KEP KLINGER
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Lehr– und Didaktiksysteme
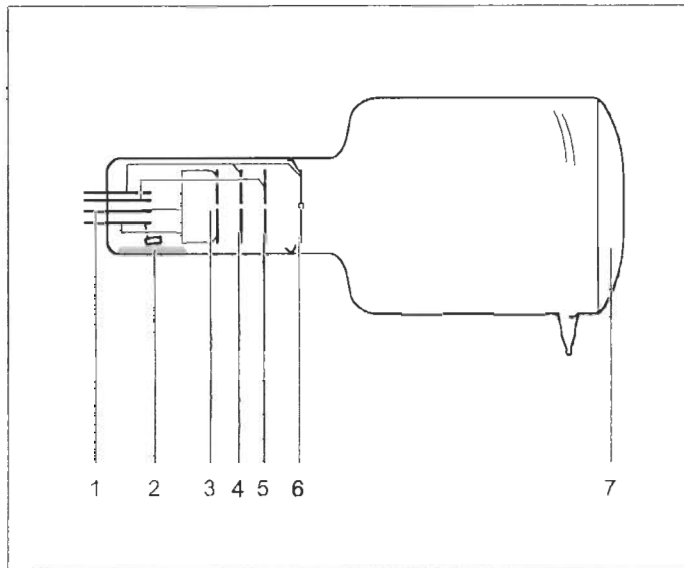LD Didactic GmbH
Leyboldstrasse 1 · D-50354 Huerth

06/05-W97-Iv/Sel

Instruction sheet 555 626

Electron diffraction tube (555 626)

1 Pin base (for electron gun contacting)
2 Getter mirror (for maintaining the vacuum)
3 Cathode cap
4 Anode plate 1
5 Focussing electrode
6 Anode plate 2, with graphite sample
7 Screen

Safety notes

When the electron diffraction tube is operated at high voltages over 5 kV, X-rays are generated.

- Do not operate the electron diffraction tube with high voltages over 5 keV.

The connection of the electron diffraction tube with grounded anode given in this instruction sheet requires a high-voltage enduring voltage source for the cathode heating.

- Use the high-voltage power supply 10 kV (521 70) for supplying the electron diffraction tube with power.

Danger of implosion: the electron diffraction tube is a high-vacuum tube made of thin-walled glass.

- Do not expose the electron diffraction tube to mechanical stress, and connect it only if it is mounted in the tube stand.
- Treat the contact pins in the pin base with care, do not bend them, and be careful when inserting them in the tube stand.

The electron diffraction tube may be destroyed by voltages or currents that are too high:

- Keep to the operating parameters given in the section on technical data.

1   Description

The electron diffraction tube enables the wave character of electrons to be demonstrated through their diffraction (Debye-Scherrer diffraction) at a polycrystalline graphite lattice. From the radii of the diffraction rings and the lattice plane spacings in graphite the wavelengths of the electrons for different anode voltages can be determined and compared with de Broglie's equation.

2   Scope of supply

1 Electron diffraction tube
1 Adjusting magnet

3   Technical data

Heating voltage U_F:	6-6.5 V~ (rec.: 6.3 V~)
Heating current I_F:	approx. 1.5 A at 6.3 V
Anode voltage U_A:	2.5-5 kV
Distance crystal-screen:	135 mm
Pressure:	$<10^{-6}$ hPa
Diameter:	90 mm
Total length:	270 mm
Mass:	250 g
Incandescent cathode:	heated directly
Lattice plane spacings in graphite:	123 pm, 213 pm

4   Putting into operation

additionally required:

