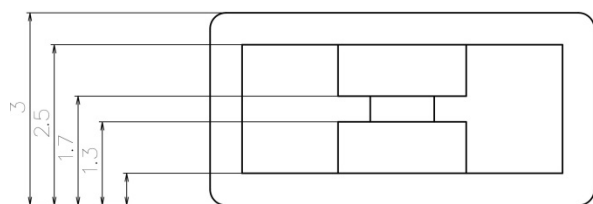
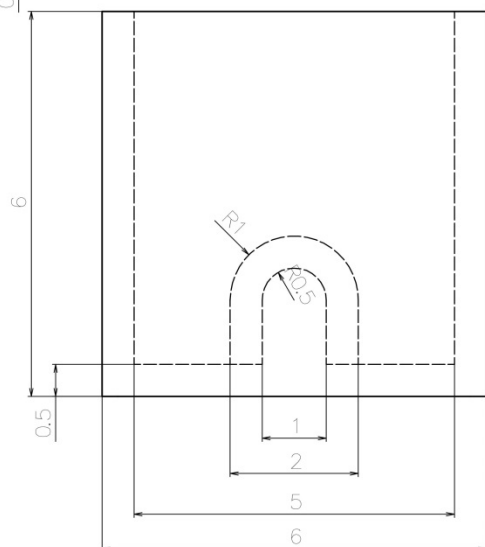


Supplementary Information

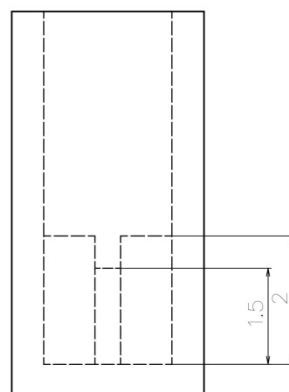
Top View



Front View



Side View



Unit: mm

Fig. S1 Size specifications of the capsule. The microtweezers were inserted into the slit of 0.4 mm width.

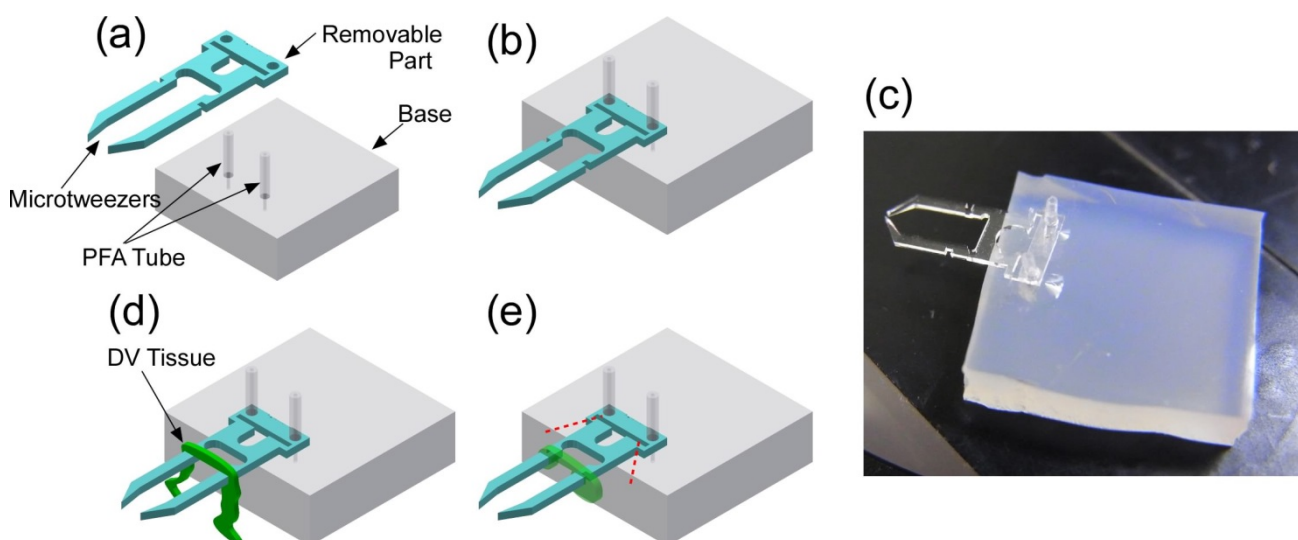


Fig. S2 Assembling process of the DV tissue onto the microtweezers. (a) A fixture with pre-punched holes was fabricated as a removable part of the microtweezers. A needle was used to insert two perfluoroalkoxy (PFA) tubes into the holes and then the fixture was adhered to the silicone rubber

base with PDMS. (b) Inserting the tubes into the two fixture holes immobilized the microtweezers. This ensured the DV tissue would be assembled precisely. (c) Photo of the microtweezers with the fixture. (d) The DV tissue was temporarily fixed on the microtweezers by embedding it into the notches. The length of the DV tissue between the notches was adjusted to apply an appropriate load to the DV tissue. (e) The DV tissue was fixed to the microtweezers by wrapping twice or three times. After that, the microtweezers were detached from the fixture by cutting along the red dotted line using scissors.

