2.1.4 Summary to: 2.1 General Chemistry and Structure

- Structure and size matter!
  - Mostly we need single crystals, as perfect (and as large) as possible
  - Either in bulk, or thin films
  - If thin film, substrates matter.
- For some applications (solar cell , **LCD**, ...) polycrystalline or amorphous semiconductors are used.
  - "**CIGS**" or **CdTe** for solar cells.
  - Amorphous or poly-**Si** for **LCD** transistor matrix.

Typical Si wafer:	**300 mm**, **850 µm** thick, perfect single crystal
Solar cell: Si	• Single crystalline, bulk. • Poly crystalline, large grain, bulk. • Polycrystalline, micro grain, "thick" film • Polycrystalline, nano grain, thin film. • Amorphous (plus **H**), thin film

- Important *elemental* semiconductors are **Si** and marginally **Ge**.
  - Forget **Se**, **C**, **P**, **As** and **B**.
- Compound semiconductors are important.
  - Group **IV** and compounds: **SiGe**, **SiC**.

    III-V compounds (**Al**, **Ga**, **In**) - (**N**, **P**, **As**, **Sb**). Important G**aAs**, **$Ga_xAl_{1-x}As$**, **GaP**, **InP**, ..

    Chalkogenides A_xB_y(S, Se, Te)$_2$. Important "**CIGS**" = **$CuIn_xGa_{1-x}Se_2$**.

    "**Newcomers**" like organic semiconductors, Metal oxides (e.g. **TiO_2**).
- Properties matter! Some properties are rather independent of the structure (= defects), others can be structure sensitive

Some important **Properties**	**Remarks**
Lattice type, lattice constant	**Structure independent**
Melting point, diffusion constants	
Bandgap type and energy	
Dielectric constant	
Thermal expansion coefficient	
Doping range	**Structure dependent**
Transport of electron / holes (mobility, life time, diffusion length, ..	
Unwanted levels in bandgap	

- What counts in the end are products that sell and make a profit!
  - Besides the direct semiconductor products, there are also products that contain semiconductors (**PC's**, Cars, TV's, any modern machine,...) and products that are needed to make semiconductor products (crystal growers, ovens, plasma etchers, ion implanters, ..).

Integrated circuits, Solar cells, Liquid crystal displays, Micro electronic and mechanical systems, Light emitting diodes, (Diode) Lasers, Sensors, ...

Exercise 2.1-1

All Class Exercises to 2.1