

Wherever there is a dynamic touch, there is electromagnetic field

— a discovery for power generation

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Abstract

Can you imagine that when you slide gently on an acrylic board with hand, hundreds of LEDs under the board will be lit up! Here we have found that all matters under forces can generate electromagnetic energy, even under a tiny force like wind blow. When a polytetrafluoroethylene sheet is tapped by a hand, the generated electromagnetic field can drive three light boards directly, producing a high output voltage of 3678 V. Amazingly, there was an electrical signal when the wind blew onto a matter such as flower, water, wood, polymethyl methacrylate, paper, stone, ceramic etc. There is an optimal matching state between the substance and the force to reach the maximum electrical output. Finding the best matter and the best collision state of it has significant impacted on the development of new energy and nuclear energy. According to these discoveries, the simplest and the most efficient power generation devices and self-powered systems were designed for collecting electromagnetic energy. The power generation bucket can be easily used to collect energy in the ocean. The power generation stone, and the power generation road can supply for streetlamps, traffic lights, electronic advertising boards, and distributed sensors, etc. These discoveries reported here are expected to have profound impacts on a broad range of applications.

Key words

New energy; electromagnetic field; electromagnetic energy; energy collectors; wireless transmission

1. Introduction

Collision is a complex physical process, which is often accompanied by a loss of mechanical energy. In the traditional theory of collision, the loss of mechanical energy of the collision system will be converted into the internal energy of the system or other forms of energy such as heat during the collision process.[1] It mainly focuses on the change of mechanical energy and change of momentum. However, the production of other type of energy during the collision is often neglected. In nature, there is always energy conversion in the process of contact and collision of any substances if they are charged. In other words, the collision will always release electromagnetic energy. A common lightning phenomenon is the result of collision between two charged clouds, which simultaneously releases sound, light, and electricity.[2] Moreover, the collision of macro objects can definitely release energy, and the collision of huge celestial bodies will release gigantic amount of energy in the form of electromagnetic waves and gravitational wave.[3] In 2016, scientists successfully detected the gravitational waves that were generated by the collision of two black holes in the distant universe. Besides, super-high-speed collisions will also generate electromagnetic fields, which will generate electromagnetic energy. The collision of microscopic particles can also generate huge energy. The explosion of an atomic bomb can release huge energy through numerous collisions between atomic nuclei and release them in the form of heat, nuclear radiation and possibly electromagnetic radiation.[4]

There are many forms of energy: mechanical energy, electrical energy, magnetic energy, radiant energy, nuclear energy, thermal energy, light energy and chemical energy etc. Each form of energy can be converted into other forms, but the total energy is conserved. In 1831, Faraday discovered the electromagnetic induction

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phenomenon that is also an energy conversion process. It can convert the potential energy of gravity and kinetic energy into electrical energy. According to the principle of electromagnetic induction, electromagnetic generators have been invented and developed, which make a huge contribution to the use of electricity.[5] Electromagnetic induction associates electromotive force with the magnetic flux through a circuit, while electrostatic induction is the phenomenon of the redistribution of charges in a conductor under an external electric field. In 2012, Zhong Lin Wang invented triboelectric nanogenerator by using contact electrification and electrostatic induction to convert mechanical energy into electric power.[6] Besides, the wireless power transmission has been achieved by the Maxwell's displacement current.[7, 8]. The current methods of energy conversion have their own advantages and disadvantages. The entire world is made of substances, and energy is a form of existence of substance. The best way to solve the energy crisis is to find how to use the simplest interaction to obtain electric power that we need most (electromagnetic energy).

In this paper, we mainly investigated the energy generated by the interactions between substances (we called collisional power generation). Three light boards can be driven by the electromagnetic energy released by collisions between Polytetrafluoroethylene (PTFE) sheet and hand, which produces an output voltage of 3678 V and current of 225 μ A. Amazingly, there was an electrical signal when the wind blew onto a matter such as flower, water, wood, polymethyl methacrylate (PMMA), paper, stone, ceramic etc. Besides, the same force had different electrical signals when it acts on PMMA and wood of different thicknesses. We found that where there is a touch, there is electromagnetic field. All of substances under force can generate electromagnetic energy. There is an optimal matching state between the substance and the force to reach the maximum electrical output. Some simple and efficient power generation devices based on the new discoveries have been designed, including a power generation bucket with water and sand, a power generation floor with sand, a power generation stone, and a power generation road etc. Therefore, it

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has a profound effect on the entire scientific research fields, including physics, astronomy, and new energy.

