Elektronenstreuung: schematische Energieverteilung

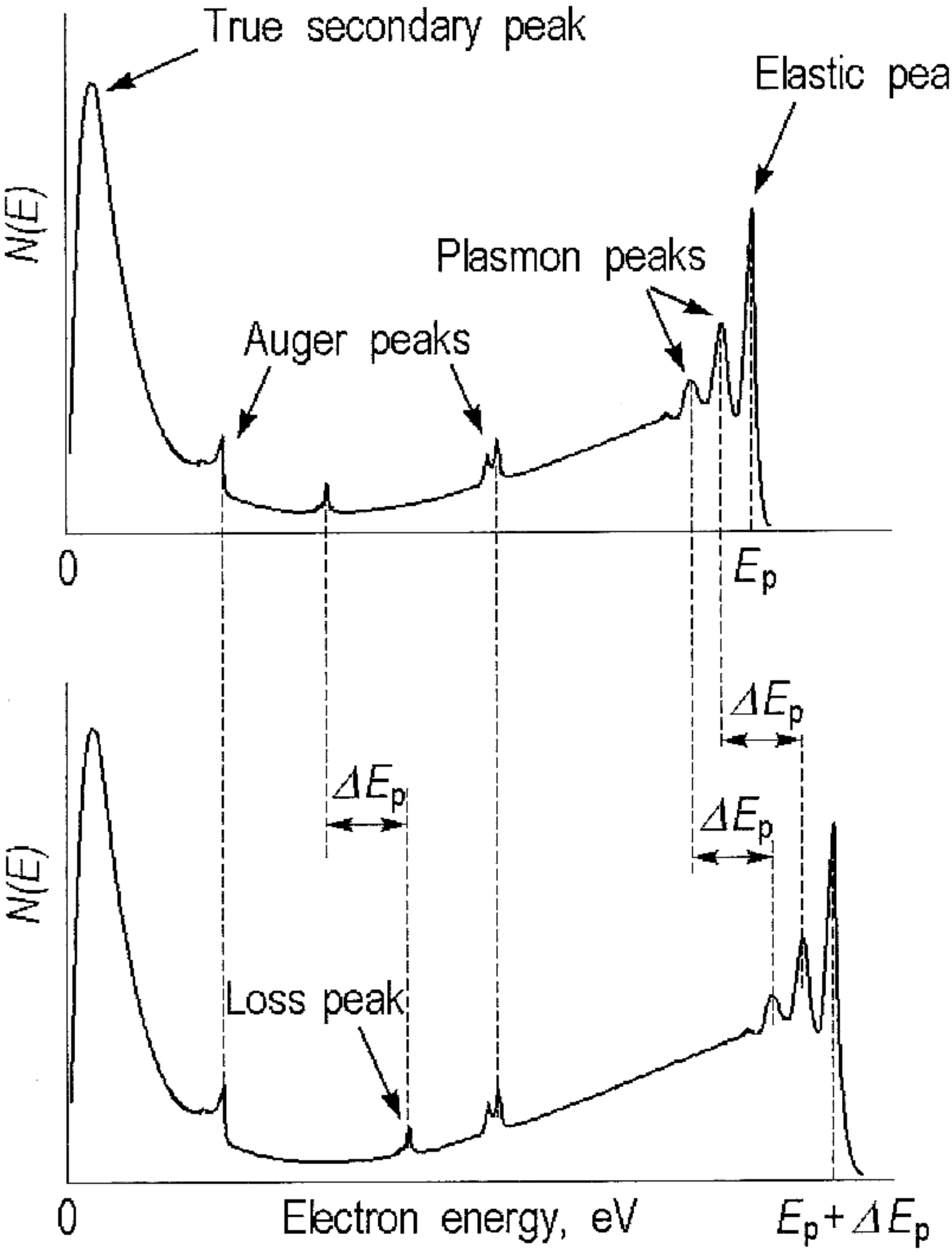
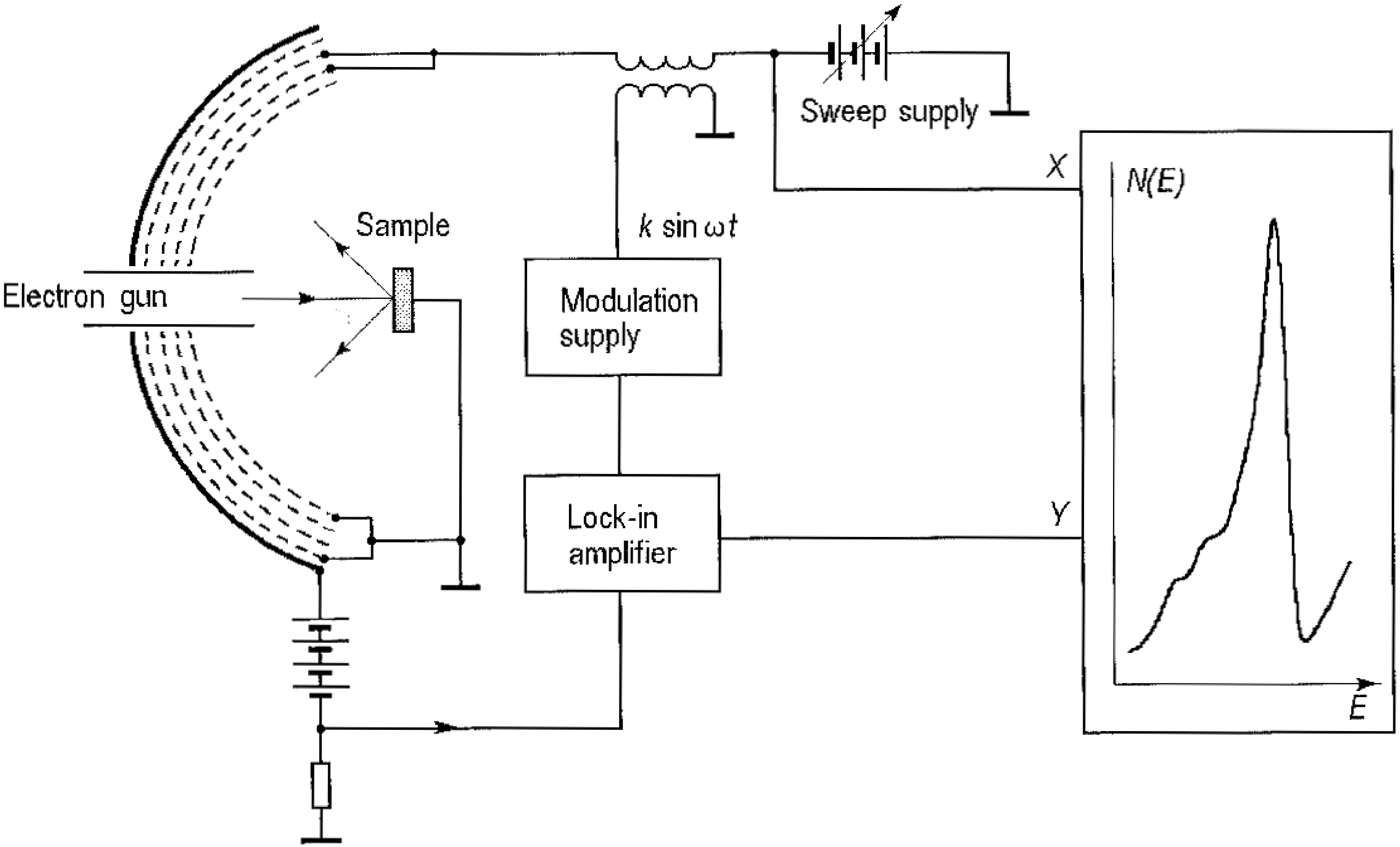


