Supplementary Information

Controlled wettability based on reversible micro-cracking on shape memory polymer surface

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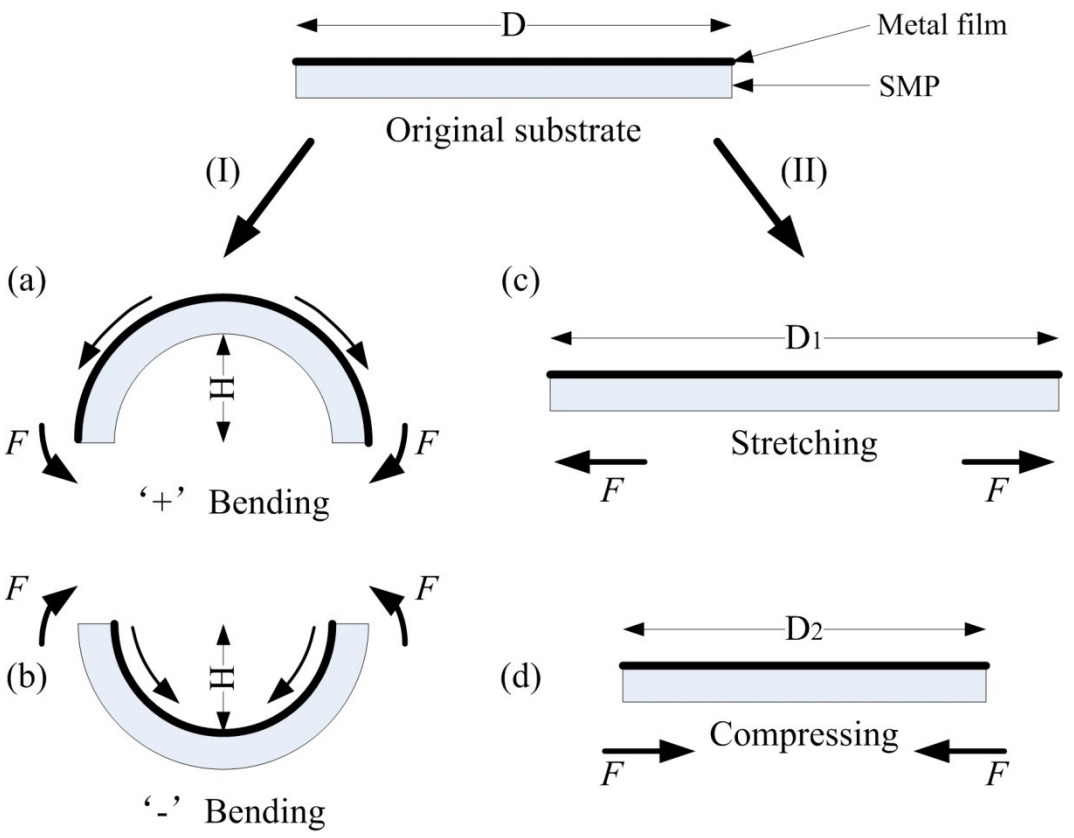

Fig. S1. Schemes for two different deformation strategies. (I) By bending: (a) the '+' bending represents the metal film being stretched, (b) the '-' bending represent the metal film being compressed; and (II) by parallel external forces: (c) substrate being stretched, (d) substrate being compressed. The deformations are described by H/D for (a), -H/D for (b), (D1-D)/D for (c) and (D2-D)/D for (d), respectively.

