Supplementary Information

Self-powered, on-line, highly-sensitive lubricating oil acidity monitoring driven by triboelectric sensor

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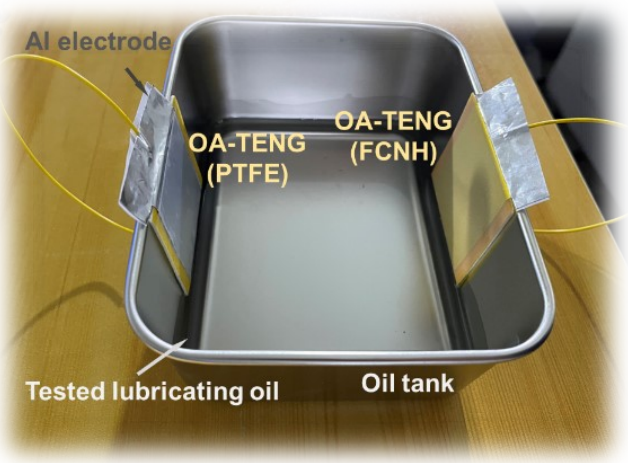

Fig. S1 The optical picture of the triboelectric rig in this study.

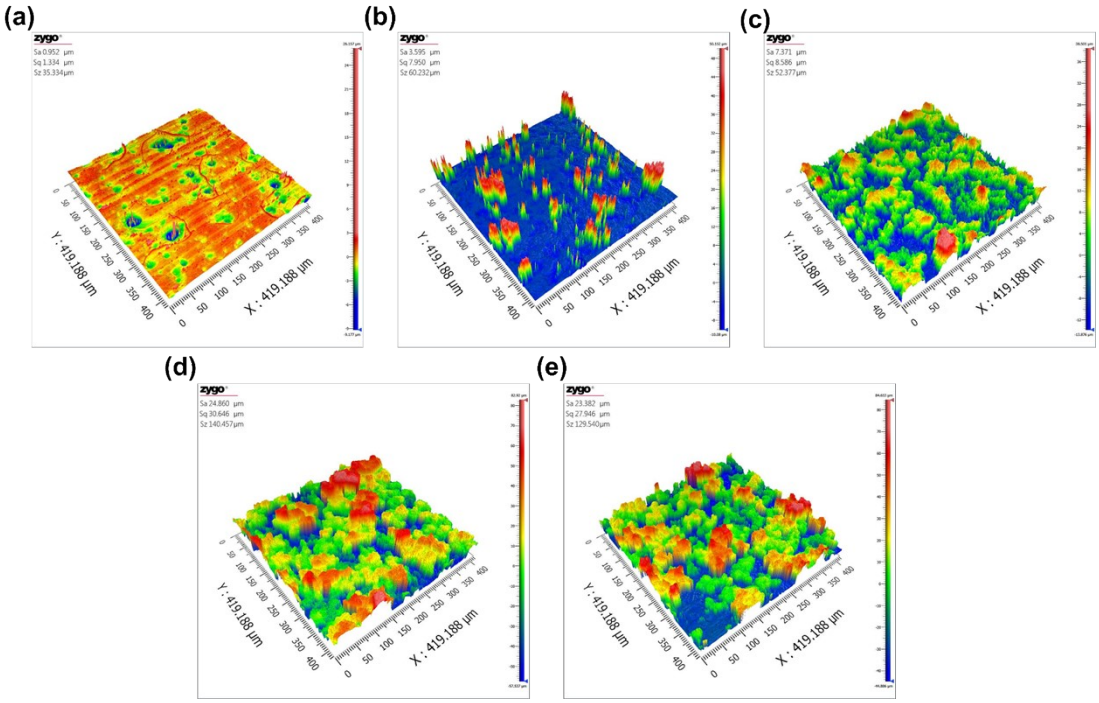

Fig. S2 Three-dimensional morphologies of the OA-TENG surfaces with different mass of SiO_2 in spraying solution. 0.1 g (a), 0.2 g (b), 0.3 g (c), 0.4 g (d), 0.5 g (e).

