

Supplementary Information

Light-controlled quick switch of adhesion on a micro-arrayed liquid crystal polymer superhydrophobic film

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Experimental Section

Materials: DA11AB and C9A were synthesized and purified according to the literature.^{1,2} Irgacure 784 (photoinitiator), the monomer and crosslinker of PDMS, and fluorodecyltriethoxysilane (FDTES) were purchased from commercial suppliers and used as received. The micro-arrayed silicon wafers with different roughness were prepared by photolithography and an inductively coupled plasma deep-etching technique.^{3,4}

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Preparation of PDMS soft template: Firstly, cleaned micro-arrayed silicon wafers, which are the mother templates, were pretreated by O₂ plasma for 3 min (Harrick Plasma PDC-002). Subsequently, the silicon wafers were modified by silanization in FDTES vapor at room temperature (23 °C) for about 12 h. Then, the PDMS soft templates were prepared by vacuum casting of the PDMS precursor (The ratio of monomer to crosslinker was 10:1 (wt:wt)) onto the silanized silicon wafers and

solidification in a thermo tank at 80 °C for about 1 h. Finally, the soft templates were directly peeled-off and then pretreated by O₂ plasma and silanization for further use in the following secondary replication.

Preparation of micro-arrayed azobenzene LCP film: The mixed precursor of DA11AB and C9A in the molar ratio of 1:4 was solved in chloroform to form a solution. Then, adequate initiator was added and fully stirred in the precursor solution in a dark room. Well-distributed precursor powder was obtained by slow and exhaustive evaporation of the solvent at 23 °C overnight. The precursor powder was casted onto a PDMS soft template which was located on a 105 °C hot plate (METTLER-TOLEDO FP82HT). Subsequently, the set was treated in a vacuum tank at 110 °C for 10 min to remove all the mini air bubbles, and then was relocated on the hot plate. In turn, spacers (two strips of 30 µm-thick polyimide thin film) and a glass slide were put onto the PDMS soft template to form a crosslinking cell. The temperature of the cell was gradually decreased from 105 °C to 93 °C at an annealing speed of 0.1 °C min⁻¹, which was regulated by a high-precision central controller (METTLER-TOLEDO FP90). The annealed monomer mixture was in a nematic phase and crosslinked by photopolymerization at > 540 nm with a high pressure Hg lamp (Beijing CHANGTUO CHF-XM250) through glass filters for 3 h (2.5 mW cm⁻²). After crosslinking, the cell was opened and the micro-arrayed azobenzene LCP film was separated smoothly from the PDMS soft template, and then was peeled-off from the covered glass slide.

Characterization Method: The morphological and POM characterizations of the micro-arrayed azobenzene LCP film were performed on Leica DM4000M. Water CAs and SAs were measured on a contact angle system (DataPhysics OCA20). Because the size of water droplet affects, especially, the SAs, the droplet size ought to be chosen so that can demonstrate the reversible switch of superhydrophobic adhesion. By a primary optimization of the droplet size, 2 µL was finally chosen for the rolling-to-pinned switch of superhydrophobic adhesion. The average CA and SA values were obtained by measuring the same sample at least in five different positions. The experimental errors of CA and SA are less than ± 2°. The temperature was controlled by an electrical temperature-control chamber (TEC400, Germany) connected on OCA20.18 MΩ cm deionized water (Millipore Milli-Q (0.22 µm)) was used for all the wettability and adhesion characterizations. The UV and visible light were obtained from a UV light emitting diode (LED) (OMRON ZUV-C30H, 365 nm) and a visible LED (CCS HLV-24, 530 nm), respectively.

