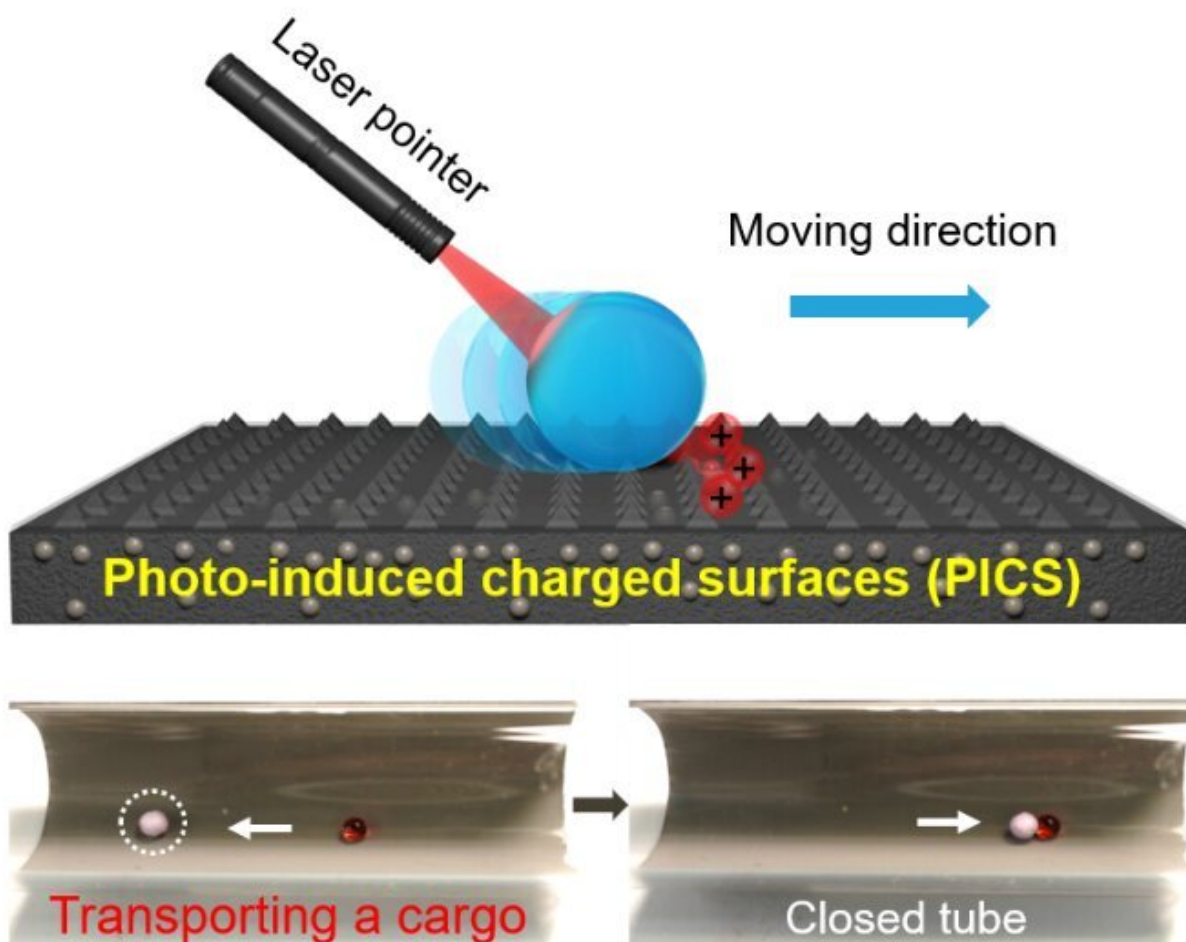


Novel smart material enables high-performance and reliable light control of droplets

August 23 2022, by Li Yuan



Schematic illustrations of light control of droplet. Credit: DU Xuemin

The ability to manipulate droplets plays a vital role in fundamental research and practical applications from chemical reactions to bio-analysis. Light control of droplets enables remote and contactless control with remarkable spatial and temporal accuracy. However, high-performance and reliable light control of droplets is still challenging.

Now, a research team led by Dr. Du Xuemin from the Shenzhen Institute of Advanced Technology (SIAT) of the Chinese Academy of Sciences has reported a new smart material with high-efficiency and durable photo-induced charge regeneration capability, enabling light control of droplets with superior performances and reliability.

This work was published in *National Science Review* on August 17.

This smart material contains three core components: first, micro-size liquid metal particles with superior photothermal and thermally conductive properties; second, polyvinylidene fluoride trifluoroethylene copolymer with excellent ferroelectric and mechanical behaviors; third, micro-pyramidal structures and low-surface-energy coatings of fluorinated SiO₂ nanoparticles for enhancing the superamphiphobicity.

"Based on the synergistic effect of these components, the photo-induced charged surfaces (PICSs) possess a superior capability of real-time and in-situ photo-induced charge generation upon exposure to light illumination," said Dr. Du.

This distinctive charge generation capability of the PICS was clearly revealed by scanning Kelvin probe microscopy, which showed the real-time and in-situ generation/disappearance of the free surface charges upon exposure to ON/OFF light irradiation.

The charge generation capability of the PICS exhibited no apparent degradation even in [extreme environments](#) including high [relative](#)

[humidity](#) (~ 90%) for 72 hours and high temperature (70 °C). The charge density of the PICS remained at stably high levels of 252 pC mm⁻² (peak to peak) even after 10,000 ON/OFF irradiation cycles.

"The outstanding efficiency, durability and stability of the photo-induced charge regeneration in PICS is critical for light control of droplets," said Dr. Du.

The researchers demonstrated that the PICS provided a new paradigm for controllable droplet motion, including high average velocity, unlimited distance, multimode motions (e.g., forward, backward, and rotation), and single-to-multiple droplet manipulation.

They also extended light control of droplets to robotic and bio-applications, including transporting a solid cargo in a closed tube, crossing a tiny tunnel, avoiding obstacles, sensing the changing environment via naked-eye color shift, preparing hydrogel beads, transporting living cells, and reliable biosensing.

"Our robust and biocompatible PICS not only provides insight into the development of new smart interface materials and [microfluidics](#)," said Dr. Du, "but also brings new possibilities for chemical and biomedical applications."

More information: Fang Wang et al, Light control of droplets on photo-induced charged surfaces, *National Science Review* (2022). [DOI: 10.1093/nsr/nwac164](https://doi.org/10.1093/nsr/nwac164)

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