Optical trapping, transport and printing of a nanoparticle to be deposited on a plasmonic nanogap antenna

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The excitation of resonant plasmonic modes of gold nanostructures makes it possible to focus the energy of an incident light beam and shape the light field in a nanoscale volume, far beyond the diffraction limit. [1] Plasmonic nanoantenna can therefore be used to sense the optical properties of single nanoparticles and molecules, tailor the light absorption and radiation properties of nano-emitters and enhance nanoscale light-matter interactions. However, the nanoscale localization of the plasmonic hotspot requires accurate positioning of the interacting object. Optical forces provide a convenient way to handle nanoparticles in a liquid medium and can be used to directly attract the desired nanoparticle toward a plasmonic nanoantenna. [2] By using a high laser intensity, we previously demonstrated that nanoparticles made of aggregated dye molecules can be trapped and deposited at the nanogap location of a bowtie nanoantenna. [3] In this work, we extend this optical printing method to nanoparticles made of hard materials by successfully trapping, transporting and depositing a 100 nm fluorescent nanodiamond on a nanogap antenna. After trapping a single fluorescent nanodiamond, its fluorescent properties are measured. When the optical trap is positioned close to the targeted nanoantenna, the nanodiamond is transferred to the plasmonic trap and is adsorbed at the surface of the nanoantenna as shown in Figure 1. This method may find applications for the bottom-up assembly of hybrid nanophotonic devices.

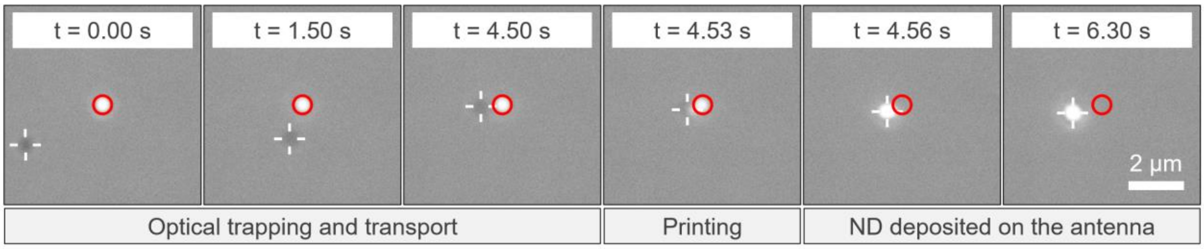

Figure 1. Optical trapping, transport, and printing of a fluorescent nanodiamond (ND) using a focused near-infrared laser beam (red circle, wavelength: 1064 nm; intensity: 2 MW.cm^{-2}). When the optical trap (and the trapped ND) approaches the plasmonic nanoantenna (white target), the ND becomes attracted by the gradient force of the plasmonic nanotweezers and gets adsorbed at the surface of the sample.

REFERENCES:

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