MAGYAR TUDOMÁNYOS AKADÉMIA
KÉMIAI KUTATÓKÖZPONT

Röntgen-fotoelektron spektroszkópia

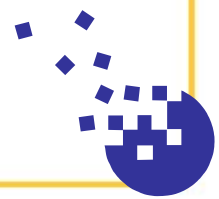
(XPS, ESCA)

Kíváncsi kémikusok:

Batki Bálint Ganyecz Ádám Ullmann Kristóf

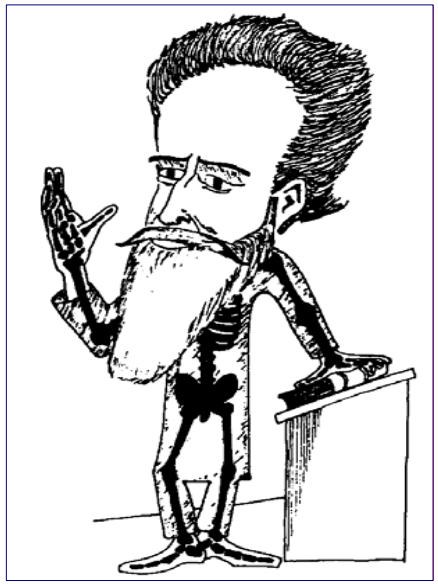
Témavezető:

Mohai Miklós



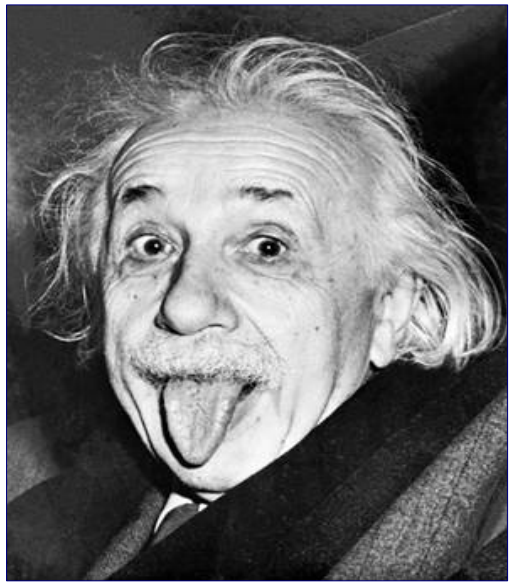
XPS – Nobel díjak

Röntgen sugárzás
(1901)



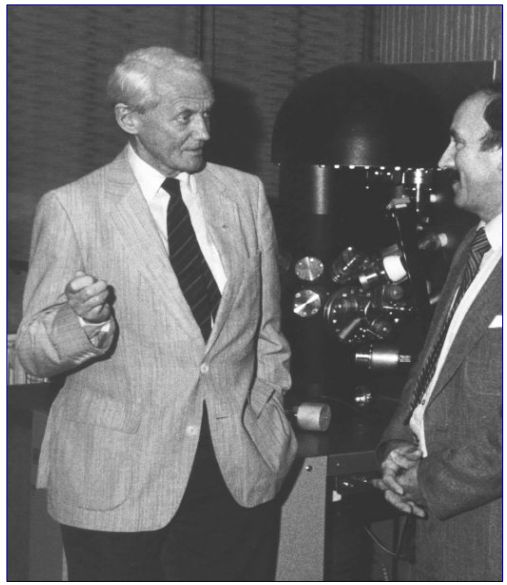
Wilhelm Conrad Röntgen
(1845-1923)

Fotoeffektus
(1921)



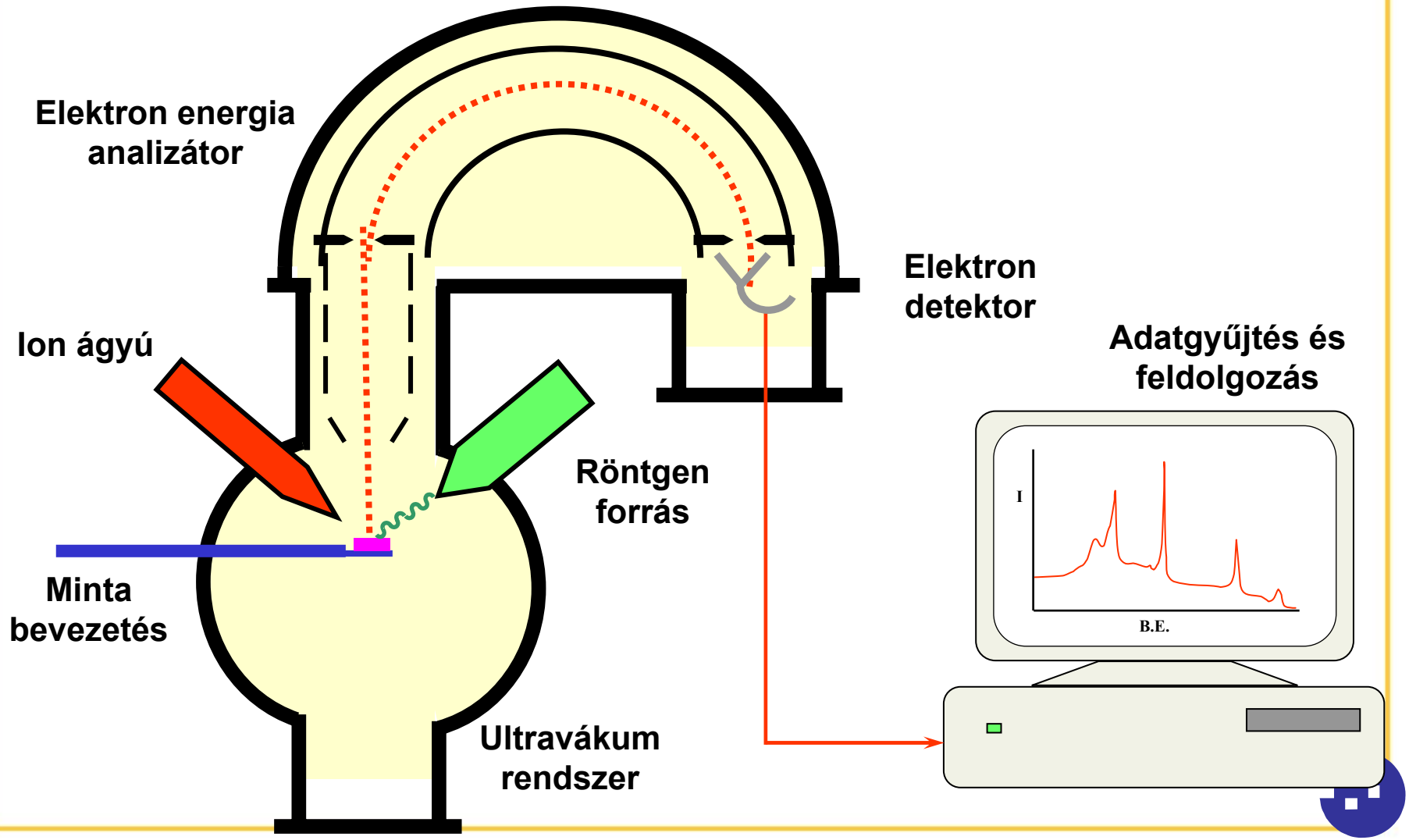
Albert Einstein
(1879-1955)

Nagyfelbontású elektronspektroszkópia
(1981)

