Capillary Number Encouraged the Construction of Smart Biomimetic Eyes

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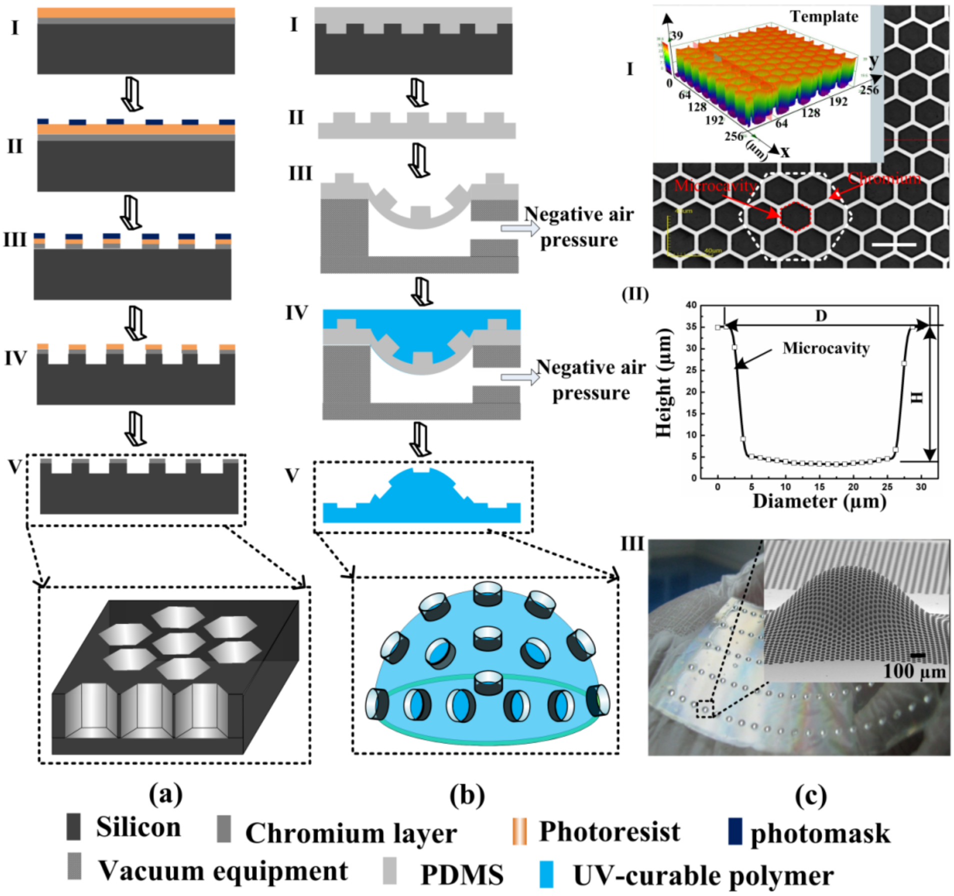
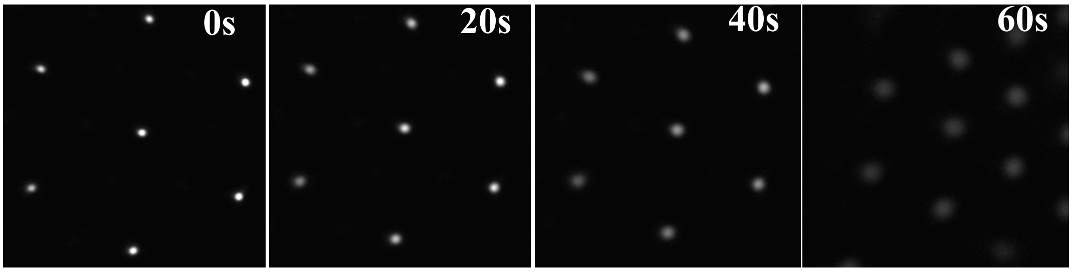
Fabrication of the MCA template

The hemispheric MCA template was achieved through a polymer replication process by reconfigurable microtemplating. The key processes are illustrated in Fig. **S1**. The planar MCA substrate was prepared by the traditional photolithography and subsequent etching processes (**Fig. S1 a**). Firstly, a 200 nm-thick chromium coating was deposited onto a cleaned silicon substrate by magnetron sputtering process, and then, a 2 μm-thick positive photoresist (e.g. EPG533 series) layer was spin-coated and pre-baked on the above substrate with a diameter of 4 inches (**Fig. S1 aI**). Secondly, the photomask was placed over the photoresist film and then exposed to the collimated UV light for a few seconds (e.g. 8 s) (**Figure S1 aII**). After soaking the substrate in the developer (e.g., 5‰ NaOH solution) for tens of seconds (e.g., 30 s), the photoresist pattern was acquired (**Fig. S1 aIII**). Then, based on photoresist pattern, microcavity structures in silicon substrate were obtained by two subsequent etching processes such as chemical wet and inductively coupled plasma (ICP) etching. The chemical wet etching process was used to pattern chromium layer. Subsequently, based on chromium pattern, ICP process was utilized to etch silicon substrate, which was achieved by successive steps of passivation (C_4F_8) and etching (SF_6) sub-cycles. The method offers a height up to 30 μm, diameter of 26 μm and period of 30 μm. Finally, after the photoresist stripped off from the silicon substrate, the planar MCA template with a large array of micro-hexagon-microcavities was obtained, as demonstrated in **Fig. S1 aV**. The top view and the 3-dimensiton image of the planar MCA template are shown in **Fig. S1 cI.** Each microcavity has a hexagon diameter of 26 μm, a period of 30 μm and a depth of 30 μm (**Fig. S1 cII**).

For reconfigurable microtemplating, the pre-prepared colloid polydimethylsiloxane (PDMS) was spin-coated onto the planar MCA template under a speed of 2000 r/min (**Fig. S1 bI**). The 200 μm-thick PDMS elastomer replica with micropillar array was achieved after curing for 2 h at 75℃ (**Fig. S1 bII**). The PDMS membrane was then laid flat on a plate with a circular through-hole (here, 800 um in diameter), as illustrated in **Fig. S1 bIII**. Subsequently, a negative air pressure of 5-20 kPa was applied through a microfluidic channel to deform the PDMS membrane into a hemispheric dome (**Fig. S1 bIII**). After that, a solvent-free UV-curable epoxy resin (NOA 71, Norland Products Incorporated, Cranbury, NJ) was precisely dispensed onto the deformed elastomer membrane, covered with a polycarbonate sheet, and fully cross-linked for 40 s with a UV light of 5.8 mW/cm^2 (**Fig. S1 bIV**). When the NOA hemispheric shell was manually peeled off the hemispheric MCA template was eventually achieved (**Fig. S1 bV**). Due to the external force, the deformation of the PDMS elastomer membrane gives rise to the extension of the sag height. Therefore, the sag height of the membrane is in proportion to the negative air pressure. The scanning electron microscopy (SEM) image of MCA omnidirectionally distributed on the hemispherical surface is indicated in **Fig. S1 cIII.** The curvature radius of the dome is ~800 µm.



Supplementary Fig. S1: (a) The traditional photolithography and etching processes were applied to fabricate closely packed MCA in the silicon substrate. (b) A reconfigurable microtemplating polymer process was adopted to construct closely packed MCA in the polymer hemispherical surface. (cI) The LSCM surface profile of the planar MCA template. The scale bar is 30 µm. (cII) The LSCM cross section of a microcavity. (cIII) The photograph and SEM image (the inset) of a MCA array. The scale bar is 100 µm.



Supplementary Fig. S2: the point spread function images of biomimetic eyes under the temperature of 50 °C.