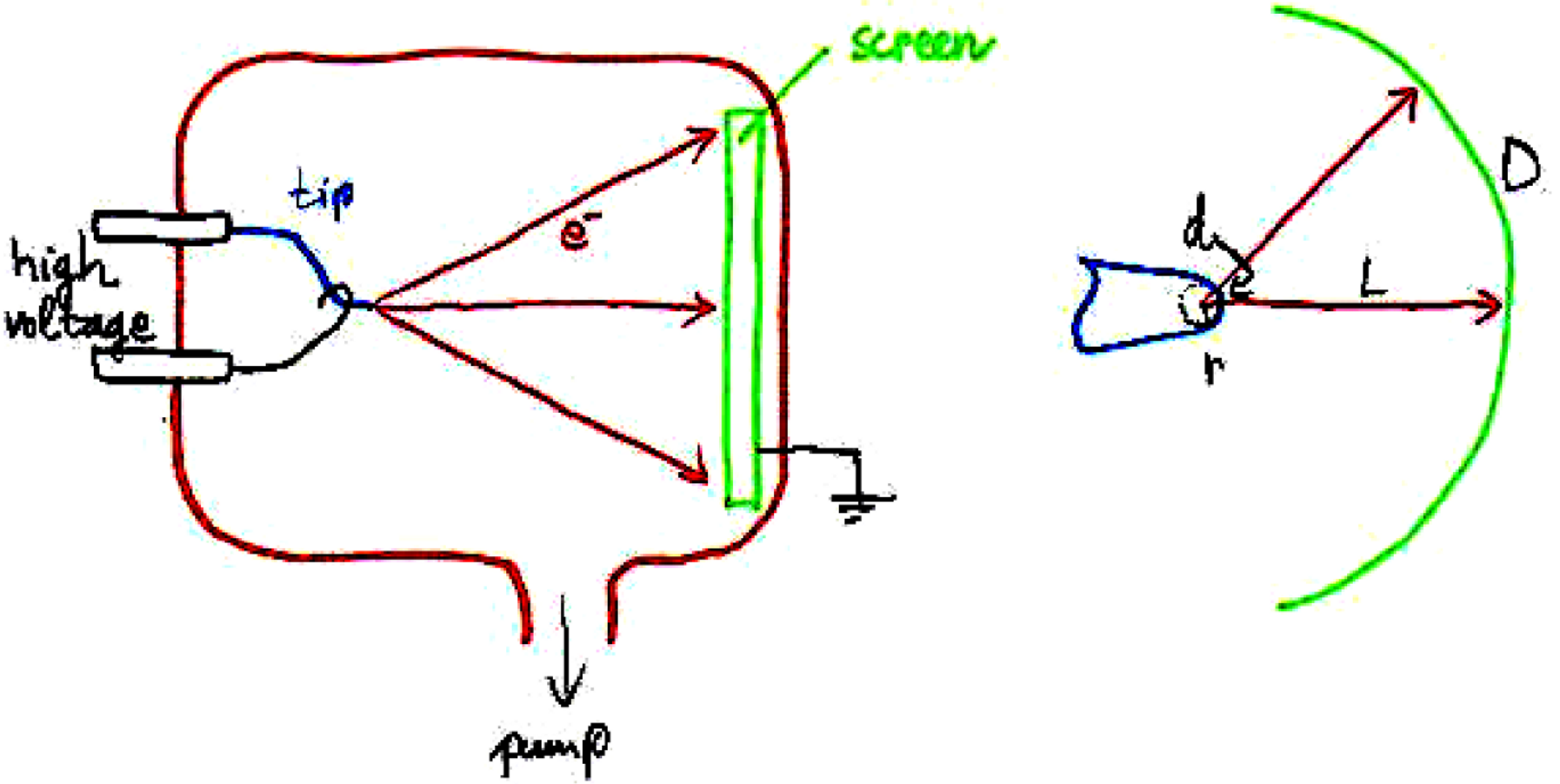
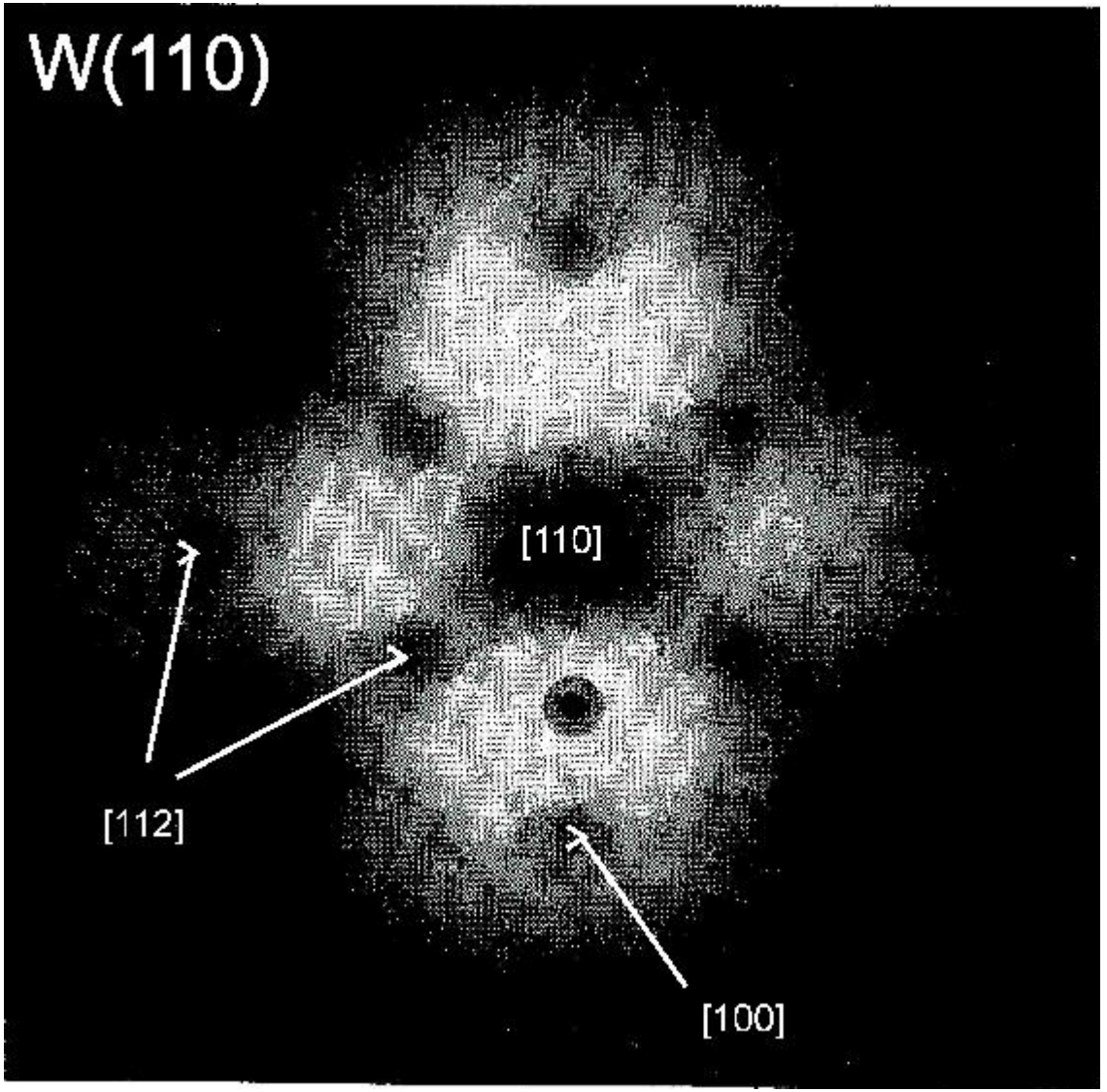
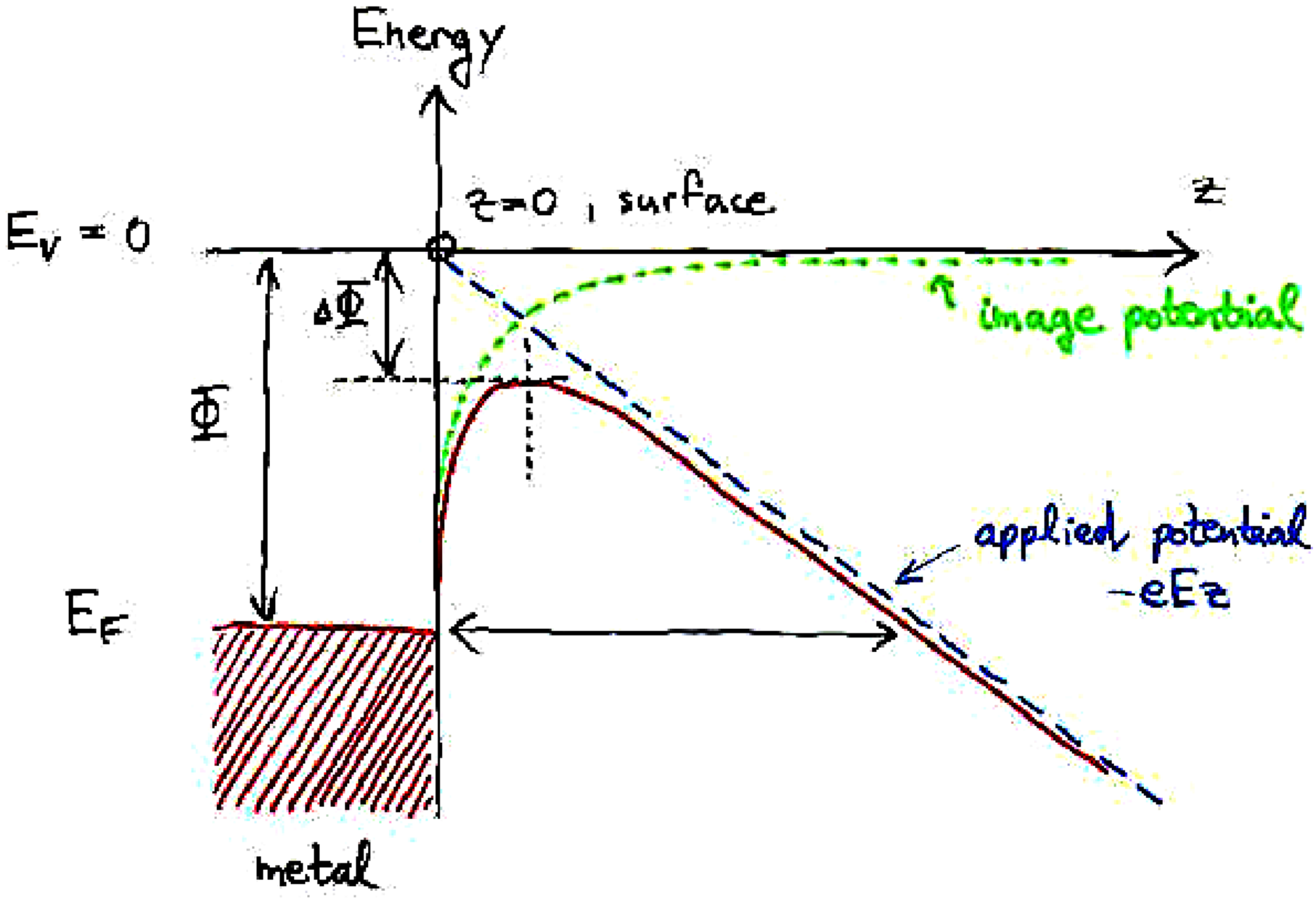
Field emission microscopy