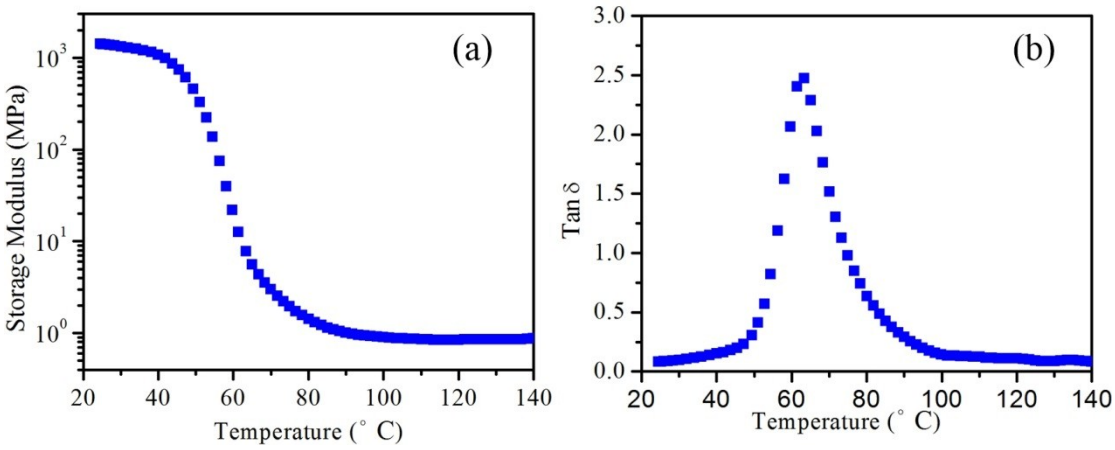

Fig. S2. (a) Storage modulus and (b) loss factor tan δ vs. temperature of the S-SMP after washed by NaOH, measured by DMA. The modulus shows a decrease from 1100 MPa to 1.5 MPa in the temperature range between 40 and 80 ℃. Meanwhile, the observed peak in the tan δ curve locates at about 63 ℃, which is the same as the one of raw S-SMP material. That is, the mechanical properties of the S-SMP before and after washed by NaOH are almost the same, indicating the S-SMP is independent of the washing by NaOH. Owning to the unique feature of thermal-responsive shape memory polymer, which becomes plastic after heated above glass transition temperature (T_g) and fixes it's shape once under T_g, the fabricated surface cracks are stable under normal environment free of heat and external forces. Contact angles of water on the surface of S-SMP before and after tested by DMA were measured at room temperature. They were 84.8° ± 0.6° and 84.6° ± 0.7°. This means that the mechanical test doesn't influence the surface wettability of S-SMP.

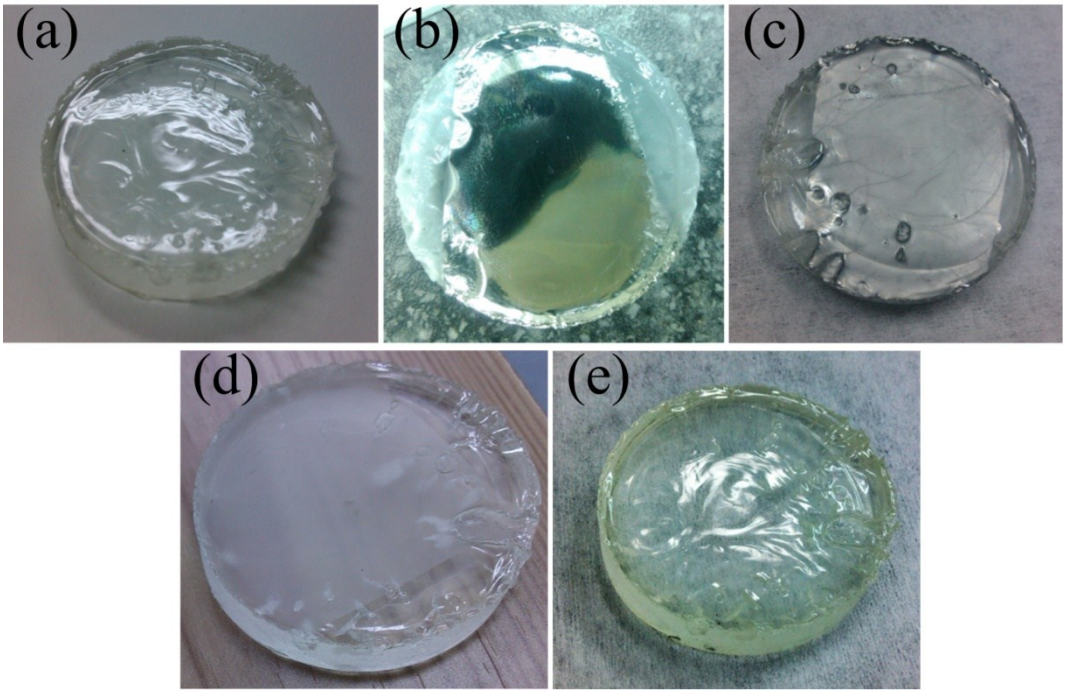

Fig. S3. Photographs of the S-SMP surface at different states: (a) the original smooth surface obtained after curing; (b) the glistening surface after coating Al; (c) the unglazed surface after deformed; (d) the frosted surface after removing Al; and (e) the recovered smooth surface after reheating. Small undulations can be observed on the original surface, which were caused by airstream perturbation during the curing process. Such small undulations only adapted the matrix shape and won't induce any influence on surface chemistry or surface energy.

