Electronic Supplementary Information

for

Fluidic shear-assisted formation of actuating multilamellar lipid tubes using microfabricated nozzle array device

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Fig. S1 Schematic diagrams showing the microchannel design having 20 micronozzles to form MLTs; (A) the whole microchannel design, and (B) the magnified view of the micronozzle area. The volume of the micronozzle is 1.8 or 9 pL. Microdevices were fabricated by bonding two PDMS plates having different channel-depth structures.



Fig. S2 Micrographs showing yarn-ball-like MLTs formed after stopping the PBS flow. (A) Sequential micrographs showing the time-course transformation of an MLT from a long tubular shape into a yarn-ball-like shape. The black arrow shows the edge of the MLT. Fluorescent polystyrene microparticles (diameter of 1 μ m; R0100B; Duke Scientific, Palo Alto, CA) were suspended in PBS to confirm that the flow in the upper channel was stopped. See Supplementary Movie S1 for the video at a speed 4 times faster than the real-time mode. (B) Arrays of the yarn-ball-like MLTs formed at the exit of the micronozzles. The MLTs shown in these micrographs were formed using devices different from that used for Fig. 3A and Fig. S2A.



Fig. S3 Micrographs showing the double-helical MLTs formed after stopping the PBS flow. (A) Sequential micrographs showing the time-course transformation of an MLT from a long tubular shape into a double-helical shape. The black arrow shows the edge of the MLT. The fluorescent polystyrene microparticles were also suspended in PBS to confirm that the flow in the upper channel was stopped. See Supplementary Movie S2 for the video at a speed 4 times faster than the real-time mode. (B) Other examples of double-helical MLTs, formed using devices different from that used for Fig. 3B and Fig. S3A.



Fig. S4 Sequential micrographs showing other examples of self-actuating MLTs detached from the micronozzle and partially adhered on the bottom (PDMS substrate) of the outlet reservoir. The MLTs in A (fluorescence micrographs) and B (bright-field micrographs) were obtained in different batches and the jerky movements of MLTs were reproducibly observed in each batch. See Supplementary Movie S4 for the video at a speed 4 times faster than the real-time mode.