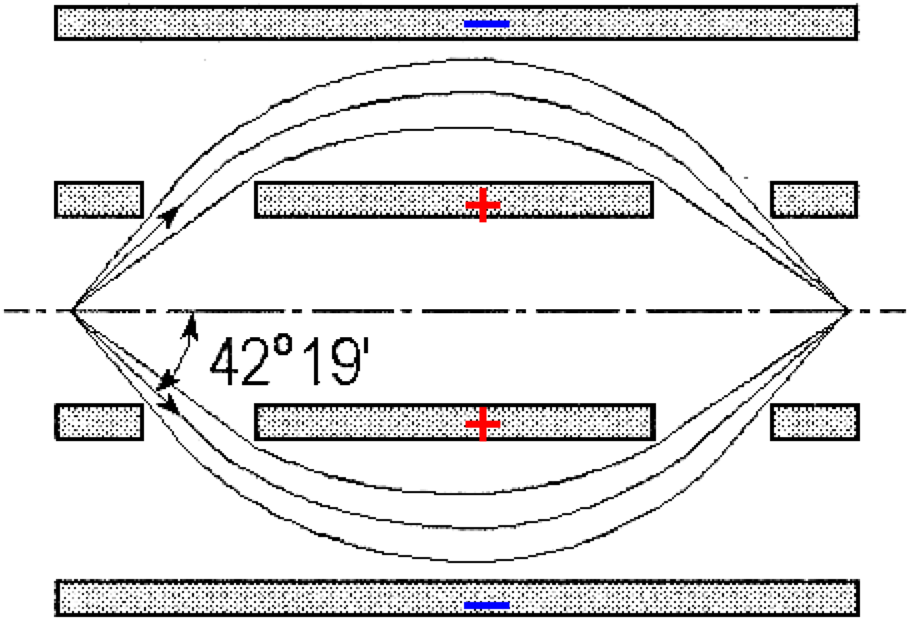
Fig. 5.2

AES mit RFA

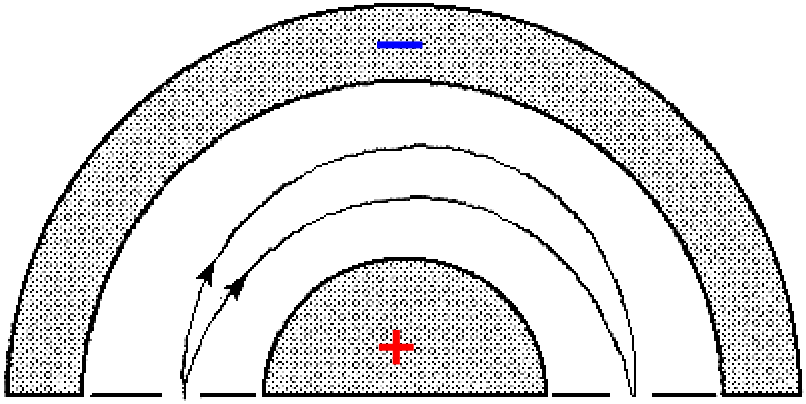


Sweep supply
X
N(E)
Sample
k sin ωt
Electron gun
Modulation supply
Lock-in amplifier
Y
E

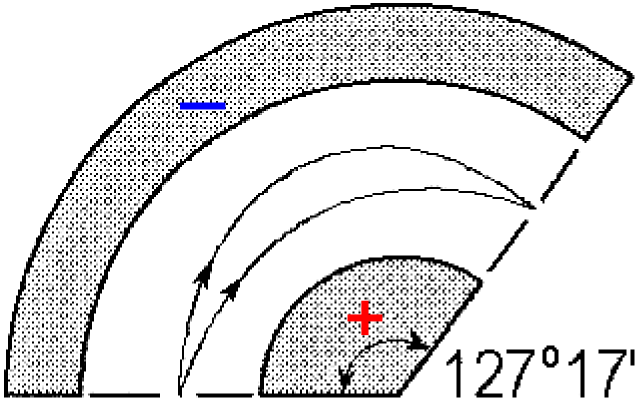
Cylindrical mirror analyser (CMA)



Concentric hemispherical analyser (CHA)



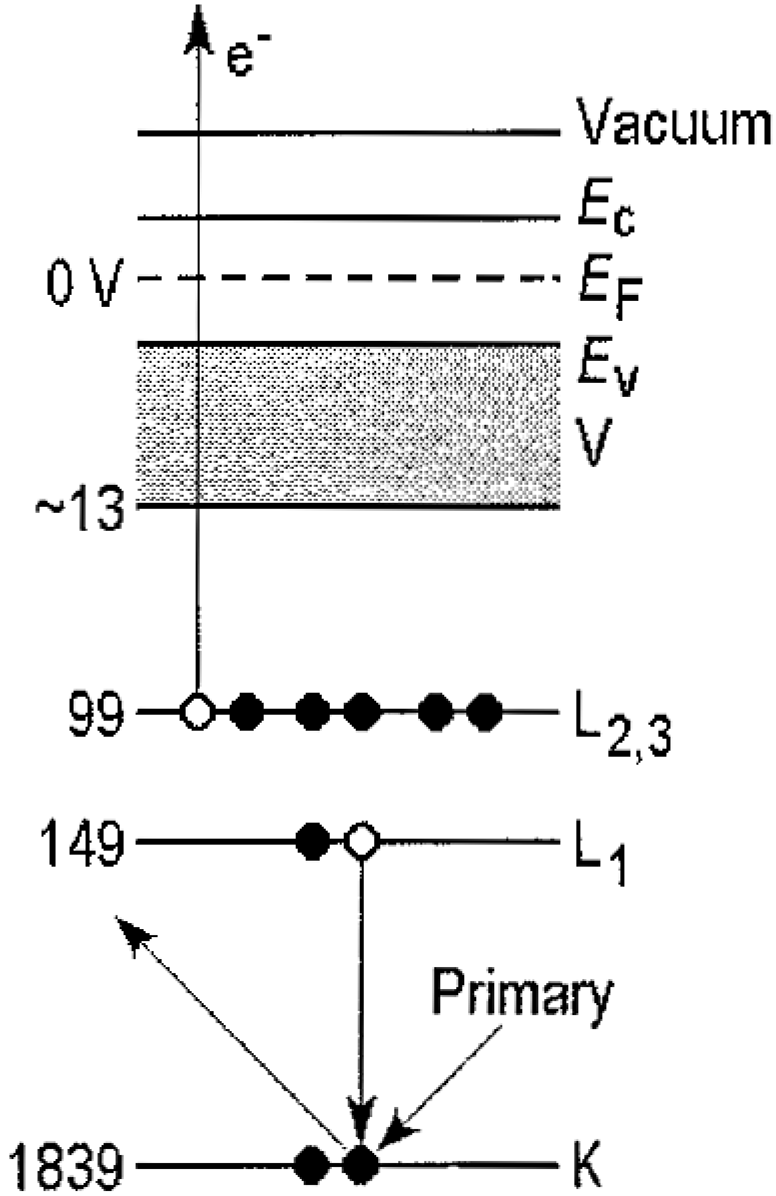
127° cylindrical sector analyser



Augerelektronensspektroskopie (AES)

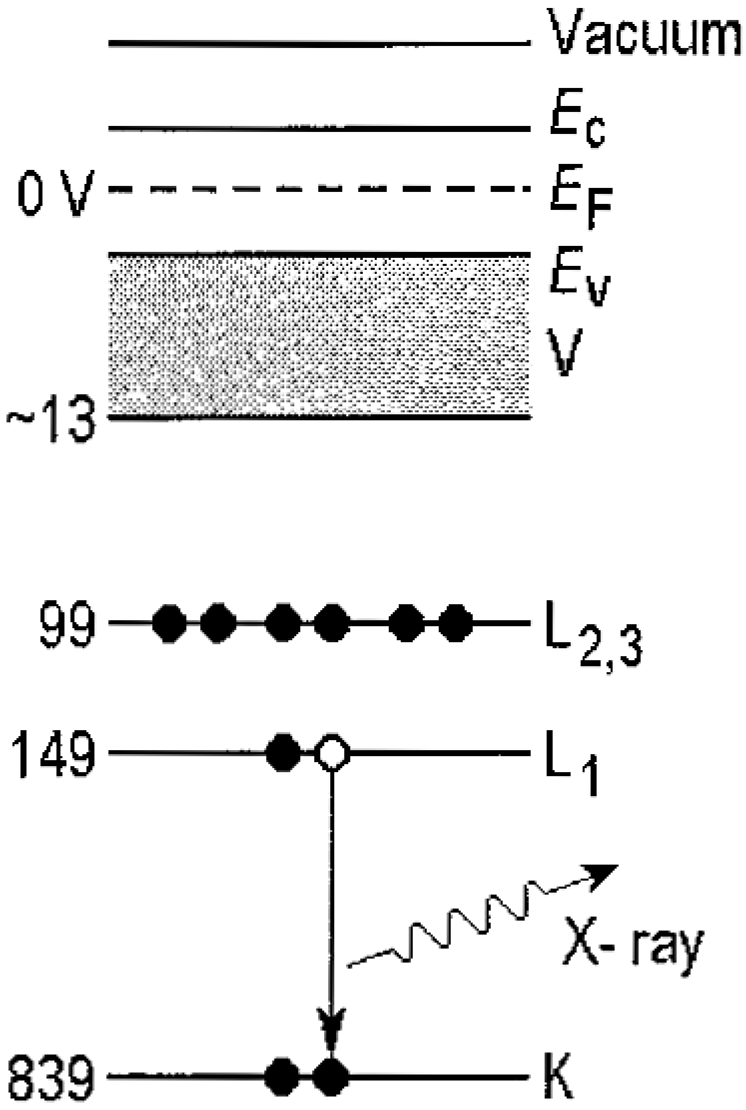
Si: $E_{K\,L1\,L2,3} = E_K - E_{L1} - E_{L2,3}$

