Structural Morphology of Nanoclay Films at Air-Water Interface under Varying Ionic Composition of Subphase Medium (Supplementary Information)

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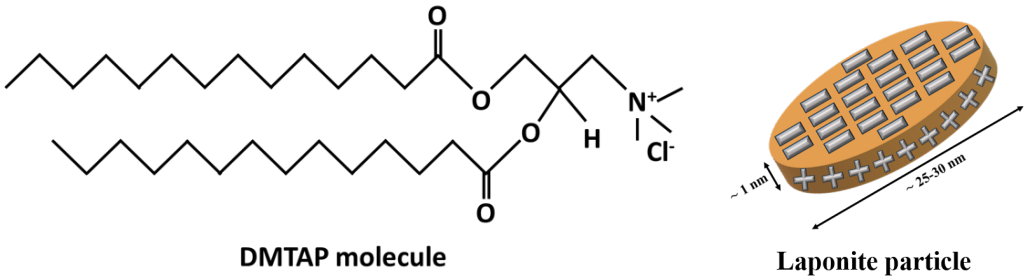

Figure S1: Schematic showing the structure of DMTAP lipid molecule and laponite particle.

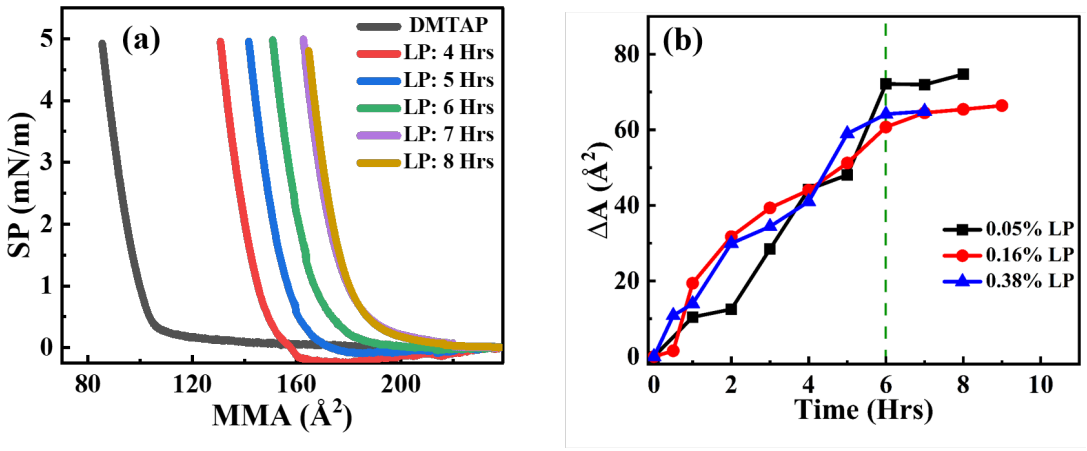

Figure S2: (a) Time-dependent isotherm measurement of DMTAP-nanoclay film with LP concentration of 0.05 wt% in the water subphase. (b) Change in lift-off area (ΔA), calculated from the difference between initial lift-off area at t = 0 (A_0) and final lift-off area at t = t (A_t). After 6 hours, no notable change in lift-off area is observed, illustrating complete nanoclay interaction with DMTAP monolayer at the interface.

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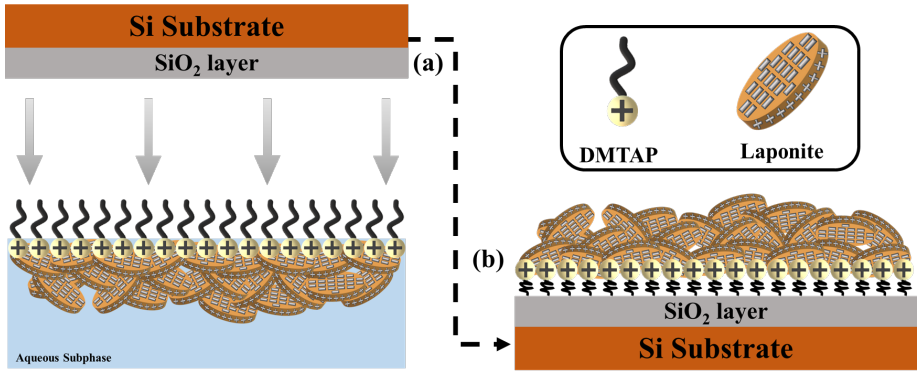

