Supplementary Information for

Domain dynamics of phase-separated lipid membranes under shear flow

Tsutomu Hamada,*[a] Shino Mizuno[a] and Hiroyuki Kitahata[b]

a. School of Materials Science, Japan Advanced Institute of Science and Technology, Nomi City, Ishikawa 923-1292, Japan

b. Department of Physics, Graduate School of Science, Chiba University, Chiba 263-8522, Japan

Movie files:

1. Domain dynamics of a phase-separated lipid vesicle under shear (shear rate is 3.0 μL/min), corresponding to Fig. 1a.

    .mp4 (0.65 MB)

2. Domain dynamics of a phase-separated lipid vesicle under shear (shear rate is 6.0 μL/min), corresponding to Fig. 1b.

    .mp4 (1.4 MB)

3. The same trend of shear-induced domain motion in the upper and lower hemispheres of a vesicle.

    .mp4 (1.5 MB)

4. Domain dynamics of a phase-separated lipid vesicle (10% cholesterol) under shear (shear rate is 5.0 μL/min), corresponding to Fig. 3b.

    .mp4 (1.4 MB)

The movies are shown in actual speed.

Microfluidic chamber:

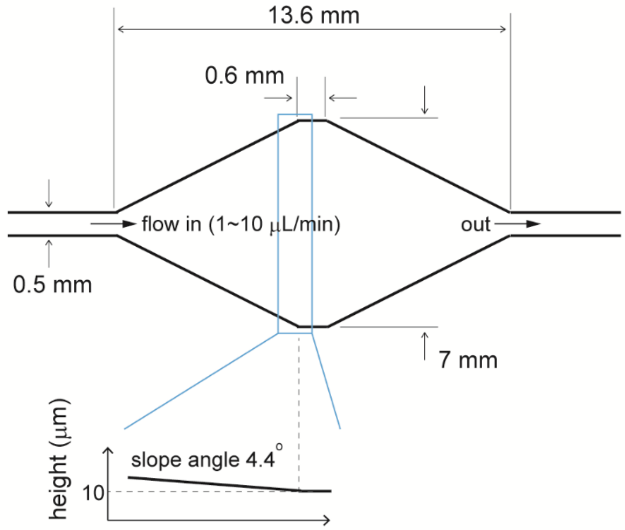

Fig. S1 Schematics of the micro-chamber (Weir-filter chip, microfluidic ChipShop) that applies external flow to vesicles.

Numerical methods:

For checking the convergence of the numerical simulation, we have performed the numerical simulation with different time step and spatial mesh. The results with $\Delta t = 0.0025$ instead of $\Delta t = 0.005$ are shown in Fig. S2a, while those with $\Delta x = 2.0$ instead of $\Delta x = 1.0$ are shown in Fig. S2b. The other parameters were the same as those in Fig. 5c. The results in Fig. S2a are identical with those in Fig. 5c as far as compared by eyes. In contrast, the results in Fig. S2b are qualitatively same as those in Fig. 5c, though the manner of the phase separation was slightly different. This could be because of the difference in the initial conditions including spatial noise, whose spatial correlation should be different. These results ensure that our numerical simulation results are robust for the change in the discretization and thus they are reliable.

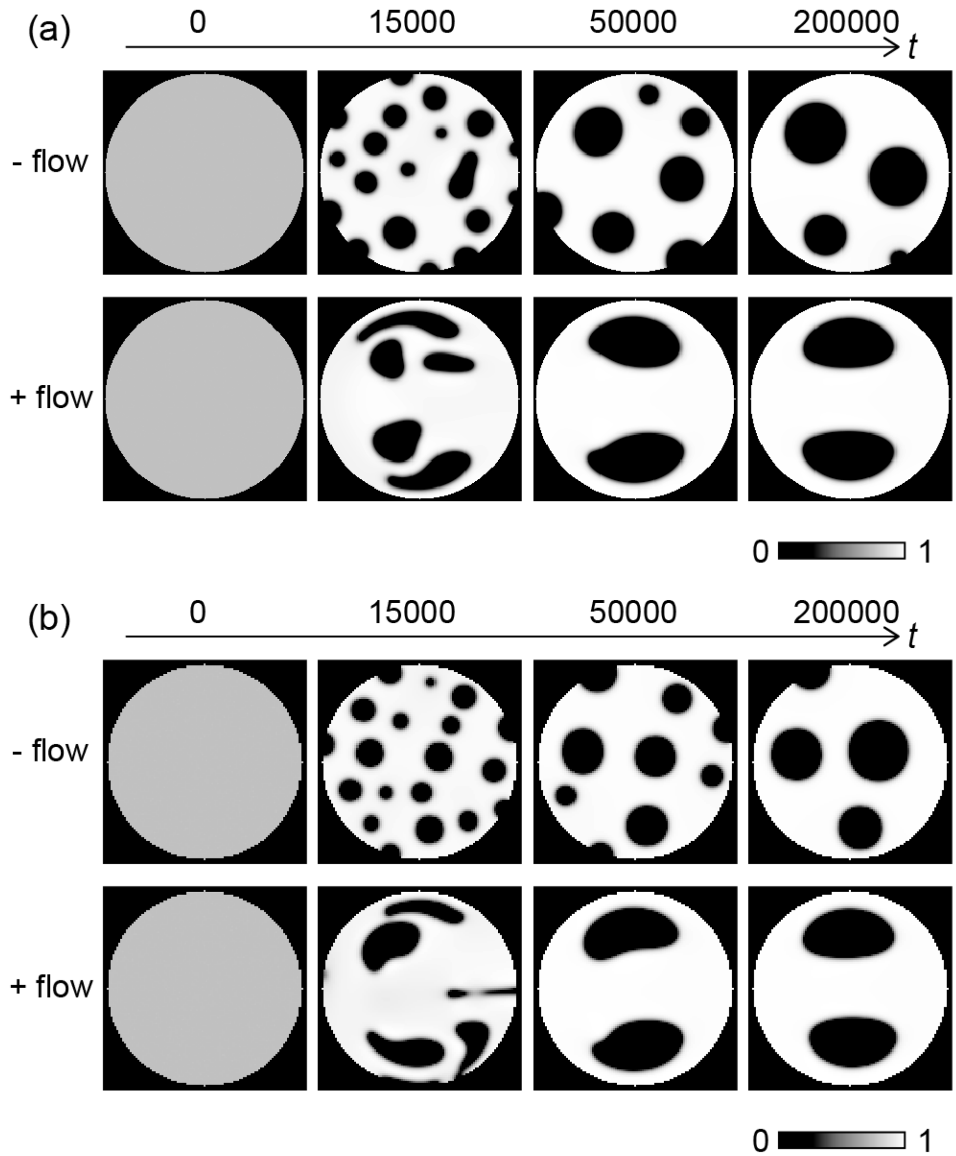

Fig. S2. Results of numerical simulation for the check of the convergence. The settings and parameters are the same as those in Fig. 5c in the main text except for the discretization. (a) Results with the time step $\Delta t = 0.0025$ instead of $\Delta t = 0.005$. (b) Results with the spatial mesh with $\Delta x = 2.0$ instead of $\Delta x = 1.0$.