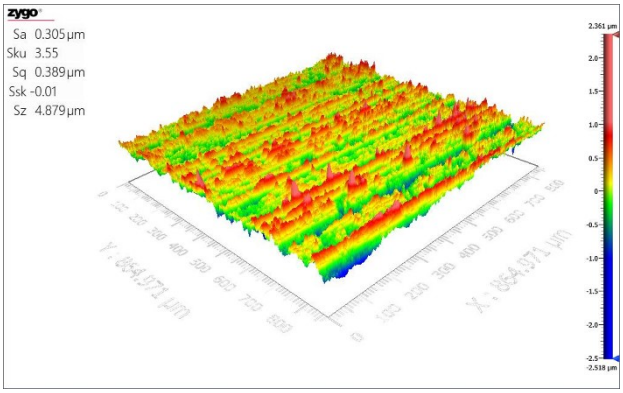

Fig. S3 Three-dimensional morphologies of commercial-received PTFE for comparison.

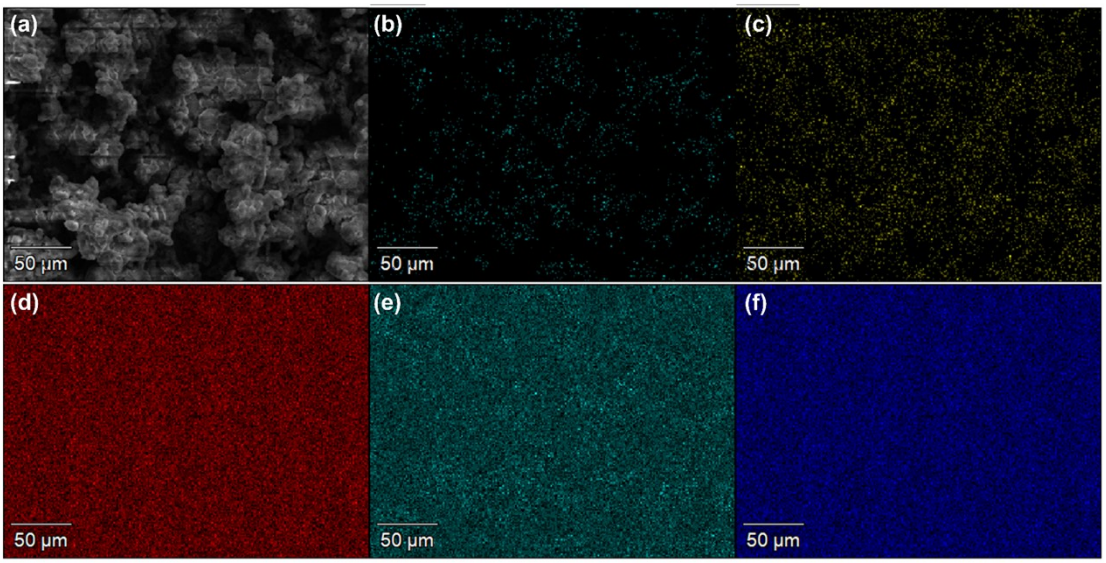

Fig. S4 The morphology and element distribution of the OA-TENG surfaces (FCNH-3). SEM morphology (a), F (b), Si (c), C (d), O (e), and N (f) element distribution.

