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Investigating parameters affecting the rotational motion of optically trapped metal nanoparticles

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Abstract
Controlling the position and motion of small objects using light offers an attractive means of manipulating tiny microscopic samples, such as biological cells or microscopic particles. Optical tweezers enable the trapping of gold nanoparticles, and by employing circular polarization of the laser, they can be rotated at a frequency of several kHz. This study aims to investigate the rotational dynamics of particles in a two-dimensional optical trap and experimentally study the factors affecting it, including laser power, numerical aperture of the focusing lens, and the medium viscosity. The rotational dynamics were analyzed using two methods, namely the power spectrum method and autocorrelation of particle movement. Experimental results on 400 nm gold particles reveal that, under a laser wavelength of 1064 nm and a numerical aperture of 1, the maximum rotation speed reaches 1470 Hz. Additionally, the observed changes in rotation speed within different liquids with different viscosity agree with the theory prediction.

Keywords: optical tweezers, rotation, power spectrum, autocorrelation, metal nanoparticles

For full article, refer to the Persian section