Übungen zur Oberflächenphysik

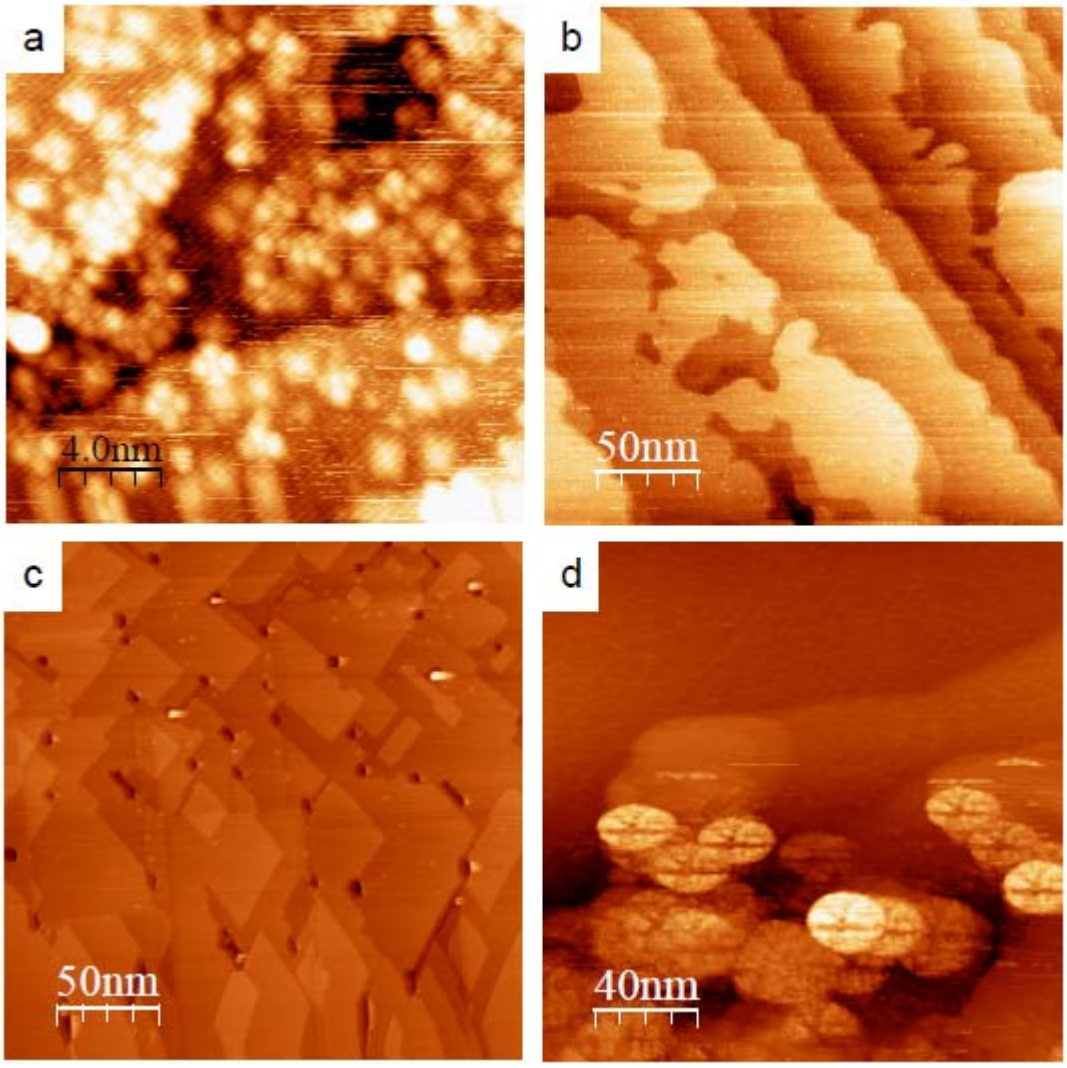
Blatt 5 – 30.04.2013

1) **STM**

a) Calculate by how much the tunnel current changes when decreasing the tip-sample distance by 0.2 nm (a typical mono-atomic step height). Assume a work function of 4 eV which is typical for a metal.

b) Name the two different STM operation modes that are commonly used. For each mode, indicate which quantity corresponds to the recorded signal and briefly discuss the advantages and disadvantages.

c) The following STM images all have an artefact. For each image, briefly discuss the reason of the artefact and how to avoid it.



