Optically and Photo-physically Lifting Up Polystyrene Microparticles to Form a Large Two-Dimensional Assembly at Solution Surface

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We have reported that the scattering and propagation of focused laser through the gathered polystyrene (PS) microparticles (MPs) expand the optical potential to a few ten micrometers outside the focus, leading to new phenomena of horn- [1], necklace-like arrangements [2], and ejection [3]. We call them as "Optically Evolved Assembling of Particles" at solution interfaces [4]. In this work, we change the optical configuration from the focused irradiation to wide field illumination, and find for the first time that plenty of PS MPs are collected to solution surface forming unorganized and organized arrangement.

Bare PS (BPS) and dye-doped PS (DPS) MPs with the size of 2 μm were irradiated by 488 nm wide field illumination (0.05 mW/μm^2). In the case of BPS MPs (Fig. 1 a), upon turning on 488 nm wide field illumination, several BPS MPs slowly moved to the irradiated area and an unorganized assembly was formed in 10 s. On the other hand, DPS MPs rapidly moved to the irradiated area and prepared hexagonal structure, which can be ascribed to optical of the 488 nm laser resonance to the dye absorption (Fig. 1 b). This result suggests that the photoexcitation provides mechanical forces for lifting up them and mediates mutual interaction between MPs. In addition, by magnifying the irradiated area, the intensity became smaller (0.01 mW/μm^2), the hexagonal structure formation was more widely achieved (Fig. 1 c). By moving the stage manually to the red direction, the hexagonal structure could be formed immediately at the new irradiated area as well. We compare this wider two-dimensional assembly formation with "Optically Evolved Assembling of Particles" in laser trapping and consider its mechanism and application.

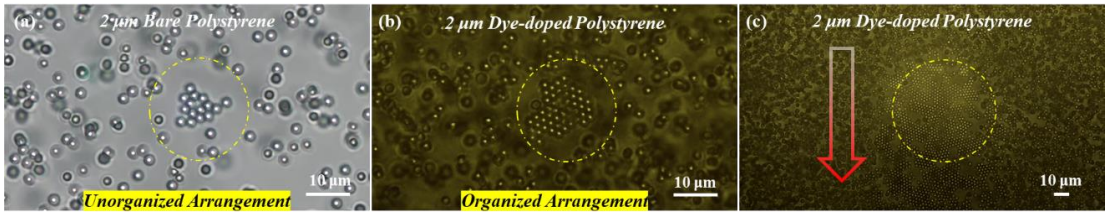

Fig. 1 These images include transmission (halogen lamp) and fluorescence (488 nm wide-field illumination) signal. The yellow dotted circle indicates the irradiated area. (a) Collection behavior. (b) Hexagonal structure formation. (c) Hexagonal structure is sequentially formed by shifting the stage. (Note the scale is different. See Text)

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