Polystyrene Nanoparticles Assembly Formed Irreversibly by Laser Trapping at Air/solution Interface

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We have carried out laser trapping and assembling of polystyrene (PS) nanoparticles (NPs) at air/solution and glass/solution interfaces [1-3]. We have observed that the assembly always undergoes dispersion upon stopping laser irradiation. However, the assembly which is formed under long irradiation is not uniform in structure and partially stable even without trapping. We demonstrate here the optical trapping of 100 nm bare PS NPs at the air/solution interface with a tightly focused 1064 nm CW laser. Figure 1 shows a series of assembly expansion upon long time irradiation. When the sample is irradiated by the trapping laser, PS NPs are gathered at the focal spot, initially giving a small assembly. With 30 min irradiation, the assembly size becomes about 40 μm in diameter. The assembly consists of three areas; central core (C), surrounding disk (D), and peripheral region (R) as marked in Figure 1(e). It is worth noting that even the core extends larger than focal volume. After switching the trapping laser off, the peripheral region undergoes diffusional relaxation immediately, while the core and disk remain as an irreversible assembly at the solution surface. Upon irradiating the laser at the core again, the peripheral region recovered very rapidly. In order to observe more clearly the whole structure, dye-doped PS NPs are examined. The assembling dynamics and mechanism will be considered in view of trapping light propagation in the growing assembly and inter-particle interactions.

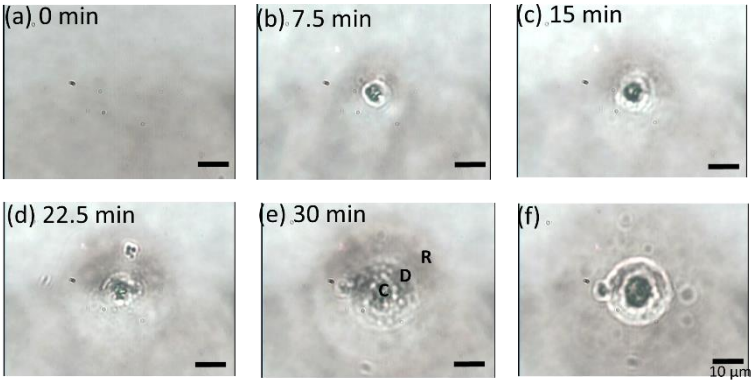

Fig.1 Transmission images of assembly growth under laser trapping (a)-(e) and shrinking process just after switching off the laser at 30 min (f).

[1] S.-F. Wang, K. Yuyama, T. Sugiyama, H. Masuhara, J. Phys. Chem. C **120**, 15578-15585 (2016)

[2] T. Kudo, S.-F. Wang, K. Yuyama, H. Masuhara, Nano Lett. **16**, 3058-3062 (2016)

[3] S.-F. Wang, T. Kudo, K. Yuyama, T. Sugiyama, H. Masuhara, Langmuir **32**, 12488–12496 (2016)