A Characterization of Ultrastable Silver Nanoparticles

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The purpose of this experiment was to characterize a newly discovered ultrastable silver nanoparticle. Silver is known to be susceptible to oxidation while metals such as gold and platinum are less reactive. Because silver is less expensive than gold and platinum, having it in an ultrastable form is desirable. A recently discovered nanocluster (Ag44(p-MBA)30) has been claimed to be ultrastable. The composition and stability of Ag44(p-MBA)30 in solution were assessed by using analytical ultracentrifugation (AUC) and UV-visible spectroscopy. The experiments were conducted in distilled water, TRIS buffer, sodium chloride, dilute sodium hydroxide, magnesium chloride, and dimethylformamide. Also investigated was the effect of incubation time on the homogeneity of the solution when Ag44(p-MBA)30 was dissolved in sodium hydroxide and water. AUC showed that the nanoparticles were most stable in NaOH, then in TRIS, but aggregated most in water, regardless of the addition of salts. This suggests that higher pH levels reduce aggregation. The spectra obtained from each solvent looked different suggesting that the solvents had different effects on the silver nanoparticle. In contrast to water, when dissolved in NaOH, the samples became more homogeneous over time. Next, the Ag44(p-MBA)30 crystal structure was modeled using Zeno to obtain the frictional ratio. Together with AUC data, this provided the particle density, size distribution, anisotropy, and partial specific volume of the nanoparticle. It can be concluded that AUC and spectroscopy can provide detailed information about the solution properties of nanoparticles, and can help investigators identify conditions where nanoparticles are most stable.