# Supporting Information

## Slippery magnetic track inducing droplet and bubble manipulation

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**Experimental Section**

*Fabrication of superhydrophilic and superhydrophobic iron powder*: The prepared process includes etching method and low surface energy modification. The etching solution is a mixed solution of NaOH (2g, 5mol $L^{-1}$) and $(NH_4)_2S_2O_8$ (0.57g, 0.25 mol $L^{-1}$). Then the superhydrophilic particles were prepared by immersing the original iron powder (average grain diameter: 1 μm) in the etching solution for 24 h. Superhydrophobic particles were prepared by immersing superhydrophilic particles in low surface energy modifier for 24 h. The low surface energy modifier is 1 vt% 1H, 1H, 2H, 2H-perfluorodecyltriethoxysilane in ethanol.

*Preparation of slippery magnetic track (SMT)*: The superhydrophobic powder was laid on double-sided adhesive tape (made by 3M company). Then hydrophilic SMT was prepared by infusing Poly(dimethylsiloxane), hydroxy terminated (viscosity ~25 cSt) by spin coater at a rotational speed of 2500 rpm for 30 s. In addition, hydrophobic SMT was prepared by infusing Dimethicone (viscosity ~10 mPa s) at a rotational speed of 1000 rpm for 30 s.

*Characterization and Instruments*: Surface wettability and transport process was characterized by contact angle machine, JC2000D1 at 298 K. The surface profile and roughness were characterized by 3D non-contact surface profiler (KLA-Tencor MicroXAM-800). Liquid-solid adhesion force was measured by a high sensitivity micro-electromechanical balance system (DCT 11 DataPhysics, Germany). The surface topography of microrods was observed by optical microscope (Olympus

BX43). The surface morphology of superhydrophobic iron particles was observed by a field-emission SEM (QUANTA FEG 650, FEI). EDS was used to measure the element percentage and distribution. The chemical compositions of superhydrophobic iron particles were analyzed by XPS (Thermo Fisher Scientific ESCALAB 250Xi).

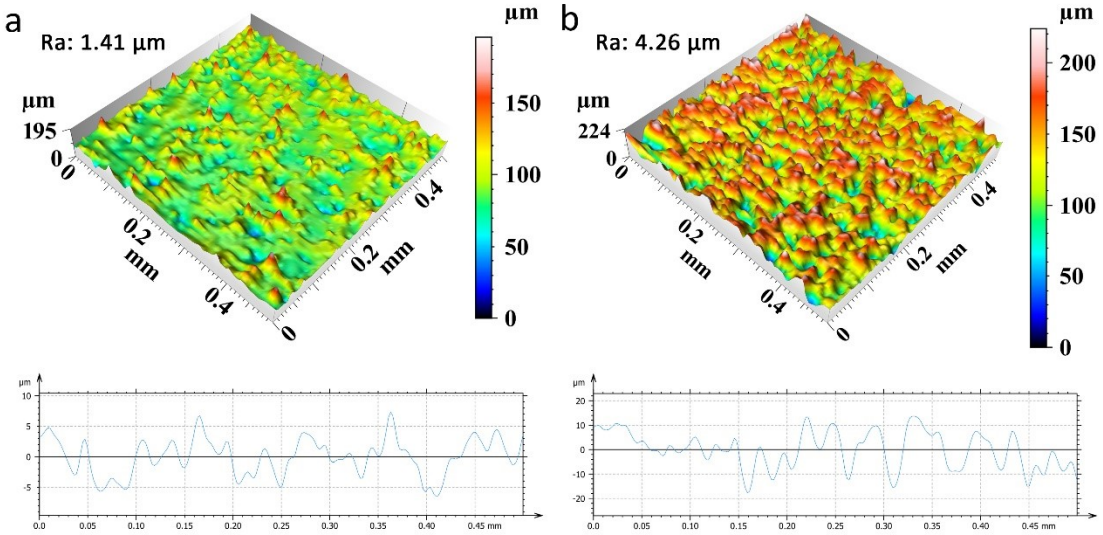


**Fig. S1.** 3D microscopy images of surfaces covered by iron particles (a) without and (b) with magnetic field. the roughness Ra is 1.41 µm and 4.26 µm.

