Date 06-12-2018

Expt. No. 1 — Electron Diffraction — Page No. 1

Apparatus Required :-

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

Objective :-

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 Fig. 1. Graphite has 2 independent lattice spacings (d_1 & d_2) & these are shown in Fig. 2. The 2 diffraction rings that will be seen at each voltage are due to these 2 planes.

Applying the diffraction formula for first order, we have,

$$\lambda = d \sin\theta \qquad (1)$$

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

$$\lambda = \frac{12.3}{\sqrt{V}} \ A^\circ \qquad (2)$$

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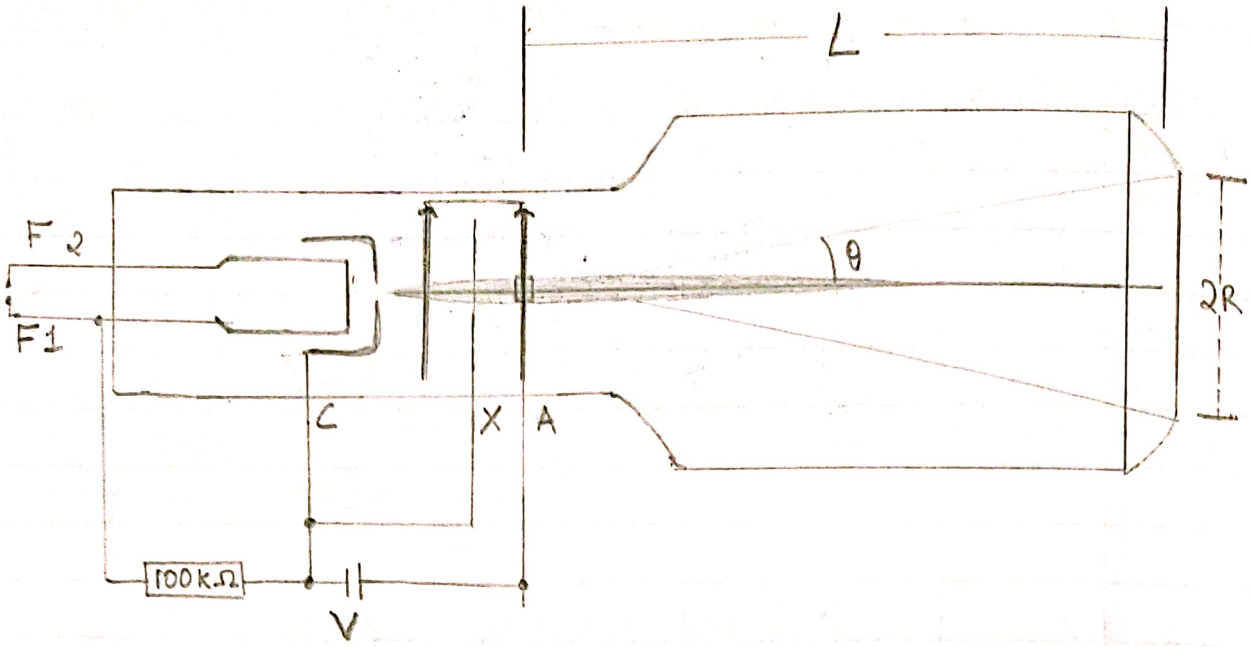
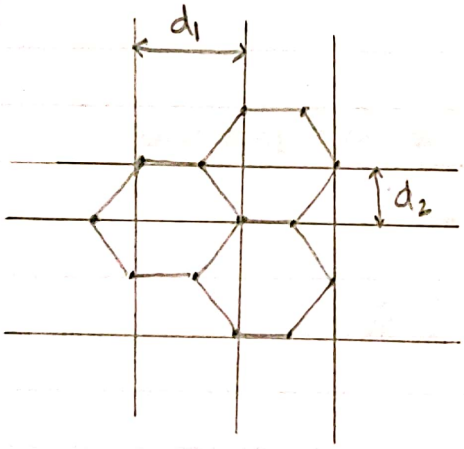
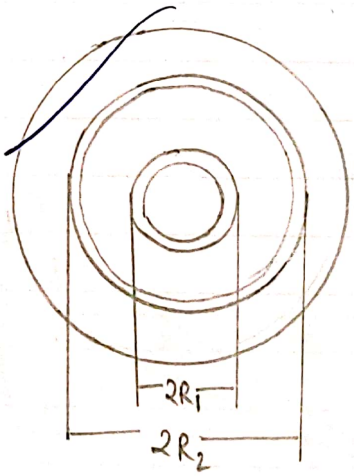

L
F 2
F 1
θ
2R
C
X
A
100 K.Ω
V


d1
d2


2R1
2R2

RING	V (kV)	$2R_1$ (cm)	R_1 (cm)	λ (Å)	$\sin\theta$	d_1 (Å)
INNER	4.0	2.55	1.275	0.194	0.094	2.063
	4.5	2.45	1.225	0.183	0.0903	2.026
	5.0	2.25	1.125	0.174	0.083	2.096
		$2R_2$ (cm)	R_2 (cm)			d_2 (Å)
OUTER	4.0	4.4	2.2	0.194	0.161	1.205
	4.5	4.1	2.05	0.183	0.150	1.22
	5.0	3.95	1.978	0.174	0.144	1.208

From geometry of Fig. 1 we have,

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

Upon simplifying & using fixed value of $L = 13.5$ cm & R expressed in cm,

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

Interplanar spacing can be calculated from eqn (1) by substituting eq(2) & eqn (4) into it

Safety guidelines & Precautions :-

1. Never accelerate beyond 5kV.
2. Never touch any controls on the power supply other than the 'On-Off' switch & the voltage varying knob.
3. Metal scales are not allowed.

Result :-

The interplanar spacings in graphite were measured as :-

$d_1 = 2.061$ Å

$d_2 = 1.211$ Å

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