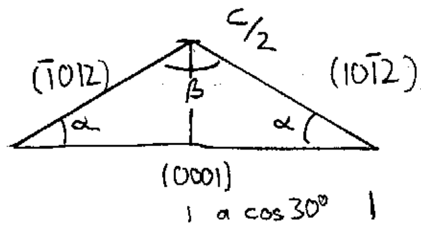
Problem #1:

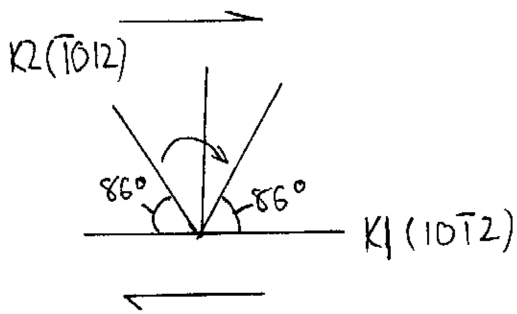


$$\tan\alpha = \frac{c/2}{a\cos 30^\circ} \overset{c/a = 1.86}{=} \frac{1.86a/2}{a\cos 30^\circ} = 1.07$$

$$\Rightarrow \alpha = 47^\circ$$

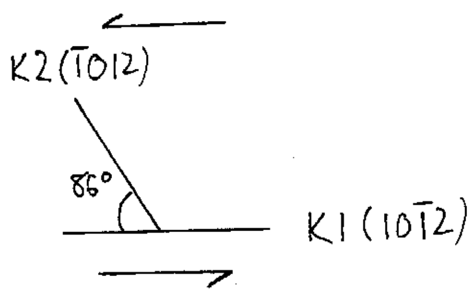
$$\Rightarrow \beta = 180^\circ - 2\alpha = 86^\circ$$

tension



twins ✓

compression



twinning not possible

- calc. β ✓
- tension and compression ✓
- c/a ratio ✓

Problem #2:

closed packed $c/a = 1.633$

$\Rightarrow \beta > 90°$ $\Rightarrow$ twins in compression e.g. Mg ($c/a = 1.624$)

- c/a ration for closed packed ✓
- $\beta > 90°$ ✓
- twins in compression ✓

Problem #3:

Tension $[\bar{2}111]$

slip system in hcp $\{0001\}\langle 11\bar{2}0\rangle$ ⇝ $[11\bar{2}0]$

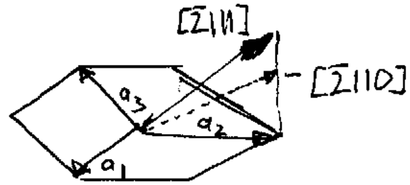
$[\bar{2}110]$

$[1\bar{2}10]$

$[\bar{1}\bar{1}20]$

$[2\bar{1}\bar{1}0]$

$[\bar{1}2\bar{1}0]$



⇝ maximum stress ⇝ $[\bar{2}110]$

Problem #4:

$(111)[11\bar{2}]$

$K_1 = (111)$ $K_2 = (11\bar{1})$

normal vectors $\vec{K}_1 = [111]$ $\vec{K}_2 = [11\bar{1}]$

$\vec{K}_1 \cdot \vec{K}_2 = |\vec{K}_1||\vec{K}_2| \cos\alpha$

$\Rightarrow \alpha = \cos^{-1}\left(\frac{1}{3}\right) \rightsquigarrow \alpha = 70.5$

$\beta = 180° - 2\alpha = 38.9 \approx 39°$

$\gamma = 2\tan(90° - \alpha) = 0.708$

or through geometrical considerations

– calc ✓ (angle + strain)
– geometrical considerations ✓

Problem #5:

tension rotates towards 101

furthestaway is 110

$$\cos\alpha = \frac{\begin{pmatrix}1\\1\\0\end{pmatrix}\begin{pmatrix}1\\0\\1\end{pmatrix}}{\sqrt{2}\cdot\sqrt{2}} = \frac{1}{2} \rightsquigarrow \alpha = 60^\circ \Rightarrow \theta = 30^\circ$$ before other slip system is activated

- find right directions ✓
- angle calc ✓

Problem #6:

use dislocation densities in shear equation

$$\Rightarrow D_1 t_1 = D_2 t_2 \overset{t_2 = t_{1/2}}{\rightsquigarrow} 2D_1 = D_2$$

$$\Rightarrow \frac{D_2}{D_1} = 2$$

$D_i = D_0 \exp[-Q/RT]$

$$\Rightarrow \frac{\exp[-Q/RT_2]}{\exp[-Q/RT_1]} = 2 \Rightarrow \exp\left[-Q\left(\frac{1}{RT_1} - \frac{1}{RT_2}\right)\right] = 2$$

$$\ln 2 = Q\left(\frac{1}{RT_2} - \frac{1}{RT_1}\right) \Rightarrow Q = \frac{R T_1 T_2}{T_1 - T_2} \cdot \ln 2 = 630 \frac{kJ}{mol} \qquad \left[\frac{J}{molK} \cdot \frac{K \cdot K}{K} = J/mol\right] \checkmark$$

depending on reference: $Q \triangleq$ W, Nb

- calc. ✓
- Q ✓

Problem #7: Yes, $T_m = 3695K \Rightarrow T > \frac{1}{3} T_m$ + short explanation (see lecture)