3D optical manipulation with plasmonic nanotweezers

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Recent advances in nanotechnologies have prompted the need for tools to accurately and non-invasively manipulate individual nano-objects [1]. In the 90's, several theoretical studies described the possibility to trap and manipulate small nano-objects with the strong optical gradients created at the extremity of near field optical probes [2-4]. This has never been experimentally demonstrated, mainly due to photothermal issues [5, 6]. Here we demonstrate the first 3D optical manipulation of a 50 nm dielectric particle with scanning near field optical nanotweezers [7].

Our approach relies on extending the concept of self-induced back-action (SIBA) mechanism [8] at the extremity of a scanning near field optical probe. In our experiment we patterned a Bowtie Nano-Aperture (BNA) at the end facet of a gold-coated tapered optical fiber. This enables us to trap a single 50 nm polystyrene particle over several minutes and manipulate in three dimensions, over tens of microns,. Both the trapping operation and monitoring are performed through the optical fibre, making these nanotweezers totally autonomous and free of bulky optical elements.

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