# Supporting Information

# Self-Powered Triboelectric Nanogenerator with Enhanced Surface Charge Density for Dynamic Multidirectional Pressure Sensing

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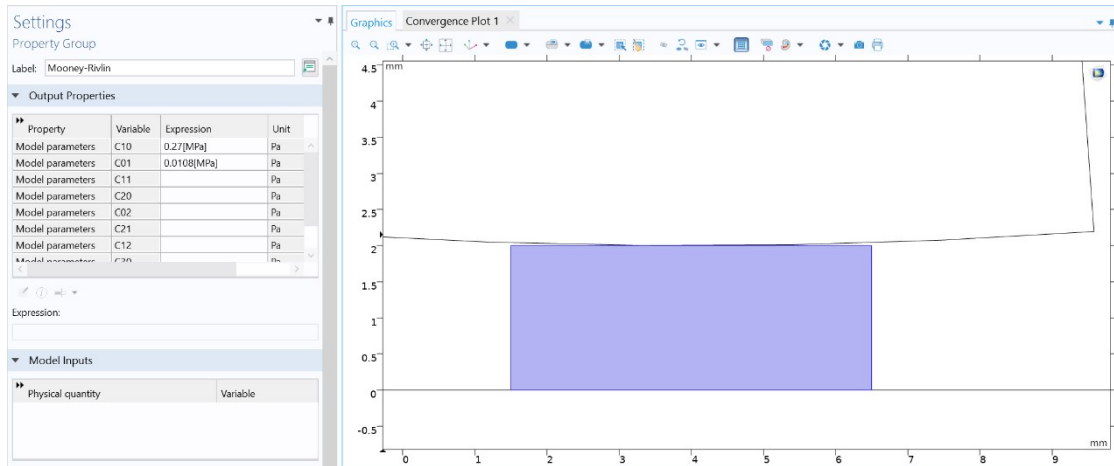
# Supporting Figures



**Figure S1.** COMSOL Multiphysics interface for simulation of von Mises Stress within cuboid sensing structure during triboelectrification.
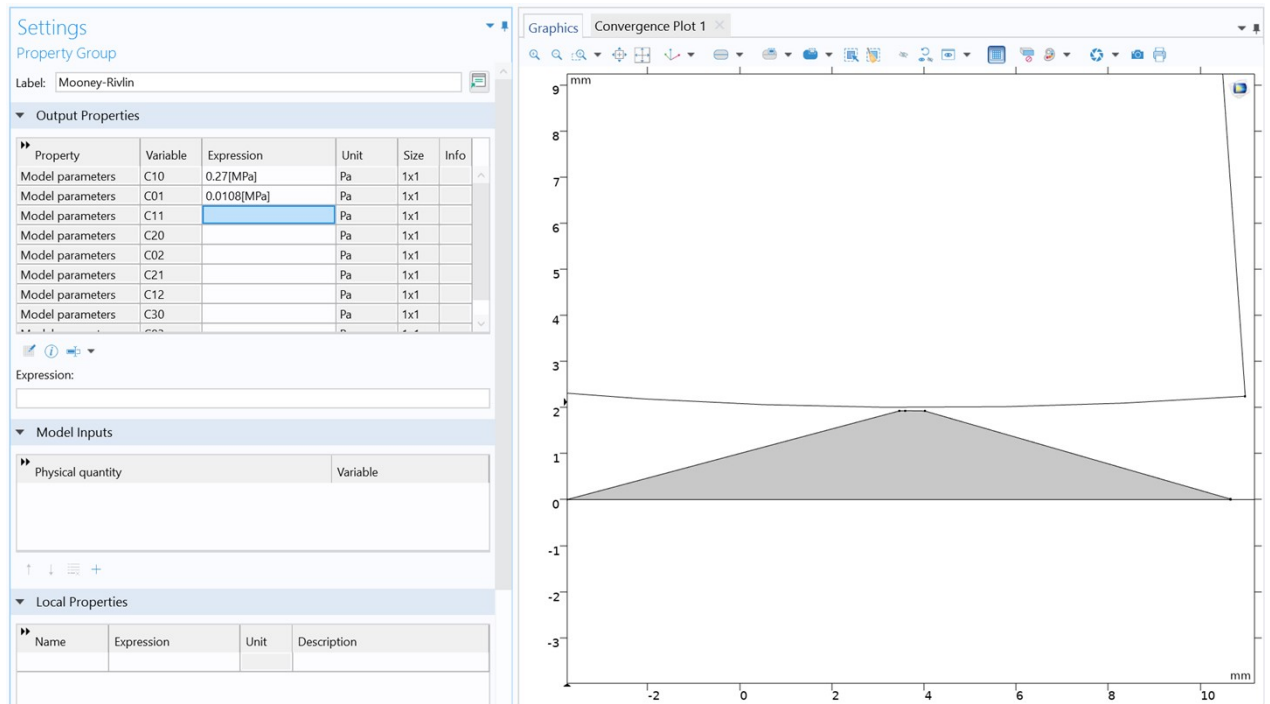
**Figure S2.** COMSOL Multiphysics interface for simulation of von Mises Stress within