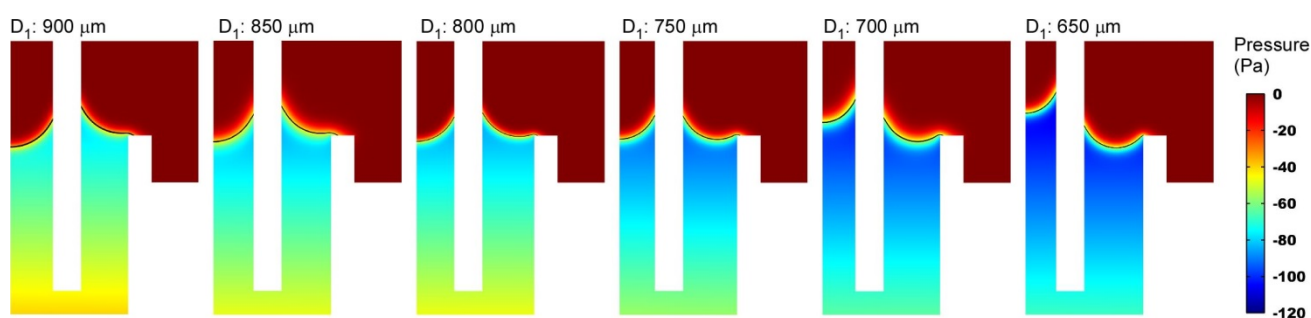


Fig. S3 Distributions of pressure and the menisci at D_1 of 900 μm to 650 μm without decline of default medium level. The menisci are shown by black solid lines. They were used to make the graph of Fig. 2(c).

