

Supporting Information

Coalescence of a Water Drop with an Air-Liquid Interface: Electric Current Generation and Critical Micelle Concentration (CMC) Sensing Application

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1. Measuring the Electrical Potential Difference Between the Droplet and the Liquid Solution

System setup

Figure S1 shows how the electrical potential difference between the droplet and the liquid solution was measured.

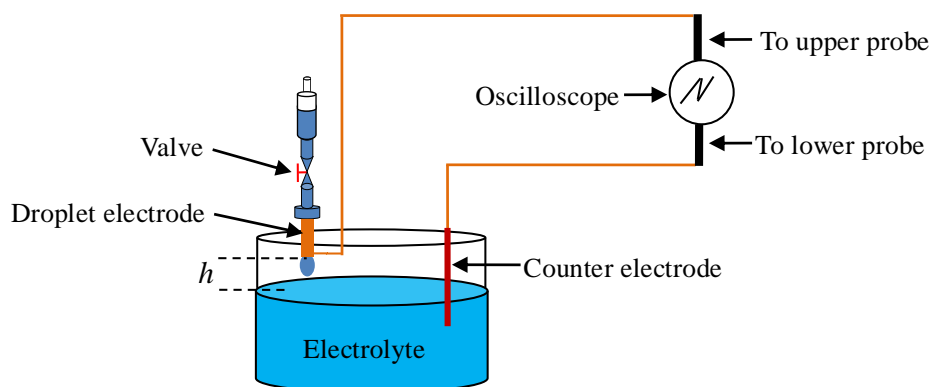


Figure S1 A schematic diagram of the system for electrical potential measurement

2. CMC Measurement

Measurement system

Figure S2 shows the experimental setup of CMC measurement which includes a droplet electrode, a counter electrode immersed in an electrolyte solution, an electrical resistor and a signal amplifier (AD620), a data acquisition device (NI USB6259, NI, USA). For this measurement system, the electrical current generated by the droplet touching the electrolyte solution will flow through the resistor and thus generate a voltage difference across the resistor. This voltage difference is inputted into the signal amplifier and then outputted to the computer via the data acquisition device. As a result, a voltage peak is generated and measured by the detection circuit system.

It should be noted that this measurement system is a little different with Figure 1 in the main paper. The main reason is that we want to use a cheap and customer-made data treatment system, rather than the bulky and expensive electrometer, for signal measurement and processing. Such a simple system is affordable for every lab and promising for the wide application of this method. Furthermore, the powerfulness of this system in Figure S2 has been well proven [1,2].

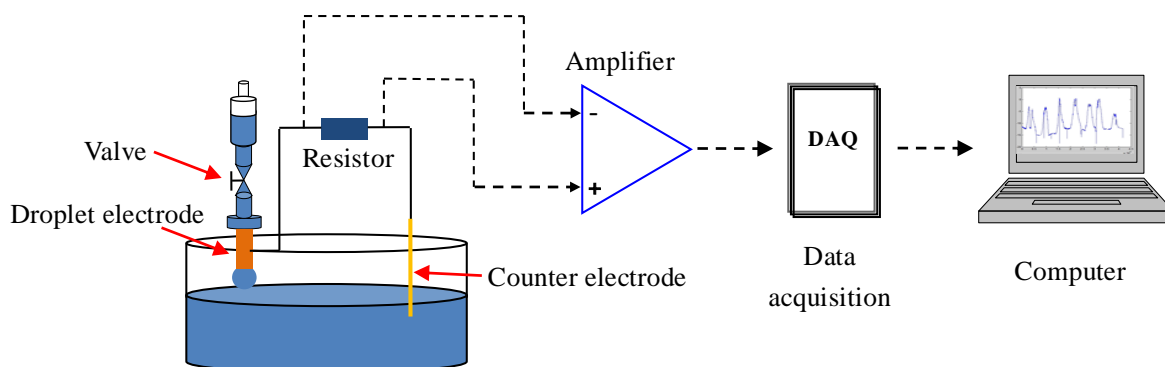


Figure S2 Measuring the electrical current with a customer-made system

Materials and experimental procedures

In this study, the droplets are pure water with different concentrations of surfactants (SDS or CTAB). The SDS or CTAB solution was prepared by directly adding a certain amount of SDS (99% purity, Saint Louis Sigma Aldrich, USA) or CTAB (99% purity, Saint Louis Sigma Aldrich, USA) to the ultra-pure water generated by a Millipore pure water system. The electrolyte solution in the container is ultra-pure water. The resistance of the resistor shown in Figure S2 is $2M\Omega$ and the gain of the amplifier is set as 100. The experimental procedures are the same as is explained in Section 2.2 of the main paper.

