Dynamic SIMS Analysis Day

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SIMS XVIII SIMS Course

Analysis Plan

O_2^+ primary beam

Three samples to demonstrate

raster versus gate

analysis method

depth resolution

Sample 1
BF_2 30 keV 5E15 atoms/cm^2

Show effect of changes in raster
with gate (detected area) left constant

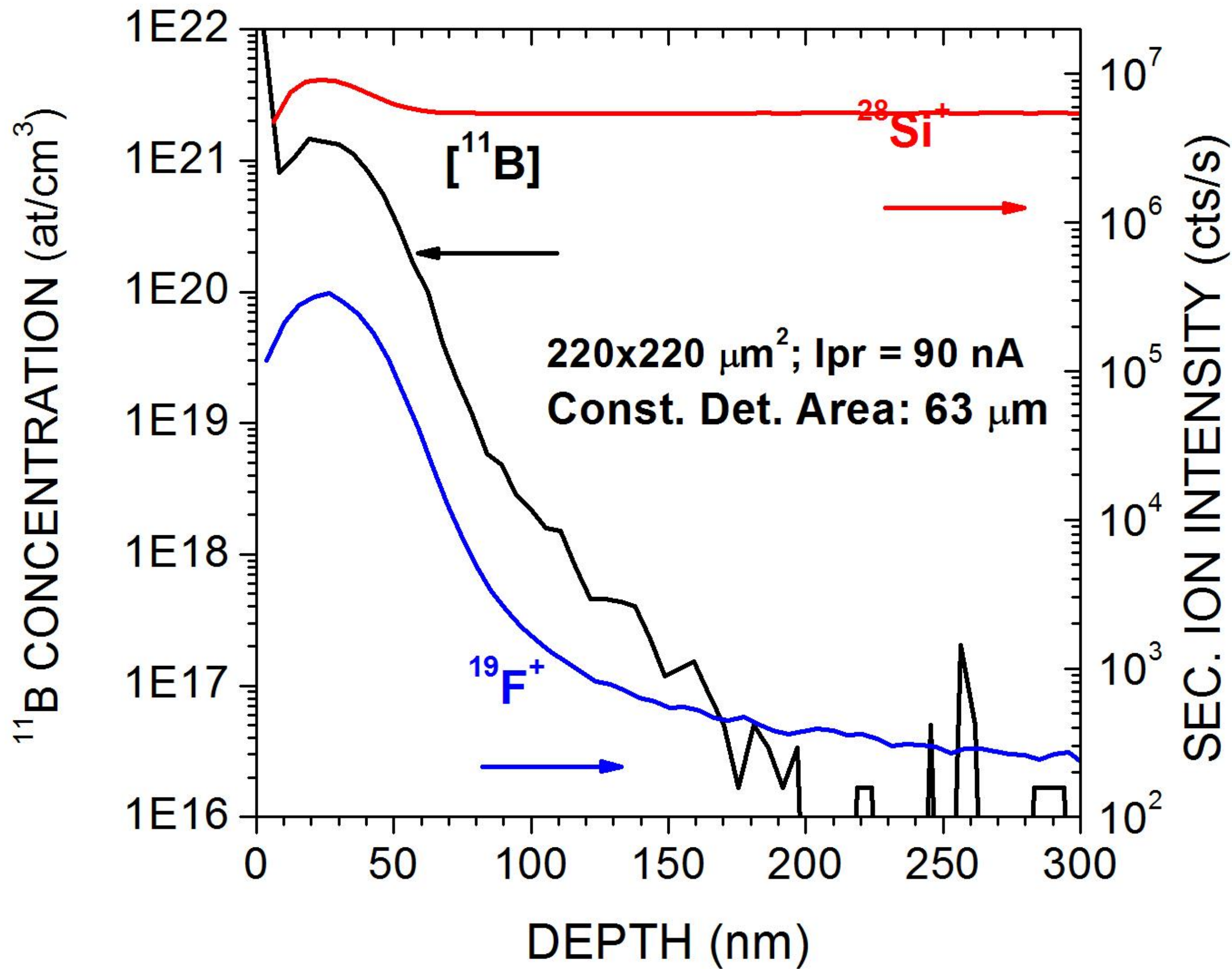
Matrix count rate affected by implant
F also present

Experimental Parameters

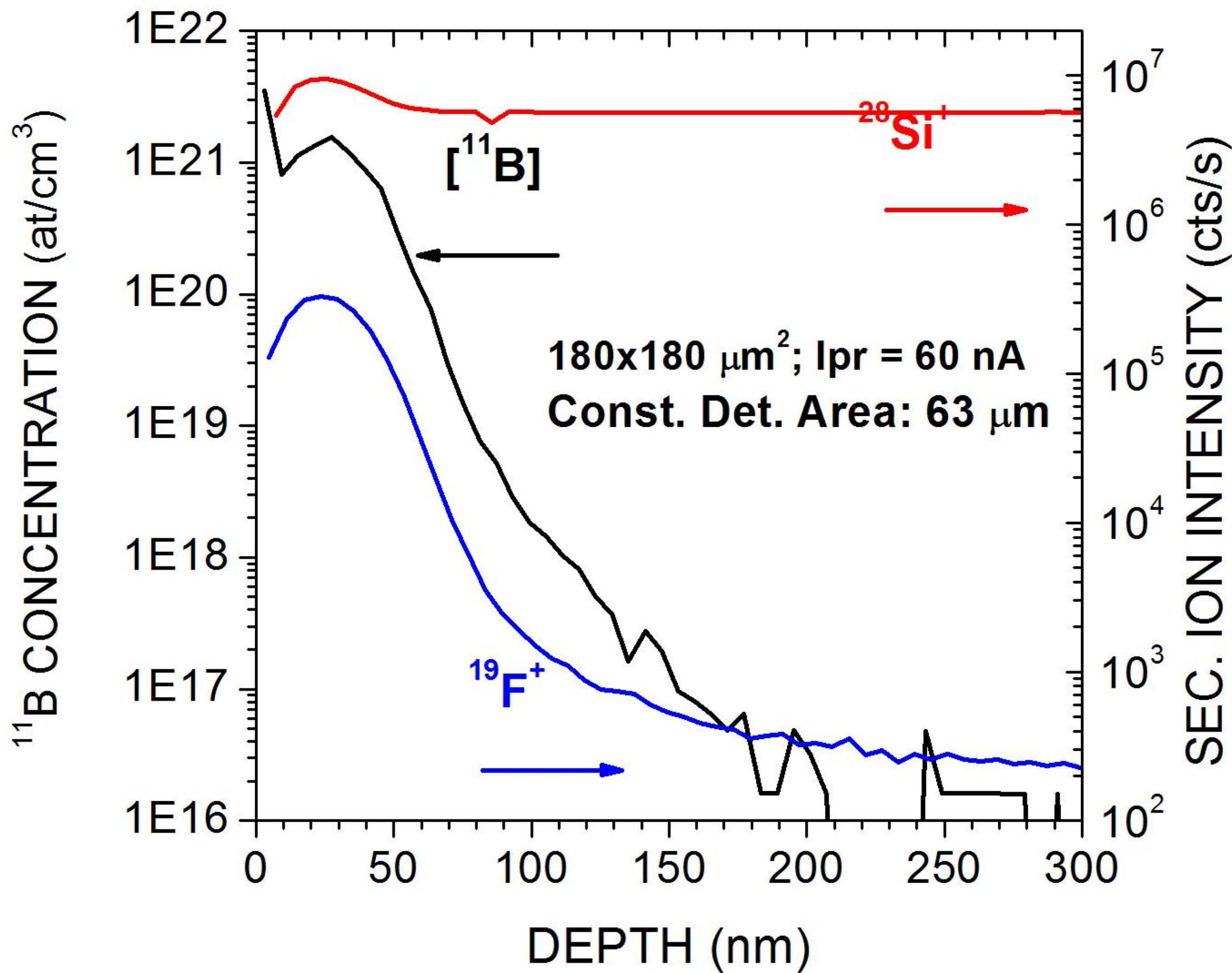
Current (nA)	Raster size (μm)
90	220 x 220
60	180 x 180
37.5	140 x 140
18.7	100 x 100
11.25	80 x 80

