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Droplet Based Electricity Generation

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***Abstract*:** *Extensive efforts have been made to harvest energy f from water in the form of raindrops, river and ocean wave, tidal and others. However, achieving a high-density of electrical power generation is challenging. Traditional hydraulic power generation mainly uses electromagnetic generators that are heavy, bulky, and become inefficient with water supply. Alternative, the water droplet or solid-based electric nano-generator, has so far generated peak power densities for less than one watt per square meter, owing to the limit at ions imposed by interfacial effects as seen in characterization of the charge generation and transfer that occur at solid-liquid or liquid-solid interfaces. Here we develop a device to harvest energy from impinging water droplet s by using an architecture that compromises a polytetrafluoroethylene film on an indium oxide substrate plus an aluminium electrode. We show that spreading of an impinged water droplet on the device bridges, the originally disconnect ed component s into a closed-loop electrical system, transforming the conventional interfacial effect into bulk effect, and so enhancing device that is limited by interfacial effects.*

***Keywords*:** *Triboelectric nanogenerator, Polytetra-fluoroethylene film, impinging, indium oxide*

I. INTRODUCTION

Electricity Generation Using Just a Few Drops of Water With a working principle like that of a transistor/FET, water droplets on coming in contact with an electrically charged surface able to produce electricity enough to light up 100 small LEDs.

We all know that water is a good conductor of electricity. Energy generated by hydroelectric dams have been powering millions of homes. But due to decreasing water levels, electricity generation has consequently suffered. Various steps are being taken to promote water harvesting techniques to restore the water levels so that electricity production does not get hampered in the future. Adding to this effort, a team of scientists from the City University of Hong Kong (City U) has recently developed a new method of generating electricity – just from a few drops of water. The method, named droplet-based electricity generator (DEG), is based on the Triboelectric effect to create an electric charge. The triboelectric effect is a process in which certain material (water, in this case) becomes electrically charged after coming into contact with another material (due to transfer in electrons). Like FET.

The entire DEG is similar in construction to a field-effect transistor (FET). An Indium tin oxide (ITO) glass electrode is coated with a thin film of Polytetrafluoroethylene (PTFE). On top of PTFE, a layer of aluminium electrodes is added. When a falling water the PTFE/I TO surface, it acts as a connection between the aluminium electrode and the PTFE/I TO electrode, thus creating a closed-looped electric circuit and allowing a flow of current.

II. METHODOLOGY

2.1 Principle and Working of the System

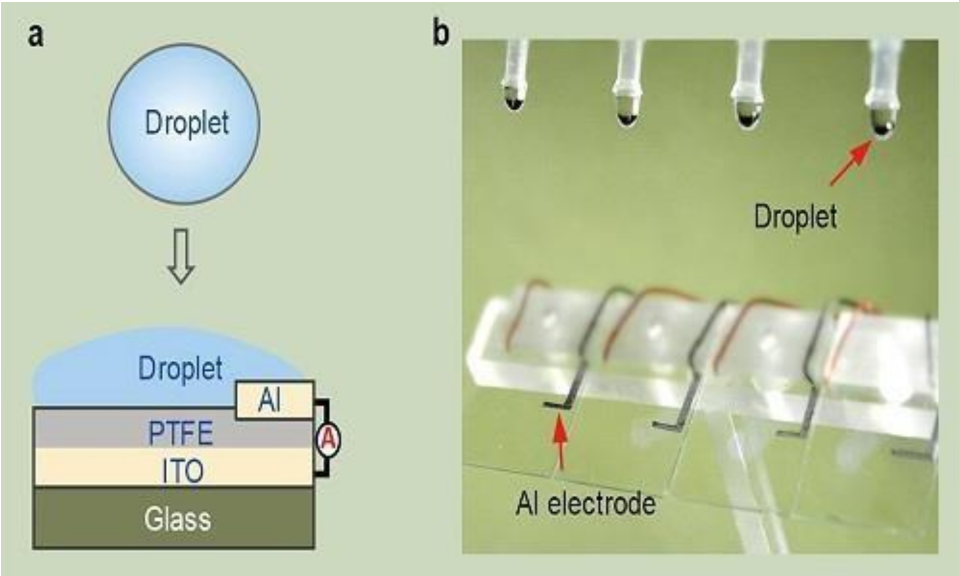

Figure 1: block diagram

Generating electricity from raindrops efficiently has gone one step further. A research team has recently developed a droplet-based electricity generator (DEG), featured with a field-effect transistor (FET)- like structure that allows for high energy- conversion efficiency and instantaneous power density increased by thousands of times compared to its counterparts without FET-like structure. This would help to advance scient if is research on water energy generation and tackle the energy crisis.

The DEG is similar in construction to a field-effect transistor (FET). An Indium tin oxide (ITO) glass electrode is coated with a thin film of Polytetrafluoroethylene (PTFE). On top of PTFE, a layer of aluminum electrodes is added. When a falling water droplet hit s and spreads on the PTFE/I TO surface, it acts as a connection between the aluminum electrode and the PTFE/I TO electrode, thus creating a closed-looped electric circuit and allowing a flow of current.

