

Exercise 2.1-8

Quick Questions to

2.1 Intrinsic Point Defects and Equilibrium

2.1.2 Frenkel Defects; 2.1.3 Schottky Defects; 2.1.4 Mixed Point Defects

Here are some quick questions:

- The *answers* are sometimes (and possibly only indirectly) contained in the links.

2.1.2 Frenkel Defects

- Why do we need "[Frenkel](#)" and "[Schottky](#)" defects besides vacancies, self-interstitials and their agglomerates?
- Draw a schematic picture of a crystal with "Frenkel" and "Schottky" defects. What kind of "[conservation laws](#)" do you have to consider, and why does that lead to a [fundamental difference](#) between the two defect kinds?
- What kind of charge would "the" vacancy carry in a **NaCl** crystal? (Consider only the realistic case).
- Give some crystals where [Frenkel disorder prevails](#).
- Give an (approximate) [equation](#) for the concentration of Frenkel defects and discuss the important terms

2.1.3 Schottky Defects and 2.1.4. Mixed Defects

- What, quite generally, is the [Debye length](#)?
- How does the [Debye length](#) come [into consideration](#) when discussing Schottky defects (and Frenkel defects)?
- If the formation enthalpies of two defect kinds differs by roughly [...???...eV](#), one defect type will be dominating and the other one can be neglected.
- Why do we usually consider *either* Schottky *or* Frenkel defects in ionic crystals but not [mixed defects](#)? For the answer check [this exercise](#).
- Can you predict for a given ionic crystal which kind of defect type (Schottky or Frenkel) [will be prevalent](#)?
- [Discuss the details](#) in the following set of equations:

$$\begin{array}{c} \text{Na}_{\text{Na}} + \text{V}_i \rightleftharpoons \text{Na}_i + \text{V}_{\text{Na}} \\ \downarrow \\ \frac{[\text{Na}_{\text{Na}}] \cdot [\text{V}_i]}{[\text{Na}_i] \cdot [\text{V}_{\text{Na}}]} = \text{const} = \exp \frac{G_{\text{Reaction}}}{kT} \\ \downarrow \\ c_{\text{V}}(\text{C}) \cdot c_{\text{i}}(\text{C}) = \frac{N}{N} \cdot \exp - \frac{H_{\text{FP}}}{kT} \\ \downarrow \\ c_{\text{V}}(\text{C}) = c_{\text{i}}(\text{C}) \end{array}$$

- Derive in an equivalent way the final relation for Schottky defects:

$$c_V(A) \cdot c_V(C) = \exp - \frac{H_S}{kT}$$

$$c_V(A) = c_V(C)$$