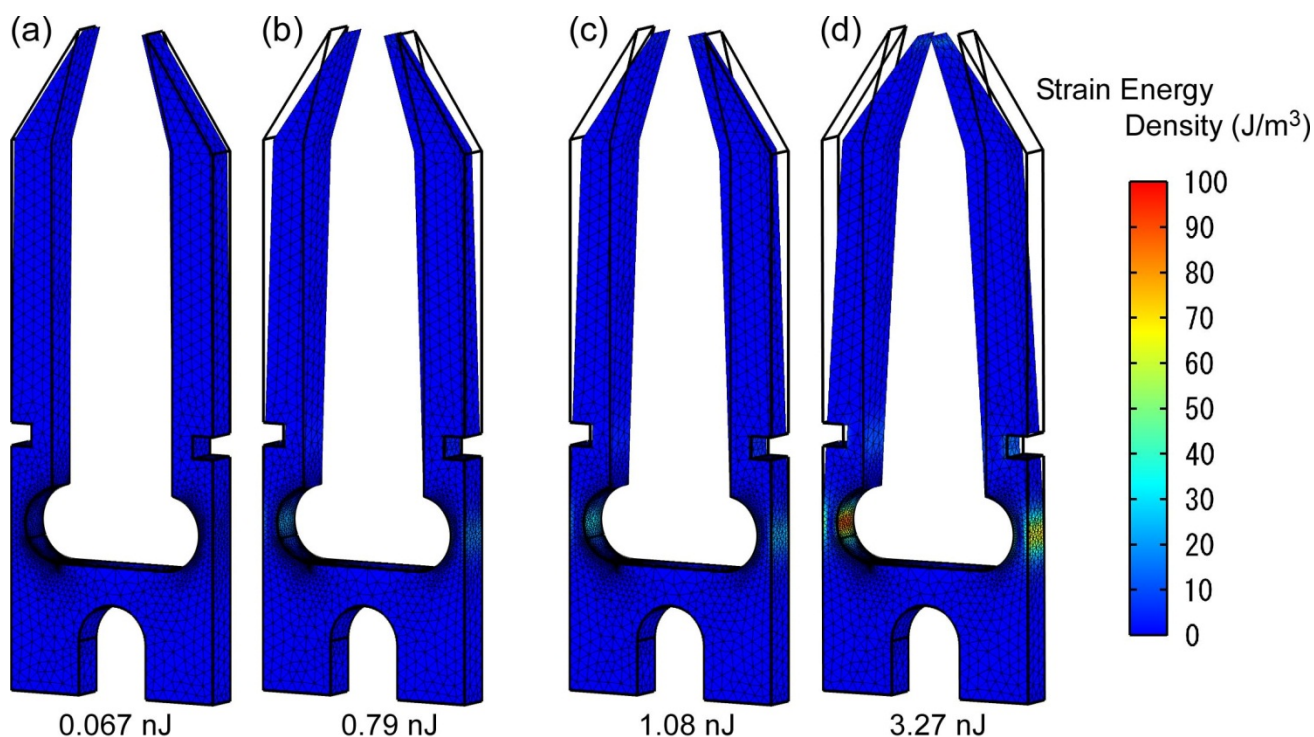


Fig. S4 Distributions of strain energy density with total strain energy (a) when relaxing in the medium (gap: 883 μm), (b) when contracting in the medium (gap: 597 μm), (c) when relaxing in air (gap: 528 μm), and (d) when contracting in air (gap: 180 μm). Strain energy was calculated by the integration of the strain energy density from each result using COMSOL Multiphysics.

