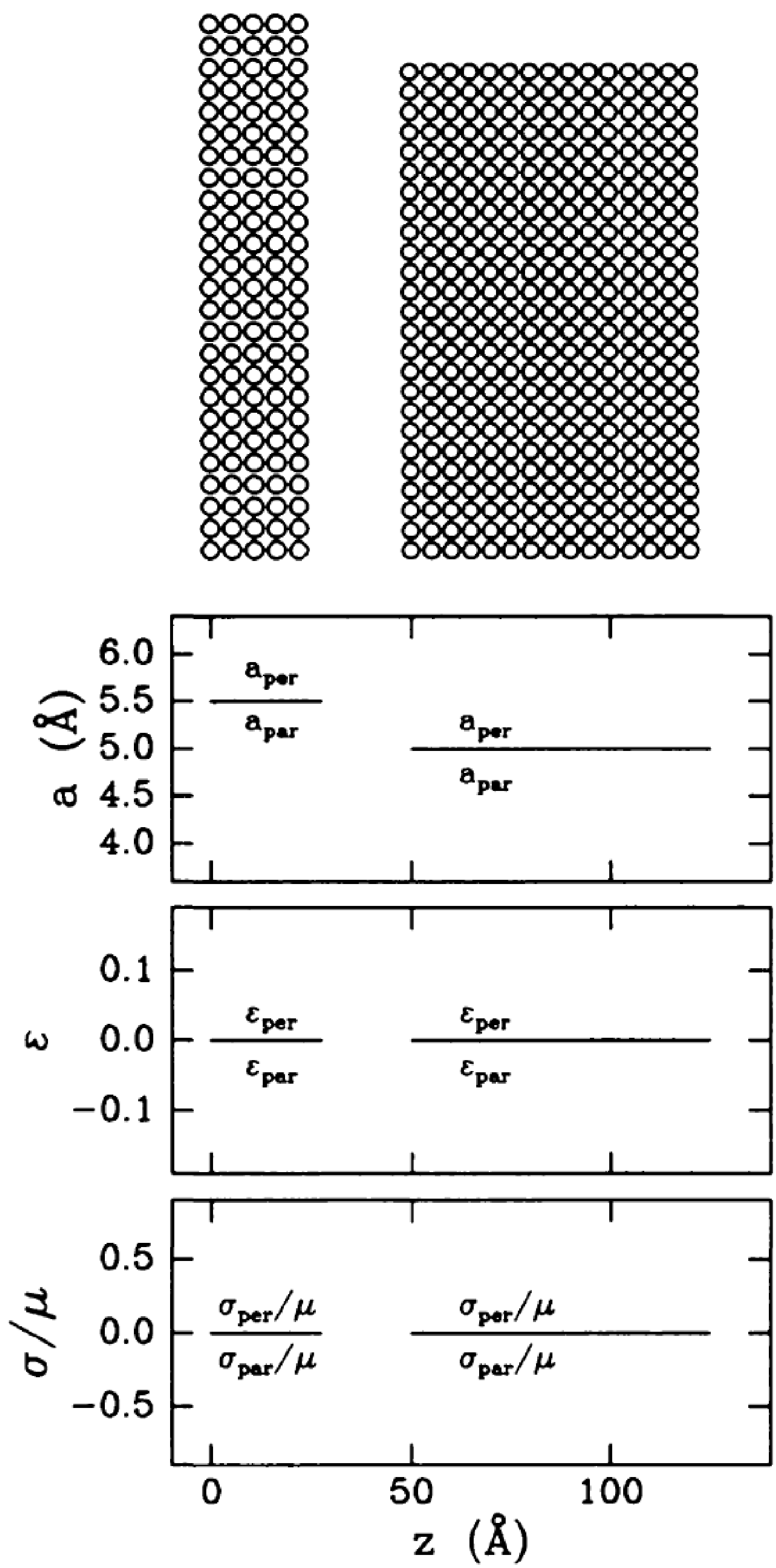
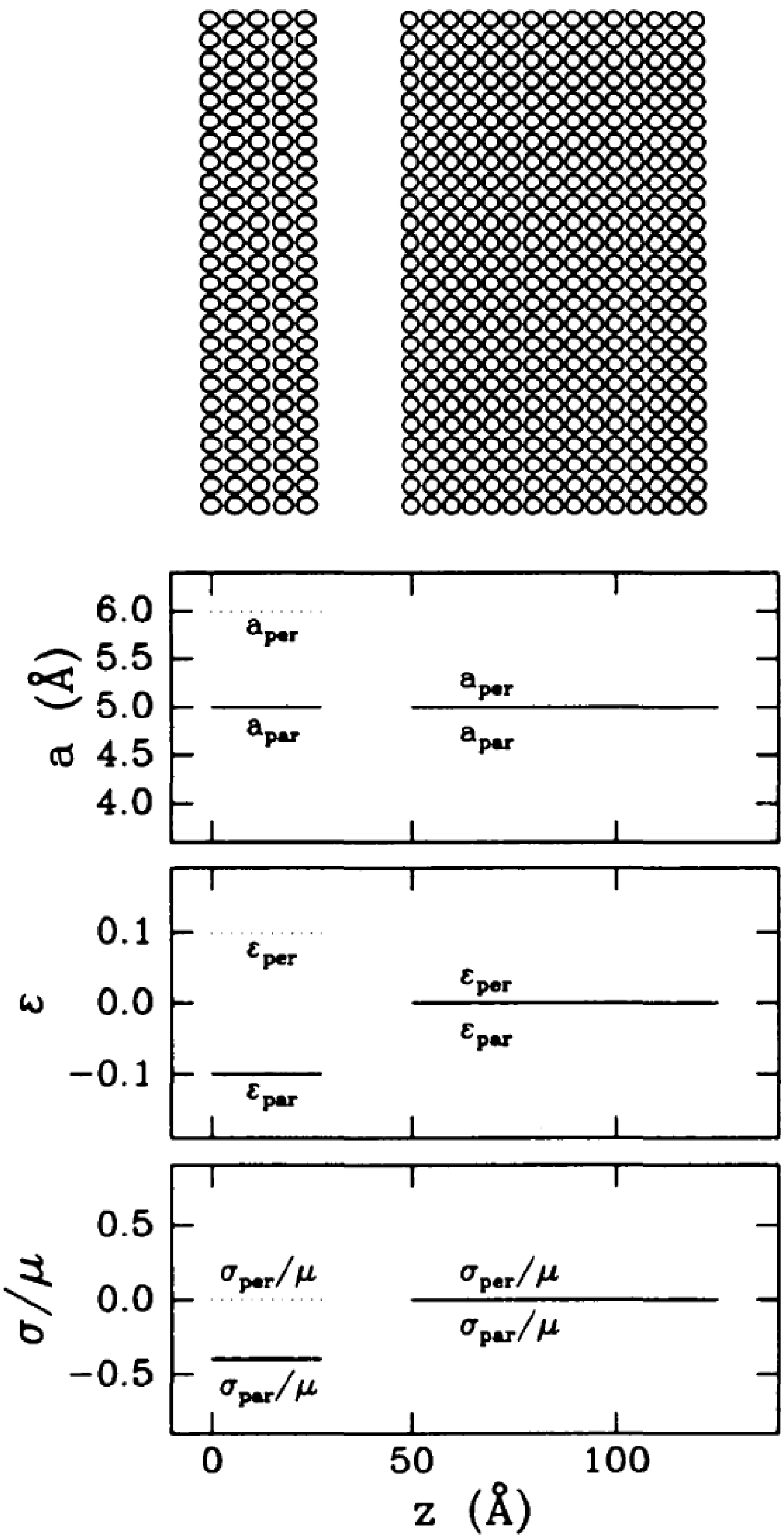
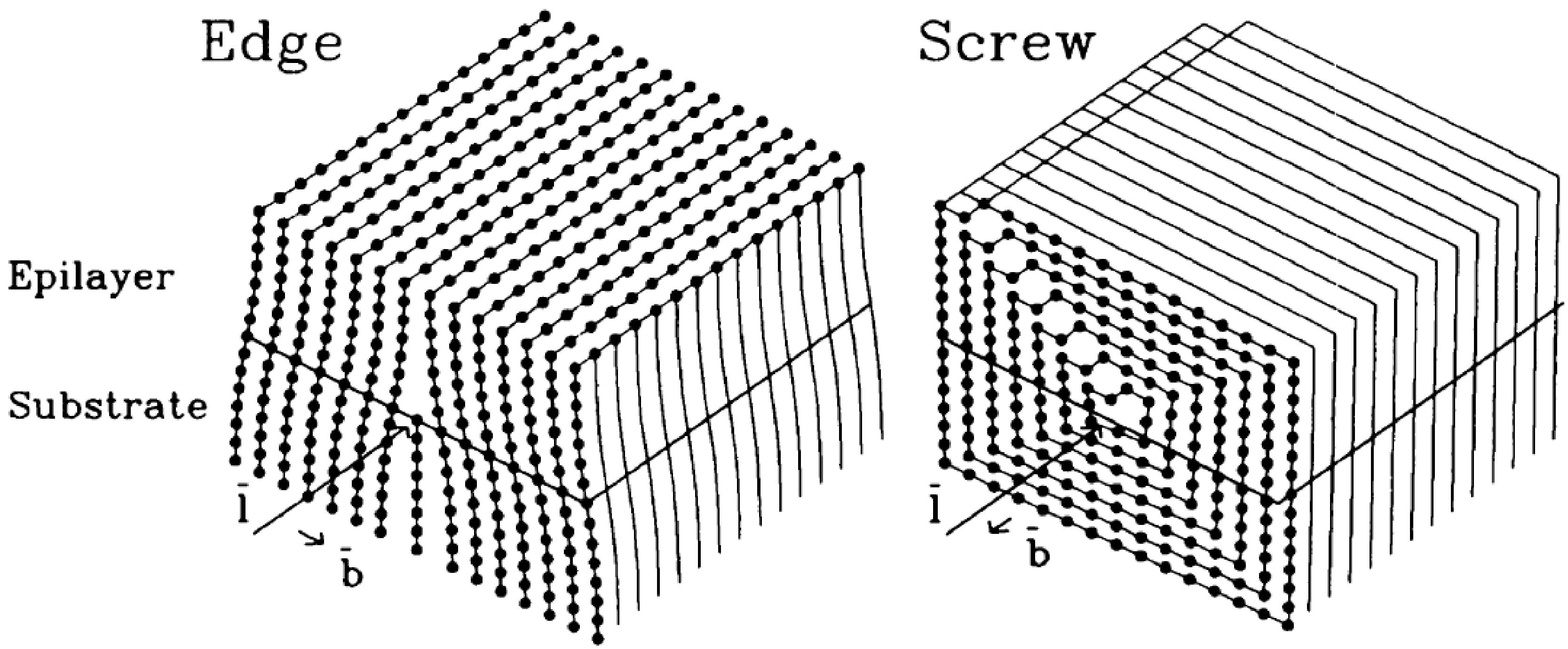
Coherency and semi-coherency



