

Review of Nanogenerator in used in Electrical Field

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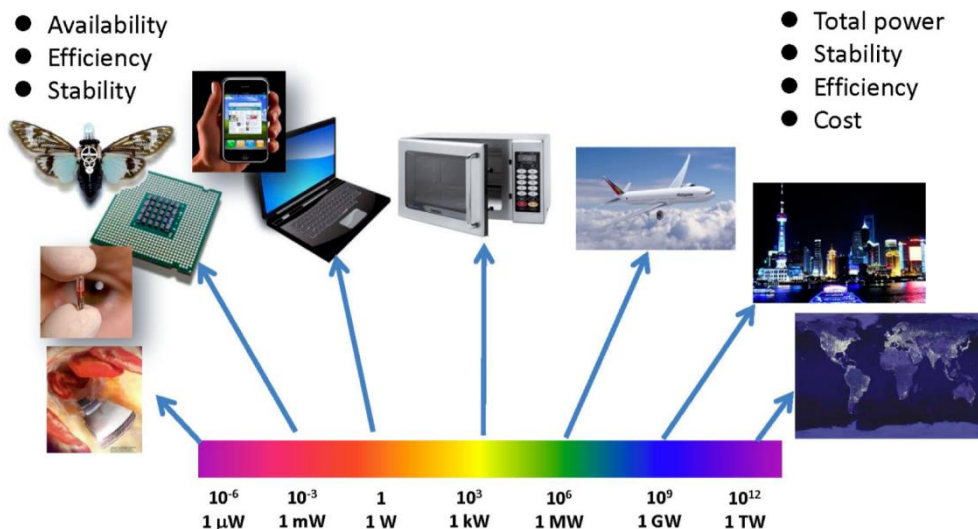
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Abstract: This paper is based on nanogenerator which is new trend of power sources used in Electrical Field, There is a many of power generation methods were invented and successfully implemented but the methods based of conventional resources and chemical resources, It has a good capacity to provide more power to load side but it affect environment and health issues to human, so now days researches are going to another approach of power sources, A nano generator is a device which generate a small amount power by using suitable material for small application like mobile charger, battery charger etc. Also nano-generators are used in electrical field for generating electrical power as well as quantity measuring devices like wind energy speed monitoring, ocean energy harvesting devices etc also triboelectric used for constant voltage generating devices. In this we provide a review of nano generation techniques and some application which are based on electrical field

Keywords: Introduction, Working Principle, Types of Nano Generator, Application, Conclusion

I. INTRODUCTION

Many decades researchers are work to make a device small in Meter to Nano-meter, like computer is shifted from Room to Pocket, an electronic world is propagated like an air, and make a small device, by this effort a new branch is emerging called “Nano-Technology”. In this technology we can make devices as small as we can imaging by using “nano-materials”. Also, different branches like medical, engineering, factory automation are used devices based on Nano technology [1]. So, we can say that “Nano-Technology” have great potential to minimize devices in different branches [2]. But this technology cannot compete with energy demand, because all instruments work with electrical energy resources and it will generated by different conventional & Non-conventional energy methods, Although this all technologies cannot reach a requirement of high-efficient & suitable capability, also it affect our environment, So it is necessary we make some new energy harvest to solving the power demand for future, That’s why “Nano-Generator” is become our future energy harvest device which easily convert mechanical energy into electrical energy. This is a small energy resources and it is flexible, small size wearable etc. Although growing of electronics demand can be fulfilled by these kinds of energy resources [3]. These sources of energy have a simple principle and by using “Nano-Material” it can give very good amount of energy by small change in physical quantity. When it applied in electrical field its gives good responses for measuring quantity like speed and also better for harvesting Non-Conventional Energy.



II. WORKING PRINCIPLE

Nano-Generator means a small-scale energy harvesting devices which generate small amount of power. A power density can be reach up-to 500W/m^2 . For Larger scale power generation, we use electromagnetic method but for small amount of power generation we use Nano-Generator. A Nano-generator is work on two effects [4].

