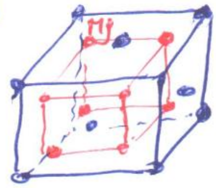
Exercice 1 :

Si → CFC , $a = 6.39\,A^\circ$.

a)



b) $\rho = \frac{n \cdot M}{V\,N_a} = \frac{4M_{Si} + 8M_{Mg}}{a^3 N_a}$

$= \frac{4(28) + 8(24,3)}{6,023\times10^{23}\times(6,39\times10^{-8})^3} = 1,94\ g/cm^3$.

c) $d_{Mg-Mg} = \frac{a}{2}$, $d_{Si-Si} = \frac{a\sqrt{2}}{2}$, $d_{Mg-Si} = \frac{a\sqrt{3}}{4}$.

d) $\tau = \frac{4\left(\frac{4}{3}\pi R_{Si}^3\right) + 8\left(\frac{4}{3}\pi R_{Mg}^3\right)}{a^3} = \ldots$

Exercice 2 : Fe_γ → CFC ($86,5\%\,Fe + 12,10\%\,Mn + 1,34\%\,C$) % en pds.

1) $\rho = ?$

a) Fe, Mn, C occupent les sites ~~interstitiels~~ propres de Fe_γ (substitution) :

$$\rho = \frac{n\,(x_{Fe} \cdot M_{Fe} + x_{Mn} M_{Mn} + x_C M_C)}{N_a\ a^3_{Fe_\gamma}}$$

On a : $x_{Fe} = \frac{n_{Fe}}{n_{Fe} + n_{Mn} + n_C}$, $x_{Mn} = \frac{n_{Mn}}{n_{Fe} + n_{Mn} + n_C}$, $x_C = \frac{n_C}{n_{Fe} + n_{Mn} + n_C}$.

$M_{Fe} \longrightarrow N_a$

$86,5 \longrightarrow n_{Fe}$ $\Rightarrow n_{Fe} = \frac{N_a \cdot 86.5}{55,85} = 1.54\,N_a$

$n_{Mn} = 0,22\,N_a$, $n_C = 0,11\,N_a$.

$\Rightarrow x_{Fe} = \frac{n_{Fe}}{n_{Fe} + n_{Mn} + n_C} = \frac{n_{Fe}}{N_T} = \frac{1,54\,N_a}{(1,54 + 0,22 + 0,11)\,N_a} = 0,82$

$x_{Mn} = \frac{n_{Mn}}{N_T} = 0,11$. et $x_C = \frac{n_C}{N_T} = 0,06$.

$$\Rightarrow \rho = \frac{4\left((0,82\times55,85) + (0,11\times54,93) + (0,06\times12)\right)}{6,023\times10^{23}\times(3,624\times10^{-8})^3} = 7,42\ g/cm^3.$$

b) C occupe l'insterstice et (Fe, Mn) occupent des sites de substitutions

$\Rightarrow$ le volume total diminue $\Rightarrow \rho' = \frac{m}{V'}$

des atomes $\longrightarrow V$

$82 + 11 + 6 \longrightarrow V$

$82 + 11 \longrightarrow V'$ $\Rightarrow V' = \frac{93V}{100} \Rightarrow \rho' = \frac{m}{0,93V} = \frac{1}{0,93} \cdot \rho = 7,97\ g/cm^3$.

2) on remarque que : $\rho_{exp} = \rho' \Rightarrow$ le cas le plus probable est le 2ème cas.

* l'existence de 2% lacunes $\Rightarrow$ le volume ~~augmente~~ diminue V''

$\Rightarrow \rho'' = \frac{m - 2\%\,m}{V''}$

93 atome $\longrightarrow V'$

93 ~~+~~ 2 $\longrightarrow V''$ $\Rightarrow V'' = \frac{91}{93}V' = 0{,}97V'$

$\Rightarrow \rho'' = \frac{(m - 2\% m)}{0{,}97V'} = \frac{(1-0{,}02)\,m}{0{,}97\,V'} = \frac{0{,}98}{0{,}97}\rho' = 8{,}052$ g/mole

__Exercice 03 :__

Zn $\to$ 35 % et Cu $\to$ 65 % en pds.

a) $M_{Zn} \longrightarrow N_a$ et $M_{Cu} \to N_a$ $\Rightarrow \begin{cases} n_{Zn} = 0{,}53\,N_a \\ n_{Cu} = 1{,}02\,N_a \end{cases}$

$35 \longrightarrow n_{Zn}$ $\quad 65 \to n_{Cu}$

$\frac{n_{Cu}}{n_{Zn}} = 2 \Rightarrow n_{Cu} = 2\,n_{Zn}$

on propose la composition chimique comme suivant $Cu_x Zn_y$

on pose $y = n_{Zn} = 1 \Rightarrow x = n_{Cu} = 2 \Rightarrow$ __Cu_2Zn__

* $M_{maille} = \frac{(x_{Zn} M_{Zn} + x_{Cu} M_{Cu}) \times n}{N_a}$

$x_{Cu} = \frac{n_{Cu}}{n_{Cu} + n_{Zn}} = \frac{2}{3} = 0{,}66$ et $x_{Zn} = \frac{n_{Zn}}{n_{Zn} + n_{Cu}} = \frac{1}{3} = 0{,}333$.

$\Rightarrow M_{maille} = 42{,}57 \times 10^{-23}$ g.

b) $\rho = \frac{M_{maille}}{a^3} \Rightarrow a = \left(\frac{M_{maille}}{\rho}\right)^{\frac{1}{3}} = 3{,}69 \times 10^{-8}$ cm $= 3{,}69$ A°.

* la loi de végard s'exprime comme suit : $Z_{solu} = \sum_{i=1}^{N} x_i Z_i$

grandeur quelconque (E. a. R. m)...

alors : $\langle R_{solu} \rangle = x_{Cu} R_{Cu} + x_{Zn} R_{Zn} = \frac{2}{3}(1{,}27) + \frac{1}{3}(1{,}33) = 1{,}29$ A°.

on a une structure cfc $\Rightarrow 4R_{sol} = a\sqrt{2} \Rightarrow R_{sol} = 1{,}30$ A°

$\Rightarrow \langle R_{sol} \rangle = R_{sol} \Rightarrow$ la loi de végard est vérifié.