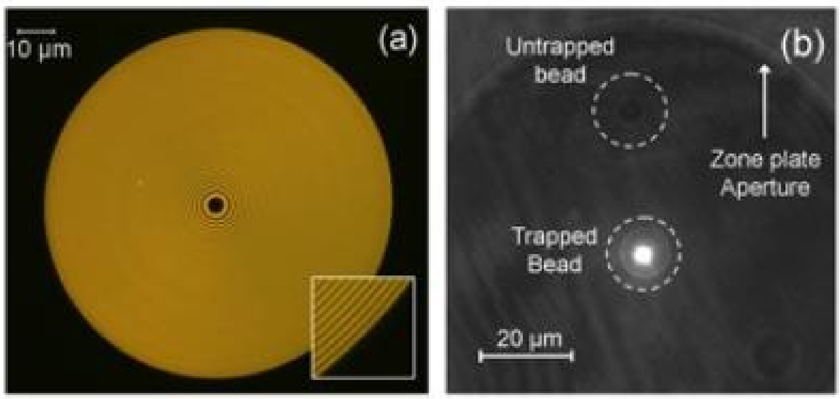
Researchers demonstrate a new type of optical tweezer

February 25 2008



(a). Photograph of microfabricated Fresnel Zone Plate optical tweezer, consisting of concentric gold rings (50 nm thick) on a microscope slide. The Zone Plate outer diameter is 100¼m, and the focal length is 8¼m. (b). CCD camera image of fluorescent bead (2¼m diameter) trapped in Zone Plate focus. Credit: Ken Crozier, Harvard School of Engineering and Applied Sciences

Researchers at the Harvard School of Engineering and Applied Sciences (SEAS) demonstrated a new type of optical tweezer with the potential to make biological and microfluidic force measurements in integrated systems such as microfluidic chips. The tweezer, consisting of a Fresnel Zone Plate microfabricated on a glass slide, has the ability to trap particles without the need for high performance objective lenses.

The device was designed, fabricated, and tested by postdoctoral fellow

Ethan Schonbrun and undergraduate researcher Charles Rinzler under the direction of Assistant Professor of Electrical Engineering Ken Crozier (all are affiliated with SEAS). The team's results were published in the February 18th edition of *Applied Physics Letters* and the researchers have filed a U.S. provisional patent covering this new device.

"The microfabricated nature of the new optical tweezer offers an important advantage over conventional optical tweezers based on microscope objective lenses," says Crozier. "High performance objective lenses usually have very short working distances -- the trap is often ~200 mm or less from the front surface of the lens. This prevents their use in many microfluidic chips since these frequently have glass walls that are thicker than this."

The researchers note that the Fresnel Zone Plate optical tweezers could be fabricated on the inner walls of microfluidic channels or even inside cylindrical or spherical chambers and could perform calibrated force measurements in a footprint of only 100x100Î¼m.

Traditional tweezers, by contrast, would suffer from crippling aberrations in such locations. Moreover, in experimental trials, the optical tweezers exhibited trapping performance comparable to conventional optical tweezers when the diffraction efficiency was taken into account.

The researchers envision using their new tweezer inside microfluidic chips to carry out fluid velocity, refractive index, and local viscosity measurements. Additional applications include biological force measurements and sorting particles based on their size and refractive index. Particle-sorting chips based on large arrays of tweezers could be used to extract the components of interest of a biological sample in a high-throughput manner.

Source: Harvard University