Multilayer Assembly Formation of Lysozyme at Solution Surface by Optical Trapping of Gold Nanoparticle

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Optical trapping is a technique for manipulating small particles in the solution by a tightly focused laser beam. Our group has demonstrated disk-like assembly of lysozyme solution under laser irradiation at the solution surface. A white ring resembling the border of the assembly was observed in the transmission image and it expanded with irradiation time.[1] Yet, a systematic examination from various viewpoints, such as optical, fluidic, or thermal, is needed to fully address the formation mechanism of this phenomenon.

In order to investigate the thermal effect on the lysozyme assembly formation, we employed 200 nm gold nanoparticles as a heat source due to its high photothermal conversion efficiency. The transmission images showing the assembly evolution and dissipation are shown in Figure 1. Upon laser irradiation, concentric layers are sequentially formed in an assembly. The outer layer rapidly expanded while the inner layer remained similar. We found that the characteristic multilayer assembly arises from the sequential arrival of Au NPs which are pumped up from the bottom to the surface by the trapping laser. The timing of new layer formation matches with the arrival of next Au NP. Once the trapping laser is turned off, the layers shrank and disappeared sequentially. By adjusting the Au NPs concentration, the number of multilayers can be controlled to two layers with the present time scale. The concentration difference between different layers will be examined via fluorescence image and Raman spectroscopy and the formation mechanism will be discussed.

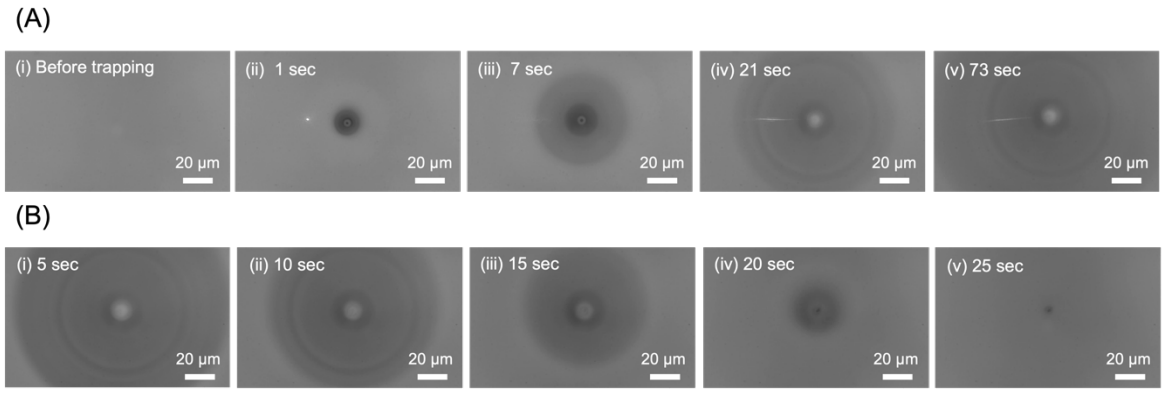

Figure 1. Transmission images showing temporal evolution of multilayer assembly of lysozyme (375 mg/mL) under 1 W laser trapping. (A) Growing process of the assembly; (i) before irradiation; (ii)-(v) after switching on 1064 nm CW trapping laser. (B) Shirking process of the assembly; after switching off the 1064 nm trapping laser.

Reference

1. Yi, P.-W. *et al. The Journal of Physical Chemistry C* **125**, 18988–18999 (2021).