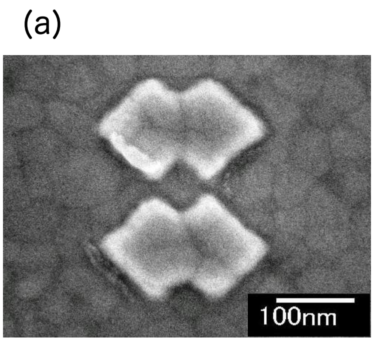
18a-C3-1

Optical Nanomanipulation Using Nanoshaped Plasmonic Fields

RIES, Hokkaido Univ., °Keiji Sasaki, Shutaro Ishida, Kyosuke Sakai, Yoshito Tanaka

E-mail: sasaki@es.hokudai.ac.jp

Plasmonic trapping has attracted significant attention because of its applicability to nanoparticle manipulations such as single-molecule trapping and quantum-dot sorting. In this presentation, we report super-resolution trapping where nanoparticles are optically manipulated in nanoscale space smaller than the diffraction limit [1]. We performed two-dimensional mapping of optical trapping potentials experienced by a 100-nm dielectric particle above a plasmon resonant gold nanoblock pair with a gap of several nanometers. The experimental results demonstrated that the potentials have nanometer-sized spatial structures that reflect the near-field landscape of the nanoblock pair. When an incident polarization parallel to the pair axis is rotated by 90°, a single potential well turns into multiple potential wells separated by a distance of approximately 230 nm (<λ/2). We show that the trap stiffness can be enhanced by approximately 3 orders of magnitude compared to that with conventional far-field trapping. In addition, we propose new concept for controlling spatial profiles of gap-mode localized plasmonic fields toward the flexible nanomanipulation. We theoretically and experimentally show that the field distributions within hot spots are formed by constructive and destructive interferences of dipolar, quadrupolar, and higher-order multipolar plasmonic modes, which can be drastically altered by adjusting parameters of the excitation optical system [2-4]. Optical switching of hot spots separated by an 80-nm distance is also demonstrated using a double-nanogap plasmonic structure.



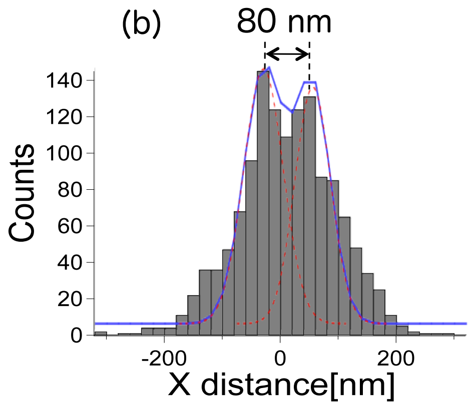


Fig. 1: (a) SEM image of the double nanogap gold structure. (b) Cross-section profile

References:

[1] Y. Tanaka, S. Kaneda, K. Sasaki, *Nano Lett.* 13, 2146 (2013).

[2] Y. Tanaka, K. Sasaki, *Opt. Express* 19, 17462 (2011).

[3] Y. Tanaka, K. Sasaki, *Appl. Phys. Lett.* 100, 21102 (2012).

[4] Y. Tanaka, A. Sanada, K. Sasaki, *Sci. Rep.* 2, 764 (2012).