Laser Trapping Dynamics of Polystyrene Assembly at Glass/Solution Interface Observed by a Dual-Objective Lens Microscope

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We have systematically reported on "Optically evolved assembly formation in laser trapping" where optical potential expands from the focus to the surrounding area of a few ten micrometer through scattering and propagation of the trapping laser[1,2]. Polystyrene (PS) nanoparticles (NPs) at a glass/solution interface form a periodical assembly and additionally horns at the certain directions, and the structure and morphology depend on trapping laser polarization and NP size. Here we apply a dual objective lens microscope to observe these assembling behavior at different depth and understand their dynamics.

Aqueous NaCl solution of PS NPs with the diameter of 500 nm was set between two glasses and the upper glass/solution interface was irradiated by the trapping laser through one objective lens. Induced behavior of NPs was monitored by the other objective lens by shifting the focal plane from the focus to the bulk solution. A single PS assembly much larger than the focal spot is prepared and its size decreases with lowering the observation plane as shown in Fig. 1. At z = 0, a periodic hexagonal structure was observed in the center which is surrounded by fluctuating NPs. At lower z < 0, the periodic structure became unclear and its size smaller. The structure and morphology are illustrated in Fig. 2, where PS NPs surrounding the periodic structure is being examined as a possible swarming behavior.

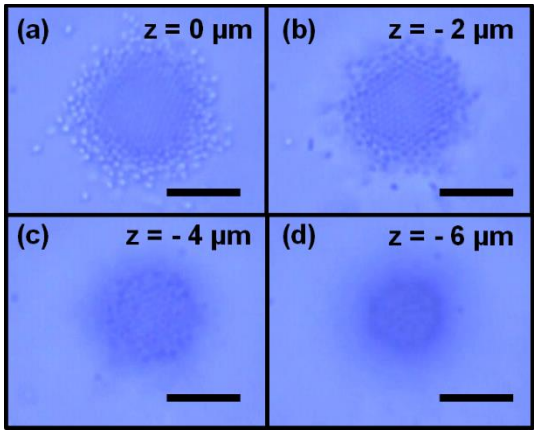

Fig. 1. Transmission images of a single NP assembly formed by circularly polarized light at 0.3 W. z represents the observation depth and the black bar corresponds to 5 μm.

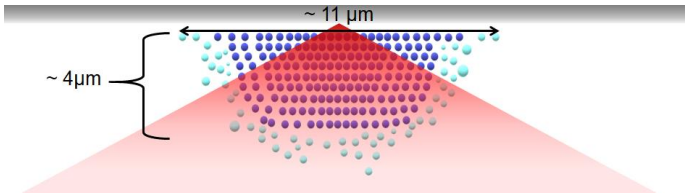

Fig. 2. A side-view illustration of a single NP assembly derived from Fig. 1. Dark and light blue particles correspond to periodically aligned and dynamically fluctuating NPs, respectively.

[1] Wang, S.-F.; Kudo, T.; Yuyama, K.; Sugiyama, T.; Masuhara, H. Langmuir, **32,** 12488−12496 (2016).
[2] Kudo, S.-F. Wang, K. Yuyama, H. Masuhara, Nano Lett., **16**, 3058–3062 (2016).