3.2.3 Crystal Lattice Defects in Si

- Strangely enough, while single crystalline **Si** as used in the micro electronics industry is the most perfect material in existence (at least on this side of Pluto), investigations of the possible lattice defects (point defects, dislocations, grain boundaries and so on) fill many volumes of scientific literature.
  - For the time being, however, we will not delve into this subject here in any great depth but refer to some links
- **Point defects** in **Si** are of prime importance for three independent reasons:
  - They are the vehicles for the all-important diffusion processes of dopants and other foreign atoms. Since there is a definite (and very unusual) contribution from self-interstitial present in thermal equilibrium, diffusion in **Si** is much more complicated than in other elemental semiconductors and still an object of study.
  - They are unavoidable defects because they are present in thermal equilibrium. This puts limits to the perfection of **Si** single crystals, and the microdefects introduced during crystal growth by agglomeration of point defects are a major object of investigation. The link leads to a recent article reviewing this part of defects in **Si**
  - Last not least: As long as we do not really understand point defects in **Si** - and we still don't - there is a need for basic research for basic research sake. After all, **Si** is not such a complicated crystal and if do not know everything there is to know about its thermal equilibrium defects, there is little hope to understand this in more complicated materials.
- "Larger" defects, i.e. **dislocations**, **grain boundaries** and **precipitates**, are also objects of intense investigations for the following reasons:
  - They are present in **poly-Si** that is used for, e.g., solar cells, and they will influence the technology and the device properties. It was (and still is) a major question if these defects are "electronically active" (meaning that they act as recombination centers), and what determines the level of those activities.
  - They may be formed during the processing of **Si** - mostly inadvertently with deadly effects, but sometimes intentionally (for the so-called "intrinsic gettering"). More about this subject in the link (and in the links going out from there).
  - They are studied in basic research to learn more about defects in covalently bonded crystals - the precise atomic structure of grain boundaries, e.g., is far from being completely understood.