Figure S3: (a) Schematic illustration of the Langmuir–Schaefer (LS) film transfer process from the air–aqueous interface onto a silicon substrate. Upon exposure to air, the top surface of the silicon substrate forms a native SiO_2 layer. (b) Schematic of the resulting dried DMTAP–laponite hybrid film on the substrate. The uppermost layer of the transferred film consists of adsorbed laponite clusters.

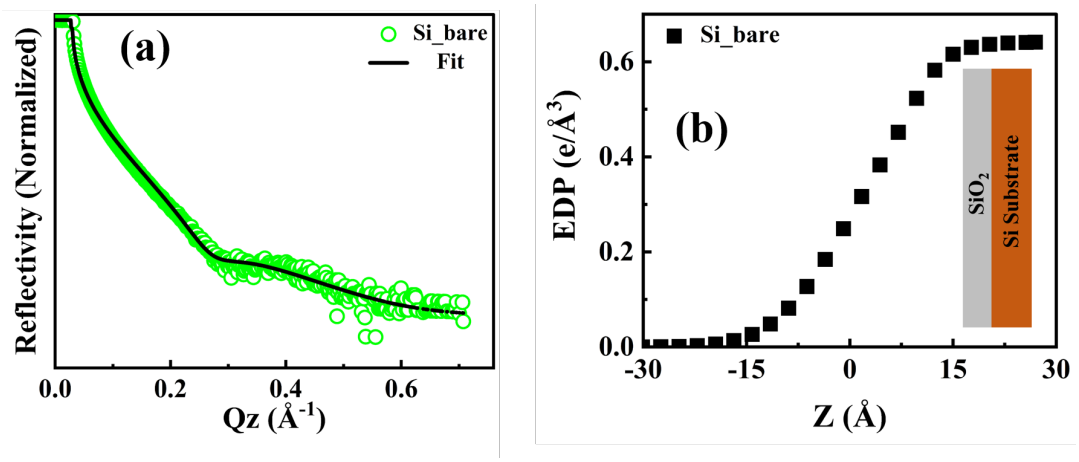

Figure S4: (a) XRR data of bare silicon substrate without any film. The open circle shows experimental data and the solid line shows its fitting using Parrat's algorithm. (b) EDP extracted from the fitting of XRR data. Inset shows the layers used for fitting the model.

