Photoconductivity spectra and persistent conductivity in the irradiated Si samples (WODEAN)

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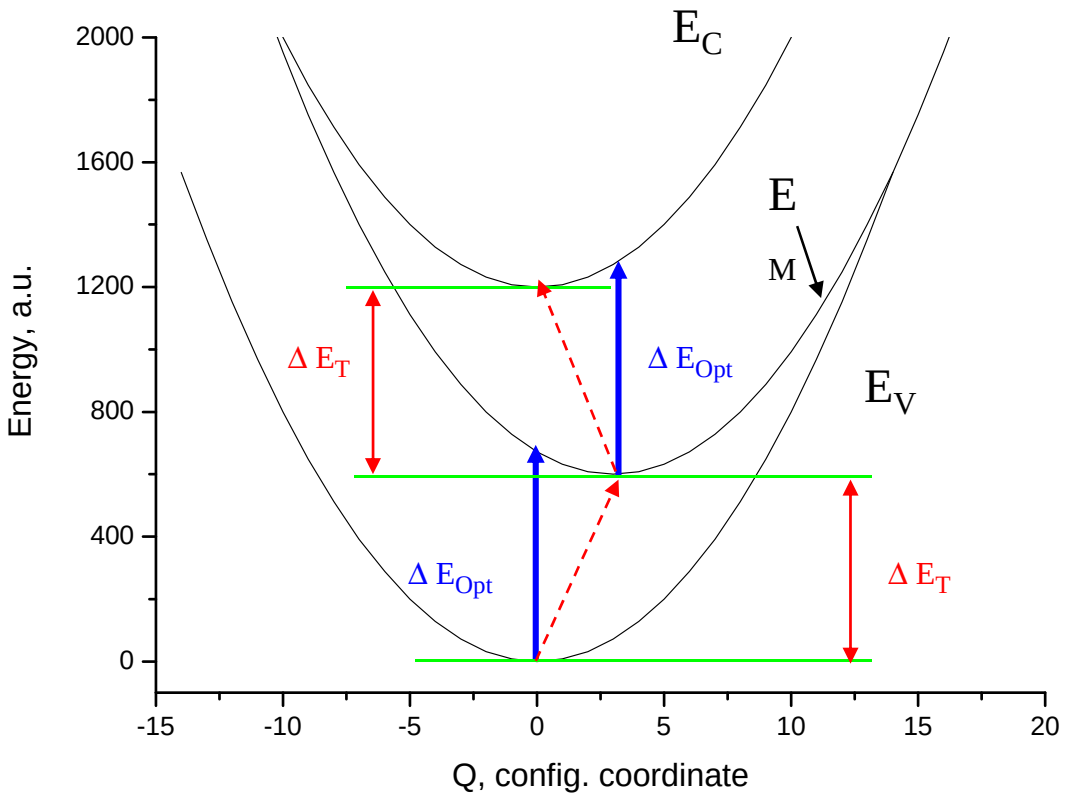
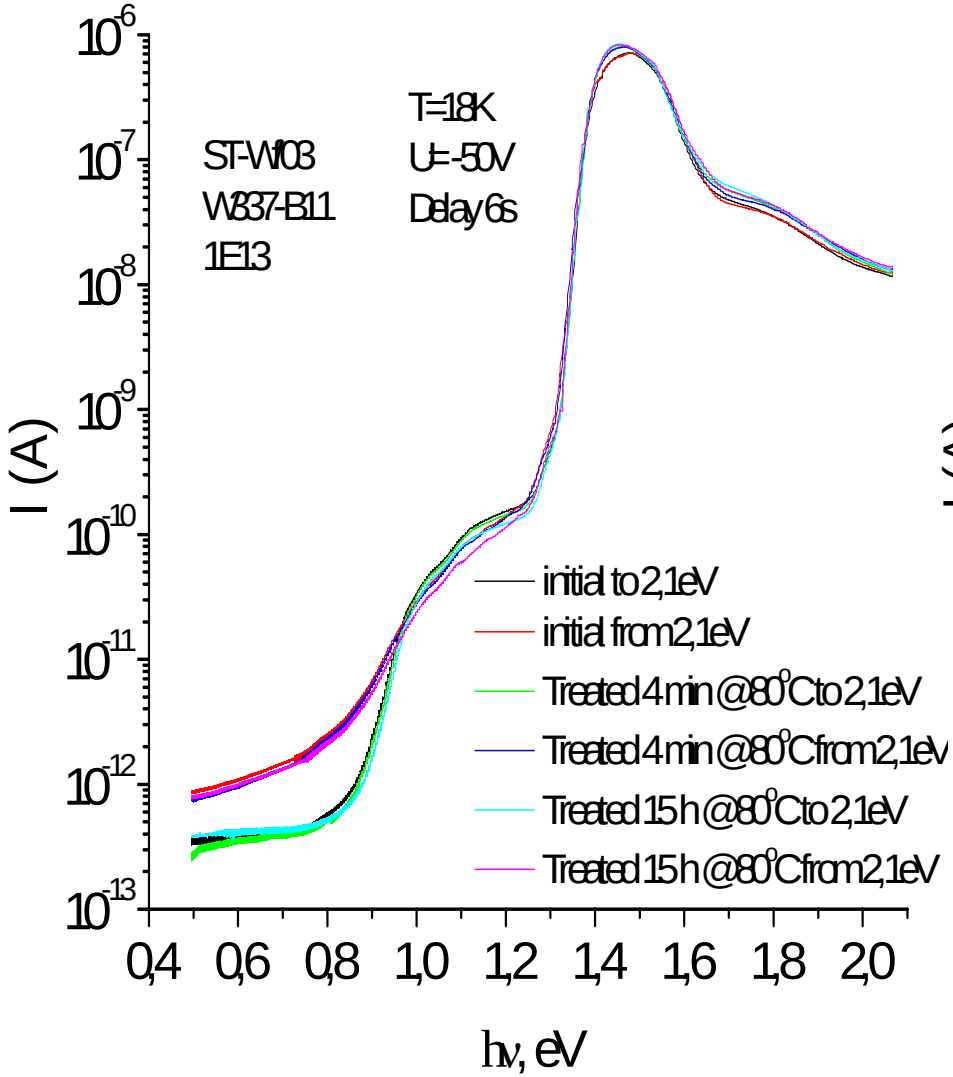
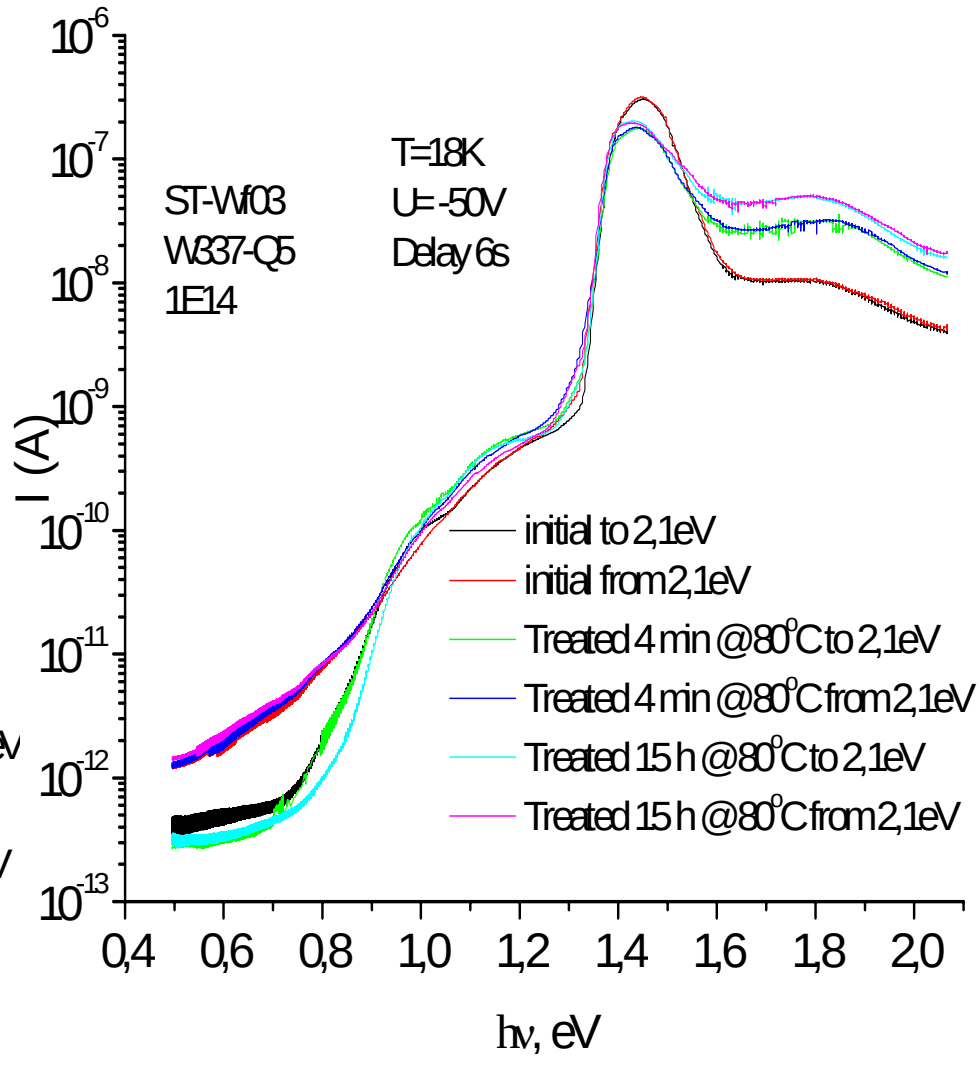
E.Fretwurst (Hamburg U)

Deep centre model

