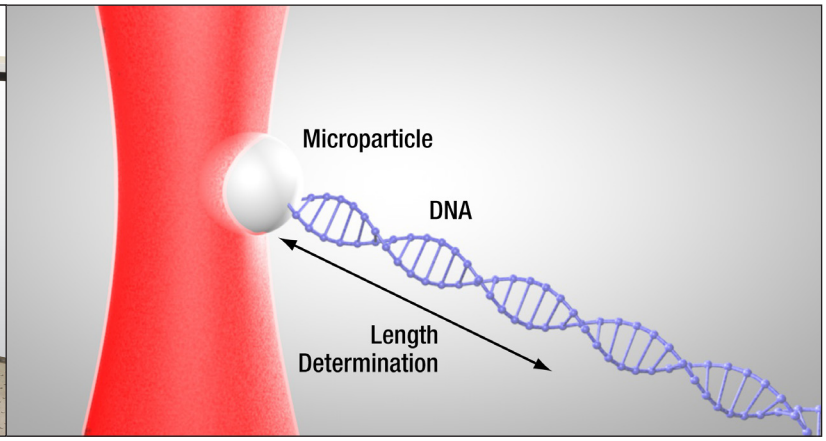
THORLABS
Optical Micromanipulation

Microscope Tweezers System



Thorlabs' Optical Tweezers Microscope System provides scientists with a tool to manipulate and spatially confine microscale objects in biological systems. It is created for users who desire an out-of-the-box optical tweezers solution for inverted microscopes. In addition, our optical tweezers can operate in conjunction with other imaging modalities such as confocal microscopy and Raman spectroscopy. Biological applications for this system include trapping viruses and bacteria, manipulating cellular structures, patterning of surfaces, and measuring the forces of molecular motors and biological molecules such as DNA and proteins.

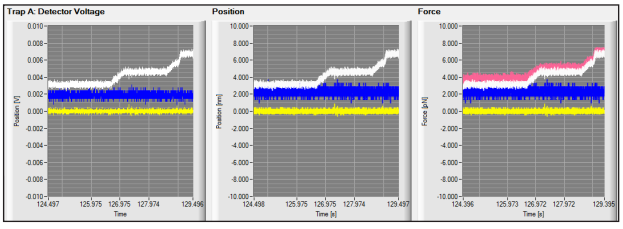
Features

- Optical Manipulation of Microscopic Particles
- High-Resolution Force Measurements
- Particle Tracking
- Multiple Computer-Controlled Traps
- Custom Wavelength Options (830 nm, 976 nm) Available
- Integrate with Existing Inverted Microscope

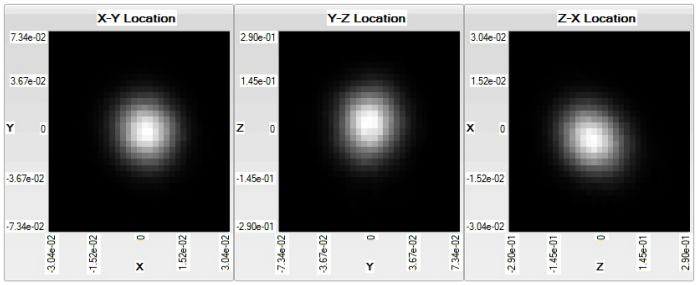
The optical tweezers system is available with or without a microscope, depending on the user's requirements. The system is designed to interface with multiple ports, such as the side or epi-fluorescence ports, on the Nikon Eclipse Ti microscope. Versions for other microscopes are available upon request. Please contact our product specialists at techsupport@thorlabs.com for details.

Force Measurement

The force measurement module lets the user apply and measure forces in the piconewton range. Within the Microscope Tweezers System, the user can run an automated calibration sequence *in situ* without the need for special samples, which might not match the condition during the experiment. This optional module also allows the tracking of trapped particles in three dimensions. The panels below to the right show a histogram of a trapped particle's position in the proximity of a glass surface. The X-Y data shown is symmetric, whereas the Z-data is truncated, as the particle cannot penetrate the surface.