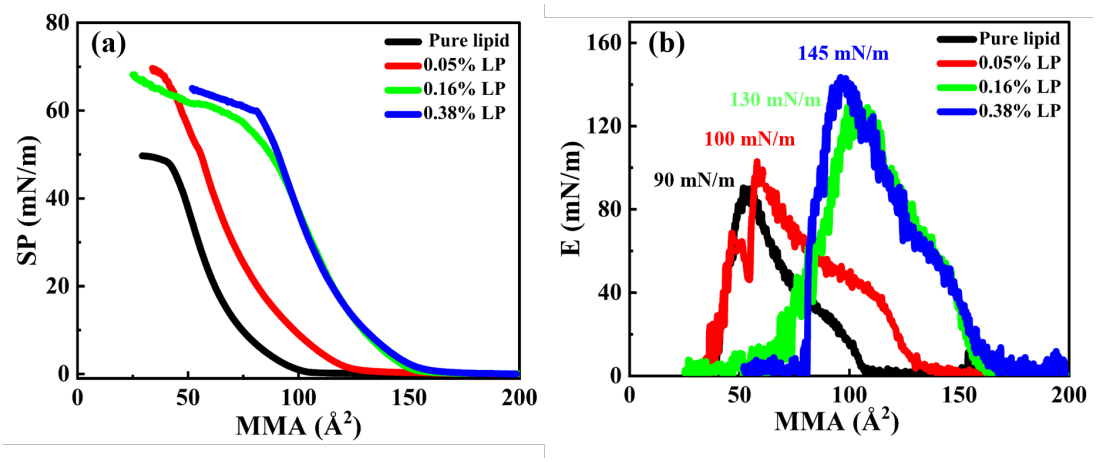

Figure S5: (a) Surface pressure–area compression isotherms of the pure DMTAP monolayer and DMTAP-laponite composite films formed on the water subphase. (b) Corresponding static elastic modulus (E) profiles, illustrating the increase in E_{max} with rising laponite concentration, indicative of enhanced film rigidity.

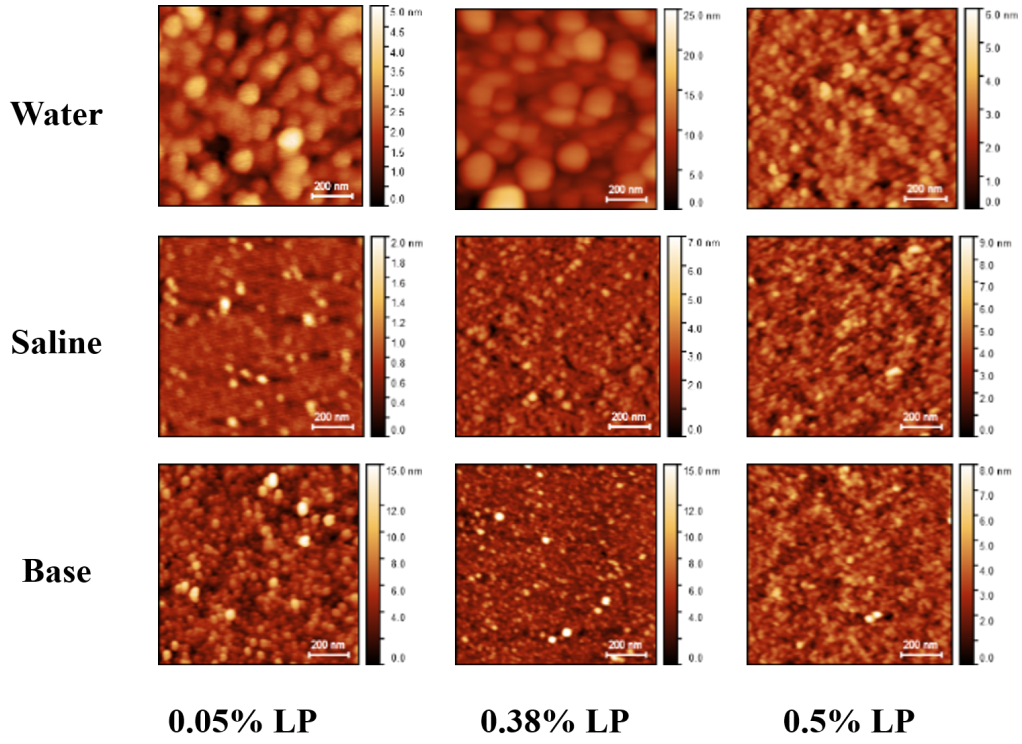

Figure S6: High magnification images of DMTAP-LP films transferred from water (a-c), saline (d-f) and basic (g-i) subphase. The film shows formation of laponite clusters at the interface. Frame size of AFM micrographs: 1 μm $\times$ 1 μm.

