Supporting Information

Programmable Soft Robotics Based on Nano-Textured Thermo-Responsive Actuators

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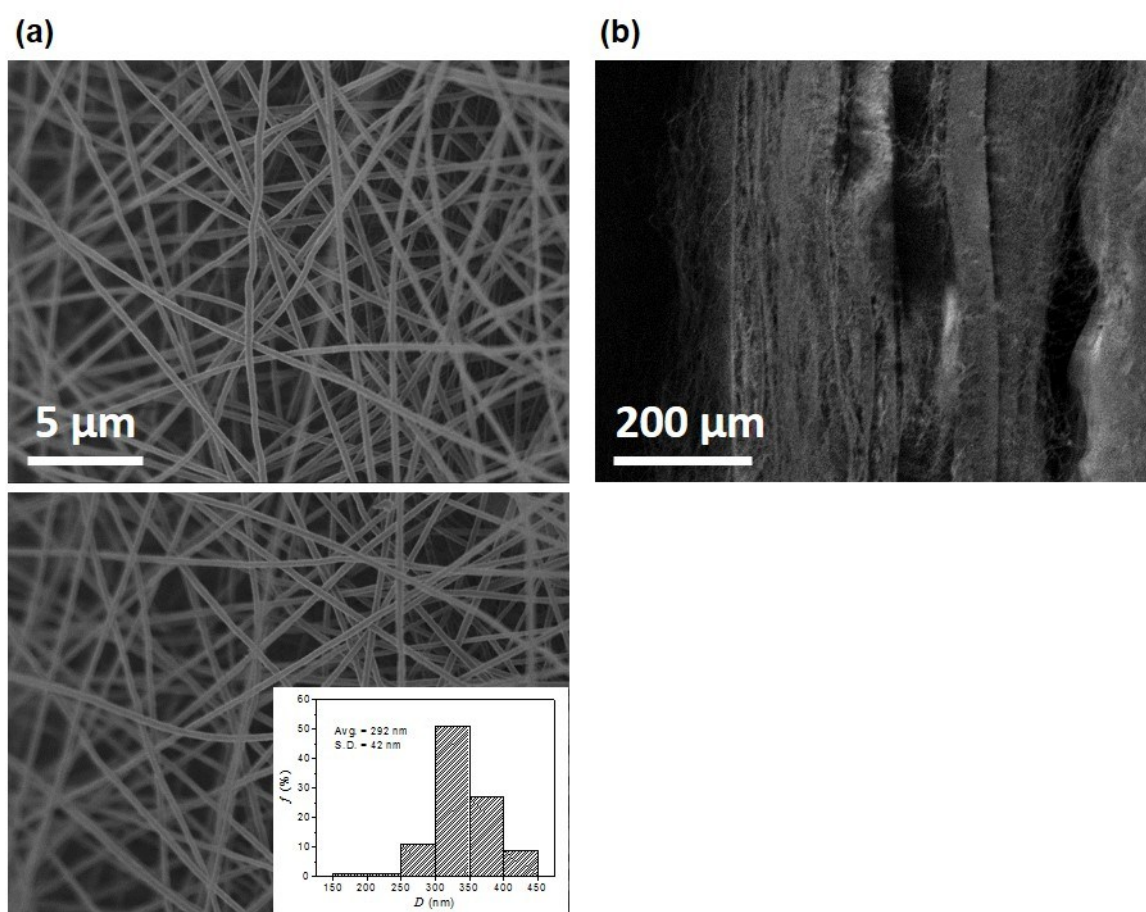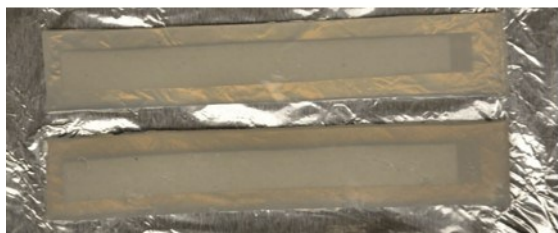
Fig. S1 SEM images and size distribution of PAN NFs: (a) surface morphology of PAN NFs, (b) cross-sectional image of PAN NFs.