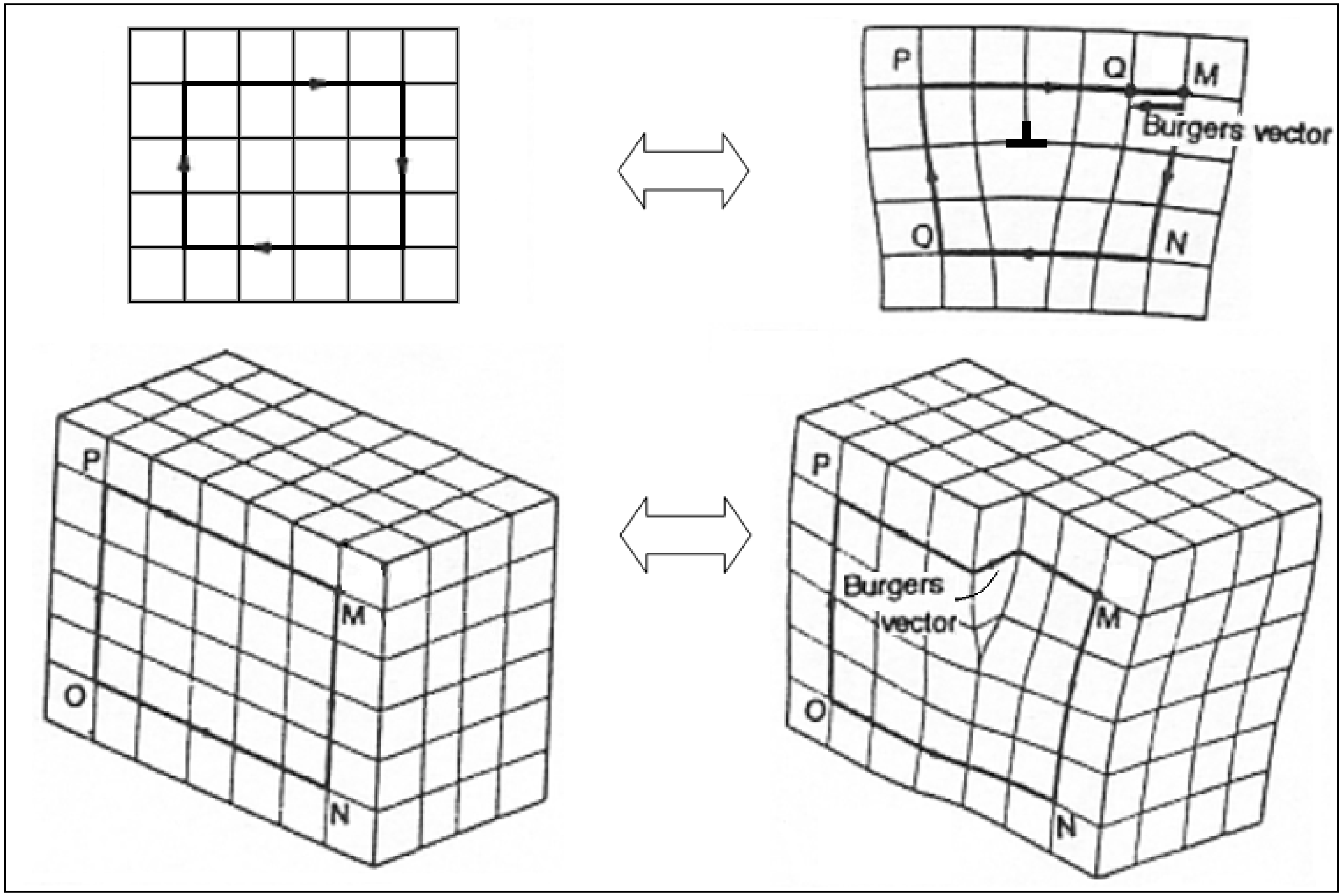
a (Å)
6.0
5.5
5.0
4.5
4.0
a_per
a_par
ε
0.1
0.0
−0.1
ε_per
ε_par
σ/μ
0.5
0.0
−0.5
σ_per/μ
σ_par/μ
0
50
100
z (Å)



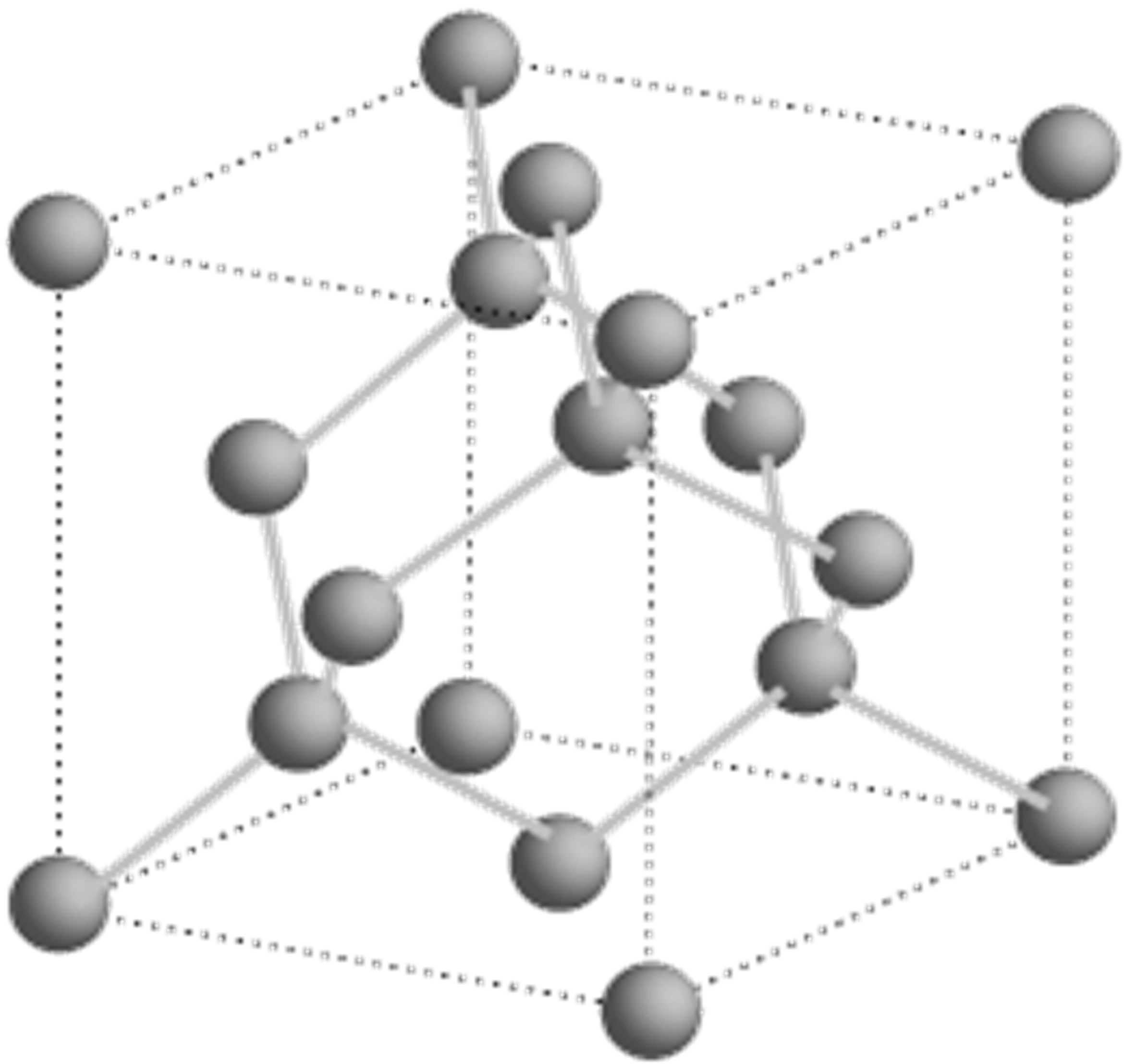
a (Å)
6.0
5.5
5.0
4.5
4.0
a_{per}
a_{par}
a_{per}
a_{par}
ε
0.1
0.0
−0.1
ε_{per}
ε_{par}
ε_{per}
ε_{par}
σ/μ
0.5
0.0
−0.5
σ_{per}/μ
σ_{par}/μ
σ_{per}/μ
σ_{par}/μ
0
50
100
z (Å)

