Long-range and rapid transport of individual nano-objects by a hybrid electrothermoplasmonic nanotweezer - DTU Orbit (08/11/2017)

Long-range and rapid transport of individual nano-objects by a hybrid electrothermoplasmonic nanotweezer

Plasmon-enhanced optical trapping is being actively studied to provide efficient manipulation of nanometre-sized objects. However, a long-standing issue with previously proposed solutions is how to controllably load the trap on-demand without relying on Brownian diffusion. Here, we show that the photo-induced heating of a nanoantenna in conjunction with an applied a.c. electric field can initiate rapid microscale fluid motion and particle transport with a velocity exceeding 10 mu m s(-1), which is over two orders of magnitude faster than previously predicted. Our electrothermoplasmonic device enables on-demand long-range and rapid delivery of single nano-objects to specific plasmonic nanoantennas, where they can be trapped and even locked in place. We also present a physical model that elucidates the role of both heat-induced fluidic motion and plasmonic field enhancement in the plasmon-assisted optical trapping process. Finally, by applying a d.c. field or low-frequency a.c. field (below 10 Hz) while the particle is held in the trap by the gradient force, the trapped nano-objects can be immobilized into plasmonic hotspots, thereby providing the potential for effective low-power nanomanufacturing on-chip.

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