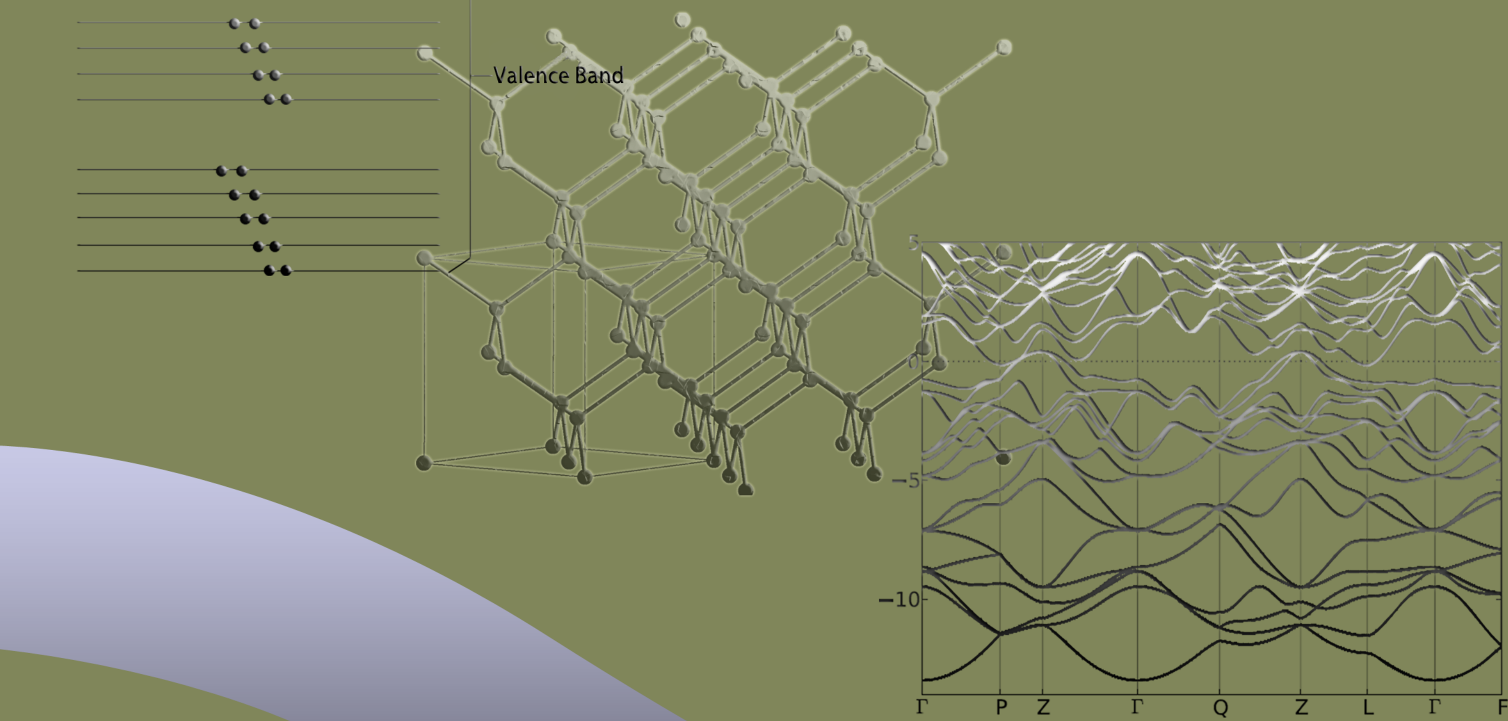
Queen Mary, University of London

School of Physics and Astronomy

Useful Equations



- Equation-1: The conversion equation for energy (eV) and wavelength (nm):

$$E(eV) = \frac{1240}{\lambda(nm)}$$

- Equation-2: The conversion equation for energy (eV) and temperature (K):

$$\frac{1eV}{k_B} = \frac{1.6022 \times 10^{-19} J}{1.3806 \times 10^{-23} J/K} = 11604.5052K$$

- Equation-3: The X-ray absorption coefficient dependence on several parameters:

$$\mu \approx \frac{\rho Z^4}{AE^3}$$

where μ is the absorption coefficient, ρ is the sample density, Z is the atomic number, A is the atomic mass, and E is the X-ray energy.

- Equation-4: The pressure unit exchange relationship:

$$10kbar = 1MPa$$
$$1MPa = 10^6 Pa$$
$$1GPa = 10^3 MPa = 10^9 Pa$$

- Equation-5: The commonly used formula to determine the lattice spacing in selected area electron diffraction (SAED):

$$R = \frac{L\lambda}{d}$$

The illustration for what each parameter means is given in the following figure: Here L and λ

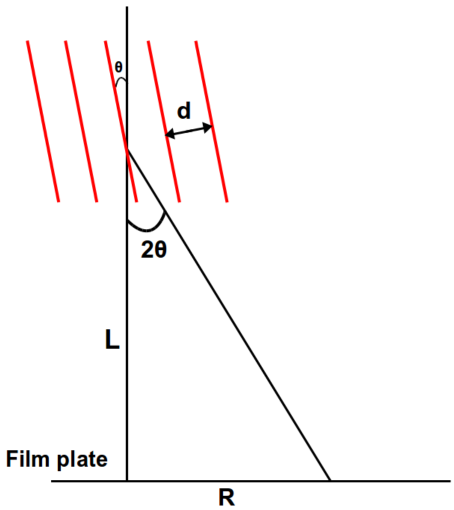


Figure. 1 The illustration for SAED.

is constant, and therefore the measurement on the film plate R is directly linked to the lattice spacing d. The derivation is as following:

$$R = Ltan2\theta \approx 2Lsin\theta$$

where θ is taken as quite small, thus we have $tan2\theta \approx 2tan\theta \approx 2sin\theta$. Then according to Bragg's law, we have:

$$2dsin\theta = \lambda$$

By combining the above two equations we can obtain:

$$\frac{L}{d} = \frac{R}{\lambda} \Rightarrow R = \frac{L\lambda}{d}$$

This is just the commonly used formula for SAED pattern to extract lattice spacing information.