Enhanced optical forces ~~and~~ in~~?~~ plasmonic microstructures

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Abstract

Micromanipulation of dielectric ~~objects,~~objects ~~from polystyrene spheres to living cells,~~ is achieved when radiation pressure forces create stable trapping by highly focused laser beams through microscope. However, the impressive history of optical trapping is shadowed by light ~~the light~~ diffraction limit, as the research interest has currently focused on nano-scale materials, ~~below the micron scale,~~ requiring stronger optical confinement and higher intensities than can be provided by the conventional optical tweezers. Recently, plasmonic nanostructures have entered the field, either as trapped particles or ~~as trapping~~ structures. In this study, we present experimental results ~~of~~ on using localized fields of metallic structures for efficient trapping, with various patterns (dots, squares etc.). The structures were produced by laser interferometry on almost continuous Ag ~~and~~or Au ~~layers~~films ~~8**~~on glass ~~and~~or glass covered by an amorphous Al_2O_3 layer (~~**~~10 nm thick). ~~developed on glass and Si substrates, on which a thin film (~80 nm) of Au or Ag was deposited.~~ Optical trap was achieved with a c~~.~~w~~.~~ Nd:YAG laser, at 1.064 μm in TEM_{00} mode by ~~. The laser beam was~~ introducing the beam~~ed~~ into an optical microscope and focused~~ed~~ by a 40X objective ~~onto the substrate lens~~. To demonstrate the action of plasmonic optical tweezers, we used polystyrene nanospheres suspended into deionized water of refractive index 1.33. We calculated the optical forces by measuring the particle's escape velocity. The maximum observed escape velocity for 900 nm diameter beads was 600 μm/s, for ~~the glass/~~Au microstructures, corresponding to trapping force of ~50 pN~~,~~. The calculated Q factor was ~0.2, which is, according to the literature, almost two orders larger than the corresponding one of a conventional optical trap with the same objective lens ~~(40X)~~. In addition, mathematical simulation of plasmonic fields is investigated to predict theoretically the plasmonic enhancement.

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