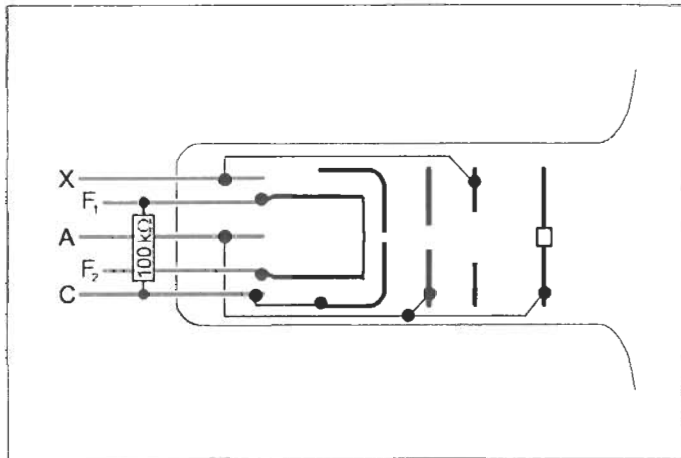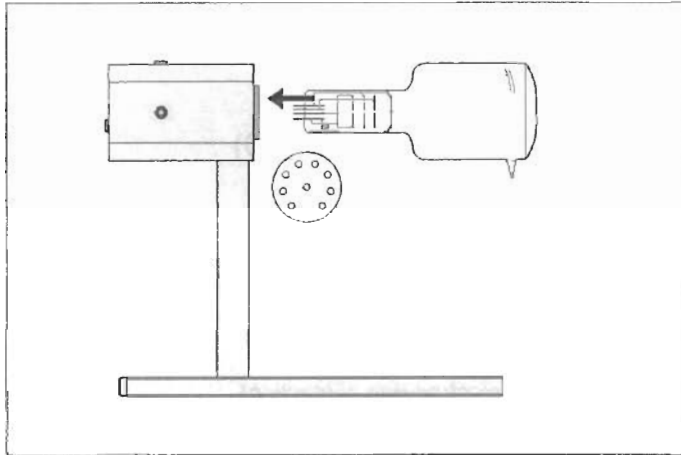1 tube stand   555 600
1 high-voltage power supply 10 kV   521 70

4.1   Mounting in the tube stand:

- Hold the electron diffraction tube horizontally, and turn it so that the two pins with the greatest distance in the pin base point downwards.
- Carefully insert the pin base in the socket of the tube stand until it stops.
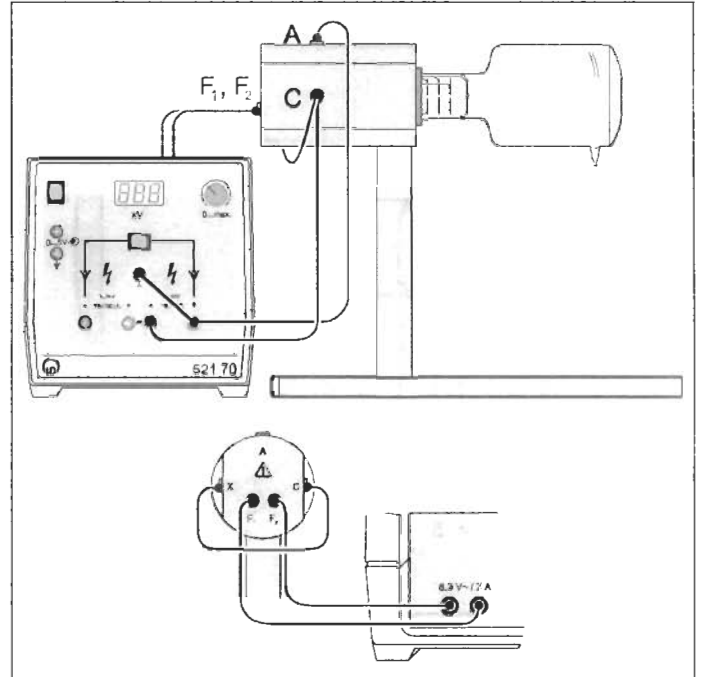
Pin connection:

|			
F_1, F_2	heating filaments	C	cathode cap
A	anode	X	focussing electrode

4.2   Connection to the high-voltage power supply 10 kV:

- For the cathode heating connect the sockets F_1 and F_2 of the tube stand to the output on the back of the high-voltage power supply 10 kV.
- Connect the sockets C and X of the tube stand (cathode cap and focussing electrode) to the negative pole and the socket A (anode) to the positive pole of the 5kV/2mA output, and ground the positive pole.

5 Debye-Scherrer diffraction at graphite
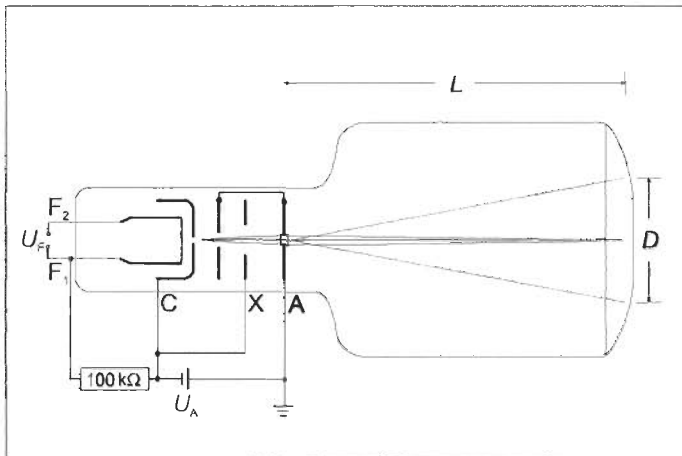
- Apply an accelerating voltage $U \leq 5\,kV$, and observe the diffraction pattern.
- In order to illuminate another spot of the sample, you may clamp the adjusting magnet and rotate and shift it around the neck of the tube.
- Determine the diameter D of the diffraction rings on the screen.