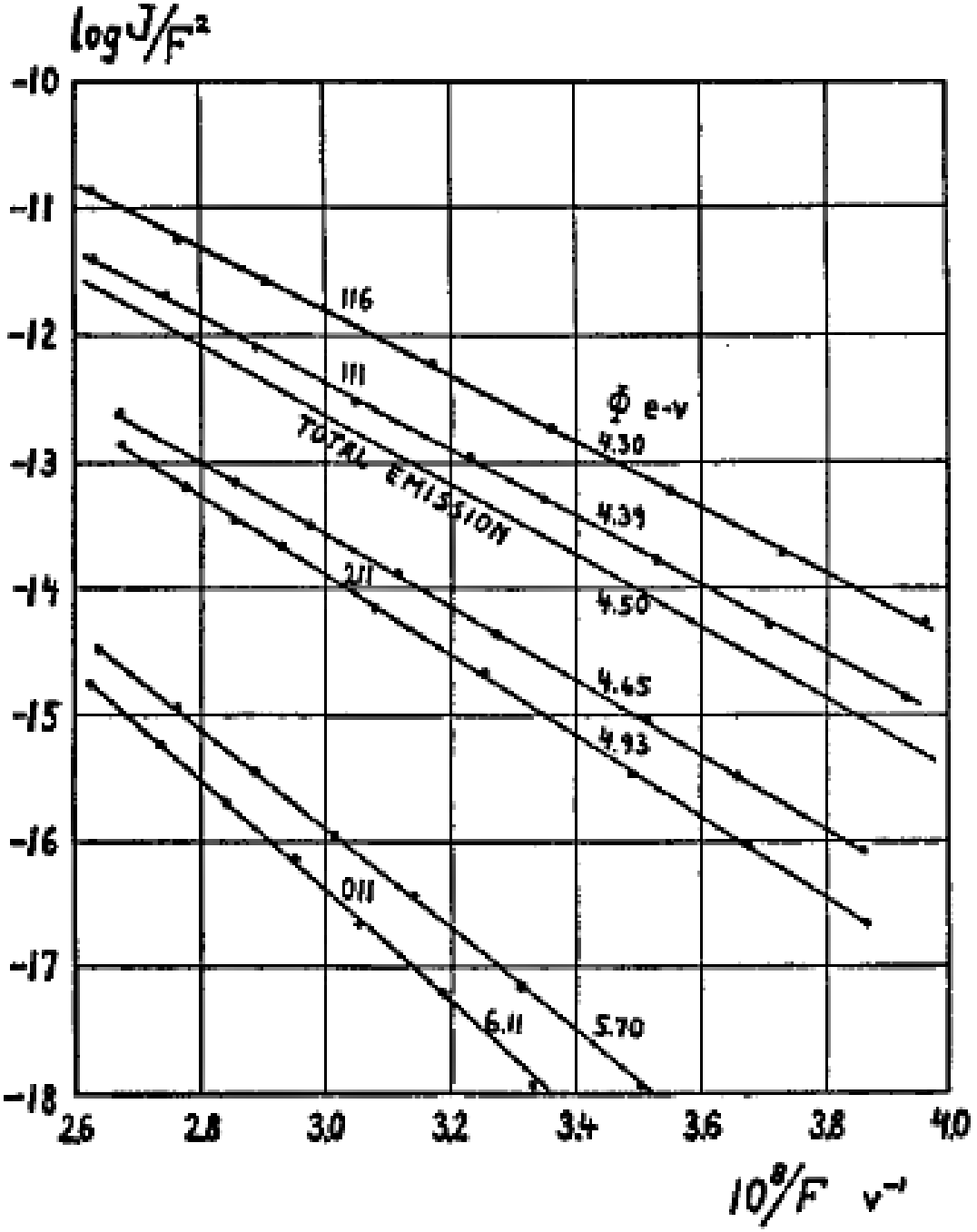




E. W. Müller, J. Appl. Phys. **26**, 732 (1955).

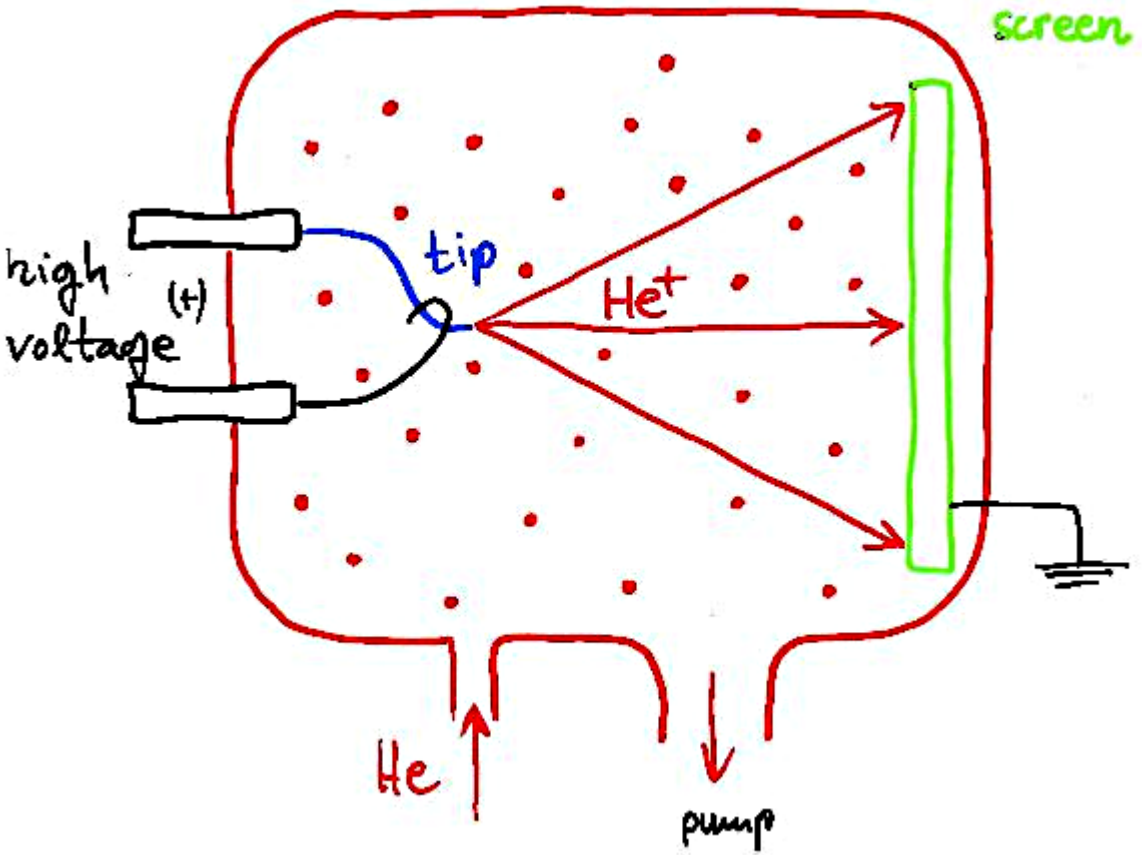

Energy
z=0 , surface
z
$E_V = 0$
$\Delta\Phi$
Φ
image potential
applied potential
$-eEz$
E_F
metal