(a) Without EtOH imbibition
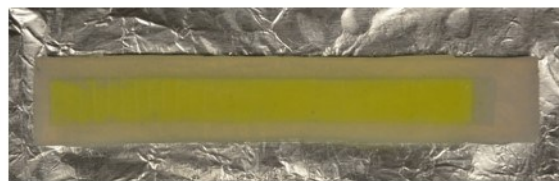
(b) With EtOH imbibition

Fig. S2 Photographs of bubble wrap-shaped and rectangular-shaped soft actuator before and after imbibition of ethanol: (a) Without ethanol imbibition, (b) with ethanol imbibition.
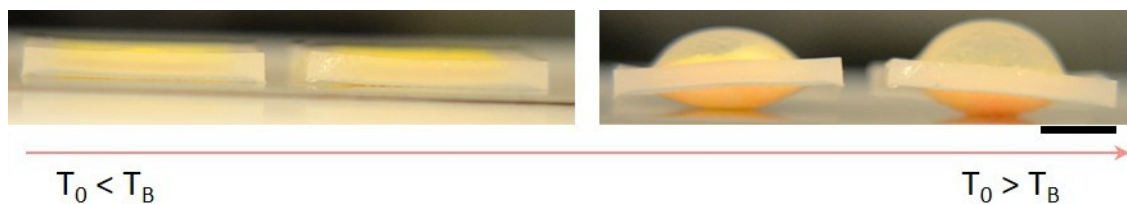

$T_0 < T_B$ $T_0 > T_B$

Fig. S3 Shape change of a soft actuator without 5th passive layer as a function of temperature. The side-view images of the soft actuator below and above the boiling point of ethanol. The scale bar is 1 cm.
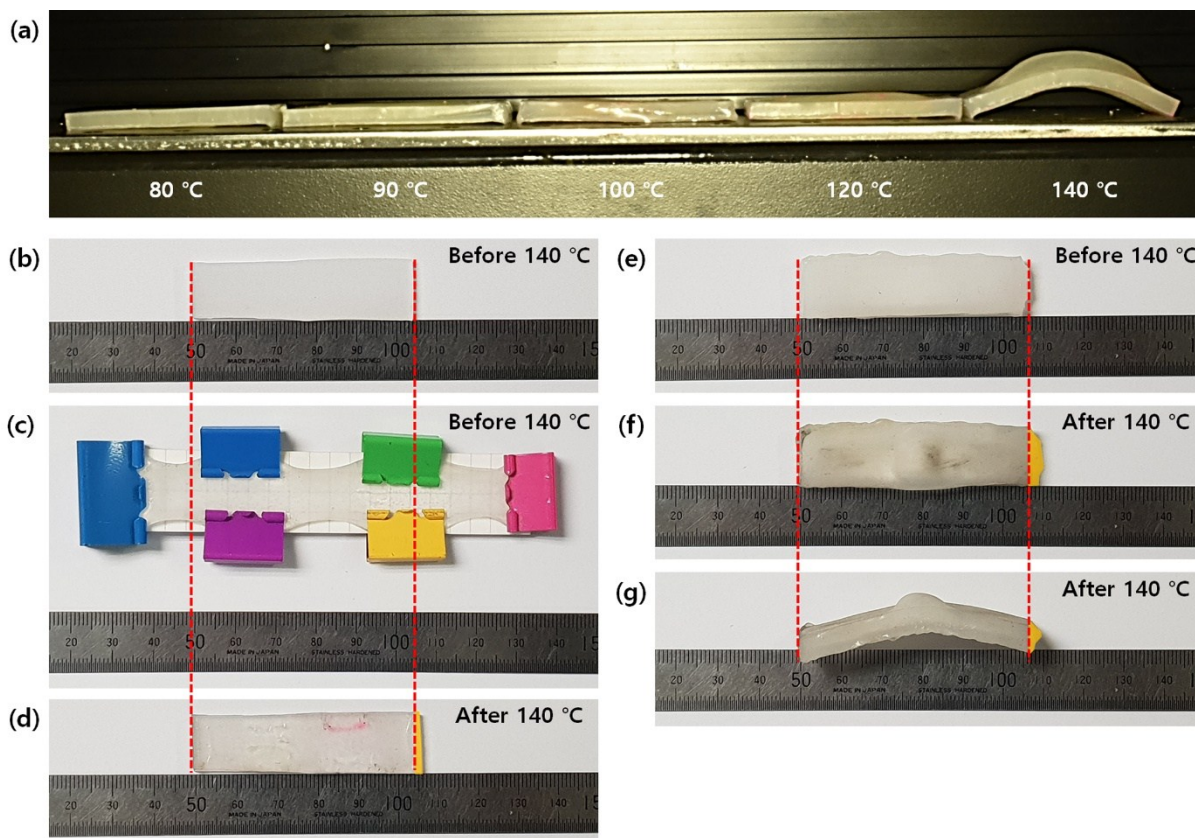
Fig. S4 (a) Photo of the actuators at different temperatures. Photos of panels (b–d) - the Ecoflex sample, and panels (e–g) - the Ecoflex-based actuator before and after the heat treatment at 140 °C for 10 min. Note that the Ecoflex sample was thermally treated being stretched, as shown in panel (c). Panels (f) and (g) are the top and cross-sectional views, respectively. The orange-colored insets in panels (d), (f), and (g) are the irreversibly deformed parts.
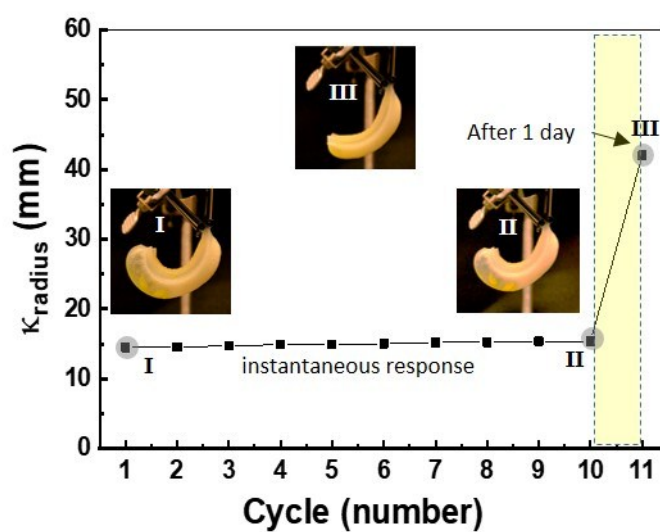

