Supporting Information

Synergistic Binding Ability of Electrostatic Tweezers and Femtosecond Laser-Structured Slippery Surfaces Enabling Unusual Droplet Manipulation Applications

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This PDF includes:

Figure S1-S11

Captions of Movie S1-S15

Supplementary Figures

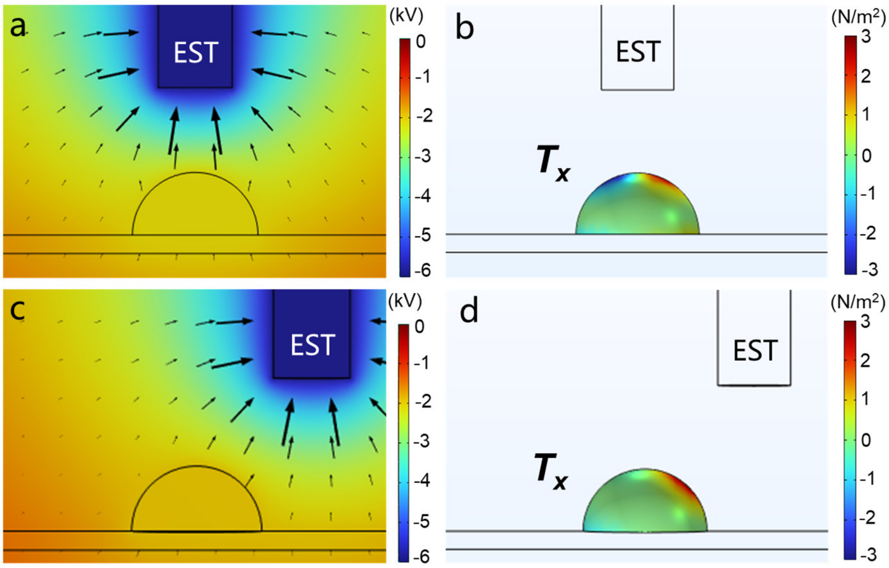

Figure S1. Simulation analysis showing the mechanism of EST droplet manipulation when negative potential is applied to the EST. (a,c) Distribution of the electrostatic potential and electric field intensity (the arrows reflecting its local direction and strength) around a -6 kV charged rod electrode. (b,d) Distribution of the horizontal component (T_x) of the Maxwell stress tensor acting on the surface of the droplet. The droplets in (a,b) are directly under the EST, and the droplets in (c,d) horizontally deviate from the EST. The droplet is also subjected to an attractive electrostatic force, which is directed towards the EST. Therefore, the droplet is able to move forward with the EST.

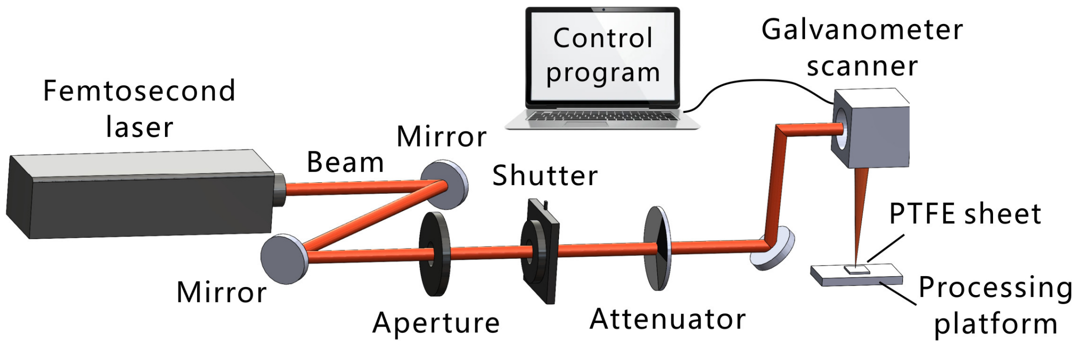

Figure S2. Schematic diagram of the femtosecond laser processing system.