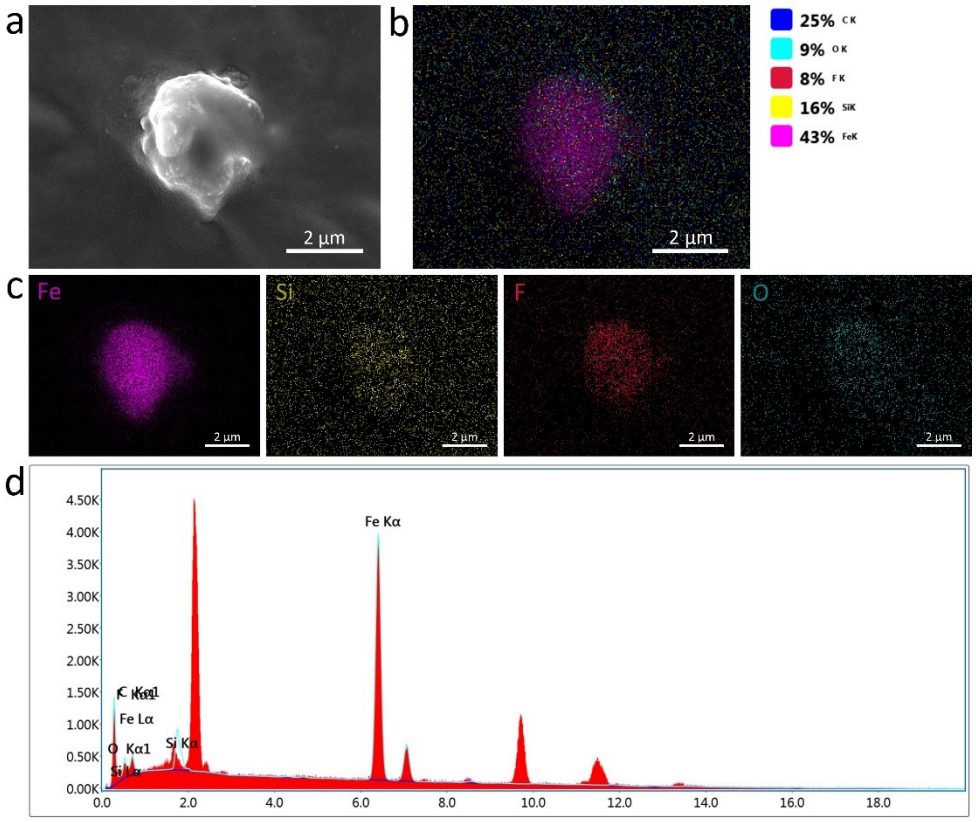


**Fig. S2.** (a) Scanning electron microscope image of superhydrophobic iron particle, (b, c) element distribution images of Fe, Si, F and O. (d) energy dispersive spectrum of superhydrophobic iron particle.

