



Switchable power generation in triboelectric nanogenerator enabled by controlled electrostatic discharge

Jiaming Zhou¹, Xiaoting Ma¹, Eunjong Kim¹, Jingyi Gao¹, Dong-myeong Shin^{1,*}

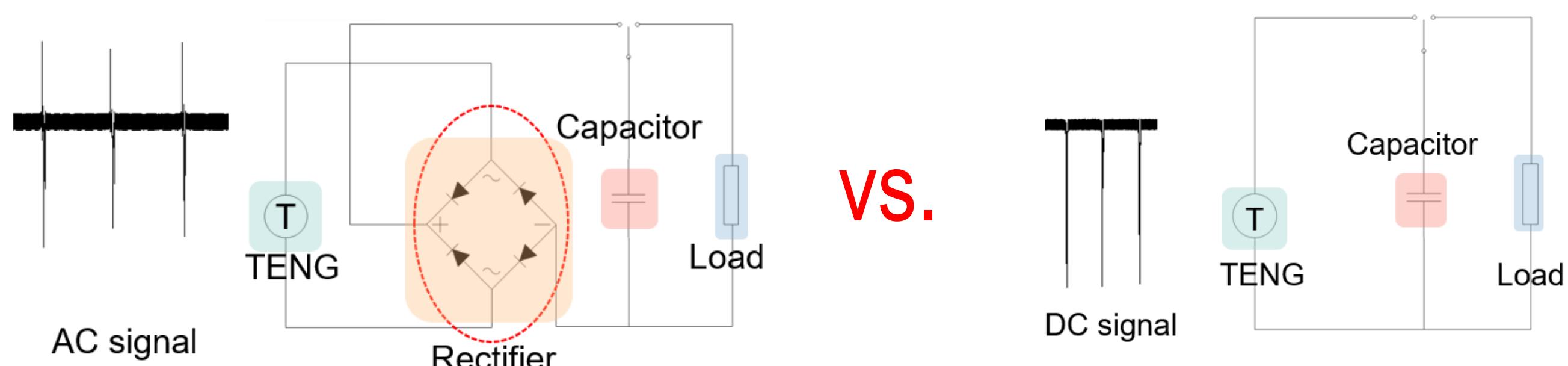
¹ Department of Mechanical Engineering, University of Hong Kong, Pokfulam, Hong Kong 999077, China

* E-mail : dmshin@hku.hk

Energy & Environmental Engineering Lab.

INTRODUCTION

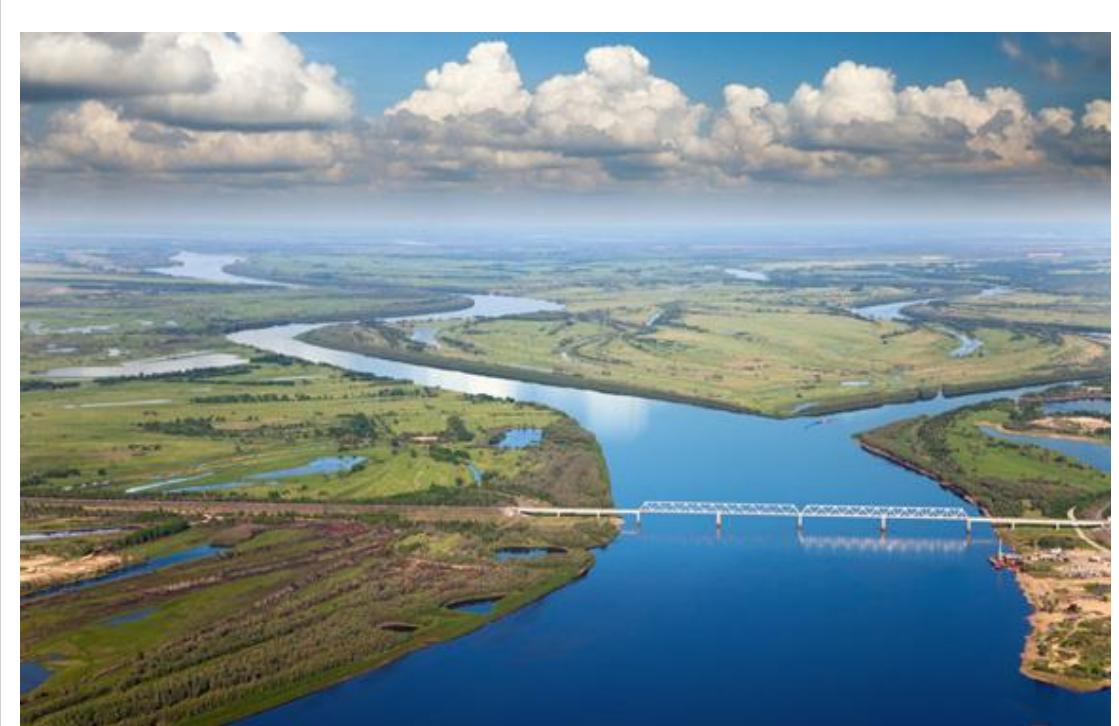
ADVANTAGE OF DIRECT CURRENT (DC) SIGNAL



VS.