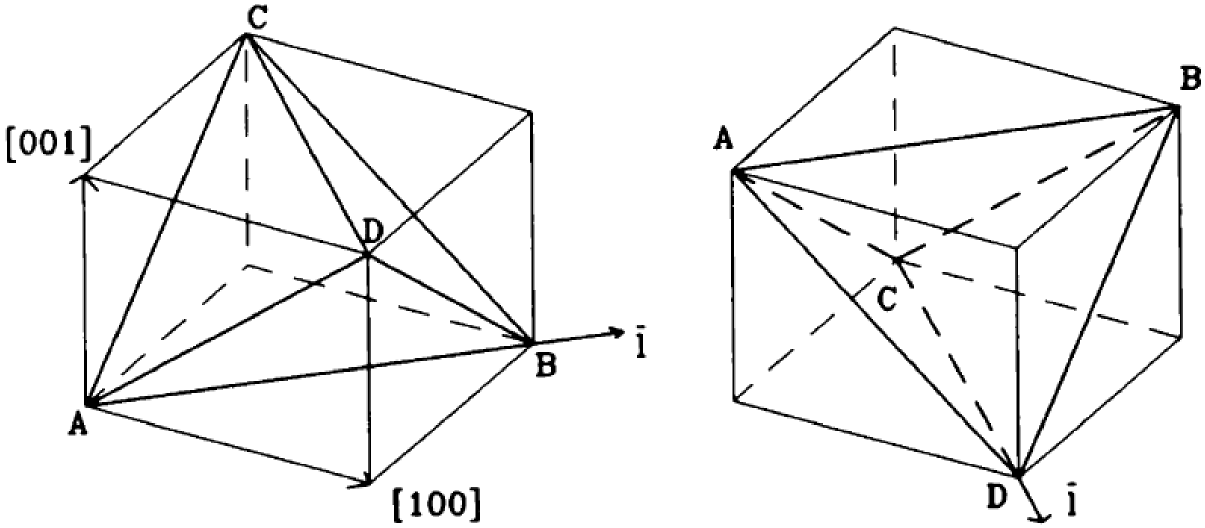

Edge
Screw
Epilayer
Substrate
$\bar{l}$
$\bar{b}$
$\bar{l}$
$\bar{b}$

the **Burgers vector**, **b=<hkl>**, that represents the magnitude and direction of the lattice distortion resulting from a dislocation in a crystal lattice.
The magnitude is represented by the equation: $\|\mathbf{b}\| = (a/2)\sqrt{h^2 + k^2 + l^2}$

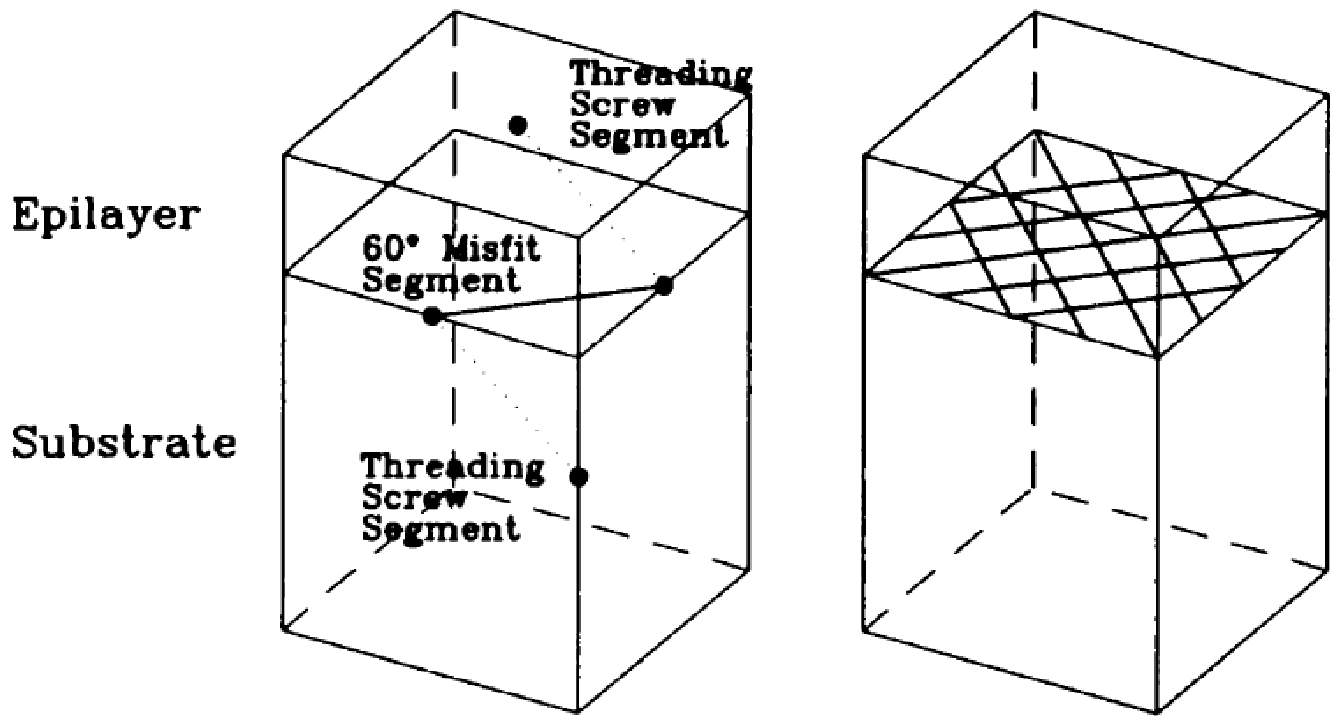


Diamond lattice

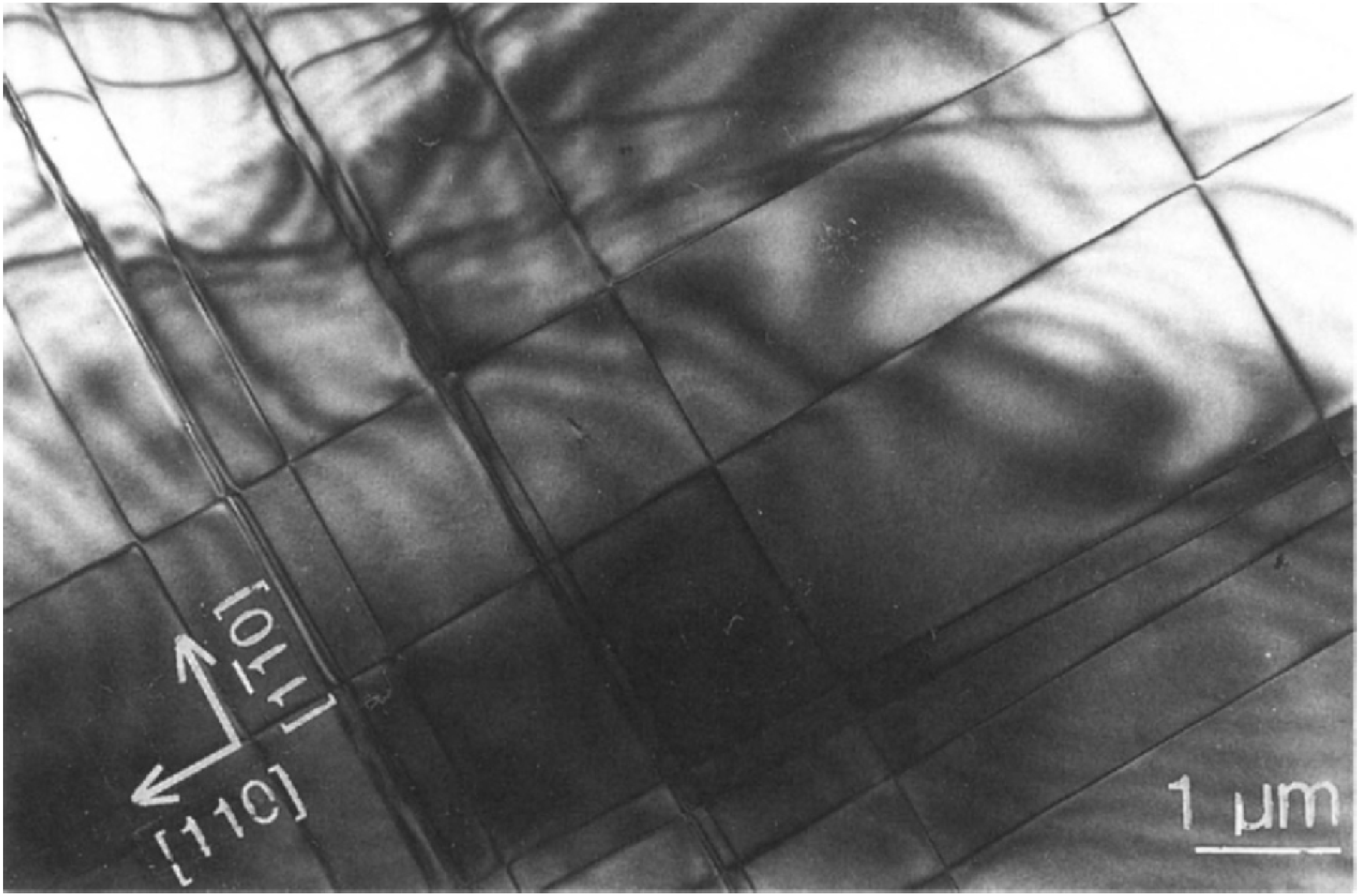




C
[001]
D
A
B
i
[100]
A
B
C
D
i



Epilayer
Substrate
Threading Screw Segment
60° Misfit Segment
Threading Screw Segment