2. Results and discussions

Figure 1a and 1b show the experimental setup for investigating the releasing of electromagnetic energy by collision. A light board was placed on a fixed PTFE sheet, and two light boards (light board 2 and light board 3) were away from the PTFE sheet and connected with the light board 1. And the PTFE sheet can be tapped by hand from its bottom. As shown in Figure 1c, three light boards can be all driven by tapping the PTFE sheet. Figure 1d shows the bright light board 1, which collected the electromagnetic energy released from the collision. Figure 1e shows the bright light board 2 and light board 3, which directly reflects the strong electromagnetic energy. In order to study quantitatively the magnitude of electromagnetic energy, the electrical signals of the device were detected. Figure 1f shows the voltage of the device can reach up to 3678 V. And the inset shows that a small LED lamp board can be driven. Besides, Figure 1g shows the current of the device can be up to 225 μA . A preliminary conclusion could be achieved that there is electromagnetic energy released from the collision when two substances collide with each other under force.

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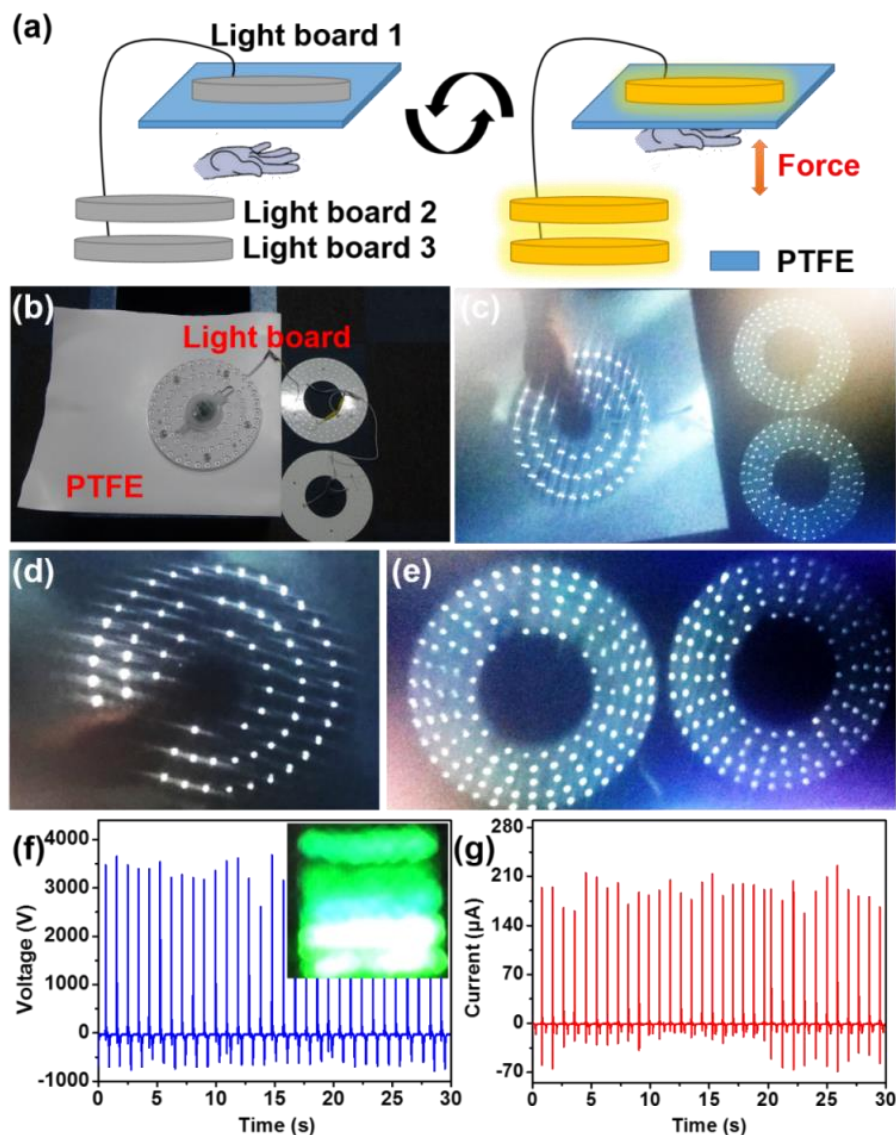


Figure 1. (a) Experimental setup and working principle of the device. (b) Photo of the experimental setup. (c) Three light boards were all driven by tapping a PTFE sheet. (d) Photo of the bright light board 1. (e) Photo of the bright light board 2 and 3. (f) The voltage of the device tapped by hand, and the inset shows the small LED lamp board driven by tapping the PTFE sheet. (g) The current of the device tapped by hand.