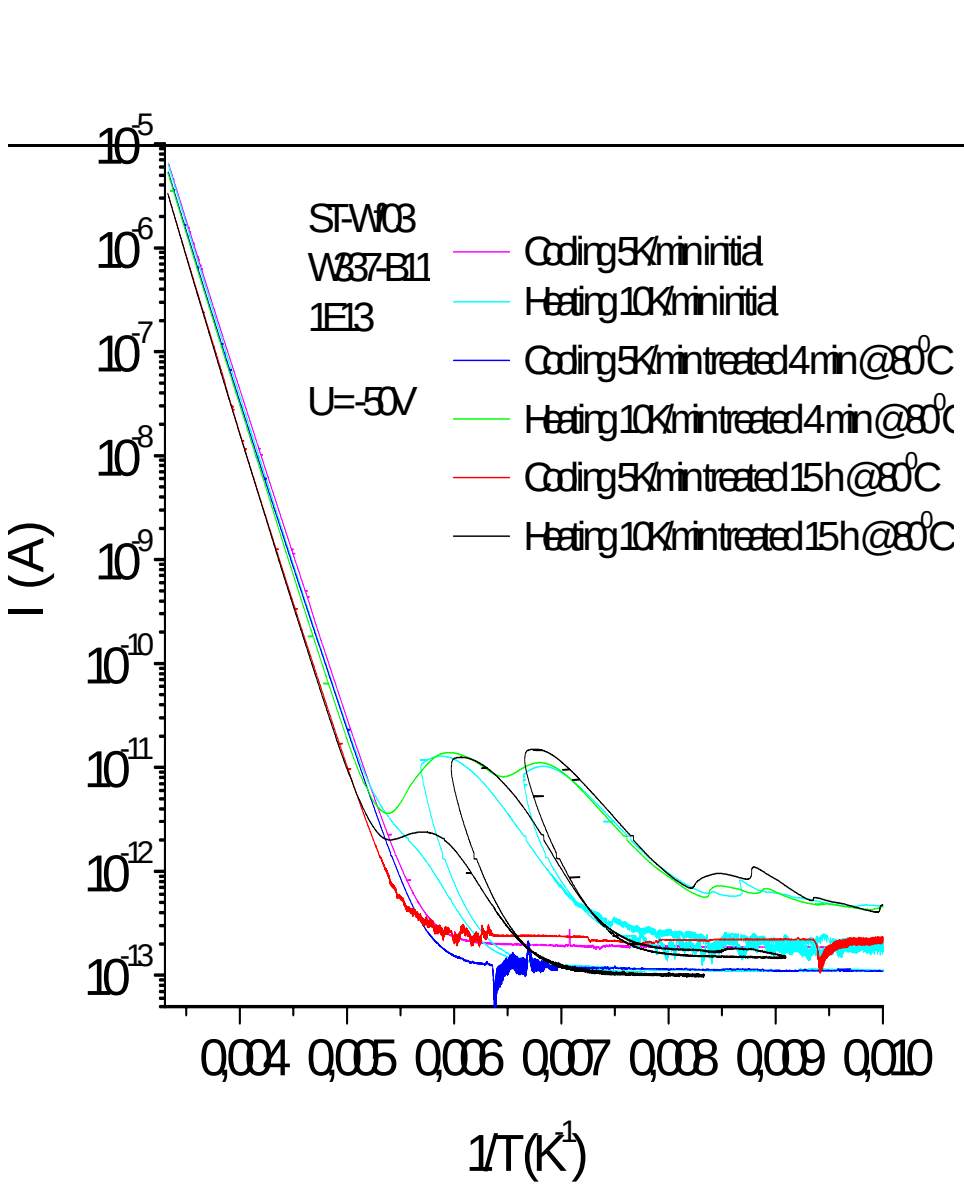


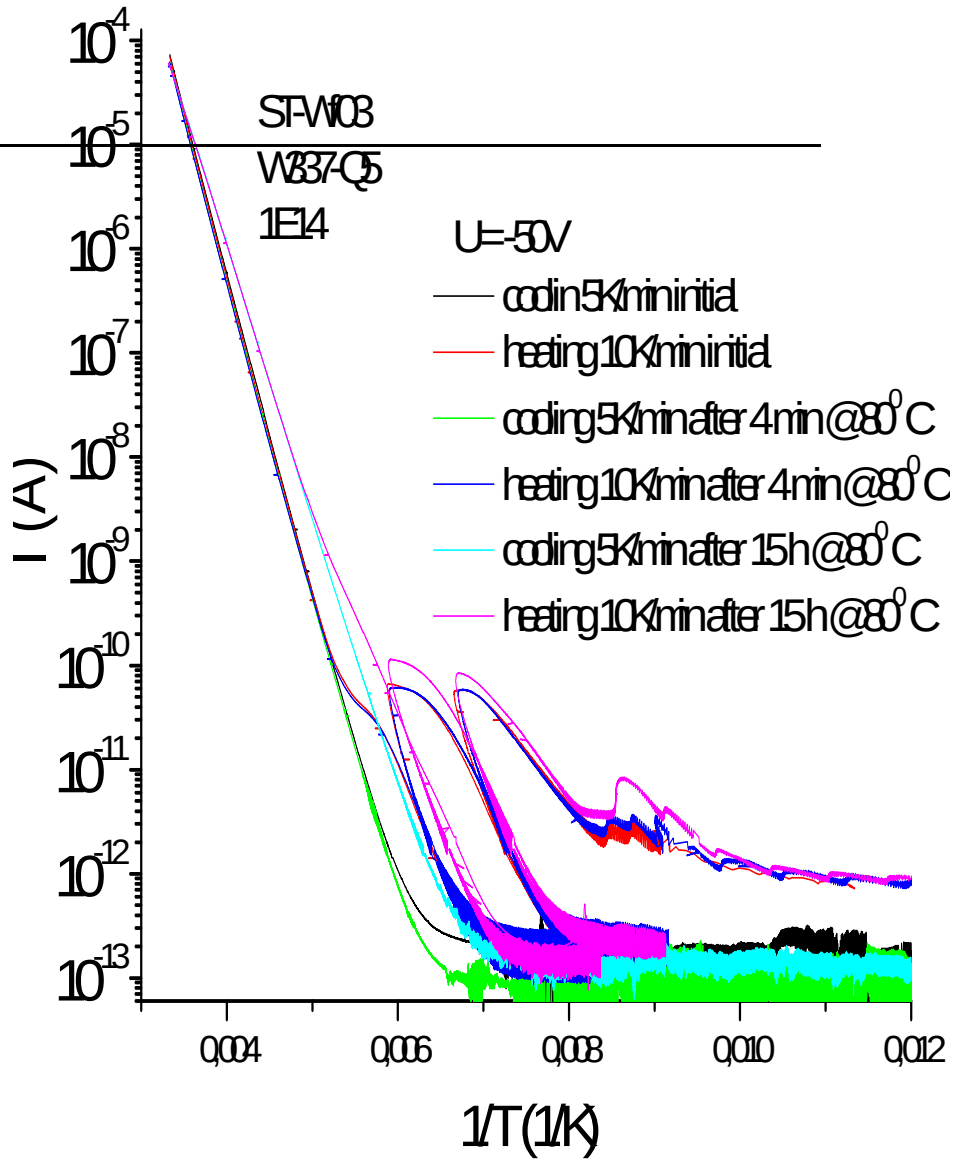
1e13 vs 1e14


ST-Wf03
W337-B11
1E13
T=18K
U=-50V
Delay 6s
initial to 2,1eV