1. Piezo Electric
2. Tribo-Electric
3. Pyro Electric

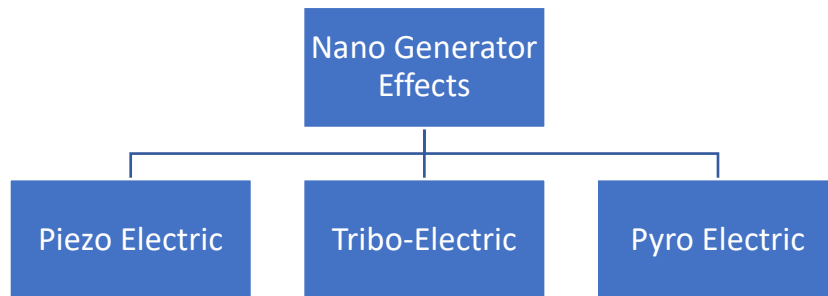


Fig 2. Effects of Nano-Generator

III. TYPES OF NANO GENERATOR

Types of Nano-Generators are based on its effect, A types are as follow:

1. Piezo-Electric Nano-Generator
2. Tribo-Electric Nano-Generator
3. Pyro-Electric Nano-Generator

1. Piezo-Electric Nano-Generator:

This kind of Nano-Generator has thin layer of Polymethylmethacrylate (PMMA) between the nano wires (NW's) and metal electrode that contributes to the superior performance of newly design nanogenerator.

This also designed by ZnO with Shockley contact which create potential barrier for charge accumulate. An insulated layer of PMMA which provides infinitely high potential barrier preventing electrons from transporting through ZnO/metal interface, Also PMMA infiltrates into gap between nanowires. When compressive force applied the stress can be transmitted through PMMA layer to all nanowires even through they vary in length, so consequences efficiency of the Nano-Generator greatly enhanced.

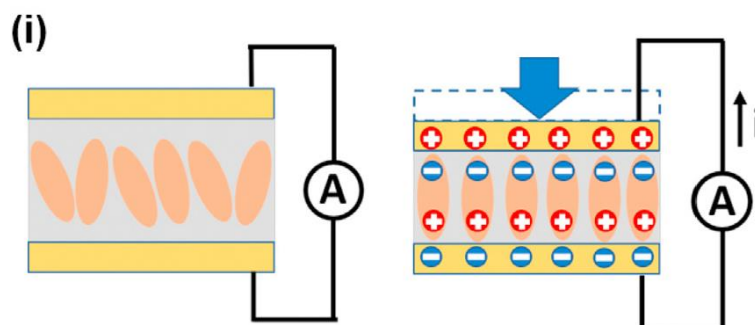


Fig 3 Piezo Electric

2. Tribo-Electric Nano-Generator:

It is a multi-layer structure. A two polymer layers are separated by a spacer forming a cavity in between two metal electrodes are deposited on the back of polymers is given two polymers deform and contact with each other, A surface charger transfer then takes place at the contact area due to the tribo-electric effect.

In triboelectric series electrons are injected from PMMA into Kapton, resulting in net negative charges at the Kapton surface and net positive charges at the PMMA surface, when we remove force the two polymers separated due to the elastic properties of the polymer materials. As long as a gap forms between them, an electric potential difference is established across the two electrodes are drive to flow through the external circuit in order to screen such a potential difference. Also, two polymers are brought close to each other by an external force electrode flow back in reverse. An open circuit voltage is 10V and short circuit current 6μA at 2cm2 size and maximum output power on the load 8mW. In triboelectric generator, we can get electrical voltage by following action [4]