Einstein said that everything has gravitation. In fact, everything has energy because there is energy inside any substance. We speculate that an electromagnetic field can be generated when any substances are collided, and their energy is excited by an external force. Even a tiny force like a wind blow can generate electromagnetic

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field. The same wind (wind speed: 10 m/s) was used to act on different substances, including flower, water, wood, PMMA, paper, stone, ceramic. Figure 2a shows a schematic diagram of the experiments for investigating the electromagnetic field generated by the impact action of wind on different substances. It was found that the electromagnetic fields can be generated when the wind acts on these substances. As shown in Figure 2b and 2c, each kind of substance can release different electromagnetic energy under the impact force of wind. The flower has the largest current of 0.2 μA , while the PMMA has the largest voltage of as high as 28 V. Surprisingly, we found that the same substance under the same external force generates different electromagnetic energy. Figure 2d and 2e show the voltage and current of PMMA with different thicknesses under the pressure when the same person stepped on the PMMA. It can be seen that the voltage and current of the PMMA under the force increases regularly with the increase of film thickness within 12 mm. But the electrical signals decrease with the thickness of the PMMA when it exceeds 12 mm. As shown in Figure 2f, the change of current with the thickness of wood is similar to that of the PMMA, when the same person stepped on the wood. Therefore, it can be initially derived that any substance under the force will generate electromagnetic field. Under the same external force, different substances have different abilities of generating electromagnetic field. Even the same substance could generate different electromagnetic energy. There is an optimal collision state for releasing of electromagnetic energy, which may be related to the thickness, mass, hardness, structure and other factors of the substance. It is known that substance is made up of molecules or atoms, which contain huge internal molecular and atomic energy and even surface charge energy due to contact-electrification. Therefore, the energy will be excited when impacted by external force, and different energies will be excited under different external forces. Different materials and different objects will have an optimal collision state under the action of external forces. To find the best substance and the best collision state of the best substance have special significance for the development of new energy and nuclear energy. Next, we will carry out more in-depth

and detailed studies.

