EFFECT OF STABILIZING MECHANISMS ON THE STABILITY AND THE DISPERSITY OF GOLD NANOPARTICLES

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Gold nanoparticles are considered to be a versatile colloid in different applications due to their size, stability and shape dependent physicochemical properties. In this work, effects of the stabilizer concentration on gold nanoparticles, the stability and dispersity of gold nanoparticles with time were investigated for different stabilizers. The particle sizes obtained from Dynamic Light Scattering (DLS) data and Surface Plasmon Resonance (SPR) peak of absorption spectra obtained from UV- Visible spectrophotometer were used to investigate the effects of the stabilizers on gold nanoparticles.

Gold nanoparticles were prepared by sodium borohydride ($NaBH_4$) reduction method in the presence of a stabilizer. Hydrogen tetrachloroaurate ($HAuCl_4$) aqueous solution was used as the precursor where Au^{3+} ions were reduced by $NaBH_4$. Citric acid, Triton X-100 and sodium hexametaphosphate were used as the three stabilizers. These stabilizers employ three different mechanisms to stabilize gold nanoparticles. Citric acid and sodium hexametaphosphate stabilize metal nanoparticles through electrostatic and steric stabilization mechanisms respectively. Whereas, metal nanoparticles are stabilized by Triton X- 100 through a micellization mechanism. In all the experiments, the reagent mixture was heated and kept at 80 °C with continuous stirring for 30 minutes under reflux. The three stabilizers were tested at different concentrations with constant concentrations of $HAuCl_4$ and $NaBH_4$.

First, the samples were characterized by UV-Visible spectroscopy and particle size analyser on the day they were synthesized, to obtain the initial reading. Then the samples with smallest nanoparticles were analysed after 1, 2 and 3 weeks of ageing, by UV-Visible spectroscopy and particle size analyser. The effectiveness of different stabilizing mechanisms was compared by the aggregation rates of gold nanoparticles. The aggregation rate of gold nanoparticles for each week was measured through hydrodynamic diameter difference. (Current week's reading- Previous week's reading)

The smallest diameter for gold nanoparticles among all three stabilizers was obtained by Triton X- 100. The aggregation rates for Triton X- 100 were much smaller than the aggregation rates for citric acid and sodium hexametaphosphate systems. Therefore, stability and dispersity analysis through DLS data and, SPR peak positions indicate that micellization is the most successful mechanism to stabilize gold nanoparticles through $NaBH_4$ reduction method.