1. Vertical contact separation mode
2. Contact Sliding mode
3. Single Electrode mode
4. Freestanding mode

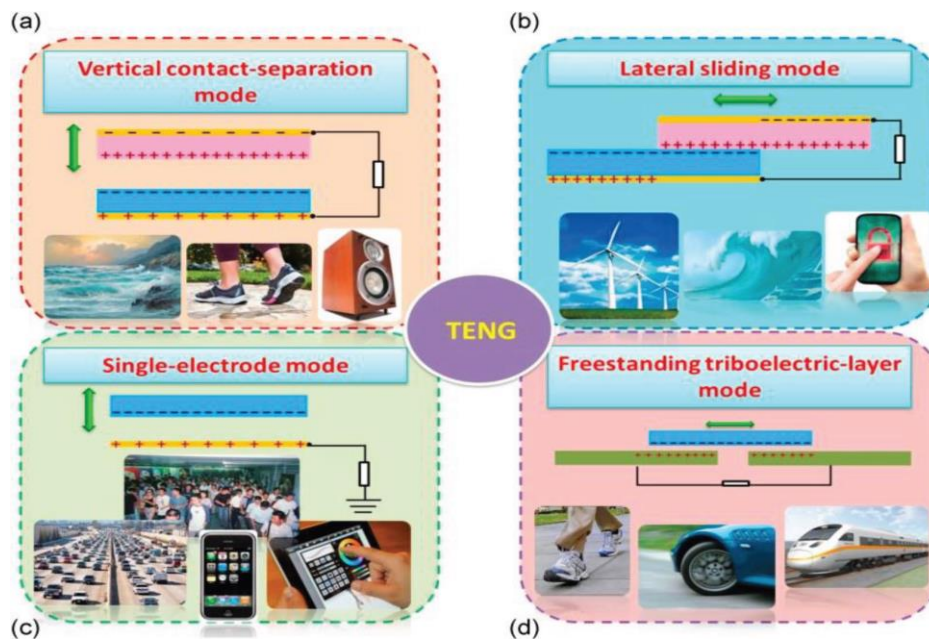


Fig 4. Different action for Triboelectric Nano Generator

3. Pyroelectric Nano-Generator:

Pyroelectric devices mainly consist 3-layers, an Ag film as the top electrode, a nanowires composite film & an indium tin oxide (ITO) film as the bottom electrode where both the Ag and ITO film used as electrode, A material used KNbO3 and its diameter 150nm, an output is 2mV and current 20pA of the devices under the cyclic change of the temperature from 295 to 298K, The spontaneous electric dipole in KNbO3 nanowires original from Nb5+ ion movement in NbO6 octahedra, where there are six possible orientations along the <001> directions.

When it is cooled instead of heated, the spontaneous polarization will be enhanced in the electric dipoles oscillates within a small degree of spread angle due to the lower thermal activity.

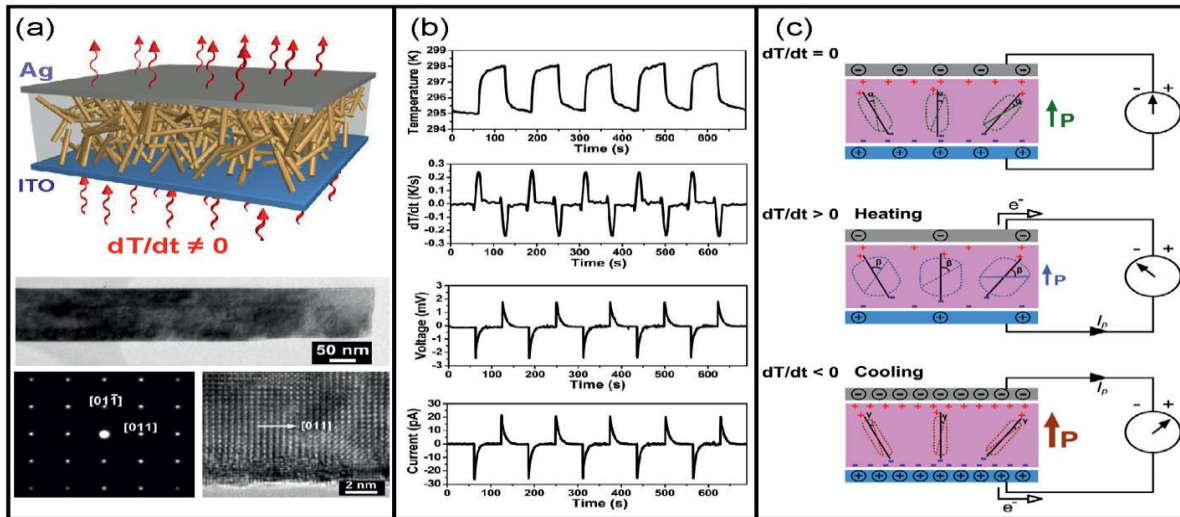


Fig 5 Pyroelectric primary and secondary Effect

IV. APPLICATION

1. Ocean Wave Energy Harvesting [5]

Ocean wave energy have most potential energy stored and having good energy density, If utilize this energy by applying “Nano-Generator” principle we can make new energy generator generating devices in electrical field. In this application a proposed “Boat Swinging” type tribo-electric nanogenerator concept for low frequency wave energy collector. In this application nylon roller triboelectric nano generator electrodes which are make up the swinging boat type triboelectric nano generator. An abbreviation “ST-TENG”.

