# pH-Induced Motion Control of Self-Propelled Oil Droplets Using a Hydrolysable Gemini Cationic Surfactant

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## Supporting Information

### Figures

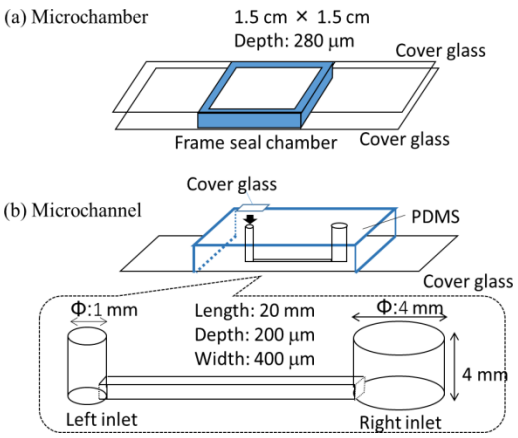


**Figure S1.** Schematic representation of (a) a microchamber made from two cover glasses and a frame seal chamber and (b) a microchannel composed of PDMS with a cover glass.

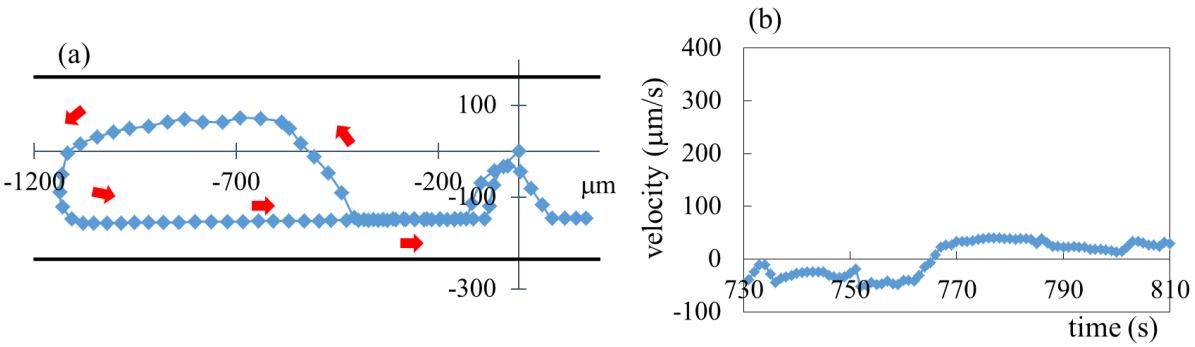


**Figure S2.** Typical trajectory of the center of an oil droplet (a) and velocity of the self-propelled oil droplet (b) in the microchannel at room temperature in 30 mM **2G12C** solution win the presence of 10 mM NaOH. Red arrows correspond to the direction of the self-propelled oil droplet (Movie S2). Each dot was plotted by every 1 s interval.

We observed the dynamics of **HBA** oil droplets in the microchannel without additional NaOH solution. After putting emulsion which contains **HBA** oil droplets in 30 mM **2G12C** solution into microchannel, we carried out observation of oil droplet dynamics. We analyzed the trajectory of the center of oil droplets and velocity of self-propelled oil droplets from 730 s to 810 s after the start of the observation. In this time, we regarded the time when emulsion was put into microchannel as $t = 0$. In this graph we defined the right and upper sides of microchannel as plus direction. It was observed that oil droplets with diameter of 100-200 μm were self-propelled changing its direction. The absolute value of the velocity of oil droplets was below 50 μm/s.

# Table

**Table S1.** Motion time of the self-propelled oil droplets in various surfactant solutions under basic conditions (10 mM NaOH) at room temperature

| Surfactant | Average motion time with standard deviation (min) |
|---|---|
| **2G12C**[a] | 23 ± 6 |
| **6G12C**[a] | n.o.[c] |
| **8G12**[a] | 5 ± 0.8 |
| **12G12**[a] | n.o.[c] |
| **DTAB**[b] | 7 ± 1.2 |
| **2H12**[b] | 5 ± 3 |

[a] The concentration of the gemini cationic surfactants was 30 mM. [b] The concentration of the monomeric surfactants was 60 mM. [c] n.o.: self-propelled oil droplets were not observed.

## Video clips

Six video clips have been attached to show the directed motion of oil droplets composed of **HBA** in microchannel in the solution of gemini cationic surfactant. All movies except for Movie S1 were recorded by 1 frame/s and converted to 10 times speed of real time. Movie S1 was recorded by the real time speed.

**Movie S1:** Typical self-propelled motion of oil droplets in microchamber in 30 mM **2G12C** solution and convection flow inside oil droplets.

**Movie S2:** Typical self-propelled motion of an oil droplet in microchannel in 30 mM **2G12C** solution in the presence of 10 mM NaOH

**Movie S3:** Typical directed motion of an oil droplet in microchannel in the presence of NaOH flow in 10 mM **2G12C**. It initiated self-propelled motion toward high concentration area of NaOH solution and then ceased the motion. After that it restarted self-propelled motion toward the same direction.

**Movie S4:** Typical directed motion of an oil droplet in microchannel in the presence of NaOH flow in 10 mM **2G12C.** Both solutions of NaOH and **2G12C** were colored by 0.05 wt% BTB. It initiated self-propelled motion toward high concentration area of NaOH solution and then ceased the motion. After that it restarted self-propelled motion toward the same direction.

**Movie S5:** Typical directed motion of an oil droplet in microchannel in the presence of NaOH flow in 10 mM **8G12**. It initiated self-propelled motion toward high concentration area of NaOH solution, and then ceased the motion.

**Movie S6:** Typical directed motion of an oil droplet in microchannel in the presence of NaOH flow in 10 mM **8G12**. Both solutions of NaOH and **8G12** were colored by 0.05 wt% BTB. It initiated self-propelled motion toward high concentration area of NaOH solution, and then ceased the motion.