Detected area constant at 60μm diameter

BF$_2$/ Si 5E15 at/cm^2 at 30keV

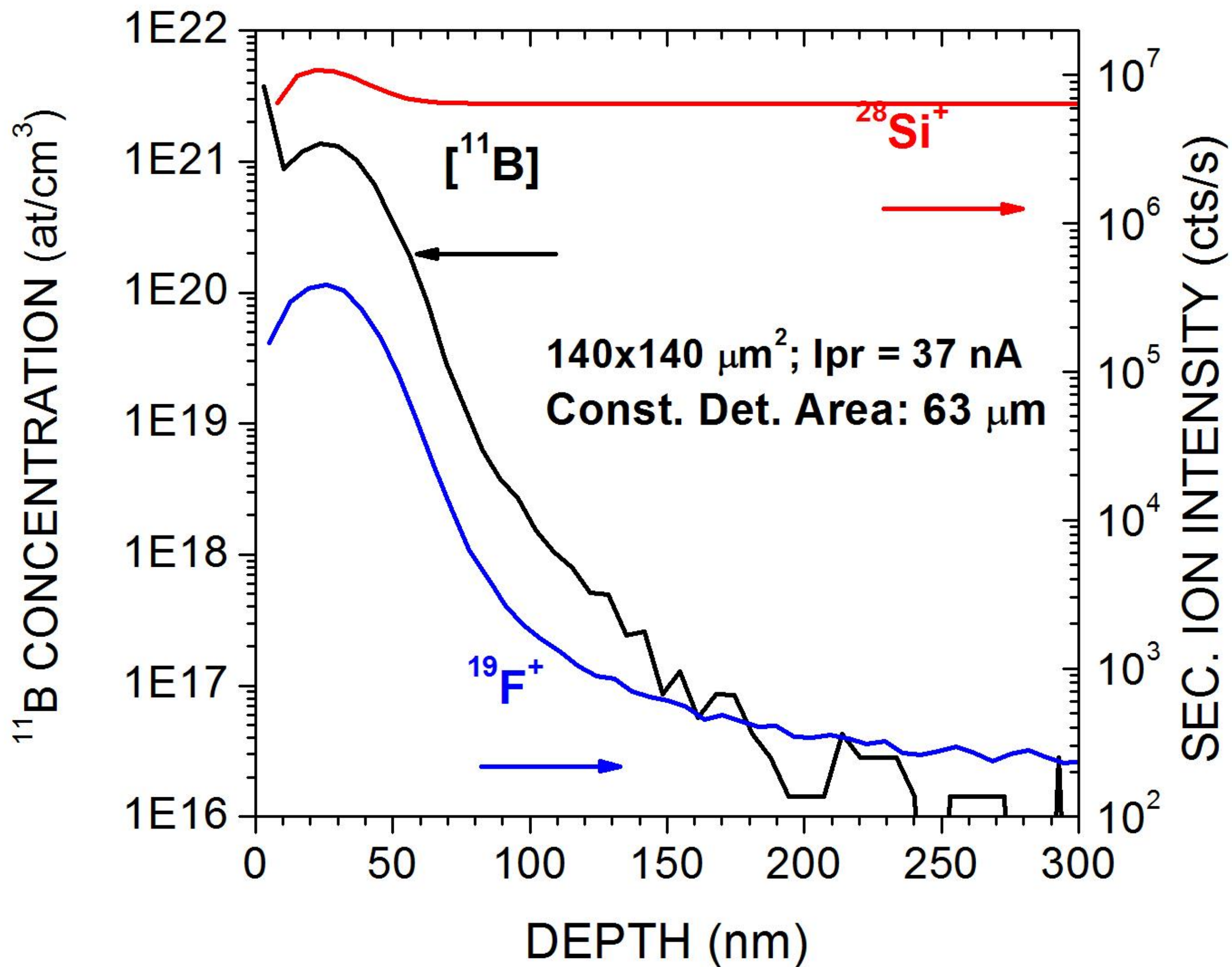


220µm



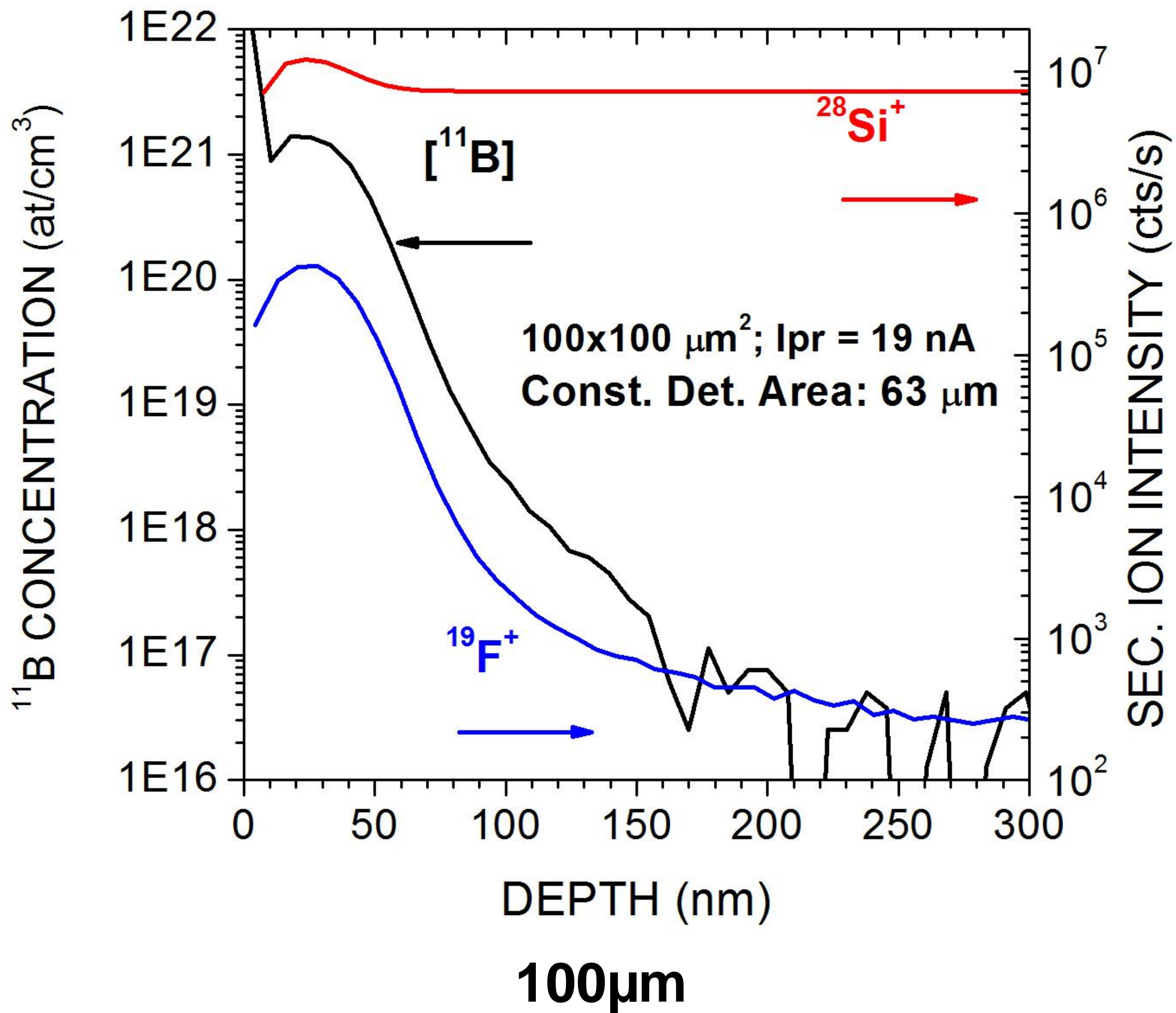
180µm

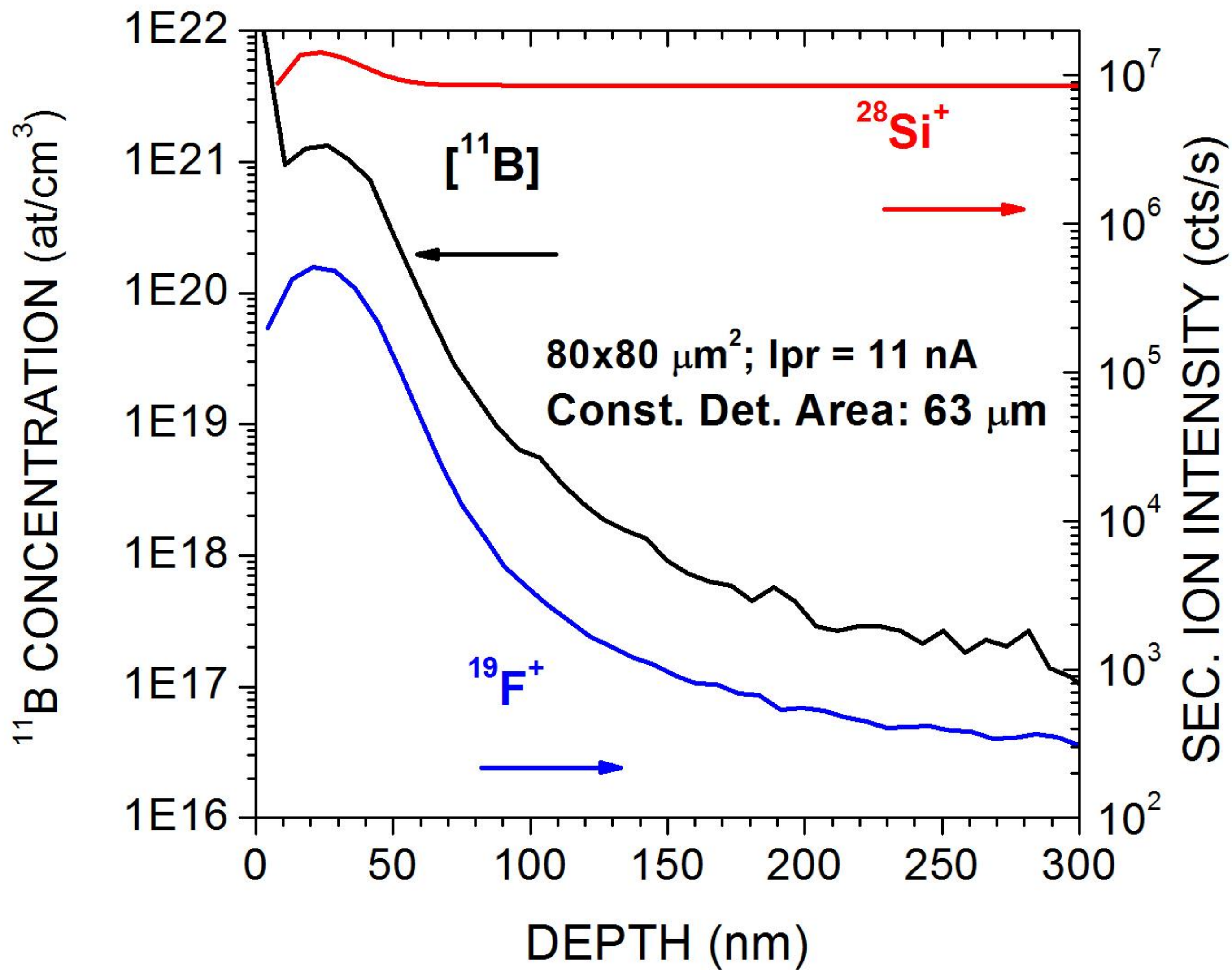
BF$_2$/ Si 5E15 at/cm^2 at 30keV



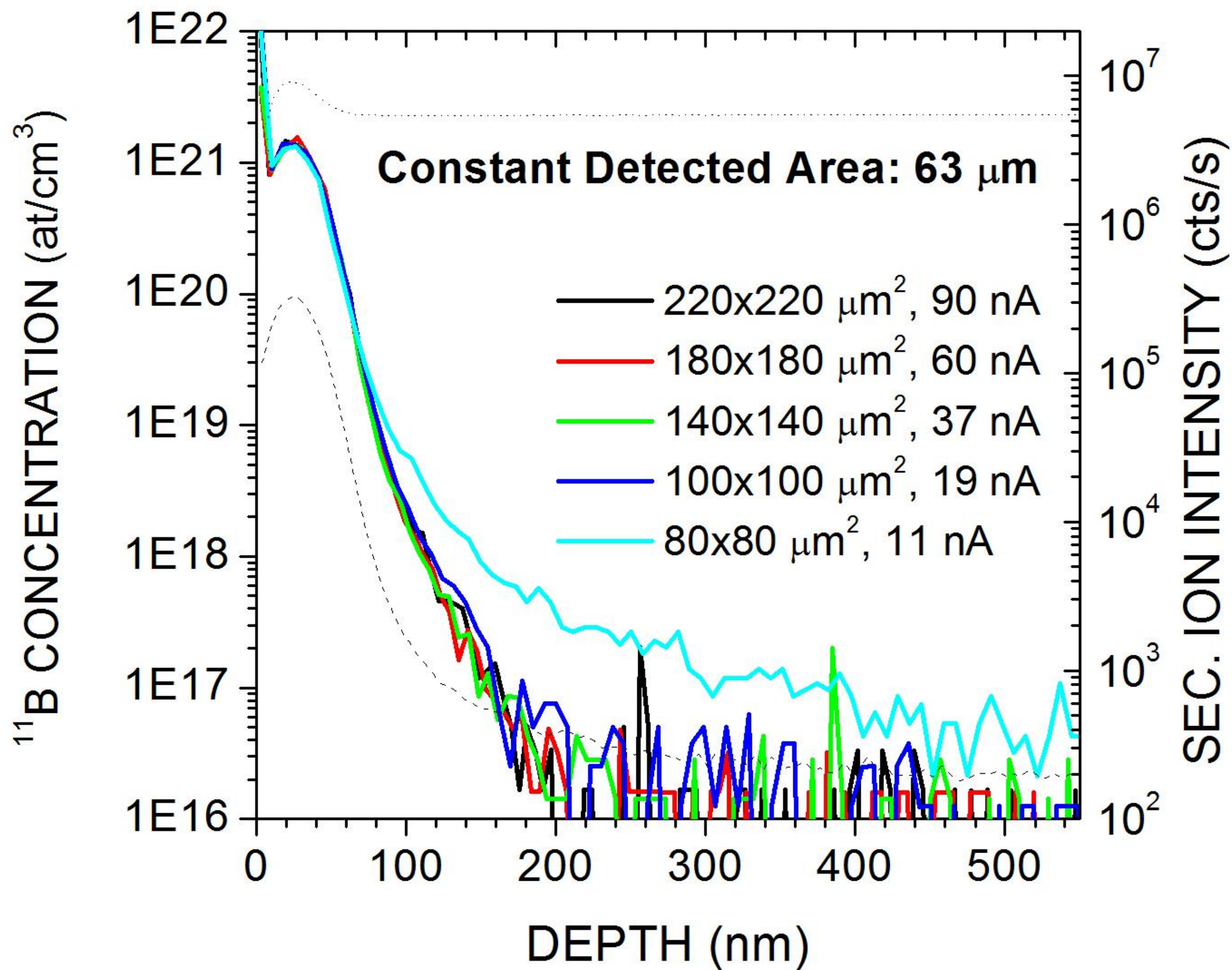
140μm

BF_2/ Si 5E15 at/cm^2 at 30keV