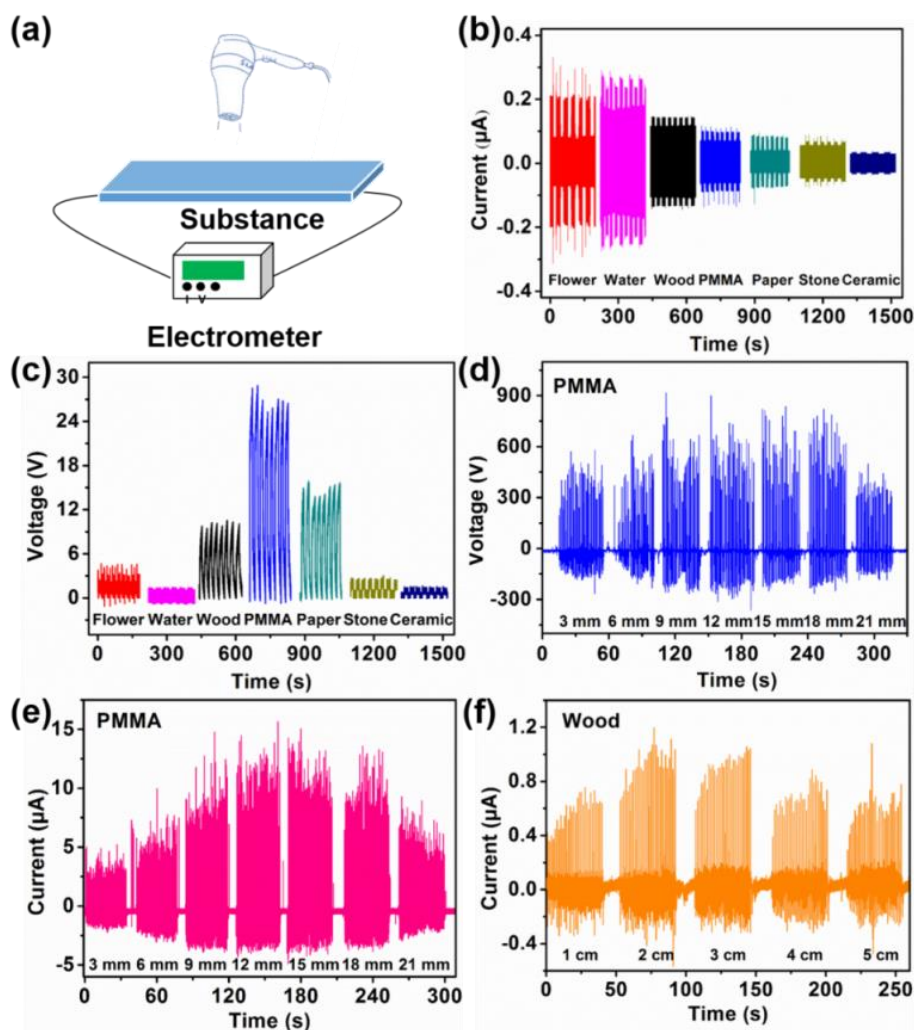


Figure 2. (a) Schematic diagram of the experimental setup. (b) The current of different substances when blown by wind. (c) The voltage different substances when blown by wind. (d) The voltage of PMMA with different thicknesses under the force. (e) The current of PMMA with different thicknesses under the force. (f) The current of wood with different thicknesses under the impact force.

71% of the earth's surface is covered by water, which has great potential as energy collector for collecting the electromagnetic fields. As shown in Figure 3a and 3b, a power generation bucket with water was designed. When the bucket is tapped by a hand, the hand does work on the wall of the bucket. The electromagnetic field is generated by the collision and is collected by the water in the bucket to drive the

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LEDs. As shown in Figure 3c, 3d and 3e, 480 LEDs in series can be driven by the power generation bucket with water, and even more amazing is that the 3 W bulbs on the Christmas tree can be also driven by tapping the bucket with hand. Besides, the electrical outputs generated by each tap were tested, which showed a current of up to 175 μA and a voltage of up to 2989 V. (Figure 3f and 3g) The maximum instantaneous power can be up to 0.523 W and the power density is 25.39 W/m^2 . The as designed power generation bucket with water provides us with new ideas for collecting abundant energy from water. Compared with the traditional hydropower and the harvesting method of blue energy proposed by Zhong Lin Wang, this new idea provides a new approach.[9] It can easily collect the ocean wave energy and integrate the electricity by wireless transmission, which offers the possibility for power generation by waves, tides, and underwater ultrasound etc.[7]

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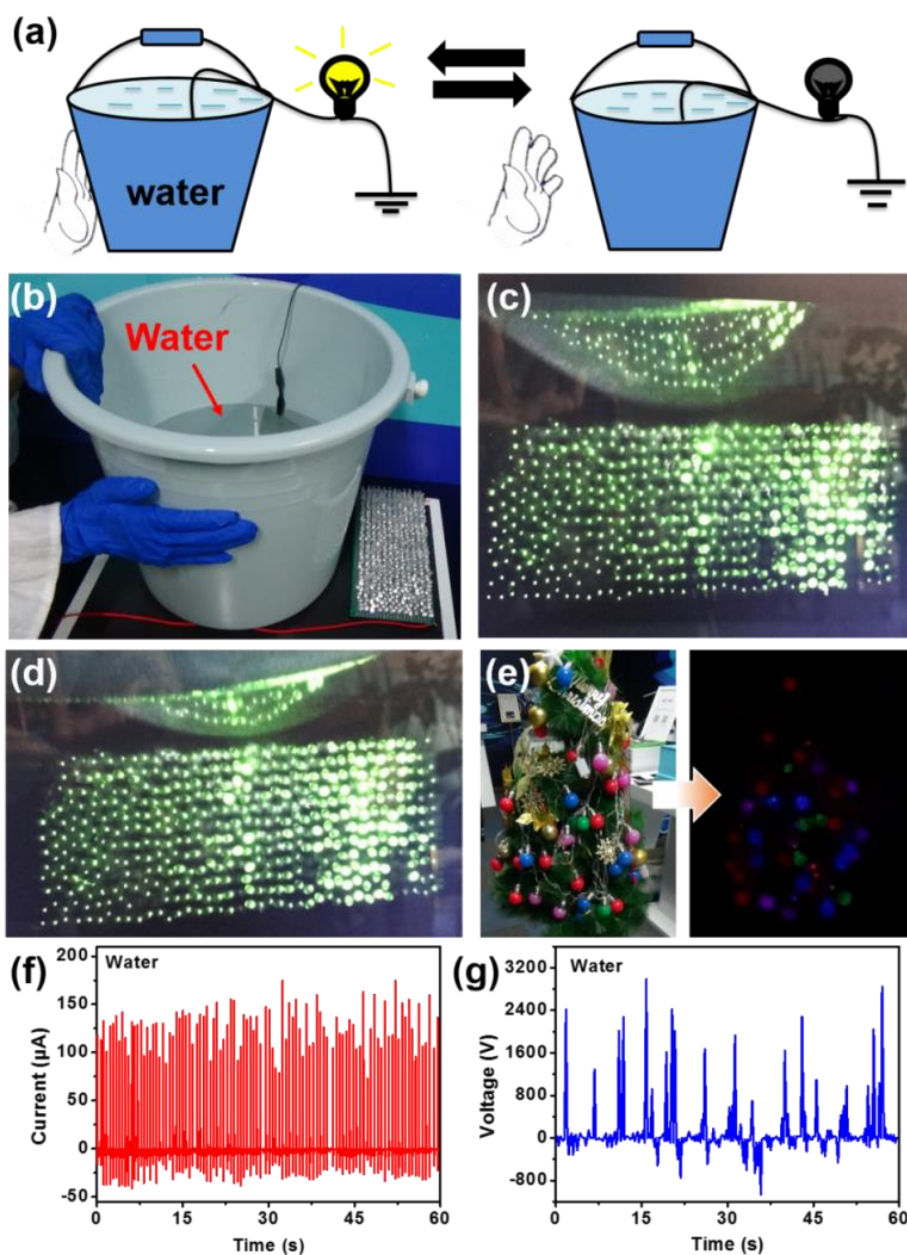