[110]
[1̄10]
1 μm

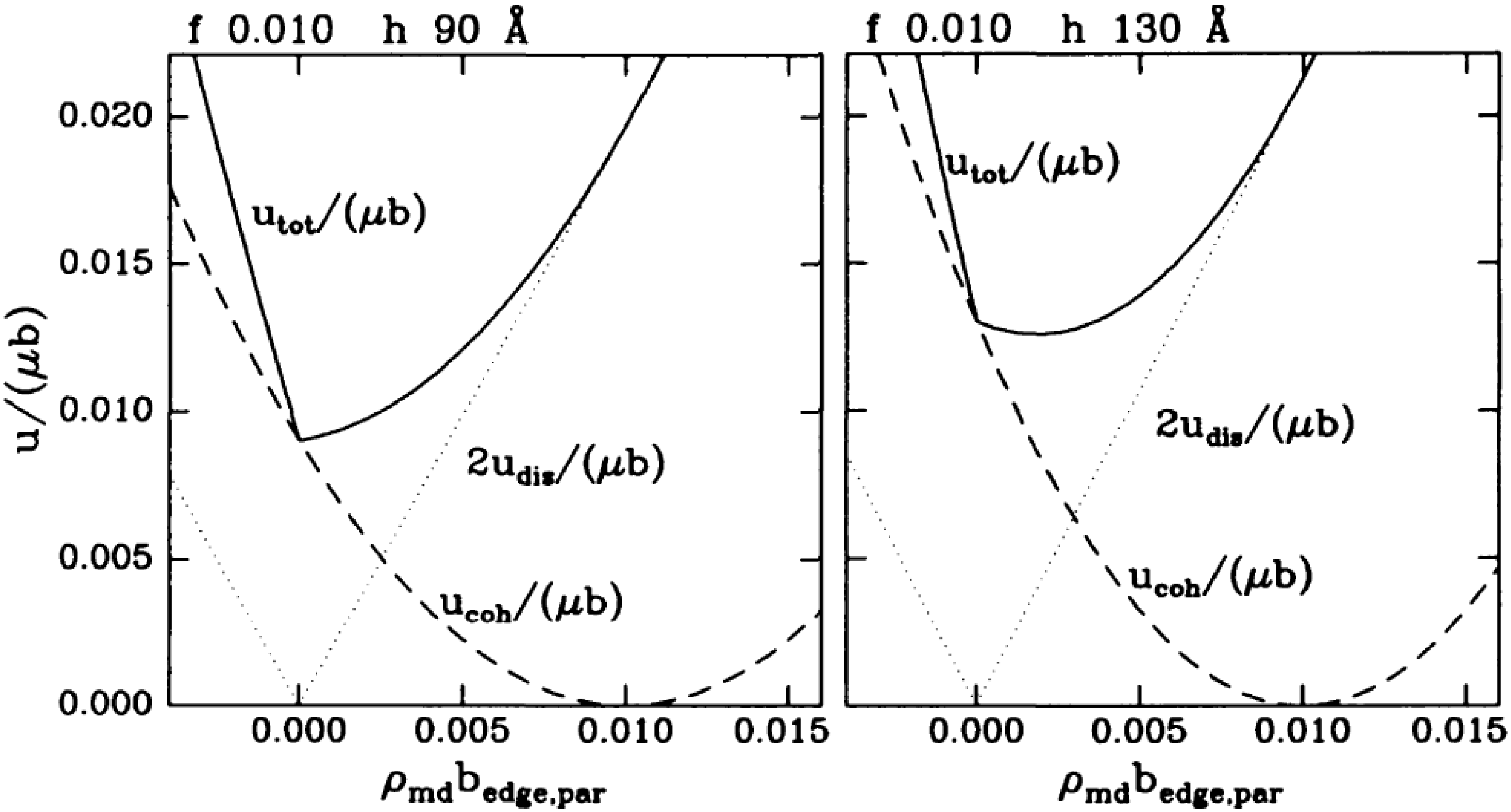
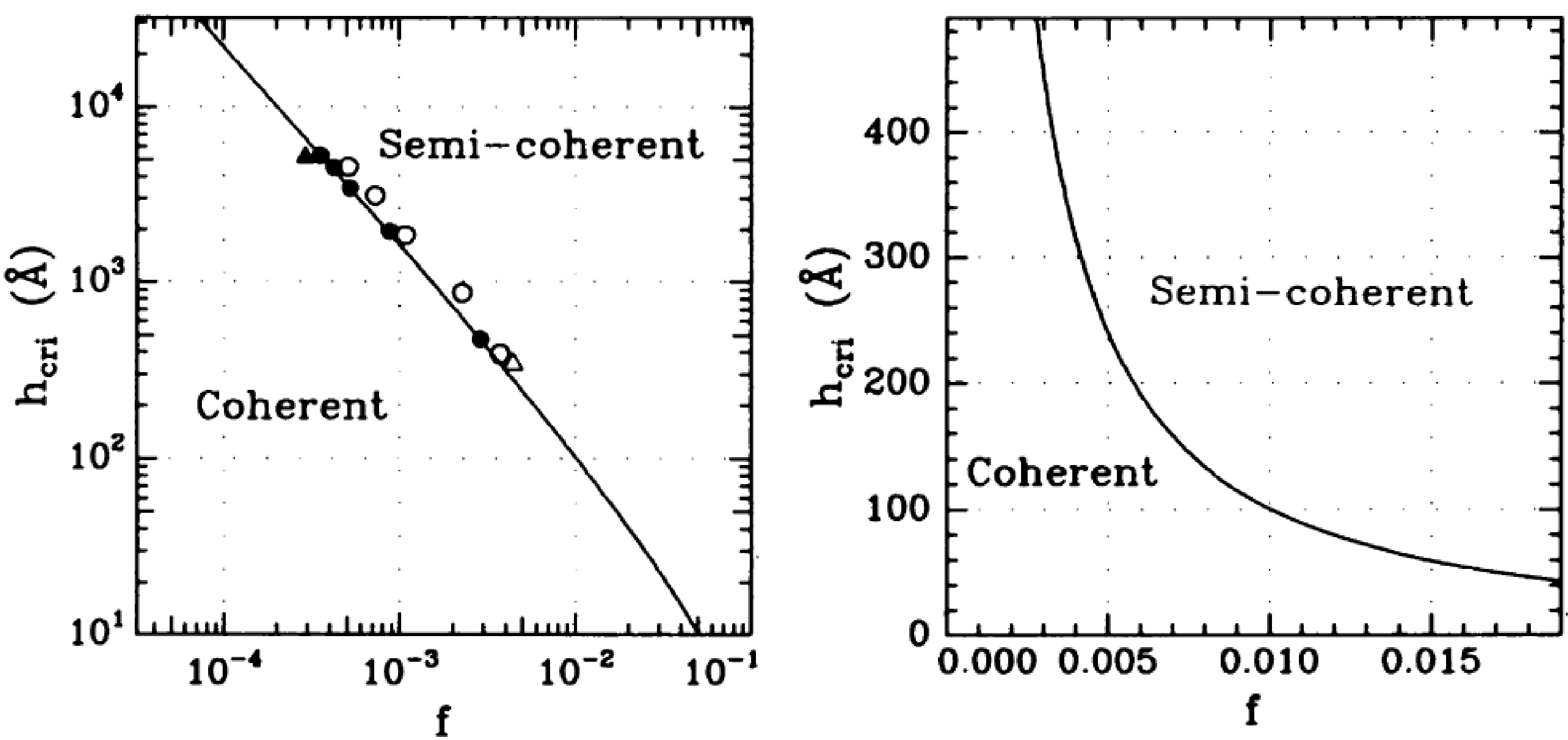


Figure 5.7: Areal energy densities, normalized by the product of the shear modulus and the Burgers vector, as a function of the misfit taken up by dislocations, $\rho_{md} b_{edg,\|}$. The dotted lines represent the energies of two dislocation arrays; the dashed lines represent the coherency strain energies; the full lines represent the sum.



