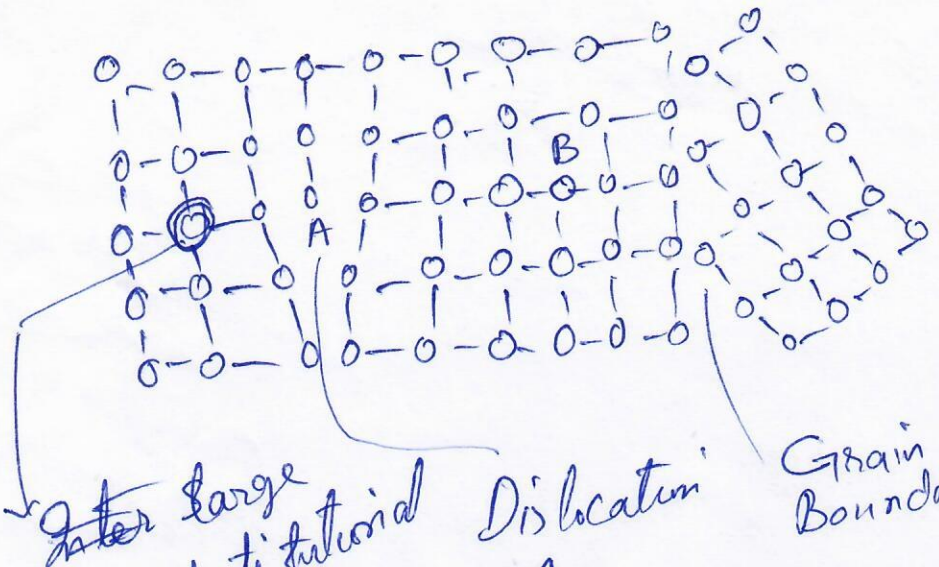
6-5-2012

CONTROL OF SLIP PROCESS



If the dislocation at point A moves to the left, it is blocked by the point defect. If the dislocation moves to the right, it interacts with the disturbed lattice near the second dislocation at point B. If the dislocation moves farther to the right, it is blocked by a grain boundary. This is called STRAIN HARDENING and we achieve more strength by substitutional atom grain boundary.

ATOMIC MOVEMENT IN MATERIALS

Diffusion is the moment of atoms within a material. Atoms move in an orderly fashion to eliminate concentration differences and produce a homogeneous uniform composition. Atoms also can be forced to move by applying voltages or external forces to the material. In fact atoms even move about randomly in pure metals when no external forces are applied or no concentration differences exist.

Moment of atoms is required for many of the treatments that we perform on materials. Diffusion is required for the heat treatment of metals, the manufacture of ceramics, the

manufacture of transistors and solar cells, and even the electrical conductivity of many ceramic materials.

STABILITY OF ATOMS

Atoms may jump across a grain boundary, permitting the grain boundary to move

Rate of moment $= C_0 e^{(-Q/RT)}$

$C_0 \rightarrow$ constant

$R \rightarrow$ Gas constant $8.31\ J/(mole\ K^\circ)$

$T \rightarrow$ Temp K°

$Q \rightarrow$ activity energy (J/mol) required to cause imperfection to move.

EXAMPLE

Suppose that interstitial atoms are found to move from one site to another at the rates of 5×10^8 jumps/sec at $500^\circ C$ and 8×10^{10} jumps/sec at $800^\circ C$. Calculate the activation

$5 \times 10^{8} = C_0 e^{(-Q/RT)} = C_0 e^{\frac{-Q}{8.31 \times (850+273)}}$ P-4

$8 \times 10^{10} = C_0 e^{\frac{-Q}{8.31 \times (800+273)}}$

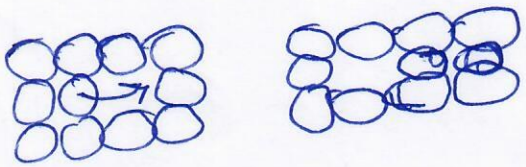
$$C_0 = \frac{5 \times 10^{8}}{e^{-0.000155675/Q}}$$

or sub in 2nd.

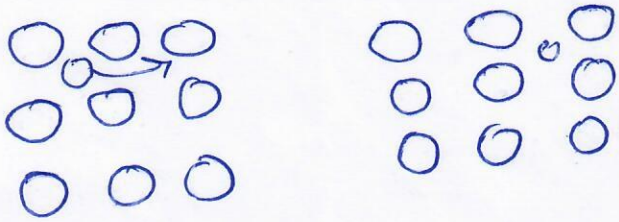
$$8 \times 10^{10} = \frac{5 \times 10^{8}}{e^{-0.000155675/Q}} \times e^{\frac{-Q}{(8.31 \times 800+273)}}$$

or $Q = 117{,}000$ Joules/mol.

Vacancy Diffusion

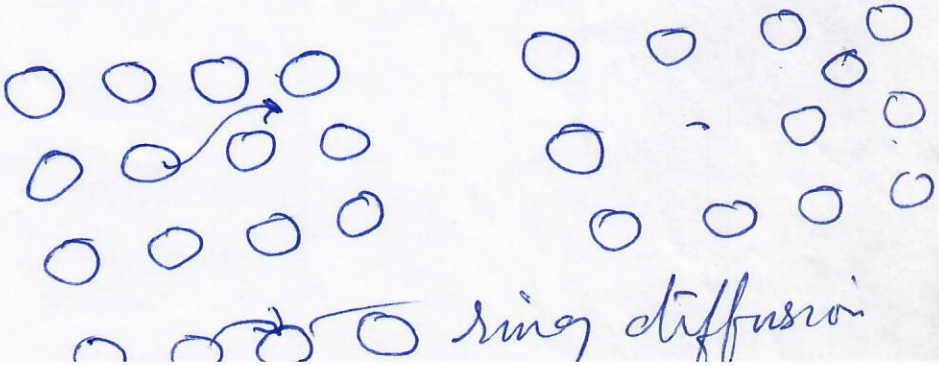


racancy diffusion



Interstitial diffusion

Interstitialcy



ring diffusion

Activation energy for diffusion

Energy required to move atom from one regular position to another.

Rate of Diffusion (Ficks' first Law)

$$J = -D \frac{\Delta C}{\Delta x}$$

$j \longrightarrow$ is the flux (atoms $/m^2 - s$),

$D \longrightarrow$ is diffusivity or Diffusion coefficient m^2/s

$\frac{\Delta C}{\Delta x} \longrightarrow$ Concentration gradient

Rate depends on (atoms $/m^3 . m$)

1. Concentration gradient