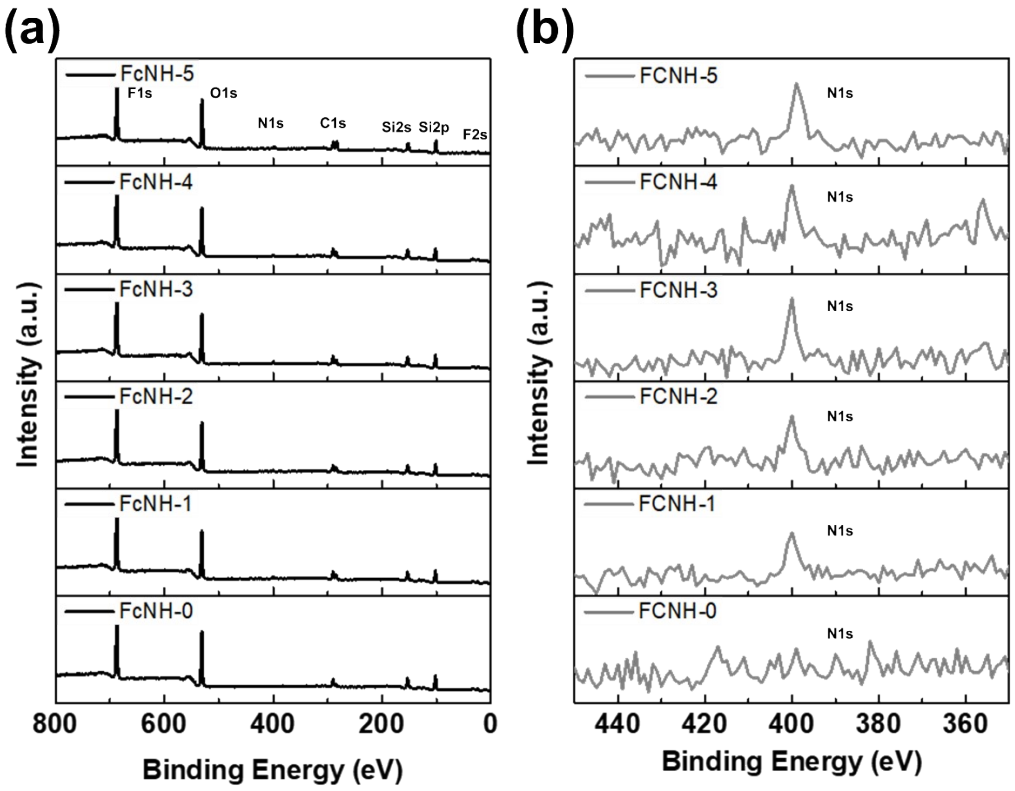

Figure S5 XPS survey spectra of the OA-TENG.

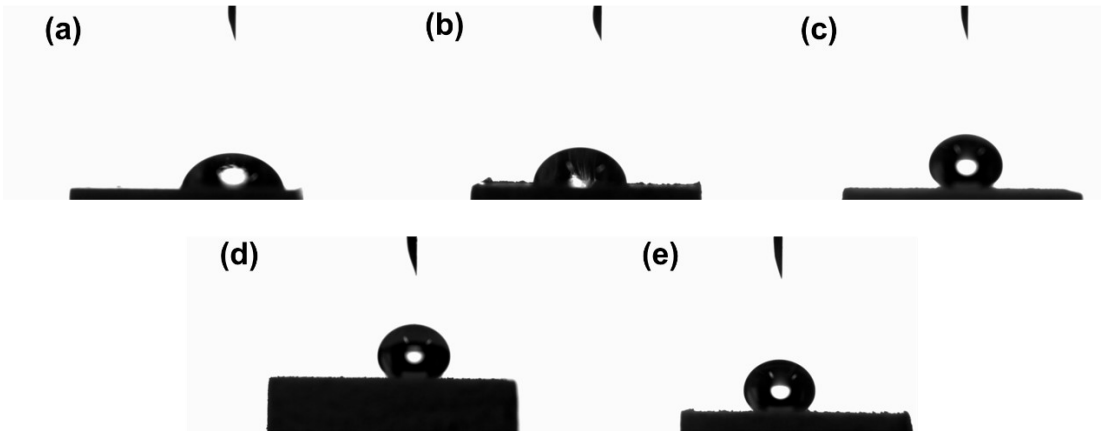

Fig. S6 The images of oil contact angle on the OA-TENG (FCNH) (FC: 6 g, APTES: 90 mg) with different mass of SiO_2: 0.1 g (a), 0.2 g (b), 0.3 g (c), 0.4 g (d), 0.5 g (e).