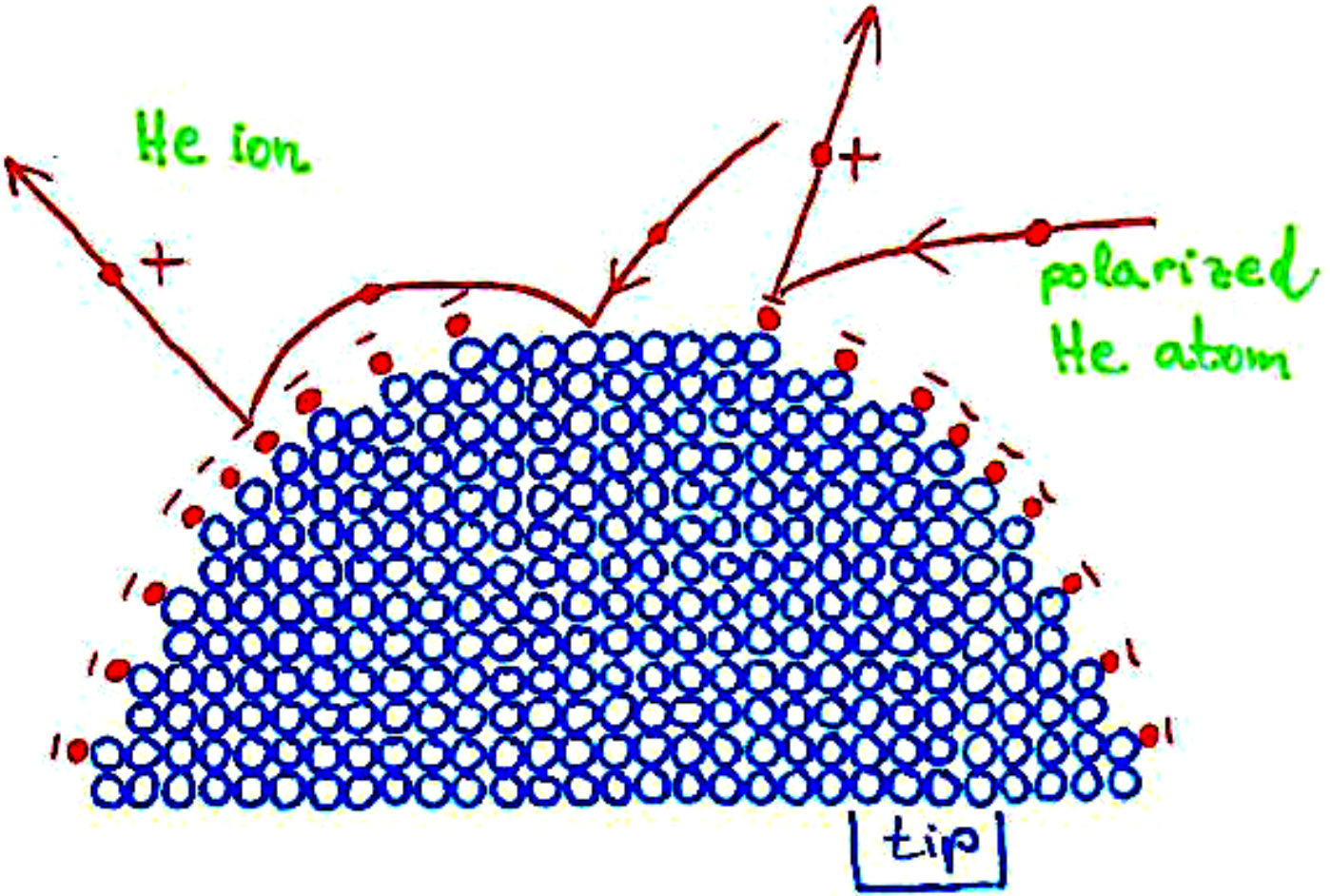
Surface Orientation & Work Function



E. W. Müller
J. Appl. Phys. **26**, 732 (1955)

From FEM to Field ion microscopy

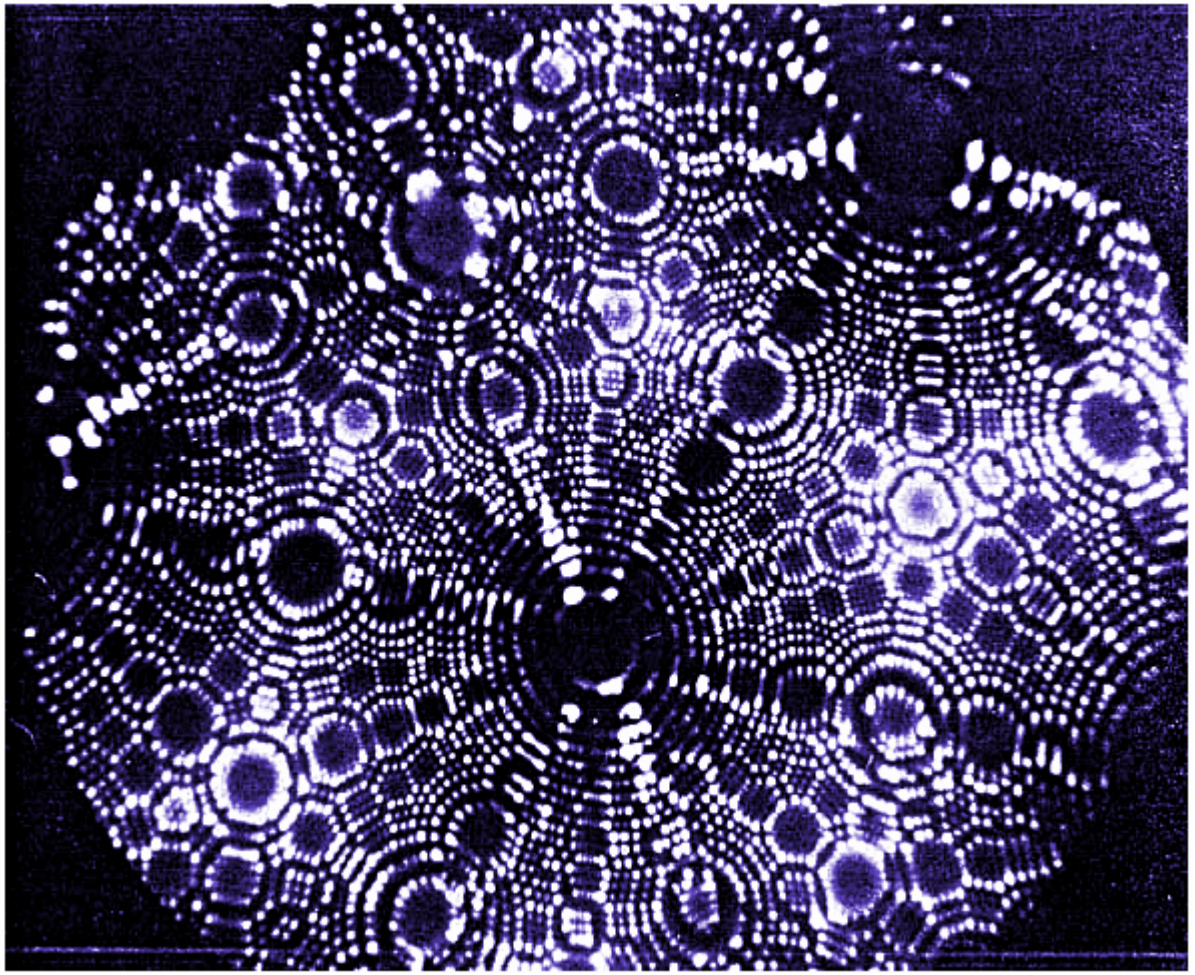




• He atom

o metal atom

FIM image of tungsten tip



T. T. Tsong, E. W. Müller, Phys. Stat. Sol. A **1**, 513 (1970)

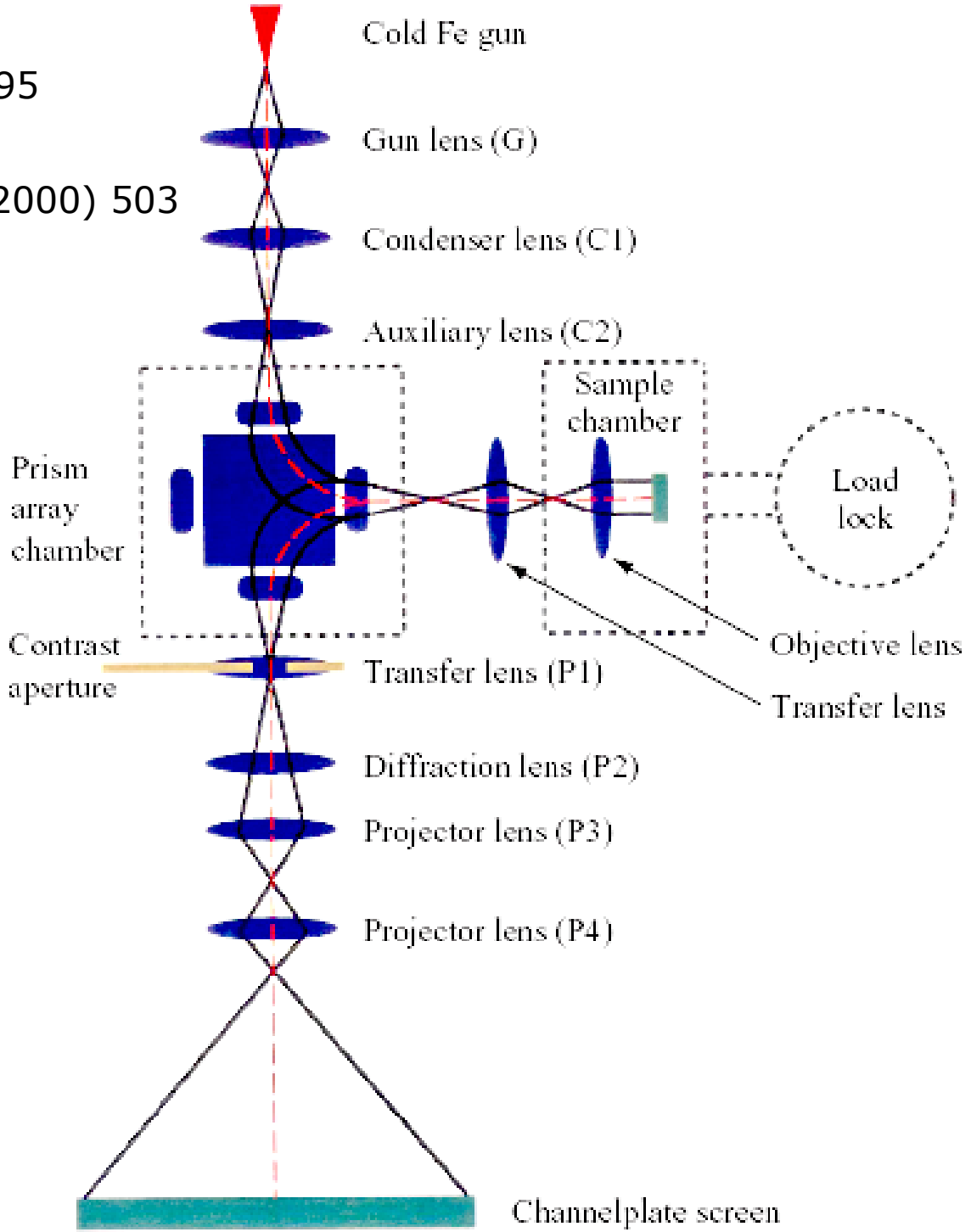
LEEM SPLEEM

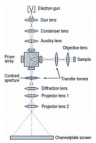
E. Bauer, Rep. Prog. Phys. **57** (1994) 895