2) **AFM**

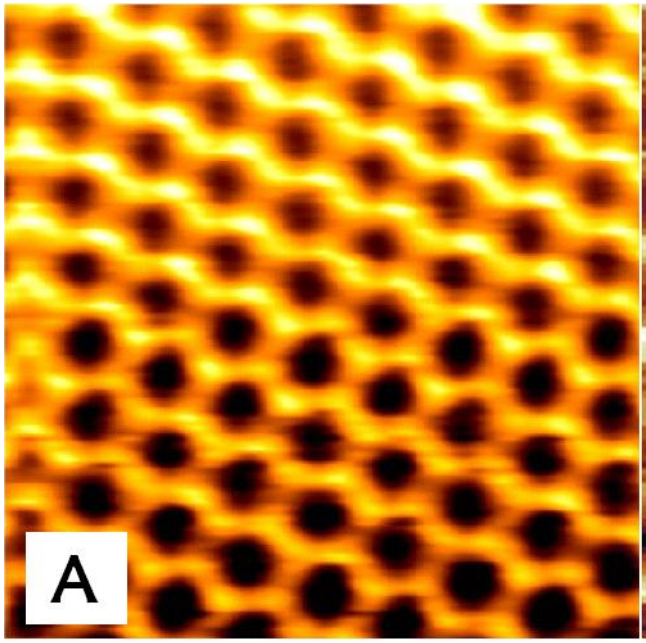
a) In case of a Lennard-Jones potential, sketch the force acting on the tip.

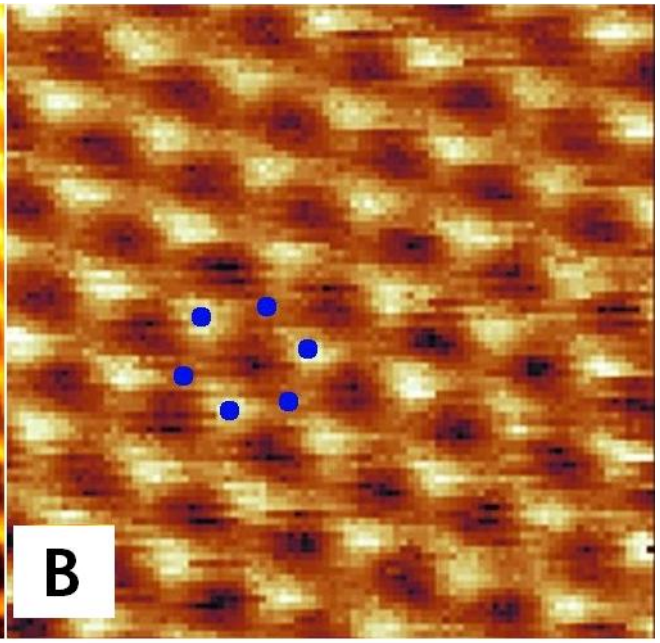
$$V = 4\varepsilon\left(\left(\frac{\sigma}{r}\right)^{12} - \left(\frac{\sigma}{r}\right)^{6}\right)$$

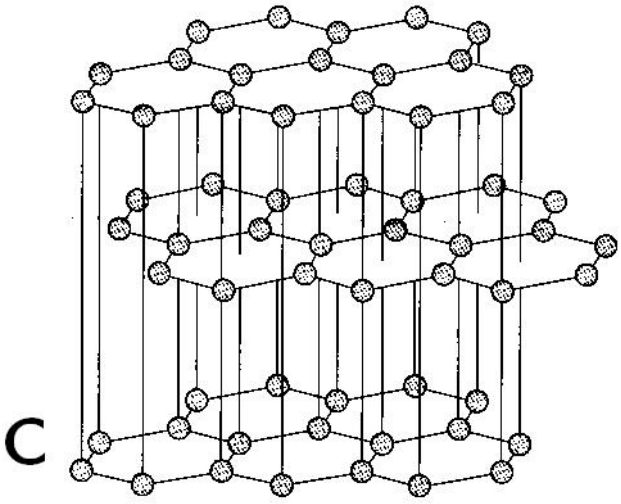
b) In which range are the contact, tapping and non-contact AFM used? Where do you use a stiff respectively a soft cantilever?

