Electronic Supplementary Material

Bio-inspired smart surface to achieve controllable locomotion through adjustable anisotropic friction

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The fabrication process of shape memory polymer (SMP) pattern and the composition of SMP monomer are shown in Fig. S1.

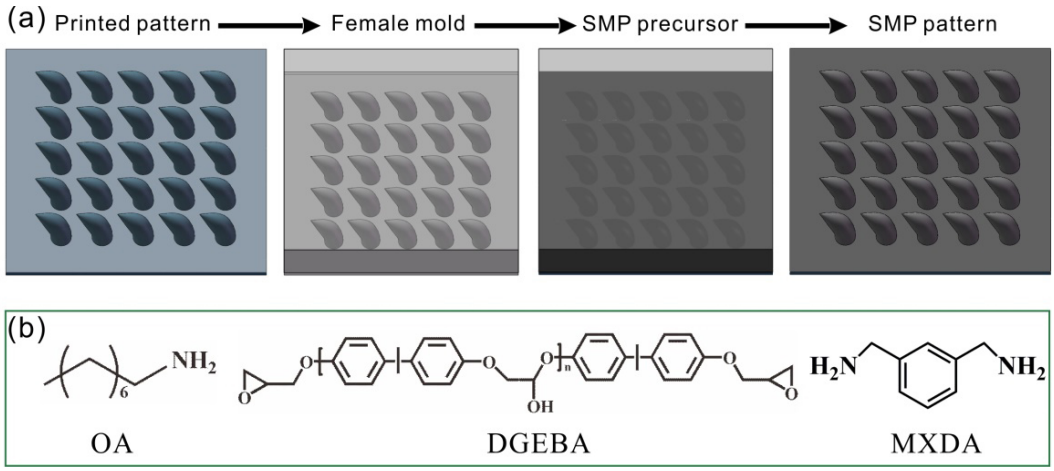

Fig. S1 Schematic illustration of (a) the preparation process for the shape memory surface with oriented microstructures and (b) the chemical structures of the SMP pre-polymer ingredients.

For measuring the external force, a surface covered with switched spines was put face down on a thermostatic heater and with a weight on top of it (Fig. S2). When the temperature increased to 100 °C, the switched spines began to revert to their initial state under the external load, and the critical weight that enabled the switched spines to recover their initial state was designated the "employed external pressure". A surface with a size of 20 mm × 5 mm was used to perform the measurements and its critical weight was ~10 g; the calculated external pressure was 10 × 9.8 = 0.098 N.

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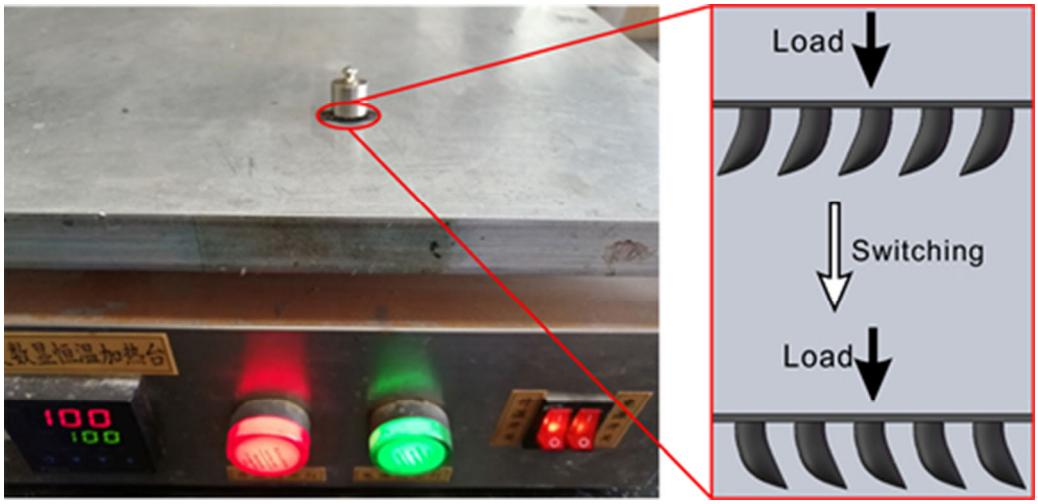

Fig. S2 Measurement of the external pressure employed for switching the oriented spines.

