Demonstration of the type of charge on rubbed rods

Physics > Electricity & Magnetism > Electrostatics & electric field

Difficulty level	Group size	Preparation time	Execution time
easy	-	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/6425dea8ce1a1f0002719840

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Teacher information

Application

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Light bulb

The phenomenon investigated in this experiment is the so-called frictional electricity. This was already described by the Greek mathematician and astronomer Thales.

In this process, electrons of two objects that are rubbing against each other move back and forth depending on the electron affinity of the respective material.

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Other teacher information (1/2)

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Prior knowledge

Students should already have a sound knowledge of electric charge and Ohm's law.

The function of the glow lamp should be assessed in advance by the teacher with a power supply unit (voltage approx. $100\,V$-, series resistance approx. $100\,k\Omega$) and be demonstrated so that the students know how to detect positive and negative charges (the negative electrode lights up).

Principle

If you rub a material with a high affinity with one whose electron affinity is lower, the higher affinity material will subsequently be negatively charged and the lower affinity material positively charged.

If, for example, Teflon (high affinity) is rubbed with wool (low affinity), the wool is positively charged and the Teflon negatively charged.

Other teacher information (2/2)

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Learning objective

The students should recognise that when different materials (insulators) are rubbed (touched closely), a negative or positive charge occurs, which can be detected with a glow lamp.

Tasks

The students are to use a glow lamp to investigate which types of charge occur on rubbed plastic rods.

Notes on set-up and procedure

To obtain convincing experimental results, make sure that the students use clean, dry paper, rub very vigorously and that the classroom is sufficiently darkened.

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Safety instructions

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The general instructions for safe experimentation in science lessons apply to this experiment.

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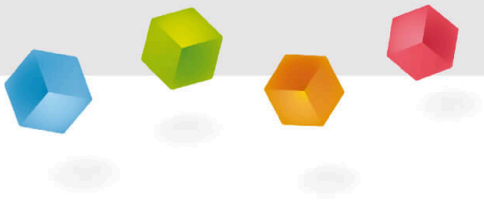

Student information

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Motivation

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Light bulb

As you know, lamps light up because of an electric charge. Usually, lamps are made to glow by activating a switch on the wall, which closes a current circuit and ensures that a current flows through the lamp. The electricity needed for this was generated in a power station and fed into the lamp via cables.

However, lamps can also be made to glow in other ways. The effect used for this is called frictional electricity.

You have certainly felt the electricity of friction yourself when you rubbed a balloon against your hair and it "stood on end" and was electrically charged.

Tasks

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Use a glow lamp (neon tube) to determine which types of charge occur on rubbed plastic rods.

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Equipment

Position	Material	Item No.	Quantity
1	Polypropylene rod, l=175mm, d=10 mm	13027-09	1
2	Acrylic resin rod, l=175 mm, d=8 mm	13027-08	1
3	Neon tube	06656-00	1

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Additional Equipment

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Position	Equipment	Quantity
1	Dry, rough paper	DIN A4

Set-up

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Neon glow lamp

- Lay out the two sticks (polypropylene and acrylic glass).
- Look closely at the glow lamp: As you can see, there are two electrodes inside, one connected to each of the metal caps.
- The glow lamp is a gas discharge tube and is found as a signal lamp in various electrical appliances (irons, multiple sockets, etc.) to indicate the operating status. The glass bulb of a glow lamp is filled with a gas (here neon) at low pressure. The glow light is produced at the cathode (negative charge). The two electrodes have such a small distance d that at approx. $U = 100\,V$ a spontaneous impact ionisation is caused, which, after an avalanche effect, at least partially transforms the contained gas mixture into the necessary plasma (orange-red glow).

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Procedure

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Rubbing the polypropylene rod with paper

- Hold the grey stick (polypropylene) at one end and rub the other end vigorously with the paper.
- Hold the glow lamp by one metal cap and touch the rod at the rubbed end with the other metal cap. Observe the electrodes of the glow lamp.
- Carry out the same experiment with the acrylic rod and note your observation in the report.

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Report

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Task 1

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Light bulb

How does the glow lamp behave in the experiment with the polypropylene rod?

- ○ When touched, the electrode facing away from the rod lights up briefly.
- ○ Nothing conspicuous happens.
- ○ When touched, the electrode facing the rod lights up briefly.

Check

Task 2

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Light bulb

How does the glow lamp behave in the experiment with the acrylic rod?

- ○ Nothing conspicuous happens.
- ○ When touched, the electrode facing the rod lights up briefly.
- ○ When touched, the electrode facing away from the rod lights up briefly.

Check

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Task 3

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Light bulb

What can you conclude from the observations regarding the charges of the two rods?

- ○ The polypropylene rod was negatively charged and the acrylic rod positively charged.
- ○ No statement applies.
- ○ The polypropylene rod was positively charged and the acrylic rod negatively charged.

Check

Slide	Score / Total
Slide 14: Behaviour of the glow lamp with the polypropylene rod	0/1
Slide 15: Behaviour of the glow lamp with the acrylic rod	0/1
Slide 16: Electric charge of the bars	0/1

Total 0 / 3

Solutions Repeat

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