$= 1591$ eV

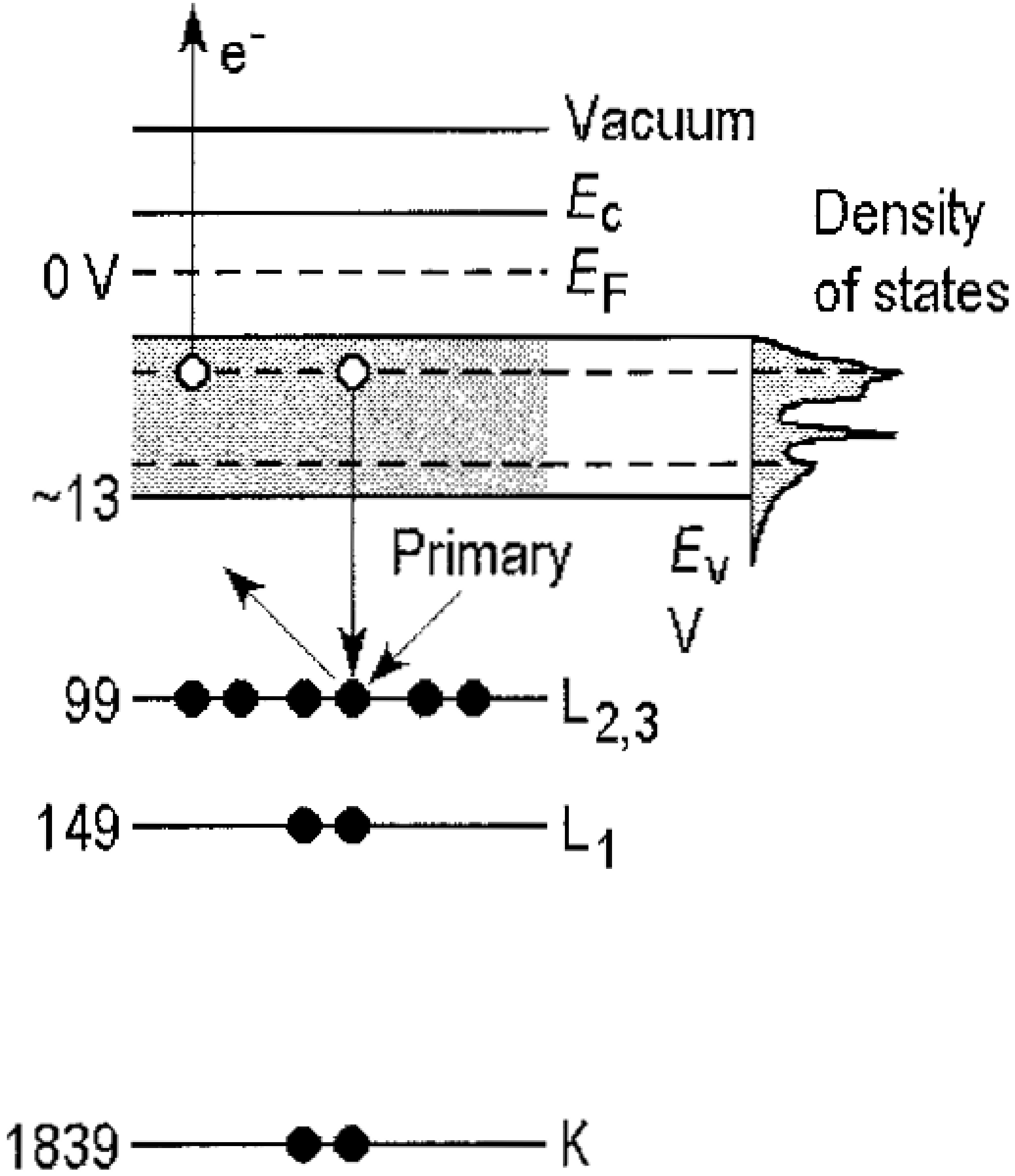


Konkurrenzprozess: Röntgenfluoreszenz

$h\nu = E_K - E_{L1} = 1690$ eV



Augerprozess von Valenzbandelektronen: $L_{2,3}VV$



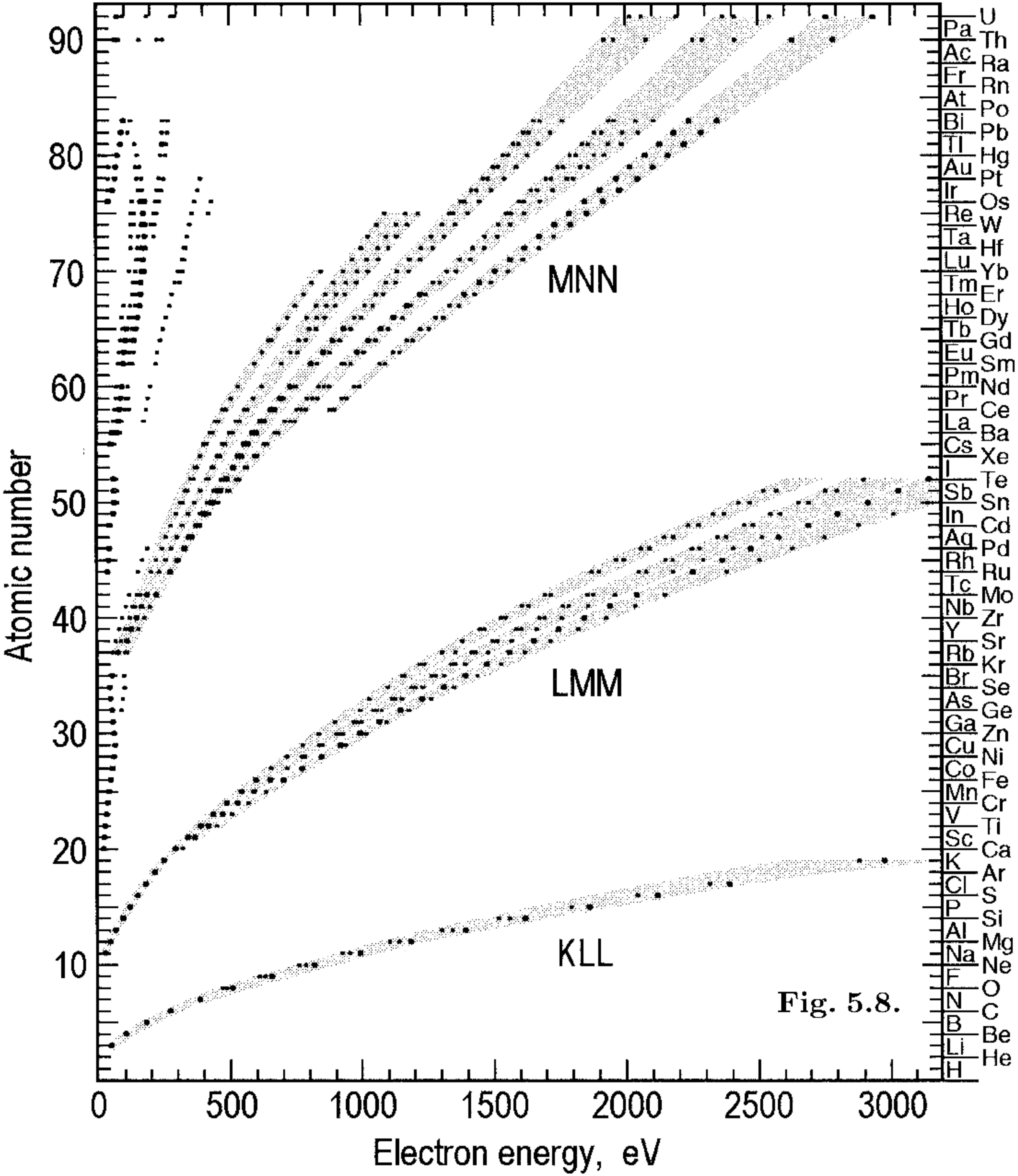
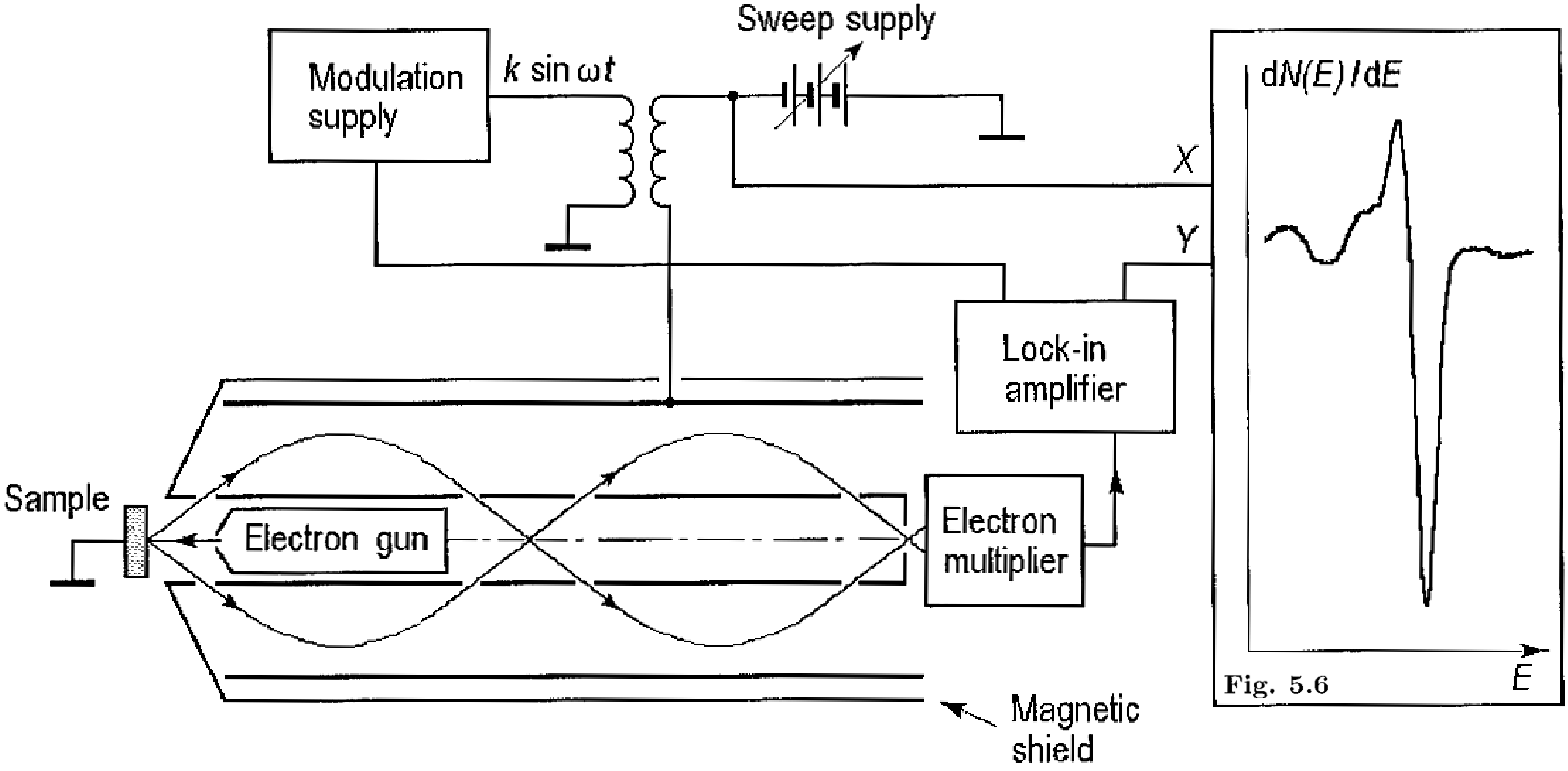