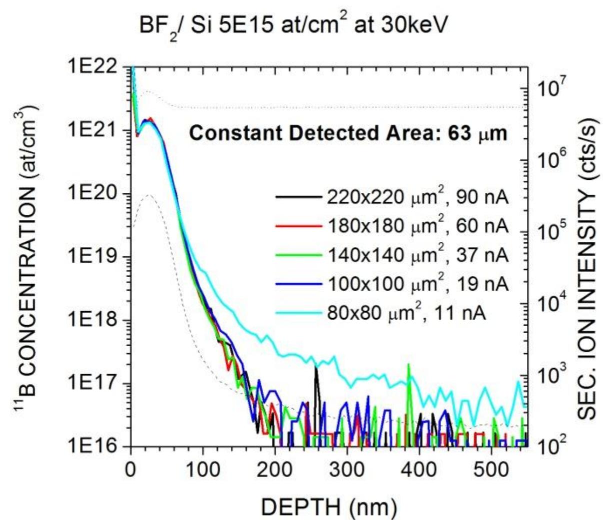




80µm



BF2/ Si 5E15 at/cm2 at 30keV
Constant Detected Area: 63 μm
220x220 μm2, 90 nA
180x180 μm2, 60 nA
140x140 μm2, 37 nA
100x100 μm2, 19 nA
80x80 μm2, 11 nA
11B CONCENTRATION (at/cm3)
SEC. ION INTENSITY (cts/s)
DEPTH (nm)
1E22
1E21
1E20
1E19
1E18
1E17
1E16
10^7
10^6
10^5
10^4
10^3
10^2
0
100
200
300
400
500