Semi-coherent
Coherent
h_{cri} (Å)
f
10^4
10^3
10^2
10^1
10^{-4}
10^{-3}
10^{-2}
10^{-1}
Semi-coherent
Coherent
h_{cri} (Å)
f
400
300
200
100
0
0.000
0.005
0.010
0.015

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Misfit dislocation gettering by substrate pit-patterning in SiGe films on Si(001)

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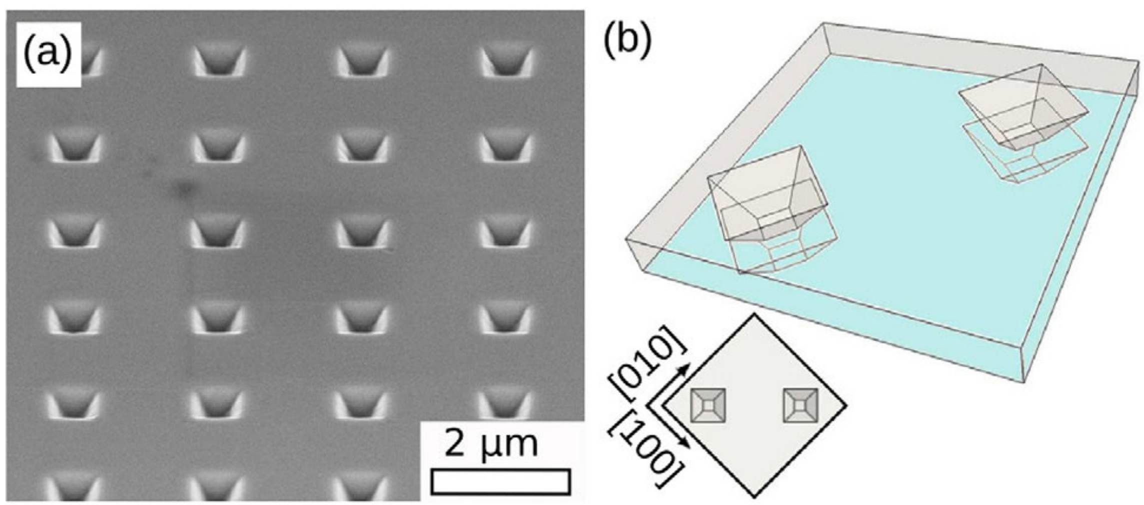
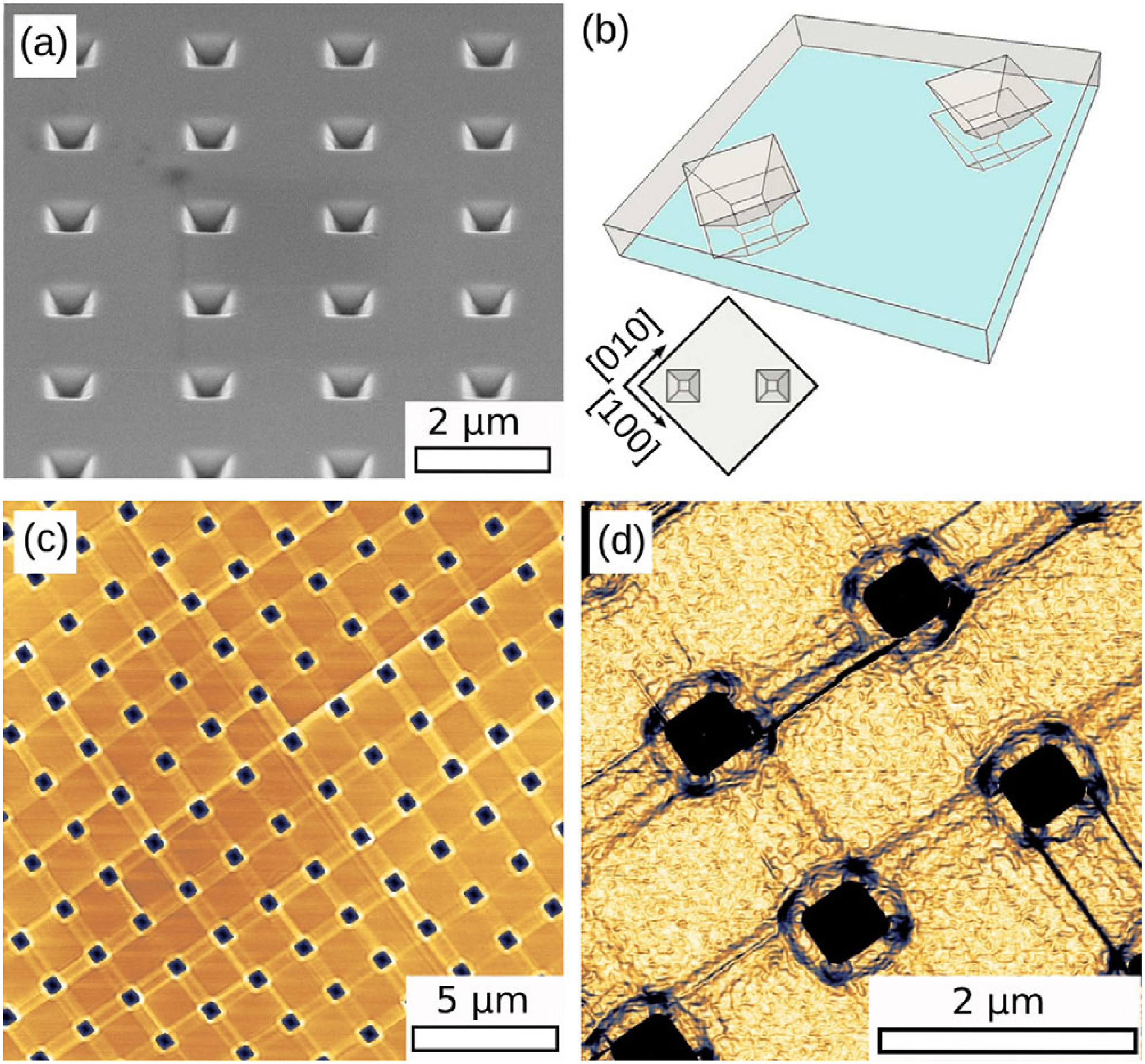
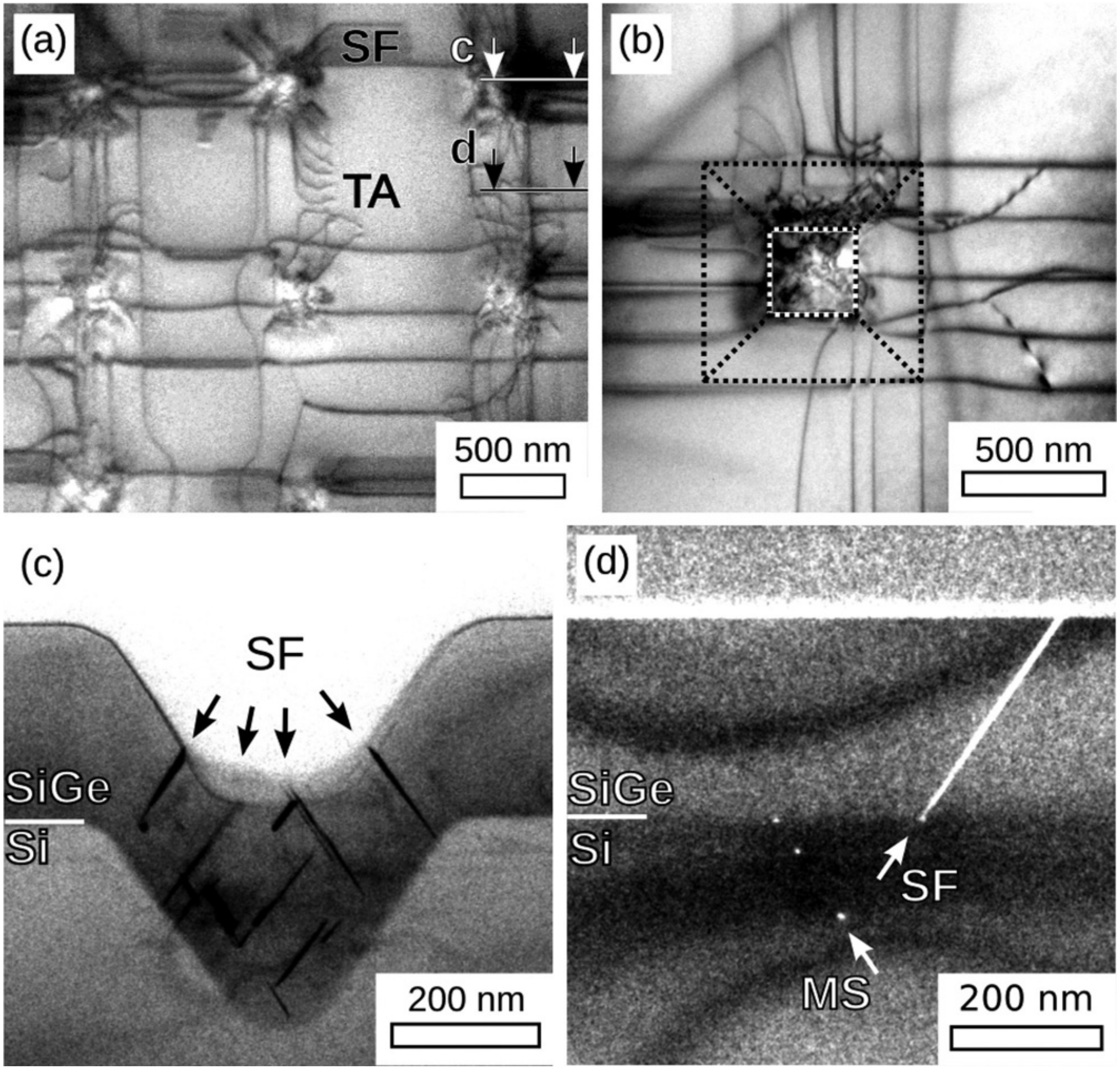
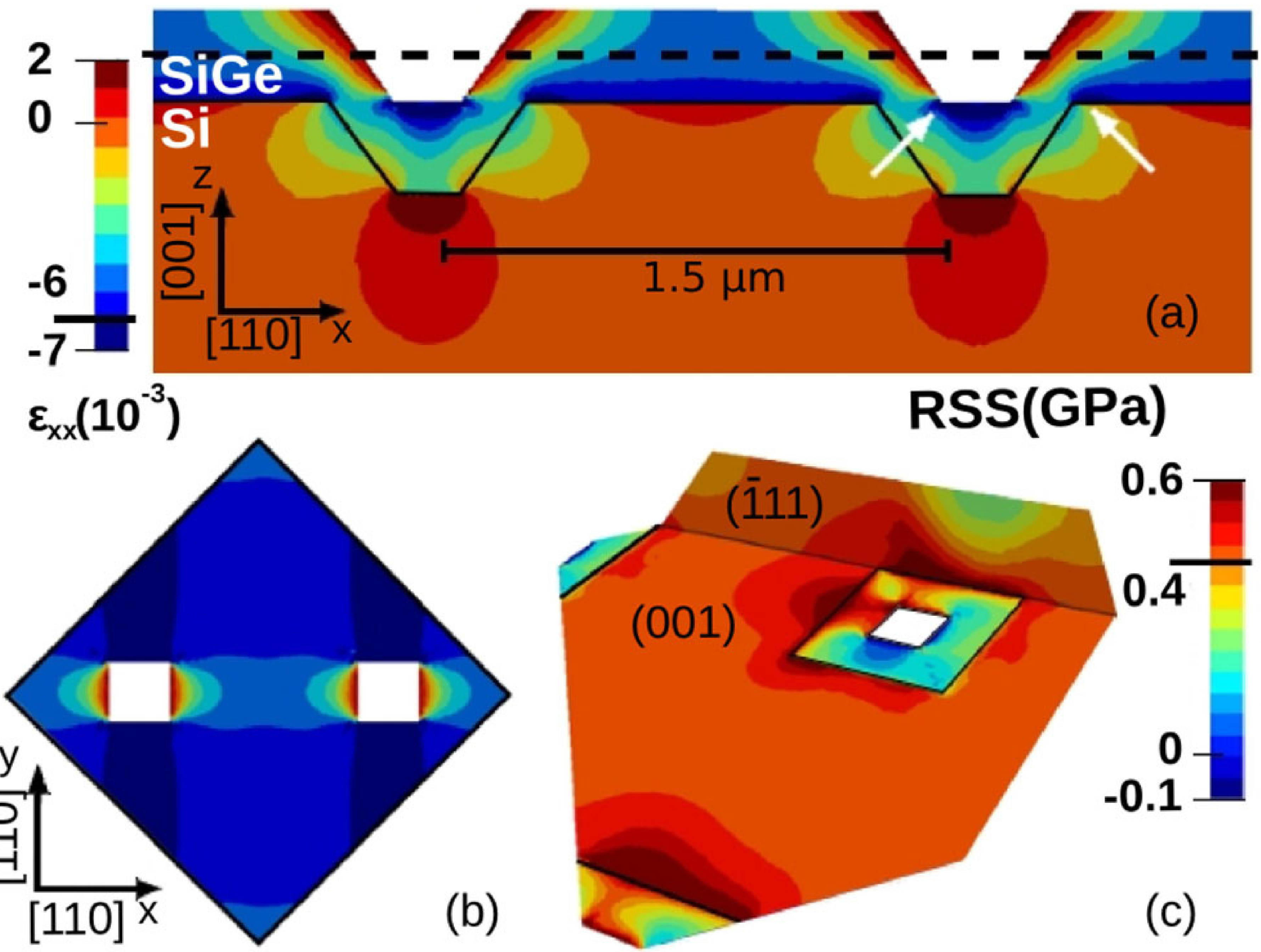
We show that suitable pit-patterning of a Si(001) substrate can strongly influence the nucleation and the propagation of dislocations during epitaxial deposition of Si-rich $Si_{1-x}Ge_x$ alloys, preferentially gettering misfit segments along pit rows. In particular, for a 250 nm layer deposited by molecular beam epitaxy at $x_{Ge} = 15\%$, extended film regions appear free of dislocations, by atomic force microscopy, as confirmed by transmission electron microscopy sampling. This result is quite general, as explained by dislocation dynamics simulations, which reveal the key role of the inhomogeneous distribution in stress produced by the pit-patterning. © *2012 American Institute of Physics*. [http://dx.doi.org/10.1063/1.4733479]