Atomic number
10
20
30
40
50
60
70
80
90
Electron energy, eV
0
500
1000
1500
2000
2500
3000
KLL
LMM
MNN
H
Li
B
N
F
Na
Al
P
Cl
K
Sc
V
Mn
Co
Cu
Ga
As
Br
Rb
Y
Nb
Tc
Rh
Ag
In
Sb
I
Cs
La
Pr
Pm
Eu
Tb
Ho
Tm
Lu
Ta
Re
Ir
Au
Tl
Bi
At
Fr
Ac
Pa
He
Be
C
O
Ne
Mg
Si
S
Ar
Ca
Ti
Cr
Fe
Ni
Zn
Ge
Se
Kr
Sr
Zr
Mo
Ru
Pd
Cd
Sn
Te
Xe
Ba
Ce
Nd
Sm
Gd
Dy
Er
Yb
Hf
W
Os
Pt
Hg
Pb
Po
Rn
Ra
Th
U

Fig. 5.8.

AES mit CMA


Sweep supply
Modulation supply
$k \sin \omega t$
$dN(E)/dE$
X
Y
Lock-in amplifier
Sample
Electron gun
Electron multiplier
Magnetic shield
E
Fig. 5.6

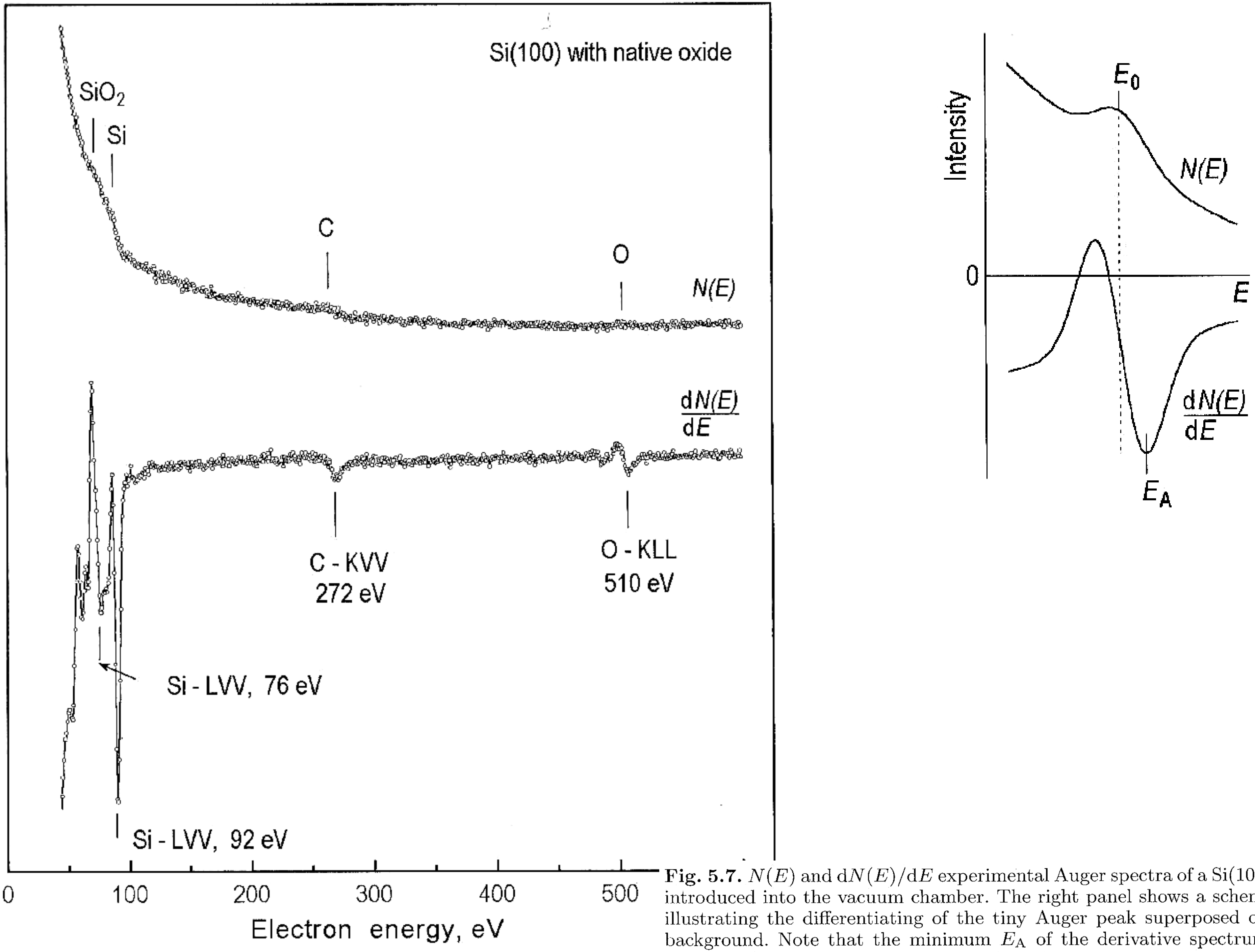
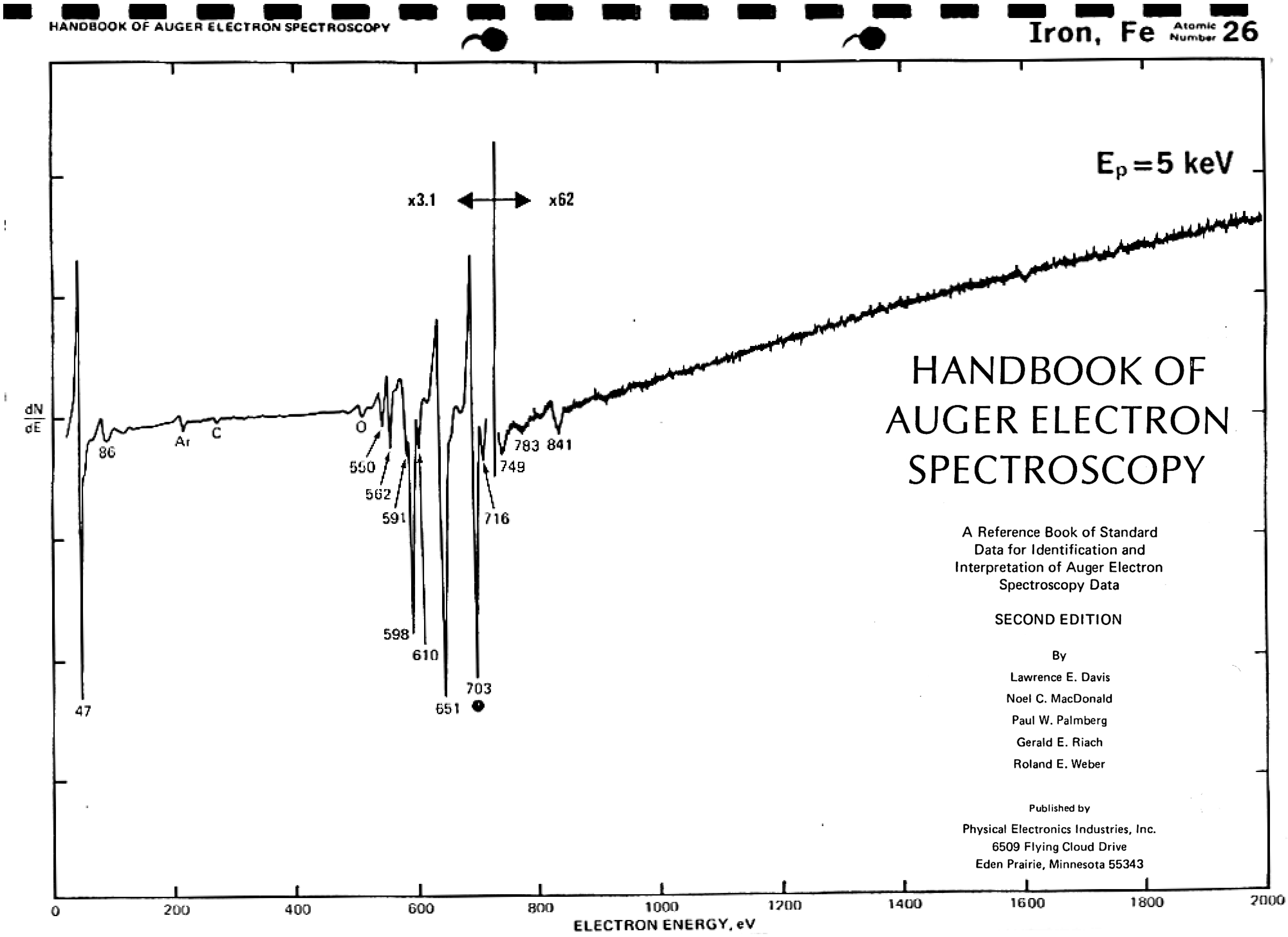