Results

Figure S3 shows a typical signal when a SDS droplet (3.47mmol/L) contacts the air-pure water interfaces. It's clear that a downward voltage signal pulse with a magnitude of about 2.7V is measured. This voltage signal is due to an electrical current flowing through the resistor.

It should be noted that the direction of the signal pulse depends on how the output from the resistor is inputted to the amplifier. That is, the downward signal does not represent the potential polarity of the droplet.

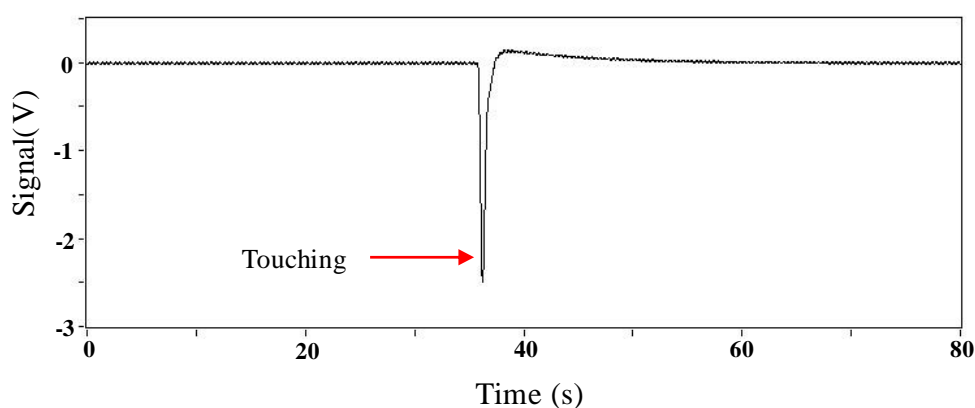


Figure S3 A typical voltage signal when a SDS droplet touches the air-pure water interface ($h=1.5\text{mm}$)

Table S1 and Table S2 summarize voltage signals when droplets with different concentration of SDS and CTAB touch the air-pure water interface.

Table S1 Voltage signals when droplets with different concentration of SDS touch the air-pure water interface

Concentration (mmol/L)	Average Signal (V)	SD
1.00	-0.95	0.076
1.74	-1.78	0.08222
3.47	-2.59	0.08452
5.21	-3.40	0.11367
6.94	-4.48	0.07552
7.99	-4.98	0.06711
8.68	-5.00	0.07003
10.42	-4.97	0.08639
11.00	-4.90	0.04707
12.15	-4.93	0.1306
13.00	-5.00	0.07283

Table S2 Voltage signals when droplets with different concentration of CTAB touch the air-pure water interface

Concentration (mmol/L)	Average Signal (V)	SD
0.27	-7.80	0.08818
0.41	-8.23	0.09308
0.55	-8.94	0.07031
0.69	-9.35	0.09765
0.82	-9.81	0.09389
0.96	-10.23	0.10538
1.10	-10.20	0.11513
1.24	-10.24	0.14134
1.38	-10.28	0.16334

1.53	-10.22	0.1257
1.68	-10.19	0.12696

References

1. Yongxin, S.; Kai, Z.; Mengqi, L.; Xinxiang, P.; Dongqing, L., A Novel Method for Measuring Zeta Potentials of Solid–Liquid Interfaces. *Anal. Chim. Acta.* **2015**, 853: 689-695.
2. Yongxin, S.; Runzhe, S.; Kai, Z.; Xinxiang, P.; Hao, Z.; Dongqing, L., An Induction Current Method for Determining the Critical Micelle Concentration and the Polarity of Surfactants. *Colloid. Polym. Sci.*, **2015**, 293: 1525-1534.