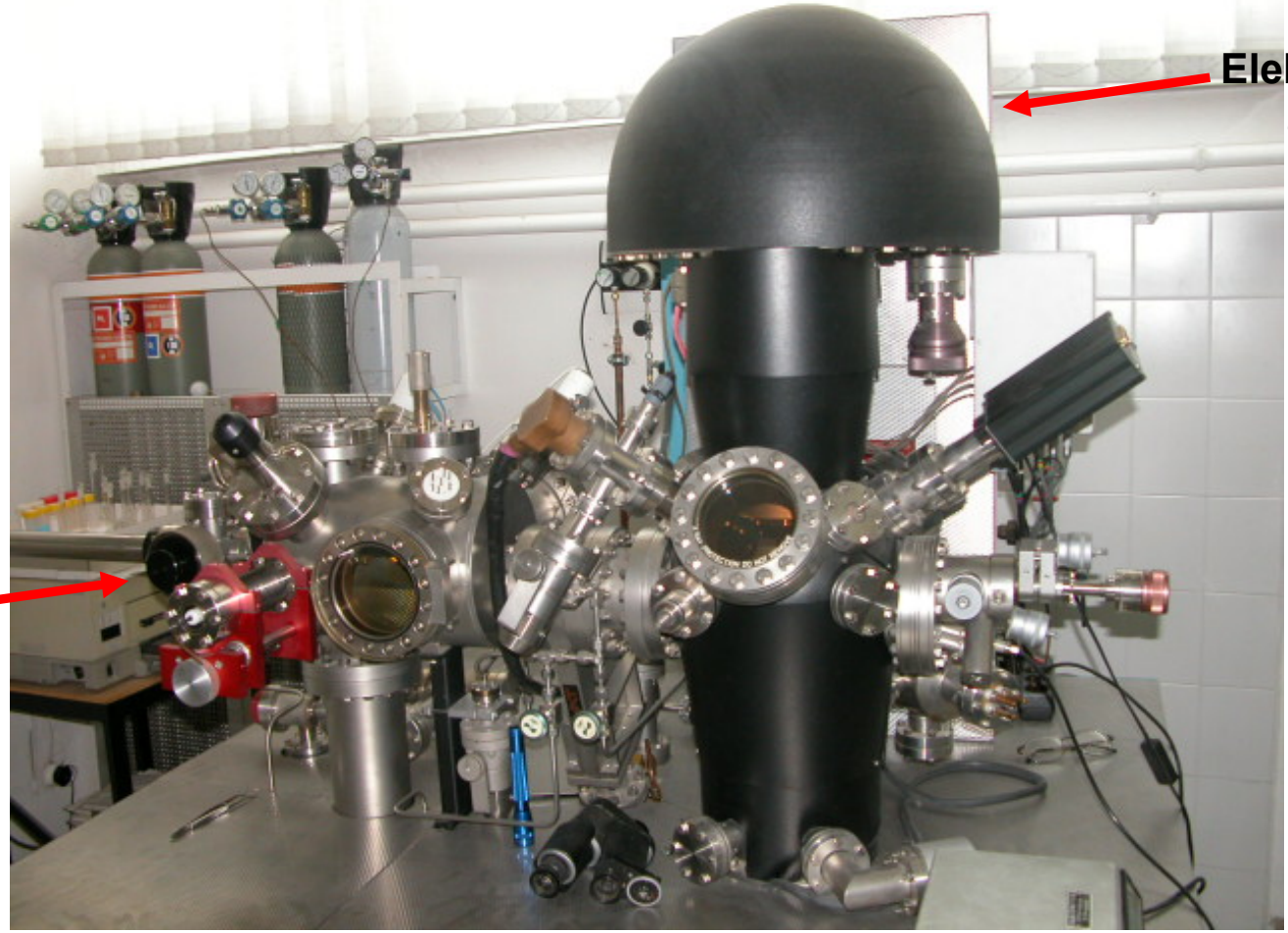


Kai M. Siegbahn
(1918-2007)

Spektrométer



Spektrométer



Ultravákum rendszer

A nyomás:

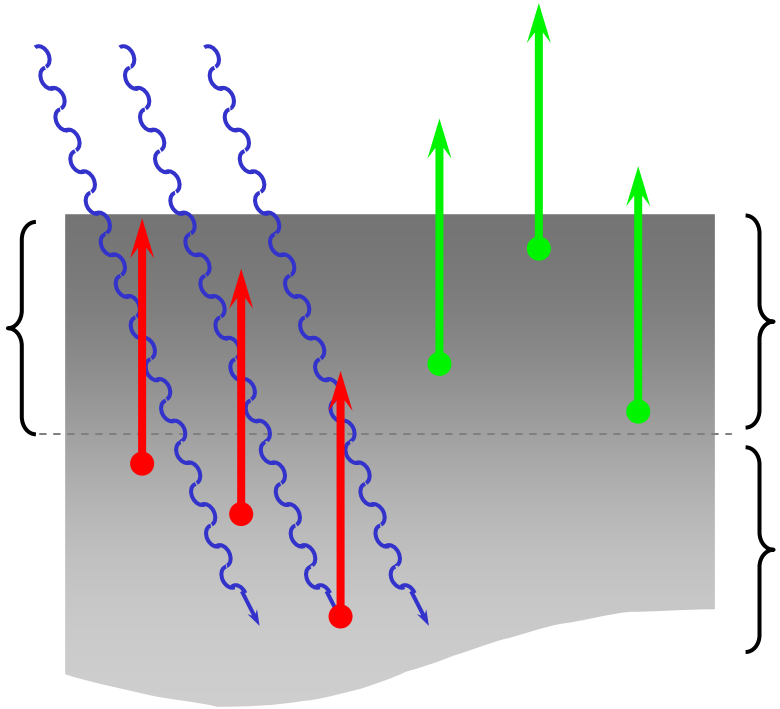
10^{-6} ... 10^{-14} mbar

1 mbar = 1 hPa

Felületi módszer

A röntgensugarak mélyen behatolnak a mintába.

Az XPS jellemző *kimutatási mélysége* **5 – 10 nm**.

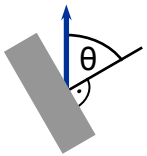


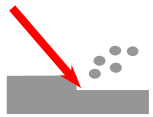
Ezek az elektronok el tudják hagyni a felületet.

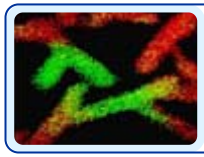
Ezek az elektronok nem tudják

Felhasználási területei

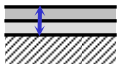
Mélységi információ:
Szögfüggés
Mélységi profil



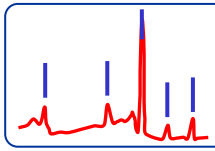




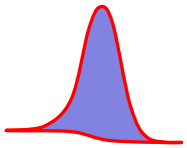
Felületi (laterális) eloszlás:
Képek (chemical map)