initial from 2,1eV
Treated 4 min @80°C to 2,1eV
Treated 4 min @80°C from 2,1eV
Treated 15 h @80°C to 2,1eV
Treated 15 h @80°C from 2,1eV
I (A)
hν, eV

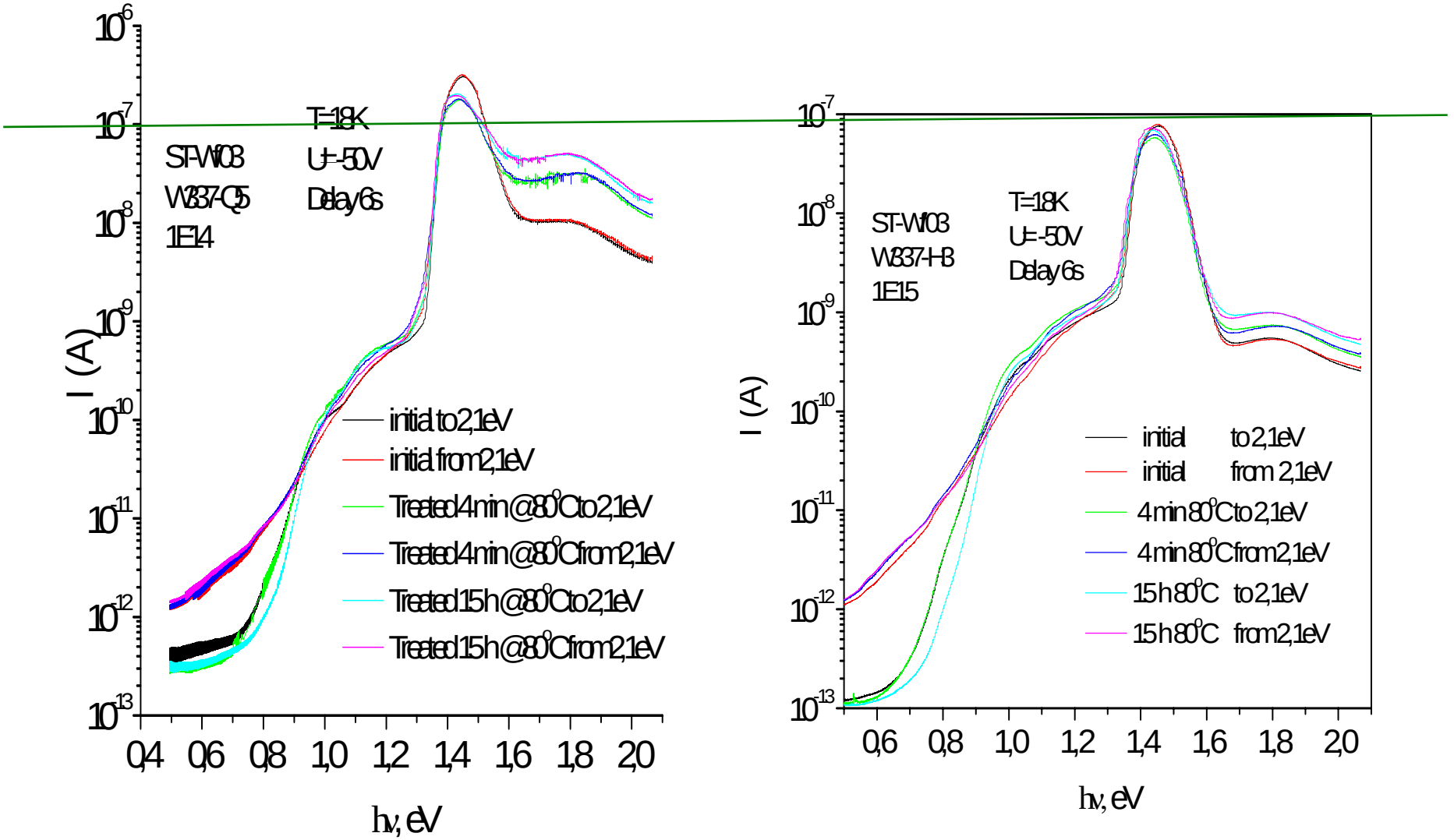

ST-Wf03
W337-Q5
1E14
T=18K
U=-50V
Delay 6s
initial to 2,1eV
initial from 2,1eV
Treated 4 min @80°C to 2,1eV
Treated 4 min @80°C from 2,1eV