In this Proposed technology a “Vertical contact” separation mode and “Independent Layer “mode used to design swinging ship type triboelectric nano-generator shown in fig. 6

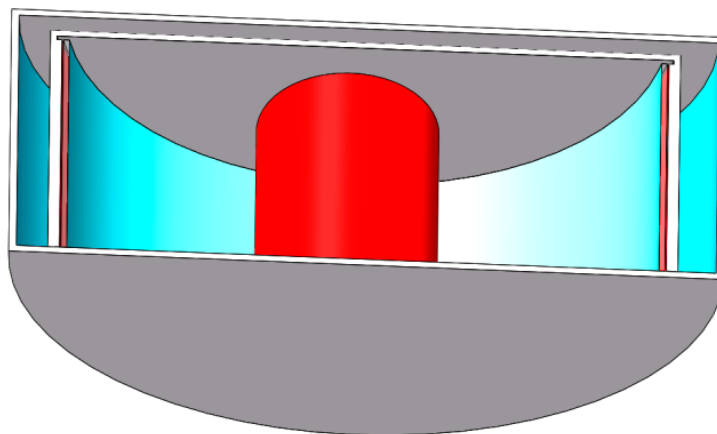


Fig 6 Shape of ST-TENG

There are three parts

1. Nylon roller
2. Boat type inner device
3. An external boat shaped device

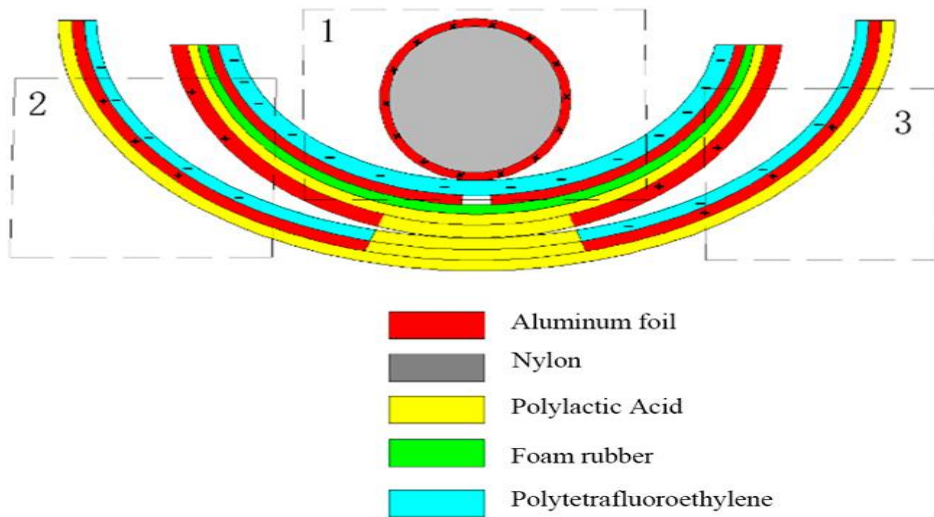


Fig 7. Structure of ST-TENG

A freestanding layer structure which includes nylon roller with electrodes connected to surface, polytetrafluoroethylene, aluminum electrode for an adhesive and an integrated boat shaped devices constructed of polyactic acid material. To extract a generating current an extra load connecting the two electrodes. When Ocean waves are coming a response to external excitation an rolling back and forth an inner response surface of the built in boat shaped devices, the aluminum coating on the drum's surface become positive charged, When numerous cycle of friction a PTFE films become negative charged and charged persisted on its surface for a long time since PTFE is electret.