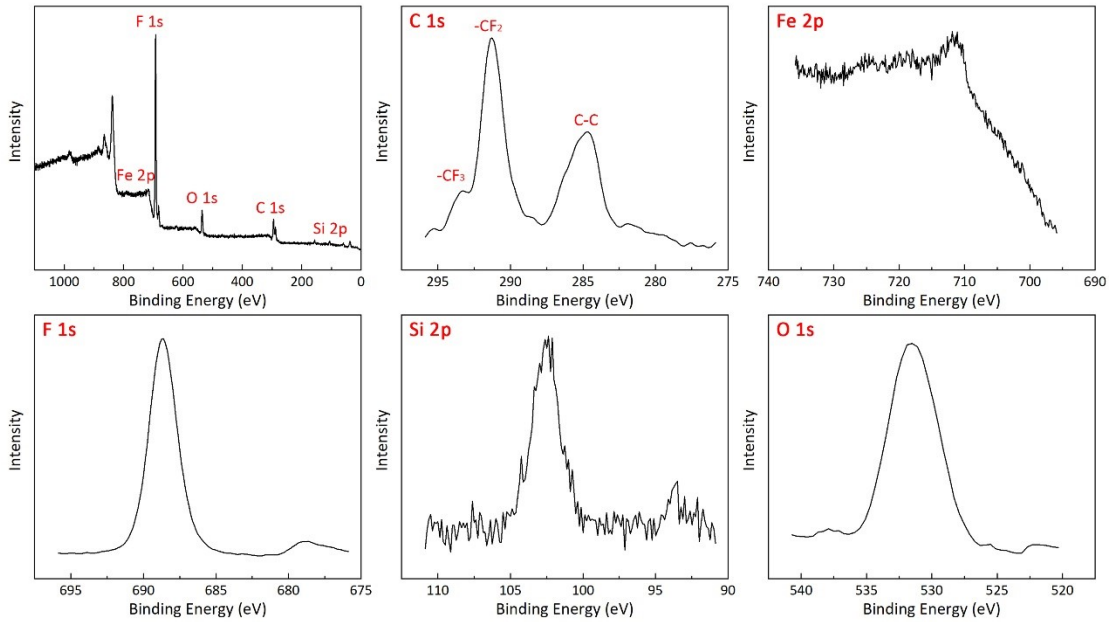


**Fig. S3.** X-ray photoelectron spectroscopy of superhydrophobic iron particle. Survey spectrum and fine spectrum of C, Fe, F, Si and O elements.

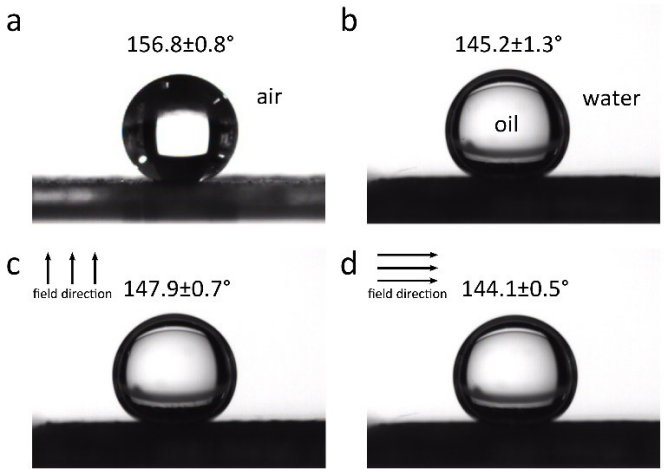


**Fig. S4.** (a) A water droplet resting on the surface assembled by superhydrophobic iron particles with a contact angle of 156.8° ± 0.8°. (b) An oil drop underwater on the surface assembled by superhydrophilic iron particles with a contact angle of 145.2° ± 1.3°. The vertical and horizontal field directions alter the contact angle of oil drop underwater with (c) 147.9 ± 0.7° and (d) 144.1 ± 0.5°.

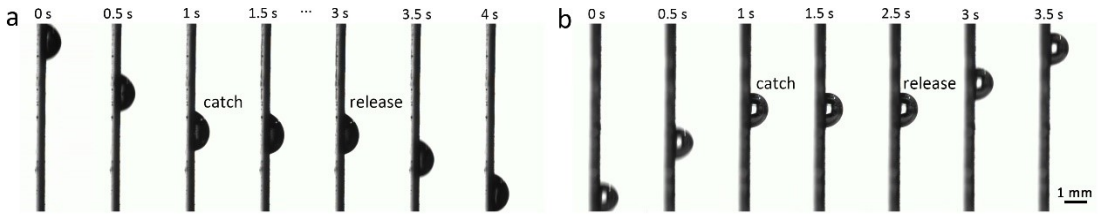


**Fig. S5.** (a-b) Rapidly capturing and releasing of droplets and bubbles by SMT in vertical direction. 1 μL droplets/bubbles was captured by exerting magnetic field and released by removing magnetic field.