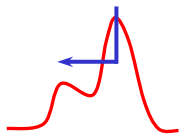
Rétegvastagság



Minőségi (kvalitatív) összetétel:
Vonal helyzetek

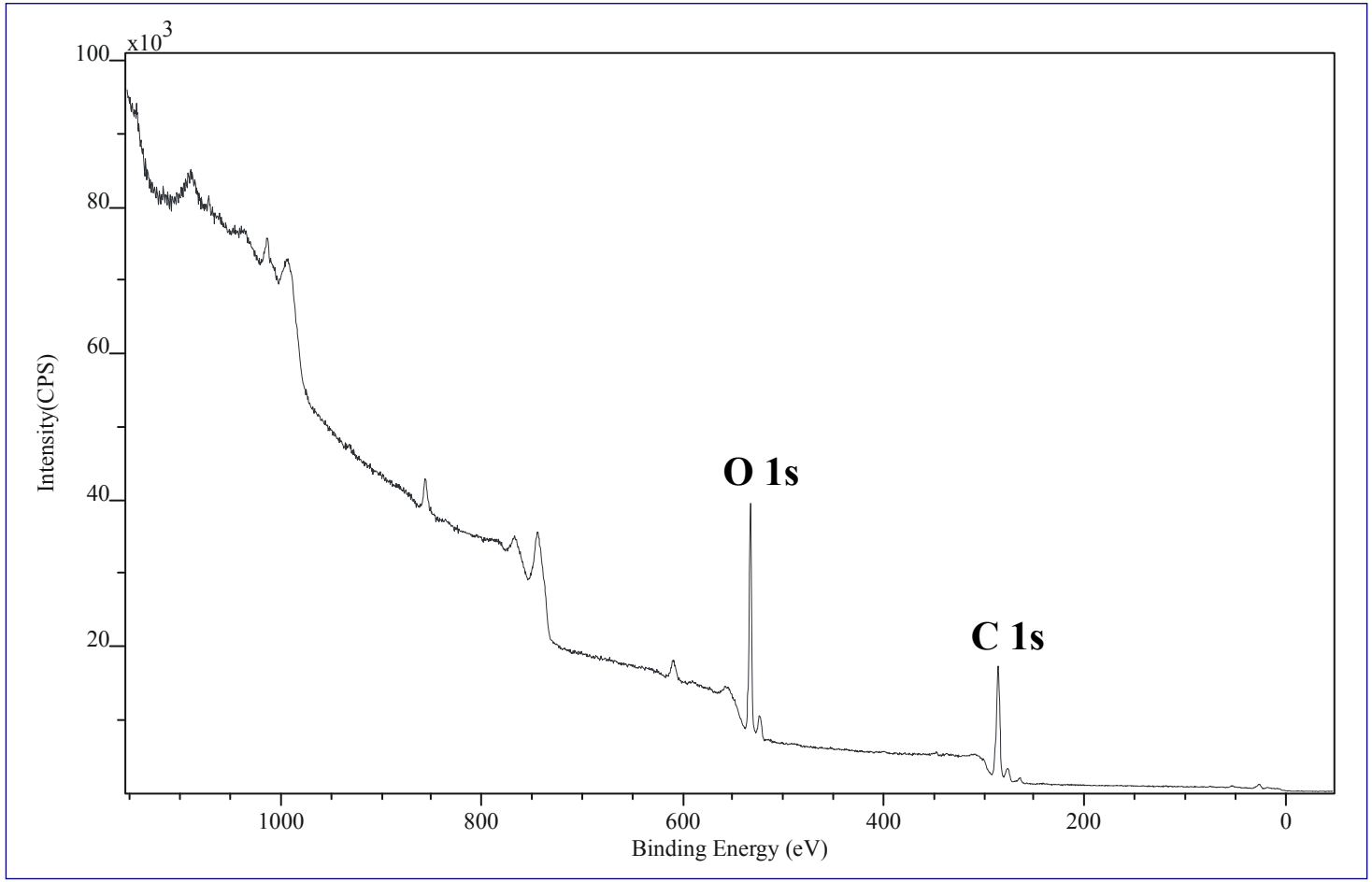


Mennyiségi (kvantitatív) összetétel:
Integrális intenzitás



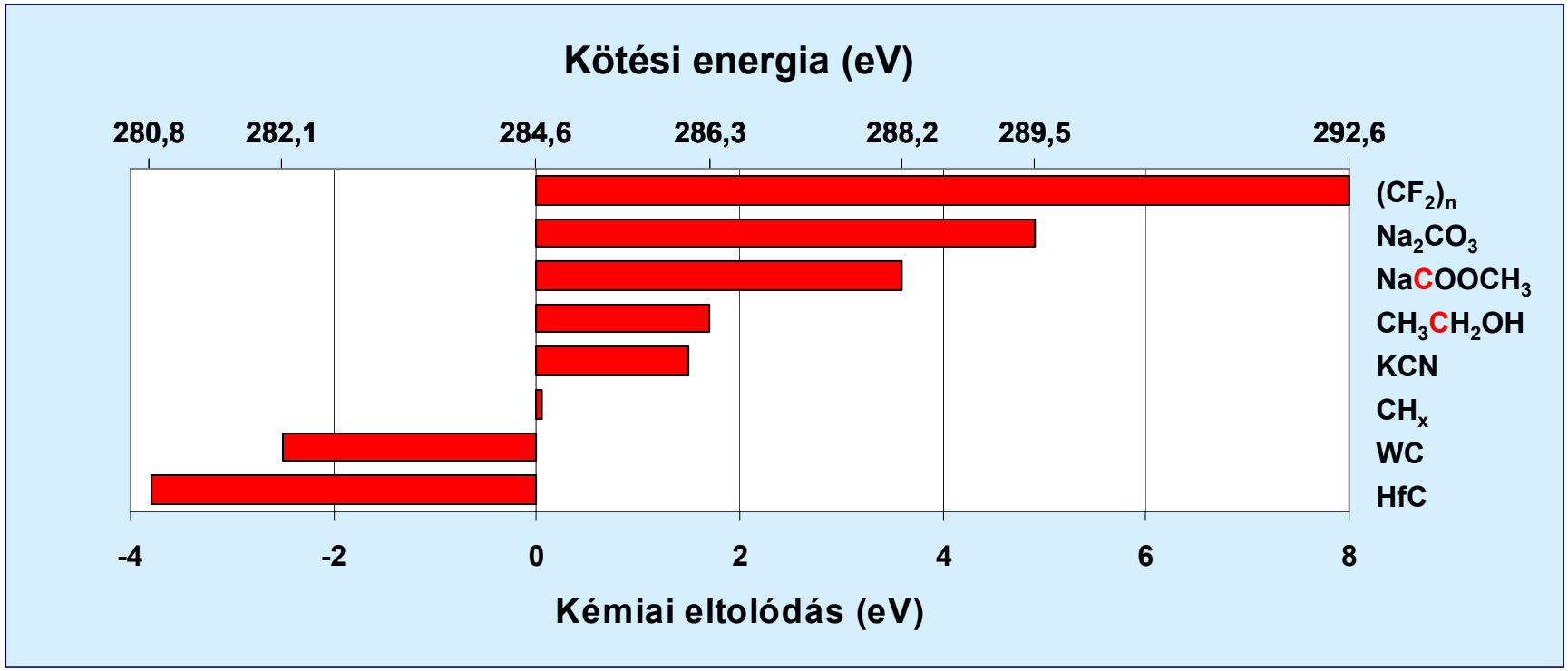
Szerkezet (kémiai állapot):
Kémiai eltolódás

Minőségi elemzés



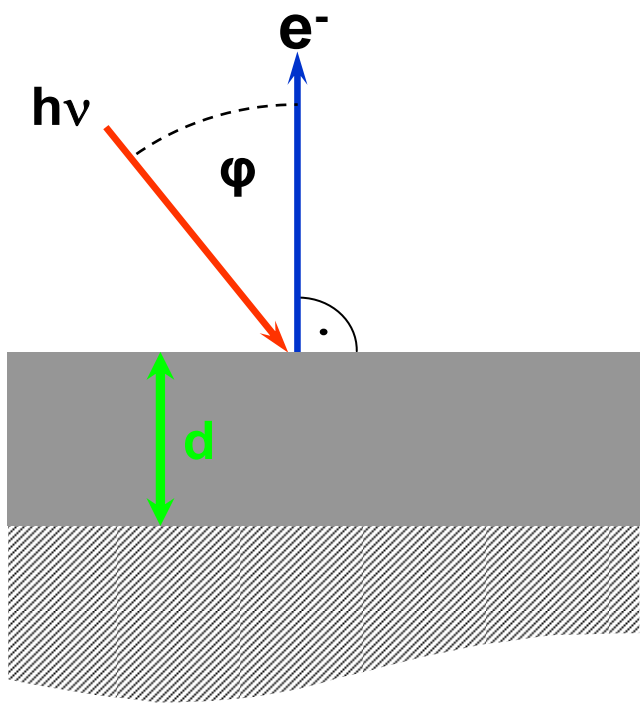
Kémiai állapot

A szén C 1s vonalának kémiai eltolódása

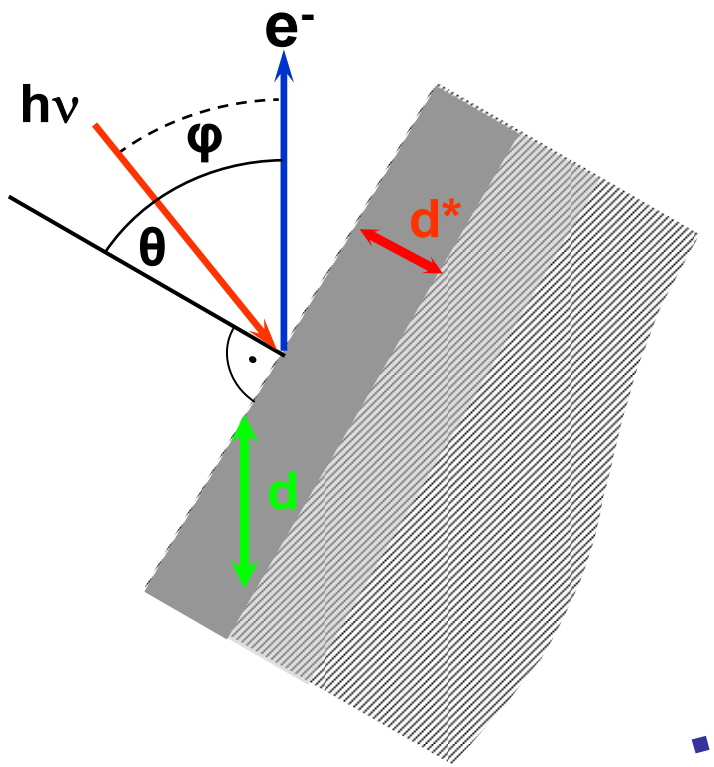


Szögfüggő kísérletek

θ = 0°



θ = 60°

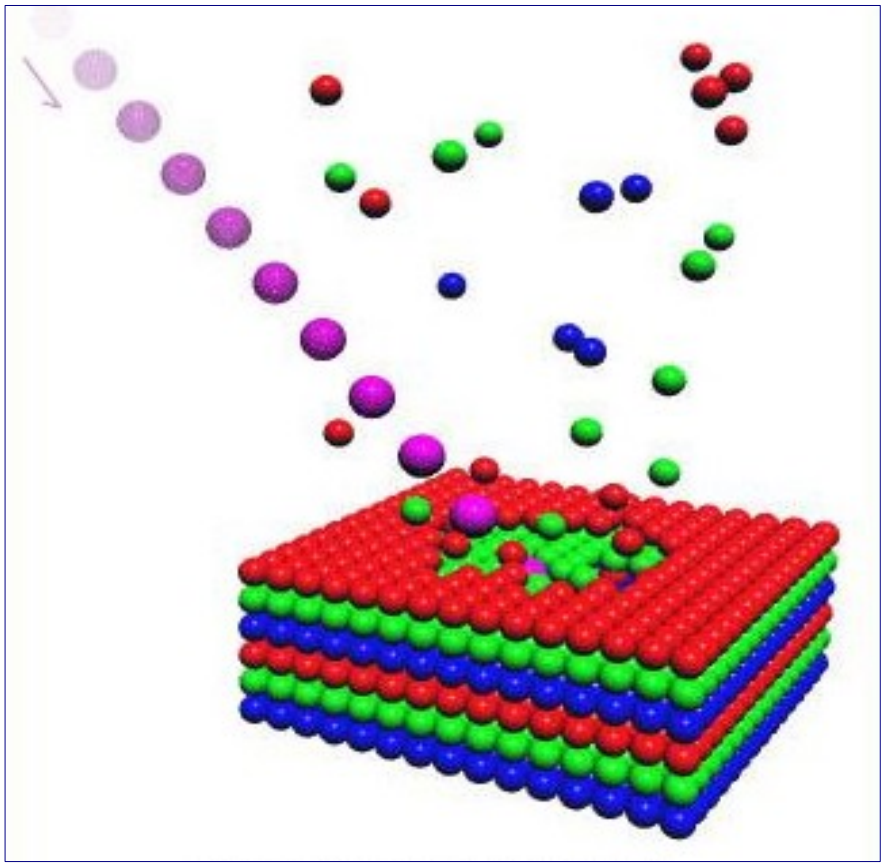


$d^* < d$ $\quad d^* = d \cos\theta$

Mélységi profil

Ion maratás

Ar^+ (N_2^+, O_2^+, He^+, C_{60}^+)



