Electronic Supplementary Material (ESI) for Soft Matter.

Supplementary Information for

"Slip of a liquid crystal droplet rotator in viscous fluids"

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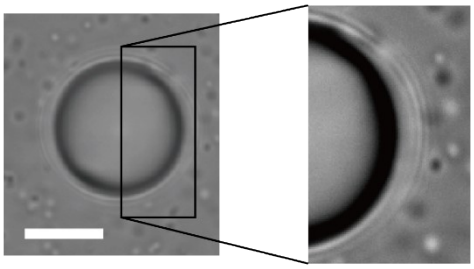
Supplementary movie

Movie S1. Time-lapse movie of a rotating NLC droplet in C_m = 20 wt %. The laser power used was 18.8 mW, and scale bar is 5 µm.

An image of the fringe pattern of an NLC droplet

Supplementary Figure 1 is an image of an NLC droplet captured under the bright field for PIV analysis. The diffraction at the edge of a droplet induces a fringe pattern at the droplet surface. This overlaps the images of tracer particles and makes it difficult to measure the flow velocity correctly. The interrogation window size was 2.0 µm for PIV analysis in this study. This makes it even more difficult to measure the flow velocity near the droplet surface.



Supplementary Figure 1. Microscopic image of an NLC droplet. Scale bar: 5 µm.

Estimation of effective viscosity η_{eff} from Brownian motion near the cell bottom.

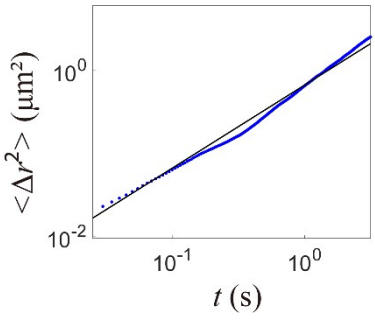
We measured the Brownian motion of a tracer silica particle (radius a = 500 nm, Micromod) near cell bottom. The mean squared displacement Δr^2 (MSD) was calculated from the two-dimensional trajectory of the particle (Supplementary Figure 2). The MSD for a freely diffusing particle is written by,

$$\langle \Delta r(t)^2 \rangle = 4Dt, \tag{1}$$

where D is the diffusion constant and t is the elapsed time. The estimated value of D is 8.9×10^{-2} µm²/s at C_m = 60 wt %. The effective viscosity η_{eff} is calculated by Stokes-Einstein equation as,

$$\eta_{eff} = \frac{k_B T}{6\pi D a}, \tag{2}$$

where k_B is the Boltzmann constant, T is the absolute temperature and a is the particle radius. The estimated value of η_{eff} is larger than the literature value η_0 due to the particle-wall interaction. The value of η_0 and η_{eff} are listed in Table 1.



Supplementary Figure 2. Mean square displacement of a tracer particle in the aqueous glycerol solution of C_m = 50 wt%. Blue dots: the measured values. Solid line: the best-fitted lines with Eqn (1).

The flow velocity measured by PIV were corrected by considering the reduction in velocity due to the wall effect.

C_m (wt%)	η_0 (mPa·s)@25℃ [1]	η_{eff} (mPa·s)
0	0.89	0.92
20	1.5	1.8
40	3.1	3.5
50	5.0	6.2
60	8.8	9.8

Supplementary table 1. η_0 **and** η_{eff} **at various** C_m**.**

Supplementary reference

1. N.-S. Cheng, *Ind. Eng. Chem. Res.*, 2008, **47**, 3285–3288.