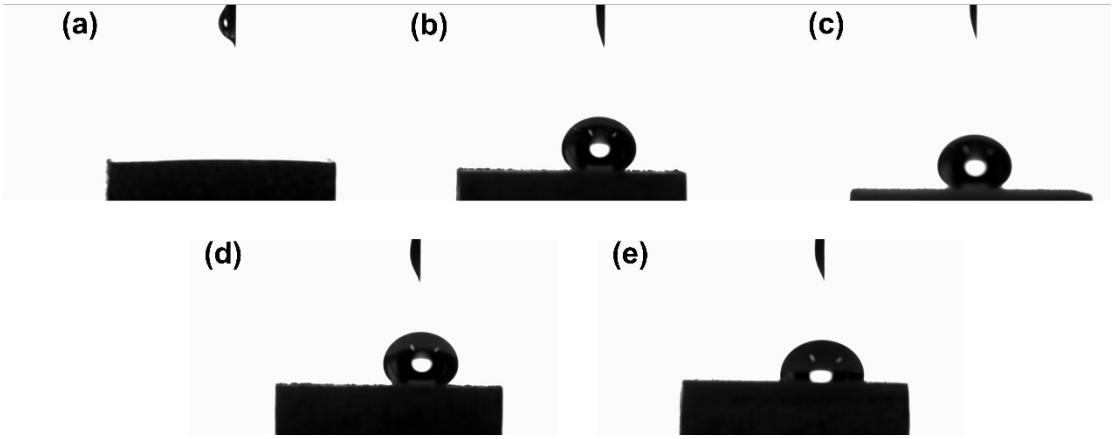

Fig. S7 The images of oil contact angle on the OA-TENG (FCNH) (SiO_2: 0.3g, APTES: 90 mg) with different mass of FC: 0 g (a), 2 g (b), 4 g (c), 6 g (d), 8 g (e).

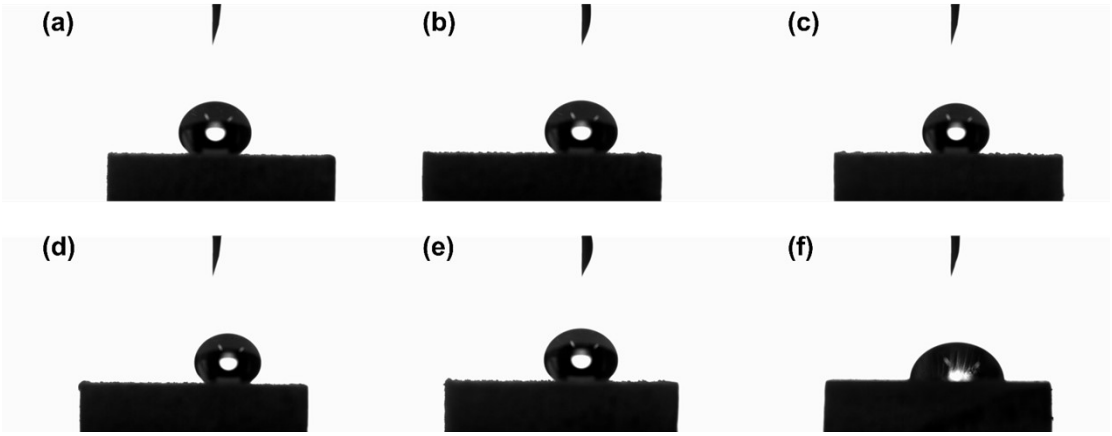

Fig. S8 The images of oil contact angle on the OA-TENG (FCNH) (SiO_2: 0.3g, FC: 6 g) spraying with different mass of APTES: 0 g (a), 30 mg (b), 60 mg (c), 90 mg (d), 120 mg (e), 150 mg (f).

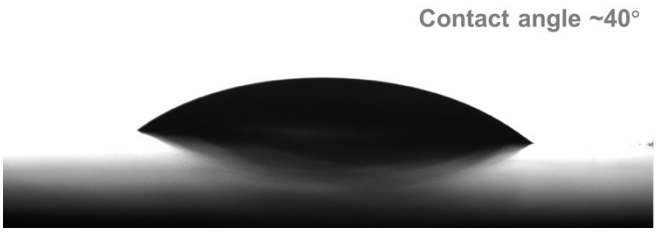

Fig. S9 The image of oil contact angle on commercial pure PTFE.

