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TOPIC: Electron diffraction

Apparatus Reqd.:

1. Electron diffraction tube with stand.
2. High Voltage power supply (up to 10 kV).
3. Connecting wires
4. Plastic measuring scale

Aim: To calculate the interplanar spacing in graphite from the diffraction pattern.

Basic Information: In this experiment, electrons get transmitted through a very thin polycrystalline graphite sheet. The schematic sketch is shown in the diagram. Graphite has 2 independent lattice spacings (d_1 and d_2). The 2 diffraction rings that will be seen at each voltage are due to these 2 planes. Applying the diffraction formula of 1st order, we've:

$$\lambda = d \cdot \sin\theta \quad \text{——— (1)}$$

where, λ is the de Broglie wavelength of the electron, d is the interplanar spacing and θ is the angle of diffraction. Electrons are accelerated through a potential difference of V volts and hence their de Broglie wavelength is :-

$$\lambda = \frac{12.3}{\sqrt{V}} \text{ Å} \quad \text{——— (2)}$$

$$\sin\theta = \frac{R}{\sqrt{R^2 + L^2}} \quad \text{——— (3)}$$

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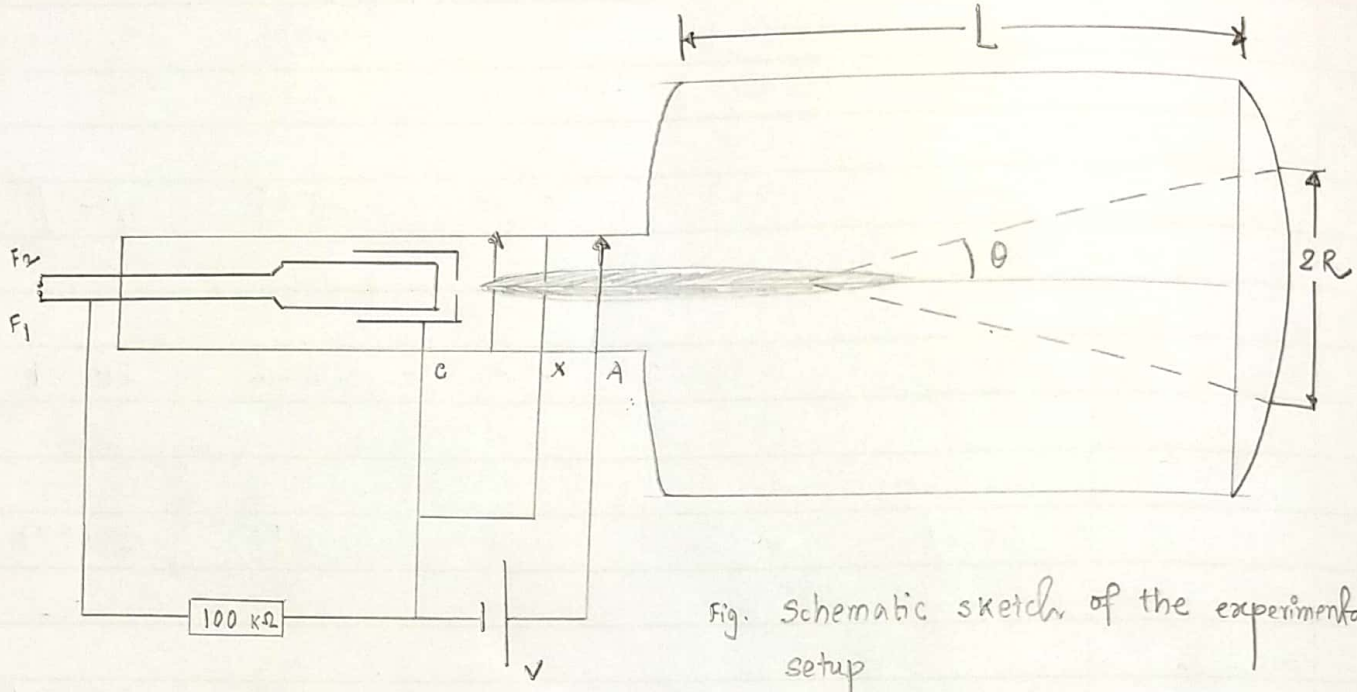
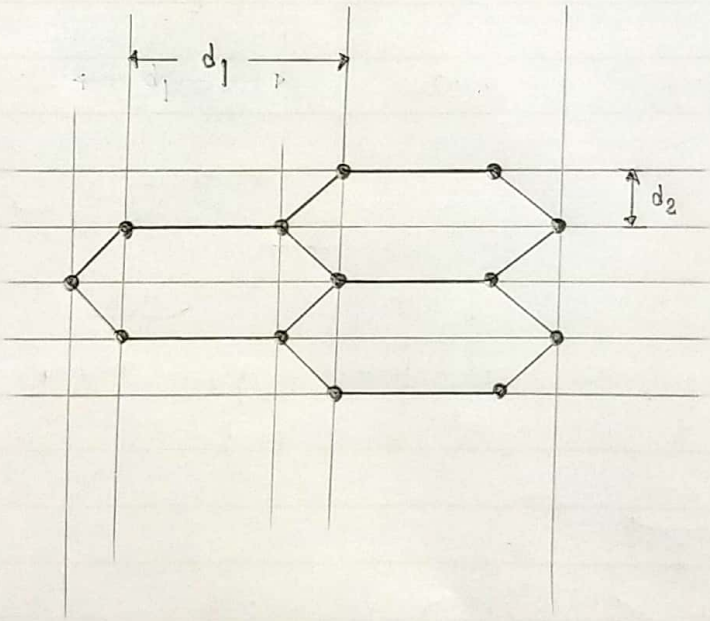
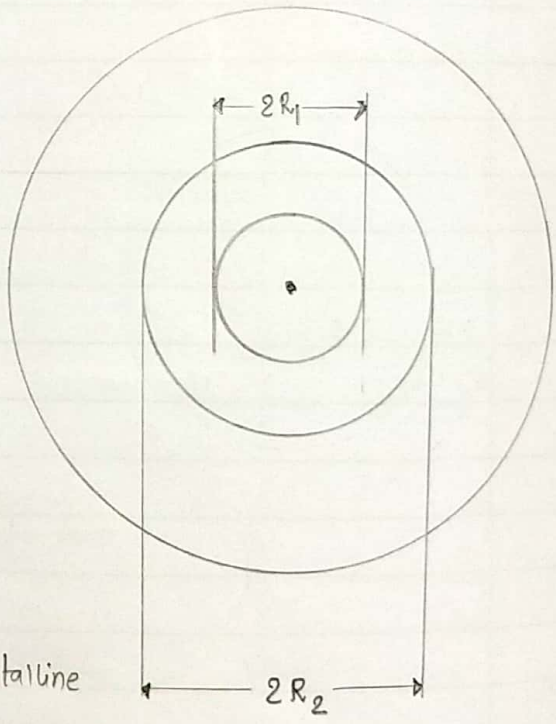


