Electra-electric Induction

-Induction current generated by cutting the electric field line

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Abstract

It is well known that cutting magnetic field lines leads to the generation of an induced current and induced electromotive force in a closed circuit coil, called as electromagnetic induction. In this paper, we found that rotating a closed circuit coil in a changing electric or electrostatic field could also generate an induced current and induced electromotive force in the coil without any external magnets..Here we call it Electra-electric induction (EEI). This is a completely new discovery, and will be of great significance both in theory and in applications. We deduced that both Maxwell's displacement current and the Electra-electric induced current we found are generated by the changing electric field. They are two forms of changing electric field. One exists in space. The other exists and flows in the conductor. Maxwell's displacement current is collected by a coil and flows in a conductor, that is induced current. In addition, one can expect that the extremely strong electrostatic field near the high-voltage wire, as well as the strong electromagnetic field generated by the radiation of nuclear reactor or nuclear waste dumping, can be collected by the rotated coil driven by the windmill which results in a continuous induced current flow generated. This work not only provides new thinking on the physical meaning of the last two terms of Maxwell's equations, but also opens up new possibilities for

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non-electromagnetic induction and provides a new idea for the generation and transmission mode of power energy. Just like the invention of electromagnetic induction by Faraday in 1831, it is a milestone progression.

Key words

Induced current; Cutting the electric field line; Electric-electric induction

1 Introduction

Faraday discovered electromagnetic induction in 1831[1]. That is, induced current and induced electromotive force will be generated in the closed circuit coil when a part of the coil cuts the magnetic field line[2, 3]. The traditional theory has holden that the electric field is the magnetic field, and the magnetic field is the electric field [4]. However, the induced current generated by a closed circuit coil cutting the electric field line has never been discovered and reported yet.

We have focused on the study of Maxwell's displacement current in those days. It was accidentally found that when one put a closed circuit coil into a changing electric field or electrostatic field and rotated it, an induced current would be generated in the coil. In other words, the coil and the electric field moving relatively will lead to the coil cutting the electric field lines continuously. And an induced current will be generated in the coi. This should be the first report in the world that in the absence of external magnets, an induced current is generated in a closed circuit coil by coil cutting electric field lines. We call it Electra-electric induction, which is essentially Maxwell's displacement current generated by the changing electric field. And Maxwell's displacement current is collected by the coil and creates an induced current in the coil. In this way, no external magnets needed, the extremely strong electrostatic field near the high-voltage wire, as well as the strong electromagnetic field generated by the radiation of nuclear reactor or nuclear waste dumping, can be collected based on these findings. therefore achieving energy recovery and effective utilization. This research has a profound impact on the field of electricity and new

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energy.

2 Experimental methods

2.1 The Electra-electric induction generated by an ionizing sphere

An ionizing sphere (Electric Voltage: 220 VAC, Total Power: 8 W) was used to produce a changing electric field. The coils (Diameter of wire: 0.5 mm, Number of turns: 100, 200, or 300) were placed near the energized ionizing sphere, and rotated to collect the energy of changing electric field.

2.2 The Electra-electric induction generated by a power outlet

A power outlet (Electric Voltage: 220 VAC) was used to produce a leaking electric field. The coil (Diameter of wire: 0.5 mm, Number of turns: 300) was placed near the power outlet, and rotated to collect the energy of the leaking electric field.

2.3 The Electra-electric induction generated by a plastic sheet with an electrostatic field

A polymethyl methacrylate (PMMA) sheet with the dimension of 20 cm*30 cm*3 mm was rubbed by a fluorinated ethylene propylene (FEP) film to generate the electrostatic field. The coil (Diameter of wire: 0.5 mm, Number of turns: 300) was placed near the PMMA sheet, and rotated to collect the energy of the electrostatic field. Besides, the coil was rotated to collect the changing electric field when the PMMA sheet was rubbed by the FEP film constantly. The PMMA sheet with an electrostatic field can also be shaken to wirelessly light up the 28-watt fluorescent tube lamp nearby.

2.4 Electrical measurement

The current and voltage were measured by an electrometer (Keithley 6514) with computer measurement software written in LabVIEW.

