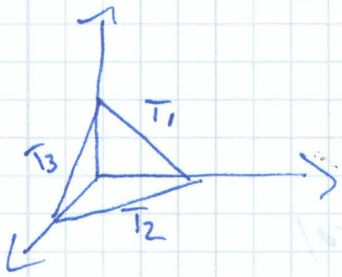
FKP Blatt 8



$$\vec{T}_1 = n_2\vec{a}_2 - n_1\vec{a}_1$$
$$\vec{T}_2 = n_1\vec{a}_1 - n_3\vec{a}_3$$
$$\vec{T}_3 = n_3\vec{a}_3 - n_2\vec{a}_2$$

$$h = \frac{KGV}{n_1}\,;\quad k = \frac{KGV}{n_2}\,,\quad l = \frac{KGV}{n_3}$$

$$\vec{G} = h\vec{b}_1 + k\vec{b}_2 + l\vec{b}_3$$

KGV = kleinstes gemeinsames Vielfaches

a)
$$\vec{G}\cdot\vec{T}_1 = (h\vec{b}_1 + k\vec{b}_2 + l\vec{b}_3)\cdot(n_2\vec{a}_2 - n_1\vec{a}_1) \qquad \vec{a}_i\vec{b}_j = 2\pi\delta_{ij}$$
$$= 2\pi(kn_2 - hn_1) = 2\pi\left(\frac{KGV}{n_2}n_2 - \frac{KGV}{n_1}n_1\right) = 0$$

b)
z.z.: $d_{hkl} = \frac{2\pi}{|G|}$ $\qquad |\vec{G}_{hkl}|\cdot\vec{e} = \vec{G}$

$$d = \vec{r}\vec{e} = r\frac{\vec{G}}{|\vec{G}|} \quad ;\quad r = n_1 a_1$$
$$= n_1 a_1 (h\vec{b}_1 + k\vec{b}_2 + l\vec{b}_3)\frac{1}{|\vec{G}|}$$
$$= 2\pi h n_1 \frac{1}{|G|} = \frac{2\pi\, KGV}{|G|} = \frac{2\pi}{|G|}$$

c)
z.z.: $d_{hkl} = \frac{a}{\sqrt{h^2+k^2+l^2}} \Leftrightarrow d_{hkl} = \frac{2\pi}{|G_{hkl}|}$

$$= \frac{2\pi}{\sqrt{h^2b_1^2 + k^2b_2^2 + l^2b_3^2 + 2hk\,b_1b_2 + 2hl\,b_1b_3 + 2kl\,b_2b_3}} \qquad b_i \perp b_j$$

$$= \frac{2\pi}{\sqrt{h^2b_1^2 + k^2b_2^2 + e^2b_3^2}} = \frac{2\pi}{\sqrt{\frac{4\pi^2}{a^2}(h^2+k^2+l^2)}}$$

d)
$a = 2\text{Å}$ $\qquad (100) \Rightarrow d = a$

$$2d\sin\vartheta = n\lambda \Rightarrow \vartheta = \sin^{-1}\left(\frac{\lambda}{2d}\right)$$

- Röntgen, $5\,keV$: $\lambda = \frac{hc}{E} = 2.48\text{Å}$ $\qquad = 38.3^\circ$
- e^-, $5\,keV$: $\lambda = \frac{h}{\sqrt{2mE}} = 0.17\text{Å}$ $\qquad = 2.44^\circ$
- n, $10\,meV$: $\lambda = 2.86\text{Å}$ $\qquad = 45.6^\circ$

Blatt 9

a)

$V = 0 \qquad t = 1 \,, \; r = 0$

$\cos(ka) = \frac{1}{2}\left(e^{ika} + e^{-ika}\right) = \cos(ka)$

b)

$\Rightarrow \omega(\psi, \psi^*)\,(\text{für } x \leq -\frac{a}{2}) = \omega(\psi, \psi^*)\,(\text{für } x \geq \frac{a}{2})$

$\Rightarrow |t|^2 + |r|^2 = 1$

c)

$\omega(\psi_l, \psi_r^*)\,(x \geq \frac{a}{2}) \overset{!}{=} \omega(\psi_l, \psi_r^*)\,(x \leq -\frac{a}{2})$

$t = |t| e^{i\beta} \qquad r = |r| e^{i\alpha}$

$rt^* = r^* \Rightarrow \beta - \alpha = \pm \pi/2$