a) Bragg equation: $\lambda = 2 \cdot d \cdot \sin \vartheta$

λ: wavelength of the electrons, ϑ: glancing angle of the diffraction ring, d: lattice plane spacing in graphite, L: distance between sample and screen (135 mm)

$$\tan 2\vartheta = \frac{R}{L} \qquad \lambda = d \cdot \frac{D}{2 \cdot L} = d \cdot \frac{R}{L}$$
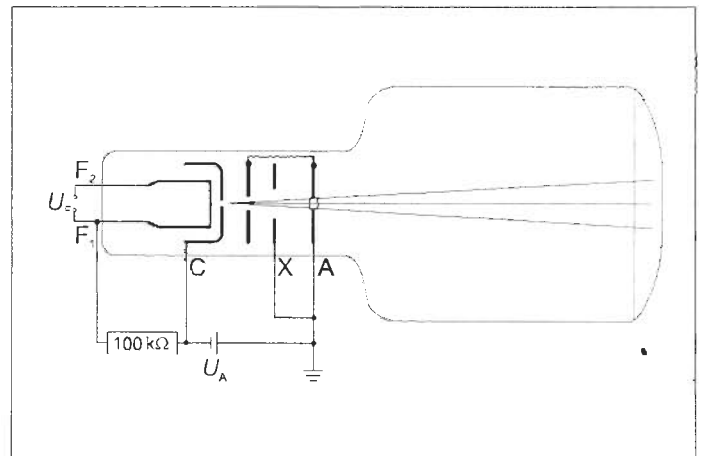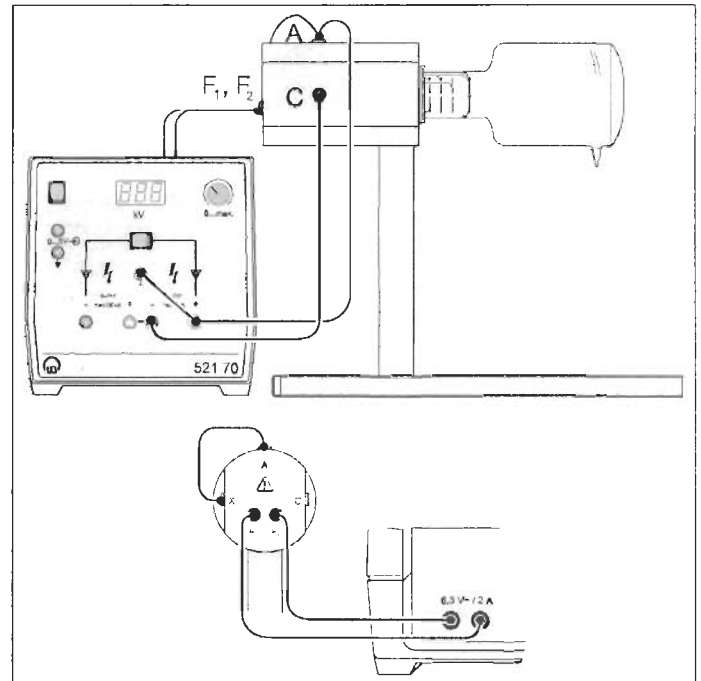
b) de Broglie equation: $\lambda = \dfrac{h}{p}$

h: Planck's constant, p: momentum of the electrons

$$e \cdot U = \frac{p^2}{2 \cdot m} \qquad \lambda = \frac{h}{\sqrt{2 \cdot m \cdot e \cdot U}}$$

m: electron mass, e: electron charge

6 Magnified image of the graphite sample

- For the cathode heating connect the sockets F_1 and F_2 of the tube stand to the output on the back of the high-voltage power supply 10 kV.
- Connect the socket C of the tube stand (cathode cap) to the negative pole and the sockets A and X (anode and focussing electrode) to the positive pole of the 5 kV / 2 mA output, and ground the positive pole.
- Apply an accelerating voltage $U \leq 3$ kV, and observe the magnified image of the graphite sample on the screen.