Figure 3. (a) Schematic diagram of the working principle of the power generation bucket with water. (b) Photo of the experimental setup. (c-d) 480 LEDs in series were all driven by the power generation bucket with water. (e) The 3 W bulbs on the Christmas tree were driven by the power generation bucket with water. (f-g) The electrical outputs generated by tapping the power generation bucket with water.

Sand can be found anywhere, and every building around us is built on sand. Besides, sand can be also used to collect electromagnetic field and generate electricity.

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Therefore, the power generation bucket with sand was designed, as shown in Figure 4a and 4b. The principle of the power generation bucket with sand is the same as that of the power generation bucket with water. The sand can collect electromagnetic field generated by continuously tapping the bucket. Figure 4c and 4d show 480 LEDs were driven by tapping the bucket with hands, which reflects the good ability of sand for energy collection. And the current can reach up to 214 μA and the voltage can be up to 3067 V, respectively (Figure 4e and 4f). The maximum power can be up to 0.656 W and the power density is 42.88 W/m^2 . Therefore, it has a broad application prospects of power generation in the desert.

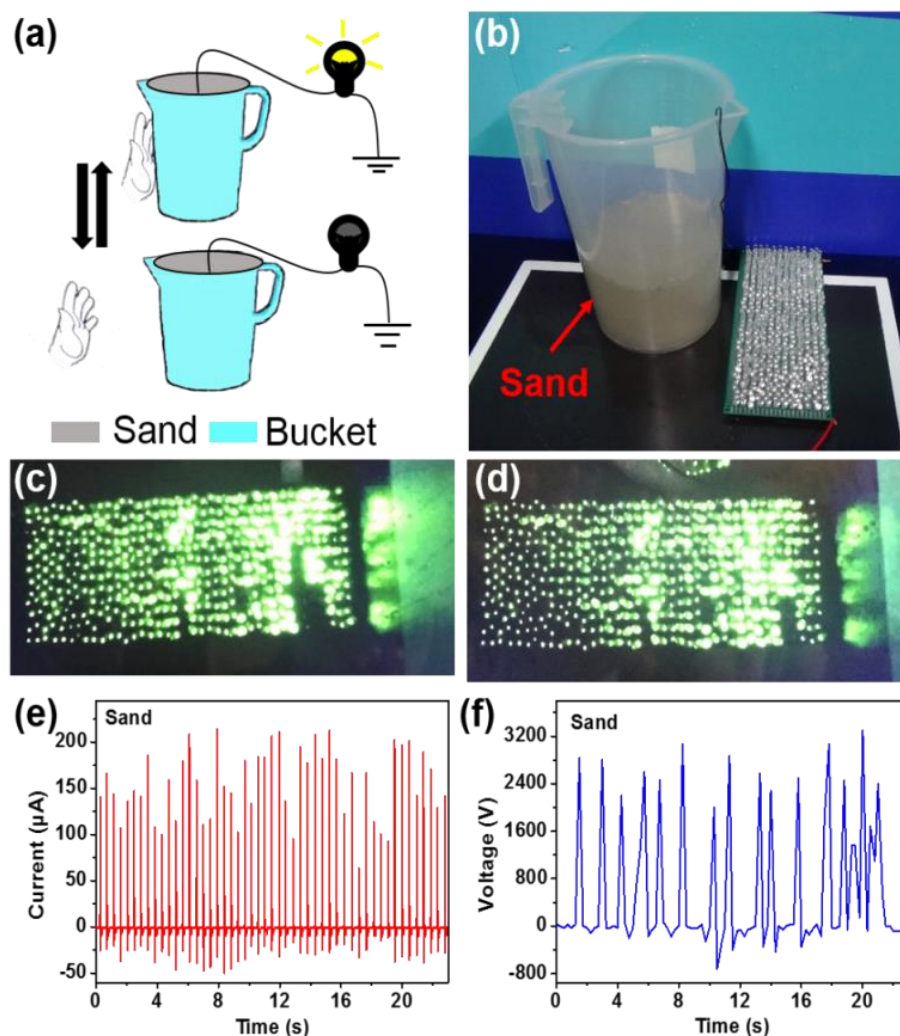


