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Hydrodynamic resonance in optical traps & friction of molecular machines

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Optical tweezers are high-resolution position and force transducers widely used in physics, material science and biology. Often dielectric particles of mesoscopic size are used as sensitive probes and handles for experiments. We designed and fabricated high-refractive index, anti-reflection coated titania microspheres (Fig. 1, [1]) and demonstrated nanonewton optical forces [2]. Using the coated microspheres, novel experiments are feasible. The high trap stiffness enabled us to directly measure the colored nature of noise that drives Brownian motion and how it depends on the distance to a nearby surface in quantitative agreement with theoretical predictions [3]. This hydrodynamic resonance can be increased by using larger particles and/or lower viscosity fluids. I will show our efforts in increasing the amplitude of this resonance peak.

Apart from diffusive motion of particles confined in optical traps, we are interested in diffusive motion of molecular motors and the corresponding friction when this motion is biased. We could show that the Einstein relation holds for molecular motors interacting with their tracks [4]. Our recent work indicates that kinesin-8 motors switch between their normal translocating mode and a diffusive mode in order to increase their run length [5]. Here, I will present how this diffusive interaction enables the motor to fulfill its cellular function of microtubule length regulation.

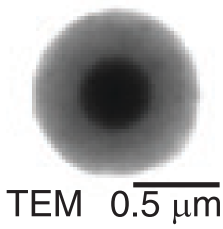

Figure 1: Transmission electron microscope (TEM) image of an anti-reflection coated, high-refractive index titania microsphere.

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