3 Results and discussions

Three experiments were designed to produce the relative motion between the coil and the electric field. One experiment involves rotating a closed circuit coil next to an

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ionizing sphere so that the electric field lines can be cut by the coil. The experimental device is shown in Figure 1a. When the ionizing sphere is energized, it radiates energy outward and creates a constantly changing electric field around it. As shown in Figure 1b and Figure 1c, put a circuit coil close to the ionizing sphere and do not rotate it, one can find that the induced current and induced electromotive force was generated in the coil. This is because the ionizing sphere is constantly radiating outward as it works, producing a changing electric field which is received by the coil. What more shocking was when we rotated the coil and made it cut the electric field lines, we found that an even larger induced current and induced electromotive force were generated in the coil. As we rotated the coil faster (2 r/s to 10 r/s), the induced current also increased and was several times larger than that generated when the coil was not rotated. As shown in Figure 1d, the energy collected by rotating the coil can light up a one-watt bulb. (Video S1 in the Supporting Information) And the induced current and the induced electromotive force were 10.16 mA and 58.82 V, respectively as Figures 1e and 1f showed . When we increased the number of coil turns, the induced current in the coil would also increase. The change of the induced current and induced electromotive force is shown in Figure 1g and Figure 1h. The induced electromotive force did not increase as fast as the induced current. Without any external magnets, the induced current can be easily generated by a closed circuit coil cutting the electric field line.

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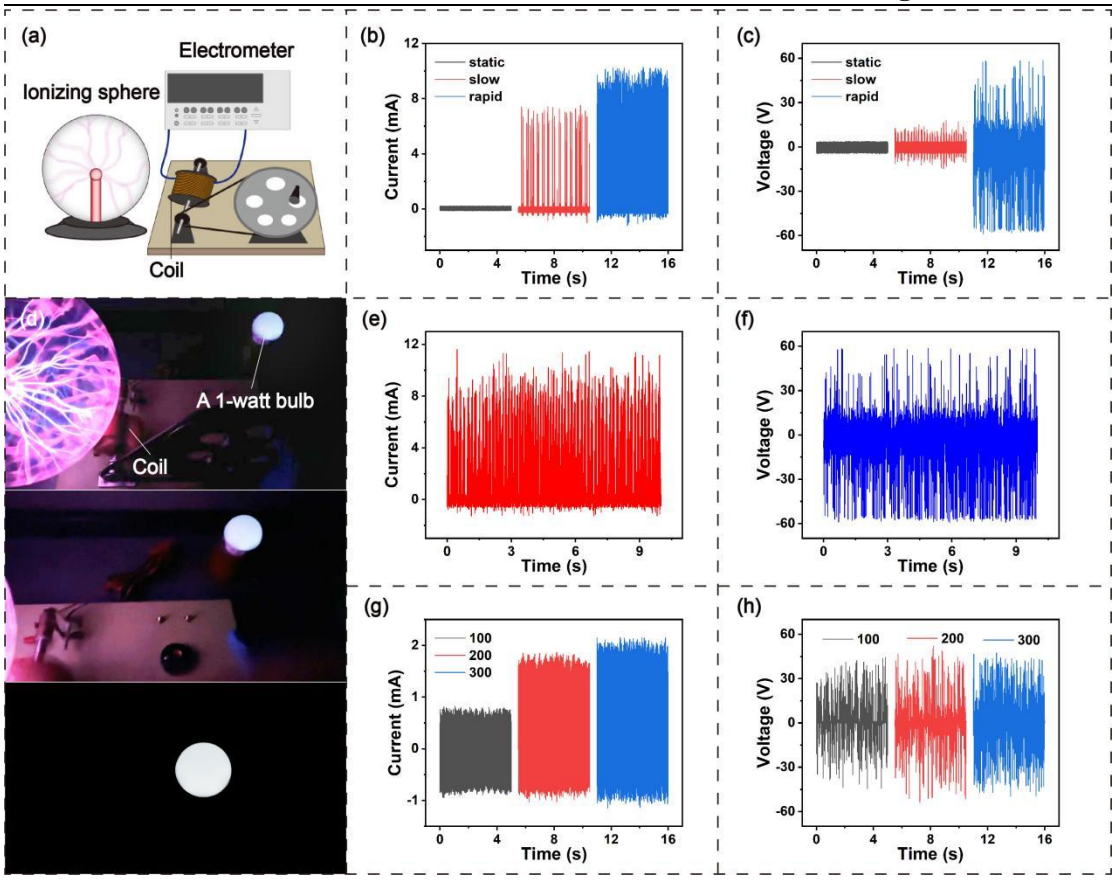

Figure 1 (a)The experimental device of the Electra-electric induction generated by an ionizing sphere; (b, c) The induced current and induced electromotive force generated in the rotating coil (slow speed: 2 r/s; rapid speed: 10 r/s); (d) A 1-watt bulb lighted up by the energy collected by rotating the coil near the ionizing sphere; (e, f) The induced current and the induced electromotive force when the coil was rotated to light the 1-watt bulb; (g, h) The change of the induced current and induced electromotive force when the number of coil turns increases.