Figure 4. (a) Schematic diagram of the experimental setup for power generation bucket with sand. (b) Photo of the experimental setup. (c-d) 480 LEDs in series driven

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by the power generation bucket with sand. (e-f) The electrical outputs generated by tapping the power generation bucket with sand.

According to the principle of the power generation bucket with sand, the power generation floor with sand was designed (Figure 5a and 5b). The sand under the acrylic sheet can collect the electromagnetic field when people walk on the power generation floor. As shown in Figure 5c, 5d, 5e and 5f, the 480 LEDs in series can be all driven by the power generation floor with sand. Besides, Figure 5g and 5h show the 3 W bulbs were driven by the power generation floor with different forces. The brightness of the bulbs increased with the increasing force, which is consistent with the production of electromagnetic fields. In addition, a foot-controlled switch was also designed to control the bulb in the self-powered mode, as shown in Figure 5i. The bulb can be easy to be controlled by stepping on the foot-controlled switch. There is a lot of sand in nature, which provides a good foundation for self-powered systems based on this power generation mode.

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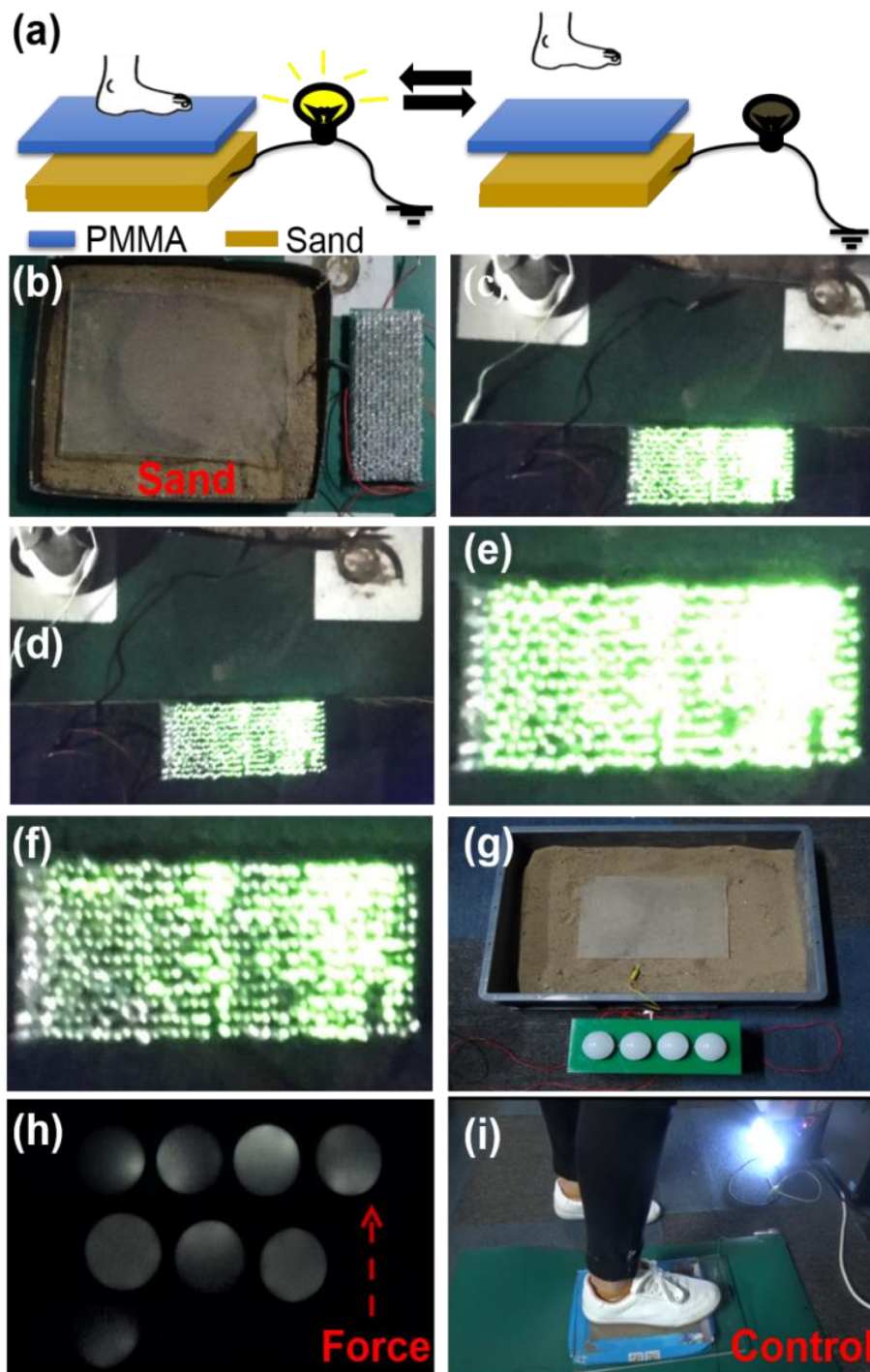