Det. Area 63 μm

DEPTH (nm)

LINE SCAN (μm)

Sample 2
$TaSi_2$ / Poly-Si / SiO_2 / Si

Show method of analysis:

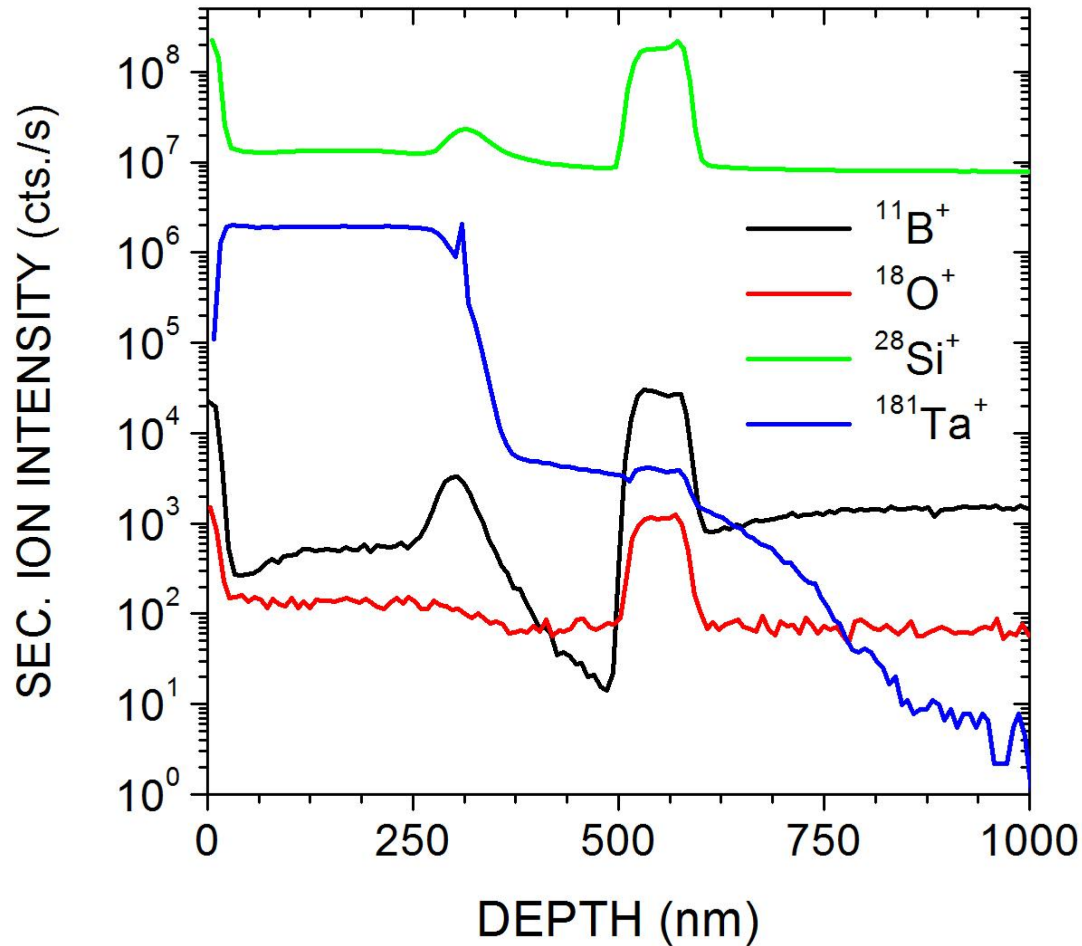
Profile, mass spectra, profile
First profile to be Ta, Si, O, B

