Electronic Supplementary Material (ESI) for Analyst.


# Supporting Information

**Self-Powered Liquid Chemical Sensors Based on Solid-Liquid Contact Electrification**

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## S1. Design and testing of the TE-based liquid sensor

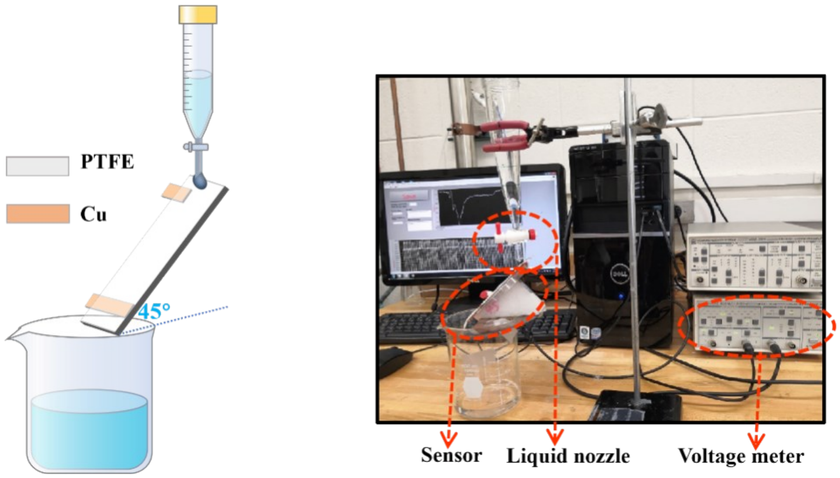



**Figure S1.** The schematic configuration and experimental setup of the TE-based liquid sensor.

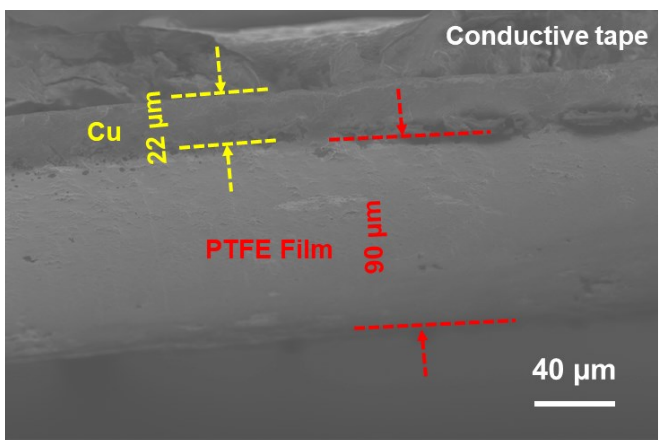
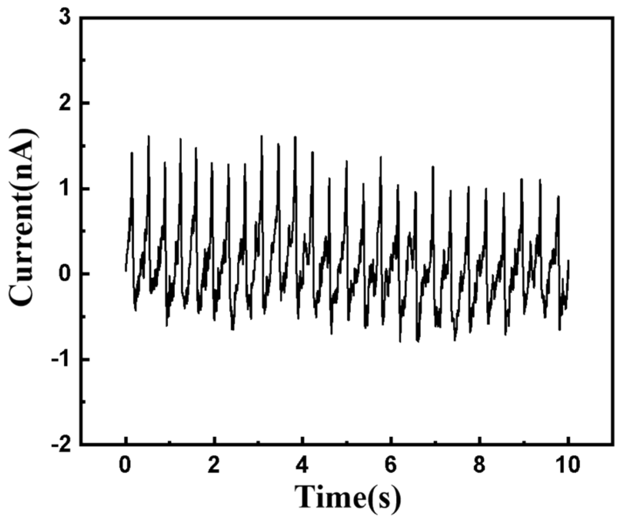



**Figure S2**. A cross-sectional SEM image of a TE-based liquid sensor.




| | Positive | Negative |
|---|---|---|
| Average value | 1.25406 | -0.630273462 |
| SD value | 0.230641772 | 0.08684424 |

**Figure S3**. The current of a TE-based liquid sensor at 45° tilting angle.

**S2: Quantification of droplet moving velocity.**

Since the peak location is directly coordinated to the location of back Cu electrodes, a device with multiple Cu electrodes was designed for quantifying the moving velocity of the liquid droplet as certain location on the sensor surface. To minimize the effect of electrodes width, three 1 mm-wide copper wires were attached on the back side of the sensor plate with a 5 cm spacing each, as depicted in the inset of Fig. S4A. The corresponding voltage profile in Fig. S4A showed that when one droplet moved across the electrodes, voltage peaks were generated on each electrode accordingly. The time intervals between two positive peaks were measured as listed in Table S1. From the time interval ($t$) and the spacing between the electrodes ($d$), moving velocity at given electrode position could be quantified by $d=vt+1/2at^2$. The average velocity was consistently found to be ~0.39 m/s at the first testing electrode. The motion characteristics of the droplet on the slope was also simulated by the commercial computational fluid dynamics (CFD) software ANSYS Fluent. The velocity contour of the droplet and the air flow surrounding the droplet are shown in Fig. S4C. The average velocity of the droplet was found to be ~0.4 m/s ((e) in Fig.S4C), which matched well with the experimental result. This study revealed that once the tilting angle and the distance between the liquid dropping position and the sensing electrode were fixed, the liquid droplet would show the same moving velocity across the sensing electrode. Therefore, it's influences to the voltage amplitude could be minimized.