- Necessary rectification methods are needed (for AC)
- Reduce the portability and energy utilization efficiency
- DC is the better choice for powering small electronics

ADVANTAGE OF WATER SOURCE USED IN TENG



Absorbing and releasing energy : 60 trillion kilowatts (annually)

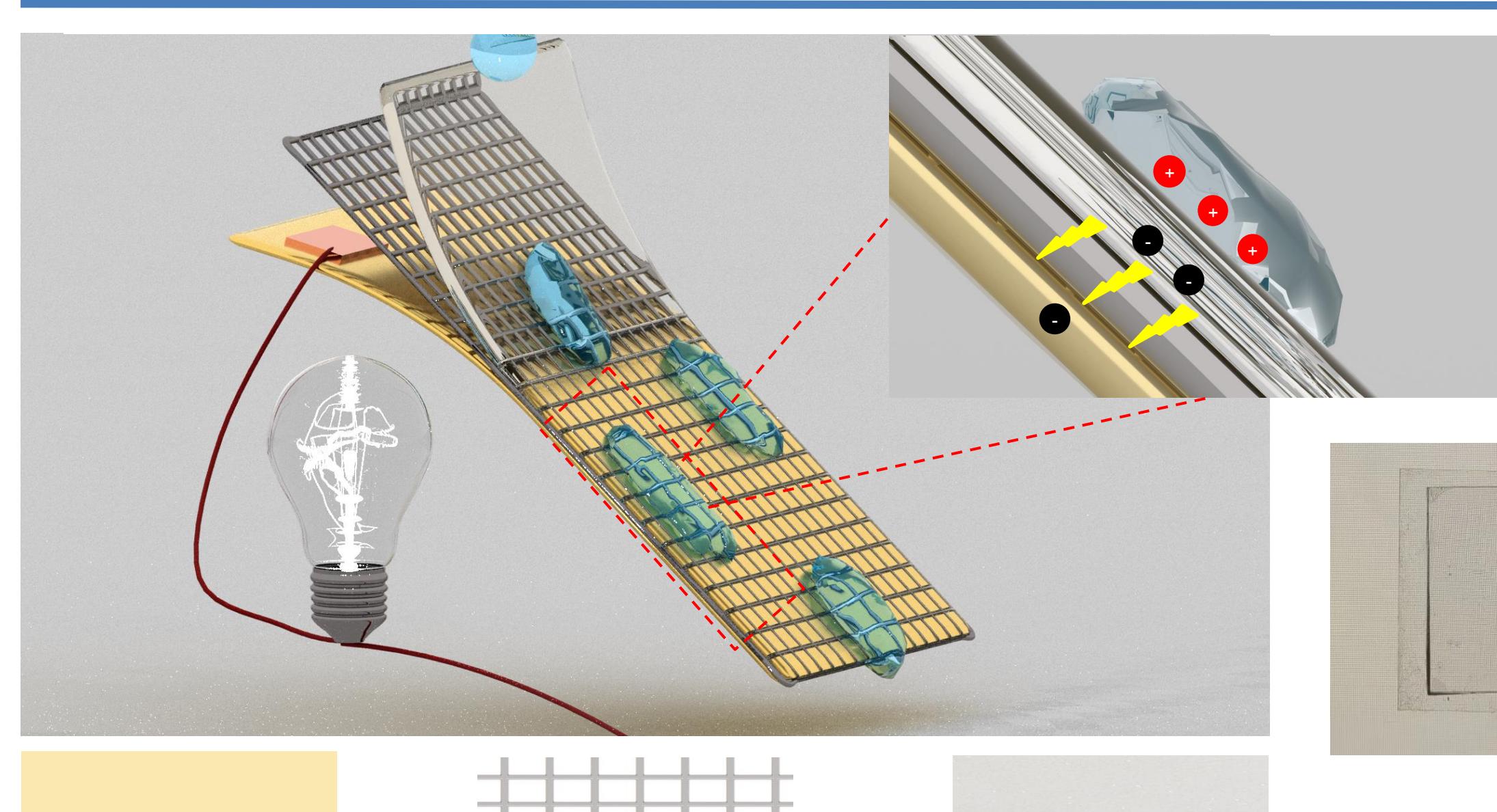
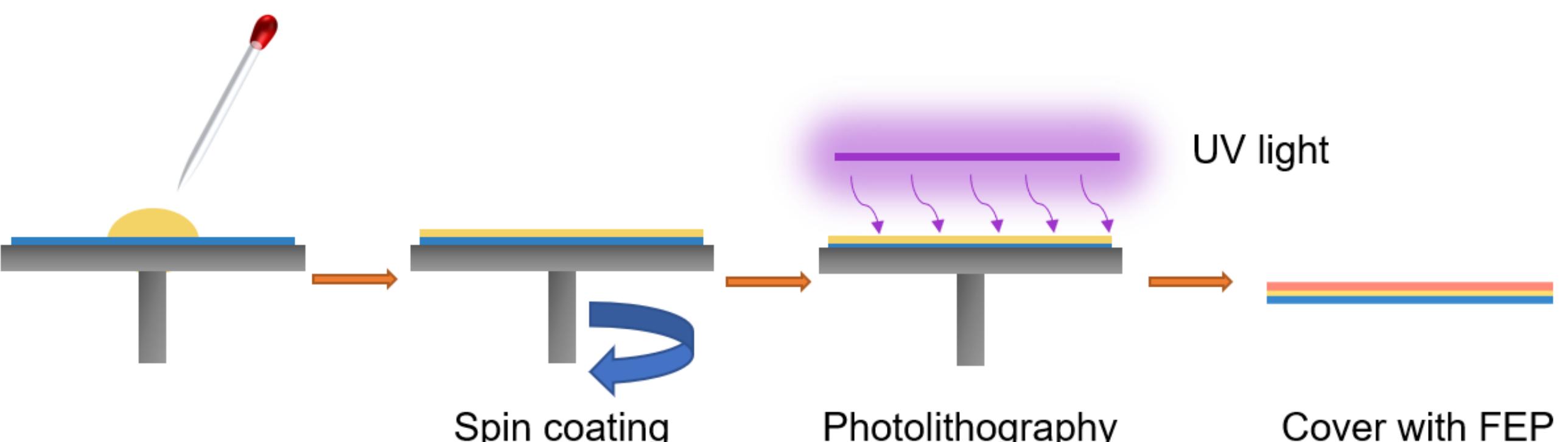
In water