Figure 5. (a-b) Schematic diagram and photo of the experimental setup of power generation floor with sand. (c-f) 480 LEDs in series were all driven by the power generation floor with sand. (g) Photo of the experimental setup of power generation floor with sand for the 3 W bulbs. (h) Photos of the 3 W bulbs driven by power generation floor with different forces. (i) Photos of the foot-controlled switch.

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We have found that electromagnetic field can be generated by a collision of stones. As shown in Figure 6a and 6b, the power generation stone was designed to collect energy from human body motions. Small stones were laid on the carpet, and the small LED lamp board (480 LEDs in series) was connected to the carpet and the ground. Figure 6c, 6d and 6e show that the LEDs can be driven by the power generation stone, when the person walked or jumped on the small stones. It can be found the efficiency of energy collection is very high. The whole system is very simple even without an acrylic sheet, and people wearing shoes are free to move. Furthermore, Figure 6f and 6g demonstrate the power generation road, which was discovered to effectively collect the mechanical energy from human body motions. The acrylic sheets need to be placed on the road, which can be connected to the electrical appliances. As shown in Figure 6h, 6i and 6j, 480 LEDs in series were all driven by the power generation road when the person walked or jumped on the acrylic sheet. These new and simple power generation modes can supply for streetlamps, traffic lights, electronic advertising boards, and distributed sensors, etc. Based on our new findings, more detailed research focused on the power generation pavement will be presented in our following work.

