Exercise 3.4-1

Quick Questions to

3.4 Structure, Interface and Some Properties

Here are some quick questions:

- What is epitaxial growth? Consider the possibility of epitaxial growth; giving possible conditions (e.g. with respect to structures, lattice constants, ...) and use simple pictures:

  - **A** on **A**.
  - **A** (**fcc**) on **B** (**fcc**).
  - **A** (**fcc**) on **C** (**hex**).
  - **A** (**fcc**) on **B** (**fcc**) with intermediate layer.
  - ....

- **B (fcc; (100))** with lattice constant a_A is deposited on **A (fcc; (100)** with $a_B = 0.95\ a_A$. Sketch the structure for

  - Thickness of **B** only a few atomic layers.
  - Thickness of **B > 50 nm**

- *Difficult!* Sketch a pure edge misfit dislocation network on a **{100}** interface plane for a misfit of **10 %** for the case of

  - Burgers vector of the dislocations is <u>**b**</u> = <u>**a**</u>**<100>**.
  - Burgers vector of the dislocations is <u>**b**</u> = <u>**a/2**</u>**<110>**.

- *Difficult!* What would happen if the (square) network of misfit dislocations on a **{100}** type interface would be changed from edge dislocations to screw dislocations?

- What are the energetic reasons for introducing misfit dislocations into epitaxial interface it the layer thickness is larger than a critical thickness? What determines the critical thickness?

- Sketch the curve for the critical thickness d_{crit} in a d_{crit} - misfit diagram, Try to give approximate numbers.

- Enumerate and discuss *structures* obtainable with thin films but not (easily) with bulk materials. Give examples for applications.

- Give reasons why thin film properties can be quite different from bulk properties; give examples.

- Name some technologically extremely important special thin film properties; discuss with actual numbers.