Applications of Single Molecule Fluorescence Spectroscopy and Microscopy in the Study of Nanomaterials and Biopolymers

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ABSTRACT

We have used single molecule chemical analysis techniques, including single molecule fluorescence spectroscopy, fluorescence correlation spectroscopy, and scanning probe microscopy, to investigate the kinetics and mechanisms of biomolecule conformational fluctuations and the inter-particle electronic interactions of semiconductor nanocrystals. Single molecule analysis techniques enable us to investigate these processes under conditions of macroscopic thermodynamic equilibrium by isolating the equilibrium fluctuations that occur within a small subset of the overall system. In the case of biological macromolecules, we have examined the mechanism of DNA hairpin folding and unfolded, and have uncovered a complex mechanism for this reaction, whereby the DNA molecules can become trapped in long-lived partially folded or misfolded conformations. The implications of this study for understanding the general principles of base-pairing and base-stacking in RNA and DNA will be discussed. In the case of semiconductor nanocrystals, we have investigated the role of inter-particle electronic interactions to modulate the fluorescence intensity fluctuations of the particles. The implications for solid state devices formed from these nanocrystals will also be discussed.

BIO

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