Crystallization of colloids secured to oil-water interface responding to laser illumination

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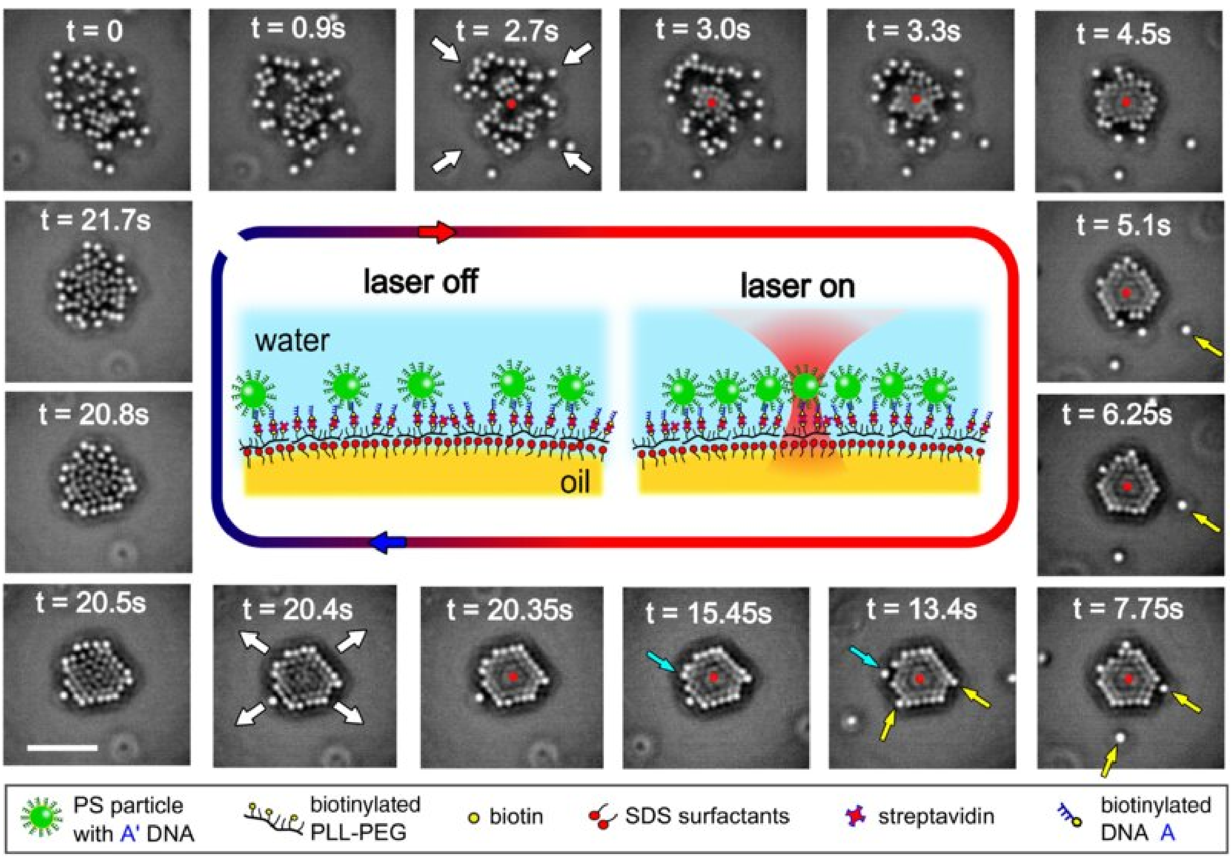

The panels in the rim of the figure show a time trace (clockwise) of the video-microscopy images of the light-induced entrapment and release of 0.53 μ m large polystyrene colloids tethered to the water-oil interface (the sale bar is 20 μ m). Credit: *Physical Review Letters* (2020). DOI: 10.1103/PhysRevLett.125.068001

A team of researchers at the University of Cambridge has developed a method for the crystallization of colloids secured to an oil-water interface in response to laser illumination. In their paper published in the journal *Physical Review Letters*, the group describes their method and possible uses for it.

One of the basic ideas in the physics world is that when particles are suspended in a liquid gradient, they move from warmer areas to cooler areas. In this new effort, the researchers have demonstrated an exception to that rule—colloids crystalizing when the liquid around them becomes warmer.

The work involved placing micrometer-sized balls of polystyrene (particles) into a mix of water and oil and then shining a light on the mixture to force it to grow warmer. But they also added something else—DNA "tethers" that constrained the particles.

In their setup, a drop of oil was placed in a small tank of water. The oil floated on top, forming an island of sorts, completely surrounded by the water. The polystyrene balls were then added to the mix—the DNA tethers allowed them to move freely around in the water, but prevented them from entering the oil drop. Next, the team trapped one of the balls with a laser beam, which forced the temperature around the ball to rise, creating a gradient in the water.

As a result, the particle moved toward the oil, which set off a flow near the edge of the oil drop. That fluid flow pulled on other balls that were near the one that was heated, packing them into a crystal. The overall takeaway from this experiment was that crystallization of tethered balls could be achieved by simply turning on a small laser—and that it could be just as easily undone by turning the laser off. The researchers had created a switching system that allowed for on-demand crystallization using colloids. The work demonstrates a laser-based method to manipulate particles that are not themselves trapped. The researchers note that such a system could prove useful in developing new kinds of micrometer-sized tweezers.

More information: Alessio Caciagli et al. Controlled Optofluidic Crystallization of Colloids Tethered at Interfaces, *Physical Review Letters* (2020). DOI: 10.1103/PhysRevLett.125.068001