ion ágyú

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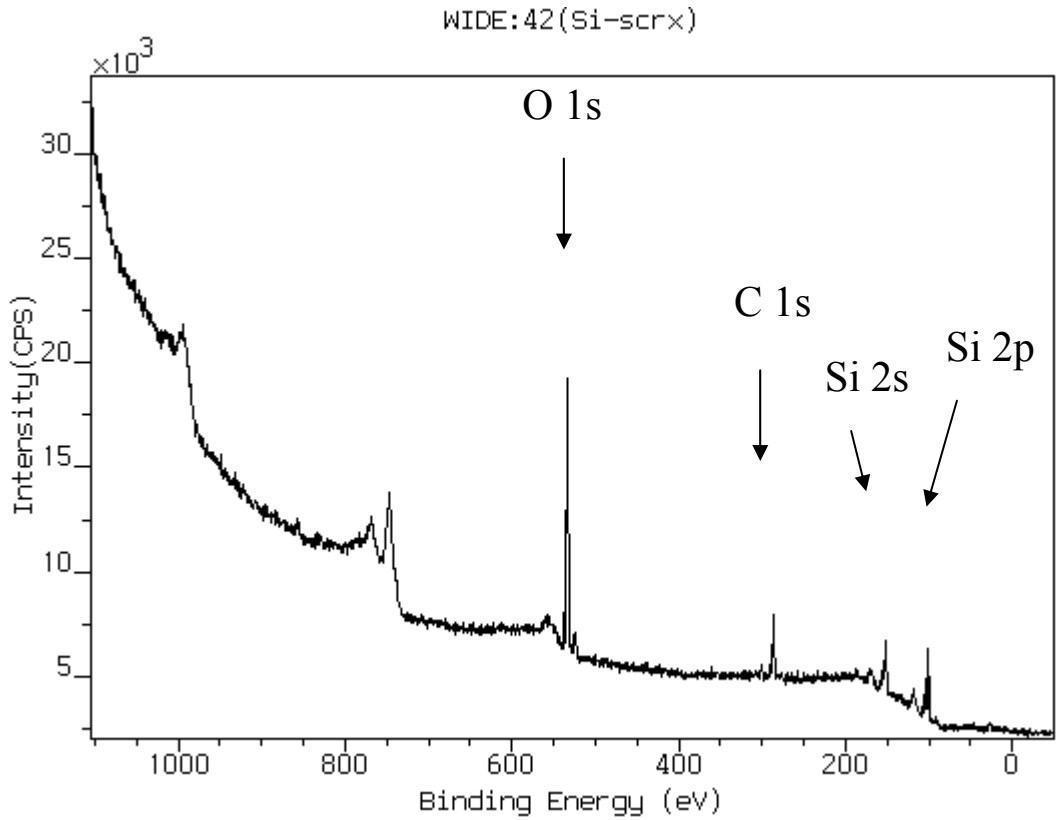
II.

