Lighting Experiment
Using Discharging Tubes

NaRiKa Corporation

1. Learning Outcome

We will confirm that electrical current is flow of electrons through Glow Discharge and Arc Discharge.

2. Introduction of various types of Discharges

[1] Dark Discharge:

If high voltage is applied to two of electrodes, electric field appears between those electrodes. Then, if radioactive ray (including natural radiation) strikes the electric field, discharging phenomenon, namely "Dark Discharge", occurs. Spark Chamber is the apparatus to observe natural radiation based on the "Dark Discharge" phenomenon.

[2] Spark Discharge:

Spark Discharge is the phenomenon of electrons transferred between two electrodes in a discontinuous manner when insulation breakdown occurs after high voltage is kept impressed to two electrodes and the voltage reaches a tipping point. Electrostatic discharging phenomenon that occurs when human fingers touch metallic doorknob is seen as Spark Discharge.

[3] Corona Discharge:

Also, known as "Point Discharge" that is the continuous discharge from accurate electrode. The name of "Corona Discharge" is derived from the emission at the discharging point that resembles solar corona.

[4] Glow Discharge:

Discharging phenomenon that persists in the low-pressure gas. Type of the gas encapsulated in discharge tube determines the color of emission. If the amount of current carried is increased, Glow Discharge migrates to Arc Discharge.

[5] Arc Discharge:

Release of electrons known as the final shape of discharge. Applied in lights like fluorescent lamp and arc welding.

Both of Glow Discharge and Arc Discharge are discharging and emission phenonena that occur when high voltage is impressed after decreasing the pressure of interior of discharging tube. When free electrons collide with gaseous atom, the atom is ionized and separated into positive ion and electron, which is transferred to the positive (+) electrode (anode) by flowing inside the discharge tube. The flow is called "current".

3. Electrostatic Generator: "Static Genecon"

We already know that if we rub piece of plastic with felt or different kind of cloth then static electricity will be generated. And we have in various ways confirmed properties of above mentioned way of generating static electricity. As a result, we have learned among other things as well, that electrostatic charge has two kinds. Furthermore, we can store static electricity because of the invention of Leyden jar and Electrophorus. By using them we can store greater amount of static electricity, thus conducting experiments with large amount of static electricity. Because of that invention research about static electricity accelerated in the past.

In 1929, Robert J. Van de Graaff (1901-1967, USA), with purpose to invent particle accelerator, invented high voltage electrostatic generator, so called:" Van de Graaff generator". Van de Graaff generator can generate low electric current, but it can accumulate high amount of voltage. It is often used for demonstration experiments in schools.

In this unit, we will use "Static Genecon" that generates static electricity continuously in the same way as Van de Graaff generator to perform various experiments. For example: Charge & Discharge, or Repulsion and Attraction experiments, by analysis of the behavior during experiments, let's deepen our understanding of static electricity.

Static Genecon
(Narika B10-1324)

"Static Genecon", developed by NARIKA Corporation, is a smaller version of Van de Graaff generator. Below you can find a simple explanation of the operating principle. The basic principle is by rubbing two things against each other, static electricity is generated.

In drawings below, we can see simplified internal structure of Static Genecon. Felt reinforced with metallic copper is in contact with drum made of PVC. Also, to collect electricity charge generated on the surface of the PVC drum, there is a collector made of metal (Figure 1).

If you rotate slowly the handle of Static Genecon, PVC drum will rotate, and rub felt. As a result of the friction, on the surface of PVC drum negative charge, and on the felt positive charge will be generated. On the surface of nonconductor static electricity will not move, therefore when PVC drum is rotated, negatively charged static electricity formed on the surface of PVC drum is transferred to the collecting plate.

Because collecting plate and PVC drum are not in contact, due to negative charge on the surface of PVC drum, collecting plate will be induced and negative electric charge on the surface of PVC drum will be neutralized. Because of the electrostatic induction of collecting plate, negative charge will easily move inside the conductor. On the other hand, positive charge generated on

the surface of felt will be supplied by negative charge from metallic copper plate inside of the felt, therefore it will be electrically neutralized (seemingly it looks like transference of positive charge. See Figure 2 and Figure 3.).

