

Frenkel Defects

Basics

- Historically, point defects in crystals were first considered in ionic crystals, not in the much simpler metal crystals. The reason was that some known properties of ionic crystals (e.g. their conduction by ion migration at high temperatures) could be understood for the first time in terms of point defects, while no special properties of metals (in the twenties) were in desperate need of an explanation.
 - Since point defects in ionic crystals are charged, they can only come in pairs to maintain charge neutrality.
 - Frenkel defects** are charged interstitial - vacancy pairs carrying automatically different charge, e.g. a vacancy on a Na^+ site and a Na^+ interstitial (the other principally possible pairing of point defects is described by [Schottky defects](#)). Frenkel defects are dealt with in detail in [chapter 2.1.2](#).
 - In contrast to Schottky defects, there is no (or only a negligible) volume expansion of the crystal when Frenkel defects are formed.
- Researchers with a chemical or ceramics background tend to classify all point defects in the category "Schottky" or "Frenkel".
 - In this classification system, Frenkel defects do not appear in [thermal equilibrium](#) in simple (elemental) crystals. They may, however, be produced in non-equilibrium, e.g. by energetic irradiation which transfers sufficient energy to crystal atoms to displace them into interstitial sites while at the same time creating a vacancy.
 - The defect situation in Si, however, where vacancies and interstitials coexist in thermal equilibrium in comparable, but not necessarily equal amounts, cannot be accounted for in the "Schottky" / "Frenkel" system.
- It is thus not always useful to force all possible point defect assemblies in the narrow corset of "Schottky" or "Frenkel". The general situation of arbitrary numbers of several different point defects will be dealt with in [chapter 2.2](#)