Fig. 5.7. $N(E)$ and $\mathrm{d}N(E)/\mathrm{d}E$ experimental Auger spectra of a Si(100) sample just introduced into the vacuum chamber. The right panel shows a schematic diagram illustrating the differentiating of the tiny Auger peak superposed on the intense background. Note that the minimum E_A of the derivative spectrum $\mathrm{d}N(E)/\mathrm{d}E$ corresponds to the steepest slope of $N(E)$ (not to the maximum E_0 of the Auger peak). Nevertheless, E_A is usually accepted in reference works as the Auger line energy



HANDBOOK OF AUGER ELECTRON SPECTROSCOPY

A Reference Book of Standard
Data for Identification and
Interpretation of Auger Electron
Spectroscopy Data

SECOND EDITION

By

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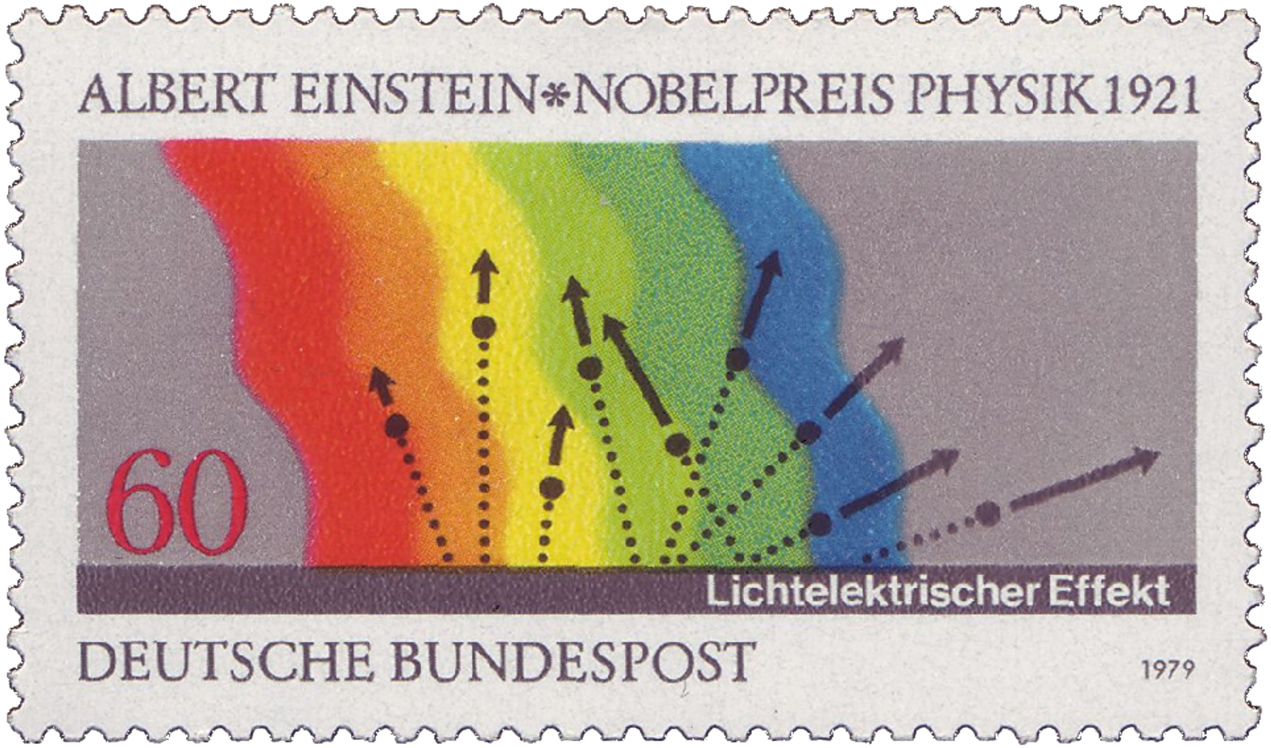
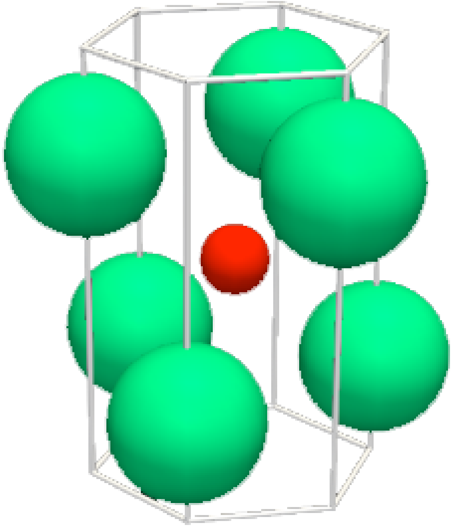
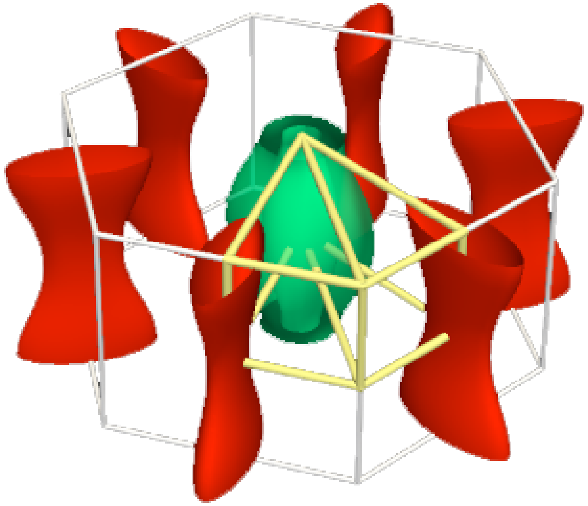


