Synthesis of Dendrimer-Passivated Noble Metal Nanoparticles in a Polar Medium: Comparison of Size between Silver and Gold Particles

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The synthesis of silver and gold metal nanospherical particles stabilized by the fourth-generation poly(amido amine) (G4 PAMAM) dendrimer is reported. The reduction of silver nitrate and sodium tetrachloroaurate in the presence of the PAMAM dendrimer having terminal amine groups results in the formation of stable, water-soluble nanoparticles. The formation and size of the particles have been determined from the UV−vis plasmon absorption band and transmission electron microscopic (TEM) analyses. The average particle sizes are (6.2 ± 1.7)−(12.2 ± 2.9) nm for silver and are (3.2 ± 0.7)−(7.3 ± 1.5) nm for gold, depending on the metal ion-to-dendrimer terminal amine ratio (M:D) used. Thus, dendrimer-protected silver particles are substantially larger than the gold particles synthesized in similar systems. Nanoparticles prepared at 0.25:1 and lower M:D ratios are stable for a long period of time. A TEM study of the morphology also shows a short-ranged hexagonal arrangement of particles in a monolayer onto the carbon-coated copper TEM grid. Detailed particle size analysis studies by TEM support the possibility that the terminal amino groups of the dendrimers take part in the stabilization of the nanoparticles. The evidence from X-ray photoelectron spectroscopic and Fourier transform infrared absorption spectroscopic investigations confirms the valence state of the gold and the encapsulation by the dendrimer.

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