1.3 Defects, Materials and Products

1.3.1 General Classification of Defects

Crystal lattice defects (defects in short) are usually classified according to their dimensions. Defects as dealt with in this course may then be classified as follows:

0-dimensional defects

- We have "**point defects**" (on occasion abbreviated *PD*), or, to use a better but unpopular name, "**atomic size defects**" .

- Most prominent are **vacancies** (*V*) and **interstitials** (*i*). If we mean **self-interstitials** (and you should be careful with using the name interstitials indiscriminately), these two point defects (and if you like, small agglomerates of these defects) are the only possible **intrinsic** point defects in element crystals.

- If we invoke *extrinsic* atoms, i.e. **impurity atoms** on lattice sites or interstitial sites, we have a second class of point defects subdivided into interstitial or substitutional impurity atoms or **extrinsic point defects**.

- In slightly more complicated crystals we also may have mixed-up atoms (e.g. a **Ga** atom on an **As** site in a **GaAs** crystal) or **antisite defects**

1-dimensional Defects

- This includes all kinds of **dislocations**; for example:

- Perfect *dislocations*, partial dislocations (always in connection with a *stacking fault*), dislocation loops, grain boundary and phase boundary dislocations, and even

- Dislocations in **quasicrystals**.

2-dimensional Defects

- Here we have **stacking faults** (*SF*) and **grain boundaries** in crystals of *one* material or phase, and

- **Phase boundaries** and a few special defects as e.g. boundaries between ordered domains.

3-dimensional Defects

- This includes: **Precipitates**, usually involving impurity atoms.

- **Voids** (little holes, i.e. agglomerates of vacancies in three-dimensional form) which may or may not be filled with a gas, and

- Special defects, e.g. stacking fault tetrahedra and tight clusters of dislocations.

If you understand German, you will find an elementary introduction to all these topics in chapter 4 of the "Materialwissenschaft I" Hyperscript