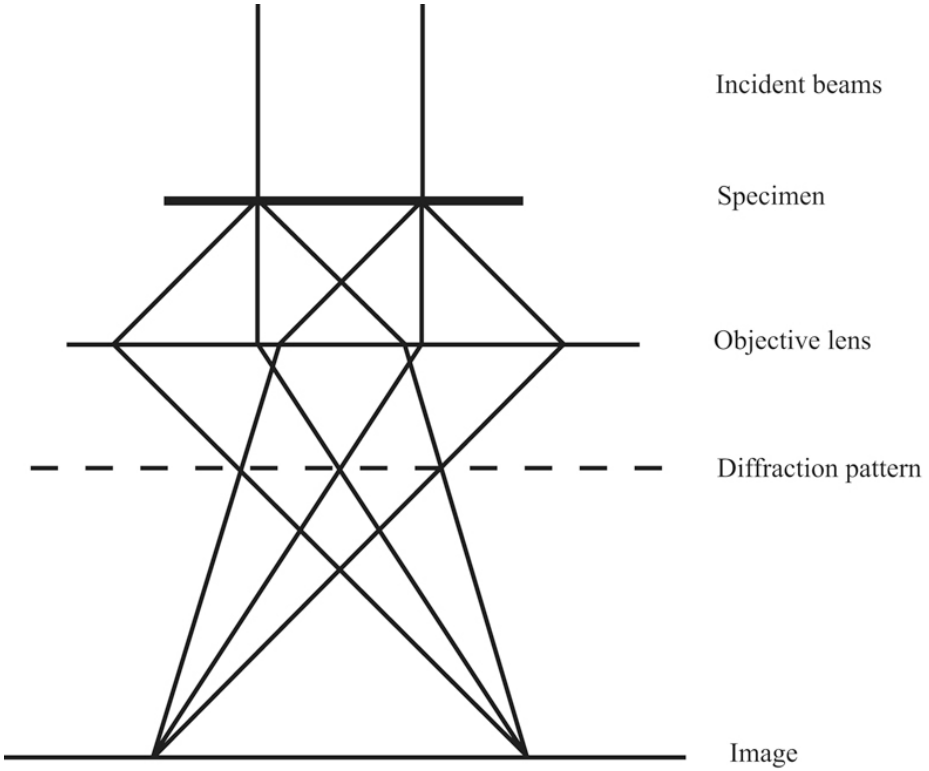
Doi:10.1088/0034-4885/57/9/002

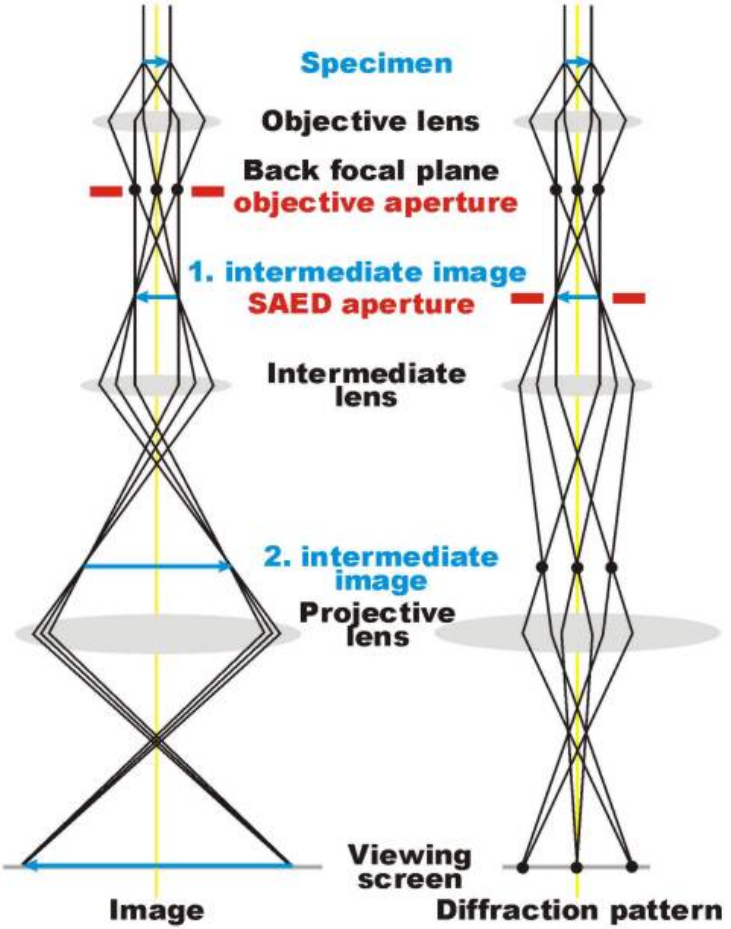
R. M. Tromp, IBM J. Res. Develop. 44 (2000) 503

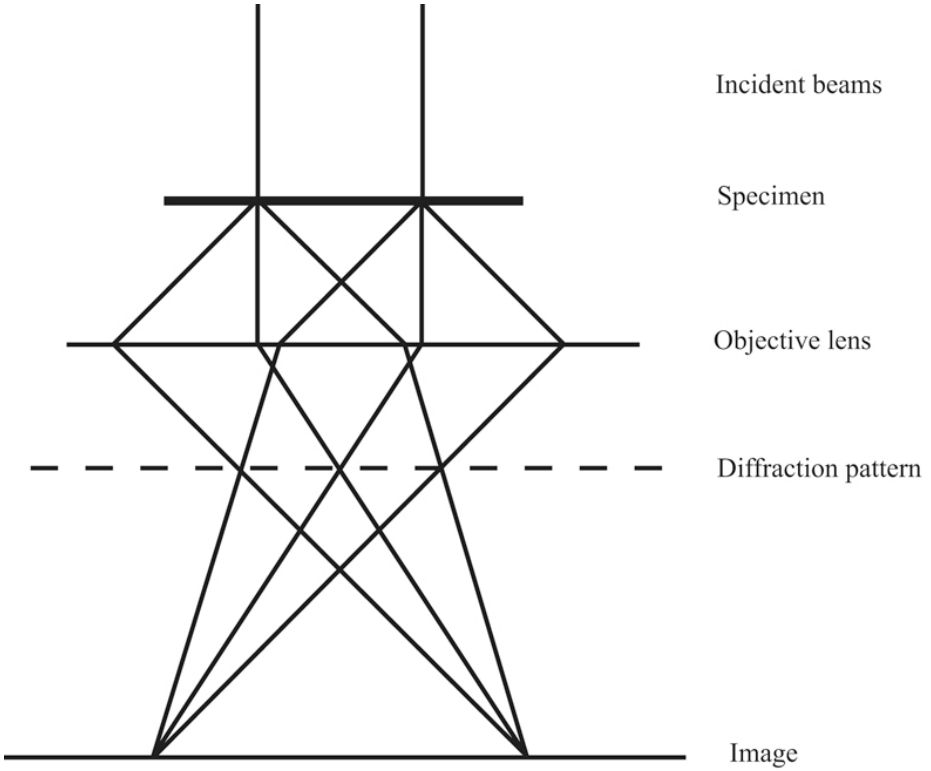
(Abb!)

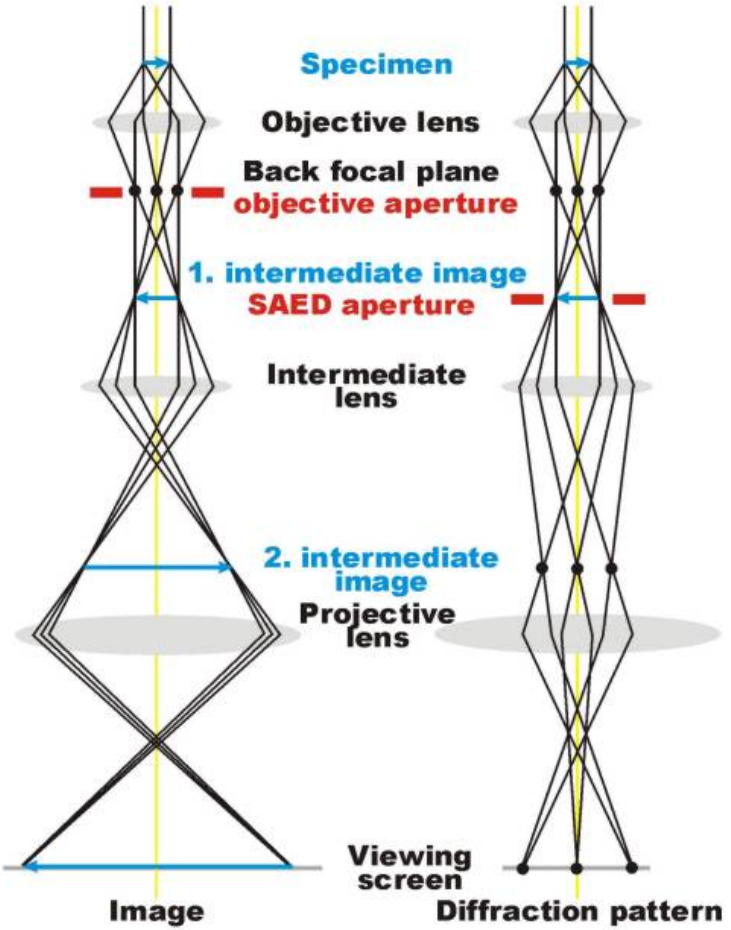





Incident beams
Specimen
Objective lens
Diffraction pattern
Image

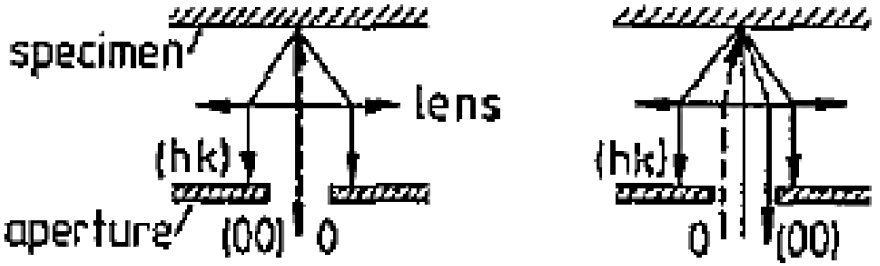

Specimen
Objective lens
Back focal plane
objective aperture
1. intermediate image
SAED aperture
Intermediate
lens
2. intermediate
image
Projective
lens
Viewing
screen
Image
Diffraction pattern

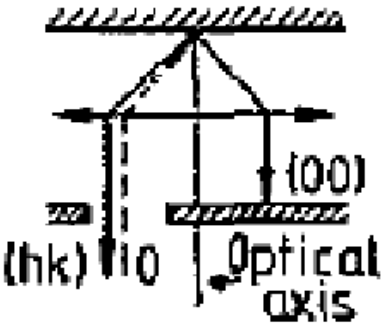




Bright-Field Imaging

Dark-Field Imaging





LEEM

Low energy electron microscopy

Si(111)