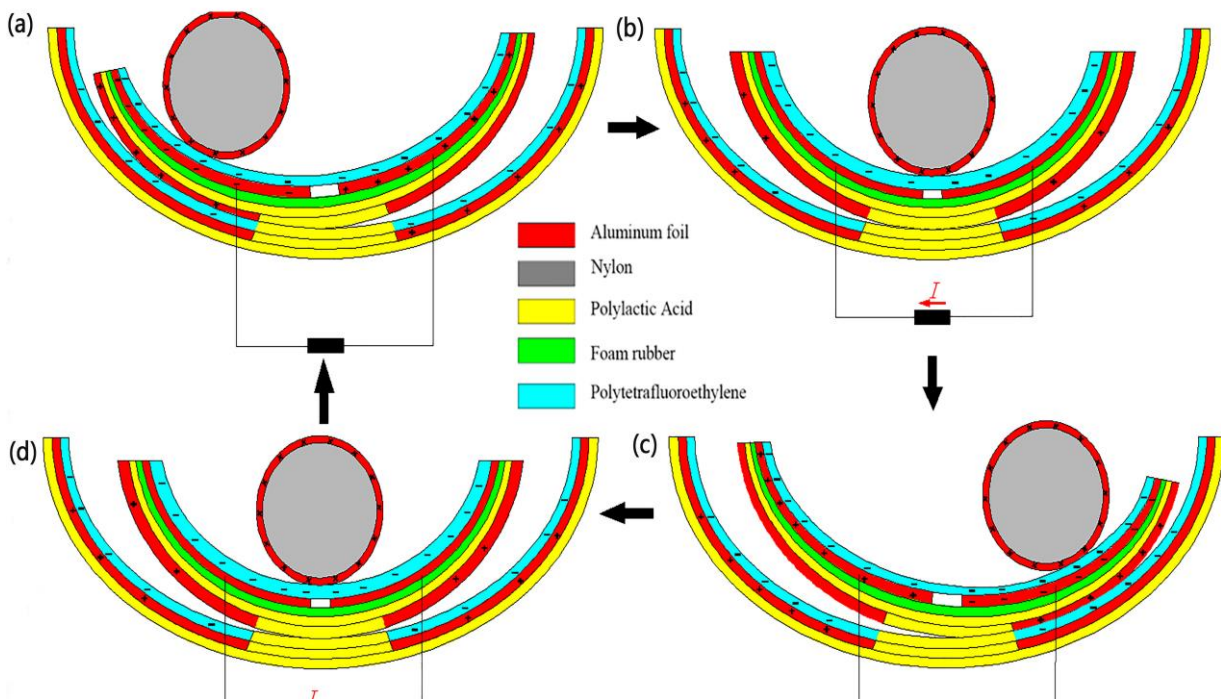


Fig 8 Working of ST-TENG

when the drum rolled to the left above the electrodes, a negative charge was generated on the left electrode, and a positive charge was induced by the aluminum coating on the surface of the drum. When the drum was pounded from left to right (Figure 8b), the induced current flowed from right to left because the electrons in the external circuit flowed from left to right to compensate for the potential difference between the left and right electrodes. All negative charges were on the

right electrode when the whole drum rolled over it (Figure 8c). When the drum rolled back to the left (Figure 8d), electron backflow occurred, causing a reverse current to be induced in the external circuit. Therefore, the drum could be rolled between the left and right electrodes, which inducing an alternating current (AC) in external circuit.

2. Constant Voltage Triboelectric Nano-Generator [6]

For constant voltage TENG (CV-TENG) which is based on a phase-shift design is presented to enhance the energy output by converting a conventional pulse-voltage output into a constant-voltage one and decreasing the crest factor approximately 1.03. The average power is unexpectedly increased 1.9-fold compared with that of a pulse voltage TENG (PV-TENG) without a phase-shift design. The energy enhancement is even more than 3-fold under a capacitance load in response to a low-frequency input. Furthermore, the dynamic process of charge transfer under a capacitance load is revealed, which gives a theoretical guide to improving the energy output efficiency of a TENG toward 100%. This work provides a paradigm shift when it comes to achieving high-efficiency CV-TENGs (Constant Voltage), and it is of great importance for the acceptance of TENGs as a major form of energy technology.