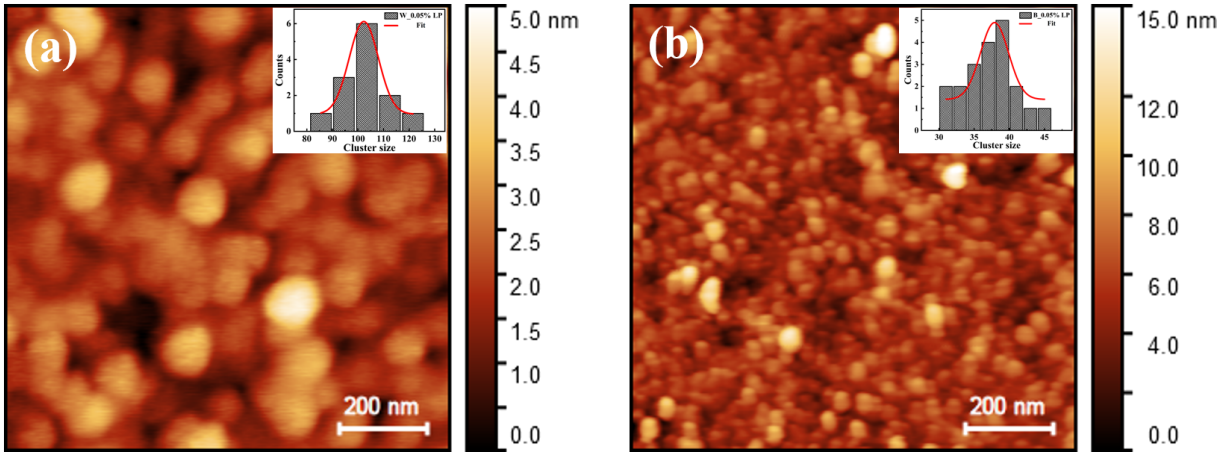

Figure S7: Calculated nanoclay cluster size from highly magnified AFM image of (a) water and (b) basic subphase. The estimated cluster size of nanoclay present in DMTAP-LP films transferred from water and basic subphase is $\sim$ 100 nm and $\sim$ 40 nm respectively.

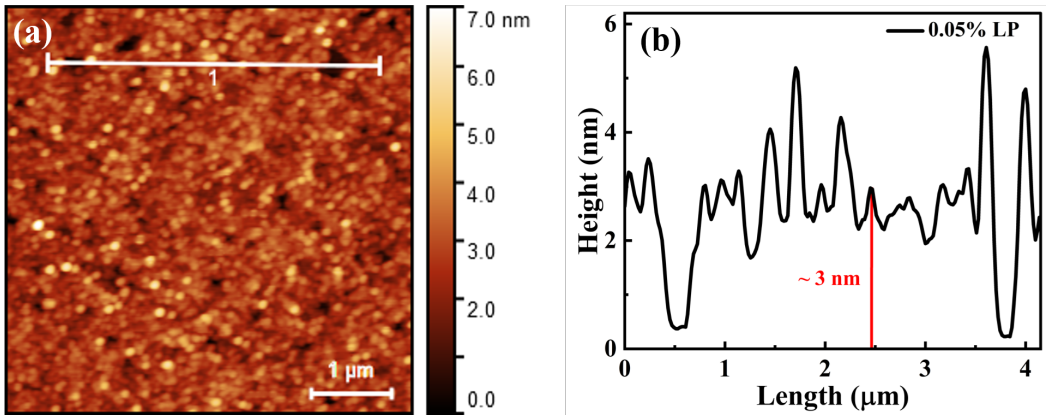

Figure S8: Film thickness calculated from AFM micrograph of DMTAP-LP film transferred from water subphase at 0.05% LP. Film thickness is ∼ 3 nm.