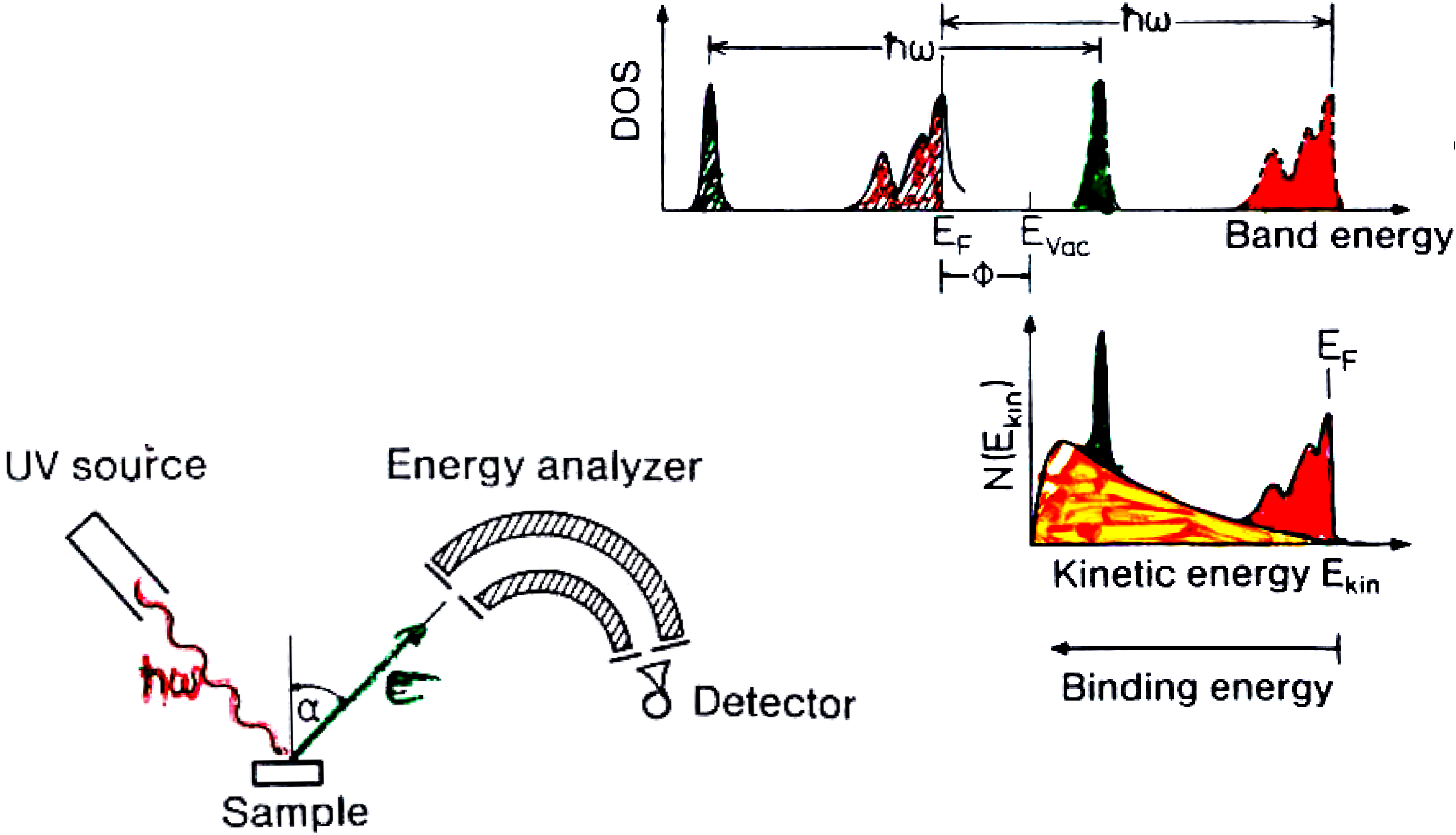
Geometrische Struktur



Elektronische Struktur



Photoelectron Spectroscopy (PES)



Photoelectron Spectroscopy (PES)

occupied states

- UPS: valence band (ARPES)
- XPS: core levels (ESCA)

escape depth 0.5 nm for E_{kin} = 5 ... 200 eV

requires UHV

lab sources

- He 21.1 eV 40.8 eV
- Ne 16.8 eV 26.9 eV
- Al   1486 eV
- Mg 1253 eV

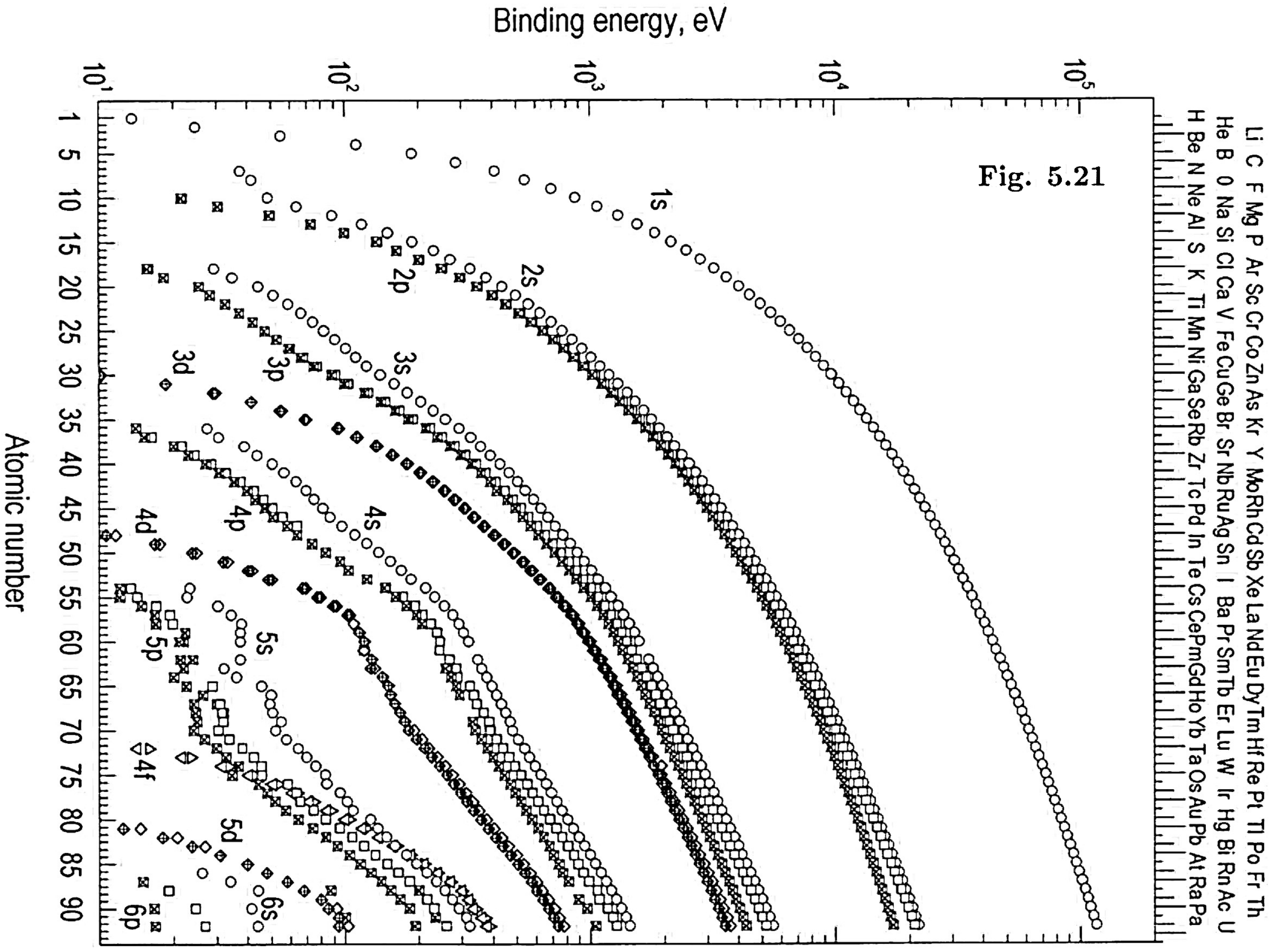
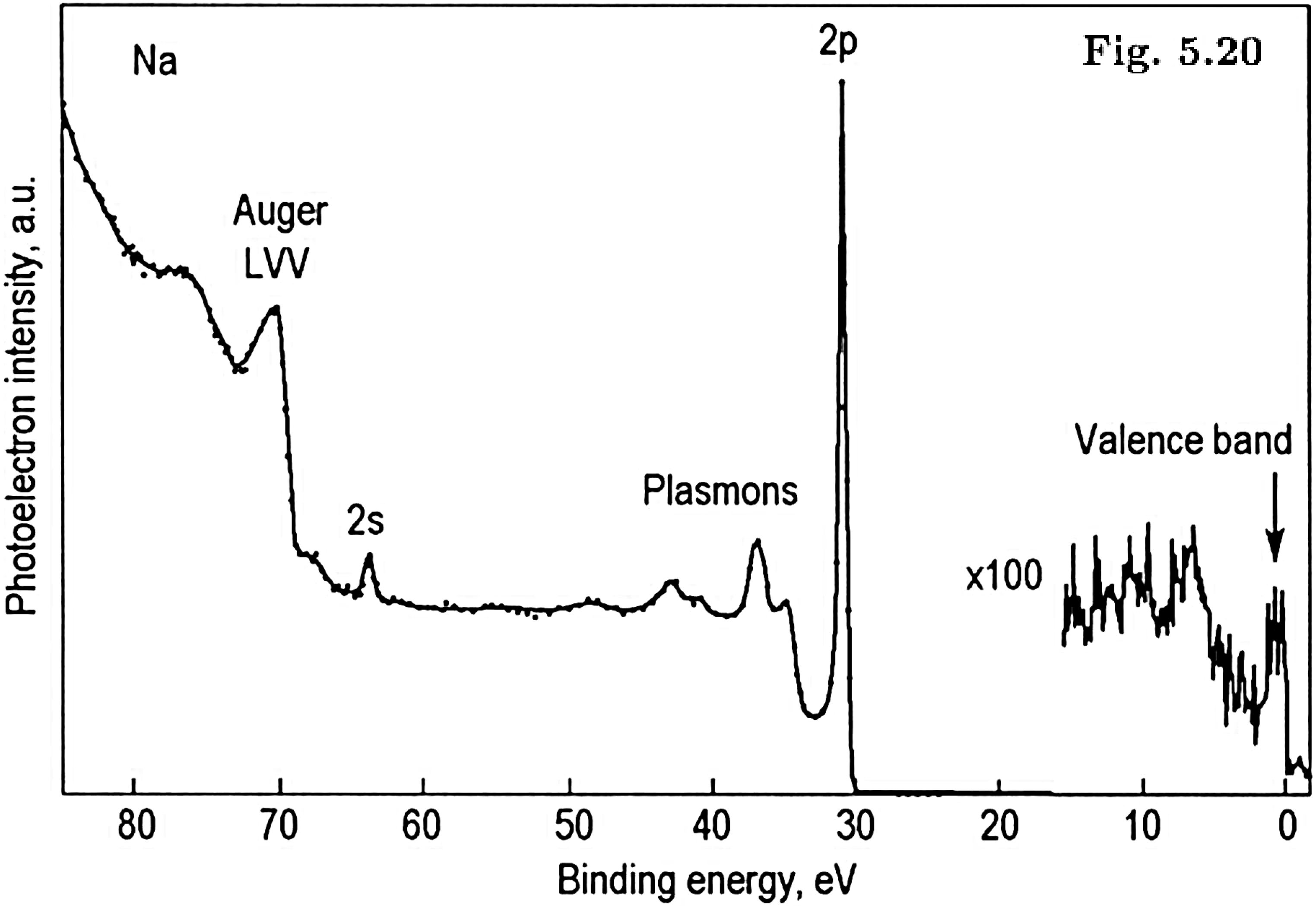
Binding energy, eV
10^1
10^2
10^3
10^4
10^5
Atomic number
1
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
1s
2s
2p
3s
3p
3d
4s
4p
4d
4f
5s
5p
5d
6s
6p
Li C F Mg P Ar Sc Cr Co Zn As Kr Y Mo Rh Cd Sb Xe La Nd Eu Dy Tm Hf Re Pt Tl Po Fr Th
He B 0 Na Si Cl Ca V Fe Cu Ge Br Sr Nb Ru Ag Sn I Ba Pr Sm Tb Er Lu W Ir Hg Bi Rn Ac U
H Be N Ne Al S K Ti Mn Ni Ga Se Rb Zr Tc Pd In Te Cs Ce Pm Gd Ho Yb Ta Os Au Pb At Ra Pa

