Universal triboelectric nanogenerator simulation based on dynamic finite element method model

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Table S1 Parameters used for contact mode simulation in cosine movement.

Material 2	d_1 = 100 μm, ε_{r1} = 7.2
Material 1	d_2 = 100 μm, ε_{r2} = 2.7
Contact area S	25 cm^2
Surface charge density σ	22 $\mu C/m^2$
Separation distance x_{max}	0.004 m
Average velocity v	0.04 m/s

Table S2 Simulation time under different air gap thickness. (Simulation is processed using parameters shown in Table S1 with 10 MΩ external load. The mapped mesh for vertical and horizontal boundary is 10 and 50, respectively.)

Air gap thickness (μm)	0.1	1	10	100
Simulation Time (s)	302	283	262	249

Table S3 Parameters used for contact mode simulation in practical movement.

Glass (Material 2)	d_1 = 1 mm, ε_{r1} = 7.2
PDMS (Material 1)	d_2 = 100 μm, ε_{r2} = 2.7
Contact area S	25 cm^2
Surface charge density σ	22 $\mu C/m^2$
Separation distance x_{max}	0.004 m
Average velocity v	0.04 m/s

Table S4. Fitted curve formulas for practical movement.

Time t (s)	Movement formula x (mm)	R^2
[0, 0.022)	$x = 0$	1
[0.022, 0.025)	$x = 6.67037\mathrm{t} - 0.1467$	0.99589
[0.025, 0.064)	$\mathrm{y} = 61.34173\mathrm{t} - 1.51307$	0.99981
[0.064, 0.1]	$\mathrm{y} = 0.75497 + 2.41793\sin(\pi\frac{t + 0.68721}{0.12039})$	0.99899

Table S5 Parameters used for sliding mode simulation in cosine movement.

PTFE (Material 2)	d_1 = 220 μm, ε_{r1} = 2
Nylon (Material 1)	d_2 = 220 μm, ε_{r2} = 4
Contact area S	0.01 m^2 (0.1 m*0.1 m)
Surface charge density σ	7 $\mu C/m^2$
Maximum separation distance x_{max}	0.08 m
Velocity v	1 m/s