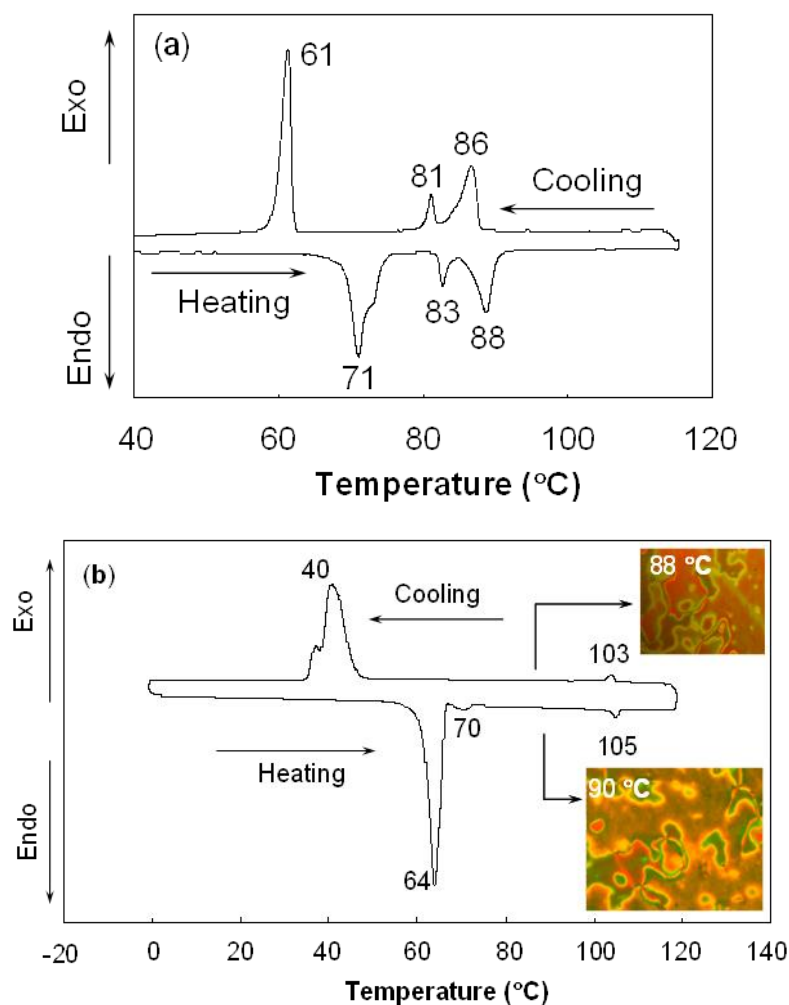


Fig. S1 DSC curves and POM images (inset) of (a) DA11AB and (b) the mixture of DA11AB and C9A in the molar ratio of 1:4 on heating and cooling ($5\text{ }^{\circ}\text{C min}^{-1}$). DA11AB only shows a very narrow nematic phase window of $5\text{ }^{\circ}\text{C}$ on cooling. After blended with C9A in the optimized proportion, the nematic phase window is greatly enlarged to $63\text{ }^{\circ}\text{C}$.

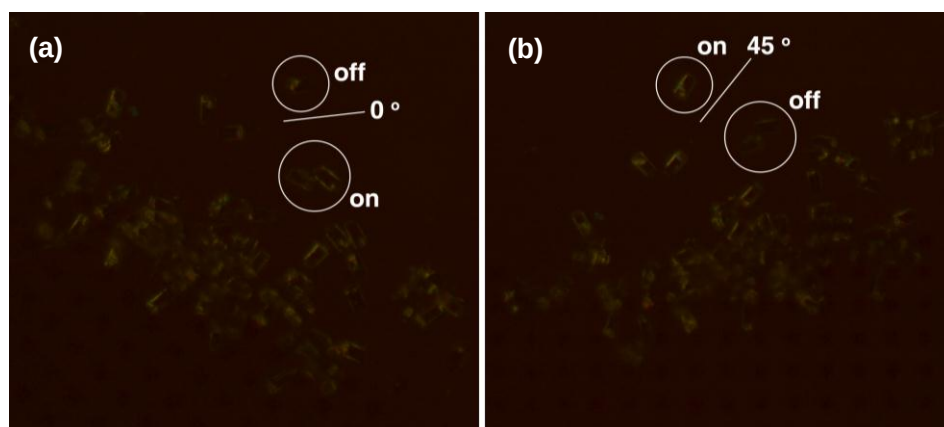


Fig. S2 POM images of the cut-off azobenzene LCP microposts in defined (a) 0° and (b) 45° . The white circles denote the edges of the posts bearing a 45° in-plane-rotating on-off alternation. Both in (a) and (b), the posts with a 45° in-plane orientation have the opposite brightness. All the observations support the fact that the azobenzene mesogens are aligned parallel in the surface region of the microposts in nematic phase.