Take mass spectra in $TaSi_2$

Add Al, Cr to profile

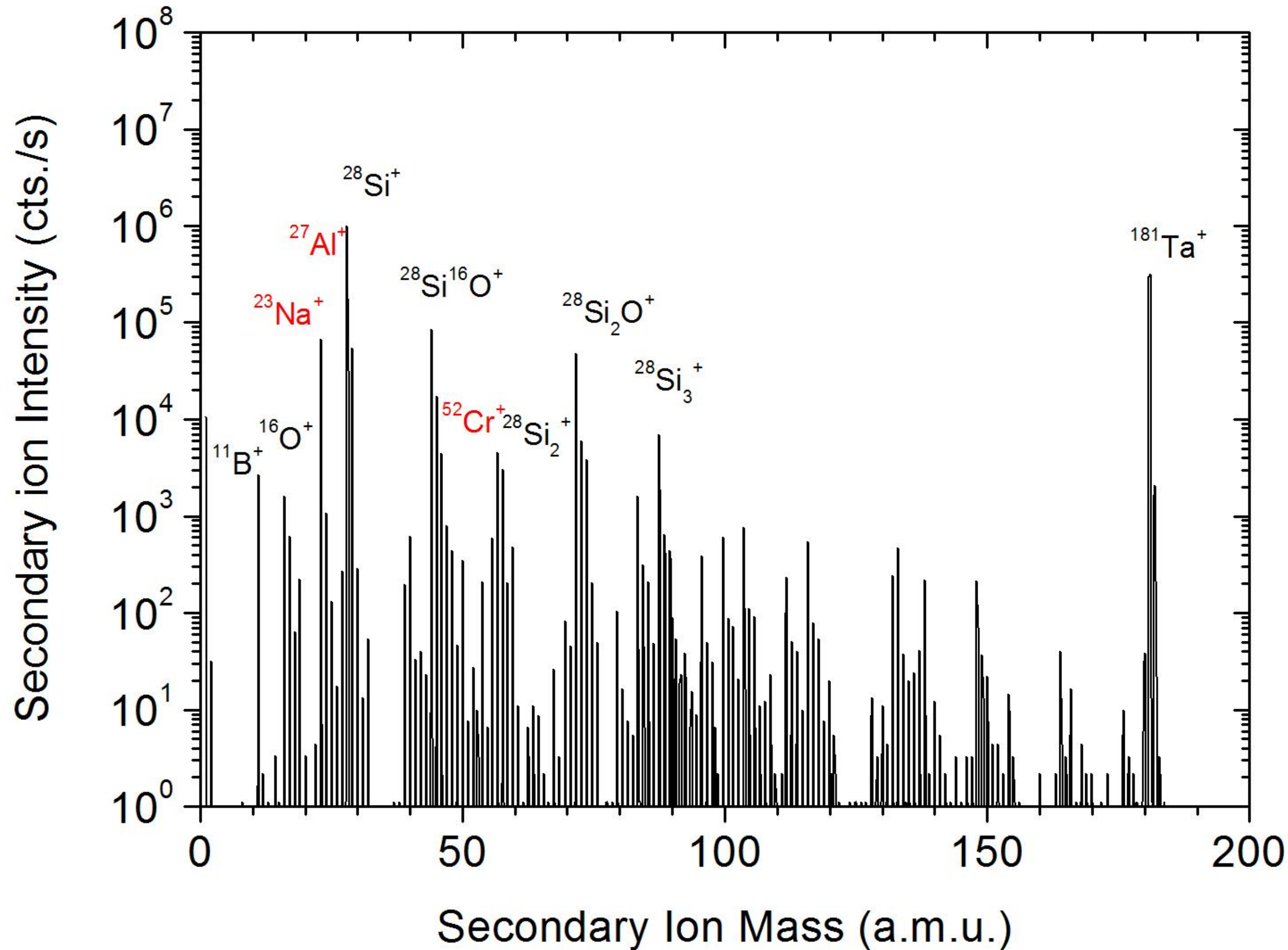
Results compared with control sample

$TaSi_2$ Structure After Anneal

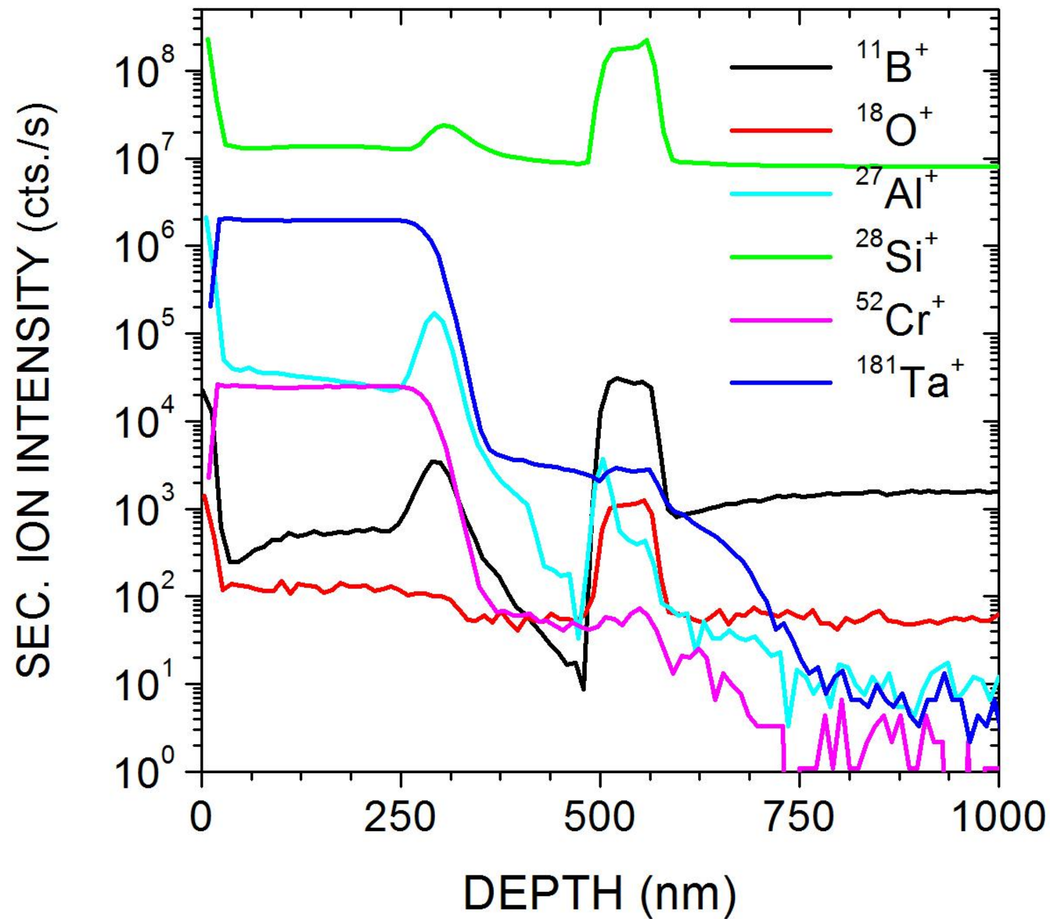


220µm **60µm diameter detected area**

Mass spectra in $TaSi_2$ layer showing presence of Al, Cr

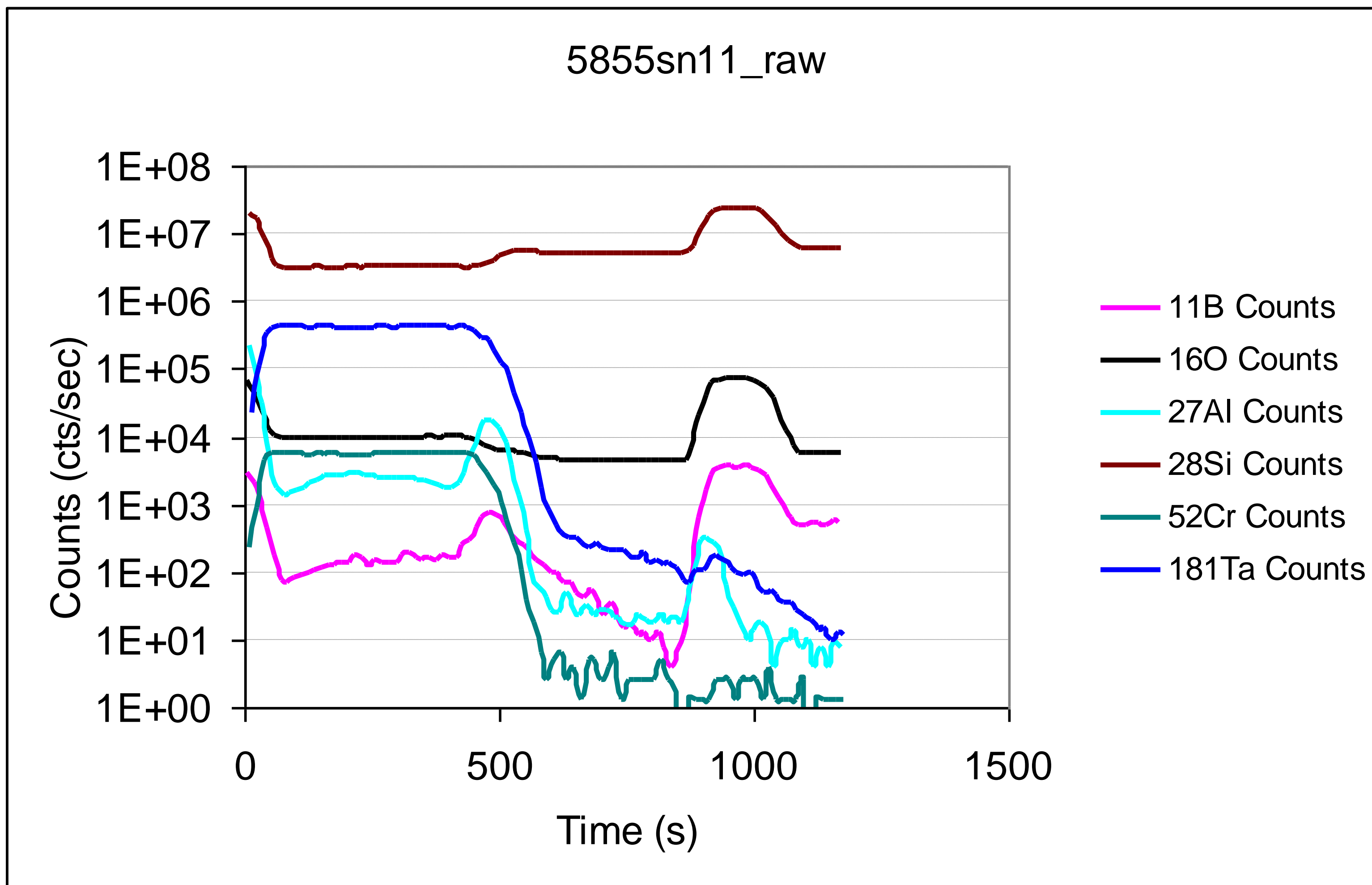


$TaSi_2$ Structure After Anneal



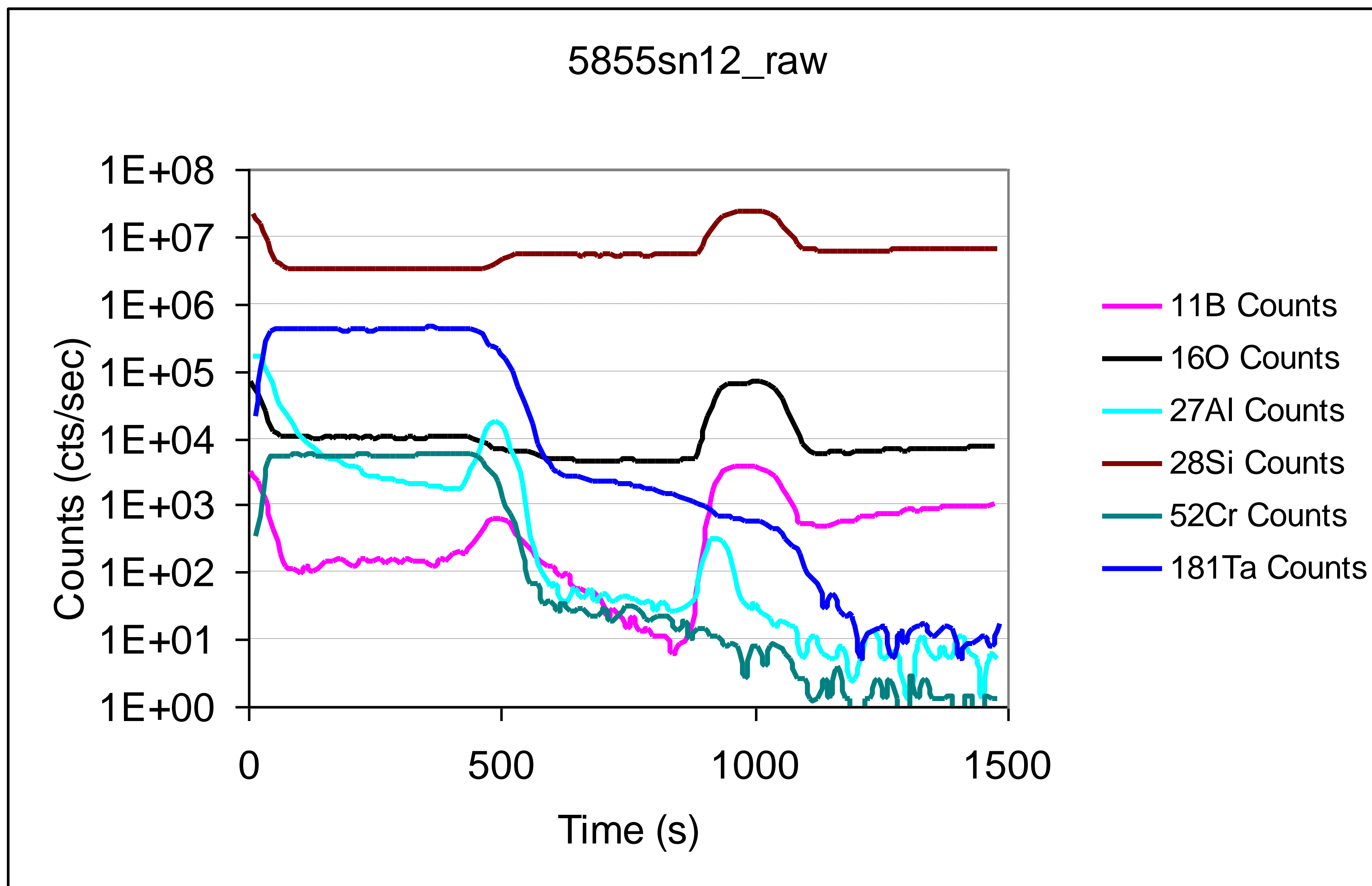
220µm 60µm diameter detected area

$TaSi_2$ Structure After Anneal



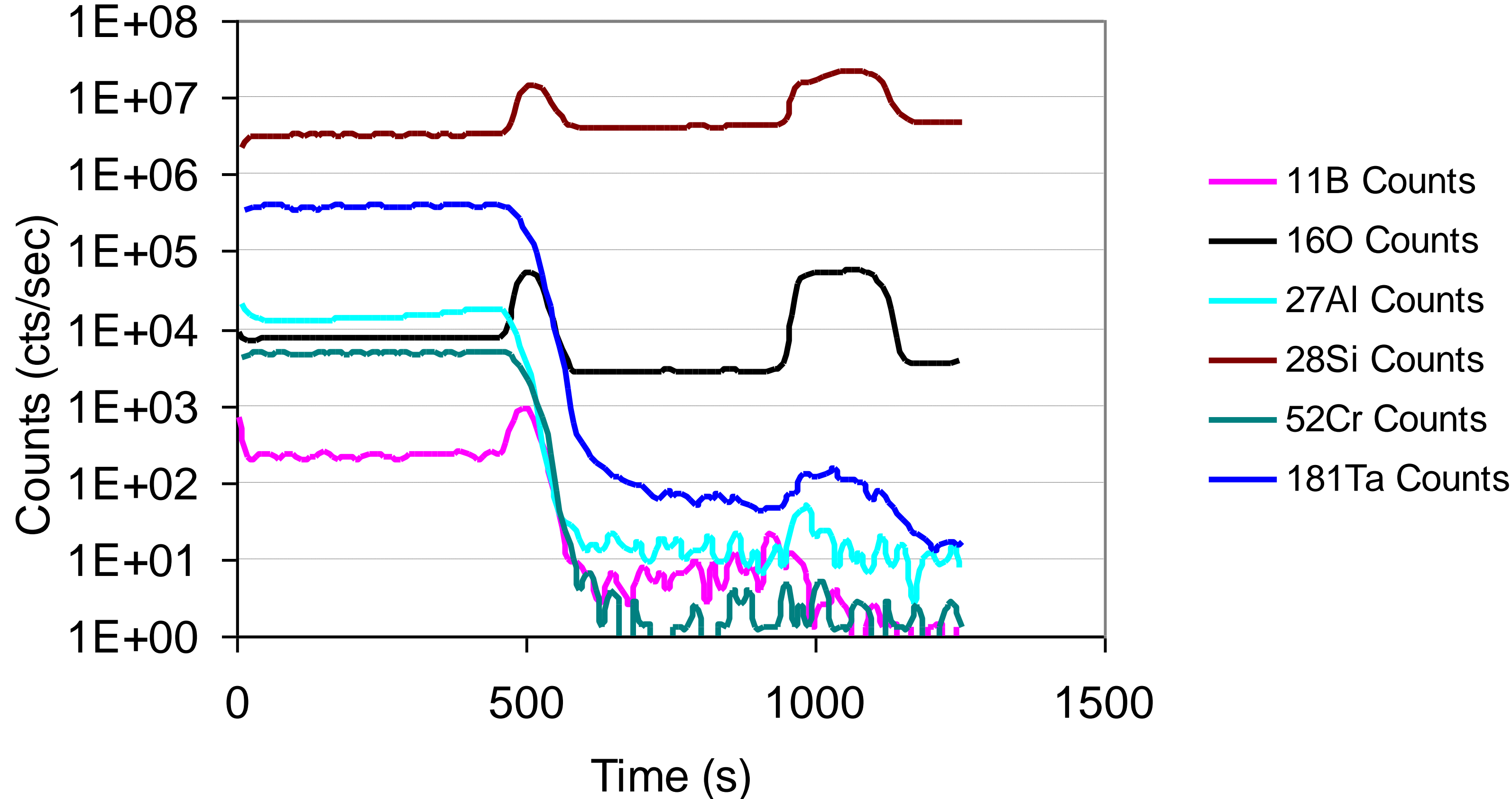
250µm raster **30µm diameter detected area**

$TaSi_2$ Structure After Anneal



250µm raster **30µm diameter detected area**

$TaSi_2$ Sample Without Anneal (control sample)



250µm raster **30µm diameter detected area**

$TaSi_2$ Structure Analysis

Mass spectra show unexpected elements present

During anneal, some elements are mobile (Al)
Some elements do not move (Cr)

Ta shows movement into poly-Si or
change in uniformity after anneal
Larger raster and smaller gate show no
improvement in Ta profile

