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Bio-inspired Semi-infused Adaptive Surface with Reconfigurable Topography for On-demand Droplet Manipulation

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Content

1. Figures

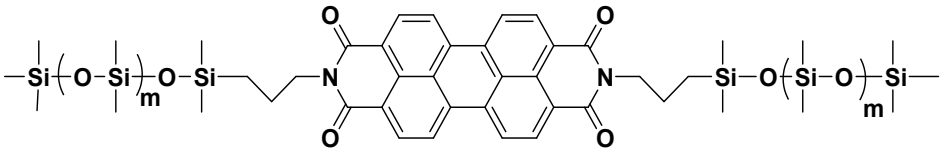

Figure S1. Structures of perylene diimide (PDI) conjugated silicone oil.

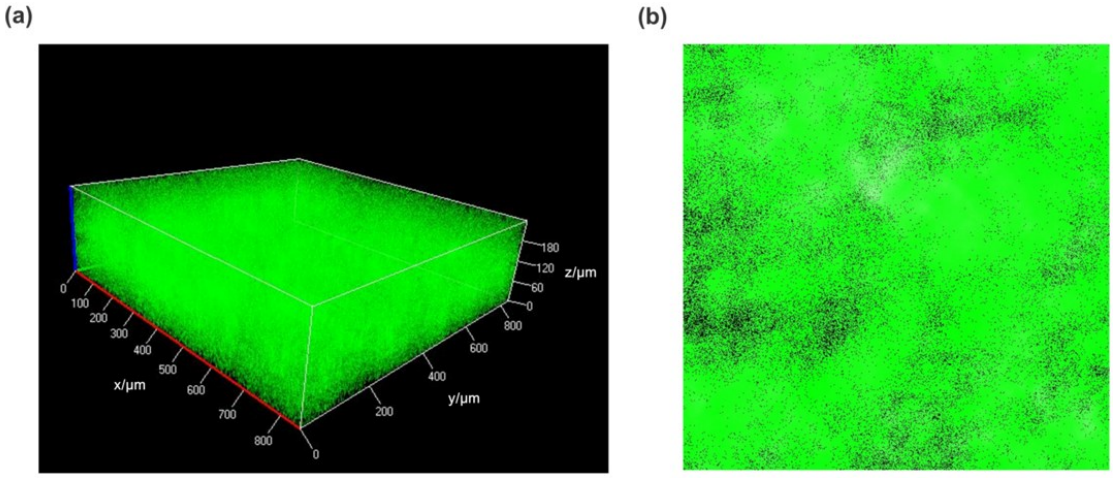

Figure S2. Confocal images of PDI-conjugated silicone oil dipped full-infused surface. (a) 3D stacked full-infused surface. (b) Top view.

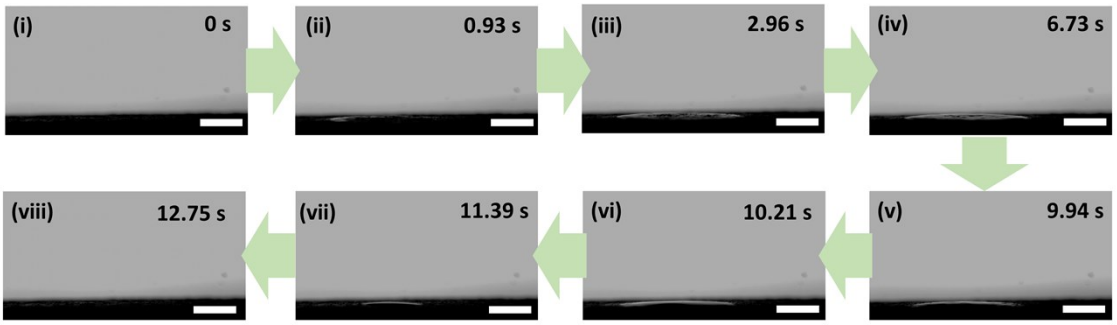

Figure S3. Magnet-responsiveness of ferrofluid on semi-infused adaptive surface: (i)-(iv) applying the magnet; (v)-(viii) withdrawing the magnet. Scale bar: 2 mm.