In the second experiment, we rotated the closed circuit coil near a power outlet to see whether we can get the same result as the above. Figure 2a shows the experimental setup. There is usually a small amount of leaking electric field around the power outlet. Put the circuit coil close to the power outlet, and the leaking electric field can be collected. As shown in Figure 2b and Figure 2c, the induced current and the induced electromotive force in the coil increased when the coil was rotated. It was found that a larger induced output would be produced when the coil was rotated faster.

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As shown in Figure 2d , imagine that we put some closed coils around a high-voltage electric field and keep them rotating by wind energy, how much energy can be re-utilized? One can also expects that the strong electrostatic field and the strong electromagnetic radiation field generated by nuclear reactor or nuclear waste can also be recollected by the rotated coil driven by the windmill as shown in Figure 2e. Without an external magnet, the closed circuit coil cuts the electromagnetic field line continuously, leading to the generation of continuous induced current flow.This can realize the secondary recovery of energy and efficient use of energy. And it also presents a new and simple power pattern for nuclear plant.

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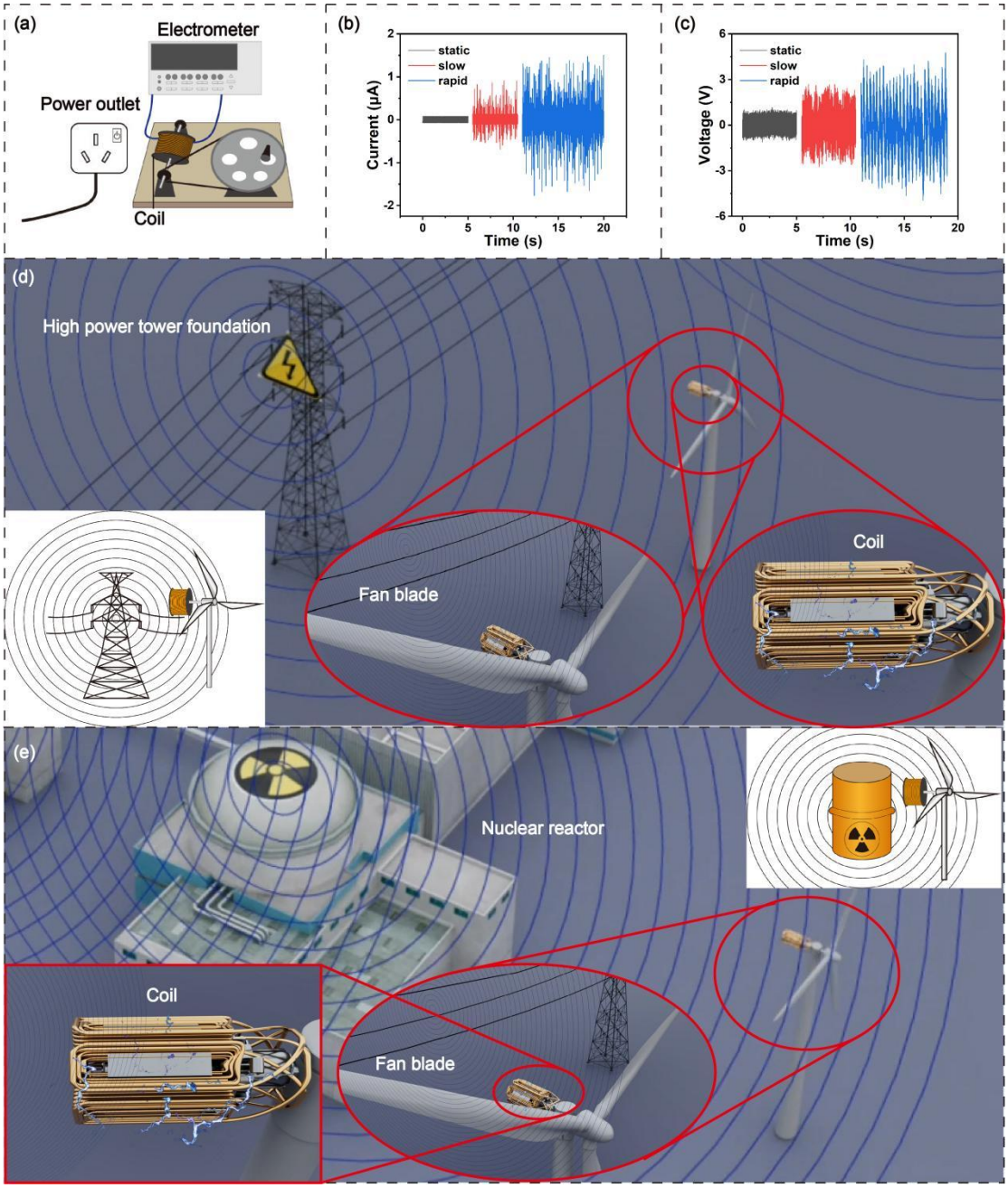

