

ANSWERS TO NUMERICAL QUESTIONS (2004-2005)

1d) Plane spacing $d_{hkl} = a_0 / \sqrt{h^2 + k^2 + l^2}$

For (101) $d_{101} = 0.5362 / \sqrt{1 + 0 + 1} \text{ nm}$
 $= 0.3792 \text{ nm}$

For (111) $d_{111} = 0.5362 / \sqrt{1 + 1 + 1}$
 $= 0.3096 \text{ nm}$

For (113) $d_{113} = 0.5362 / \sqrt{1 + 1 + 9}$
 $= 0.1617 \text{ nm}$

For (040) $d_{040} = 0.5362 / \sqrt{0 + 16 + 0}$
 $= 0.1341 \text{ nm}$

1e) Angle between planes $(h_1 k_1 l_1)$ and $(h_2 k_2 l_2)$ is given by
 $\cos^{-1}[(h_1 h_2 + k_1 k_2 + l_1 l_2) / \sqrt{(h_1^2 + k_1^2 + l_1^2)(h_2^2 + k_2^2 + l_2^2)}]$

$(100) \wedge (110) = \cos^{-1} [1/\sqrt{2}] = 45.0^\circ$

$(111) \wedge (211) = \cos^{-1} [4/\sqrt{18}] = 19.5^\circ$

2b) Diffusion coefficient $(D) = D_0 \exp -[E_A/kT]$

At 1250°C (1523K) $D = 12 \times \exp -[4.05/(8.61 \times 10^{-5} \times 1523)] \text{ cm}^2/\text{s}$

$= 12 \times \exp -[30.89] \text{ cm}^2/\text{s}$

$= 4.6 \times 10^{-13} \text{ cm}^2/\text{s}$

For 60min $2\sqrt{Dt} = 2\sqrt{(4.6 \times 10^{-13} \times 3600)} \text{ cm}$

$= 8.14 \times 10^{-5} \text{ cm}$

$= 0.814 \mu\text{m}$