Sample 3
Ultra shallow or spike layer

Depth resolution

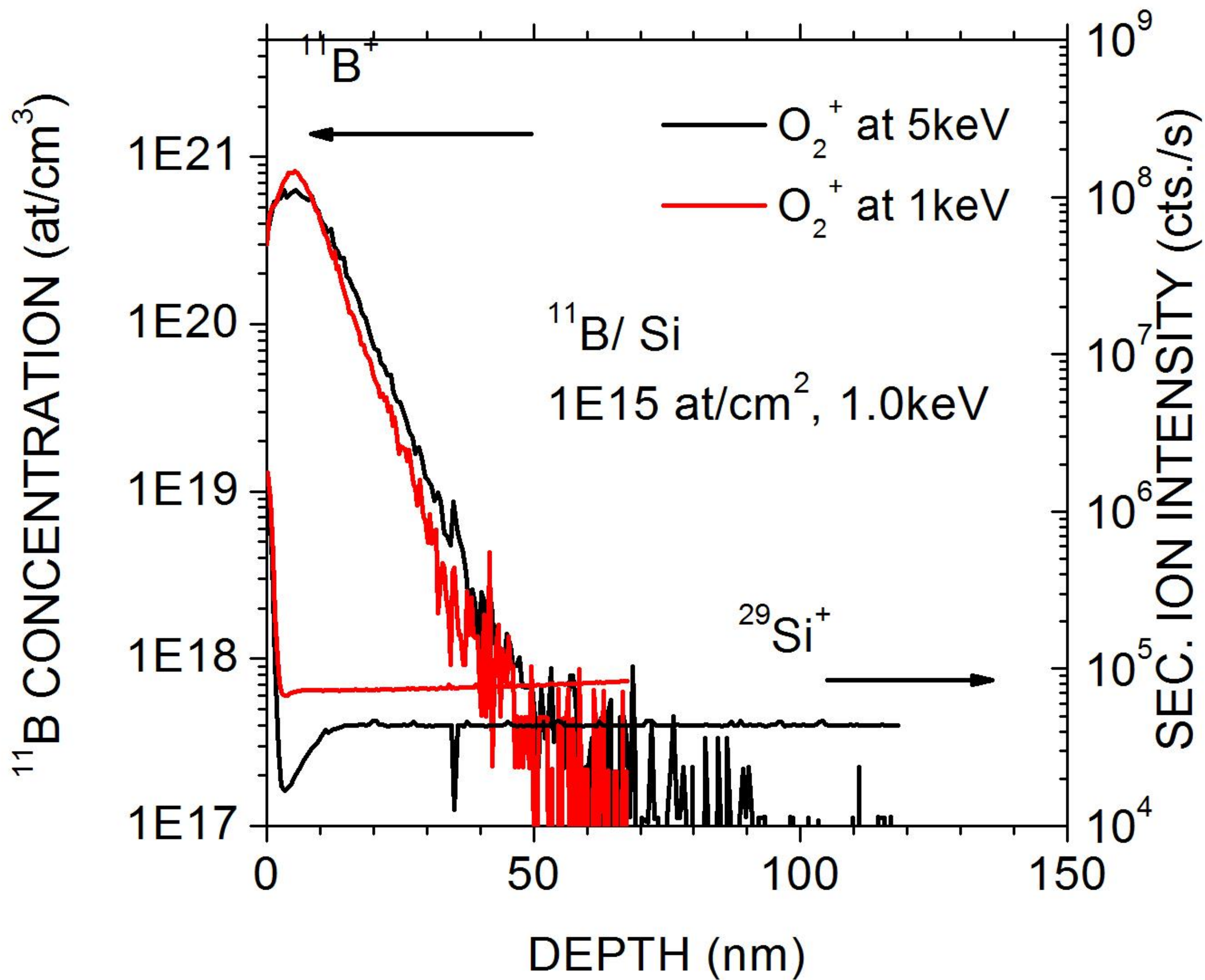
Analyze sample at two energies using O_2^+

For example:

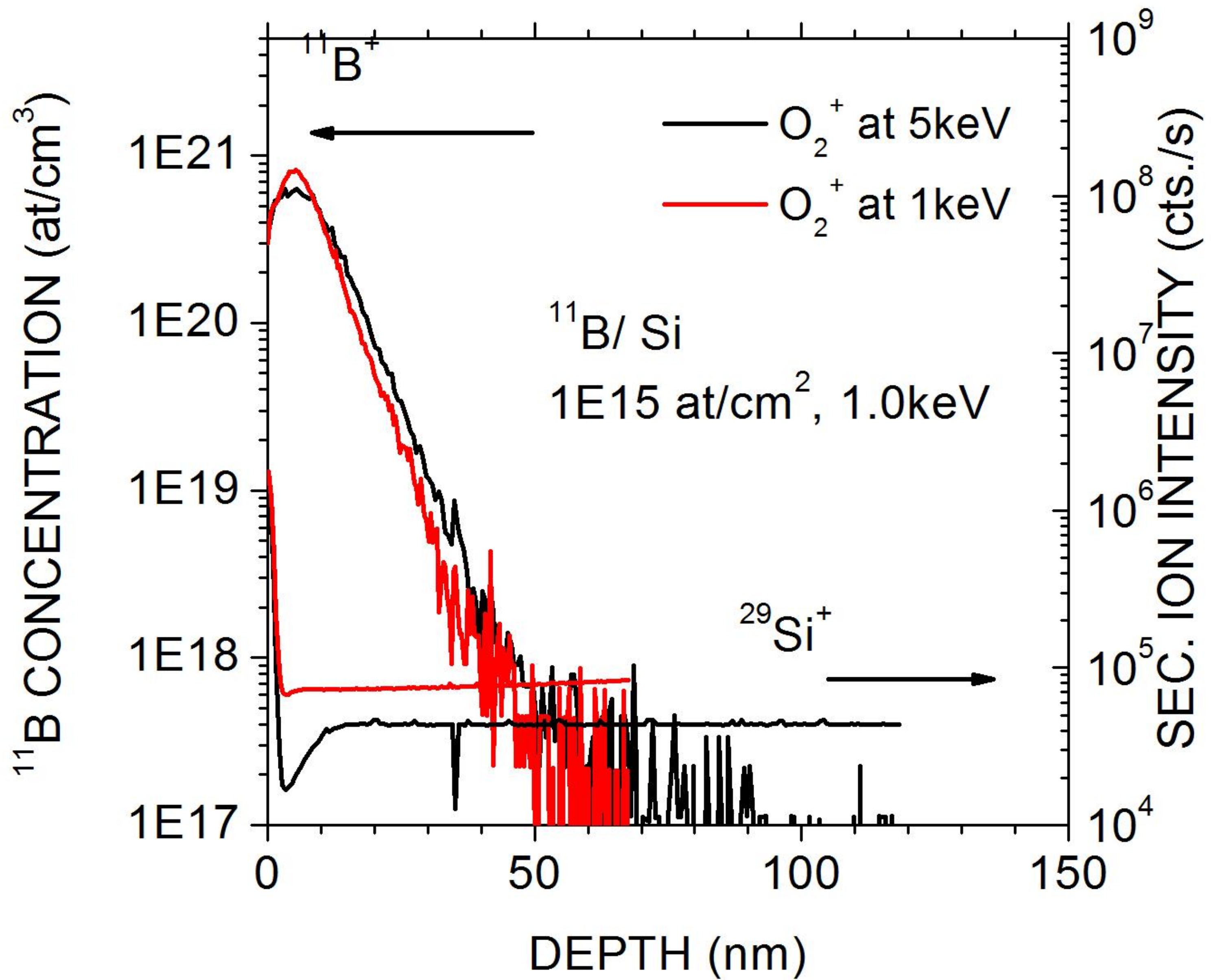
1) 10keV source 5keV sample
2) 6keV source 5keV sample

Show difference in depth resolution

Use similar incidence angle



$^{11}B^+$
O_2^+ at 5keV
O_2^+ at 1keV
^{11}B/ Si
1E15 at/cm^2, 1.0keV
$^{29}Si^+$
^{11}B CONCENTRATION (at/cm^3)
SEC. ION INTENSITY (cts./s)
DEPTH (nm)
1E21
1E20
1E19
1E18
1E17
10^9
10^8
10^7
10^6
10^5
10^4
0
50
100
150



