Date. 14.10.19

Expt. No. 9 Page No.

Title – Electron diffraction

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

Apparatus: Electron diffraction tube with rod, high voltage power supply (upto 10kV), connecting wires, plastic measuring scale.

Basic information: In this experiment, electrons get transmitted through a very thin polycrystalline graphite sill ~~the~~ (graphite has 2 independent lattice spacing (d_1 and d_2) and these are shown in Fig 2. The two diffraction rings that will be seen at each voltage are due to these two planes.

Applying the diffraction formula for first order, we have

$$\lambda = d \sin \theta.$$

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 diff. of 'V' volts and hence, their De Broglie wavelength is →

$$\lambda = \frac{12.3}{\sqrt{V}} \mathring{A}$$

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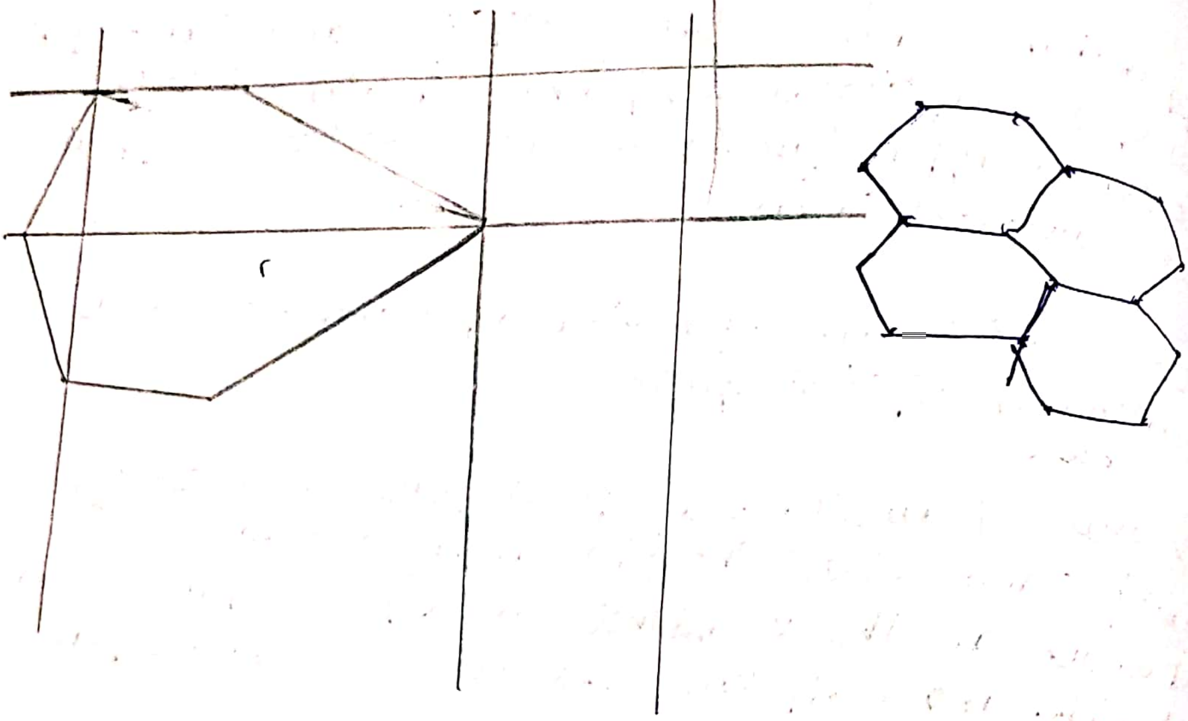