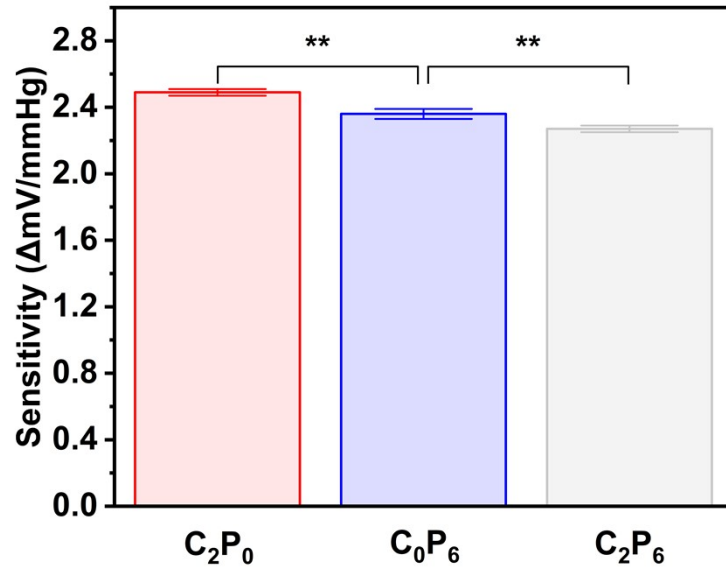cone sensing structure during triboelectrification.

**Figure S3.** Quantitative comparison for sensitivity of $C_2P_0$, $C_0P_6$ and $C_2P_6$ (n=3). Each data point represents mean ± SD. Two-sample t-test: $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.
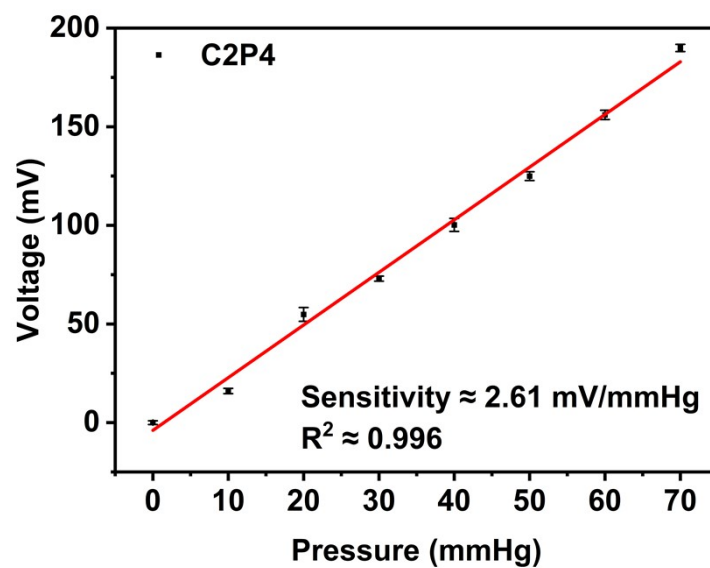
**Figure S4.** Linear regression for $V_{oc}$ responses of 2 wt% CB and 4 wt% PVP doped STEPs ($C_2P_4$) with cone sensing structure from 0 to 70 mmHg (n = 5). Each data point represents mean ± SD.
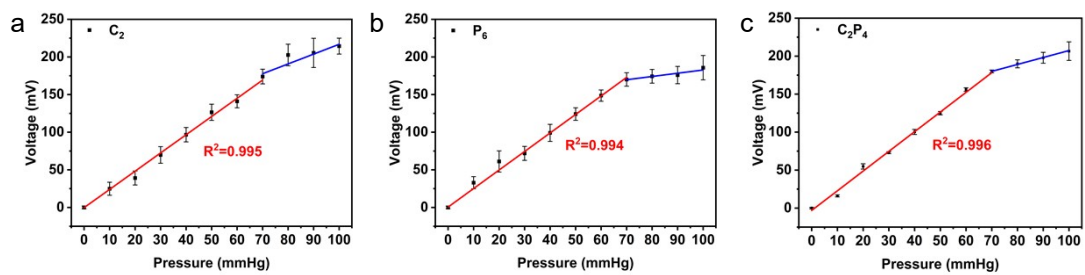
**Figure S5.** $V_{oc}$ responses from 0 to 100 mmHg for cone structure STEPs (n = 5) with (a) 2 wt% CB doped, (b) 6 wt% PVP doped and (c) 2 wt% CB and 4 wt% PVP co-doped. Each data point represents mean ± SD.