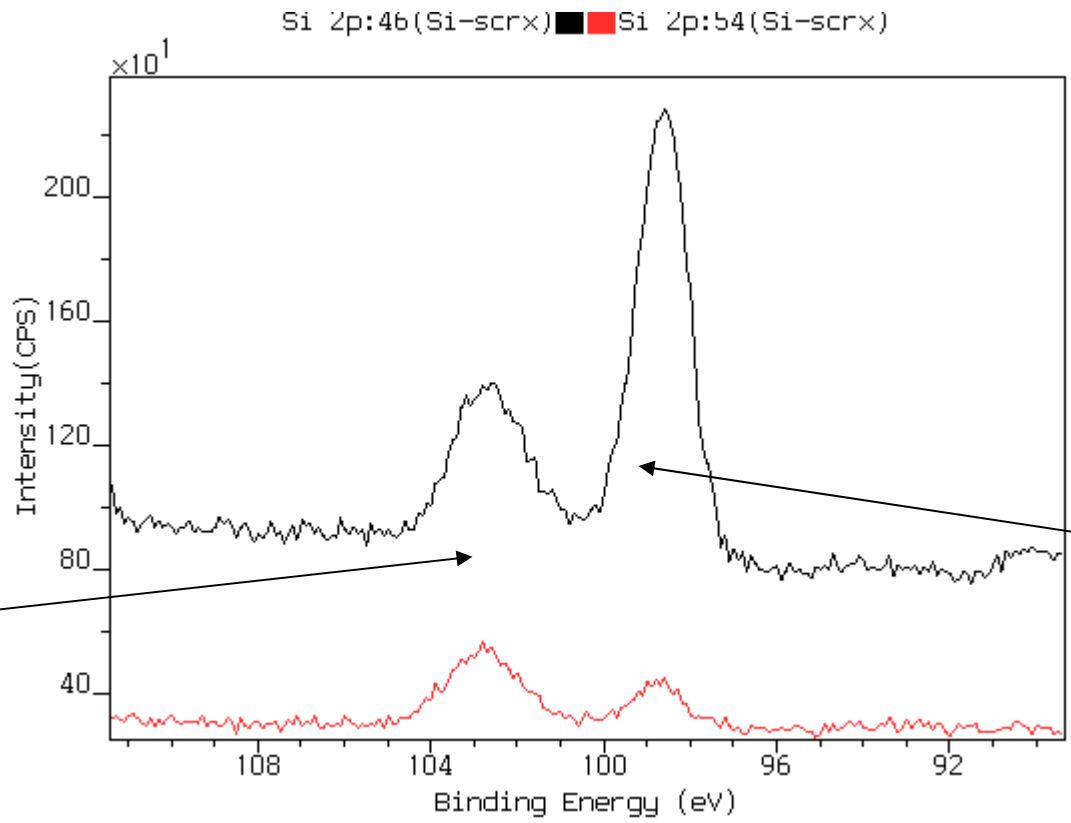
Szilícium-minta vizsgálata

Ganyecz Ádám

A minta teljes spektruma



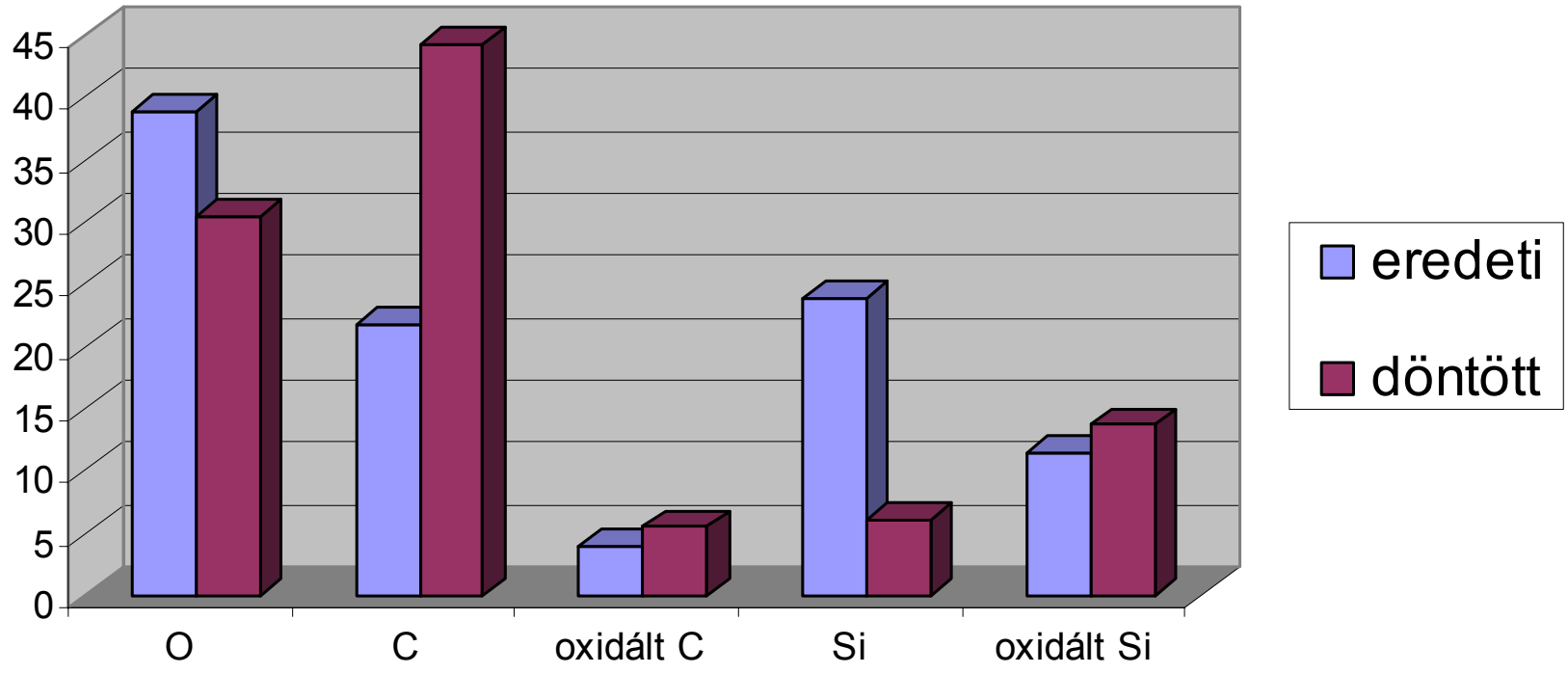
Szilicium spektruma



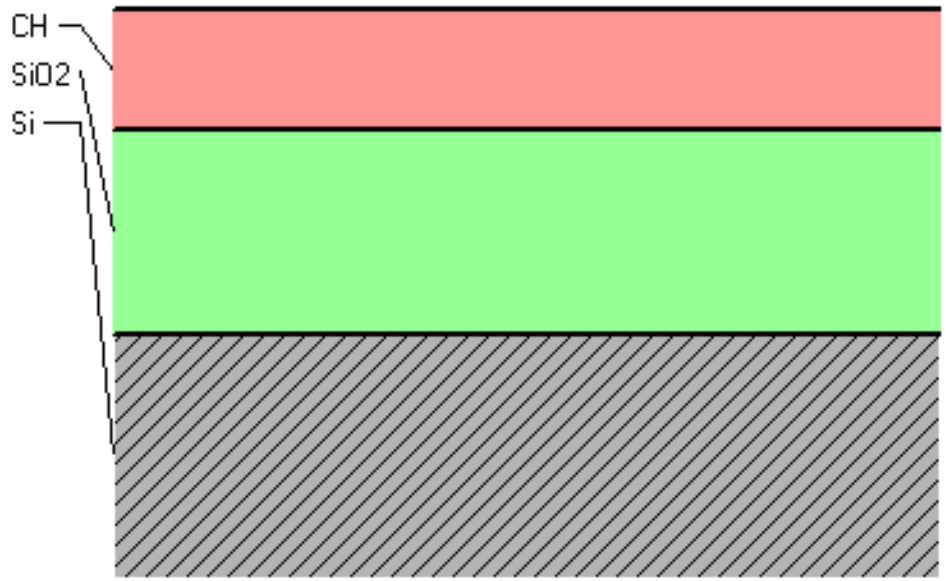
Oxidált Si

Elemi Si

Eredeti és döntött összehasonlítása



Rétegek

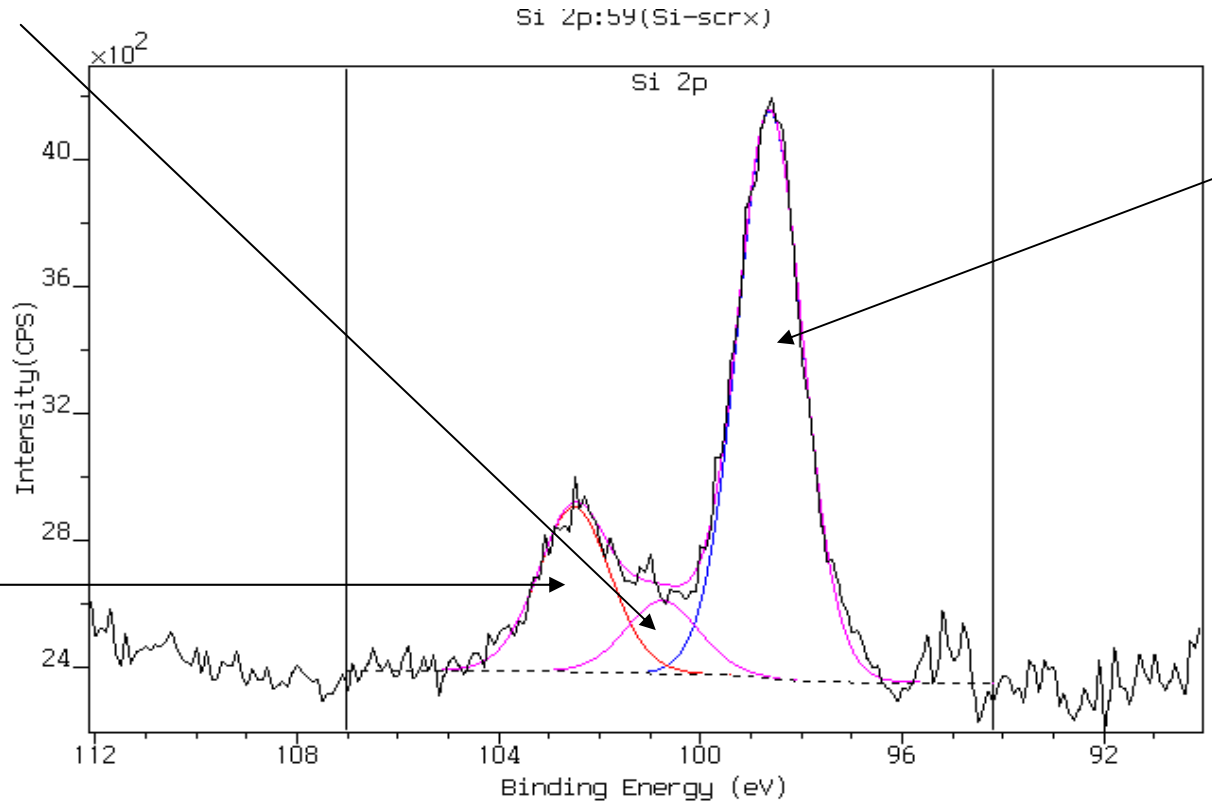


1.6 nm

2.7 nm

Szilícium spektruma 1 perces maratás után

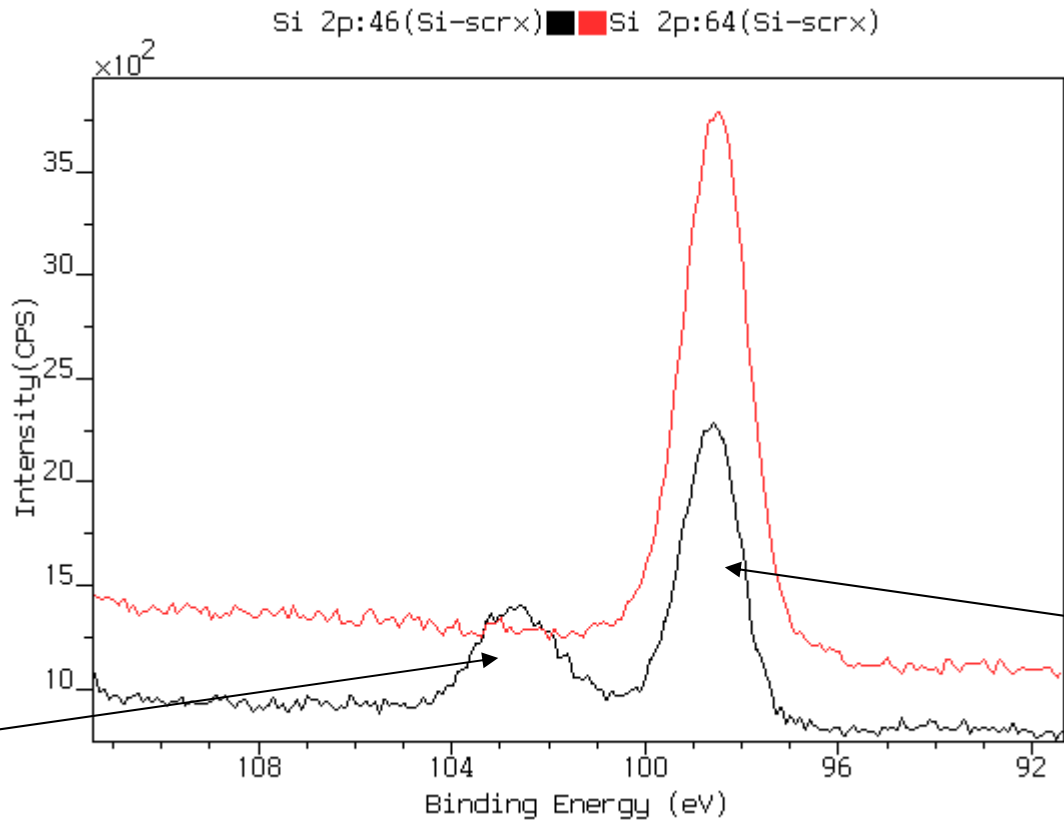