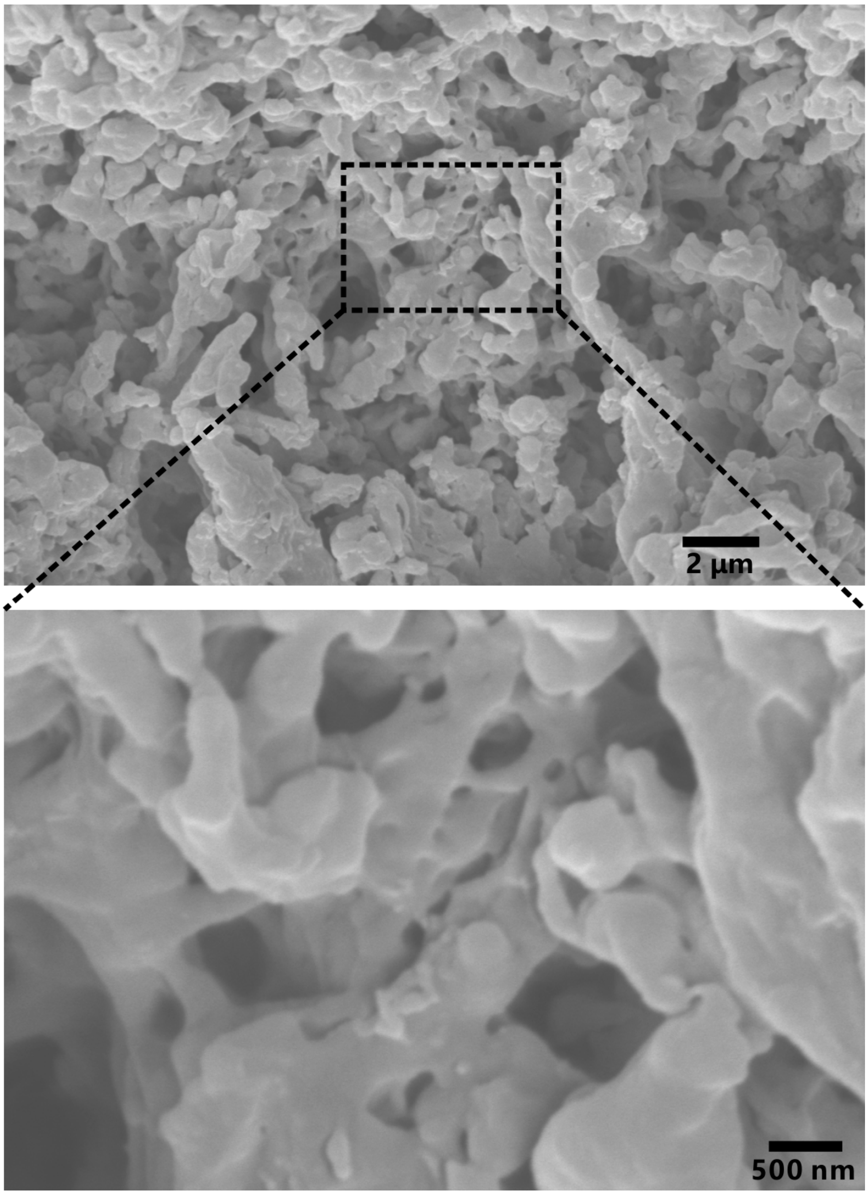

Figure S3. High-magnification SEM images of the laser-induced microstructures on the PTFE surface.

