresponding wavelengths are written down (if the spectrometer is not available, carry on with the procedure and do all the spectroscopic measurements later).
- The same procedure is repeated for solution C and D. Solution E is left in the hot bath for 30 min without stirring.
- The spectra of solutions C, D and E are obtained. The maxima of absorption and the corresponding wavelengths are written down.

How to use UV-visible spectrometer?

- cuvette must be handled carefully : any scratch or fingerprint on the cuvette would lead to incorrect measurements.
- Always hold cuvette by their ridged sides. When inserting the cuvette in the spectrometer, be sure the light source is directed through the clear sides of the cuvette.
- the cuvette used as a reference solution, filled with distilled water, is already inserted in the spectrometer.
- rinse the cuvette with the solution to be measured before filling it to about 2/3. Carefully wipe off the cuvettes with a clean tissue paper before placing it in the spectrometer

- 1 drop of concentrated NaCl is added to each of the solutions containing nanoparticles.

Write appropriate conclusion about the role of chemicals and stirring in the synthesis and stabilization of silver nanoparticles

<u>APPENDED:</u>

<u>Apparatus and glassware required:</u>

- 5 large test tubes
- 2 test tube holder
- 2 magnets
- two 500mL beaker
- 1 plastic cuvette
- washbottle with deionized water.