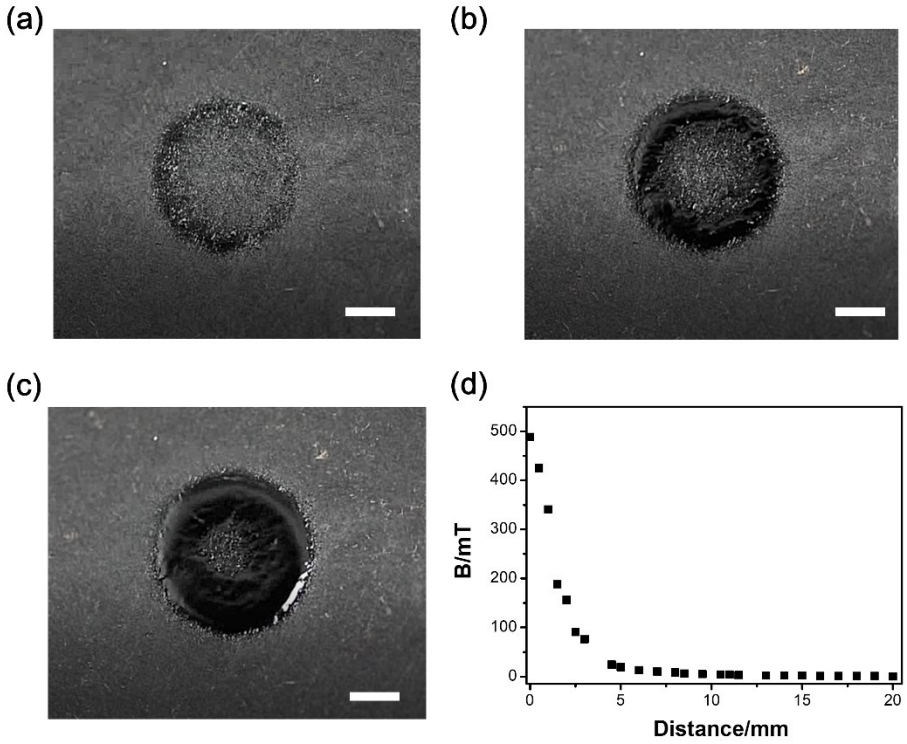

Figure S4. Accumulation of ferrofluid on semi-infused surface when applied with different magnetic fields. (a) Ferrofluid spot occurs on the adaptive surface with a magnetic intensity of 10 mT. (b) Ferrofluid begins to form a "basin" when magnetic intensity increases to 76 mT. (c) Ferrofluid "basin" expands as increasing the magnetic intensity (425 mT). (d) Reletionship of the magnetic intensity to the distance between the magnet and the membrane. Scale bar in (a), (b) and (c) is 2 mm.

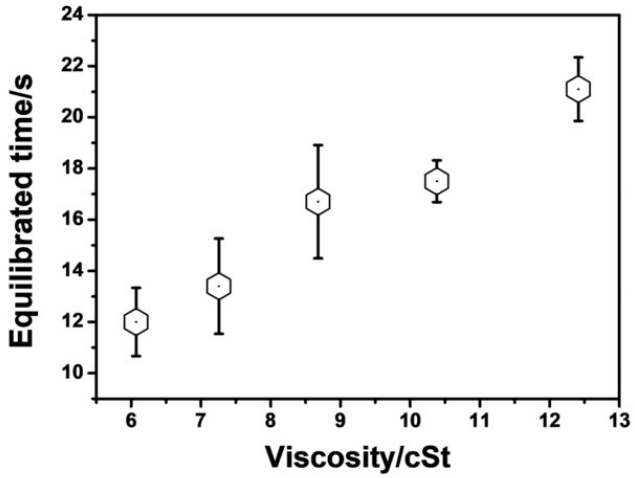

Figure S5. Equilibrated time of ferrofluid with different viscosity under a magnet field (76 mT).

