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Surface Characterization and Femtosecond-Nanosecond Transient Absorption Dynamics of Bioconjugated Gold Nanoparticles: Insight into the Warfarin Drug-Binding Site of Human Serum Albumin

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Abstract : We studied the spectroscopy of 25-nm diameter gold nanoparticles (AuNPs), coated with human serum albumin (HSA) as a model drug carrier. The morphology and coating of the AuNPs were examined using transmission electron microscopy and dynamic light scattering. Resonance energy transfer from the sole tryptophan of HSA (Trp214) to the AuNPs was observed in which the fluorescence quenching of Trp214 is dominated by a static mechanism. Using fluorescein (FL) to probe the warfarin drug-binding site in HSA revealed the unchanged nature of the binding cavity on the surface of the AuNPs, indicating the stability of the protein structure on the metal surface. The transient absorption results of the surface plasmonic resonance (SPR) band of the AuNPs show three ultrafast dynamics that are involved in the relaxation process after excitation at 460 nm. The three decay components were assigned to the electron-electron (~ 400 fs), electron-phonon (~ 2.0 ps) and phonon-phonon (200–250 ps) interactions. These dynamics were not changed upon coating the AuNPs with HSA which indicates the chemical and physical stability of the AuNPs upon bioconjugation. Binding of FL in HSA did not have any measurable effect on the bleach recovery dynamics of the SPR band, although both FL and AuNPs were excited at 460 nm. The current study is important for a better understanding of the physical and dynamical properties of protein-coated metal nanoparticles which are expected to help in optimizing their properties for critical applications in nanomedicine.

Keywords : gold nanoparticles, human serum albumin, fluorescein, femtosecond transient absorption
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