(a)
2 µm
(b)
[010]
[100]
(c)
5 µm
(d)
2 µm

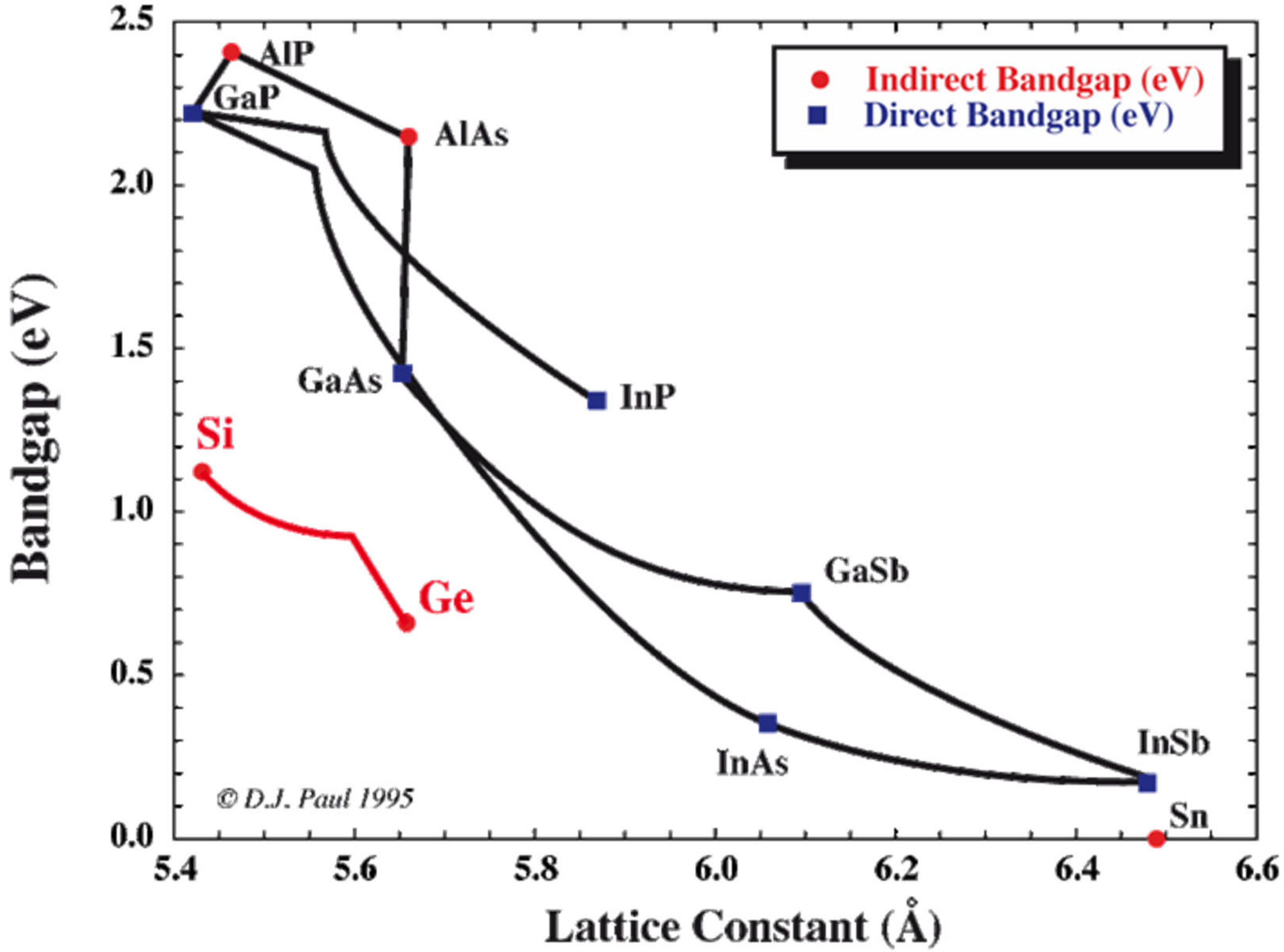

(a)
SF
c
d
TA
500 nm
(b)
500 nm
(c)
SF
SiGe
Si
200 nm
(d)
SiGe
Si
SF
MS
200 nm



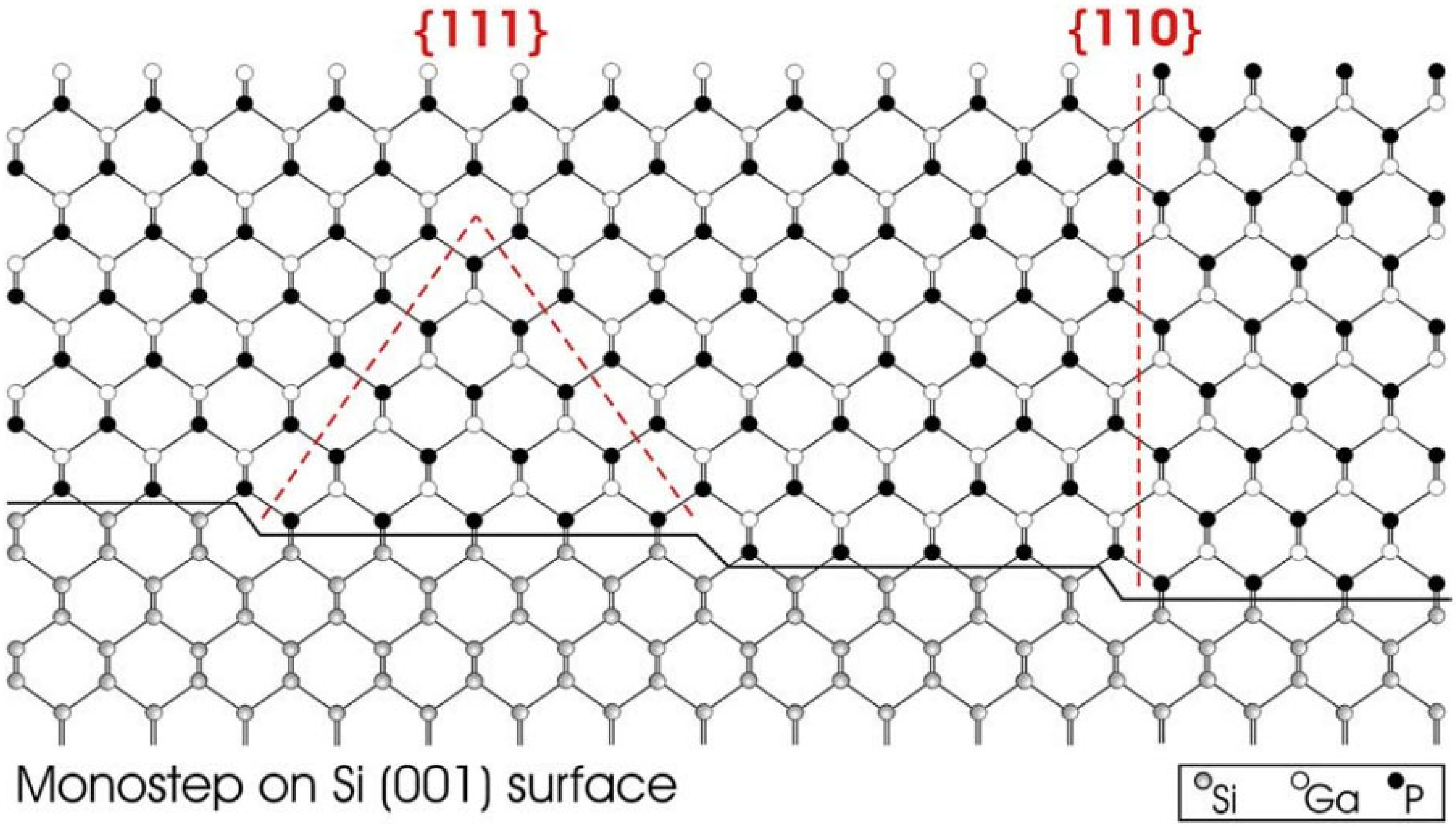
2
0
-6
-7
SiGe
Si
z
[001]
[110]
x
1.5 μm
(a)
ε_xx(10^-3)
RSS(GPa)
y
[1̄10]
[110]
x
(b)
(1̄11)
(001)
0.6