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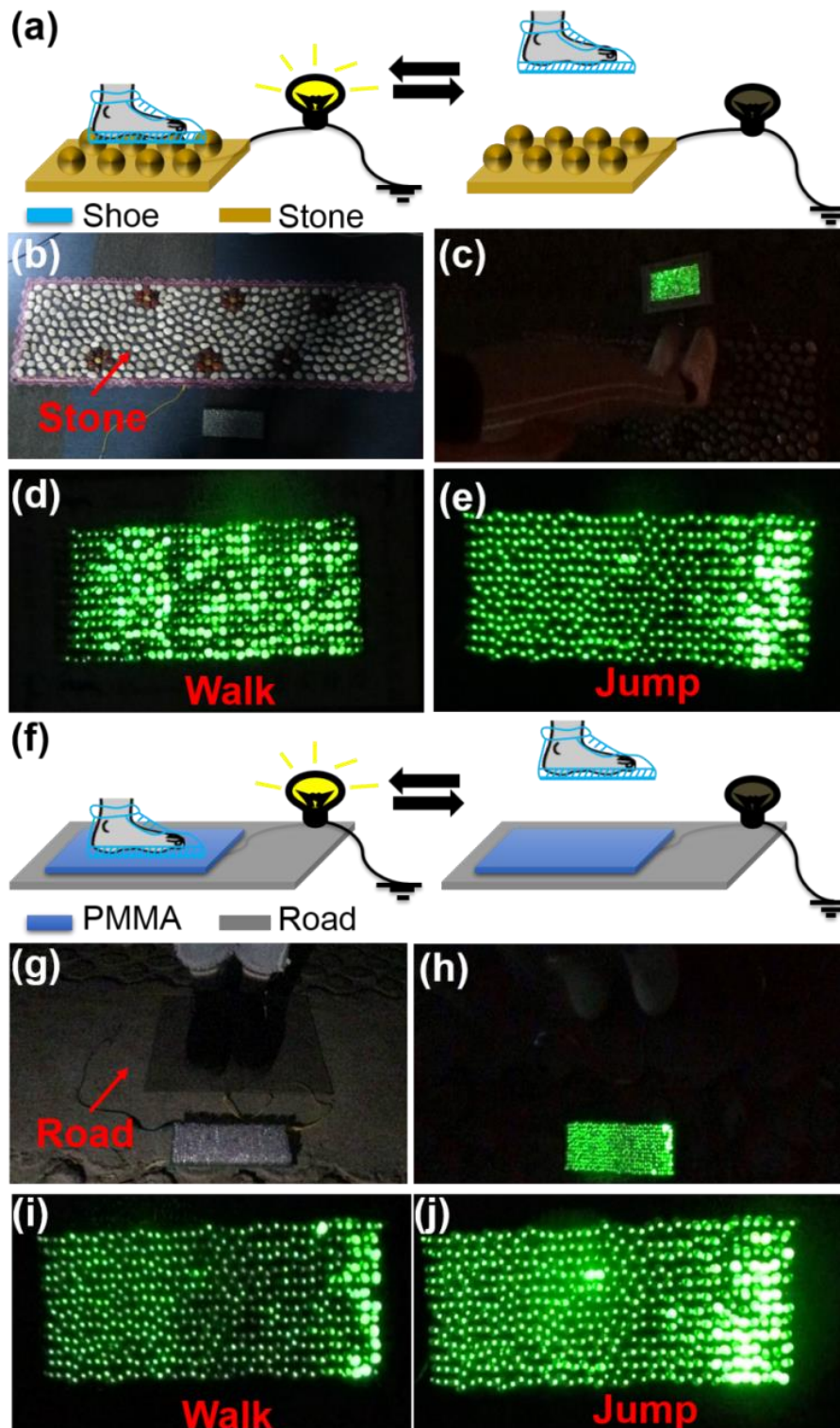


Figure 6. (a-b) Schematic diagram and photo of the experimental setup of power generation stone. (c-e) 480 LEDs in series were all driven by the power generation stone when the person walked and jumped. (f-g) Schematic diagram and photo of the experimental setup of power generation road. (h-j) 480 LEDs in series were all driven

by the power generation road when the person walked and jumped.

3. Conclusions

It is known that the Einstein's equation of mass energy is $E = mc^2$, which reflects the relationship between mass and energy. Everything has energy because there is energy inside any substance. Collisions are not only a traditionally fruitful source of exotic particle discoveries but also a simple way for power generation. Einstein's general theory of relativity predicts that a powerful gravitational wave is produced when massive celestial bodies or two black holes collide. Here, it was found that electromagnetic field would be generated when two substances were under a force such as touch, tapping, friction, collision etc. In addition, the intensity of electromagnetic field is related to the value of force and the nature of two substances. There is an optimal matching state between the substance and the force. When the PTFE sheet was tapped by a hand, the generated electromagnetic field can drive three light boards directly. Some substances were blown by wind, which demonstrates that the electromagnetic field can be generated under a very tiny force. According to these discoveries, several power generation devices and self-powered systems were designed for collecting electromagnetic energy. The power generation bucket can be easily used to collect energy in the ocean and desert. The power generation stone, and the power generation road can supply for streetlamps, traffic lights, electronic advertising boards, and distributed sensors, etc. It is suggested that the radiation of electromagnetic field during collision is likely due to the displacement current caused by the space charges created by contact-electrification during collision. Above all, these revolutionary findings provide a new approach about the utilization of new energy, as well as the new framework of scientific development. We will continue to report relevant research results about the theory of collision, and the gravitational waves, the power generation and the wireless energy transmissions etc.

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