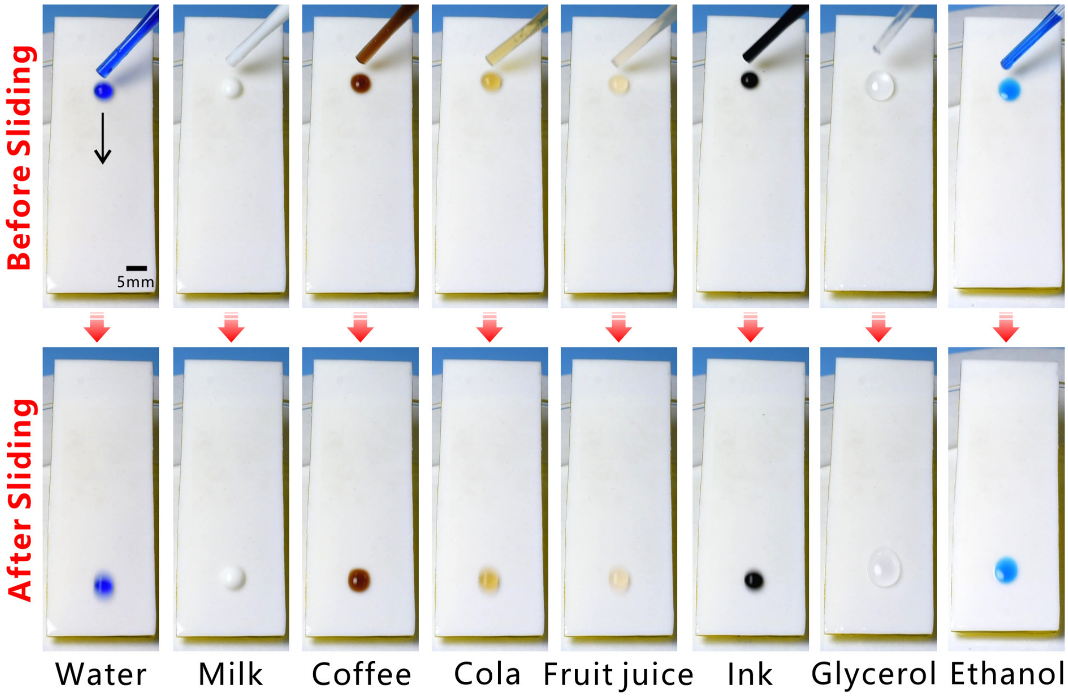

Figure S4. Sliding processes of different liquids on the inclined slippery PTFE surface. The first line shows the moment that the droplets were just dropped onto the slippery surface, and the second line shows the moment that the droplets slid to the bottom end of the PTFE plate.

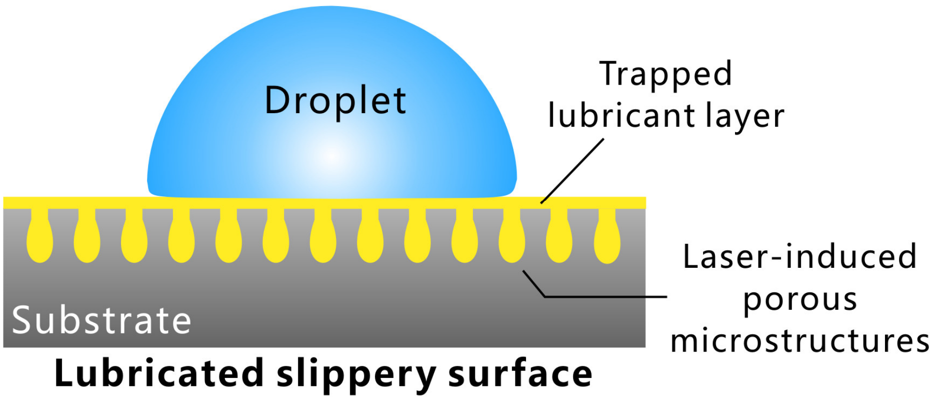

Figure S5. Contact state between a liquid droplet and the as-prepared slippery surface. The lubricating fluid (silicone oil) is infused into the laser-induced porous microstructures, resulting in the formation of a thin lubricant layer on the PTFE surface. The trapped lubricant layer can effectively prevent the strange liquids from contacting with the PTFE surface, thus endowing the lubricated slippery surface with excellent liquid repellence.

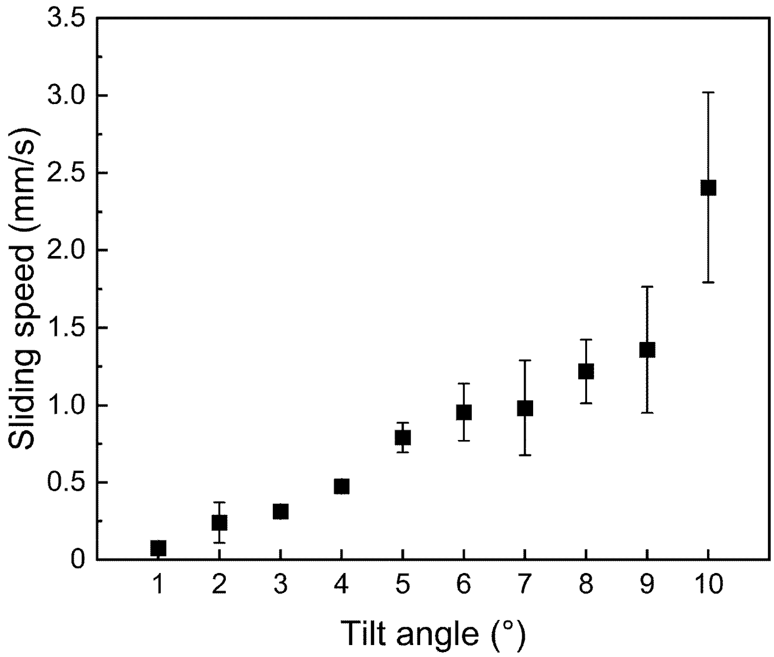

Figure S6. Relationship between the average sliding velocity of droplets and the tilted angle of the slippery PTFE surface.