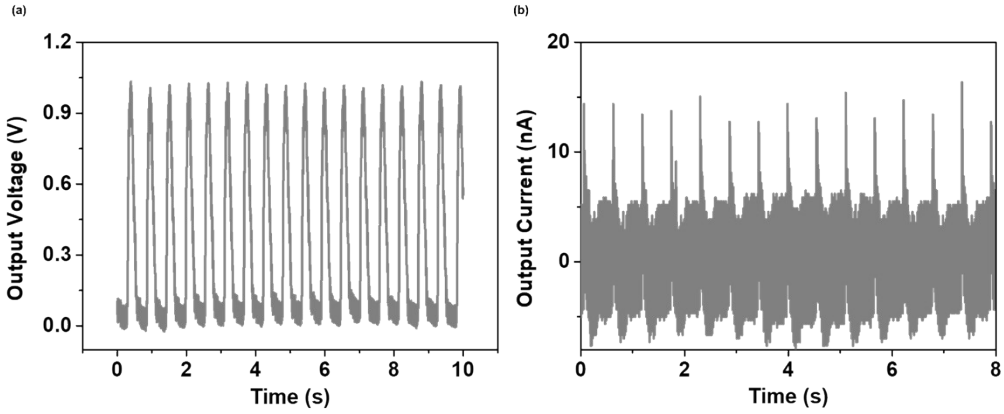

Fig. S10 The voltage (a) and current (b) output of PTFE-based OA-TENG.

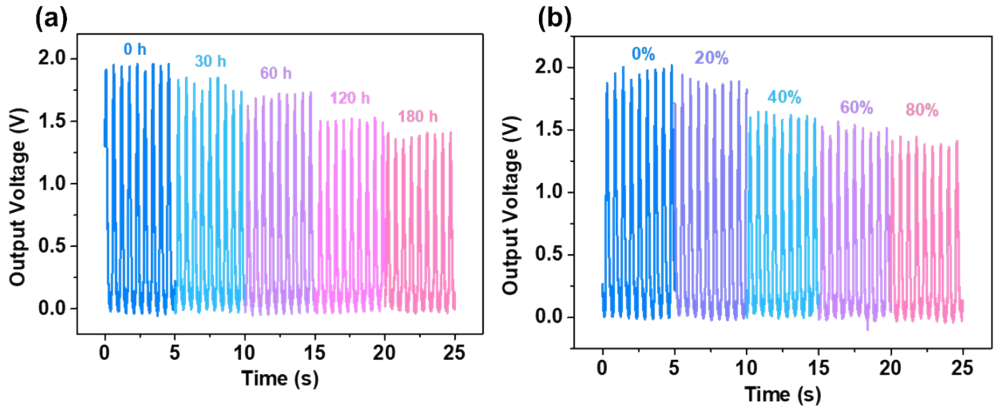

Fig. S11 The influence of the aged oil with different aging time on the voltage of the OA-TENG (FCNH-0) (a). The voltage of the OA-TENG (FCNH-0) contacting the paraffin oil ladened with different volume concentration of aged oils (180 h).

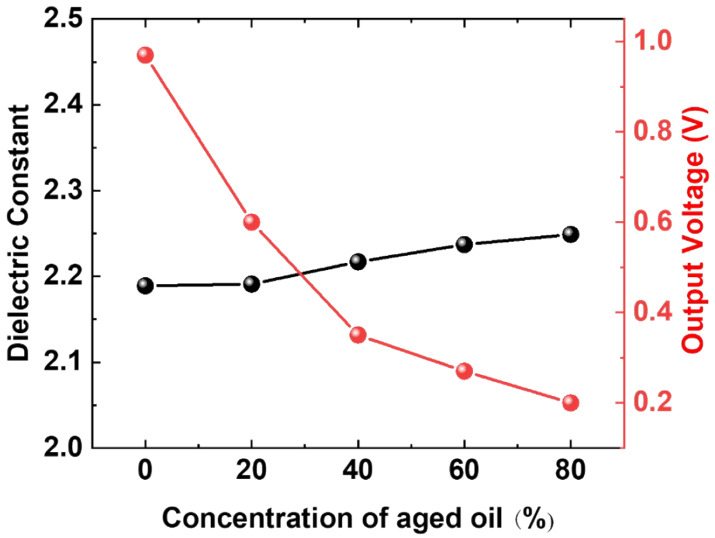

Fig. S12 The relationship between dielectric properties and output voltage of OA-TENG.