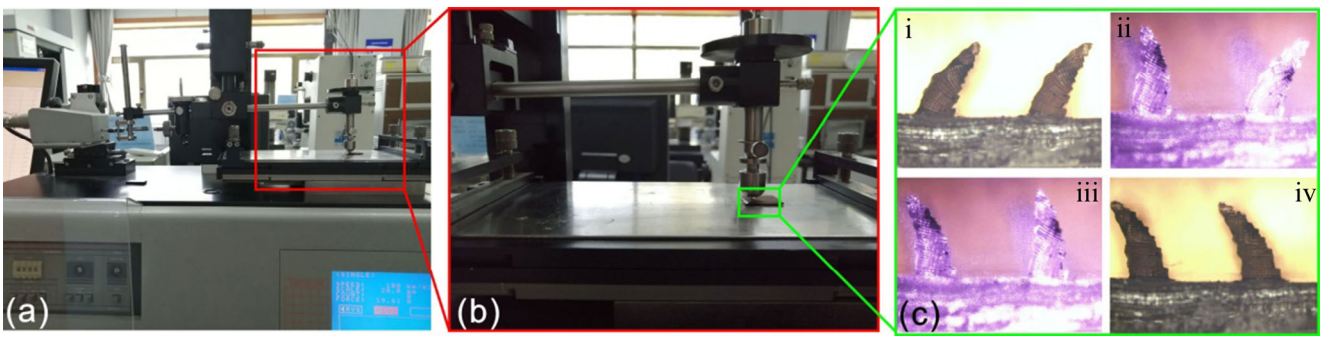

Fig. S3 (a, b) Device used for the friction tests. (c) The changes in the spines' orientation.

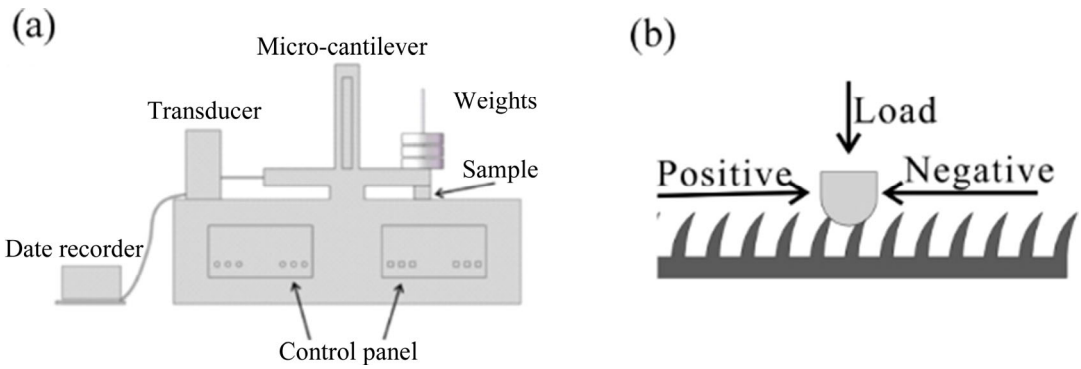

Fig. S4 Schematic illustration of (a) the friction testing device and (b) the positive and negative sliding directions under the load of the PDMS ball.

