Mikko Karkkainen 3/31/2017

Homework Ch. 6

1. **Derive eq. 6.6**

The flux into/out of a volume element is proportional to the concentration gradient:

The divergence of flux represents “flux out”- “flux in”. If more flux goes out of the volume element than comes in, concentration decreases, and vice versa. This can be expressed mathematically:

Assuming that diffusivity is independent of concentration:

For the one-dimensional case:

Permeability is proportional to diffusivity and solubility:

Solubility is a temperature activated process:

So is diffusion:

**6.3**

Answer: penetration depth is increased by factor of

**6.5 a)**

b) Since diffusion in zinc oxides is controlled by interstitial diffusion of zinc ions, we can assume that ZnS is similar. Therefore the activation is the energy required to jump from an interstitial position to another.

c) Since in ZnO, diffusion increases with partial pressure due to the interstitial mechanism, in ZnS, D grows with partial pressure of sulphur.

**6.6** a) Activation energy of Na+ is lower than Ca++ or Si++.

b) Transition to glass

c) Quenching the glass would increase the specific volume of the glass, increasing diffusivity. The plot would be shifted upwards.

d)

**Answer: 95.7 kJ/mol**

**6.7**

For metal deficient:

Diffusion increases with partial pressure of oxygen

For oxygen deficient:

Diffusion decreases with partial pressure of oxygen.