Global energy consumption: 18 billion kilowatts (in 2016)

3 orders of magnitude higher !

EXPERIMENTAL SECTION

SAMPLE PREPARATION PROCESS

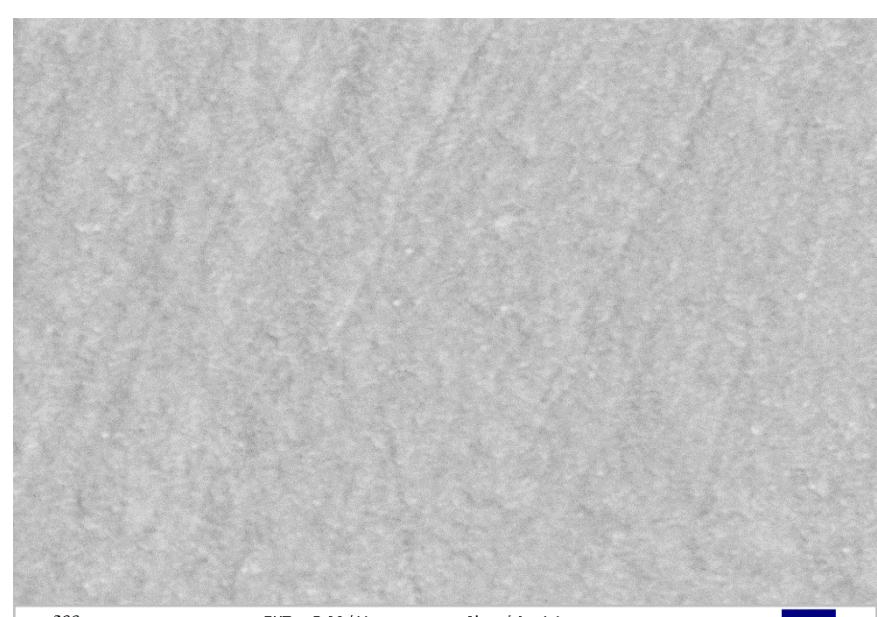


DDC-TENG

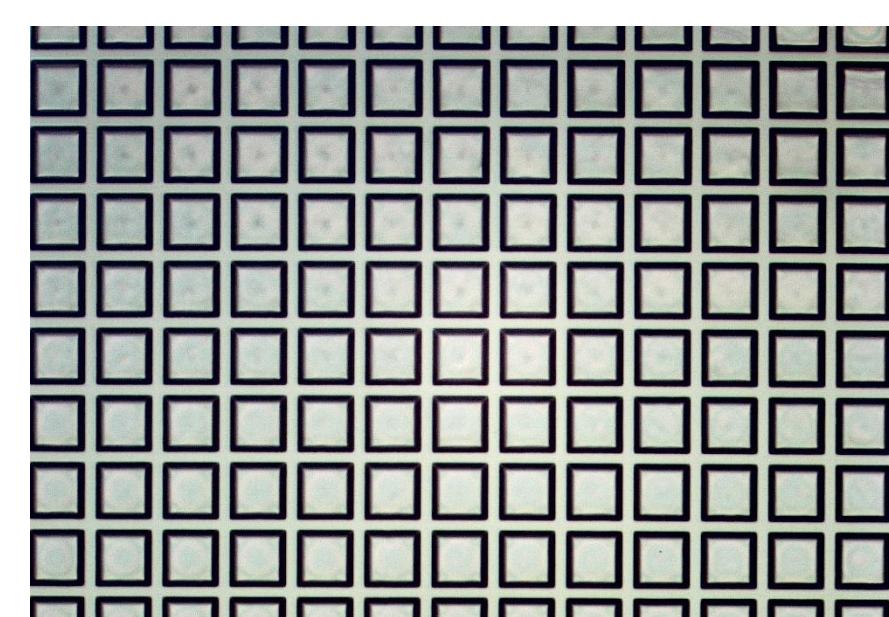
Electrode SU-8 pattern FEP

RESULTS & DISCUSSION