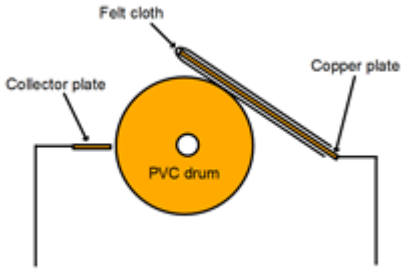


Figure1

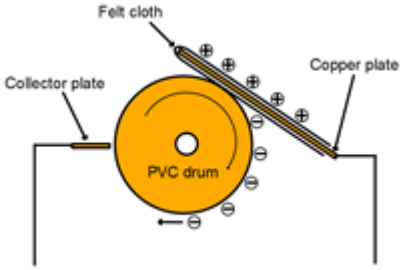


Figure2

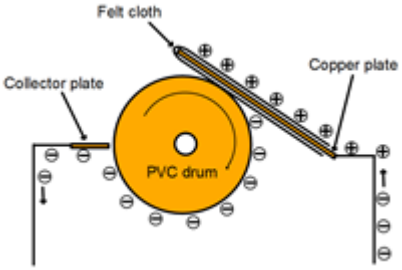
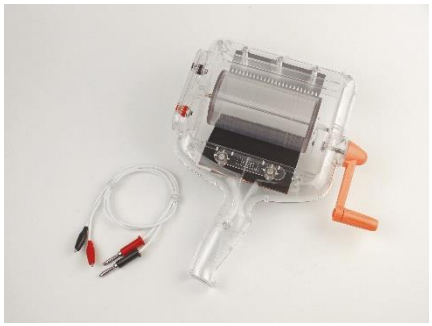


Figure3

4. Lighting Experiment Using Discharging Tubes

1.What to prepare

- Static Genecon: 1 pc (Narika B10-1324)
- Aluminum Collecting Sphere: 1 pc (Narika B10-1324-03)
- Large Neon Tube: 1 pc (Narika B10-7693)
- Small Fluorescent Tube: 1 pc (Narika P70-0741)


Static Genecon
(Narika B10-1324-W0)

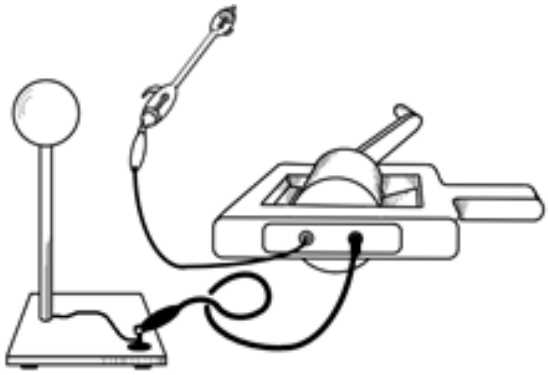

Aluminum Collecting Sphere
(Narika B10-1324-03)

2. Experiment procedure

1) Make pairs.

2) As drawing on the right, connect Static Genecon and Aluminum collecting sphere together with one cable by clip.

3) Also connect Static Genecon with Small neon tube by using the other cable and clip at the end.



4) One of the pair will start rotating the handle of the Static Genecon.

5) Please make the room dark (by switching off the lights).

6) The other person will put Small neon tube slowly closer and closer to the Aluminum collecting sphere.

7) Verify that the Small neon tube will start to shine.

8) Use other prepared discharge tubes same way as Small neon tube and confirm that all of them will shine too.

5. Questions

1. Which type of discharge happened in the experiment we just did? Choose among spark discharge, corona discharge, glow discharge and arch discharge.

Glow Discharge occurs in Neon Tube/Lamp. Arc Discharge occurs in Small fluorescent tube.

Glow Discharge:

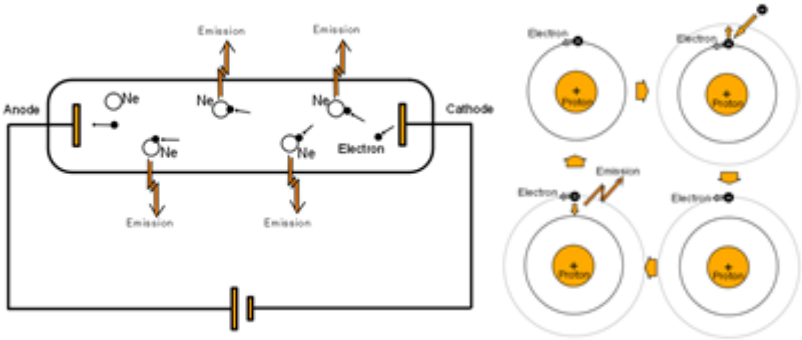
Discharging phenomenon that persists in the low-pressure gas. Type of the gas encapsulated in discharge tube determines the color of emission. If the amount of current carried is increased, Glow Discharge migrates to Arc Discharge.

Arc Discharge:

Release of electrons known as the final shape of discharge. Applied in lights like fluorescent lamp and arc welding.

Note:

Vacuum discharge occurs between both electrodes when several thousand volts are impressed to the electrodes of discharging tube, while decreasing the pressure in the tube by using vacuum pump. Then, the gas inside the tube emits and electric current is carried. Ejected electrons emitted from the electrodes collide with Neon atom and excite the outermost shell electron orbit of the atom. When the excited electrons return to the original orbit, light is emitted.



A lot of study on cathode ray became active in 19th century, including the measurement of

cathode ray mass, as well as, electric/magnetic fields effect of cathode ray done by J. J. Thomson (1856 - 1940, UK) who finally identified cathode ray as electron.