Polarization Dependent Optical Trapping Dynamics of Mutual Scattering Gold Nanoparticles and Nanodisks at Glass/solution Interface

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Non-contact technique of optical trapping is capable of gathering and manipulating nanometer to micrometer particles. Our group has demonstrated a single large assembly of 200 nm Au nanoparticles (NPs) by focusing 1064 nm trapping laser at the glass/solution interface.[1] The assembly expands much larger than the focal area and presents a dumbbell-shaped structure. We call this phenomenon swarming.

In this work, we utilized electron beam lithography to fabricate periodically aligned Au nanodisk structure on the glass coverslip, mimicking the initial growing process of the swarming. Interestingly, Au NPs are likely to locate at specific spots above or below the fabricated structure with circularly polarized trapping laser in the scattering image (Fig. 1a-i, 1a-ii), and they locate between the nanodisks when linearly polarized laser is used (Fig. 1a-iv). Besides, an assembly of few Au NPs under circularly polarized laser shows rotational motion outside the nanodisks, while it is suppressed among the nanodisks. These behaviors are also observed with different size of Au NPs; however, by replacing Au NPs with polystyrene (PS) NPs (Fig. 1a-iii), specific trapping sites are not observed. This is because the scattered light from both Au NPs and nanodisks plays important roles in generation of specific trapping sites.

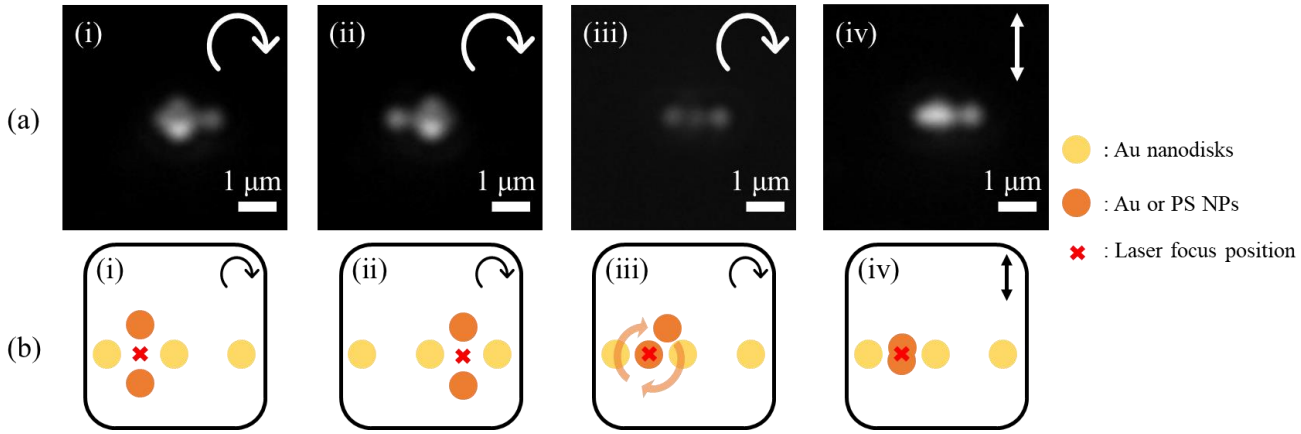

Figure 1. (a) Dark field scattering images of 200 nm Au NPs and 500 nm PS NPs with nanodisk alignment. (b) Illustration of the scattering images. (i) and (ii) 200 nm Au NPs under circular polarized laser. (iii) 500 nm PS NPs under circular polarized laser. The orange arrows in (b)-(iii) represents the randomly circular motion of PS NPs. (iv) 200 nm Au NPs under linear polarized laser.

1. Tetsuhiro Kudo, Shang-Jan Yang, Hiroshi Masuhara, **Nano Letters**, 2018, 18 (9), 5846–5853