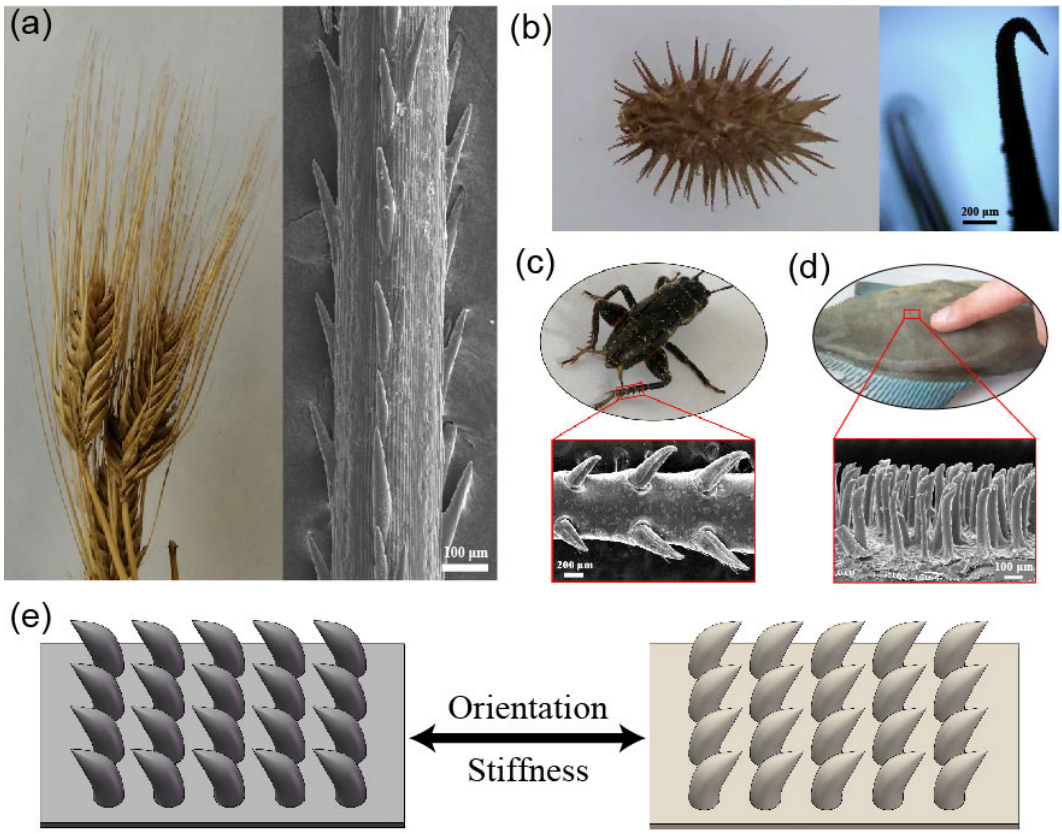

Fig. S5 SEM or digital images of hook-like spine on the (a) wheat awn, (b) fruit of Xanthium L, (c) hind leg of cricket, and (d) filefish skin. (e) Schematic illustration of the adjustable anisotropic friction induced by spines' orientation and surface's stiffness.

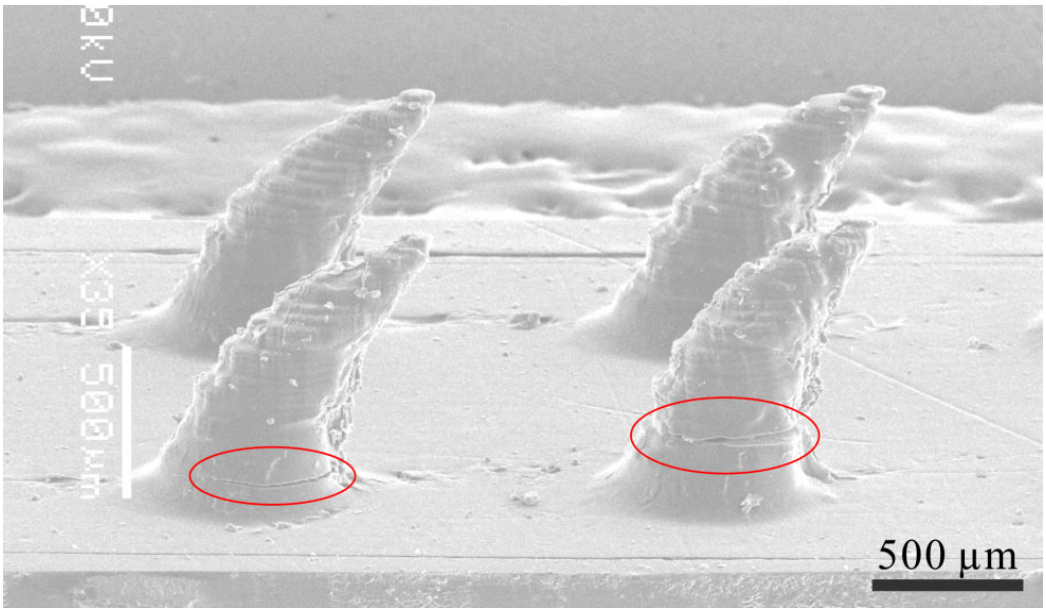

Fig. S6 SEM image of SMP spines which have experienced 7–10 bending cycles. Notably, the durability and switching ability can be improved by increasing the process temperature to 120 °C.