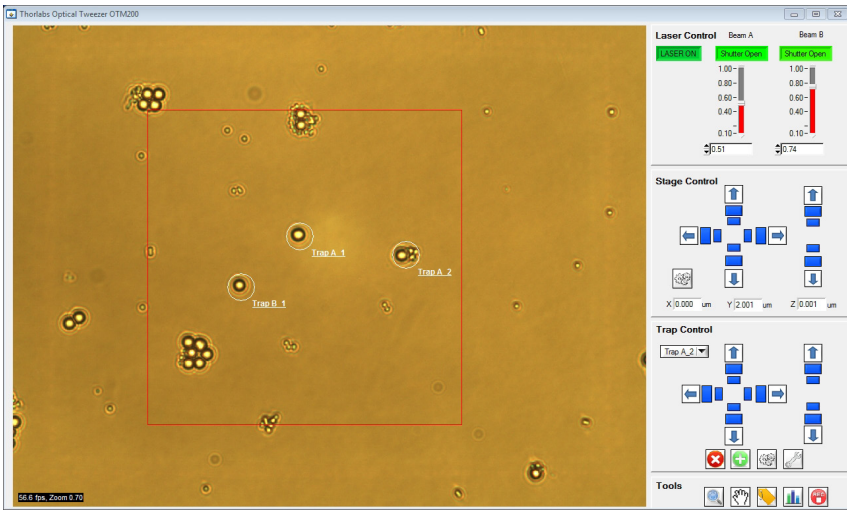
Software Screen Showing Force Tracking



Histogram of a Trapped Particle's Position

Trap Functionality

The trapping source for the Microscope Tweezers System is a power- and wavelength-stabilized 1064 nm laser, which provides two independent trapping beams. Each beam can support several time-shared traps. Other trapping wavelengths and powers are available to meet user's demands. The output of the trapping laser is collimated, and the light is focused onto the sample with diffraction-limited performance, thereby achieving trapping forces exceeding 200 pN.



Optical Tweezers Software Interface

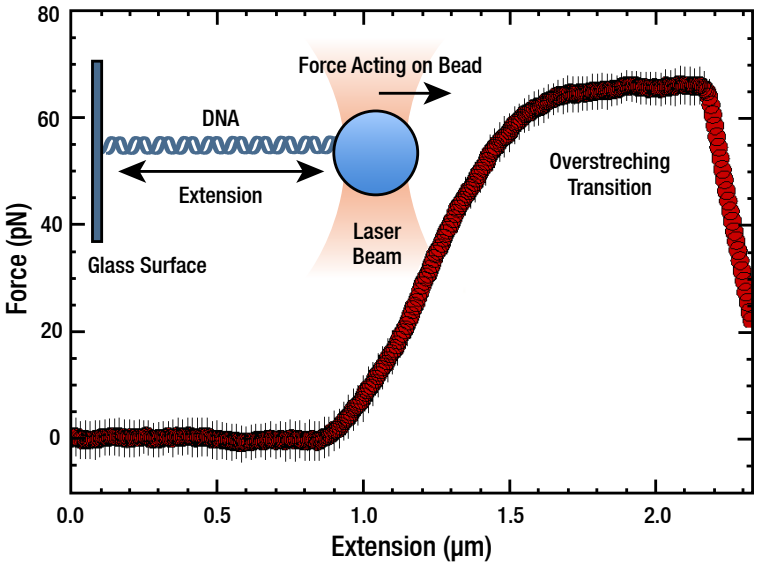
The system allows the user to precisely position two independent traps in three dimensions. Each trap's stiffness can be individually controlled and is actively stabilized. The control software provides out-of-the-box support for most general trapping experiments. In addition, a software development kit enables users to create application-specific solutions, and μManager compatibility is also provided.

This new system builds on the success of our Optical Tweezers Kit, which is a modular system designed to meet individual experimental needs. Thorlabs' optical tweezers have been employed in numerous experiments (e.g., Pang and Gordon, Optical Trapping of 12 nm Dielectric Spheres Using Double-Nanoholes in a Gold Film, Nano Lett. 2011 and Optical Trapping of a Single Protein, Nano Lett. 2012).

Optical Tweezers Application: DNA Stretching

Thorlabs' OTM200 Optical Tweezers were used to measure the forces within DNA. One end of a 1 μm long piece of dsDNA was attached to a glass slide and the other end was attached to a Ø1 μm polystyrene bead. The OTM200 was used to hold the bead, and the microscope stage was then translated along its x-axis at a rate of 10 μm/s, stretching the DNA.

The displacement (dx) of the bead was measured using the OTM200 force module, and the force was calculated using F = -k•dx, where k is the stiffness of the optical trap. The plot below illustrates a typical force versus extension curve obtained for bare DNA, represented by the red circles, with error bars denoting the standard deviation.



When stretched with a force of 65 pN, the DNA demonstrates a phenomenon known as overstretching transition. The sharp decrease in force seen at the end of the plot was caused by the bead escaping from the optical trap and being pulled back to its original position by the attached DNA.

Pricing

ITEM #	DESCRIPTION	PRICE
OTM200*	Optical Tweezers Upgrade Configuration for Existing Microscopes	$ 82,000.00

*Please contact techsupport@thorlabs.com for more information regarding the purchase of a system with the optional force module and/or a system including an inverted microscope.