(0,0) spot

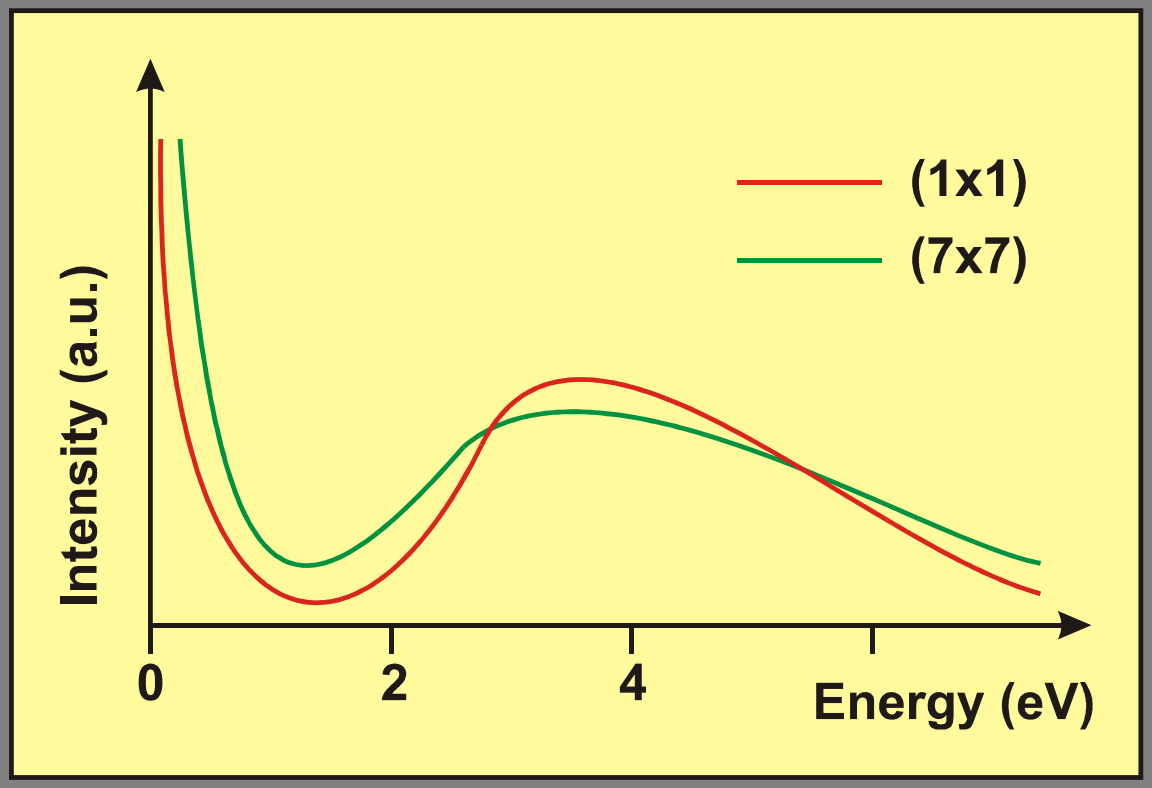
Field of view: 5 µm

Bright: 7x7

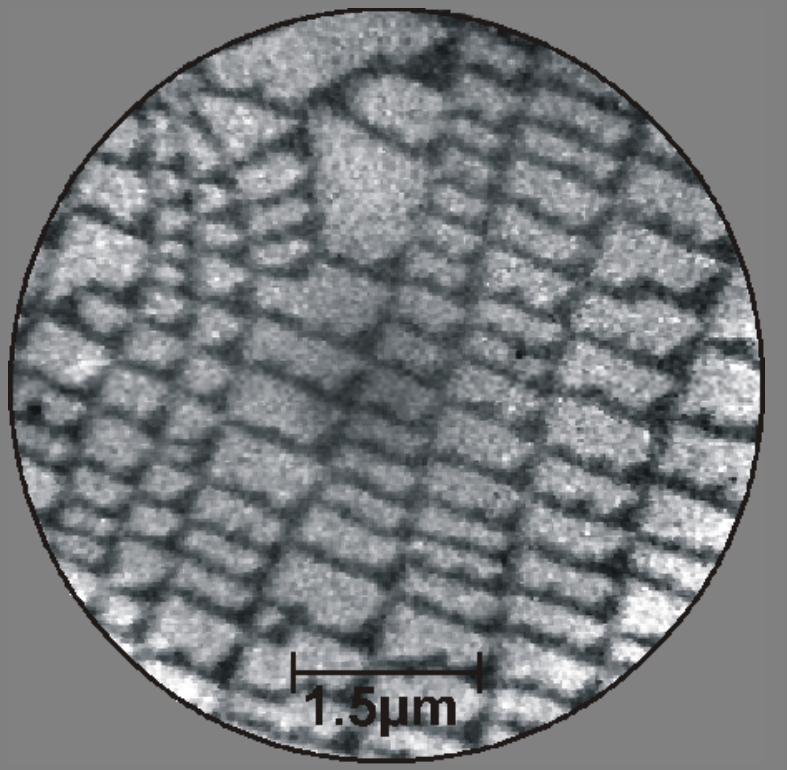
Dark: 1x1

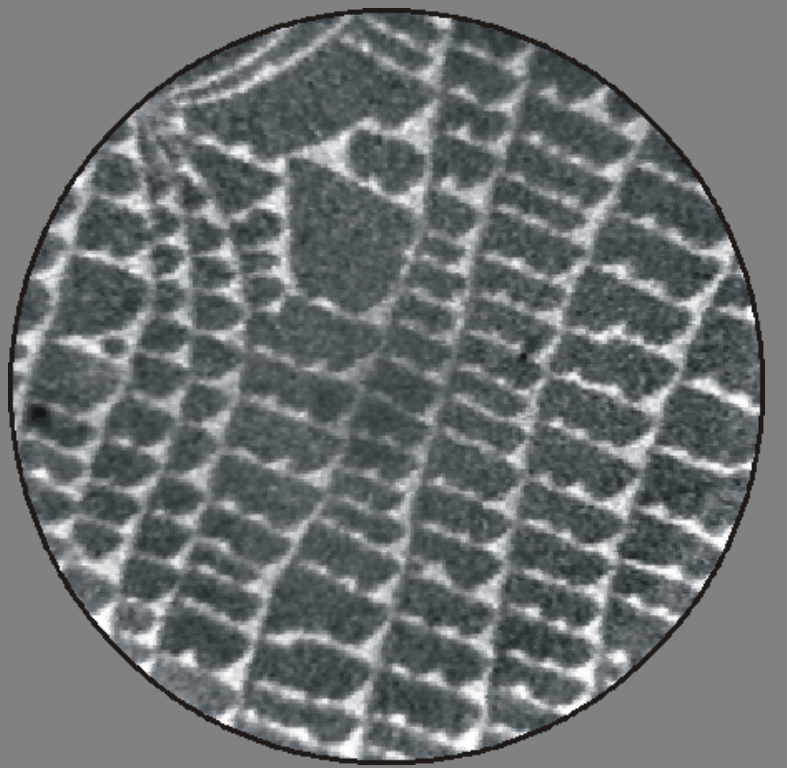
Fig. 7.11. Bright-field LEEM image of the Si(111) 7×7↔1×1 phase transition. The 7×7 phase (bright) decorates the atomic steps during the phase transition, while the terraces are mostly covered by the 1×1 structure (dark). Contrast is due to the difference in the (0,0) structure factor for the two phases. The field of view is 5 µm (after Tromp [7.7])

Bright Field Imaging of Si(111)



Energy-dependent reflectivity





Reflectivity contrast

Dark-field LEEM: different dimer orientations of Si(100) terraces

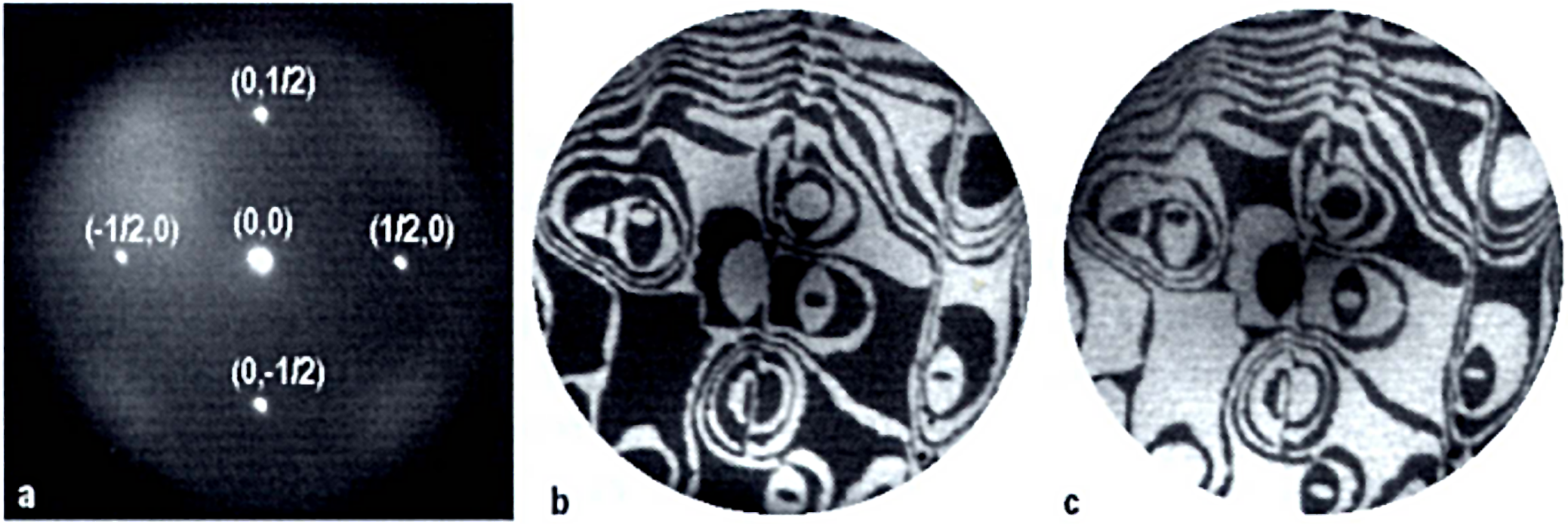
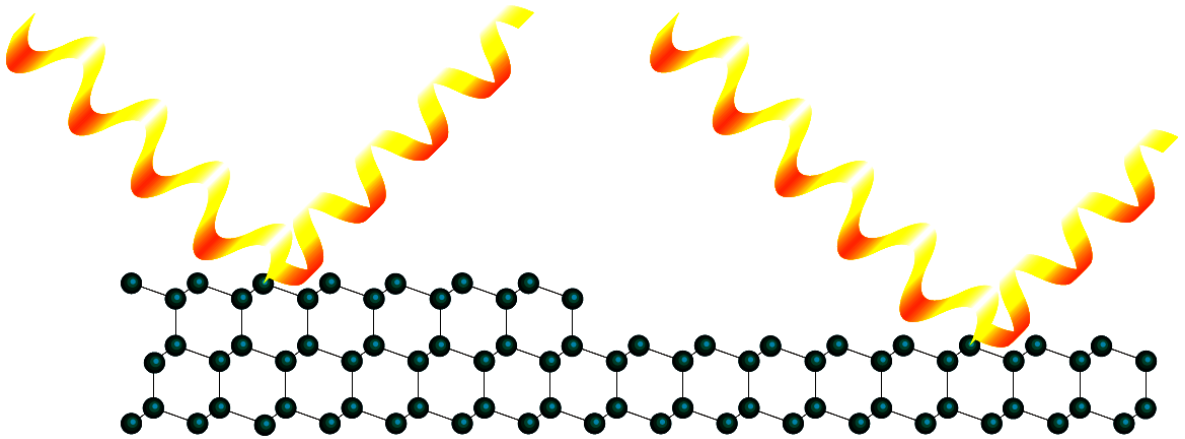
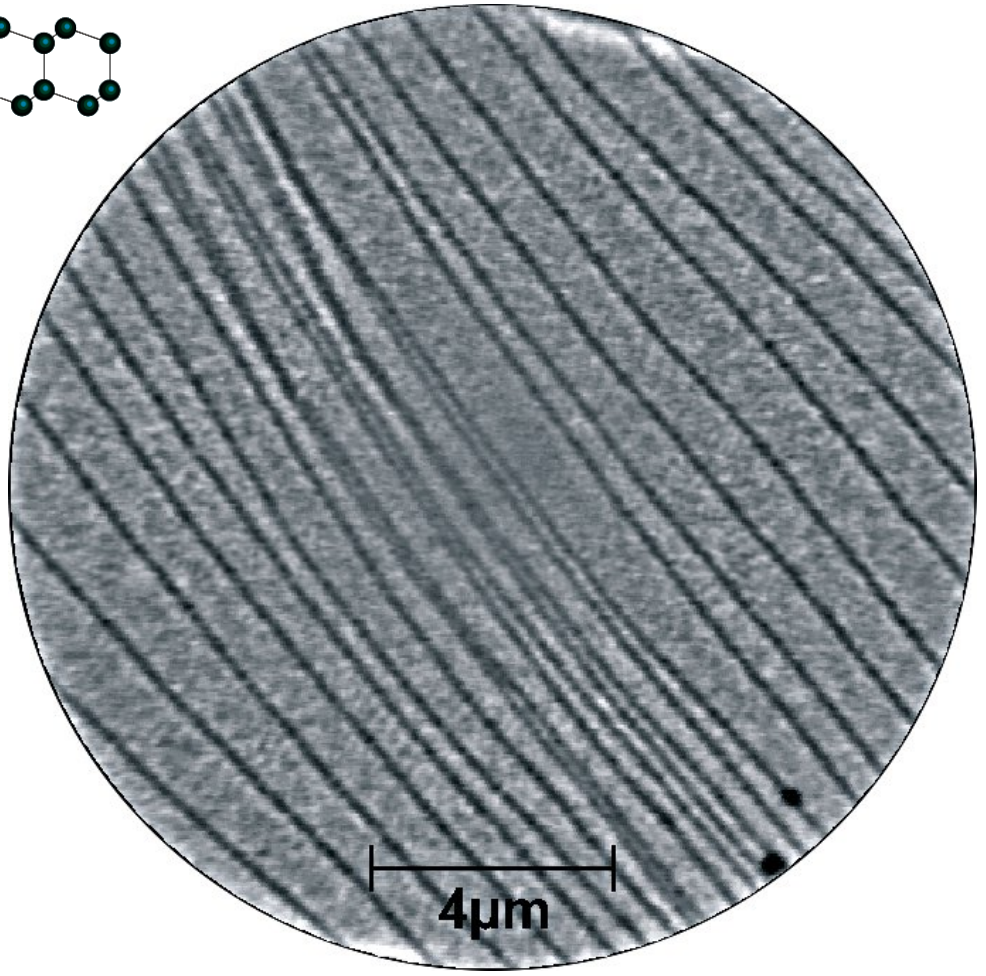