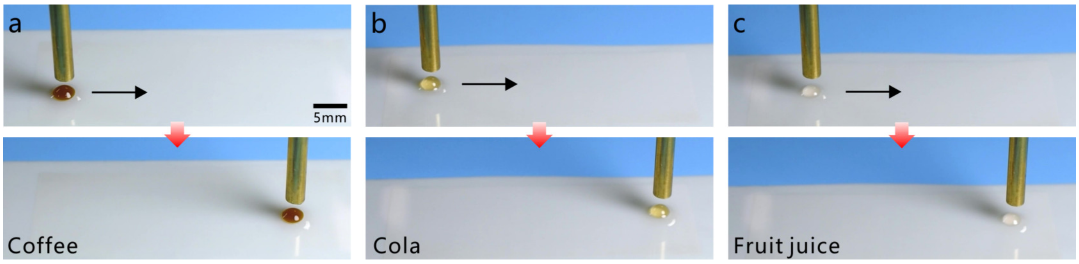

Figure S7. Manipulation of various daily liquids via EST: (a) coffee droplets, (b) Cola droplets, and (c) fruit juice droplets.

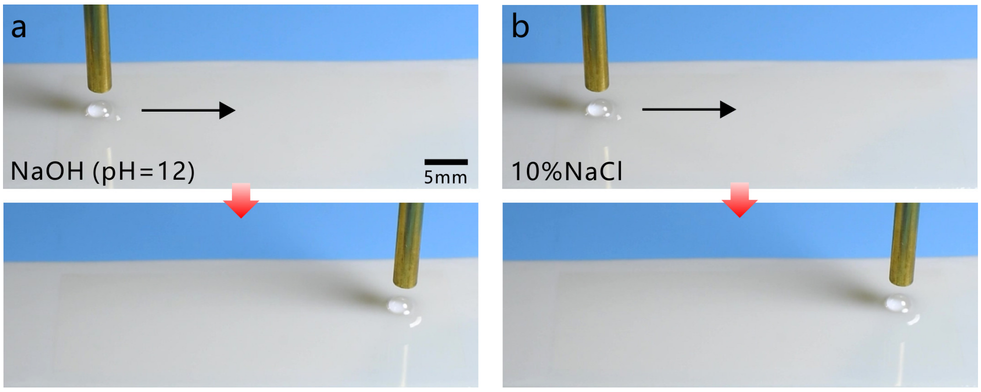

Figure S8. Manipulation of corrosive droplets via EST: (a) NaOH alkali droplets with pH = 12 and (b) 10% NaCl salt droplets.

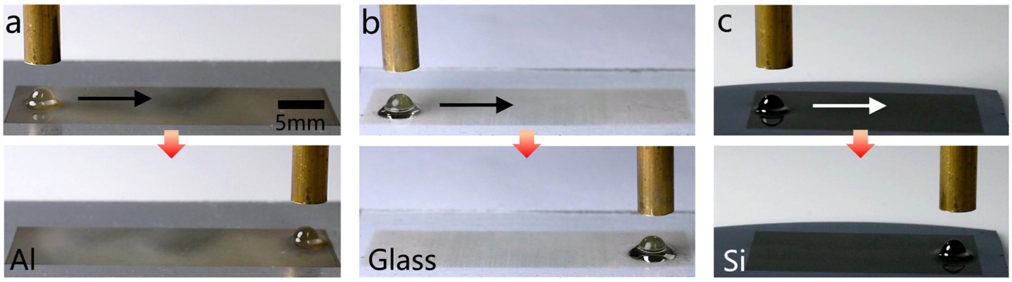

Figure S9. EST manipulation of droplets on different slippery substrates: (a) Aluminum sheet, (b) glass sheet, and (c) silicon sheet.