Fig. 5.21

XPS von Na mit 100 eV



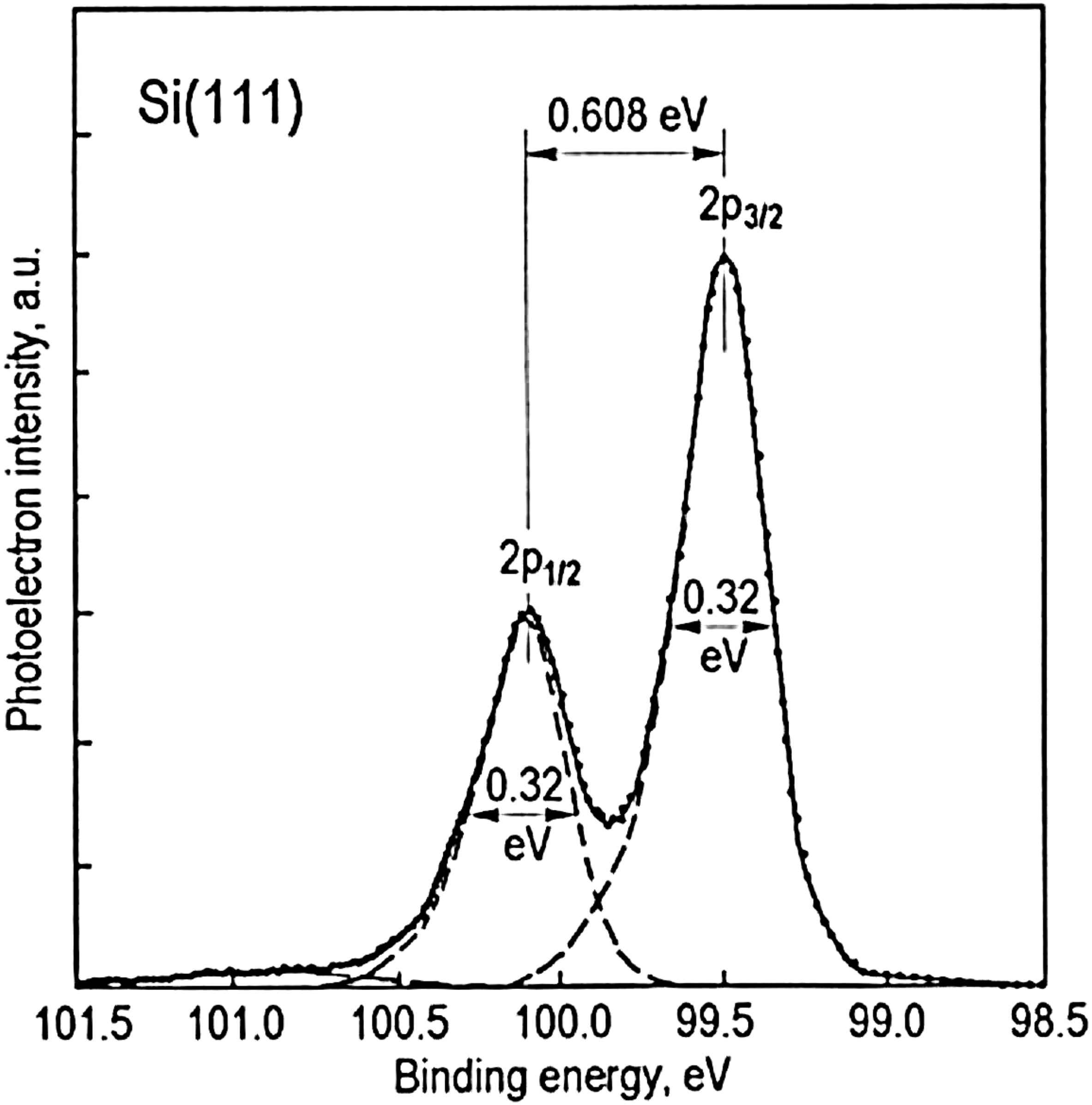


Fig. 5.22. The spin–orbit splitting of the Si 2p core level is indicated by observation of $2p_{1/2}$ and $2p_{3/2}$ partner lines. The splitting of 0.608 eV and the $2p_{1/2}$ to $2p_{3/2}$ intensity ratio of 1:2 are atomic properties and practically independent of the chemical environment (after Siegbahn [5.17])

