Molding, patterning and driving liquids with light

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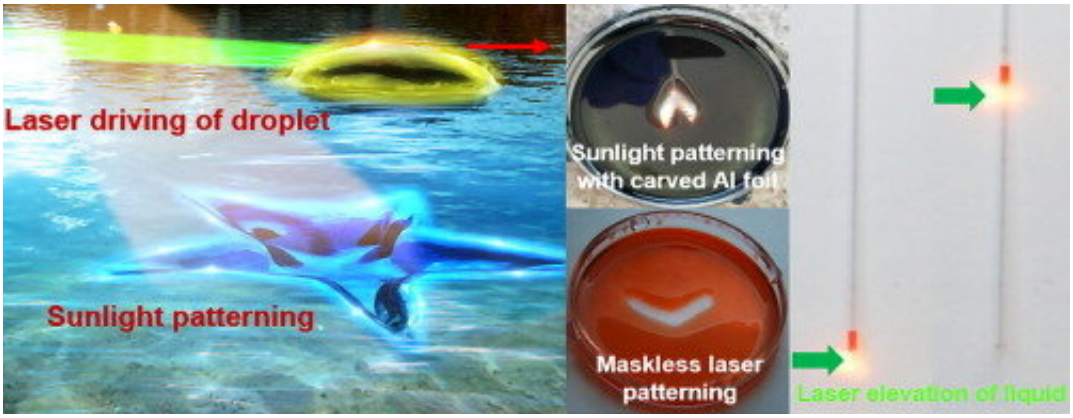

Credit: University of Houston

Jiming Bao, professor of electrical and computer engineering at the University of Houston, has developed a new fluid that can be cut open by light and demonstrated macroscopic depression of ferrofluid, the kind of fluid that can be moved around with a magnet.

The new method of molding and deforming water has potential applications in adaptive optics, mass transport and microfluidics manufacturing and molding of micro and nanostructures. Weighty implications for something that can be done with a few ingredients found at home.

"New optothermocapillary fluids were created by mixing transparent

lamp oil with different candle dyes. They can be cut open by sunlight and be patterned to different shapes and sizes using an ordinary laser show projector or a common laser pointer," reported Bao in *Materials Today*. "Laser driving and elevation of optotherocapillary fluids, in addition to the manipulation of different droplets on their surface, were demonstrated as an efficient controlling method and platform for optofluidic operations."

Optothermocapillary fluid refers to fluid in which the surface tension (capillary force) is strongly dependent on temperature, thus can be easily changed by lasers because lasers can generate a surface temperature gradient. Bao is reporting a giant depression and rupture in optothermocapillary fluids under the illumination of laser and sunlight.

"Computational fluid dynamics models were developed to understand the surface deformation and provided desirable physical parameters of the fluid for maximum deformation," said Bao. "The lasers and sunlight manipulated surface droplets and proved an efficient controlling method and platform for optofluidic operations."

Bao began surface depression experiments with ferrofluid because of its strong optical absorbance. Ferrofluid is a so-called "magic" liquid best known for its astonishing surface spikes generated by a magnetic field.

"Surprisingly, its surface can also be deformed by laser beams. To better understand the deformation mechanism, we recorded the surface deformation under lasers at three different wavelengths but with the same power. Bao determined that the surface deforms more rapidly with a shorter laser wavelength.

"The fundamental understanding of light-induced giant depression and creation of new optothermocapillary fluids encourages the fundamental

research and applications of optofluidics," said Bao.

More information: Feng Lin et al, Molding, patterning and driving liquids with light, *Materials Today* (2021). DOI: 10.1016/j.mattod.2021.10.022

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