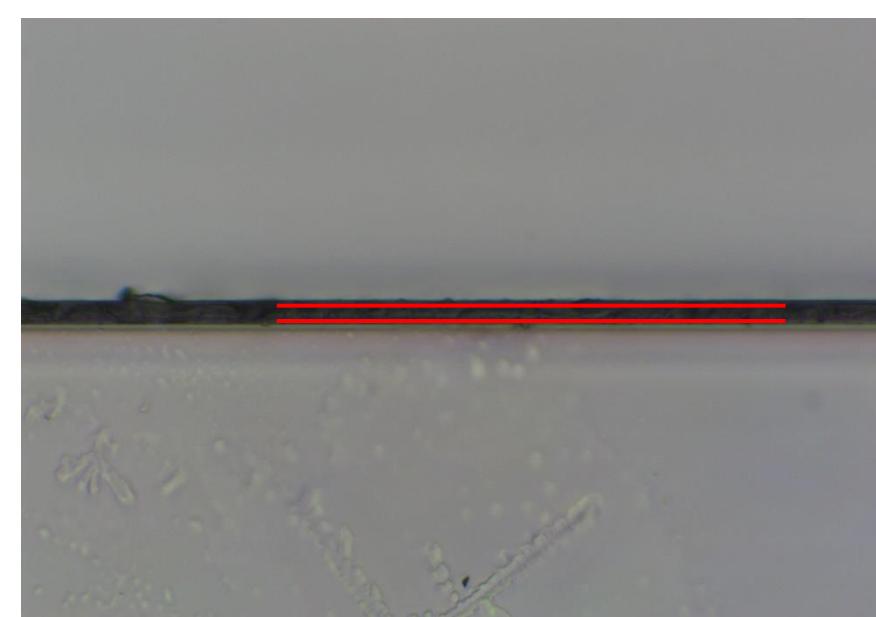
SAMPLE CHARACTERISTICS



FEP surface

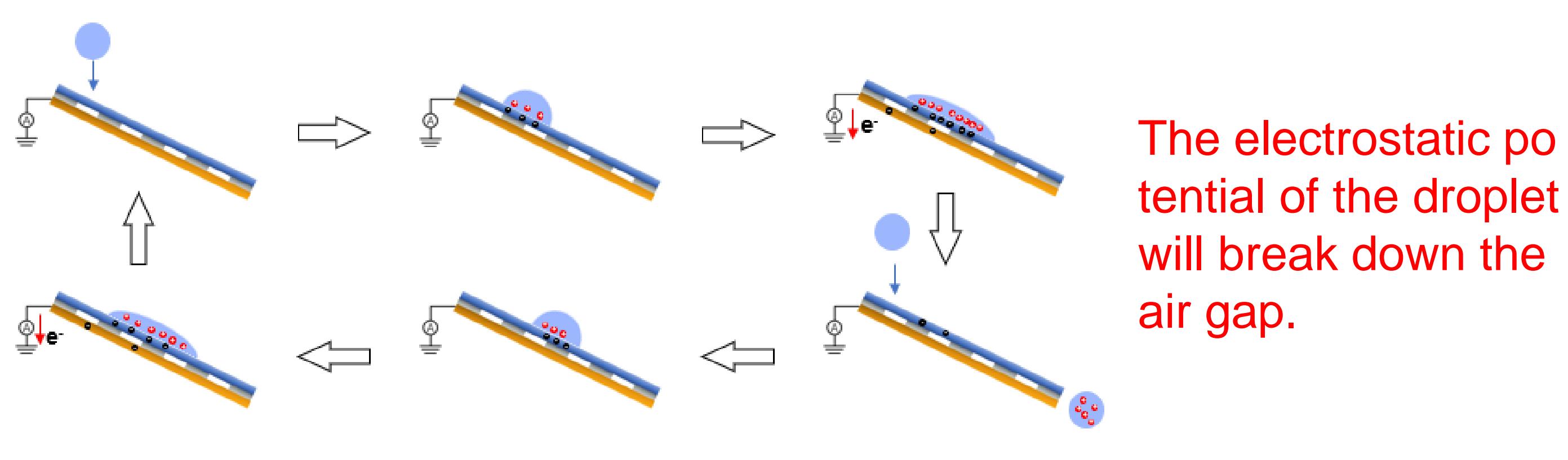


SU-8 pattern



SU-8 layer thickness

MECHANISM OF THE DDC-TENG



$$V_B = \frac{Bpd}{\ln(Apd) - \ln\left[\ln\left(1 + \frac{1}{\gamma_{se}}\right)\right]}$$