Fig. Schematic sketch of the experimental setup





Two independent types of lattice planes in polycrystalline graphite and the diffraction rings produced by these lattice planes. $2R_1$ & $2R_2$ are the diameters of the rings.

Ring	V (kV)	$2R_1$ ⓞⓡ $2R_2$ (cm)	R_1 ⓞⓡ R_2 (cm)	λ (Å)	$\sin\theta$	d (Å)
Inner	4.0					
	4.5					
	5.0					
Outer	4.0					
	4.5					
	5.0					

Average d of inner ring = Å

Average d of outer ring = Å

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Simplifying and using, $L = 13.5$ cm and R in cm,

$$\sin\theta = \frac{1}{\left[1 + \left(\frac{13.5}{R}\right)^2\right]^{0.5}} \quad \text{——— (4)}$$

Interplanar spacing can be calculated from eq^{n} (1), using eq^{ns} (2) and (4).

Safety Guides & precautions:

1. Never accelerate beyond 5 kV.
2. Never touch any controls on the power supply other than the 'On-Off' switch and the voltage varying knob.
3. Never use force to measure the ring diameters. Keep a plastic scale very gently over the tube to measure the diameter. Metal scales are not allowed.
4. You are working with a very high energy source (>5kV) and hence, touching any part of the entire setup other than what is mentioned in point 3 is prohibited.

Result:

The interplanar spacings in graphite were measured as:

d_1 = mm

and,

d_2 = nm

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