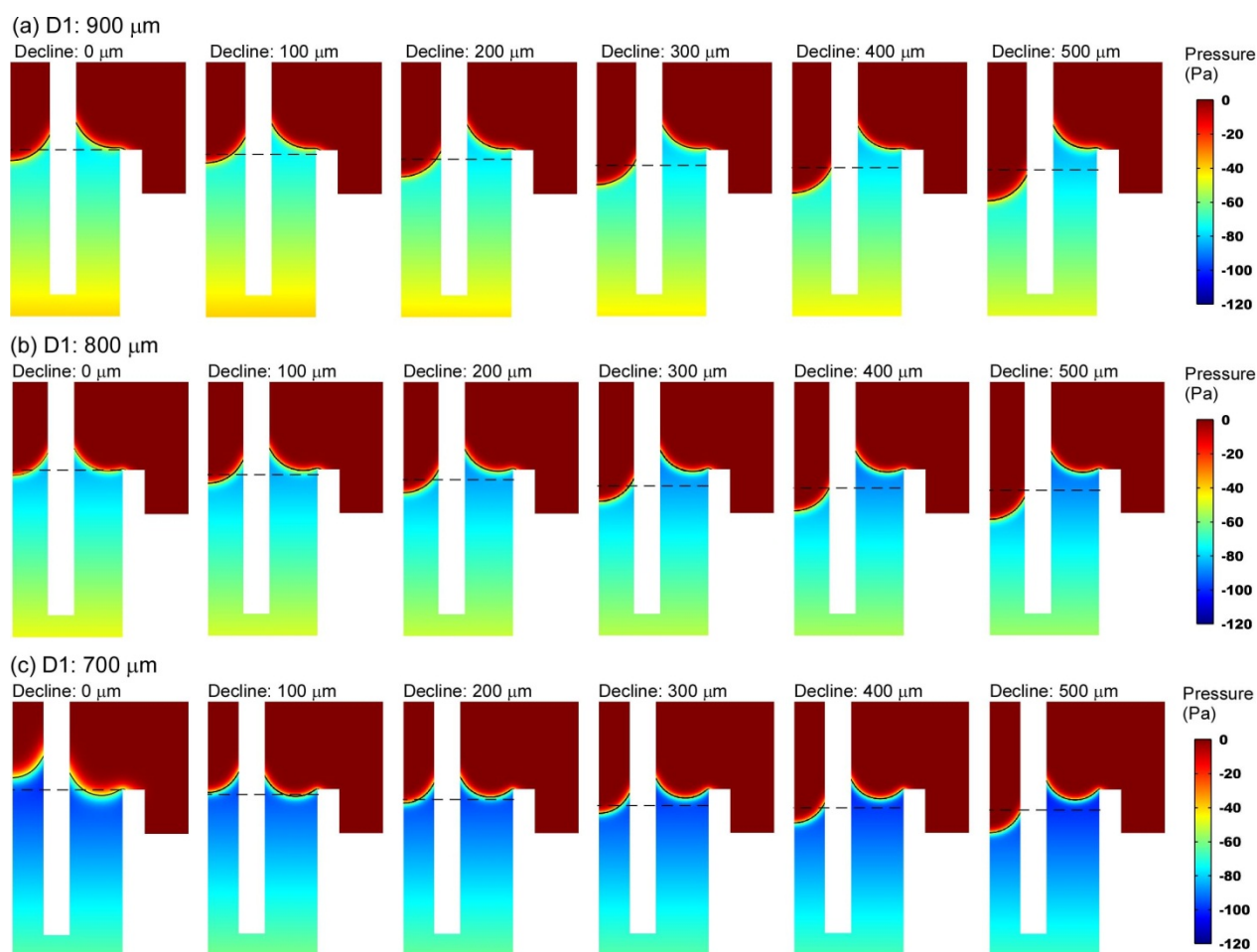


Fig. S5 Distributions of pressure and the menisci with 0 μm to 500 μm decline of the default medium levels at D_1 values of: (a) 900 μm , (b) 800 μm , and (c) 700 μm . They were used to make the graph of Fig. 2(d).

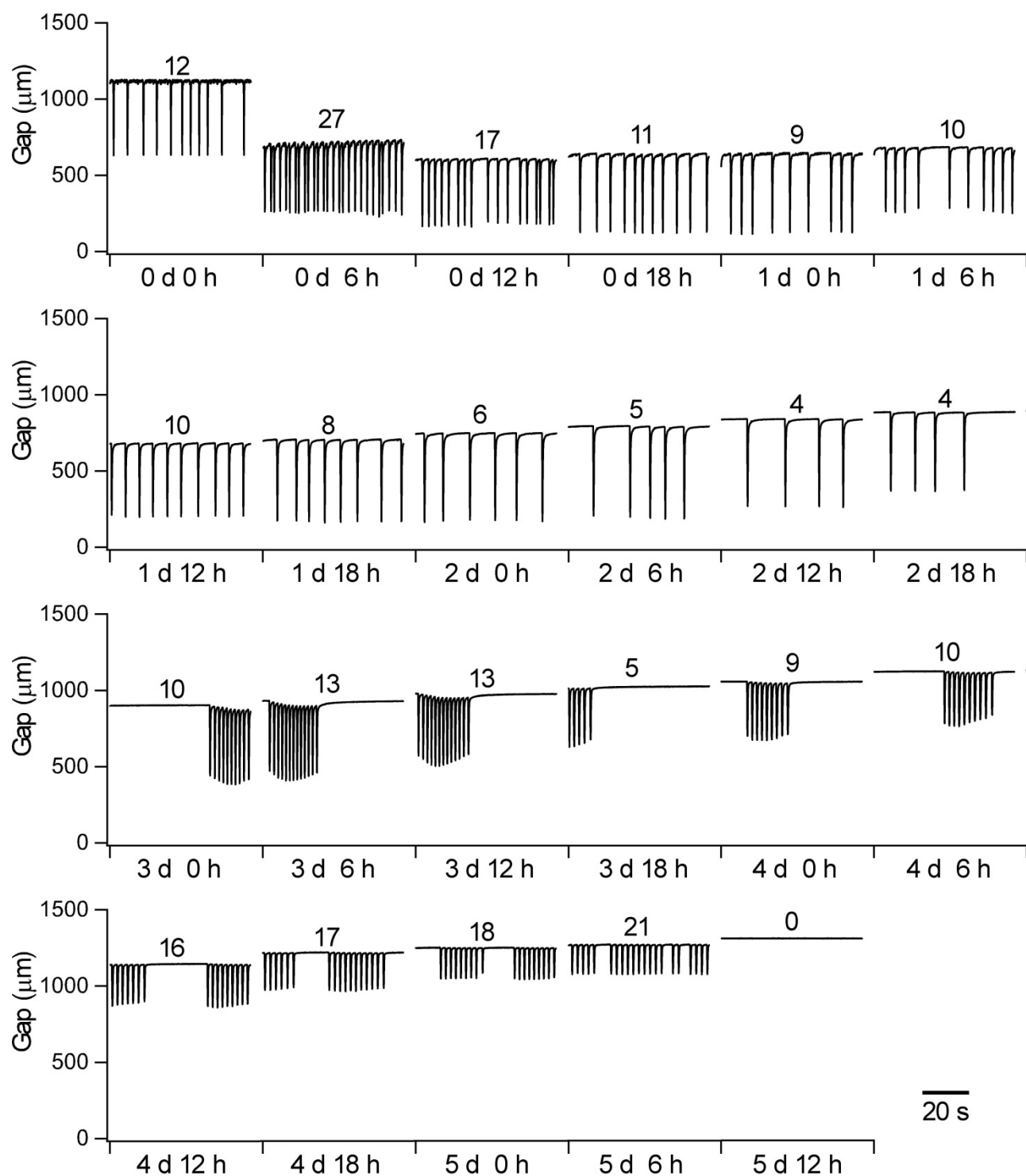
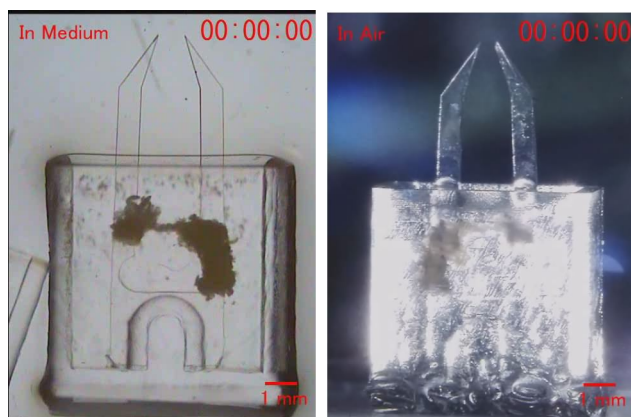
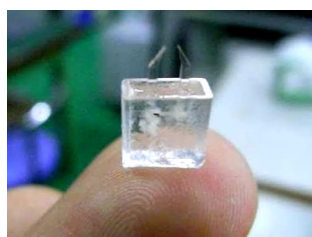