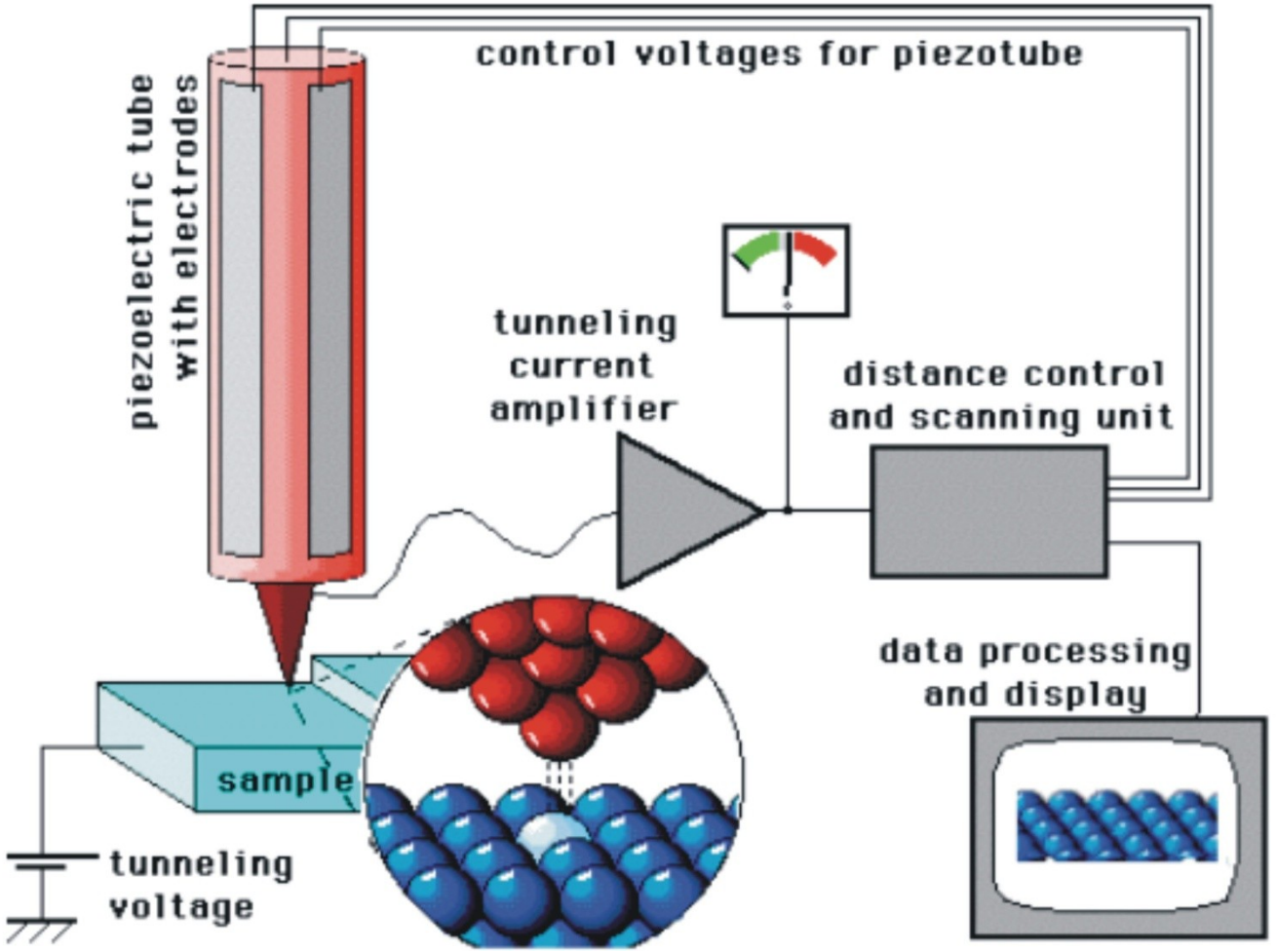
Fig. 7.12. (**a**) LEED image of the Si(100)2×1 clean surface. (**b**) Dark-field LEEM image of the surface in (**a**) taken using one of the (1/2,0) or (−1/2,0) spots for imaging. (**c**) Same as (**b**) using one of the (0,1/2) or (0,−1/2) spots. The field of view is 5 μm (after Tromp [7.8])

