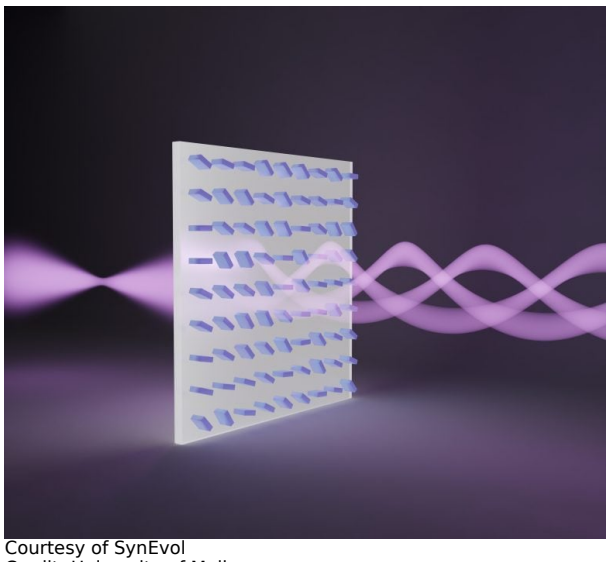
Researchers Have Created Tractor Beams at the Metasurface

Posted by Okachinepa 07/29/2024



Courtesy of SynEvol
Credit: University of Melbourne

In the process of developing tractor beams enabled by metasurfaces, researchers at TMOS, the ARC Centre of Excellence for Transformative Meta-Optical Systems, have achieved a substantial first step forward. These light beams, which have the ability to attract particles, are modeled after the imaginary tractor beams found in science fiction.

The University of Melbourne team describes their silicon metasurface-generated solenoid beam in research published in ACS Photonics. Special light modulators (SLMs) have been used in the past to make solenoid beams, but because of their mass and weight, these systems cannot be employed in handheld devices. A thin layer of nanopatterned silicon, measuring just 2,000 nanometers in thickness, makes up the metasurface. The team envisions a time when it will be able to replace the intrusive forceps biopsies that harm surrounding tissues with non-invasive biopsies.

Particles are typically pushed away from the light source by light beams. Particles have been shown to be drawn toward the light source by solenoid beams. Think about how a drill operates—pulling shavings of wood up the drill bit. Work of solenoid beams is comparable.

This specific solenoid beam has a number of advantages over previously developed solenoid beams, including the fact that it doesn't require an SLM, has much smaller size, weight, and power requirements, and has more flexible input beam requirements than previous beams.

The phase hologram of the intended beam was mapped to generate the metasurface. This served to establish a pattern. Next, using reactive ion etching and electron beam lithography, the metasurface was created from silicon. The majority of the input beam—in this case, a Gaussian beam—is transformed into a solenoid beam and bends away from the unconverted beam when it filters through the metasurface, allowing the researchers to work with it unhindered. At a distance of 21 centimeters, they were able to describe the beam.

"The compact size and high efficiency of this device could lead to innovative applications in the future," explains lead researcher Maryam Setareh. Through less intrusive techniques, the capacity to extract particles utilizing a metasurface may have an impact on the field of biopsy by potentially reducing pain.

"We are excited to investigate our device's performance in particle manipulation, as it could provide valuable insights," states Setareh.

"The next stage of this research will be to experimentally demonstrate the beam's ability to pull particles," says chief investigator Ken Crozier. "We'll be excited to share those results when they're available."

"This work opens new possibilities for using light to exert forces on tiny objects," according to Crozier.