This design demonstrates that a high instantaneous power density of up to 50.1 W/m² – a thousand times higher than similar devices without FET like design can be obtained. The electricity generation of an individual imping-ing droplet on the as-fabricated device in which the PTFE surface had been stored with sufficient and stable charges as a result of contact electrification between liquid and solid after continuous droplet impinging up to around 1.6×10^4times. As shown in Fig.2.1 commercial light-emitting diodes (LEDs) could be powered to instantaneously light up when four droplets of 100.0µl each, released from a height of 15.0cm, contact the device. Focusing on an individual DEG indicates that the open-circuit output voltage and short-circuit current were about 143.5V and 270.0µA. The instantaneous peak power density is 50.1Wm^−2 under a load resistance of 332.0kΩ which is three orders of magnitude higher than that of the control device without an aluminum electrode. As calculate the average energy-conversion efficiency of our DEG—defined as the harvested electrical energy relative to the input energy of an impinging droplet.

Principle of Polytetrafluoroethylene (PTFE)

Polytetrafluoroethylene (PTFE) is a synthetic fluoropolymer of tetrafluoroethylene that has numbers of applications. The commonly known brand name of PTFE- based formulas is Teflon by Chemours, a spin-off from DuPont, which originally discovered the compound in 1938. Her popular brand name of PTFE is Syncolon by Synco Chemical Corporation. PTFE is a fluorocarbon solid, as it is a high molecular weight compound consist of in wholly of carbon and fluorine. PTFE is hydrophobic: neither water nor water-containing substances wet PTFE, as fluorocarbons demonstrate mitigated London dispersion forces due to the high electronegativity of fluorine. PTFE has one of the lowest coefficients of friction of any solid.

Indium in oxide (ITO)

An Indium tin oxide (ITO) glass electrode is coated with a thin film of Polytetrafluoroethylene (PTFE). On top of PTFE, a layer of aluminium electrodes is added. When a falling water droplet hits and spreads on the PTFE/I TO surface, it acts as a connection between the aluminium electrode and the PTFE/I TO electrode, thus creating a closed-looped electric circuit and allowing a flow of current.

Aluminium electrodes

A layer of aluminium electrodes is added. When a falling water droplet spreads on the PTFE surface, it bridges the originally disconnected components (the PTFE/ITO and aluminium electrode) into a closed-loop, electrical system.

2.2. Mathematical formula for designing: -

1. VOLTAGE OF LED:- $\frac{\text{Total getting voltage}}{\text{Total no. LED lights}}$

Table 1: - (PTFE)SPECI FI CATI ON / PROPERTY

(PTFE)SPECI FI CATI ON / PROPERTY	VALUE
1. Density	2200 kg/m3
2. Glass temperature	114.85 °C (238.73 °F; 388.00
3. K) [20] Melting point	326.85 °C (620.33 °F.
4. 600.00 K) Thermal expansion	112–125×10−6 K−1[21]
5. Thermal diffusivity	0.124 mm2/s [22]
6. Young's modulus	0.5 GPa 23
7. Yield strength	MPa 1018 Ω·cm[23]
8. Bulk resistivity	0.05–0.10
9. Coefficient of friction	ε = 2.1, tan(δ) < 5×10−4 ε = 2.1,
10. Dielectric constant	tan(δ) < 2×10−4

III. FIGURES AND TABLES

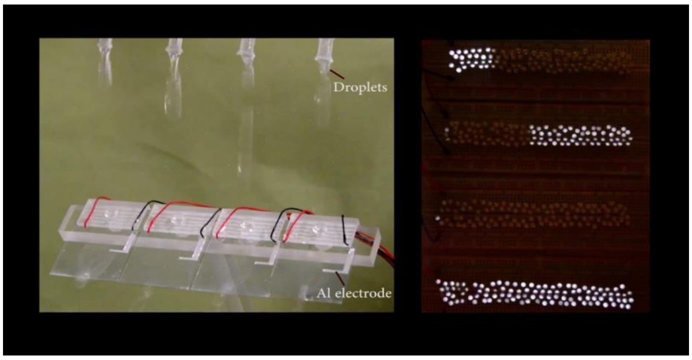

Figure 2: - Dropping drops of water On PTF & ITO Plate

Table 2: - Properties of the (ITO)

1.	Specified I TO Sheet resistivity – (~10 ohms/sq), (~20 ohms/sq) & (~100ohms/s)
2.	Typical (ITO) Sheet resistivity – (8- 11 ohms/sq), (18- 20 ohms/sq) & (90- 100)
3.	Transmittance at 550nm– ≥ 87%
4.	I TO film Thickness – (1800- 2000 Å), (1400- 1500 Å) & (500- 600 Å)
5.	Electrically conductive and optically transparent coat ing
6.	High physical density of coating
7.	Low specific electrical resistance
8.	High environment al and temperature stability
9.	Excellent electrical conductivity and optical transparency
10.	Coating uniformity
11.	Capability to shield Electromagnetic Fields
12.	Can be deposited into thin film
13.	Low electrical resistance
14.	Thermally and chemically stable

IV. CONCLUSION

However, it is hoped that will serve as a great beginning and would act as a method to harvest water-energy. Hence, we performed the generation of the electricity by the droplets of water by using PTFE/ITO.

V. REFERENCE

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