Optical manipulation and study of single gold nanoparticles in solution

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We combine optical trapping and far-field optical detection techniques as a novel approach to study single metal nanoparticles in solution. We demonstrate the first measurements of the acoustic vibrations of single gold nanoparticles optically trapped in water, and find evidence for intrinsic damping mechanisms. Additionally, we explore the potential of single gold nanorods as ultra-small mechanical actuators: we quantify the optical forces and torques on a single trapped gold nanorod (25 nm diameter and 60 nm length) and show that the rod can simultaneously exert forces and torques that would be large enough to manipulate single (macro-) molecules. We developed techniques to measure the combined translational and rotational Brownian motion of a trapped nanorod. We determine the rod's heating by the trap beam and show that translational and rotational Brownian motion of a hot particle are described by different effective temperatures and viscosities.

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