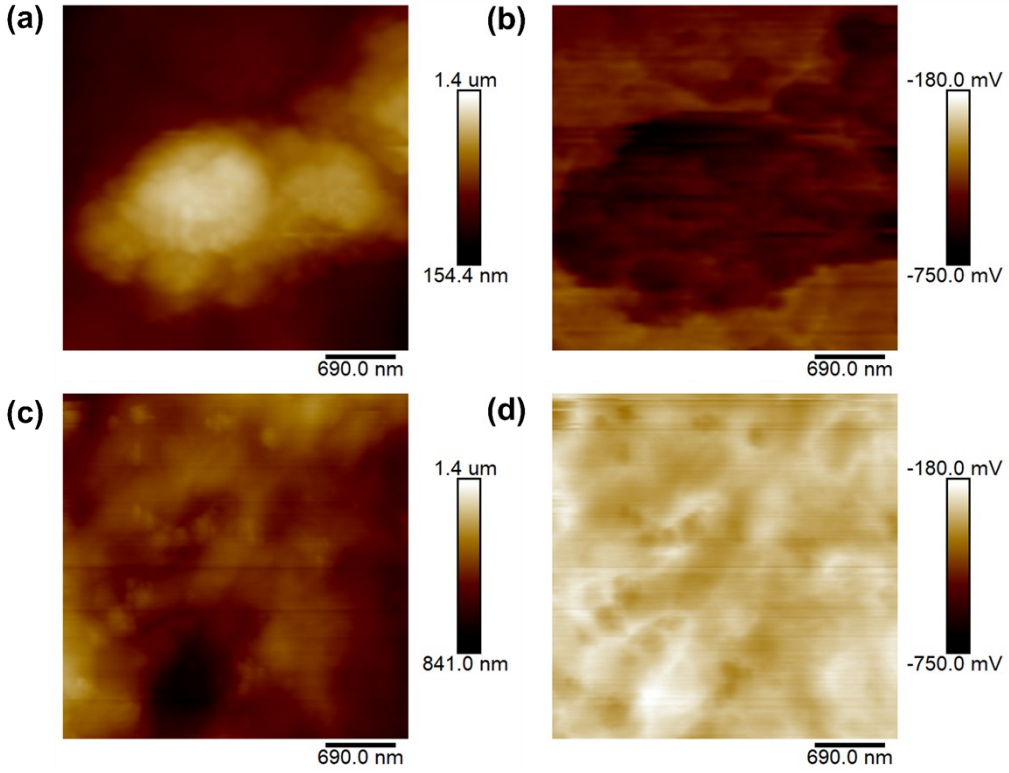

Fig. S13 KPFM results of FCNH-0 (a) topography and (b) surface potential mapping, and FCNH-3(a) topography and (b) surface potential mapping.

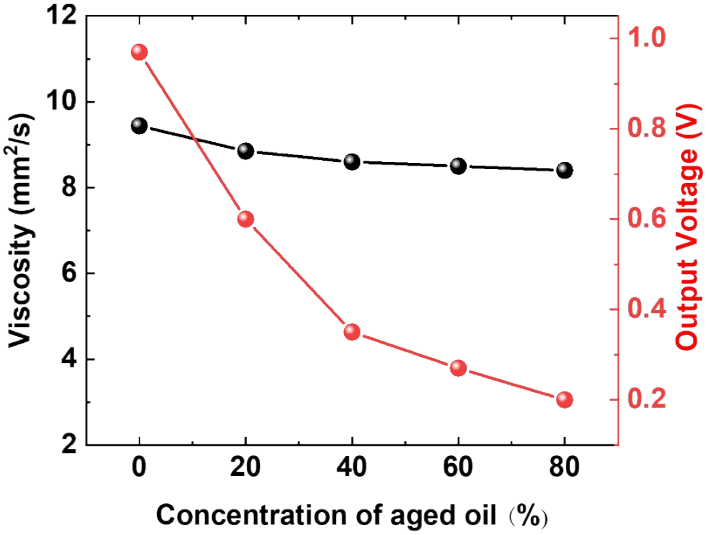

Fig. S14 The relationship between viscosity and TENG output.

