A General Method for the Preparation of Thickness-Controllable Fluoro-Containing Organic Film as Solid Lubricant

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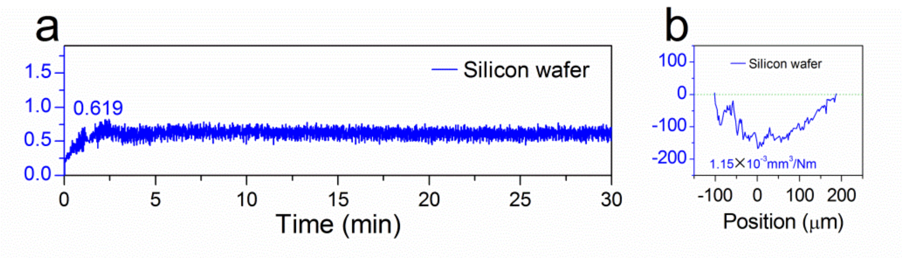

Figure S1. (a) Friction coefficient vs. time curve and (b) 2D profile plot of wear track for bare silicon wafer. Conditions for friction experiments: load = 20 mN, sliding velocity = 0.01 m/s.

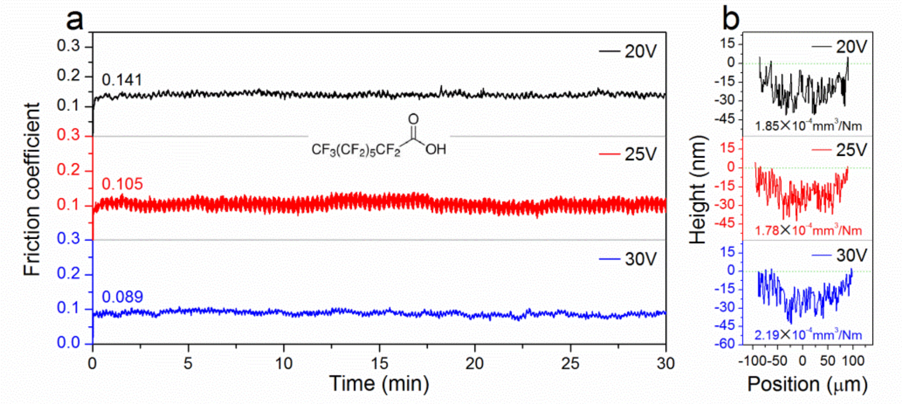

Figure S2. (a) Friction coefficient vs. time curves and (b) 2D profile plots of wear tracks of perfluorocaprylic acid films deposited at various voltages (20-30 V). Conditions for friction experiments: load = 20 mN, sliding velocity = 0.01 m/s.

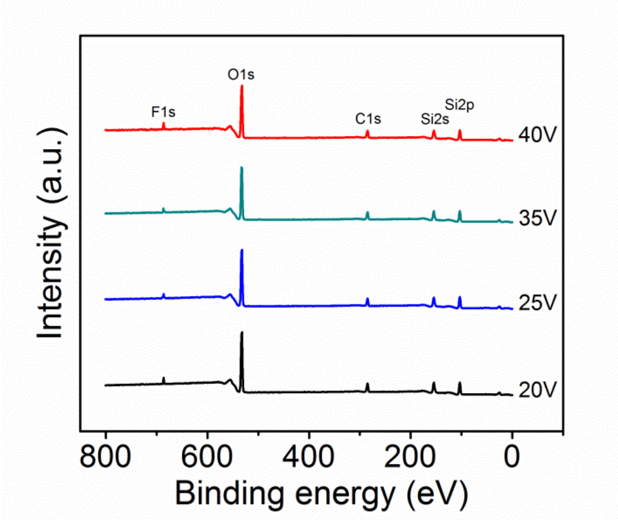

Figure S3. The full spectra of the films deposited at 20V, 25V, 35V and 40V.

Table S1. Contact angles of water and glycol and surface energy values of the TFA films

Sample	Contact angle (°)		Surface energy (mJ/m²)		
	Water	Glycol	Dispersive (γ^d)	Polar (γ^p)	Total (γ)
TFAF20	64.1	41.5	16.2	22.0	38.2
TFAF25	74.7	49.4	21.1	11.8	32.9
TFAF30	78.9	52.2	23.6	8.4	32.0
TFAF35	76.6	50.9	22.0	10.3	32.3
TFAF40	66.3	42.9	17.4	19.5	36.9

The calculation method of surface energy:

The calculation method of surface energy is on the basis of the Owens and Wendt theoretical models (Eq. (1), [1]) by measuring the contact angle values of water and glycol of the films deposited at different voltages (20-40 V), respectively. The values of the dispersive (γ^d) and polar(γ^p) components of ultrapure water and glycol are shown in the following table [2].

Liquid	Dispersive component (γ^d, mJ/m^2)	Polar component (γ^p, mJ/m^2)	Surface energy (γ, mJ/m^2)
Ultrapure water	21.8	51.0	72.8
Glycol	29.3	19.0	48.3

Therefore, dispersive, γ^d and polar, γ^p, components of the surface energy of each film can be obtained using the following equations:

$$\gamma_L (1+\cos\theta) = 2 \left((\gamma_L^d \gamma_S^d)^{1/2} + (\gamma_L^p \gamma_S^p)^{1/2} \right) \quad (1)$$

where θ is the contact angle, γ_L and γ_S are related to the liquid surface energy and solid surface energy, respectively. Combined with the Fowkes method (Eq. (2), [3]), the total surface energy is the sum of contributions from the different intermolecular forces at the surface, thus the surface energy (γ) of each film could be calculated using the following equation:

$$\gamma = \gamma^d + \gamma^p \quad (2)$$

[1] D. K. Owens, Wendt, Estimation of the surface free energy of polymers. *Journal of Applied Polymer Science*, 1969, **13**, 1741-1747.

[2] N. Huang, P. Yang, Y. X. Leng, *et al*. Hemocompatibility of titanium oxide films. *Biomaterials*, 2003, **24**, 2177-2187.

[3] F. M. Fowkes, Attractive forces at interfaces. *Journal of Industrial and Engineering Chemistry*, 1964, **56**, 40-52.