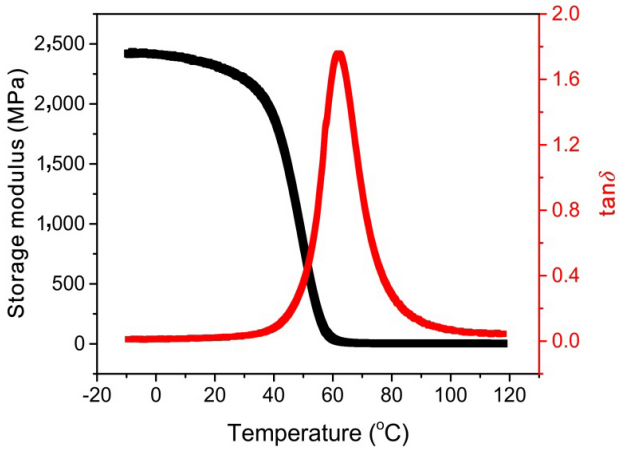

Fig. S7 Storage modulus and loss factor (tanδ) curves of the SMP as a function of the temperature.

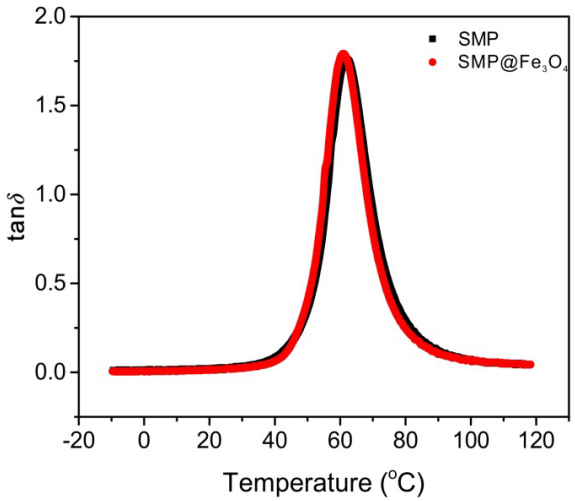

Fig. S8 Glass transition temperature (T_g) of the SMP and the SMP@Fe_3O_4 composite.

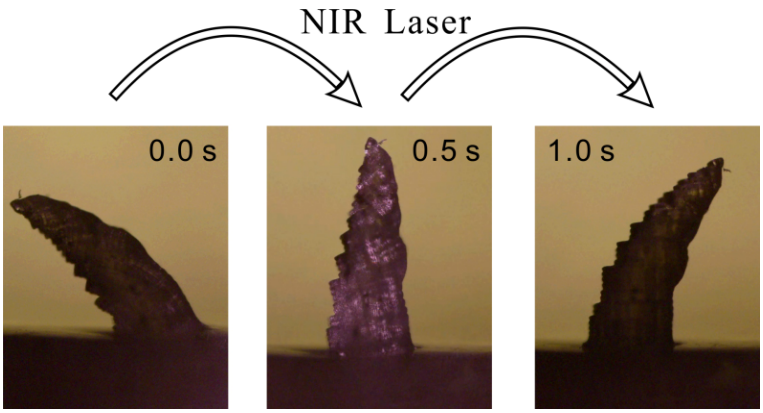

Fig. S9 Fast switching of the spines' orientation under NIR light irradiation.

Video S1 The fast switching process of the SMP spines' orientation under NIR light irradiation.

Video S2 The directional driving behaviour of the device with the anisotropic structures.

Video S3 The braking behaviour of the smart device controlled by remote NIR light.

Video S4 The round-trip locomotion of the smart device controlled by remote NIR light.