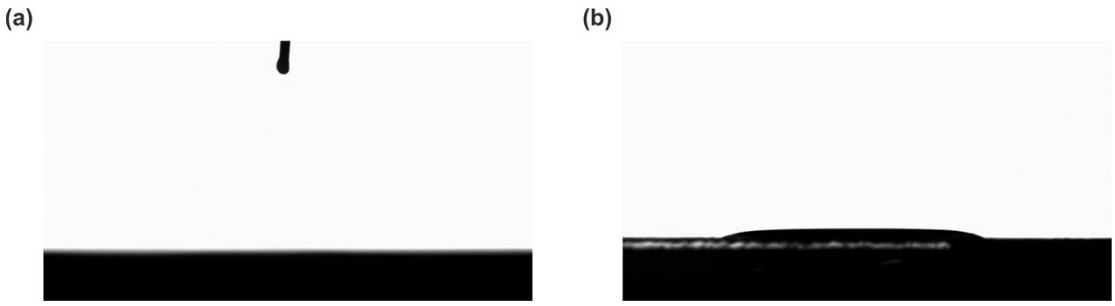

Figure S6. Ferrofluid-substrate angle of ferrofluid on flat PP membrane in the intact state (a) and (b) activated state (b).

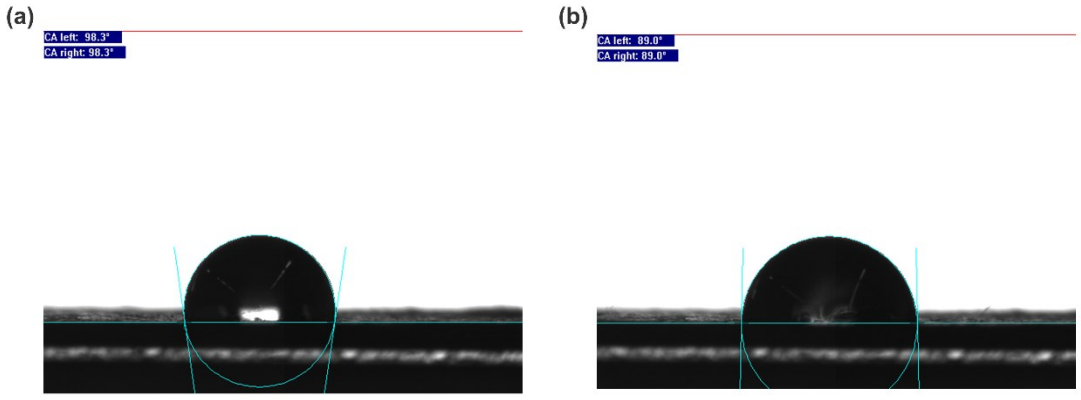

Figure S7. Water contact angle of water droplet on the flat semi-infused adaptive surface in the intact and processed state, respectively.

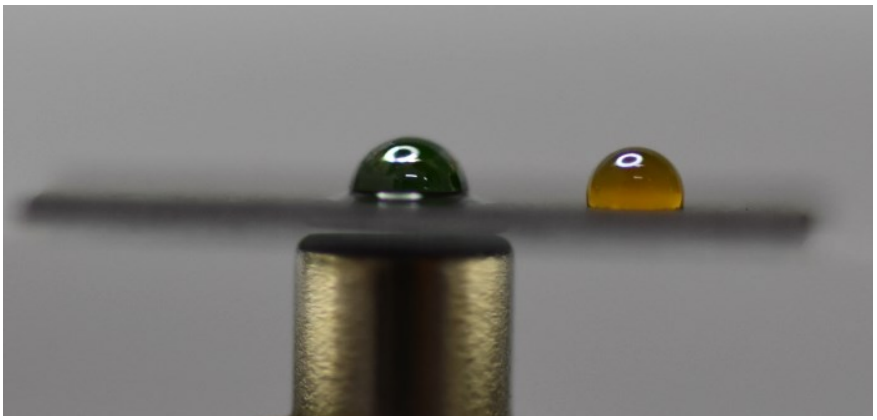

Figure S8. Droplets on semi-infused adaptive surface with and without magnetic field.

