Objects of the experiment

1. Demonstrating the emission of charge carriers from the hot cathode of a diode tube
2. Proving the negative polarity of the charge carriers

Setup

Safety note:

When the tube diode is operated, hazardous-contact voltages are applied!

The tube diode can be damaged by voltages and currents that are too high if it is not connected appropriately. Mind the information on connection and technical data in the instruction sheet 555 610.

Apparatus

1 Demonstration diode	555 610
1 Tube stand	555 600
2 Demo multimeters, passive	531 906
1 Tube power supply, 0 ... 500 V	521 65
4 Safety connecting leads, 100 cm, red	500 641
3 Safety connecting leads, 100 cm, blue	500 642

Carrying out the experiment

1. Demonstrating the emission of charge carriers from the hot cathode
   - Switch the tube power supply on, and apply an anode voltage U_A of 300 V (anode +, cathode -) between the anode and the cathode. Do not apply a heating voltage U_F to the hot cathode in the beginning.
   - Observe the pointer deflection at the amperemeter.
   - Connect the hot cathode to the tube power supply, and set a heating voltage U_F of 4.5 V with the potentiometer.
   - Observe the pointer deflection at the amperemeter, and read the anode current.
   - Repeat the experiment at other heating voltages.
2. Proving the negative polarity of the emitted charge carriers
   - Apply a heating voltage U_F of approx. 6 V to the hot cathode.
   - Change the polarity of the anode voltage U_A (cathode +, anode -).
   - Observe the pointer deflection at the amperemeter.

Measuring example

Heating voltage U_F in V	Anode current I_A in mA
0	0
4.5	0.5
5.0	1.0
5.5	2.0
6.0	4.0
6.5	8.5
7.0	15.0
7.5	22.5

Evaluation

If the hot cathode is heated by applying a heating voltage U_F, charge carriers can escape from the surface of the hot cathode.

The release of electrons from the surface of glowing metals is called thermionic emission.

By applying an anode voltage U_A (cathode -, an-ode +), the charge carriers are accelerated towards the anode.

An anode current I_A flows between the cathode and the anode.

The magnitude of the anode current I_A depends on the heating voltage U_F, which is applied to the hot cathode.

The higher the heating voltage, the more charge carriers can escape from the surface of the hot cathode.

The higher the number of released charge carriers, the higher the anode current I_A.

When the polarity of the voltage between the cathode and the anode is changed (cathode +, anode -), no anode current I_A can be detected. That means, the charge carriers released from the hot cathode are negatively charged.

LEYBOLD DIDACTIC GMBH · Leyboldstrasse 1 · D-50354 Hürth · Phone (02233) 604-0 · Fax (02233) 604-222 · e-mail: info@leybold-didactic.de