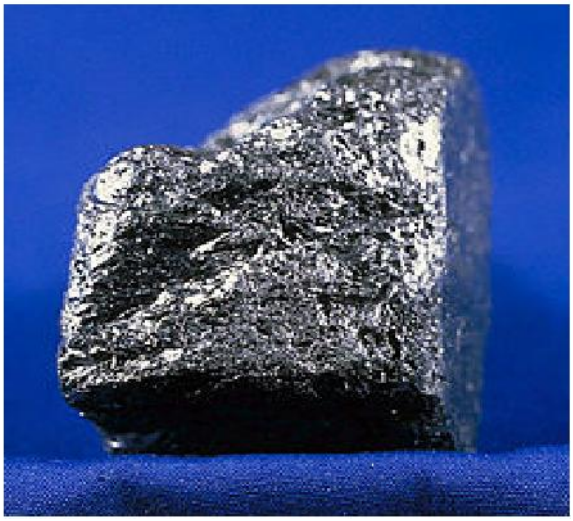
c) In the following figure there is an AFM image (A), an STM image (B), an atomic structure (C) and a picture (D) of the same substance. Answer the questions:

- What is the substance?
- What is the main difference between the AFM and the STM images?
- What causes this difference?



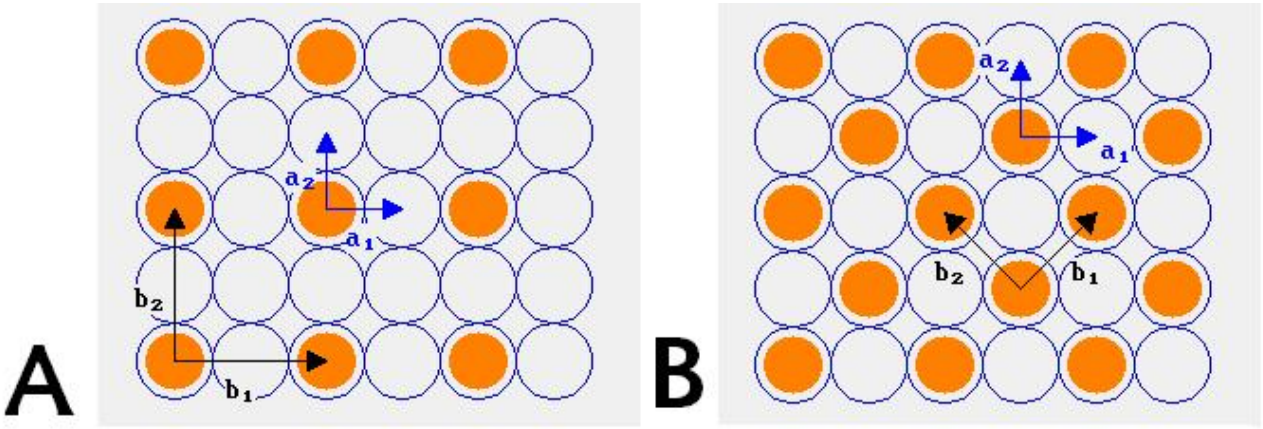




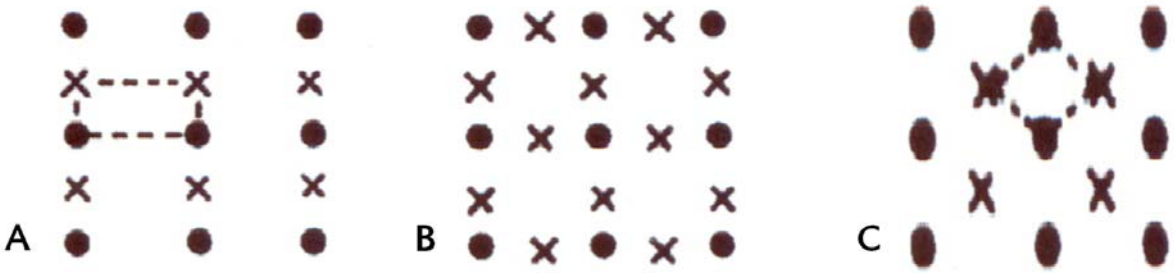


3) **LEED – a 2nd attempt**

a) Draw a LEED pattern of the following structures. White circles are the substrate, orange circles are the adsorbate (reconstruction).



b) Draw structures that would cause the following LEED patterns.



c) Write the Wood's for all five presented structures and Matrix notation for the first two.

d) In those simple drawings signal from the substrate is shown by dots and the signal from the reconstruction is show by crosses. How in a real LEED image can one distinguish them?