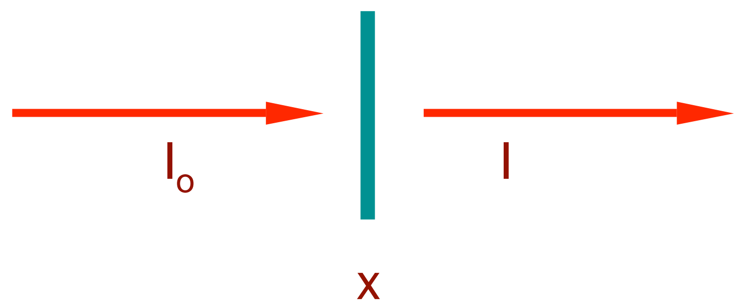
Thickness?

In transmission:



$$I/I_o = exp(-\mu\rho x) = exp(-\mu^* x)$$

μ $(= \mu^*/\rho)$ = mass attenuation coefficient

μ^* = linear attenuation coefficient

ρ = density of specimen

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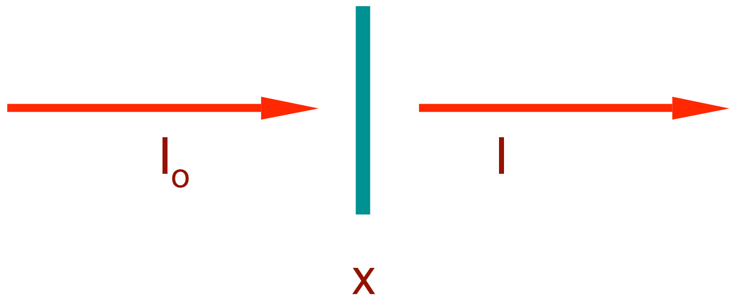

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$$\mu = wt.\ fract.\ A \cdot \mu_A + wt.\ fract.\ B \cdot \mu_B + wt.\ fract.\ C \cdot \mu_C + \ldots\ldots\ldots$$

Values for μ can be found in a number of tables (e.g., Intnl Tables for X-ray Crystallography)

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Also, scattering intensity built up by t^2, so

$$I \sim I_o\ exp(-\mu^* x)\ t^2$$

$$dI = const.\ I_o\ (exp(-\mu^* x))\ (2 - \mu^* x) = 0$$

optimum $x = 2/\mu^*$; more correct derivation gives $1/\mu^*$

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Examples (for CuKα):

Pure Ni - $optimum\ x = 1/(49.3 cm^2/gm \times 8.90 gm/cm^3) = 0.023 mm$

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Pure Al - *optimum x* = $1/(48.7cm^2/gm \times 2.70gm/cm^3) = 0.076mm$

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NiAl - $optimum\ x = 1/(((58.69/85.672) \times 49.3cm^2/gm + 0.315 \times 48.7cm^2/gm) \times 5.86gm/cm^3) = 0.035mm$

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$$optimum\ x = 1/\mu^*$$

Examples (for CuKα):

Polyethylene - $optimum\ x = 1/(((12.011/14.077) \times 5.50cm^2/gm + 0.147 \times 0.44cm^2/gm) \times 1.0gm/cm^3) = 2.1mm$

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Examples (for CuKα):

Quartz - $optimum\ x = 1/(((28.086/60.086)\ x\ 60.3 cm^2/gm + 0.533\ x\ 12.7 cm^2/gm)\ x\ 2.65 gm/cm^3) = 0.11 mm$

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Examples (for CuKα):

Quartz - *optimum x = 1/(((28.086/60.086) x 60.3cm*^{2}*/gm + 0.533 x 12.7cm*^{2}*/gm) x 2.65gm/cm*^{3}*) = 0.11mm*

Water - *optimum x = 1/(((16/18.016) x 12.7cm*^{2}*/gm + 0.112 x 0.44cm*^{2}*/gm) x 1gm/cm*^{3}*) = 0.88mm*

Thickness?

Metals & alloys

optimum $x = 10\text{-}50\mu = 0.01\text{-}0.05$ *mm*

generally cut, ground, & polished

very carefully - avoid poor surface finish

polycrystalline matls - grain size should be small

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Metals & alloys

optimum x = 10-50μ = 0.01-0.05 mm

generally cut, ground, & polished

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Polymers

optimum x = 1-2mm

slice, microtome

Water solutions ~ 1mm thick