

Electronic Supplementary Information (ESI)

Preparation of Water-dispersible Janus Nanosheets from $K_4Nb_6O_{17} \cdot 3H_2O$ and Their Behaviour as a Two-dimensional Surfactant on Air-Water and Water-Toluene Interfaces

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A. Experimental method for measurement of contact angle toward water and toluene on model substrates modified PPA moiety or PA moiety.

At first, model substrates were prepared through coating white glass plates (ϕ 30 mm) and sapphire substrates (ϕ 30 mm) with Nb_2O_5 film by radical assisted sputtering. Surface modification of two types of model substrates using phenylphosphonic acid (PPA) or phosphoric acid (PA) was conducted by heating the substrate in a 2-butanone solution of PPA (1 mol / L, 20 mL) or a 2-butanone solution of PA (1 mol / L, 20 mL) at 70 °C for 7 days. Then, resulting substrate was washed with 2-buthanol twice and wiped by non-woven fabric (nikowipe; Nihon Kogyo Bihin Co., Ltd.) moistened with methanol. Contact angles were measured by Kyowa Interface Science DMO-702 at 23 °C. Five droplets were placed on each substrate. Contact angle was calculated as an average of three values by omitting the highest and the lowest values of five values.

B. Contact angle toward water and toluene on model substrates modified PPA moiety or PA moiety.

Table S1 Contact angles toward water and toluene on Nb₂O₅ coated glass substrates.

	Contact angle toward water / °	Contact angle toward toluene / °
Unmodified substrate	56.8 ± 0.3	< 10
PPA-modified Substrate	69.6 ± 0.2	< 10
PA-modified Substrate	40.0 ± 1.1	< 10

Table S2 Contact angles toward water and toluene on sapphire substrates.

	Contact angle toward water / °	Contact angle toward toluene / °
Unmodified substrate	28.2 ± 0.4	< 10
PPA-modified Substrate	57.3 ± 1.3	< 10
PA-modified Substrate	29.2 ± 1.2	< 10

C. Enlarged snapshots of Movie S2 after 0 s, 1455 s, 2617 s, 2618 s, 2813 s, 3108 s, 3392 s and 3602s from the start point of observation.

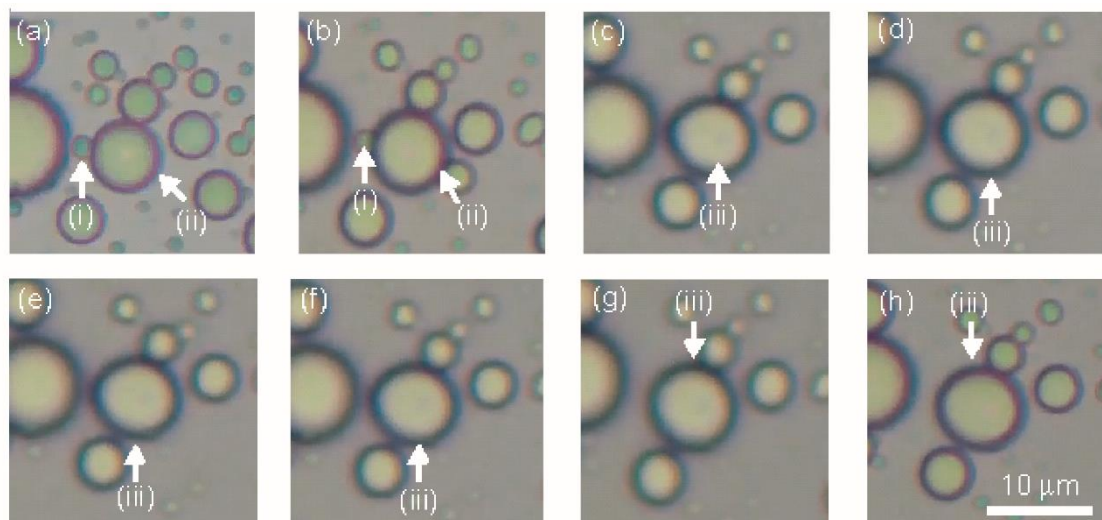


Figure S1 Enlarged snapshots of Movie S2 after (a) 0 s, (b) 1455 s, (c) 2617 s, (d) 2618 s, (e) 2813 s, (f) 3108 s, (g) 3392 s and (h) 3602s from the starting point of observation. Oil droplets (i) and (ii) were coalesced and an oil droplet (iii) was formed.

D. Enlarged snapshots of Movie S3 after 0 s, 1455 s, 2617 s, 2618 s, 2813 s, 3108 s, 3392 s and 3602s from the start point of observation.

