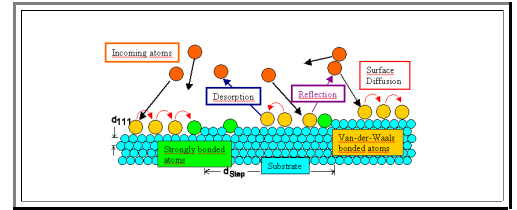


3.3.3 Summary to: 3.3 Nucleation and Growth

Deposition of a thin layer must start with a "clean" substrate surface on which the first atomic / molecular layer of the film must nucleate.

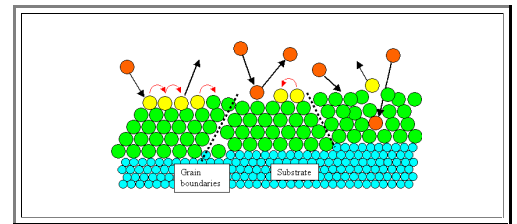
There are many possible interactions between the substrate and "first" incoming atoms.

- As the interaction energy goes up we move from "some" absorption to physisorption (secondary bonds are formed) to chemisorption (full bonding)
- The sticking coefficient is a measure of the likelihood to find an incoming atom in the thin film forming.
- Immobilization by some bonding is more likely at defects (= more partners). The initial stage of nucleation is thus very defect sensitive.



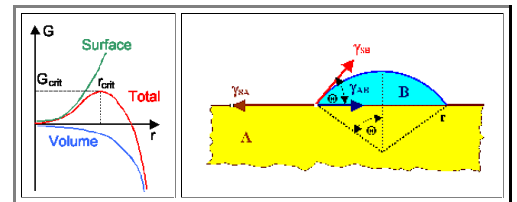
Simple surface steps qualify as efficient "defects" for nucleation.

- Small deviations from perfect orientation provide large step densities. Nucleation therefore can be very sensitive to the precise $\{hkl\}$ of the surface
- Intersections of (screw) dislocation lines with the surface also provide steps.
- This may cause grain boundaries and other defects in the growing layer.
- Scanning probe microscopy gives the experimental background

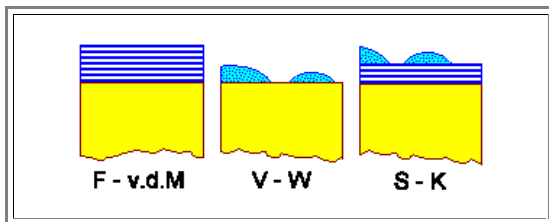


There is always a nucleation barrier that has to be overcome for the first "B-clusters" to form on "A"

- the three involved interface energies, all expressed in the "wetting angle", plus possibly some strain are the decisive inputs for the resulting growth mode.



- Frank - van der Merve:** Smooth layer-by-layer growth
- Vollmer - Weber:** Island growth
- Stranski - Krastanov:** Layer plus island growth



Exercise 3.3-1

All Questions to 3.3