

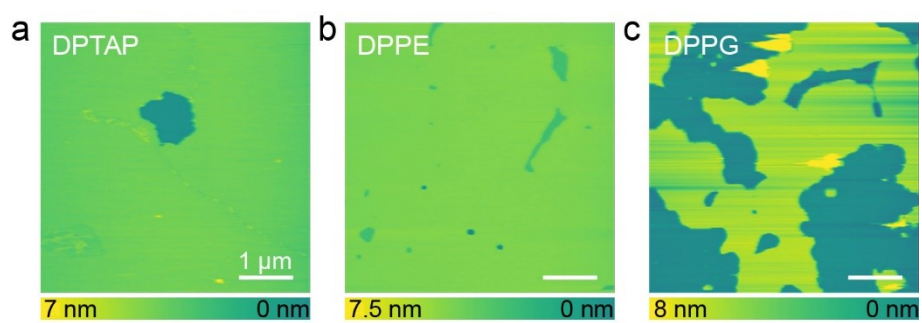
Supplementary information

## **Insight into the hydration friction of lipid bilayers**

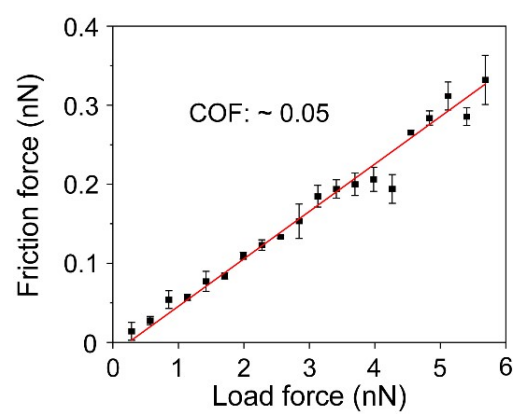
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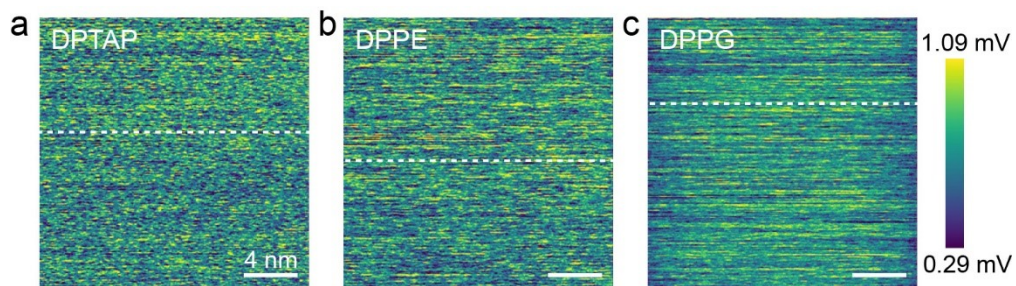
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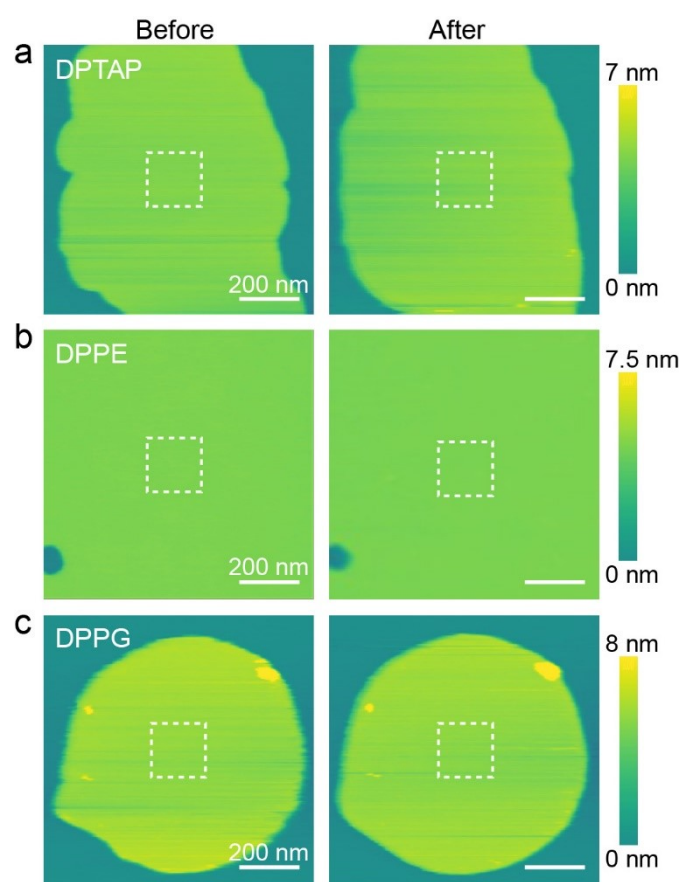
**Fig. S1** Large continuous structures of lipid bilayers supported on mica. (a) DPTAP, (b) DPPE, and (c) DPPG.