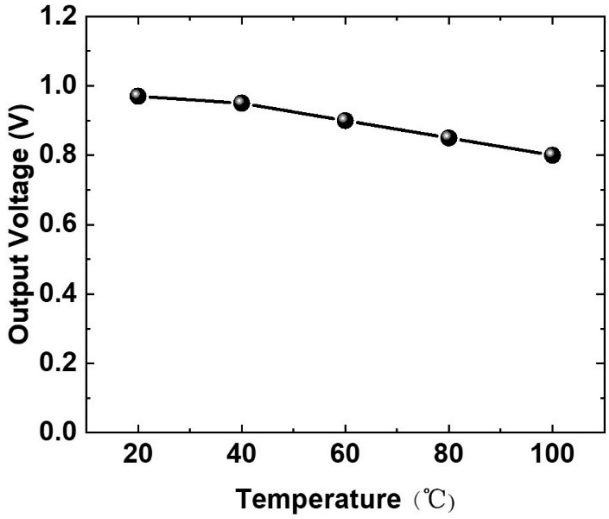

Fig. S15 Output voltage of the OA-TENG contacting with paraffin oil as a function of oil temperature.

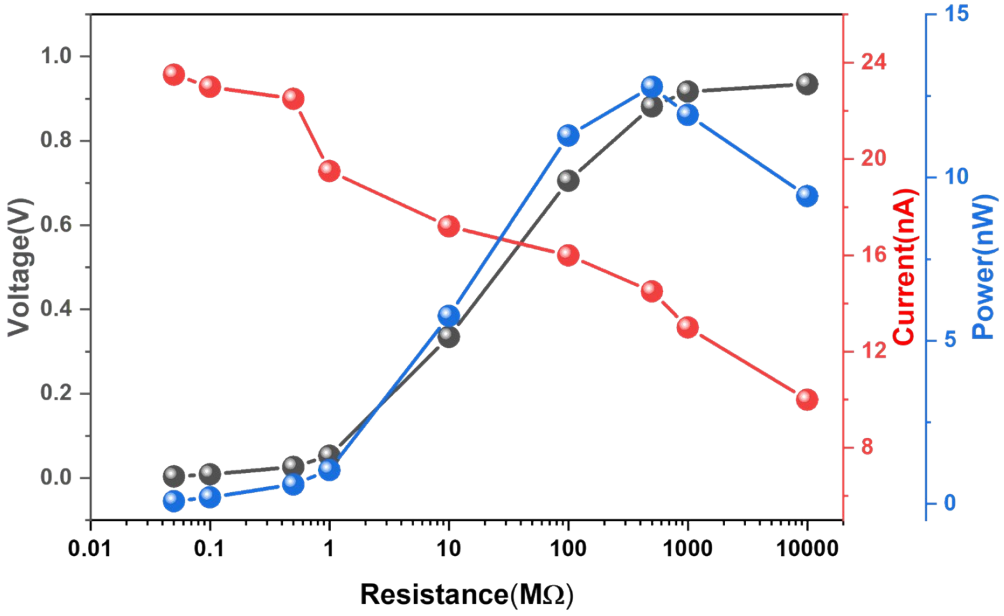

Fig. S16 The peak current, voltage and power of the OA-TENG (FCNH-3) with various load resistances.

Table S1 Fabrication of OA-TENG samples with different SiO_2

Samples	Fluorocarbon surfactant (FC)	Spraying mass of APTES	SiO_2
1	6 g	90 mg	0 g
2			0.1 g
3			0.2 g
4			0.3 g
5			0.4 g
6			0.5 g

Table S2 Fabrication of OA-TENG samples with different FC

Samples	Fluorocarbon surfactant (FC)	Spraying mass of APTES	SiO_2
1	0 g	90 mg	0.3 g
2	2 g		
3	4 g		
4	6 g		
5	8 g		

Table S3 The OA-TENG samples with different spraying masses of APTES

Sample name	Fluorocarbon surfactant (FC)	Spraying mass of APTES (~ with a -NH_2 group)	SiO_2
FCNH-0	6 g	0 g	0.3 g
FCNH-1		30 mg	
FCNH-2		60 mg	
FCNH-3		90 mg	
FCNH-4		120 mg	
FCNH-5		150 mg	

Table S4 The atomic concentration (at.%) of the OA-TENG from the XPS spectra measurement

Samples	C1s	N1s	O1s	F1s	Si2p
FCNH-0	17.12	0.28	38.24	28.64	15.72
FCNH-1	21.95	1.29	33.33	29.45	13.98
FCNH-2	21.56	1.50	33.61	29.12	14.21
FCNH-3	21.70	1.49	33.16	29.72	13.93
FCNH-4	22.64	1.56	32.95	28.88	13.98
FCNH-5	24.59	2.65	32.40	26.38	13.98