Részlegesen oxidált Si



Elemi Si

Oxidált Si

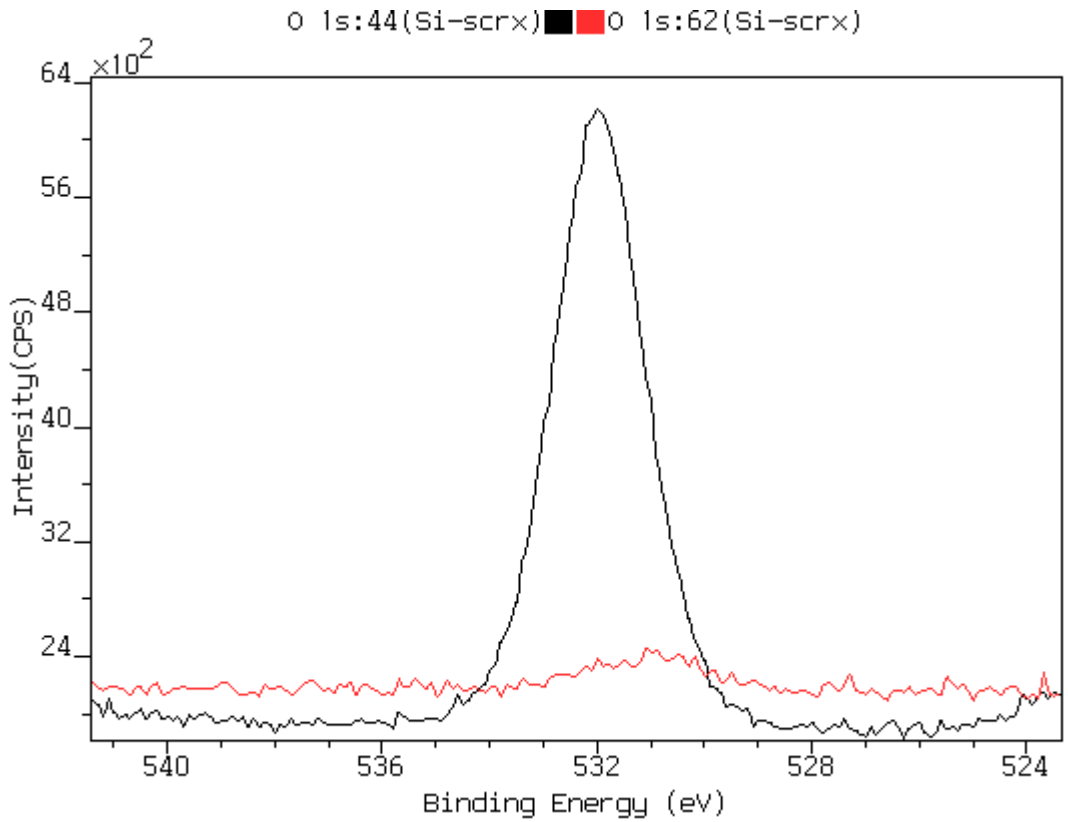
Szilícium spektruma



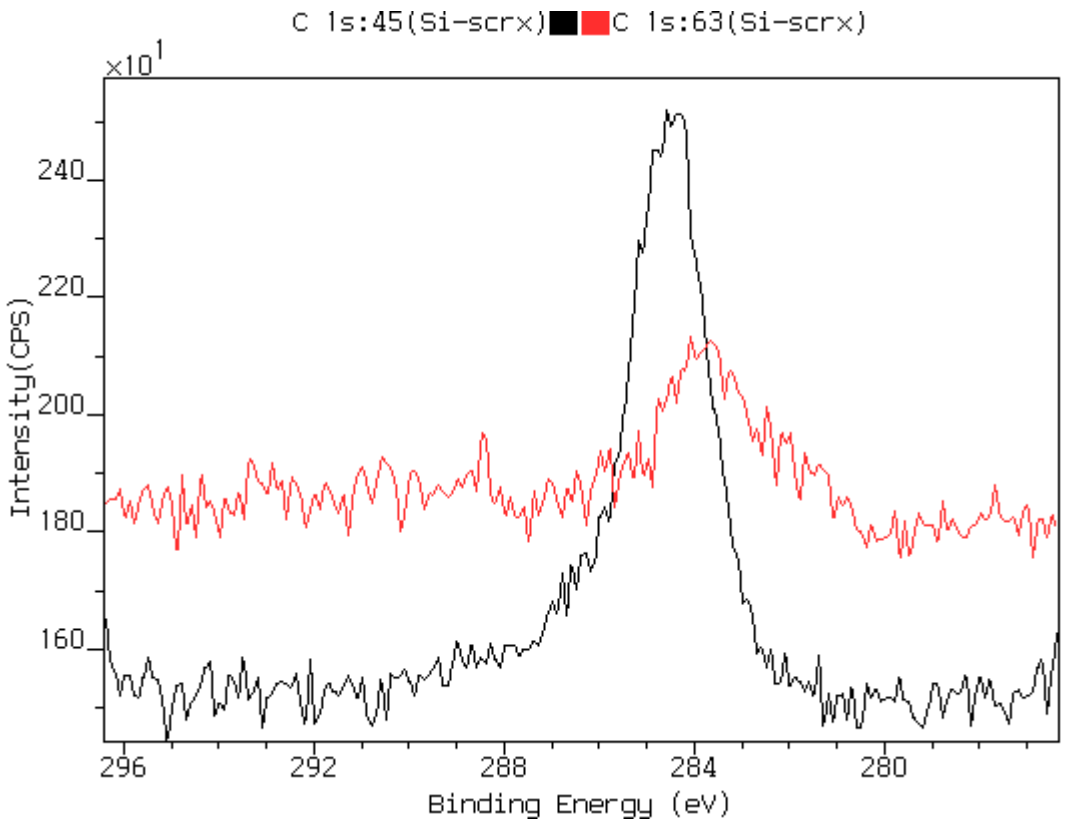
Oxidált Si

Elemi Si

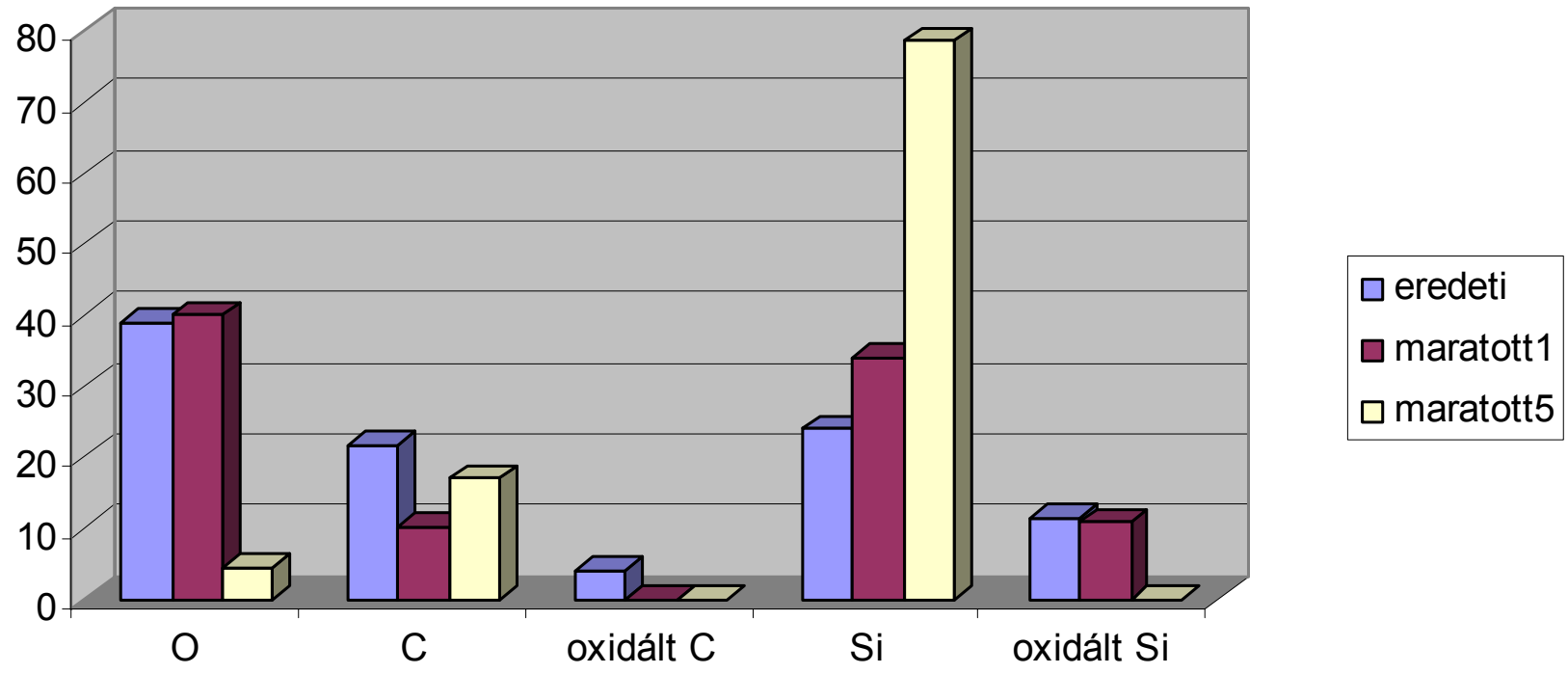
Oxigén spektruma



Szén eltűnése



Eredeti és maratott összehasonlítása



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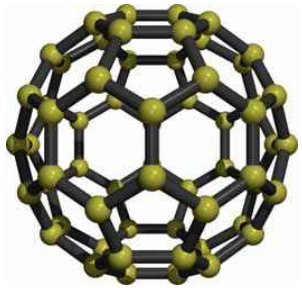
III.