Paschen's law



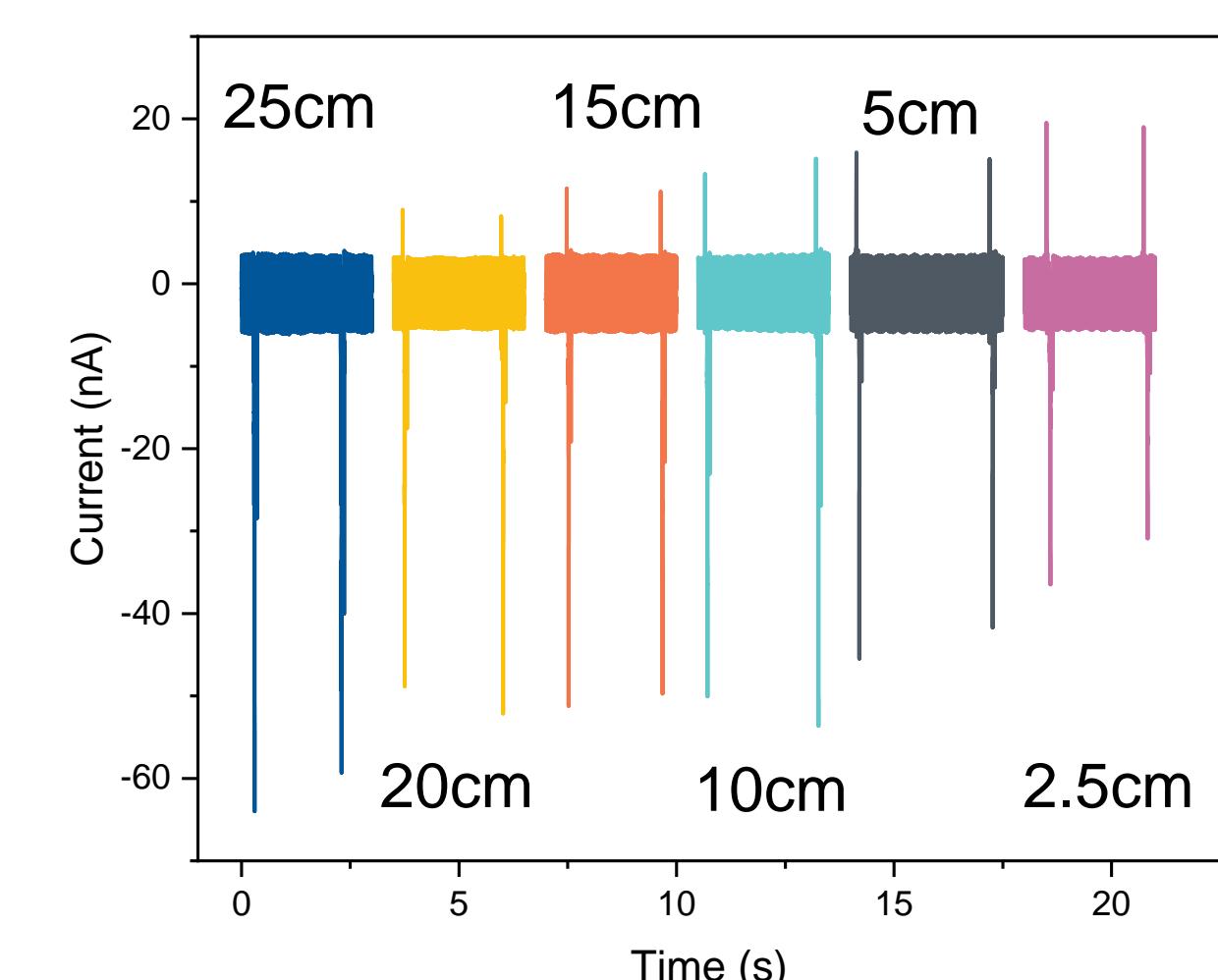
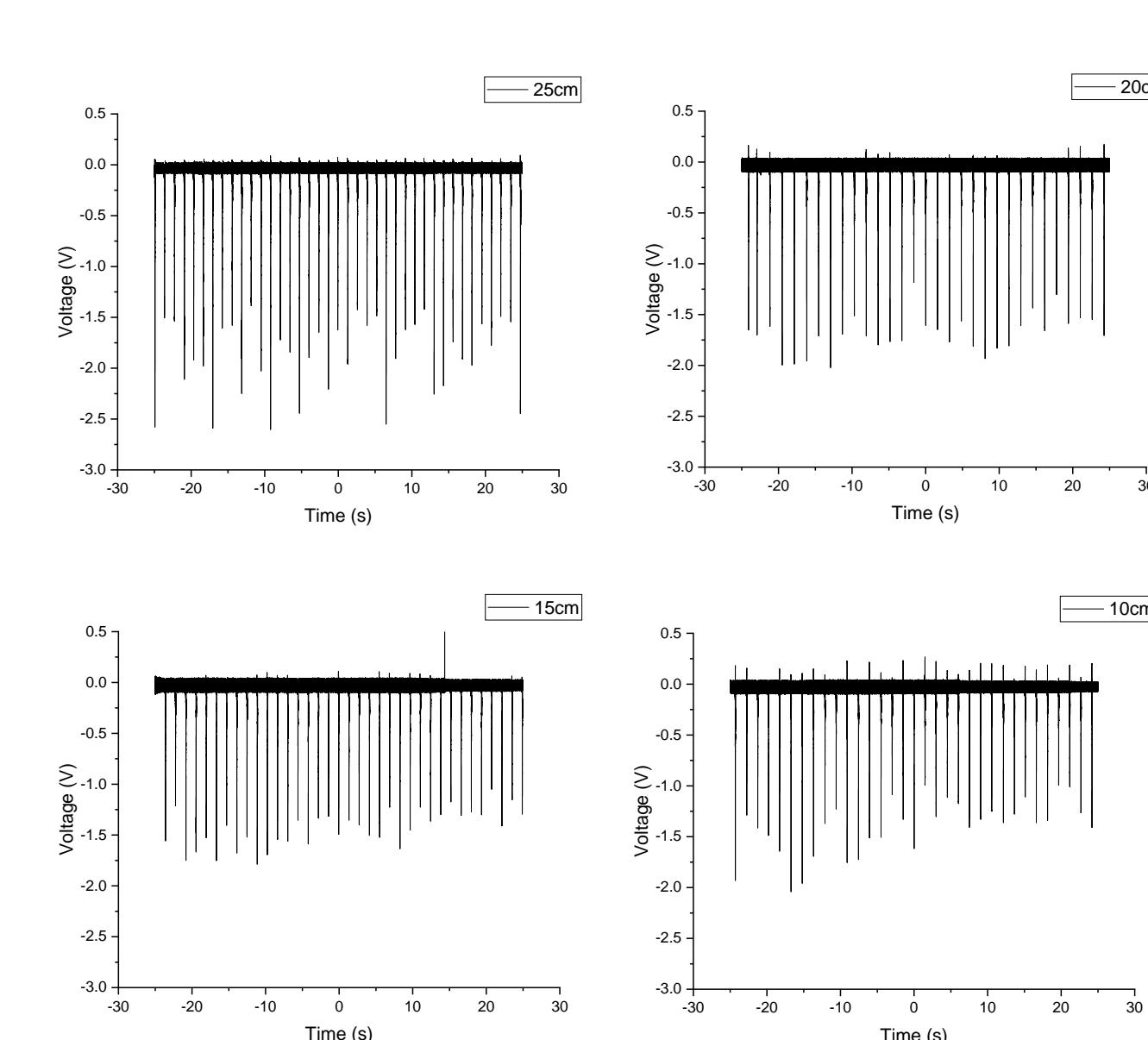
The electrostatic potential of the droplet will break down the air gap.

