Estimating Vacancy Concentration

- Find the equil. # of vacancies in 1 m³ of Cu at 1000°C.
- Given:

$\rho = 8.4\ g/cm^3$ $A_{Cu} = 63.5\ g/mol$

$Q_v = 0.9\ eV/atom$ $N_A = 6.02 \times 10^{23}\ atoms/mol$

$$\frac{N_v}{N} = \exp\left(\frac{-Q_v}{kT}\right) = 2.7 \times 10^{-4}$$

(Q_v: 0.9 eV/atom; T: 1273K; k: 8.62×10^{-5} eV/atom-K)

For 1 m³, $N = \rho \times \frac{N_A}{A_{Cu}} \times 1\ m^3 = 8.0 \times 10^{28}$ sites

- Answer:

$N_v = (2.7 \times 10^{-4})(8.0 \times 10^{28})$ sites $= 2.2 \times 10^{25}$ vacancies

October 8th 2014 (Took quiz @ beginning of class)

Midterm will be week after Fall Break

Exam question

N_v = your answer

convert temp. to Kelvins first

setting up problem will get you mostly all points

ALLOYS

Impurities or foreign atoms always present in metals
Same exist as crystalline point defects
Most familiar metals are alloys
Impurity atoms have been added to enhance material properties

Terminology
Solvent – element or compound present in the greatest amount
Solute – element or compound present in minor concentrations

Addition of impurity atoms to metal – formation of a solid solution and/or a new second phase

Solid solution – compositionally homogeneous (impurity atoms randomly and uniformly dispersed)

Solvent - greatest amt.

Solute

alloy vs. composites → heterogeneous (visible mixture)

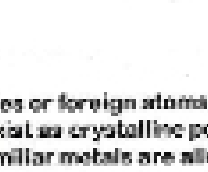
Can't identify parts of mixture homogeneous

CuNi (very compatible

Point Defects in Alloys

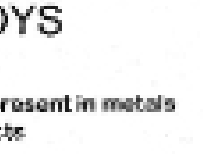
Two outcomes if impurity (B) added to host (A):

- Solid solution of B in A (i.e., random dist. of point defects)



Substitutional solid soln. (e.g., Cu in Ni)

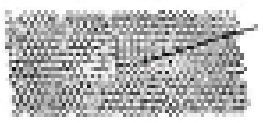
OR



Interstitial solid soln. (e.g., C in Fe)

(STEEL)

- Solid solution of B in A plus particles of a new phase (usually for a larger amount of B)



Second phase particle
--different composition
--often different structure.

Cu - FCC Ni - FCC

QUIZ NEXT WEDNESDAY 10/15

composit yet it is over saturated