When light loses symmetry, it can hold particles

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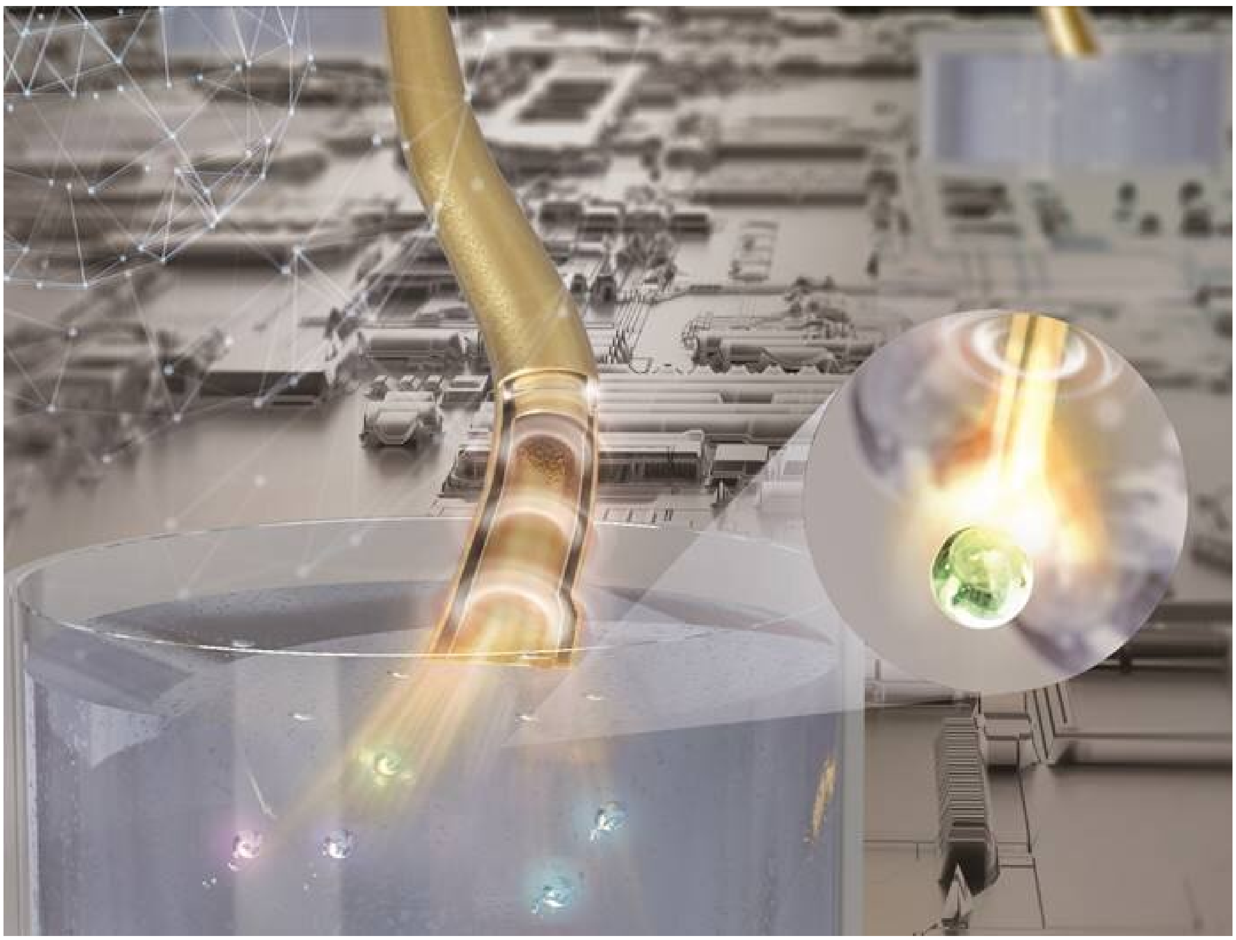

Mode symmetry-broken mechanism for enhancing optical trapping behavior. Credit: Yuanhao Lou, Xiongjie Ning, Bei Wu, Yuanjie Pang

Optical tweezers use light to immobilize microscopic particles as small as a single atom in 3D space. The basic principle behind optical tweezers is the momentum transfer between light and the object being held. Analogous to the water pushing on a dam that blocks the stream, light pushes onto and attracts objects that make the light bend. This so-called optical force can be designed to point to a certain point in space, where a particle will be held. In fact, the optical trapping technique has so far won two Nobel Prizes, one in 1997 for holding and cooling down single atoms, a second in 2018 for offering biologists a tool to study single biomolecules such as DNA and proteins.

Researchers led by Prof. Yuanjie Pang at Huazhong University of Science and Technology (HUST), China, are interested in the use of fiber optical tweezers, where light and particles are manipulated at the tip of an optical fiber. This technique eliminates the requirement of conventional, bulky, optical accessories such as microscopes, lenses and mirrors. Their idea is to start with a perfectly annular symmetric light mode that can only be transmitted in the optical fiber and will not leak into the surrounding space through the fiber tip, and have a particle to break the mode symmetry and thereby scatter light into the space. This way, by changing the symmetry and the momentum of the light, the particle receives a reactive force that holds it at the fiber tip.

The researchers predict potential applications such as performing an in-vivo single bioparticle-manipulating experiment by using the fiber optical tweezers as an endoscope in the interior of a living animal. The work entitled "Optical trapping using transverse electromagnetic (TEM)-like mode in a coaxial nanowaveguide" (published on Dec. 6, 2021) was featured on the cover of *Frontiers of Optoelectronics.*

More information: Yuanhao Lou et al, Optical trapping using transverse electromagnetic (TEM)-like mode in a coaxial nanowaveguide, *Frontiers of Optoelectronics* (2021). DOI:

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