Figure 2 (a) The experimental device of the Electra-electric induction generated by a power outlet; (b, c) The change of the induced current and induced electromotive force when the coil was rotated under different speeds; (d) The schematic diagram of collecting the strong electrostatic field near the high power tower by the coil rotated by the wind; (e) The schematic diagram of collecting the electromagnetic field generated by the radiation of nuclear reactor or nuclear waste dumping by the coil rotated by the wind.

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The last experiment, we chose another way to generate a changing electric field around the coil. A plastic sheet made of polymethyl methacrylate (PMMA) was rubbed and thus charged with an electrostatic field. We put the closed circuit coil close to the plastic sheet which had just been electrostatically charged by rubbing. When the coil was rotated, an induced current would be generated in the coil. The schematic diagram of the device is shown in Figure 3a. When the coil is not rotated, the electrostatic field produced by the plastic sheet is relatively stationary to the coil. No changing electric field is produced and no induced current is generated in the coil. When we rotated the coil slowly, it was found that there was an induced current in the coil. The induced current and the induced electromotive force in the coil can be reached up to 10.35 uA and 5.49 V respectively, when we rotated the coil fast, as shown in Figure 3b and Figure 3c. The faster the coil was rotated, the higher the induced current in the coil increased. It can be seen that when the coil cuts the electric field line, a changing electric field is generated in the coil, which lead to the generation of an induced current. Besides, the PMMA sheet was constantly rubbed with the FEP film by hand to generate changing electric field. The schematic diagram of the device is shown in Figure 3d. We also found that the rotating coil can collect more energy due to the more changing electric field generated by constantly rubbing and the even faster cutting speed of the rotated coil. As shown in Figure 3e and Figure 3f, the induced current and the induced electromotive force in the coil were increased from 54.24 uA to 70.21 uA, and from 15.39 V to 17.71 V respectively when the coil was rotated. What's more shocking is that shaking a plastic sheet charged with an electrostatic field by rubbing can also wirelessly light up the 28-watt fluorescent tube lamp nearby. (Figure 3g and Video S2 in the Supporting Information) Therefore, the induced current can also be generated in the conducted tube lamp.