$$\text{Weber number (We)} = \rho v^2 d / \gamma$$

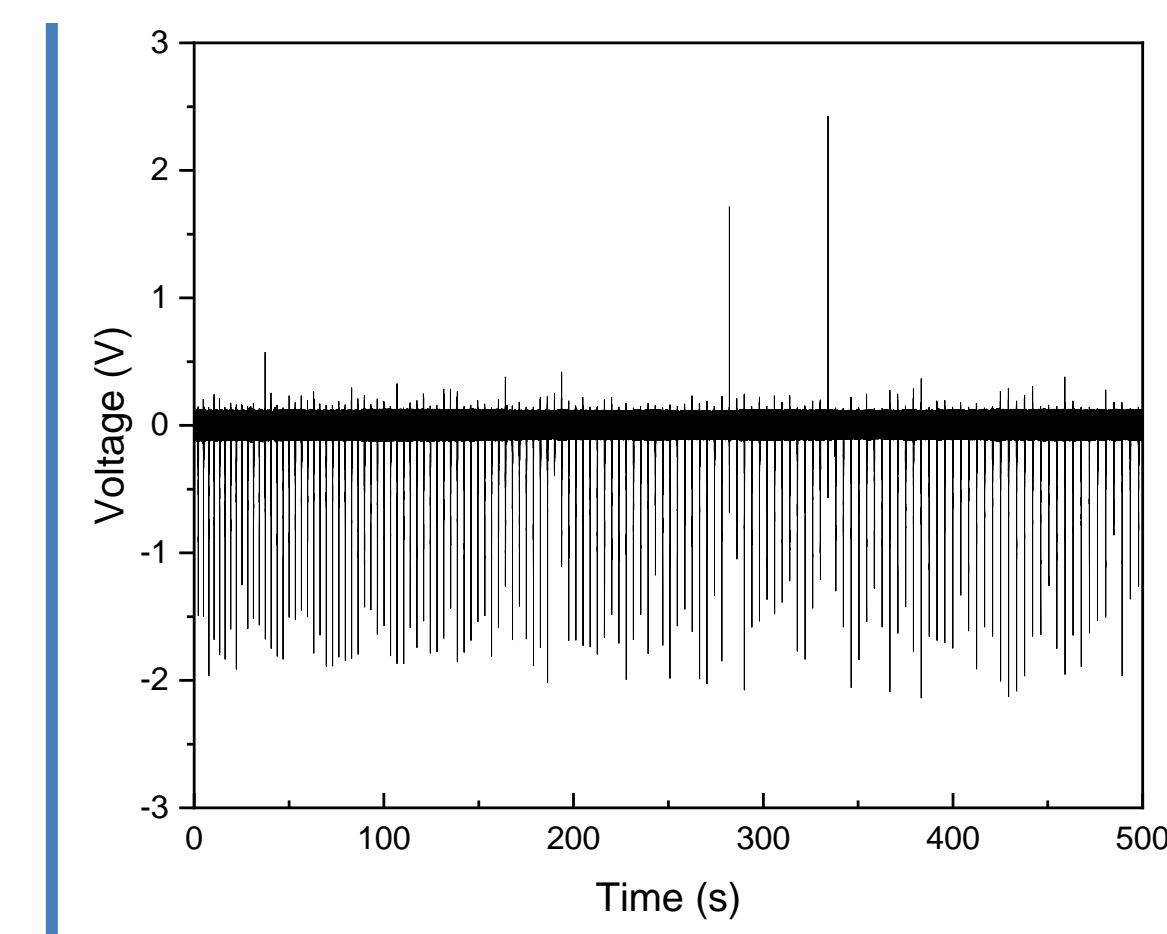
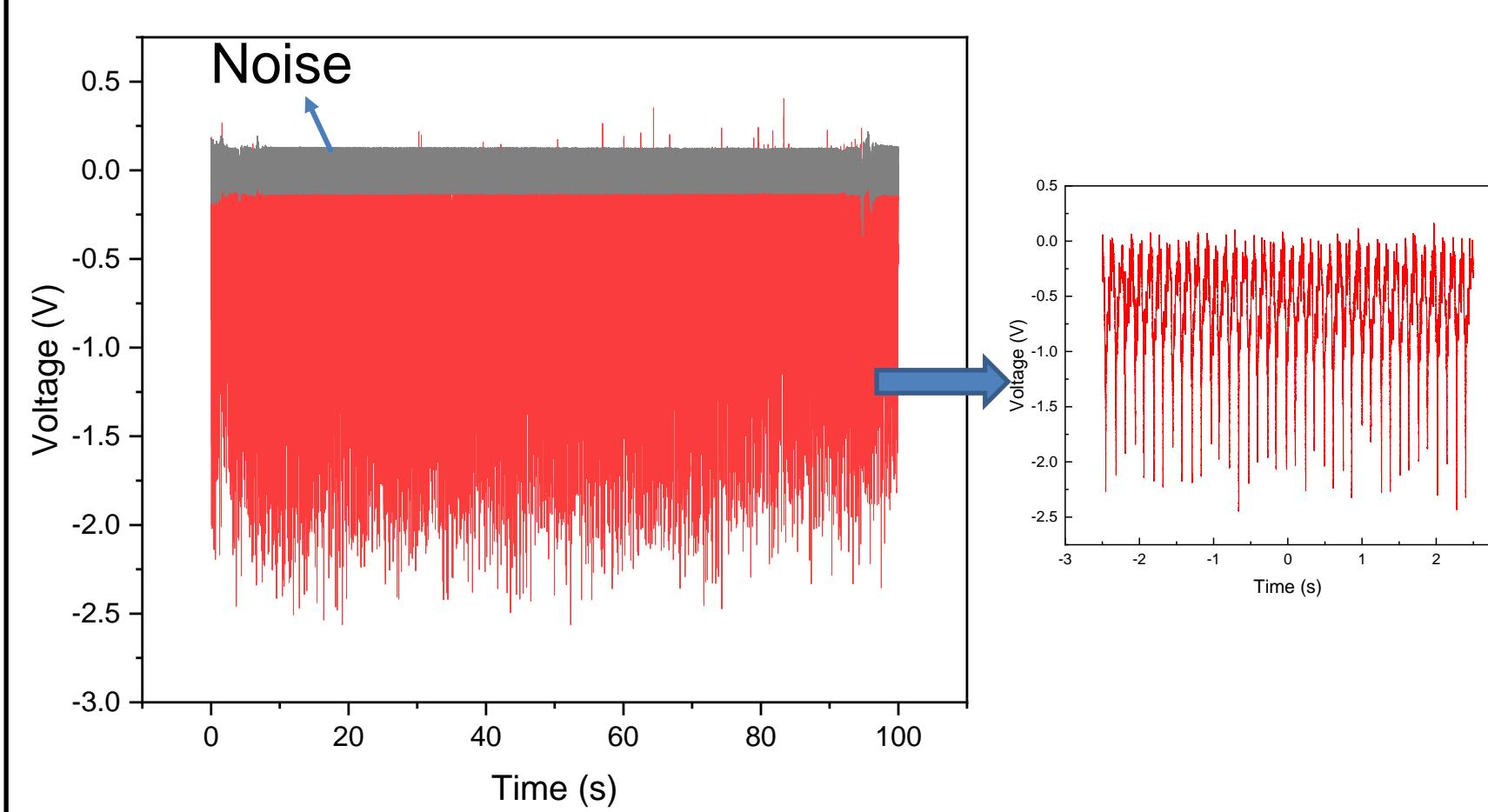
ρ : density of the droplet
 d : diameter of the droplet
 γ : surface tension of the droplet
 v : speed of the droplet

larger We, larger contact area

THE OUTPUT PERFORMANCE OF THE DDC-TENG (VOLTAGE & CURRENT)



HIGH FREQUENCY AND LONG-TIME DURATION OF THE DDC-TENG



CONCLUSION

- A DC triboelectric nanogenerator by inserting a layer of hollow mesh structure between the triboelectric layer and the electrode layer, using a high surface electrostatic potential to break down the air was formed.
- The size of the diffusion area of the water droplets on the surface is the key to the formation of the DC signal.
- This single-electrode DDC-TENG provides a way to harvest the energy of water droplets and directly use them in devices, which provides a new idea for wearable flexible electronic devices.

THE OUTPUT PERFORMANCE OF THE DDC-TENG (TRANSFERRED CHARGE)