11B+
O2+ at 5keV
O2+ at 1keV
11B/ Si
1E15 at/cm2, 1.0keV
29Si+
11B CONCENTRATION (at/cm3)
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100
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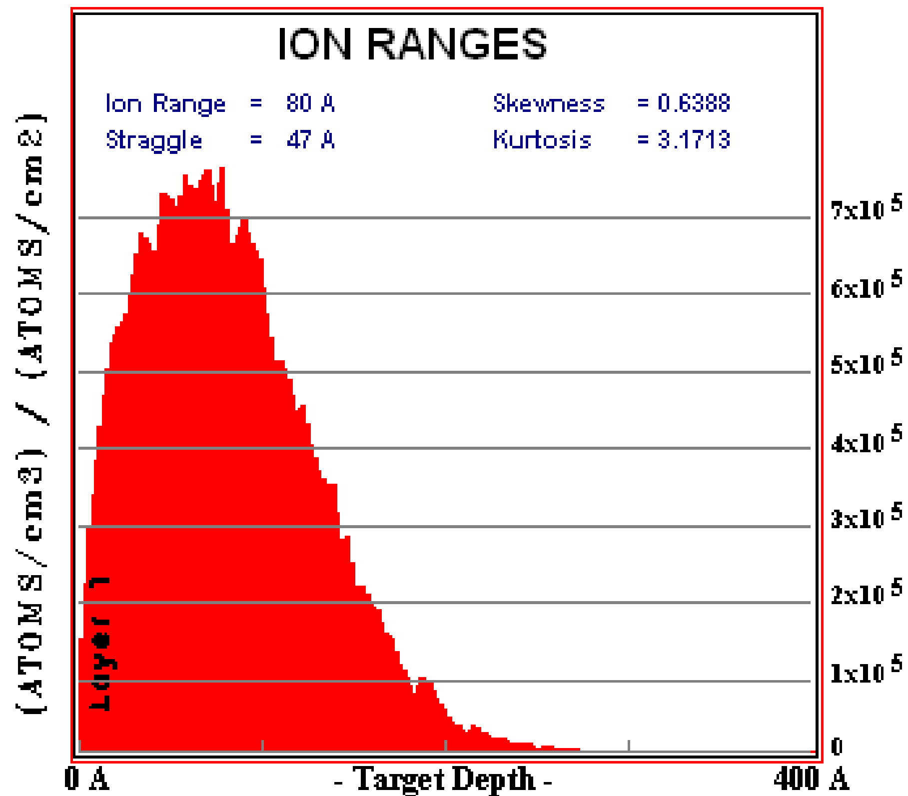
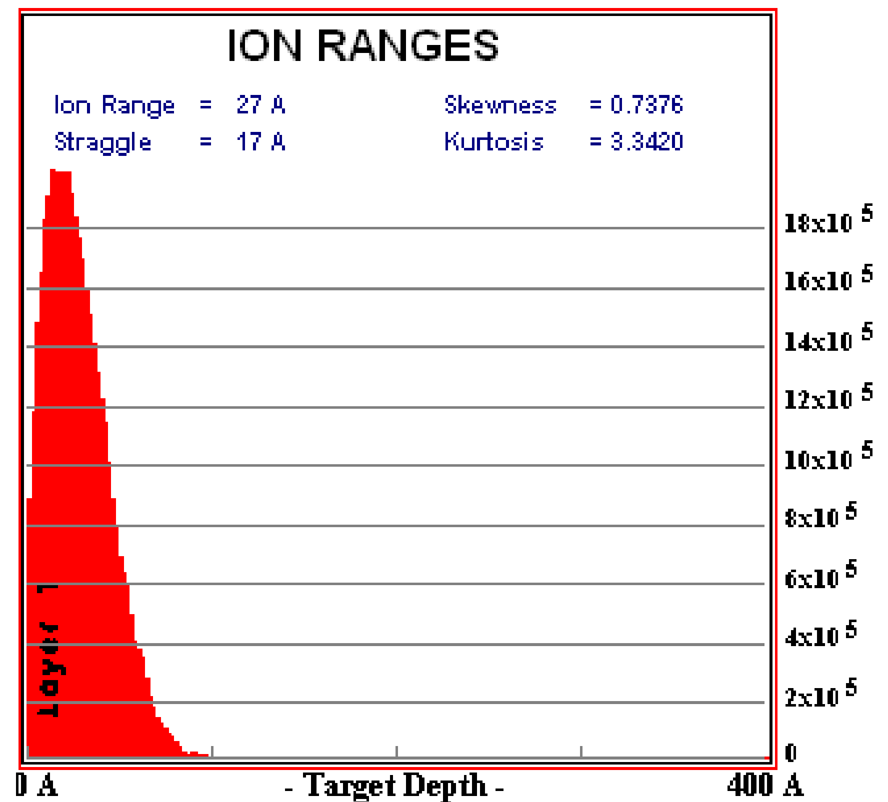


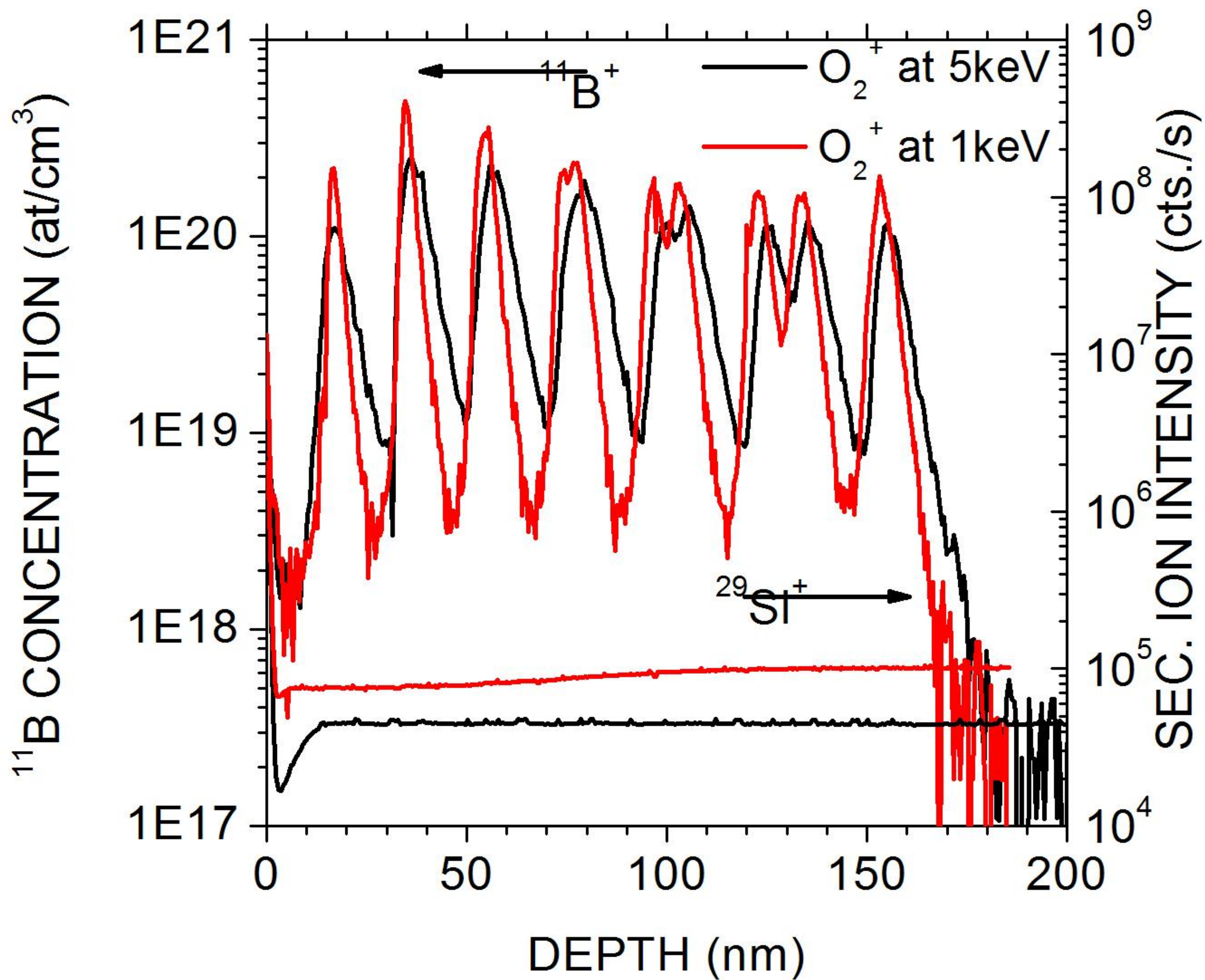


O 2.75keV (O_2^+ 5.5keV)
42⁰ from normal in Si

O 0.625keV (O_2^+ 1.25keV)
48.5⁰ from normal in Si

Projected Range drops from 8.0 to 2.7nm

www.srim.org



1E21
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O_2^+ at 5keV
O_2^+ at 1keV
0
50
100
150
200
DEPTH (nm)