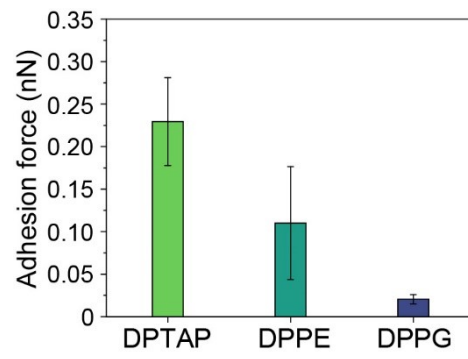
**Fig. S2** Friction *versus* normal load curve of the bare mica.



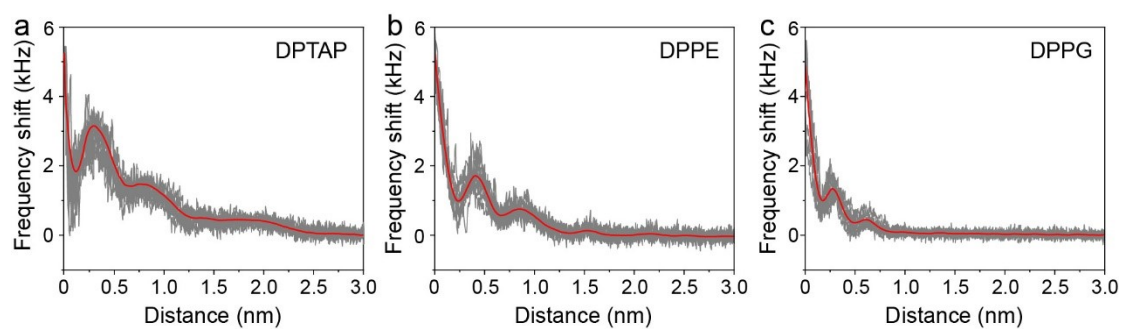
**Fig. S3** Friction images of lipid bilayers. (a) DPTAP, (b) DPPE, and (c) DPPG. The friction loops shown in Fig. 2c in the main text were extracted along the white dashed lines marked on the friction images.



**Fig. S4** AFM height images before and after friction testing to ensure the lipid bilayers were not destroyed during friction measurement. (a) DPTAP bilayer, (b) DPPE bilayer, and (c) DPPG bilayer.



**Fig. S5** The histogram of the adhesion force between the tip and lipid bilayers extracted from Fig. 3c in the main text.



**Fig. S6** The averaged  $\Delta f$  versus distance curves for (a) DPTAP bilayer, (b) DPPE bilayer, and (c) DPPG bilayer.

**Table S1** Relevant distances extracted from force-distance curves

	$d_0$ (nm)	$d_1$ (nm)
DPTAP	$0.375 \pm 0.02$	$0.596 \pm 0.03$
DPPE	$0.360 \pm 0.01$	$0.475 \pm 0.02$
DPPG	$0.289 \pm 0.02$	$0.334 \pm 0.02$