Fig. S5 Repeatability as a function of the number of cycles: I corresponds to the 1st cycle, with the sample radius of curvature of 14.1 mm; II corresponds to the 10th cycle, with the sample radius of curvature of 15.2 mm; III illustrates the sample operation in 1 day with the sample curvature of 42 mm.
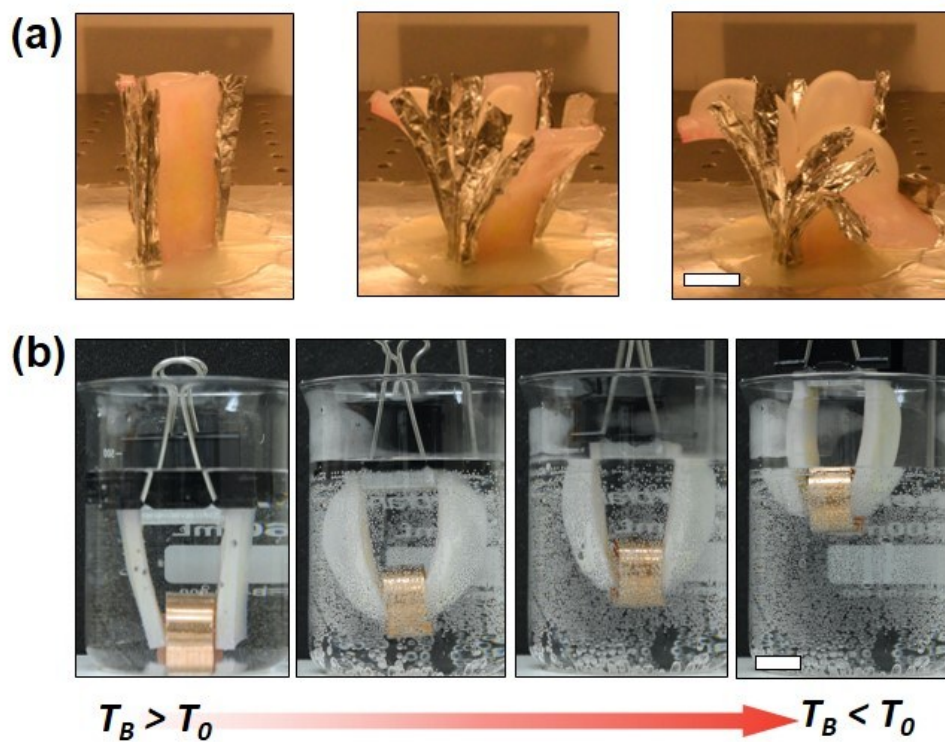
Fig. S6 Application of soft actuators: (a) Thermo-responsive flower in air at 100 °C. (b) Soft robot arms in water at 85 °C. The scale is 1 cm.