Optical force-assisted targeted deposition of molecular nanoparticles in the nanogap of a plasmonic nanoantenna

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Plasmonic nanoantennas with resonant nanogap have the ability to confine light in subwavelength volume. In a context of active research on nanotechnologies, this unique property has raised tremendous interest as it leads to enhanced light-matter interactions at the nanoscale. For instance, nanoantennas were recently used to design state-of-the-art single-molecule sensors. [1] This much localized light confinement also results in enhanced near-field optical forces, making it possible to trap single nanoparticles near or in the nanogap of plasmonic nanoantennas. [2] Over the past decade, plasmonic nanoantennas have been mainly used as plasmonic nanotweezers for reversible optical trapping, in other words, experiments consisting in successively trapping and then releasing nano-objects in suspension. We investigate here the still much unexplored field of plasmonic trapping-assisted assembly of nanomaterials.

In this work, nanoparticles exclusively made of fluorescent dye molecules were fabricated in water dispersion. Near-field optical forces arising from the resonant gap-mode of gold nanoantennas were then used to attract and deposit single nanoparticles in the vicinity of plasmonic nanogaps. Figure 1 shows a scanning electron microscope (SEM) image of a nanoparticle adsorbed in the gap of a trimer nanostructure. This one-step deposition process enables fast deposition of small amount of matter directly from a colloidal suspension to a much localized location of interest. Therefore, this work is thought to pave the way for a wide range of further applications involving light-matter interactions at the nanoscale.

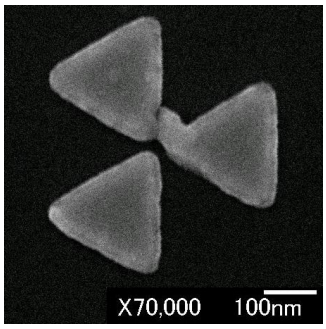

Figure 1. SEM image of a molecular nanoparticle adsorbed in the nanogap of a gold trimer nanostructure after plasmonic trapping-assisted deposition.

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