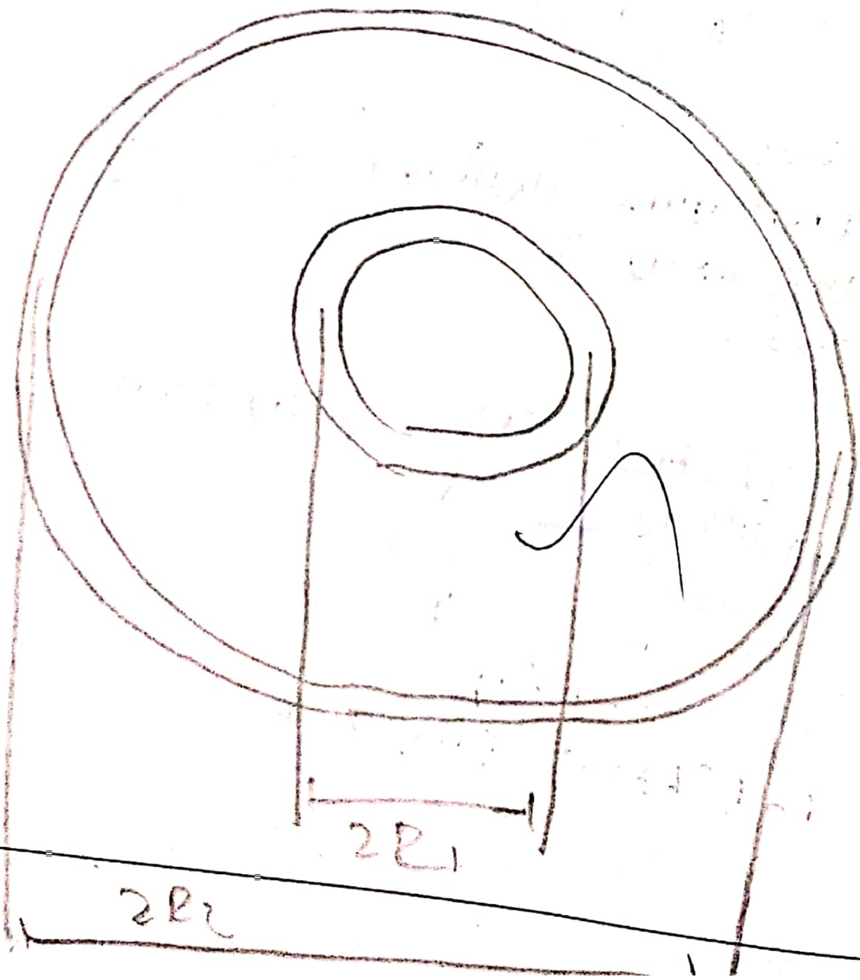
2R1
2R2

Expt. No..................

Date..........

Page No..........

Ring	V(KV)	2R1 & 2R2 (cm)	R1 (&) R2 (cm)	λ(Å)	sin θ	d(Å)
Inner	4.0	2.6	1.3	0.194	0.095	2.04
	4.5	2.4	1.2	0.183	0.085	2.08
	5	2.3	1.15	0.174	0.085	2.08
Outer	4.0	4.5	2.25	0.~~164~~ 194	B 0.164	1.18
	4.5	4	2	~~0.188~~ 0.183	0.149	1.24
	5.0	3.8	1.9	~~0.139~~ 0.174	0.139	1.25

Date..................

xpt. No.................. Page No..................

From the geometry g,

$$\sin\theta = \frac{R}{\sqrt{R^2+L^2}}$$

Upon simplifying and using the fixed value of L = 13.5 cm, and R, expressed in cm,

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

<u>Calculations</u>:

Avg d for inner ring = 2.057 Å
Avg. d for outer ring = 1.223 Å

$$\frac{2.04 + 2.08 + 2.05}{3} = 2.057\,Å$$

$$\frac{1.18 + 1.24 + 1.25}{3} = 1.223\,Å$$

$$\lambda = \frac{12.3}{\sqrt{4\times10^3}} = 0.194$$

$$= \frac{12.3}{\sqrt{4.5\times10^3}} = 0.183$$

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Date..................

Expt. No.................. Page No....................

$$= \frac{12.7}{\sqrt{5\times10^{3}}} = 0.174\ \mathring{A}$$

(inner)

$$d = \frac{0.194}{0.095} = 2.04\ \mathring{A}$$

$$= \frac{0.183}{0.088} = 2.08\ \mathring{A}$$

$$= \frac{0.174}{0.085} = 2.05\ \mathring{A}$$

d (outer)

$$= \frac{0.194}{0.164} = 1.18\ \mathring{A}$$

$$= \frac{0.183}{0.147} = 1.24\ \mathring{A}$$

$$= \frac{0.174}{0.139} = 1.25\ \mathring{A}$$

(inner)

$$\sin\theta = \frac{1}{\sqrt{1+\left(\frac{13.5}{1.3}\right)^2}} = 0.095$$

$$= \frac{1}{\sqrt{1+\left(\frac{13.5}{1.2}\right)^2}} = 0.088$$

$$\frac{1}{\sqrt{1+\left(\frac{13.5}{1.15}\right)^2}} = 0.085$$

sin θ (outer)

$$= \frac{1}{\sqrt{1+\left(\frac{13.5}{2.25}\right)^2}} = 0.164$$

$$= \frac{1}{\sqrt{1+\left(\frac{13.5}{2}\right)^2}} = 0.149$$

$$= \frac{1}{\sqrt{1+\left(\frac{13.5}{1.9}\right)^2}} = 0.139$$

Result: The interplanar spacings in graphite were measured as $d_1 = 2.05\ \mathring{A}$ and $d_2 = 1.22\ \mathring{A}$

10/10

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