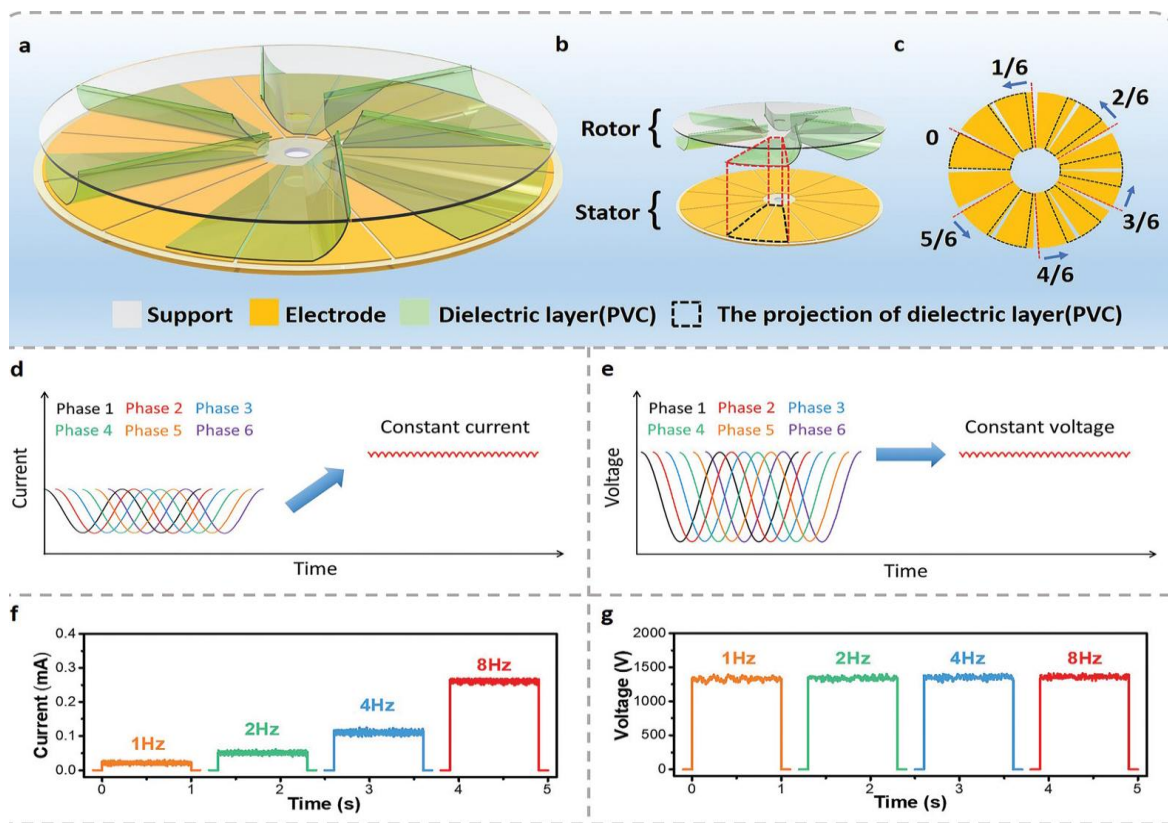


Fig 9 Structure of CV TENG & Its Result

The structure of the CV-TENG with a rational phase-shift design is presented in Fig. 1a–c, and it consists of two main parts:

1. Rotor
2. Stator.

The rotor is a disc with six radials but irregularly arrayed trenches, employing the strategy of a phase shift design where dielectric layers are inserted in the trenches Fig. 9a. The stator is another disc with twelve radial and regularly arrayed electrode sectors. The rotor and stator are stacked in the vertical direction in coaxial alignment Fig. 9b where the gap distance is about 1.0 cm. The positions of the dielectric layer are exhibited in Fig. 9c Different from the use of the same angles between trenches with fixed dielectric layers in a conventional PV-TENG, the phase-shift design selects the most qualified angle based on a strategy of reducing the crest factor effectively. The optimization of the phase-shift design is determined based on the number of individual TENG units, and the six single TENG units in our designed TENG correspond to a staggered 1/6 phase, which is the most effective way to reduce the crest factor of the current output.

Therefore, the phase-shift design converts a single phase to six different phases with an equal phase shift on the rotor compared with a conventional PV-TENG.