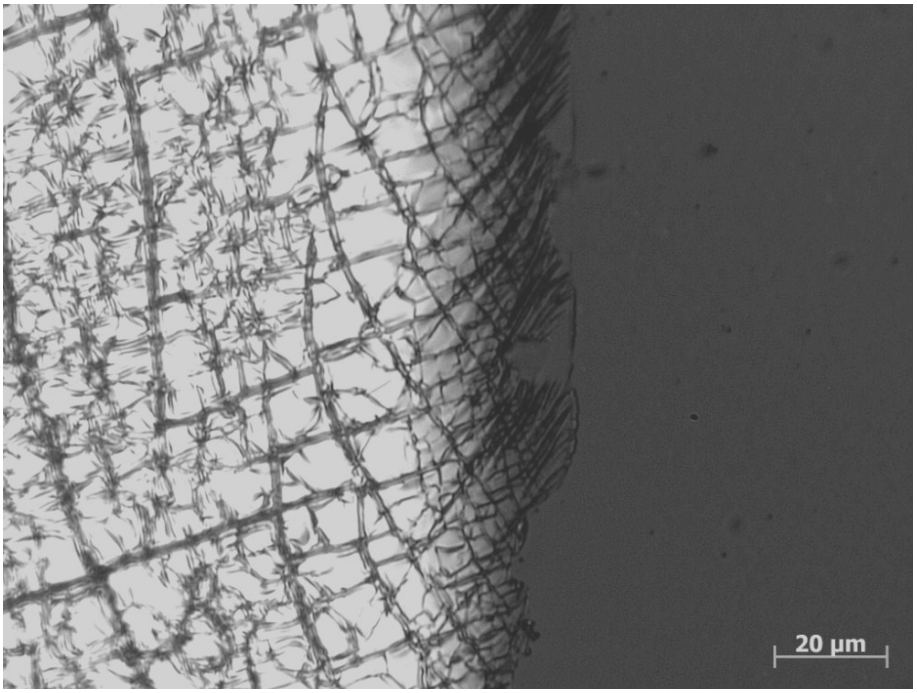

Fig. S4. Optical micrograph of deformed S-SMP surface, at the boundary between the Al-coated region (left) and the non-coated region (right).

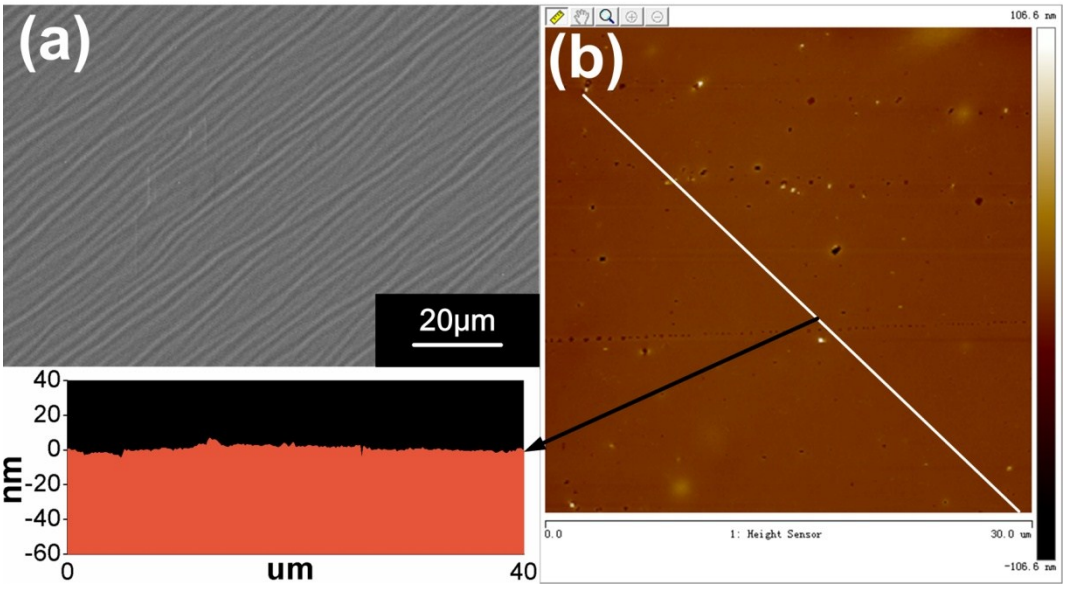

Fig. S5. The (a) SEM and (b) AFM image of the original surface of S-SMP, showing that the roughness is within 15 nm.