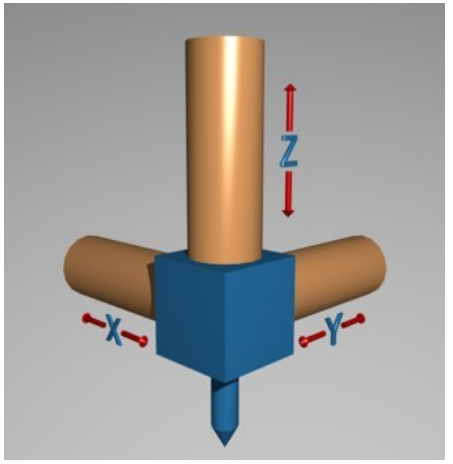
Geometric Phase Contrast

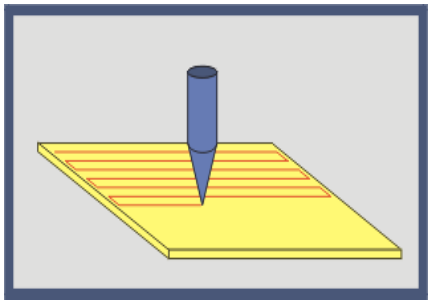


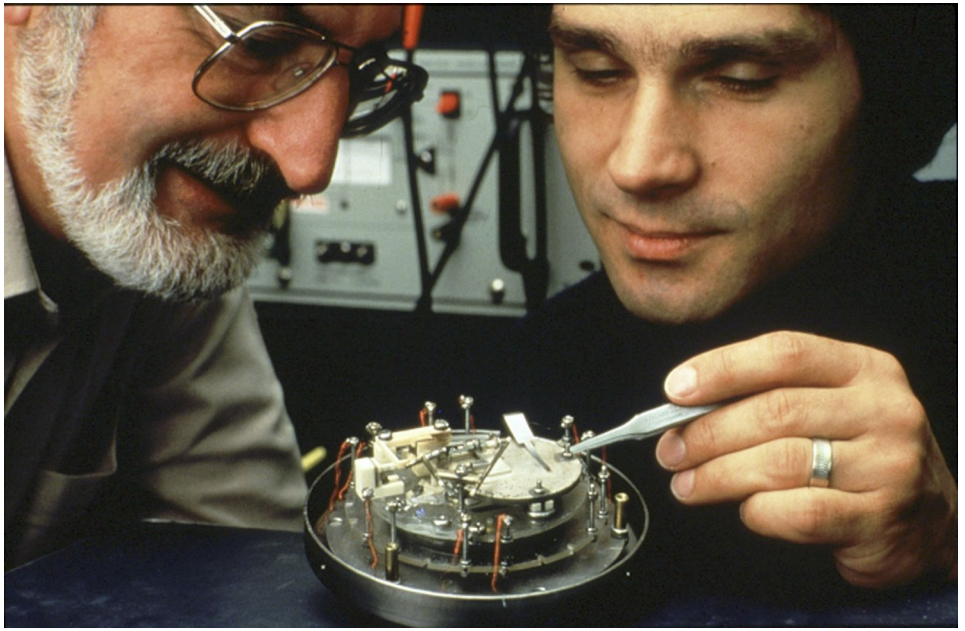


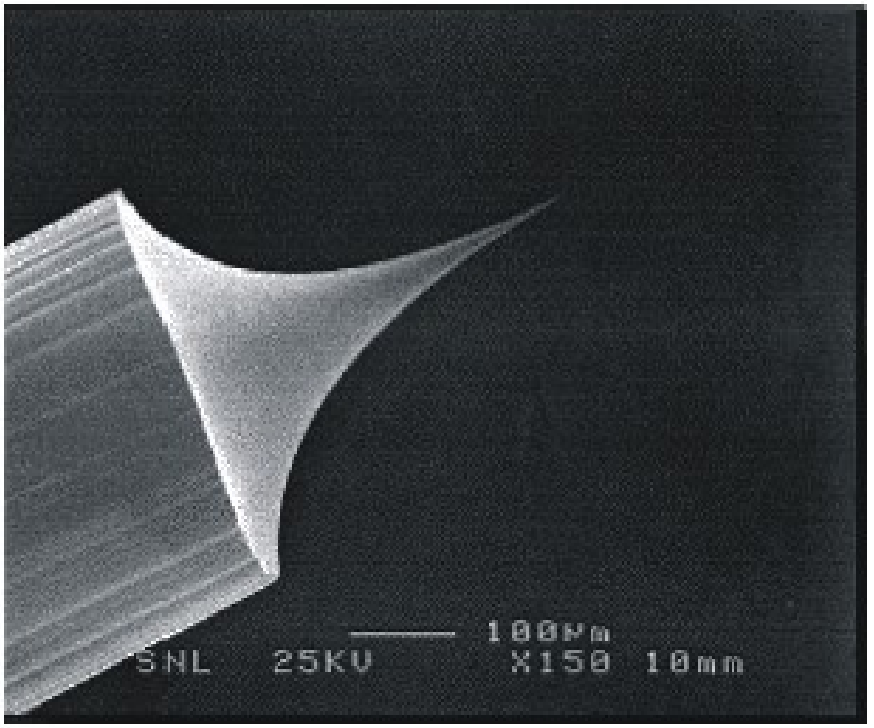
Rastertunnelmikroskopie

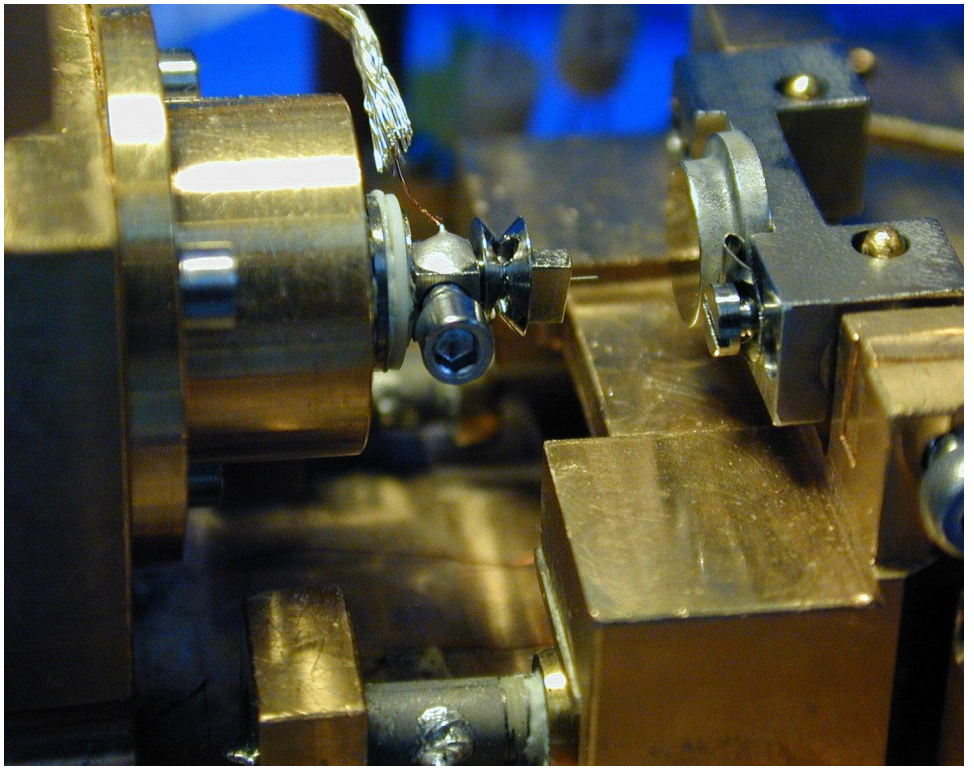


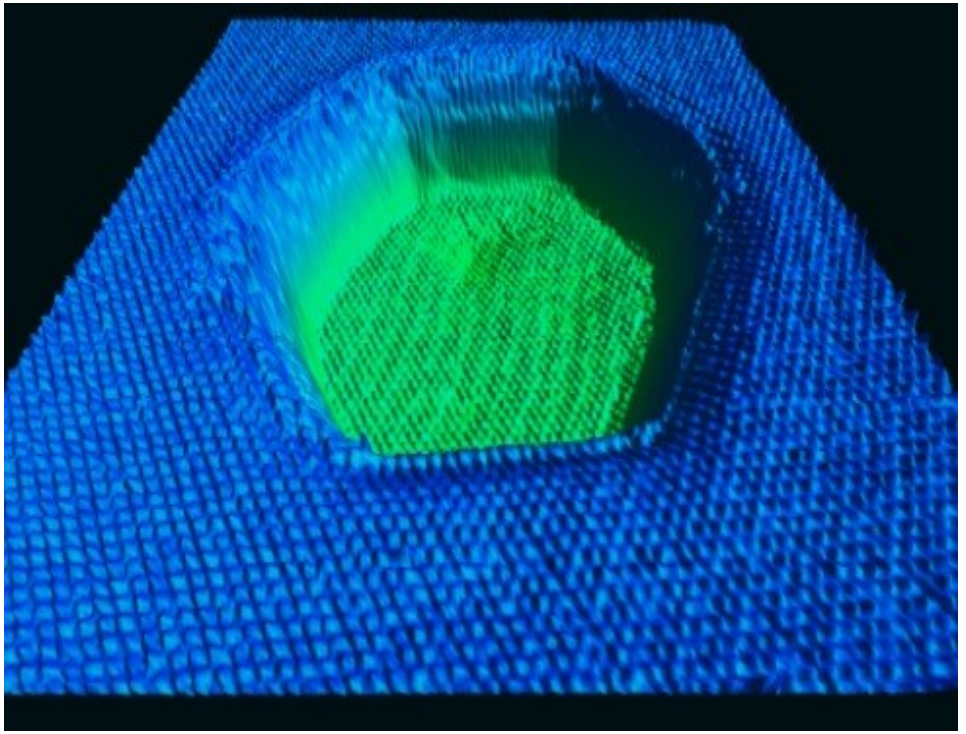


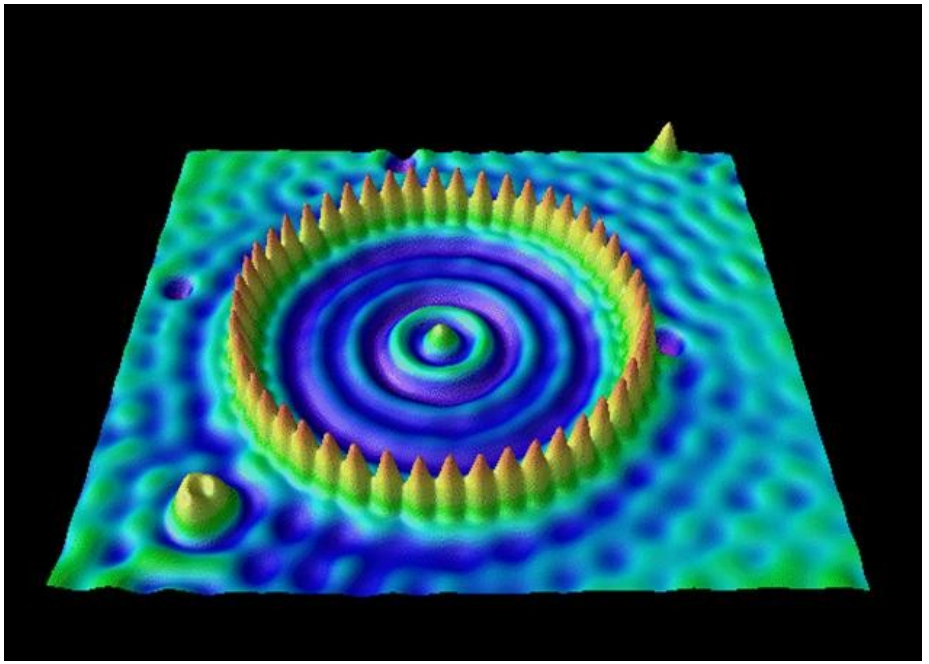


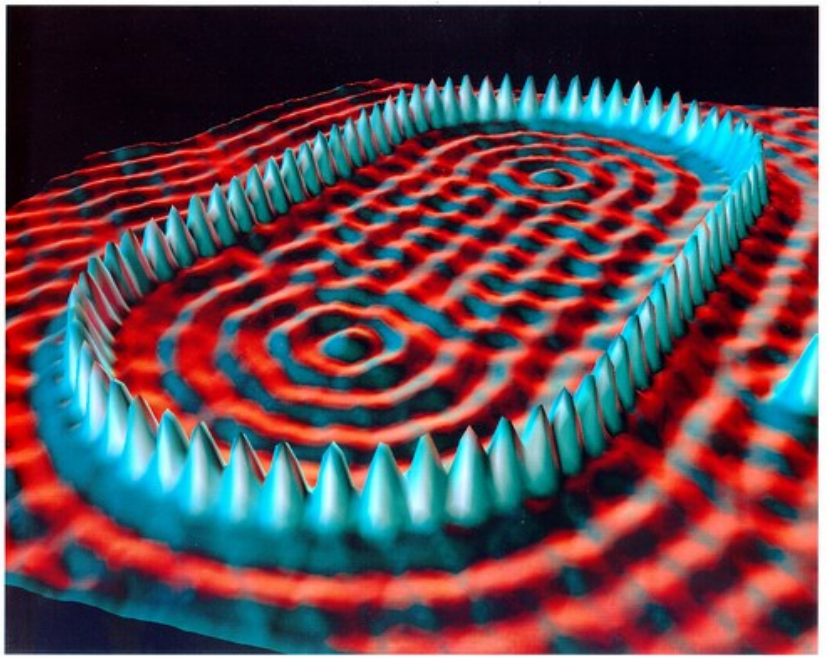


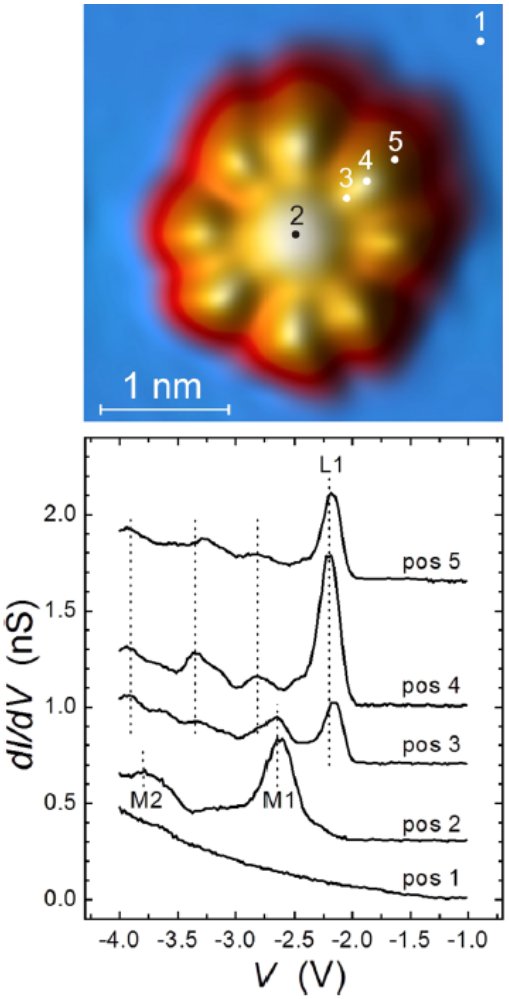

100µm
SNL 25KV X150 10mm

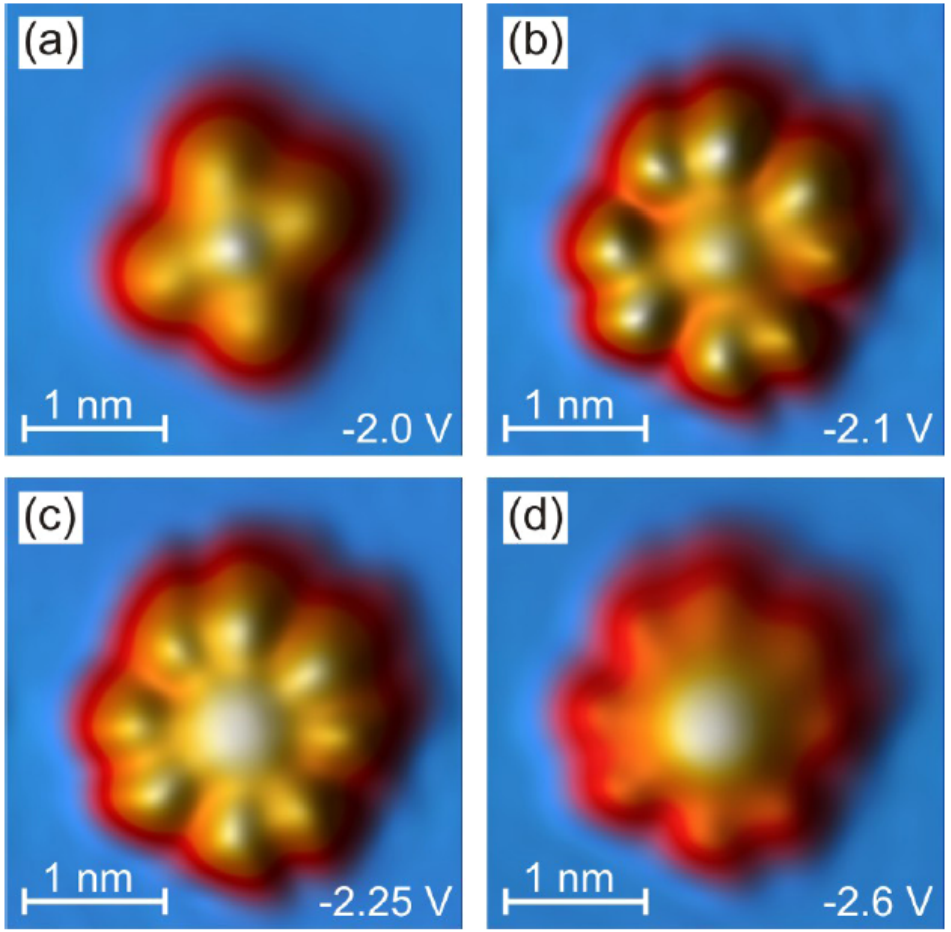