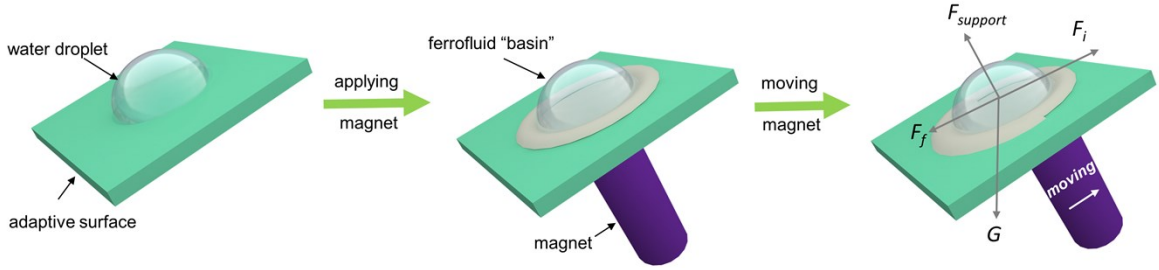

Figure S9. Force analysis of droplet manipulation on the tilted surface. When the applied magnet moved upwards, the droplet was subjected to force balance under gravity (G), friction force (F_f), support force ($F_{support}$) and interfacial force (F_i). The interfacial force leads the uphilling of a droplet.

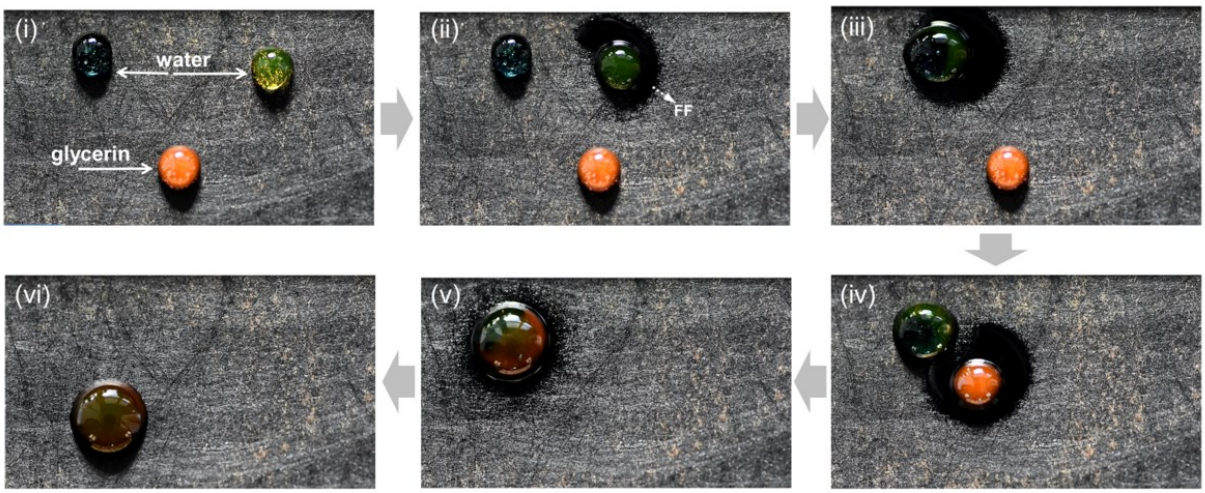

Figure S10. Droplet manipulation between water droplets and glycerin droplet. (i) Water and glycerin-based droplets pinned on the semi-infused adaptive surface. (ii) Yellow droplet was applied with a magnet and moved toward the blue one. (iii) Merging of blue and yellow water droplets. (iv) Glycerin-based droplet was applied with a magnet and moved toward the merged water droplet. (v) Droplet merging between water and glycerin droplets. (vi) Merged droplet after withdrawn the magnet.

2. Captions for supplementary movies

Supplementary Movie 1: Reversible transition between intact state and oil-accumulated state of semi-infused adaptive surface when applying and withdrawing the magnet respectively. Speed up: 4 times.

Supplementary Movie 2: Dynamic pinning and activating of droplet on inclined semi-infused adaptive surface. Speed up: 1.5 times.

Supplementary Movie 3: Water droplets manipulation on a tilted semi-infused adaptive surface. The droplet in the lower position can be driven uphill towards the droplet in the higher position, and then two droplets would merge soon.

Supplementary Movie 4: Droplets merging between a water droplet and a high viscous organic droplet. Speed up: 3 times.

Supplementary Movie 5: Chemical reaction between HCl and $NaHCO_3$ on the semi-infused adaptive surface. When these two droplets merged, CO_2 bubbles form. Speed up: 2 times.

Supplementary Movie 6: Manipulation of droplets in a bottom-up manner on the overturned semi-infused adaptive surface. Speed up: 3 times.