

UNDERSTANDING GOLD NANOPARTICLES WITH MASS SPECTROMETRY

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Nanoparticles are known to be useful and semiconductors with excellent biocompatibility. Quantum dot nanoparticles in particular facilitate electron transfer in solar cells to obtain light energy but are composed of toxic cadmium or lead cores. Widespread release of cadmium and lead from quantum dots could have harmful effects on the environment. To monitor the stability of nanoparticle monolayer coatings, mass spectrometry was used to analyze efficiency of the nanoparticle synthesis process and provide insight into the development of more stable nanoparticles. Gold nanoparticles are used in the present study as models of toxic quantum dots to further develop laser-desorption/ionization mass spectrometry (LDI-MS) as a tool for understanding nanoparticles and to design more stable and safe nanoparticles. LDI-MS analysis of synthesized nanoparticles served as a method for quality control of synthesized nanoparticles by examining samples for impurities and the presence of tetraoctylammonium bromide, a toxic surfactant used in the synthesis process. TTMA monolayer ligand quantification with HPLC-MS determined ligand coverage of gold nanoparticles to be 28 ± 2 ligands, 89 ± 27 ligands, and 213 ± 41 ligands for 2, 4, and 6 nm diameter cores respectively. However, LDI-MS analysis demonstrated a stronger ligand signal for the 4 nm over the 6 nm diameter gold nanoparticles. Lastly, nanoparticle monolayer stability in biological systems was examined with LDI-MS. It was found that nanoparticles break down significantly in cell lysate and ligands are removed or replaced over a time period as short as four hours.