0.4
0
-0.1
(c)

Other kinds of mismatch

Integration of III-Vs and Si

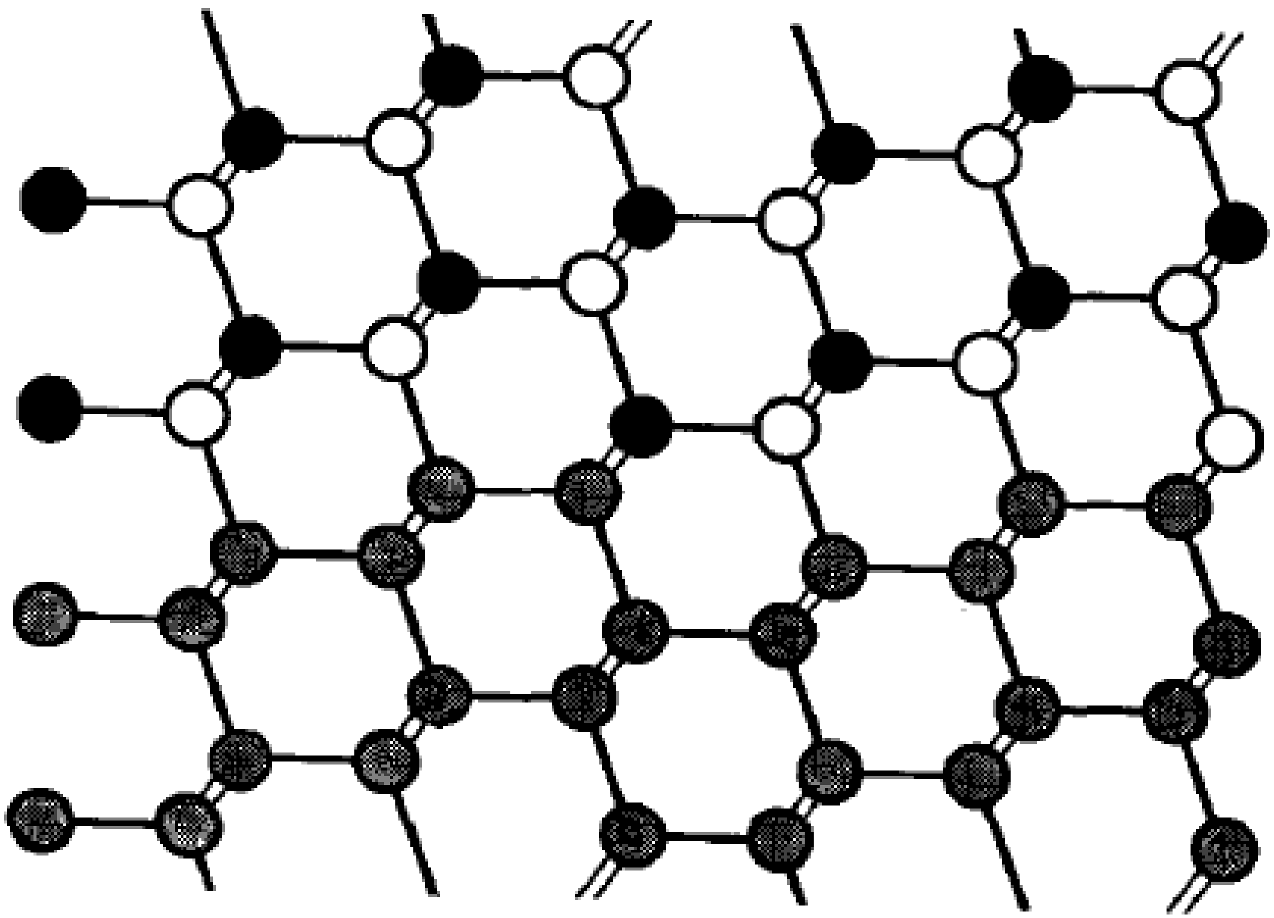


Miscut and epitaxy of III-Vs on silicon



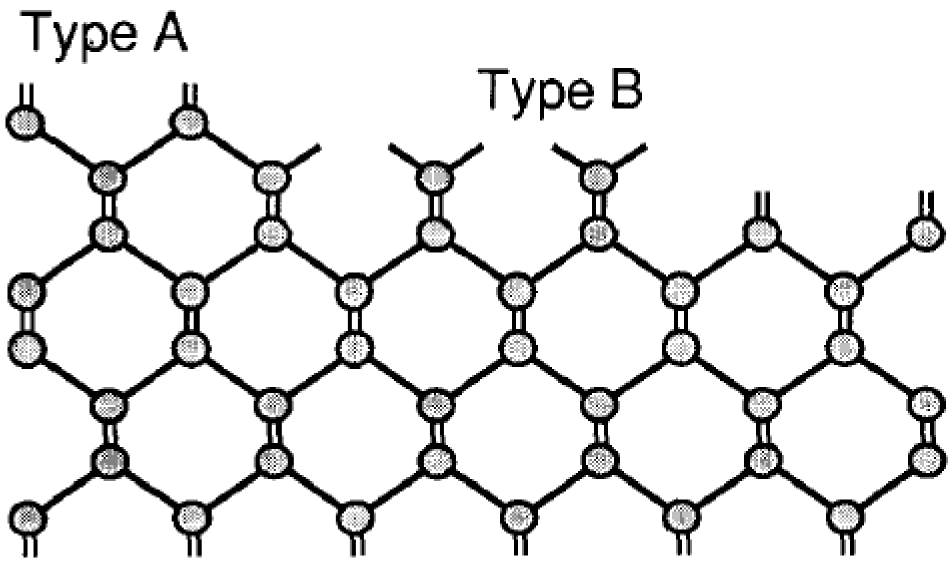
B. Kunert et al, Thin Solid Films (2008)

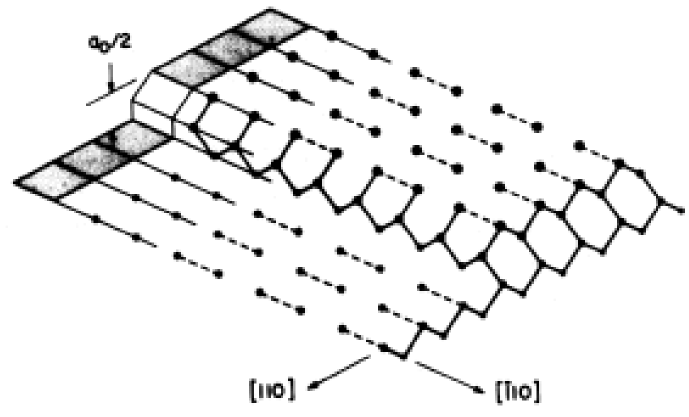
The substrate orientation (112)



