

5D OPTICAL TRACKING OF NANO-RODS

Markus Griesshammer and Alexander Rohrbach
Lab for Bio- and Nano-Photonics, University of Freiburg,
Georges-Koehler-Allee 102, 79110 Freiburg, Germany
E-mail: griesshammer@imtek.de, rohrbach@imtek.de

KEY WORDS: Optical tracking, optical trapping, optical manipulation, back focal plane interferometry, nano-rods, aspherical particle, interference microscopy.

One of the most fascinating ideas in nanotechnology is the controlled assembly of tiny building blocks (BB) into nano-systems with designed functionality. However, on a scale below 100 nm the controlled handling of BB with tools having even smaller structures is difficult, such that self-assembly processes are a means of choice. A potential candidate that meets the requirements of flexible grabbing, moving and releasing BBs are optical traps (optical tweezers, OT), which allow flexible particle manipulation by a control of laser power, focus shape and focus position.

BB with various and variable external and internal degrees of freedom are Quantum Dots, nano-rods, nano-wires, tripods, etc., which could be placed in predefined environment to assemble nano-systems with new functionality (see figure). Although complex optical force and torque distributions can be created also for subwavelength sized nano-particles ($\varnothing < \lambda/2$), their fast changes in 3D position and 3D orientation due to thermal fluctuations require novel imaging and tracking methods to get their desired and stochastic motion under control.

In this context, we engineer methods for passive and active control i.e. observing and steering of nano-rods. The scattering of rods in highly focussed fields is exploited. Its positions and orientations are detected by back focal plane interferometry and intelligent spatial filtering. We present first concepts of an ultra-fast variation of an interference microscope.

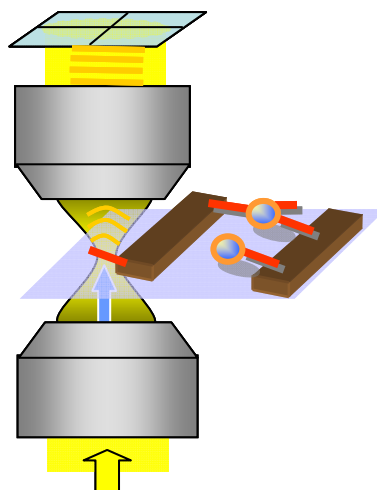


Figure: Sketch of a setup for optical trapping and tracking with back focal plane interferometry and a constructed, functional nano-system in the focal plane.