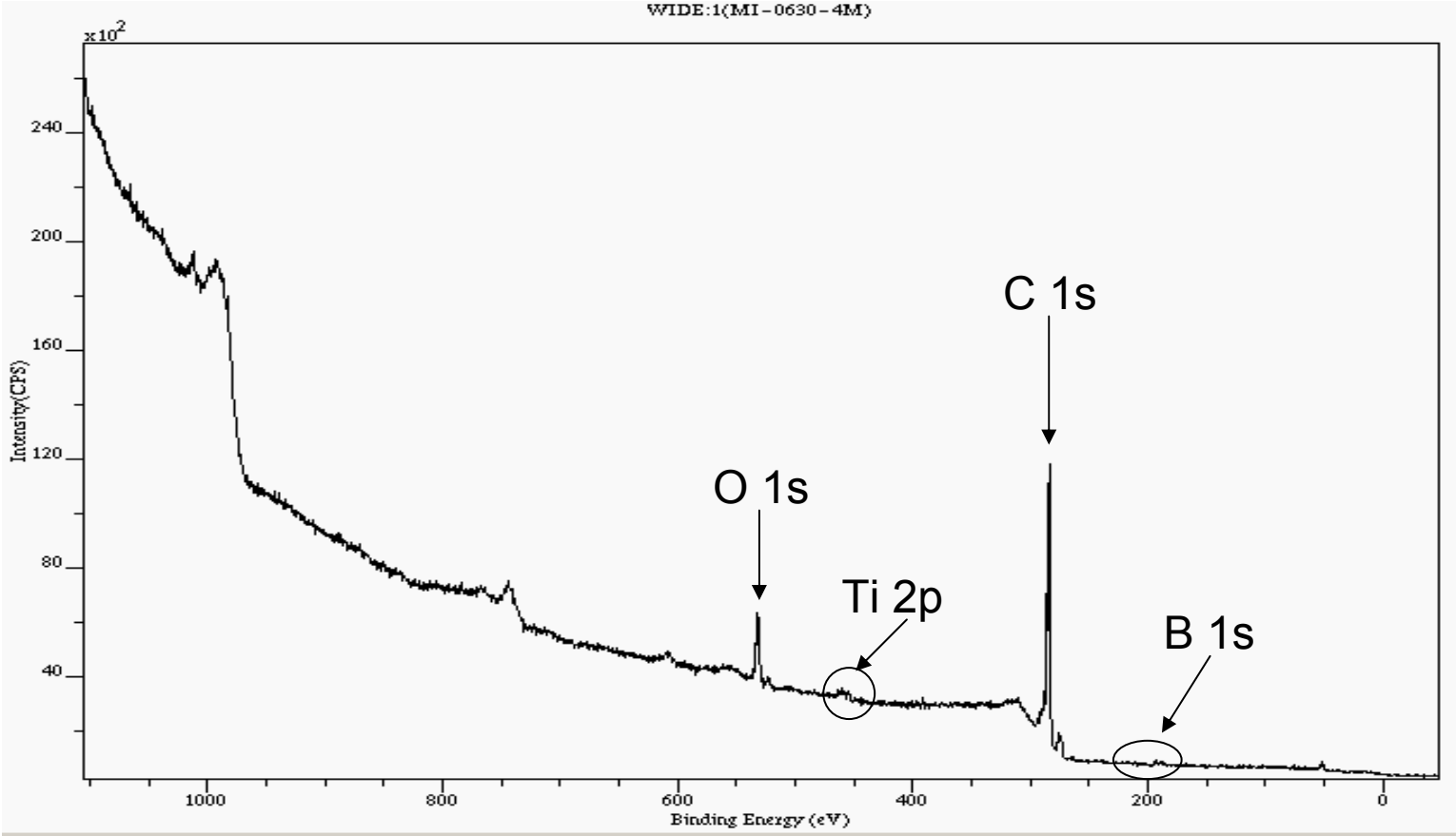
Közös munka a

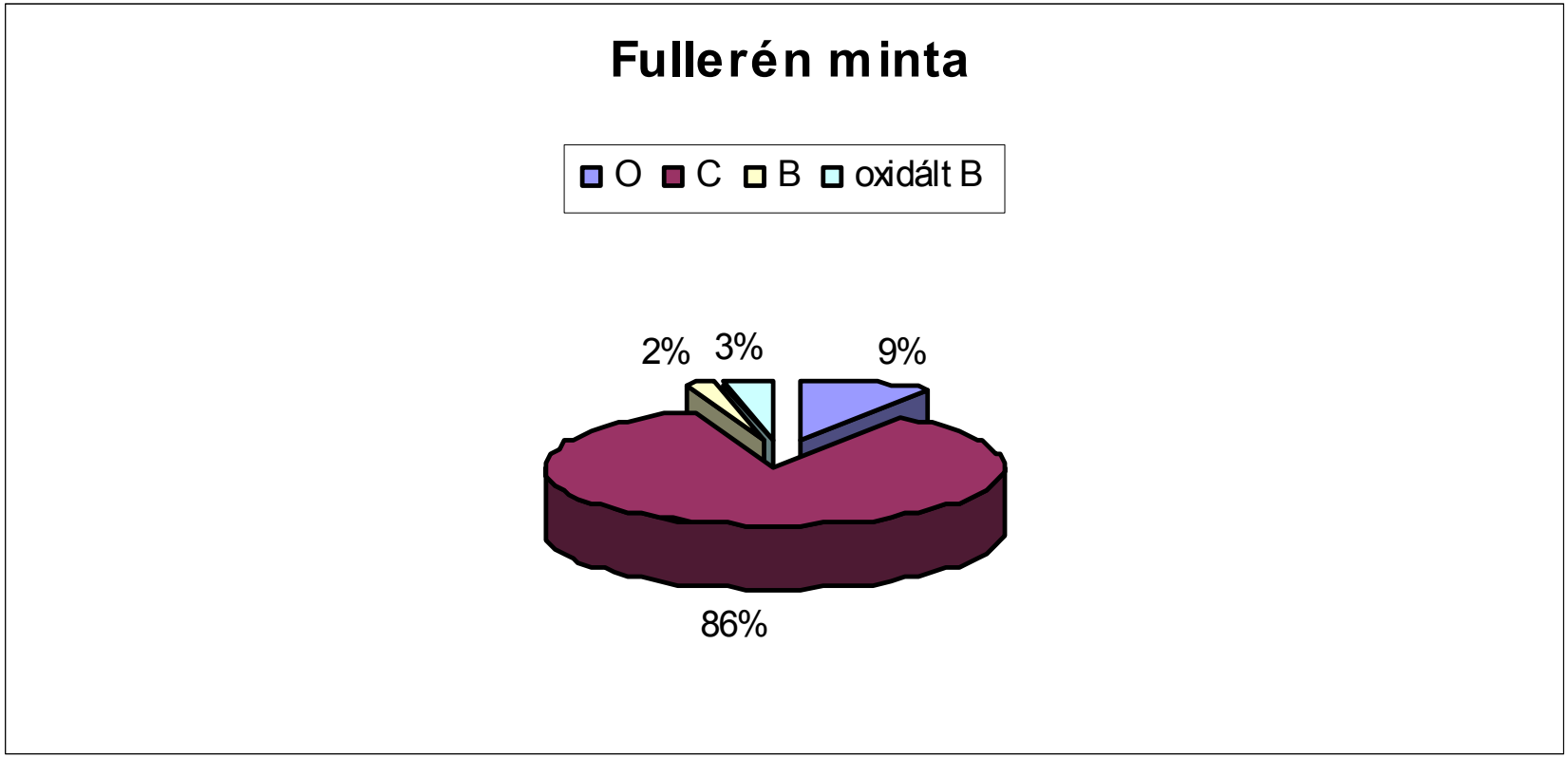
Plazmakémiai Laboratóriummal

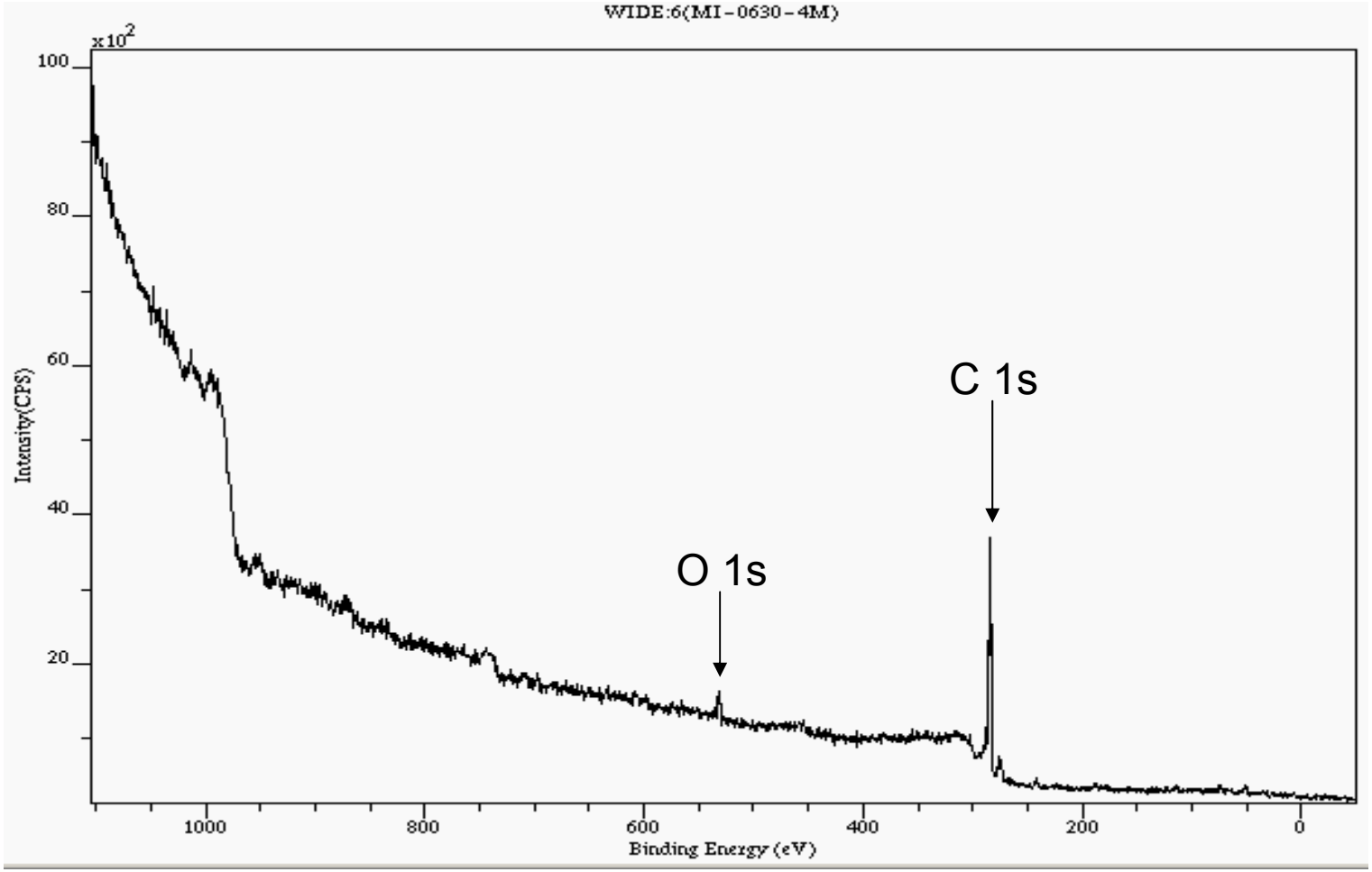
Ullmann Kristóf

kép: http://www.physics.uc.edu/~pkent/pictures/c60.html

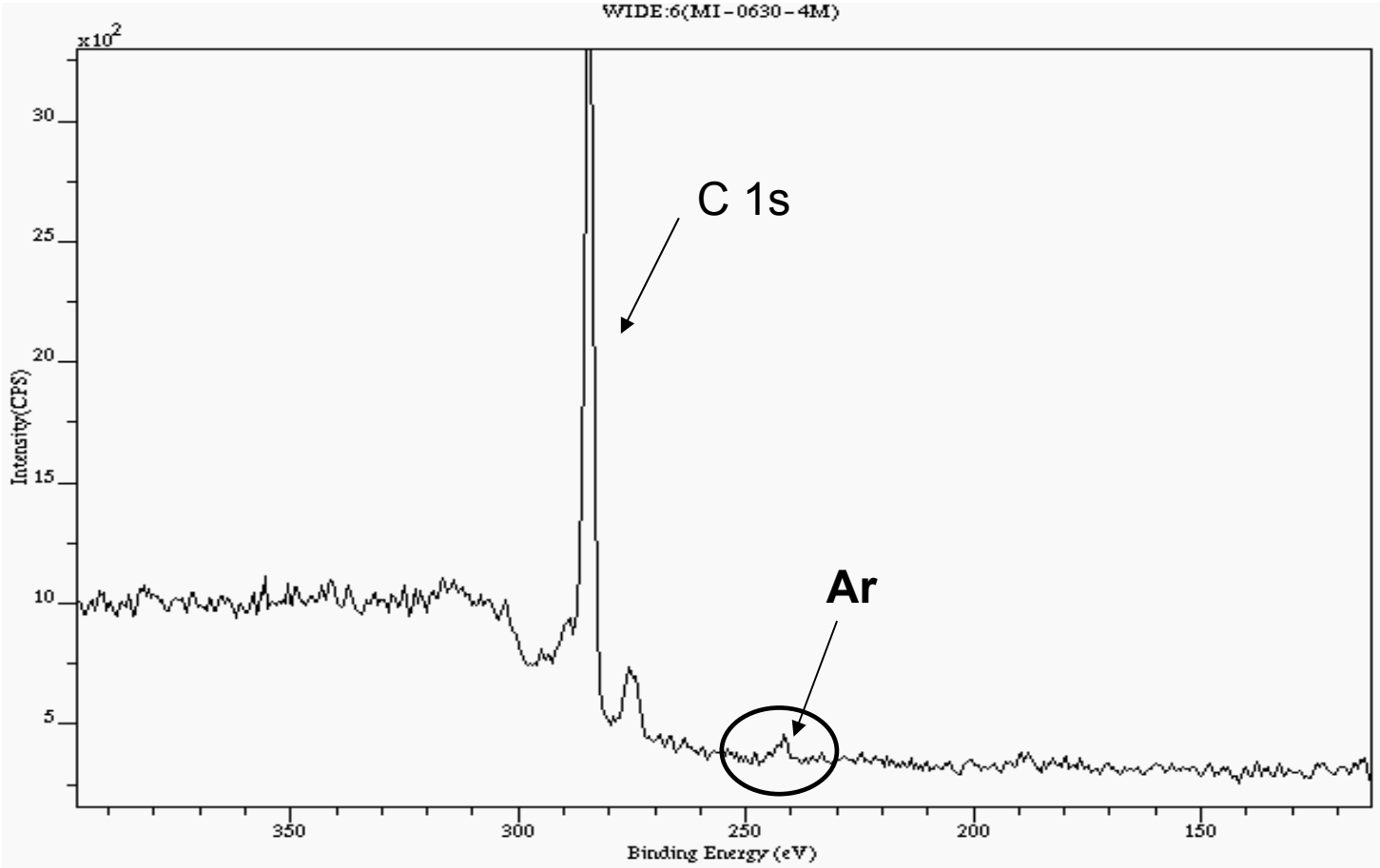
Fullerén spektrum



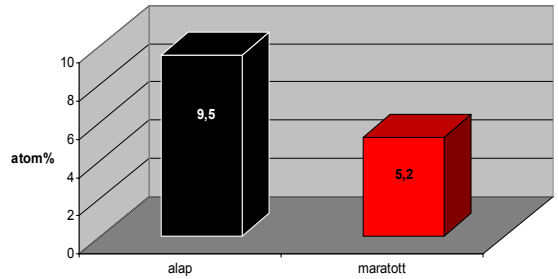

Fullerén minta
O
C
B
oxidált B
2%
3%
9%
86%

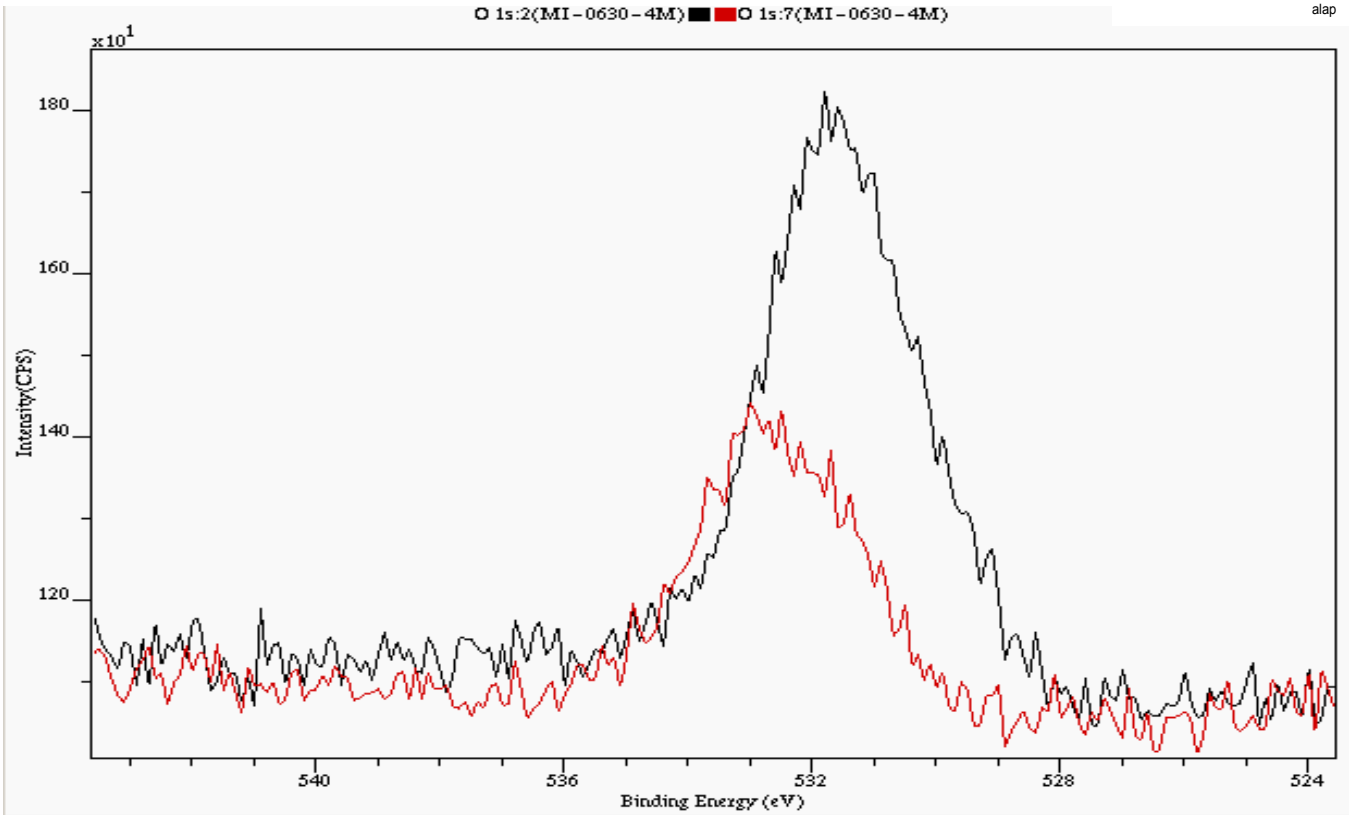

WIDE:6(MI-0630-4M)
x10^2
100
80
60
40
20
Intensity(CPS)
1000
800
600
400
200
0
Binding Energy (eV)
C 1s
O 1s

Újabb csúcs…


WIDE:6(MI-0630-4M)
x10^2
30
25
20
15
10
5
Intensity(CPS)
C 1s
Ar
350
300
250
200
150
Binding Energy (eV)

Oxigén


10
8
6
4
2
0
atom%
9,5
5,2
alap
maratott


O 1s:2(MI-0630-4M)
O 1s:7(MI-0630-4M)
x10^1
180
160
140
120
Intensity(CPS)
540
536
532
528
524
Binding Energy (eV)

A Bór mennyisége