VANDERBILT UNIVERSITY

CTTC
Center for Technology Transfer & Commercialization

Optical tweezers for nanoscale-biological materials

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VU24099

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Summary

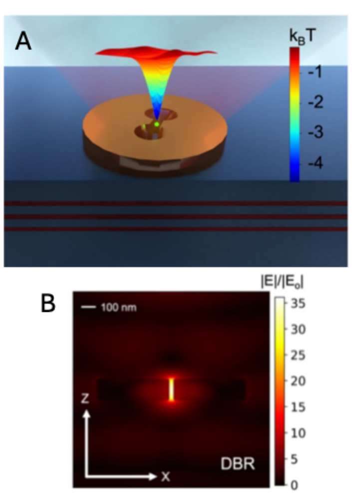
Optical tweezers have been used to study microscopic biological materials, but their application on the nanoscale has thus far been limited by technical constraints. To enable their use on the nanoscale, researchers at Vanderbilt have developed an optical trapping platform for targeting these nanoscale materials without destroying the sample.

Addressed Need

Biologists use optical tweezers to trap and manipulate biological specimens for studying the internal processes of cells, including molecular motors and intracellular trafficking. One of the major hurdles in the development of optical tweezers has been the thermal damage to the specimen caused by the tightly focused electric field of lasers. While this issue has been resolved on the microscale, lasers cannot be focused to the nanoscale, resulting in the need for greater light intensities and an increased risk of thermal damage to study these targets. A method to confine and magnify the laser's electric field without expensive hardware or increased laser power would enable the study of these nanoscale biomolecules and further medical discovery.

TECHNOLOGY DESCRIPTION

This technology provides a method to trap nanoscale biomolecules without concern for damaging the molecule or structure. Instead of using only a laser to generate the trapping force, a nanoantenna with a tailored geometry magnifies the strength of the tweezing force, stabilizing the target while maintaining a low input power. The generated electric fields are also tightly confined to the interior of the antenna, enabling the platform to be used individually or in an array without interference.



***(A)** A graphical depiction of the confined electric field. **(B)** The electric field is 35x stronger and confined to the inside of the disk, enabling multiple antennae to be used in an array.*

Competitive Advantages

1. The nanoantenna **requires 100x less power** than other optical tweezing methods for nanoparticle trapping, **preventing thermal damage to the specimen**.
2. Antennae **can be placed in an array for multi-particle trapping** and release.
3. **Electric field enhancements of up to 40x** provide applications to other, nonlinear microscopy technologies.
4. Trapping force **can be modulated by altering the polarization** of incoming light.

Intellectual Property Status:

Patents: Patent application has been filed.

Publication: *Nano Letters, 2023*

Stage of Development:

A benchtop prototype has been developed and demonstrated to stably trap nanoscopic specimens with greatly reduced power inputs. We are seeking commercial partners to further develop the technology.