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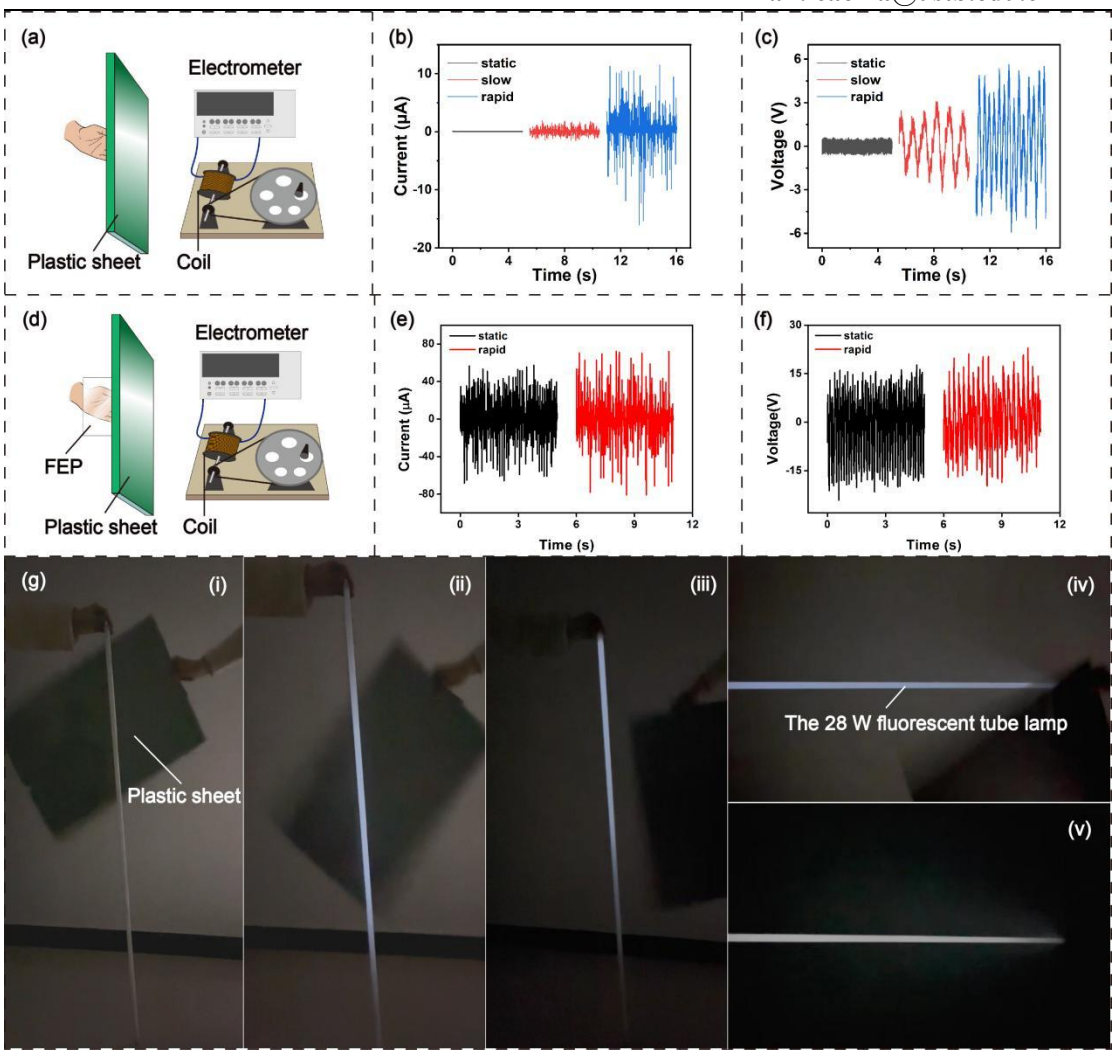

Figure 3 (a) The experimental device of the Electra-electric induction generated by a plastic sheet with an electrostatic field; (b, c) The change of the induced current and induced electromotive force when the coil was rotated under different speeds; (d) The experimental device of the Electra-electric induction generated by a plastic sheet with a changing electric field; (e, f) The change of the induced current and induced electromotive force generated by collecting the changing electric field before and after the coil was rotated; (g) A 28-watt fluorescent tube lamp lighted up by the energy collected by shaking a plastic sheet with an electrostatic field.

From the above experiments, we can conclude that cutting the electric field line will lead to the generation of induced current and induced electromotive force in coils. We call this phenomenon Electra-electric induction (EEI). This seems to be the same as electromagnetic induction. The coil cuts the electromagnetic field line, and the

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changing electromagnetic field is produced and an induced current is generated by the coil. Both Maxwell's displacement current mentioned in the classic Maxwell's equations and the induced current collected by the coil in this experiment are generated by changing electric fields, which should be the same in essence. The difference is that Maxwell's displacement current is a field current (more accurately called a changing electric field), which actually exists in space and is not been collected by the conductor. Collecting Maxwell's displacement current by a coil and making it flow in a conductor is what induced current caused by Electra-electric induction (EEI). This work provides new ideas for the power generation and reuse of energy. In addition, it presents a new examination and thinking about the physical significance of the last two terms of Maxwell's equations.

4 Conclusion

This paper proves that cutting the electric field line will lead to the generation of the induced current and induced electromotive force in the closed circuit coil. Compared to Faraday's electromagnetic induction, we call it Electra-electric induction. Both Maxwell's displacement current and the induced current generated by Electra-electric induction are generated by the changing electric field. According to the definition of Maxwell's displacement current, Maxwell's displacement current and the induced current generated are the same thing (the changing electric field) in two forms of existence. One is the changing energy field existed in space, and the other is the changing energy field flow in the conductor. Collecting Maxwell's displacement current by a coil and making it flow in a conductor is what induced current. In this way, the extremely strong electrostatic field near the high-voltage wire, as well as the strong electromagnetic field generated by the radiation of nuclear reactor or nuclear waste dumping, can be collected by the rotated coil driven by the wind, Without external magnet, the closed circuit coil cuts the electromagnetic field line continuously, leading to the generation of continuous induced current flow.The work deepens the understanding of the unified theory of electromagnetism and the

Maxwell's equations, which is of great significance to the fields of energy regeneration, energy transmission, and the efficient utilization of energy, etc. It's provides a new and simple way of power generation.

Declaration of competing interest

The authors declare that they have no conflict of interest.

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