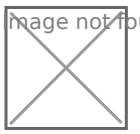
Docket #: S13-031

Optical trapping of sub-10nm particles using plasmonic coaxial apertures

Stanford researchers have designed a powerful plasmonic coaxial aperture as a low-power optical trap for nanosized specimens, a regime that is inaccessible with the other designs. This device can stably trap dielectric particles smaller than 10 nm in diameter while keeping the trapping power level below 100 mW. By tapering the thickness of the coaxial dielectric channel, trapping can be extended to sub-2 nm particles. This design constrains particles at the surface of the aperture rather than inside, and allows further particle manipulation and processing. Such capability enables trapping and manipulation of single proteins such as enzymes, and possibly molecules as small as glucose.



Stage of Research

Inventors demonstrated that coaxial apertures with a 25 nm silica channel can trap particles as small as 5 nm while keeping the required power well below 100 mW. They have also designed an aperture that can trap specific chiral molecules.

Applications

- **Trapping and detection of nanoscale particles** with end user applications in:
  - Environmental/air pollutant monitoring

- Optical filters and sensors for sub-10 nm particles
- Biotech filtering
- Lab-on-chip products
- Nanomaterial synthesis and nanostructure assembly
- Force probes
- Manipulation of single quantum emitters, proteins, or small molecules
- Enantiomer separation

Advantages

- **High performance** trapping of sub-10 nm particles - potentially as small as 2 nm
- **High efficiency / Low optical trapping power** - less than 100 mW, theoretically 20 mW
- **Accessibility of trapped particle** - the particle is trapped at the surface of the aperture rather than inside it
- **Versatile design** – device can be integrated into an optical fiber tip or patterned over a thin metal film to allow for parallel trapping
- **Easily Manufactured**

Publications

- Amr A. E. Saleh and Jennifer A. Dionne, "Toward Efficient Optical Trapping of Sub-10-nm Particles with Coaxial Plasmonic Apertures," Nano Letters, 12, 5581-5586 (2012).
- "NEW OPTICAL TWEEZERS TRAP SPECIMENS JUST A FEW NANOMETERS ACROSS," Stanford Engineering News, published online 4 Dec 2012.

Patents

- Published Application: 20140374581
- Published Application: 20160049215

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