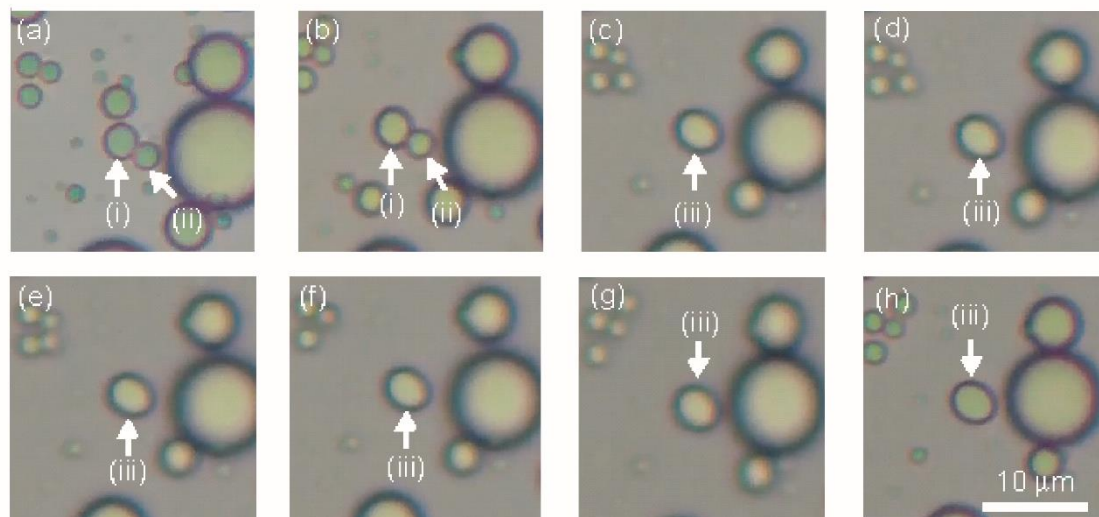


Figure S2 Enlarged snapshots of Movie S3 after (a) 0 s, (b) 1455 s, (c) 2617 s, (d) 2618 s, (e) 2813 s, (f) 3108 s, (g) 3392 s and (h) 3602s from the starting point of observation. Oil droplets (i) and (ii) were coalesced and an oil droplet (iii) was formed.

E. Enlarged snapshots of Movie S after 0 s, 1455 s, 2617 s, 2618 s, 2813 s, 3108 s, 3392 s and 3602s from the start point of observation.

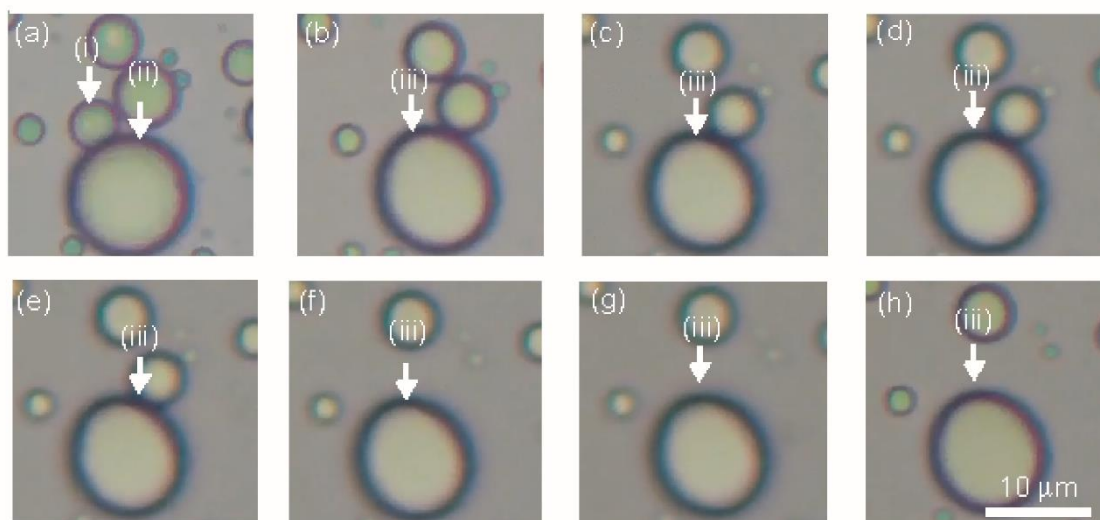


Figure S3 Enlarged snapshots of Movie S4 after (a) 0 s, (b) 1455 s, (c) 2617 s, (d) 2618 s, (e) 2813 s, (f) 3108 s, (g) 3392 s and (h) 3602s from the starting point of observation. Oil droplets (i) and (ii) were coalesced and an oil droplet (iii) was formed.