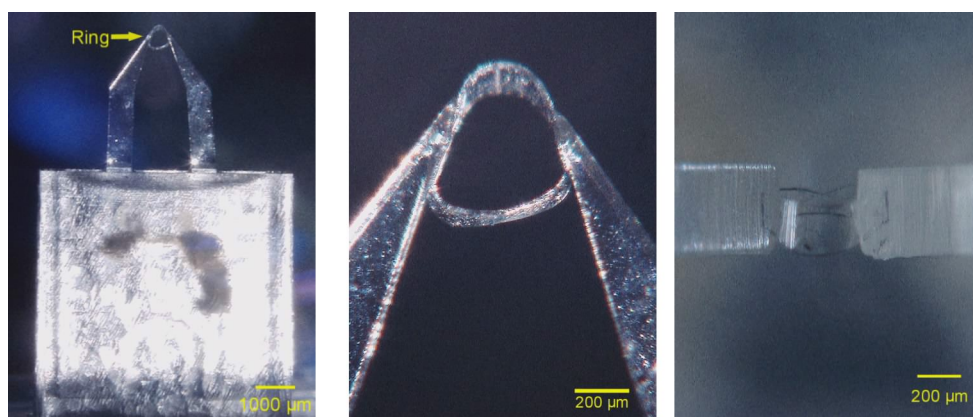
Fig. S6 Time courses at each elapsed time in the 3rd experiment of Fig. 5. The number of contractions was reduced gradually from 0 d 6 h to 2 d 18 h and then the interval between continuous contractions decreased suddenly. The numbers of contractions for 60 s at each elapsed time are given above each graph.



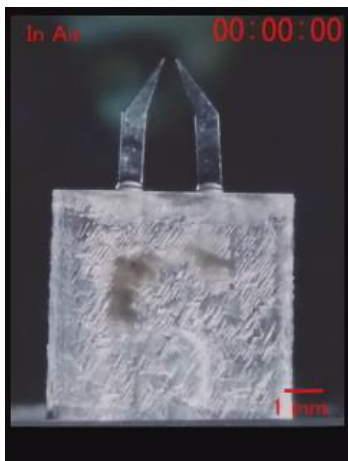
Movie S1 Combined movie of AOB in the medium from the top (left) and in air from the side (right).



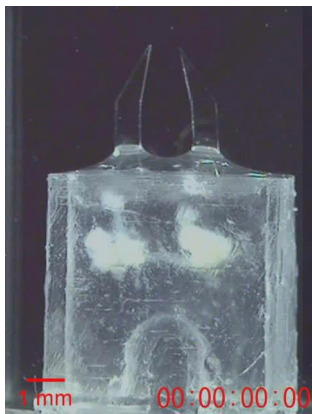
Movie S2 Demonstration of the AOB working when placed on the middle finger tip. This movie was shot with a digital camera (Caprio R6, Ricoh, Tokyo, Japan).



Movie S3 Combined movie of ring deformation by the AOB consisting of the whole movie and the movies with enlarged images from the side (left and middle) and from the top (right).



Movie S4 Combined movie of the AOB observed at 0, 10, 20, 30, and 40 min from the start point.



Movie. S5 Combined movie of the AOB used in the third experiment; images taken every 12 h.