Reflection microspectroscopic study of laser trapping assembling of nanoparticles at solution surface

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INTRODUCTION: Laser trapping of nanoparticles at solution surface is interesting and attractive, because a nanoparticle assembly with their periodic array is formed around the focal spot in a spatio-temporally controlled manner. In this presentation, we show their trapping and assembling dynamics examined by reflection imaging and microspectroscopy [1,2].

EXPERIMENT: A 1064-nm continuous-wave laser beam was focused at an air/solution interfacial layer of the colloidal D$_2$O solution (208 nm polystyrene nanoparticle, 2.8 ×10$^{11}$ particles/mL) through an objective lens (NA0.90, ×60). The sample was illuminated with white light, and transmitted or reflected light was detected with a CCD camera or a spectrometer.

RESULTS & DISCUSSION: Upon the irradiation of a focused laser beam into solution surface of the colloidal solution, nanoparticles were gathered around the focal spot and one assembly was formed. The assembly grew gradually and reached the size of 20 μm in diameter at 180 sec (Figure 1a). Interestingly, the assembly showed obvious structural color in the reflection image (Figure 1b). We measured the reflection spectra at the assembly center and found that one reflection band appeared around 600 nm, which indicates nanoparticles are periodically arrayed in the assembly (Figure 1c). During laser trapping, the band was shifted to short wavelength, and its width was narrowed. The spectral change under laser trapping strongly depended on laser power, particle concentration, and salt concentration. We will discuss their laser trapping and assembling dynamics at the solution surface on the basis of the reflection spectral change.