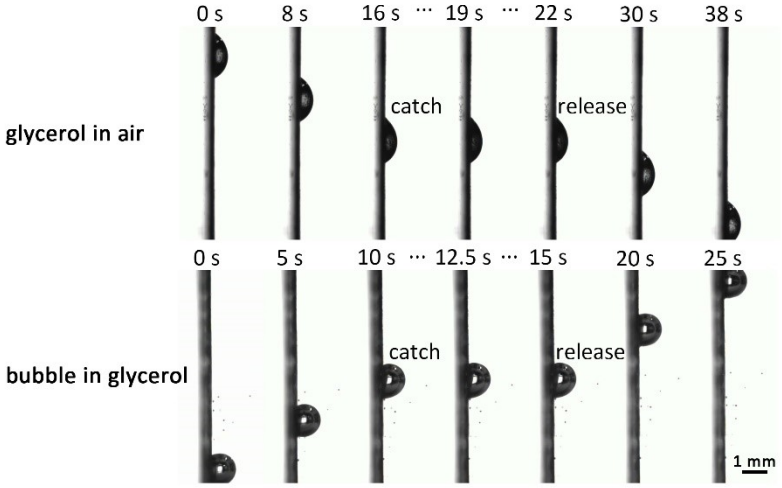


**Fig. S6.** The capture and release of glycerol droplets and the capture and release of bubbles in glycerol liquid.

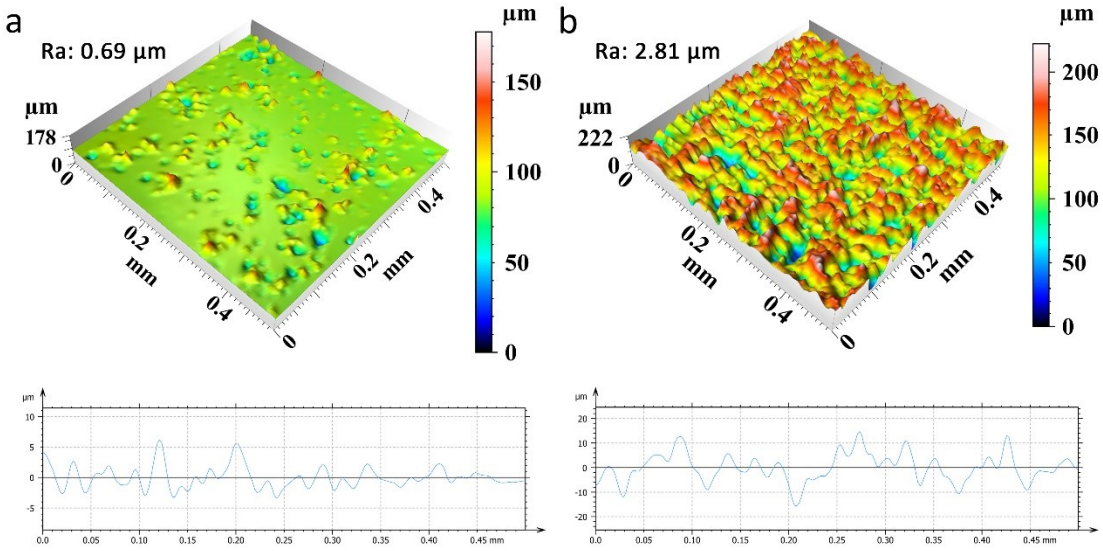


**Fig. S7**. 3D microscopy images of surfaces after 20 magnetic cycles. (a) SMT without magnetic field. the roughness Ra is 0.69 µm. (b) SMT with magnetic field. the roughness Ra is 2.81 µm.

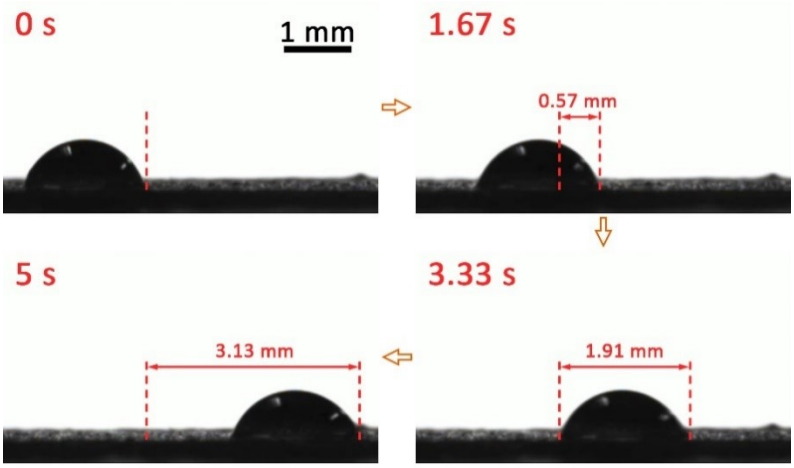


**Fig. S8.** A 0.5 μL water droplet moves on the SMT at a velocity of 626 μm $s^{-1}$ while the rotation speed of the magnet is 5 r $s^{-1}$.