# Supporting Tables

**Table S1.** Summary of the pressure-sensing results of the STEPs

| Sensor | Sensitivity / mV mmHg$^{-1}$ |
|---|---|
| $C_0P_0$-cone | $1.33 \pm 0.04$ |
| $C_2P_0$-cube | $2.15 \pm 0.03$ |
| $C_2P_0$-cone | $2.49 \pm 0.02$ |
| $C_4P_0$-cone | $1.91 \pm 0.05$ |
| $C_6P_0$-cone | $1.58 \pm 0.02$ |
| $C_8P_0$-cone | $1.43 \pm 0.01$ |
| $C_0P_2$-cone | $1.62 \pm 0.05$ |
| $C_0P_4$-cone | $2.16 \pm 0.02$ |
| $C_0P_6$-cone | $2.36 \pm 0.03$ |
| $C_0P_8$-cone | $1.91 \pm 0.01$ |
| $C_2P_2$-cone | $2.49 \pm 0.04$ |
| $C_2P_4$-cone | $2.61 \pm 0.02$ |
| $C_2P_6$-cone | $2.27 \pm 0.02$ |
| $C_2P_8$-cone | $1.77 \pm 0.02$ |
| $C_2P_{10}$-cone | $1.56 \pm 0.04$ |
| 4 $C_2P_0$-cones | $3.14 \pm 0.02$ |

**Table S2.** Comparison of pressure-sensing sensitivity with other reported sensors following a simple fabrication process with not more than 4 layers and covering the clinically relevant pressure range of 0 – 70 mmHg[1-7]

| | Papers | Layers | Sensing Range / mmHg | Sensitivity / mV mmHg$^{-1}$ |
|---|---|---|---|---|
| **1** | **This work** | **3** | **0.0 – 70.0** | **2.61** |
| 2 | *ACS Appl. Mater. Interfaces 2022, **14**, 17, 20122–20131*[8] | 3 | 37.5 – 562.5 | 0.391 |
| 3 | *Adv. Funct. Mater. 2020, **30**, 2002868*[9] | 2 | 11.3 – 225.0 | 0.306 |
| 4 | *Small Methods, 2022, **6**, 2101051*[10] | 4 | 0.0 – 750.1 | 0.203 |
| 5 | *19th International Conference on Solid-State Sensors, Actuators and Microsystems (TRANSDUCERS), 2017, pp. 1025-1028*[11] | 3 | 0.0 – 37.5 | 0.134 |

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## Supporting Videos

**Video S1.** Simulation of von Mises Stress within cuboid and cone sensing structure during triboelectrification at varying pressure.

**Video S2.** Pressure measurement with STEPs at the inner aspect of the elbow during arm flexion at constant pressure.

**Video S3.** Pressure measurement with STEPs between the finger and beaker during grip-based scenario at constant pressure.

**Video S4.** Pressure measurement with STEPs at the finger during bending at increasing pressure.

**Video S5.** Multidirectional pressure measurement with STEPs