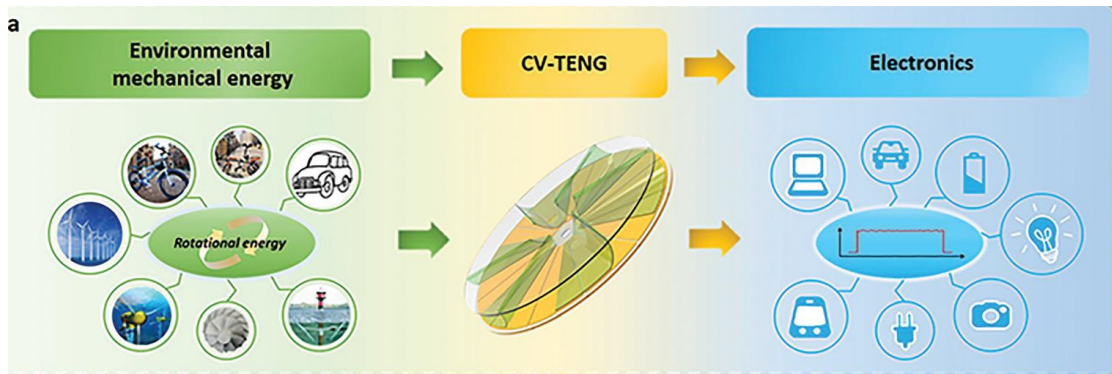


Fig 10 Energy Flow diagram of CV TENG

3. Triboelectric Nano Generator for wind energy and speed monitoring [7]

In this Application a durable triboelectric nanogenerator inspired by a ball mill was designed by using metal balls in hollow drums as carriers for charge generation and transfer. Composite nanofibers were deposited onto the balls, increasing the triboelectrification with the interdigital electrodes in the inner surface of the drum for higher output and electrostatic repulsion to each other for lower wear. Such a rolling design cannot only increase mechanical durability and maintenance convenience, where the filler can be easily replaced and recycled but also collect wind power with the decreased wearing of materials and sound efficiency in comparison with the typical rotation TENG. In addition, the short circuit current shows a strong linear relationship with the rotation speed in a wide range, which can be used to detect wind speed, thus showing potential applications in distributed energy conversion and self-powered environmental monitoring systems.

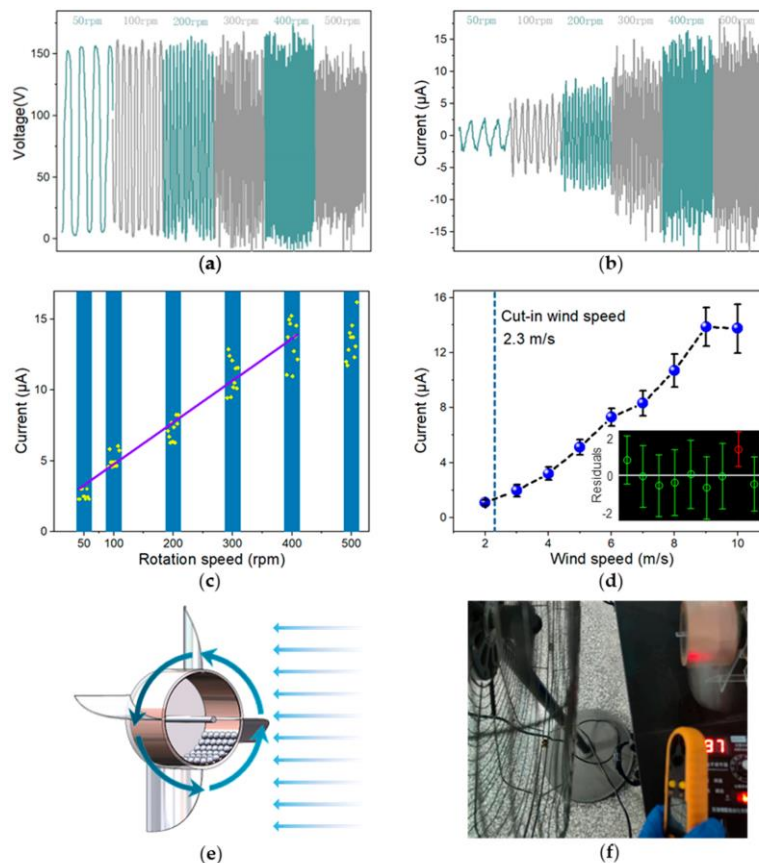


Fig 11 Result and structure of Application

V. CONCLUSION

After studied a Nano Generator, Triboelectric type Nano Generator mostly used in many kinds of application for generating electric power as we as measuring devices, In future we can make better devices and sources using this methods and fulfill large amount of power requirement and good measuring devices, Also Nano generator work as a sensors which are used in measuring devices for measure different quantities. However Green Energy concept is propagated everywhere and this technology will become vital tools for future devices and power sources.

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