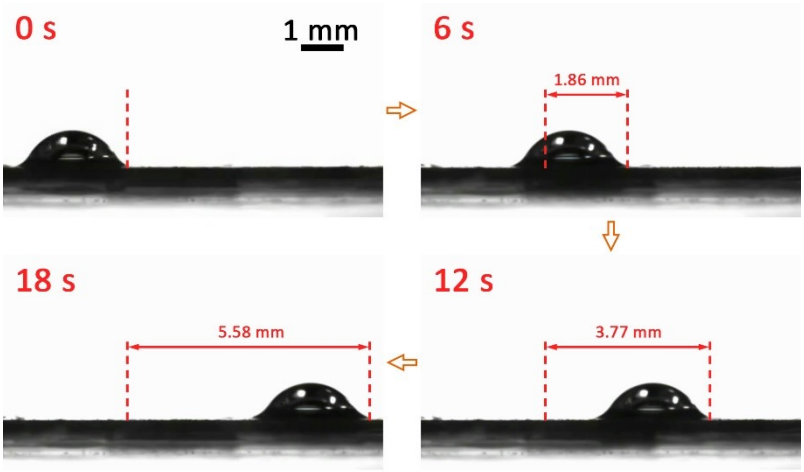


**Fig. S9.** A 0.5 μL underwater bubble moves on the hydrophobic SMT at a velocity of 318 μm $s^{-1}$ while the rotation speed of the magnet is 2.5 r $s^{-1}$.

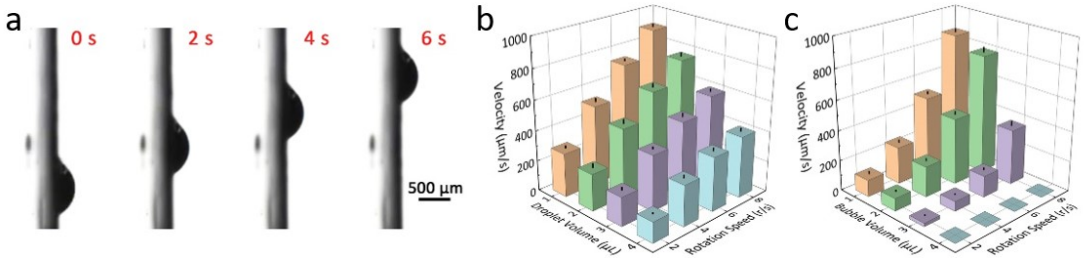


**Fig. S10**. (a) A 0.2 μL water droplet moves upward in the vertical direction at a velocity of 290 μm $s^{-1}$. (b) Effects of water droplet volume and rotation speed of magnet on transport velocity. The transport velocity is inversely proportional to the volume of the water drop and directly proportional to the rotation speed of the magnet. (c) Effects of bubble volume and rotation speed of magnet on transport velocity. When the bubble volume is 4 μL, the transport velocity is always 0.

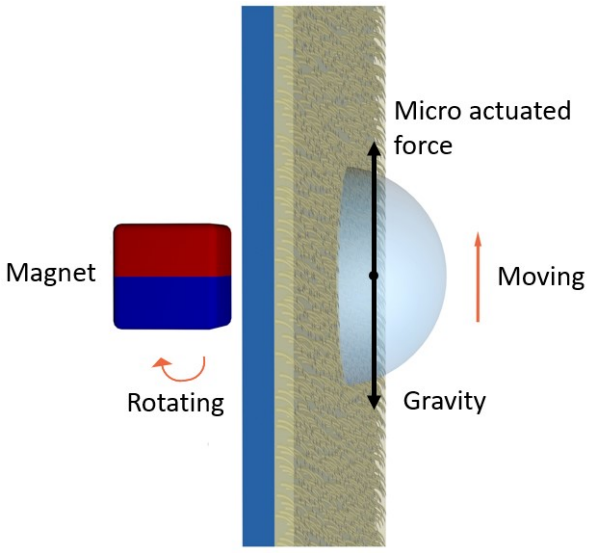


**Fig. S11.** Force analysis diagram of anti-gravity transmission.