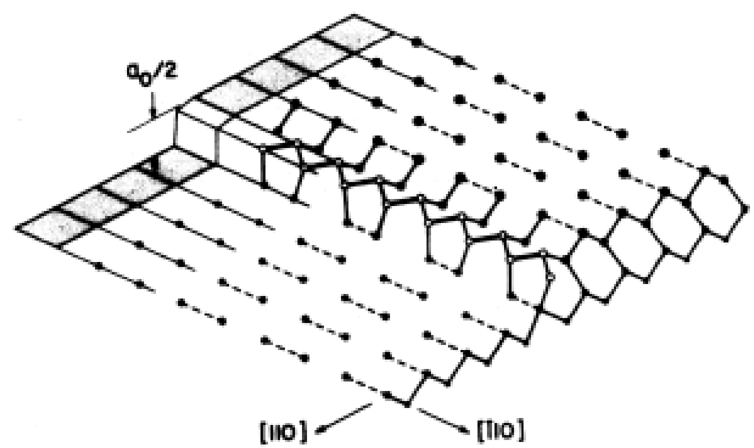
H. Kroemer, J. Cryst.Growth (1987)

Miscut and epitaxy of III-Vs on silicon





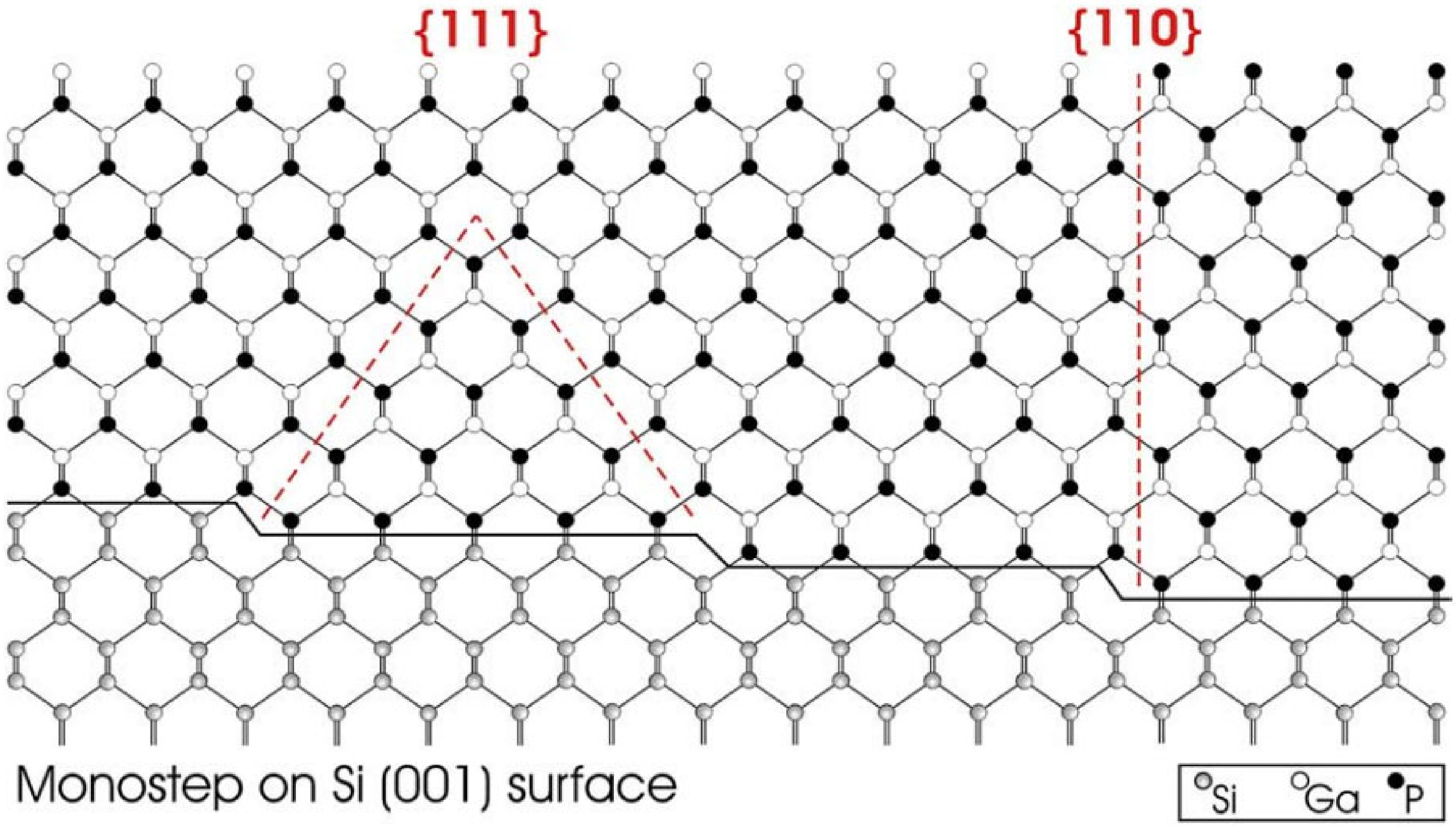
(b)



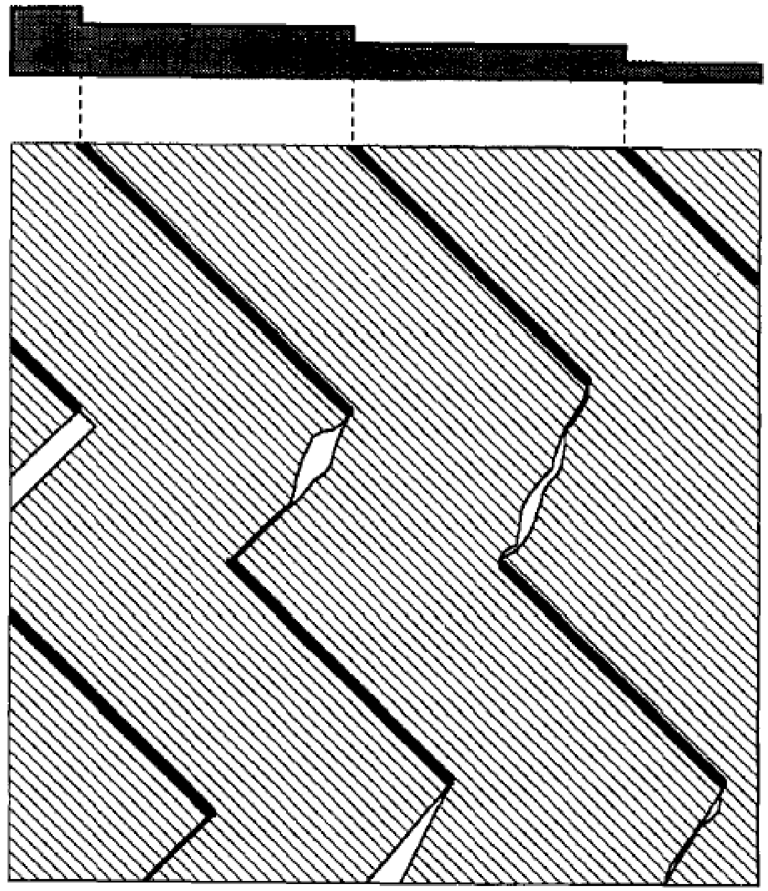
(d)

H. Kroemer, J. Cryst.Growth (1987)

Miscut and epitaxy of III-Vs on silicon



B. Kunert et al, Thin Solid Films (2008)



H. Kroemer, J. Cryst.Growth (1987)

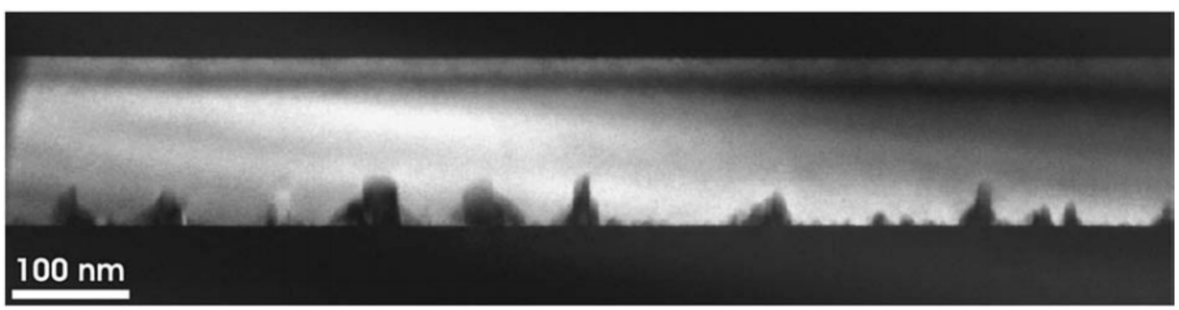


Fig. 5. (002) Dark field TEM image in [110] cross section of the GaP/Si heterolayer. Self-annihilation of all antiphase domains leads to antiphase disorder free GaP layer after about 50 nm of overgrowth.

B. Kunert et al, Thin Solid Films (2008)