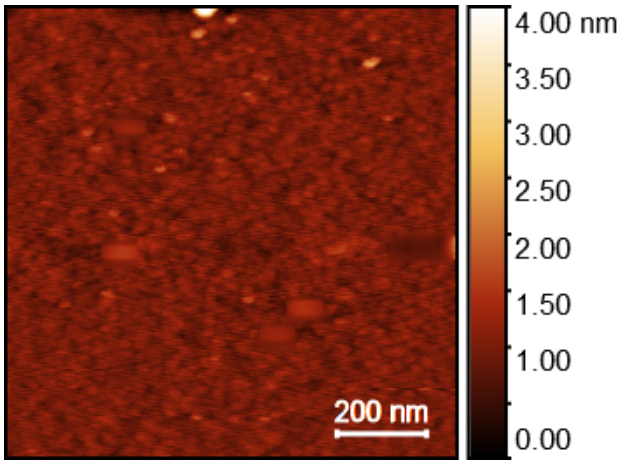

Figure S9: AFM micrograph of pure DMTAP monolayer transferred from the air/water interface. Frame size of the micrograph is 1 μm × 1 μm.

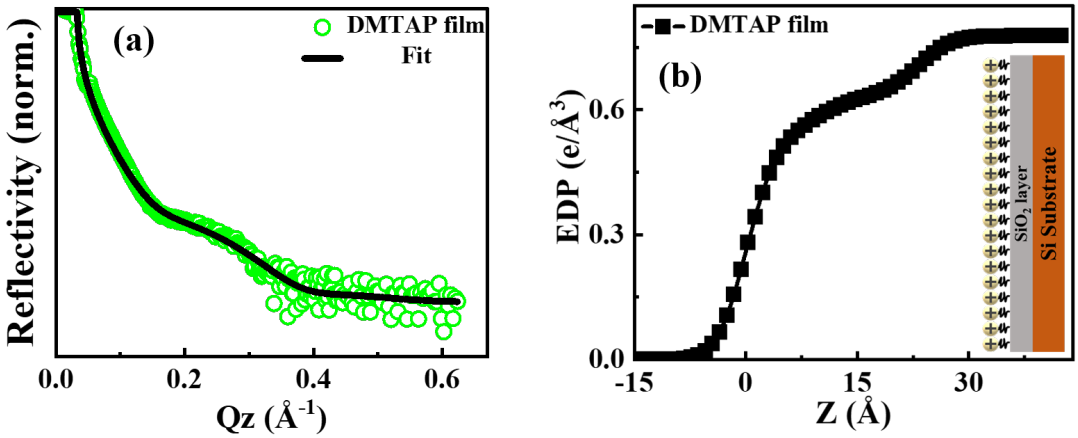

Figure S10: (a) XRR data and (b) electron density profile of DMTAP lipid film without nanoclay transferred from at air/water interface. Inset of (b) depicts the layers used in box model to fit the XRR data. Fitting parameters are added in table ST2.

Layer	Thickness	ED	Roughness
	Å	e/Å^3	Å
SiO_2	9.56	0.54	7.91
Si		0.64	2.74

Table ST1: Obtained fitting parameters for bare silicon substrate.

Layer	Thickness	ED	Roughness
	Å	e/Å^3	Å
Lipid Head (L_H)	8.35	0.5	3.1
Lipid Tail (L_T)	5.15	0.6	4.97
SiO_2	9.81	0.64	8.86
Si		0.77	3.52

Table ST2: Obtained fitting parameters for DMTAP lipid films transferred from air/water interface.

Subphase	LP Wt%	Thickness; Å		ED; e/Å^3		Roughness; Å	
		$LP+L_H$	L_T	$LP+L_H$	L_T	$LP+L_H$	L_T
Water	0.05	30.81	10.27	0.674	0.551	19.47	11.41
	0.38	37.645	8.12	0.711	0.557	19.4	7.84
	0.5	35.1	7.16	0.733	0.563	11.26	8.88
Saline	0.05	34.19	10.32	0.672	0.533	13.96	9.78
	0.38	35.43	8.23	0.705	0.562	16.93	8.01
	0.5	35.04	7.97	0.768	0.564	19.89	9.22
basic	0.05	35.27	9.15	0.662	0.562	19.91	8.59
	0.38	36.32	8.07	0.708	0.567	18.48	8.77
	0.5	41.81	7.08	0.765	0.566	28.1	10.77

Table ST3: Lponite-nanoclay film at different LP concentrations on water, basic, and saline subphases.