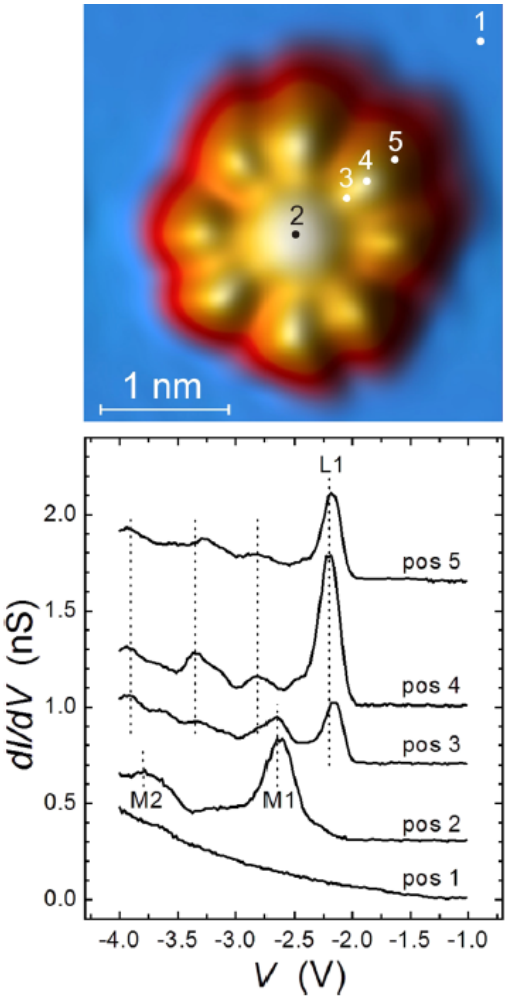


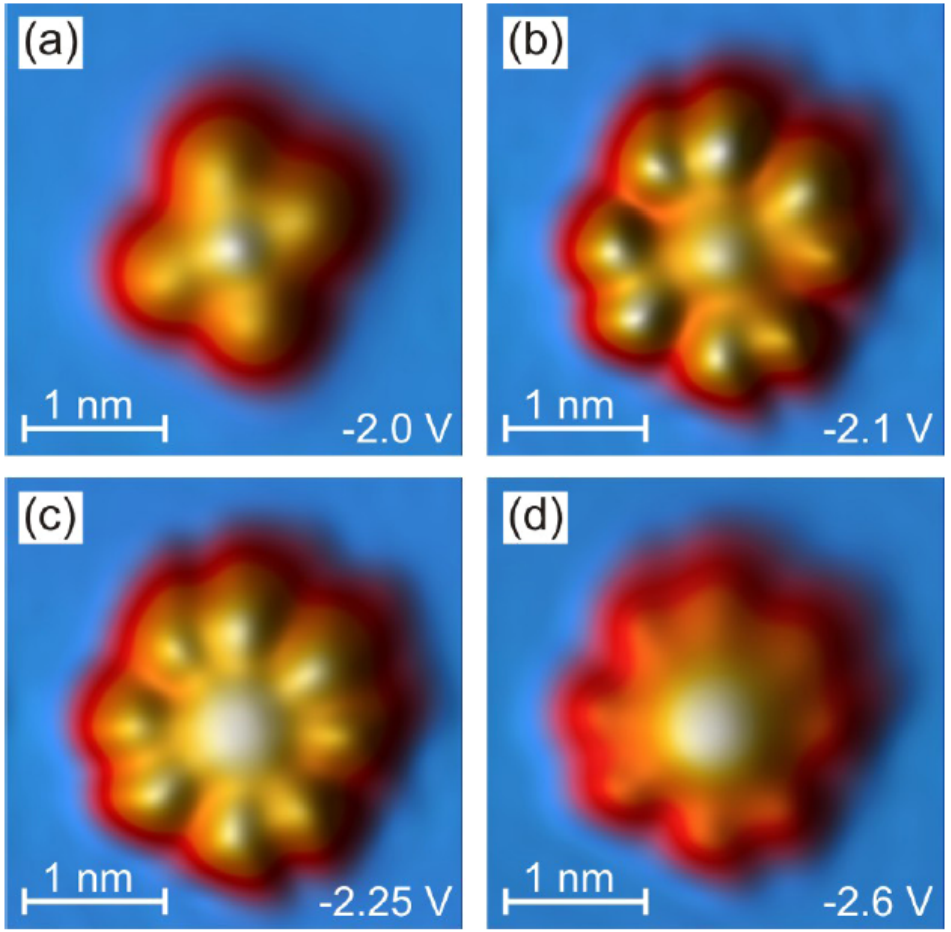





1
2
3
4
5
1 nm
L1
M2
M1
pos 5
pos 4
pos 3
pos 2
pos 1
dI/dV (nS)
V (V)
2.0
1.5
1.0
0.5
0.0
-4.0 -3.5 -3.0 -2.5 -2.0 -1.5 -1.0


(a)
1 nm
-2.0 V
(b)
1 nm
-2.1 V
(c)
1 nm
-2.25 V
(d)
1 nm
-2.6 V


1
2
3
4
5
1 nm
L1
M2
M1
pos 5
pos 4
pos 3
pos 2
pos 1
dI/dV (nS)
V (V)
2.0
1.5
1.0
0.5
0.0
-4.0 -3.5 -3.0 -2.5 -2.0 -1.5 -1.0


(a)
1 nm
-2.0 V
(b)
1 nm
-2.1 V
(c)
1 nm
-2.25 V
(d)
1 nm
-2.6 V