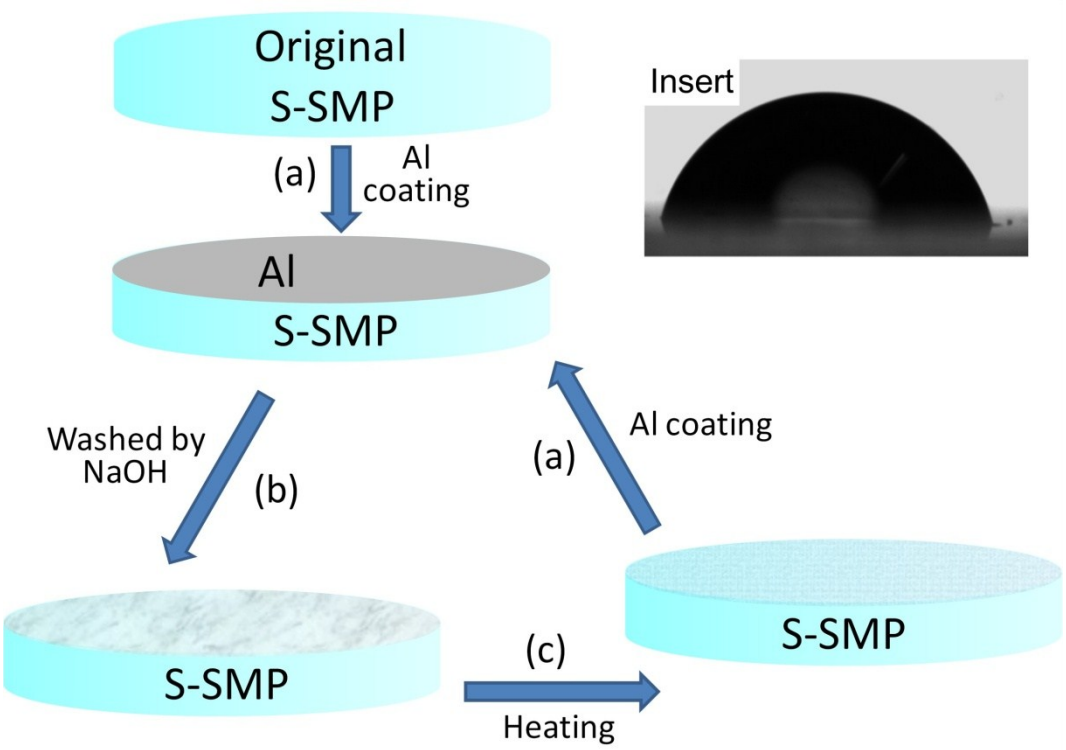

Fig. S6. Schematic for fabrication processes of the equivalent experiment. (a) The substrate was coated with Al film and heated in hot water (without any deformation); next, it was cooled down in cold water, and (b) then the Al film was washed by 10 wt% NaOH; finally, (c) the substrate was reheated just as the crackled sample had been done for comparison. Inset is the picture of water droplet in contact with the S-SMP surface (CA of ~82°) after being processed with process (b).