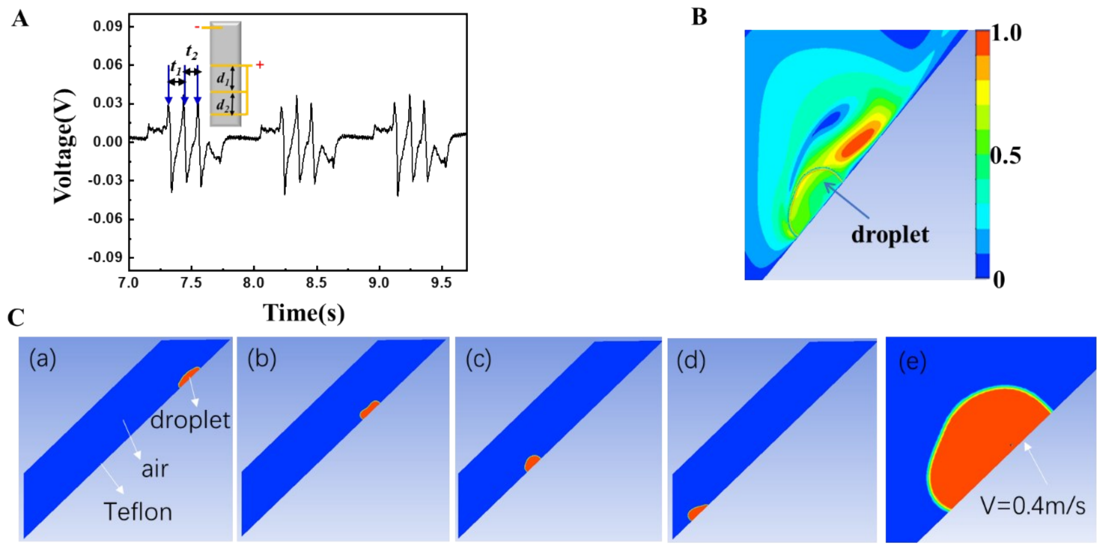



**Figure S4. The velocity result at the 45° inclined angle.** A. The voltage signals from multiple Cu electrodes. B. The velocity contour of the droplet and the air flow surrounding the droplet. C.(a) the expression of the CFD. (a-d) The dynamic features of the droplet at different time when it slides down the slope. (e)The close-up view of the droplet motion feature in (c).

**Table S1.** The data read from Figure S3A

| $t_1$ (ms) | $t_2$ (ms) |
|---|---|
| **122.5** | 113 |
| **126** | 114.5 |
| **124.5** | 116.5 |

## S3. Additional experimental data available

**Table S2.** Chemical structures and solubility in water of test samples

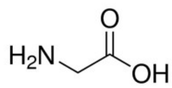
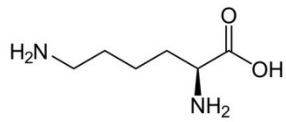
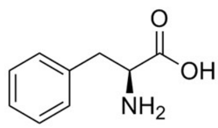
| *Test sample* | *Chemical structure* | *solubility in water(mol/L) on room temperature* |
|---|---|---|
| **Glycine** |  | 3.33 |
| **Lysine** |  | 10.24 |
| **Phenylalanine** |  | 0.163 |

**Table S3.** Logistic Fit of the three amino acids

| *Amino acid* | *y=A2+(A1-A2)/(1+(x/x0)^p)* |
|---|---|
| **Glycine** | *A1* = -0.26132, *A2* = -0.903803, *x0* = 0.138117, *p* = 1.11906. |
| **Lysine** | *A1* = 0.251133, *A2* = -0.950751, *x0* = 0.0052421, *p* = 1.17848. |
| **Phenylalanine** | *A1* = 2.89162, *A2* = -1.03556, *x0* = 0.000631993, *p* = 0.819668. |

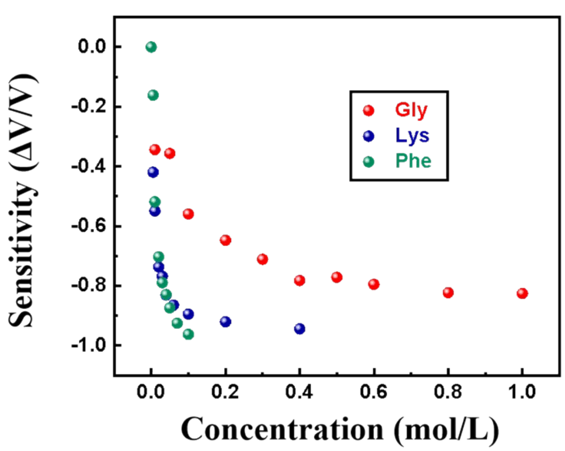



**Figure S5. The sensitivity result of the TE-based liquid sensor to three amino acids**