Introduction: # Induction of Electricity

Usually, two steel balls don't attract each other even if they are placed close together. When a south pole of a strong magnet is placed near these steel balls, they will be pulled by the magnet so as to have north poles on the surface of the steel balls. You may find that they eventually attract each other. Here, you must think that at least a south pole also appears on one of the steel balls.

In the above example, the magnetic north and south poles on the steel balls are 'induced' under magnetic fields. They can appear even if the strong magnet doesn't touch the steel balls. This is the point where such an induction phenomenon is mysterious and interesting. In the studies of magnetism or electricity, you will meet similar phenomena. A famous physicist Michael Faraday is known to have discovered the law of "electromagnetic induction[1]" where an electric current is induced on moving metal under magnetic fields.

There is another important induction when metal is placed into a strong electrostatic field. Electric charges on the surface of the metal can be induced. This phenomenon is called "electrostatic induction[2]". We can see an example of its application around us; a copy machine. Particles of toner carbon are stuck on papers by electrostatic forces on the induced charges. Similar electric induction is also observed in the case of a piece of isolated metal on a conductive rubber sheet, where the electric steady currents flow weakly.

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1 electromagnetic induction 電磁誘導

2 electrostatic induction 静電誘導

In this case of the metal on the conductive sheet, the currents flow from a positive electrode to a negative electrode. The positive electrode is the highest place of 'electric potential[3]' or voltage[4], and the negative electrode is the lowest place or zero point of the electric potential. The current can happen to flow into a part of the metal or to flow out from another part of the metal. We can say an induced negative pole is the place which the currents flow into, and an induced positive pole is the place which the currents flow out of, similar to the negative and positive electrodes.

In the experiment, you should use the following facts:

1. The direction of the currents is always normal to the equipotential[5] lines.
2. The place where the equipotential lines are spaced closely is the place where the potential is strongly changed. The magnitude of the electric currents must be large around such places, so it is natural that you draw more of the current lines there. Then, the current lines should be spaced closely.
3. The place where the equipotential lines are spaced widely is the place where the potential is weakly changed. The magnitude of the electric currents must be small around such places, so it is natural that you draw less of the current lines there. Then, the current lines should be spaced widely.

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[3] electric potential 電位
[4] voltage 電圧
[5] equipotential 等電位