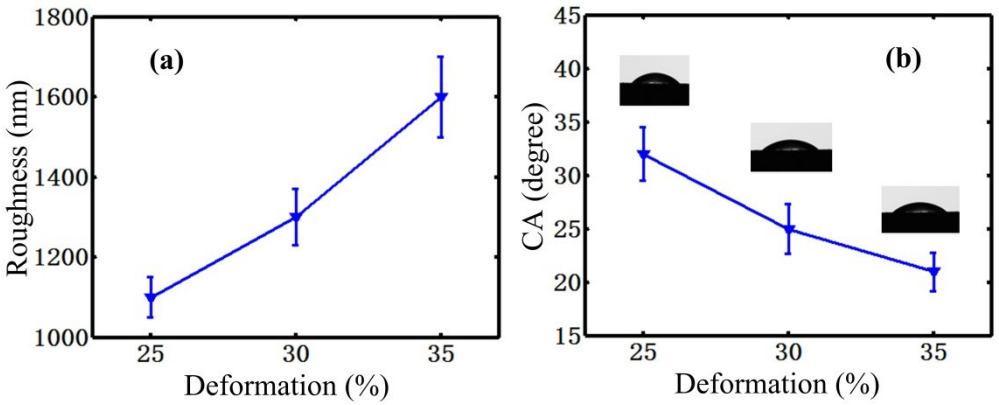

Fig. S7. Impacts of deformation rate on (a) the cracking surface roughness and (b) the water droplet contact angle on cracking surface. With the deformation intensity increasing, surface roughness increased while the CA declined. Insets are pictures of water droplet contacting with cracking surfaces.

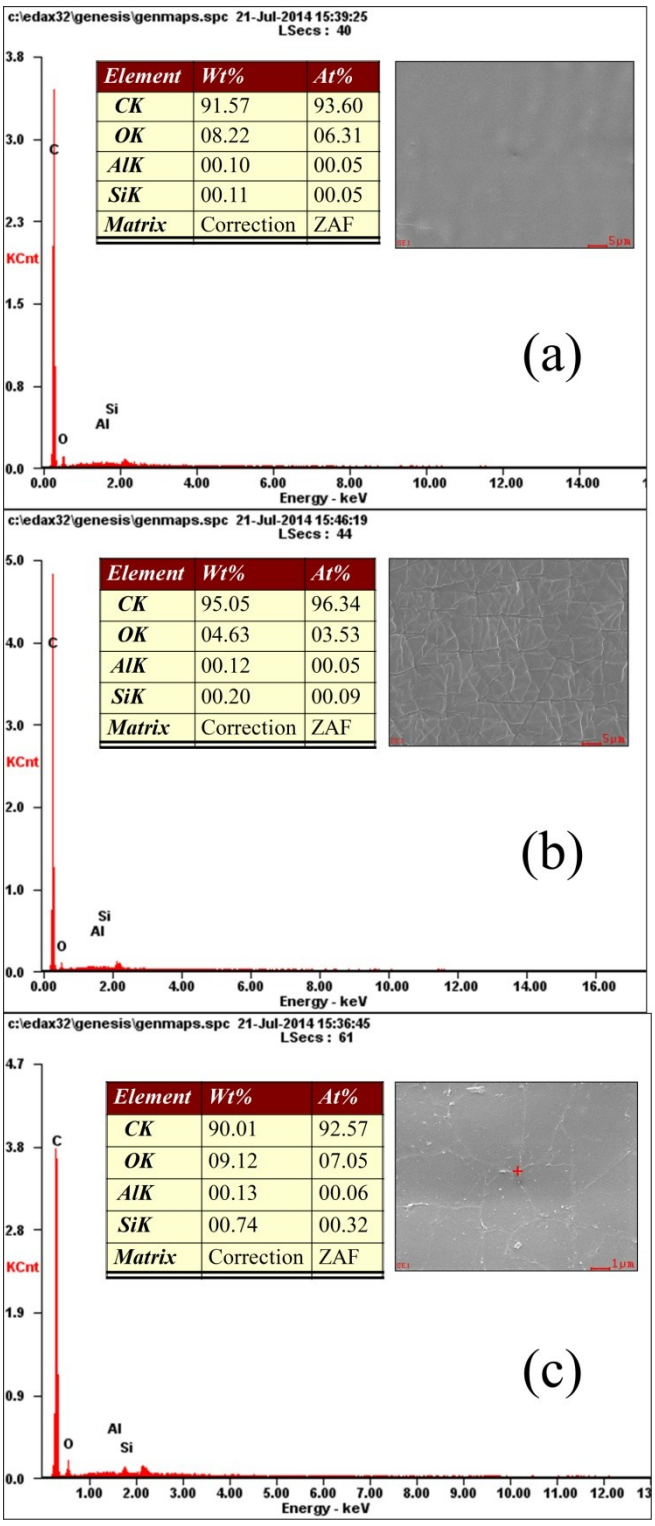

Fig. S8. EDS results of the S-SMP surface at (a) original, (b) deformed and (c) recovered state, respectively. EDS tests reveal that the major compositional elements of S-SMP kept stable in the processing cycle.