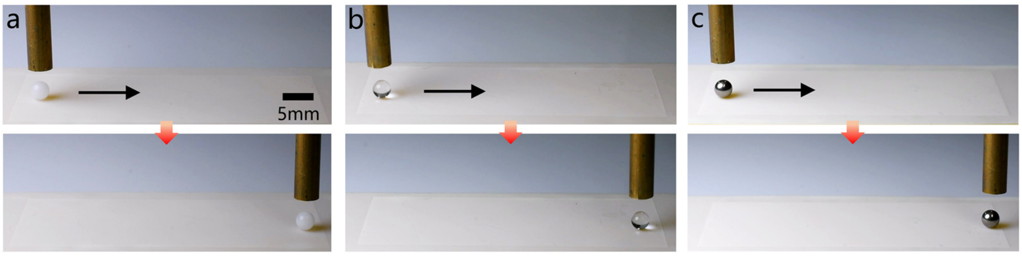

Figure S10. EST manipulating various solid spheres on the laser-structured PTFE surface: (a) small plastic sphere, (b) small glass bead, and (c) small stainless steel ball.

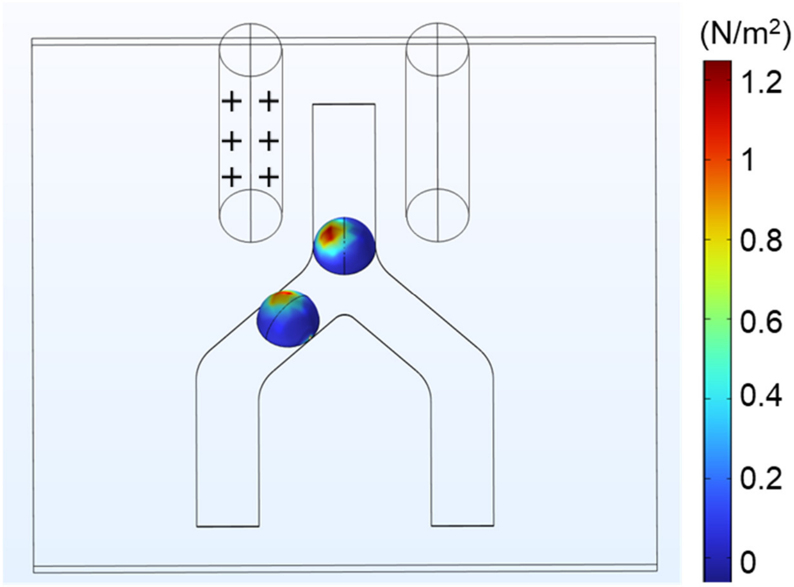

Figure S11. Simulation analysis showing the distribution of the horizontal component (T_x) of the Maxwell stress tensor acting on the droplets in the designed electrostatic-induced trajectory switching system (*e.g.*, the left EST is charged). The droplets are subjected to an attractive electrostatic force towards the left EST. Therefore, the sliding droplets are deflected toward the left EST and slide down the track on the left under gravity.

Captions of Supplementary Movies

Movie S1. Guiding a water droplet to move along different paths (*e.g.*, "USTC") via an EST.

Movie S2. Sliding processes of different liquids on the tilted slippery PTFE surface.

Movie S3. Process of moving a droplet forward and then backward with an EST.

Movie S4. EST manipulation of ultrasmall droplets, ultralarge droplets, droplets on an inclined surface, droplets hanging on an overturned surface, and multiple droplets in parallel.

Movie S5. Manipulation of various common liquids in daily life via EST.

Movie S6. Manipulation of corrosive droplets (HCl, NaOH, and NaCl droplets) via EST.

Movie S7. Manipulation of low-surface-tension organic liquids via EST.

Movie S8. Droplet manipulation on different lubricated slippery substrates via EST.

Movie S9. EST manipulation of various small solid spheres on the laser-structured surface.

Movie S10. Externally manipulating a droplet sealed in an enclosed space from the outside.

Movie S11. Self-powered EST droplet manipulation by using copper rods, pencil tips, fresh tree branches, and even fingers to guide the transport of liquid droplets.

Movie S12. Chemical microreaction based on EST droplet manipulation.

Movie S13. Connecting and repairing a broken electrical circuit via EST droplet manipulation.

Movie S14. Electrostatic-induced trajectory switching system for selectively transporting droplets along different tracks.

Movie S15. EST-based digital microfluidics.