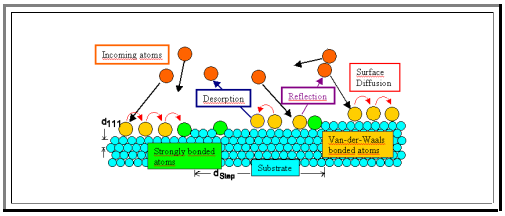
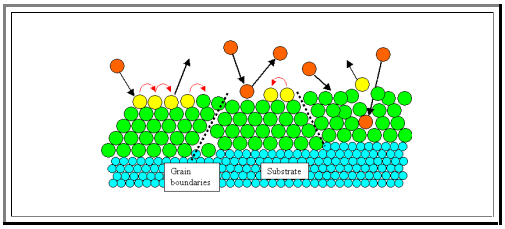
3.3.3 Summary to: 3.3 Nucleation and Growth

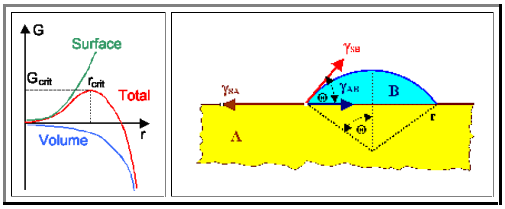
- Deposition of a thin layer must start with a "clean" substrate surface on which the first atomic / molecular layer of the film must nucleate.
- There are many possible interactions between the substrate and "first" incoming atoms.
  - As the interaction energy goes up we move from "some" absorption 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.



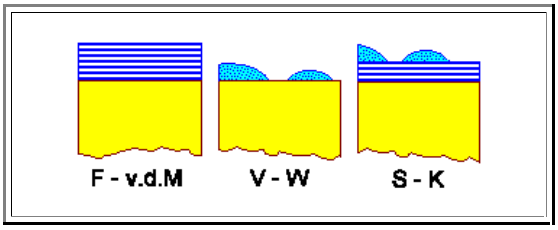
- Simple surface steps qualify as efficient "defects" for nucleation.
  - Small deviations from perfect orientation provide large step densities. Nucleation therefore can be very sensitive to the precise **{hkl}** of the surface
  - Intersections of (screw) dislocation lines with the surface also provide 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