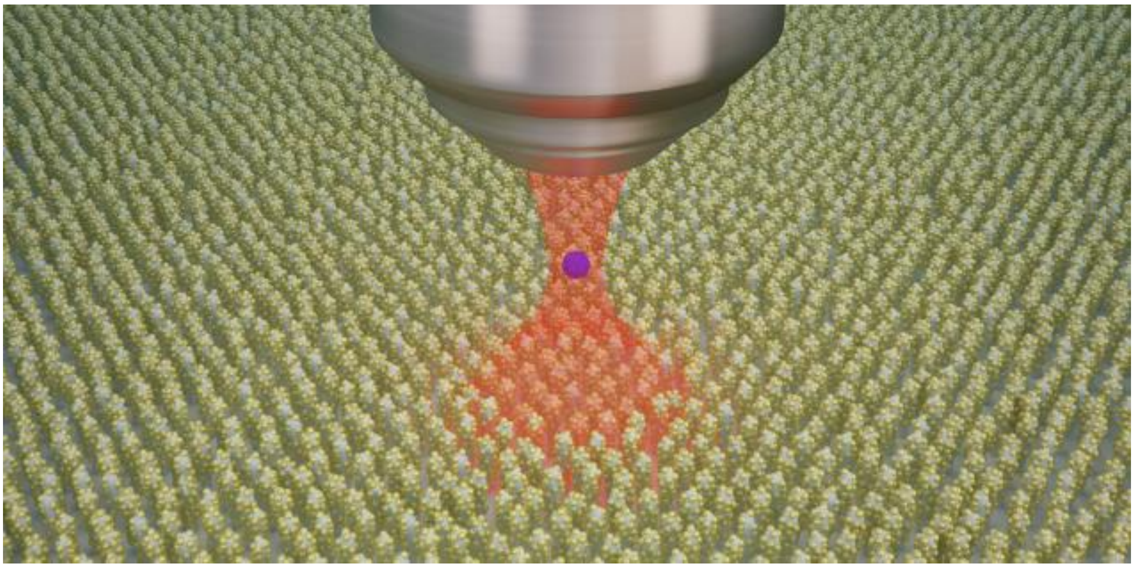
Press Release
Contactless manipulation of nano-matter



Laser physics gives us the ability to pick up and move a single cell or molecule without physically touching it by the use of optical tweezers, which employ enhanced forces at the focal point of a tightly focused laser beam to trap, accelerate, or slow down micro- and nanoparticles. Making use of recent advances in nanotechnology, novel optical nano-tweezers were developed by researchers of the Theoretical and Physical Chemistry Institute at the National Hellenic Research Foundation (NHRF) in Athens, Greece, in collaboration with researchers of the Department of Physics and Astronomy at the University of Southampton, UK.

These novel nano-tweezers employ the collective oscillatory motion of surface electrons in sharp metallized silicon nanostructures, which act like tiny antennas and amplify the electromagnetic fields near them. This way, they enable high-precision trapping and manipulation of sensitive nanoparticles and biomolecules, such as DNA or proteins, at the focal point of a laser beam near the metallized nanostructures at low photon flux to avoid photodamage. In order to adopt high-performance optical tweezers in real-world applications, it is essential to develop large-scale fabrication processes without compromising the trapping performance. In this study, simple, single-step, tabletop laser fabrication methods were used for the development of the optical nano-tweezers, which facilitate scalability. The achieved trapping performance is ten times higher than that of conventional optical tweezers and comparable to the highest ones reported to date. From a more fundamental aspect, the performance improvement is conclusively attributed to the excitation of collective surface electron oscillations in the underlying metallized nanostructures, through careful distance- and wavelength-dependent measurements. Metallized nanostructured silicon is a promising platform for large-scale parallel optical tweezer applications that will broaden the range of optical manipulation in nanoengineering, biology, and the study of collective biophotonic effects. High-performance optical tweezers, in combination with other scientific techniques, such as laser microsurgery or spectroscopy, may find important applications in nanomedicine and medical diagnostics.

Article Reference:

"Plasmon enhanced optical tweezers with gold-coated black silicon"
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