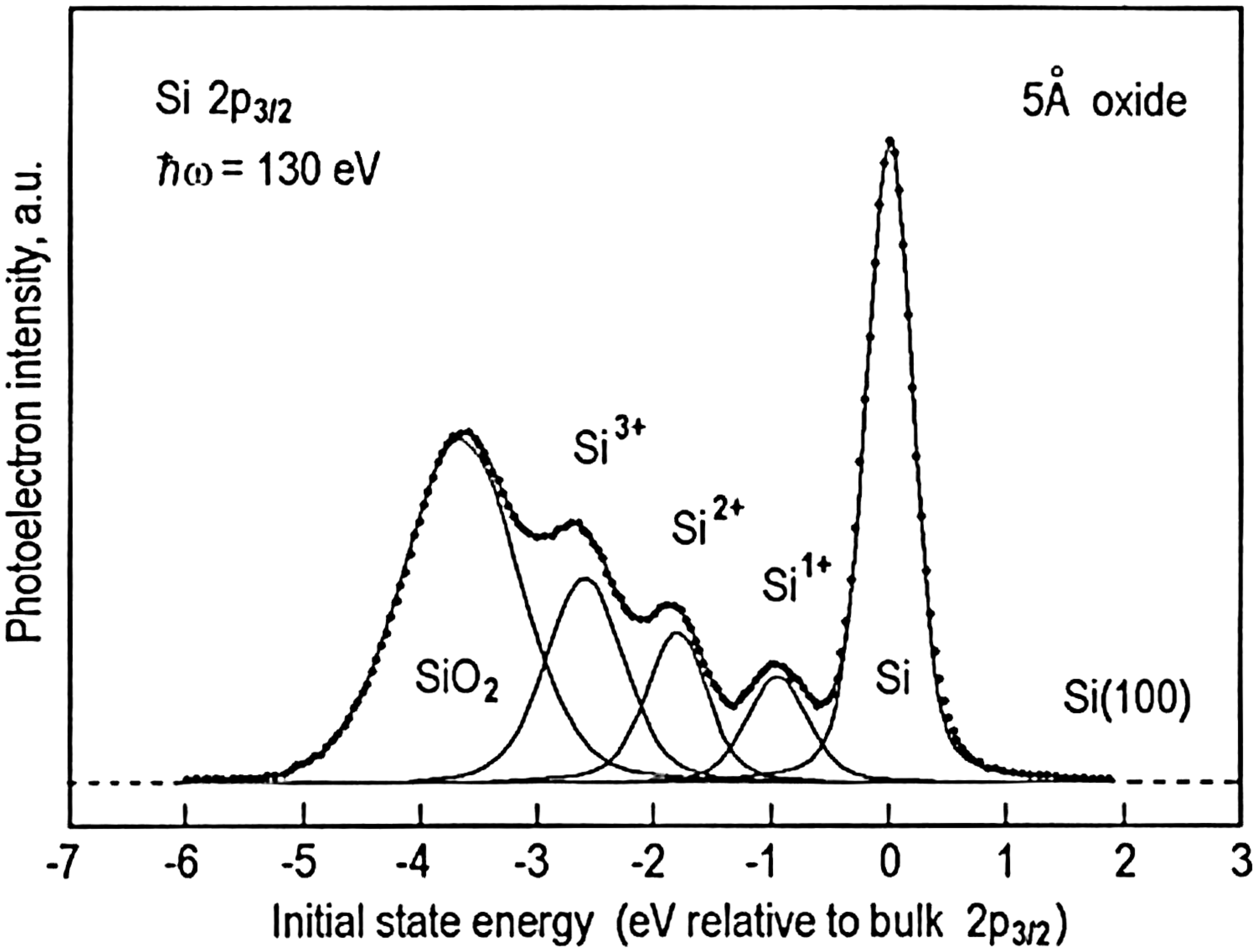
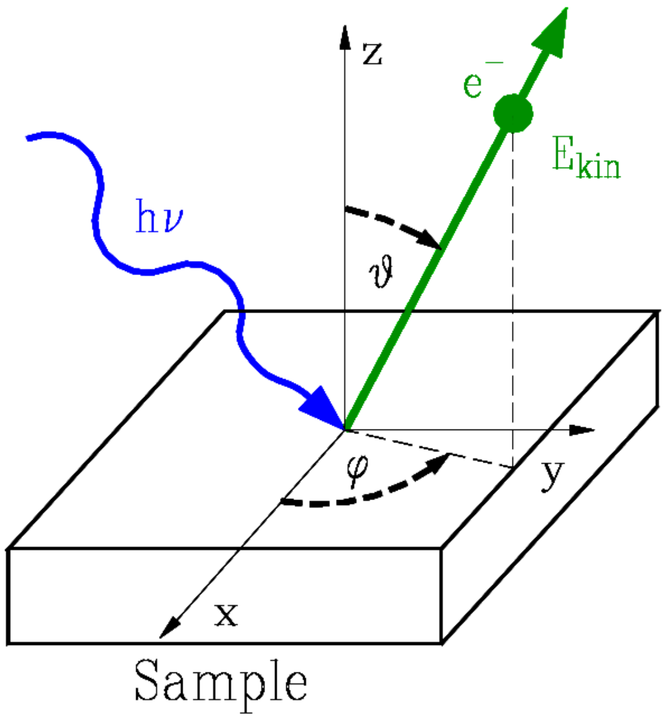


Fig. 5.23. Si $2p_{3/2}$ core-level spectrum from an ultrathin SiO_2 overlayer on a Si(100) surface (note that the Si $2p_{1/2}$ partner line is already subtracted). Besides the peak due to clean Si, the peaks due Si in different oxides are seen, showing a shift to lower energies with increasing oxidation states (after Himpsel et al. [5.18])

Photon in – electron out



conservation of energy

$$E_{kin} = \hbar\omega - E_b$$

conservation of parallel momentum

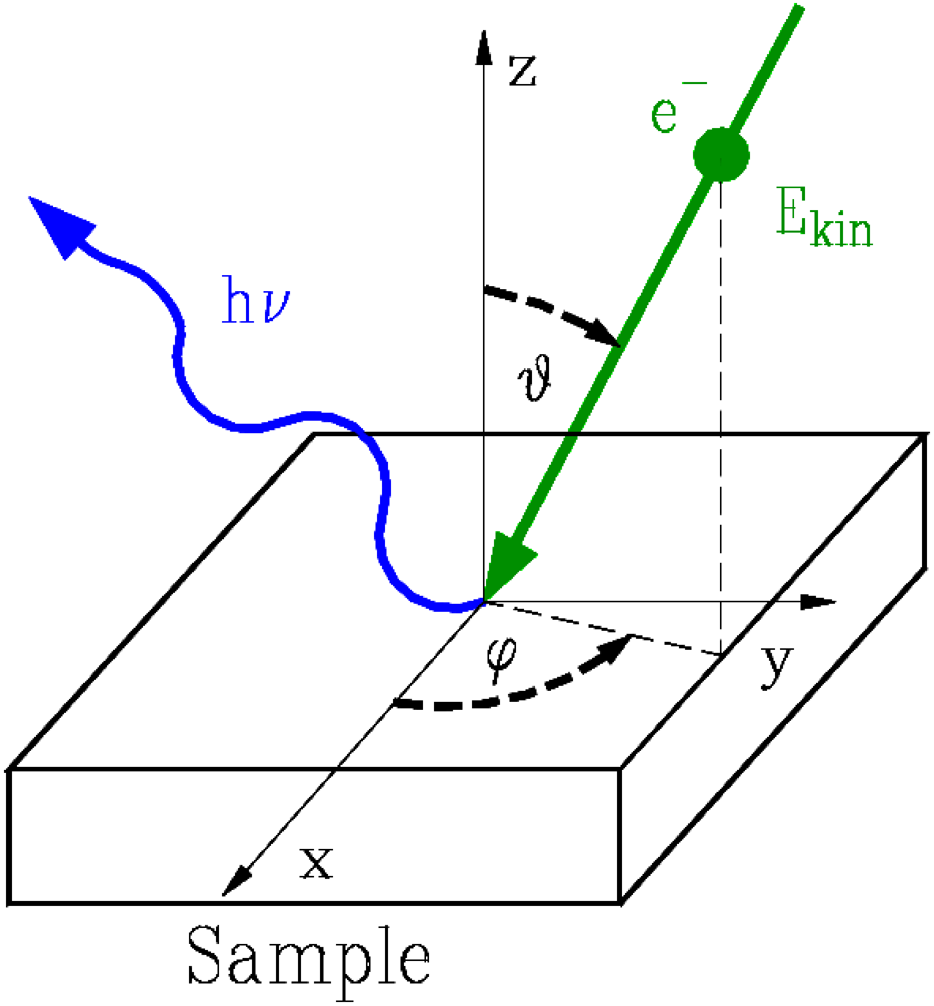
$$\hbar K = \sqrt{2 m E_{kin}} \sin(\alpha) = \hbar K_f = \hbar K_i$$

Electron in – photon out

unoccupied states: IPES

low intensities

vary E_{kin} - isochromat spectra



Angle Resolved PES/IPES

(ARUPS, KRIPES)

vertical transitions