Treated 15 h @80°C to 2,1eV
Treated 15 h @80°C from 2,1eV
I (A)
hν, eV

1e13 vs 1e14

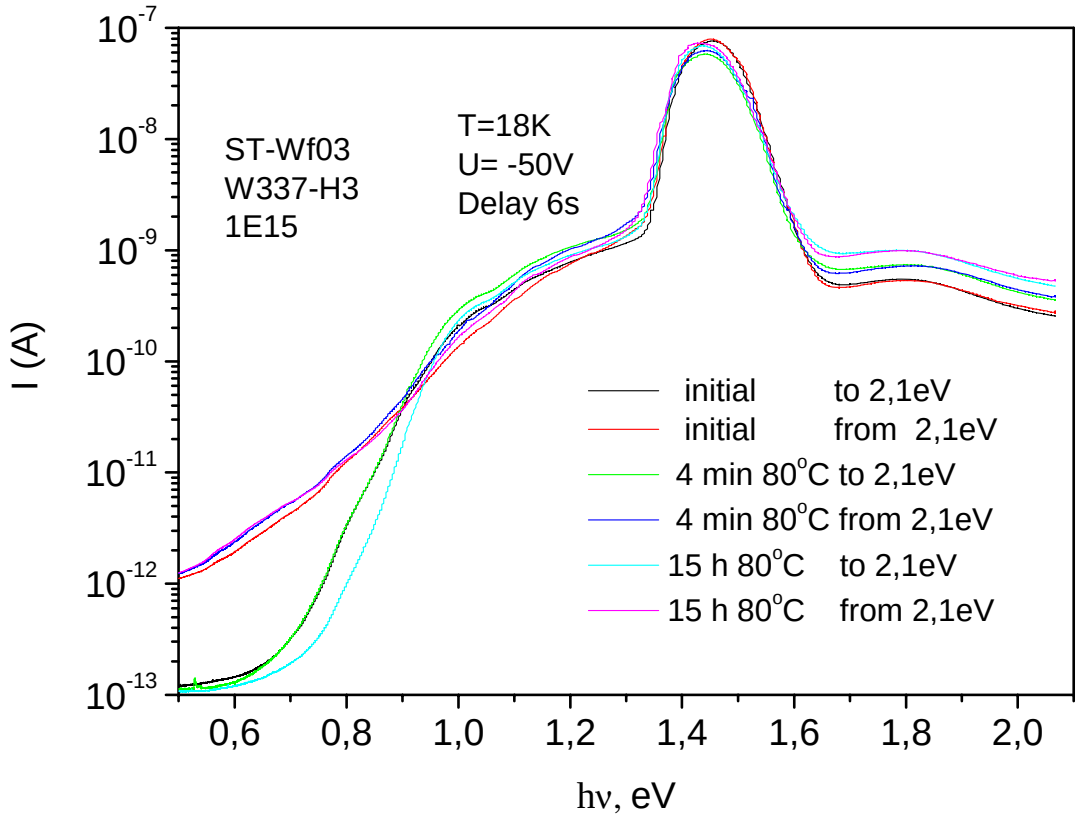

ST-W103
W837-B11
1E13
U=-50V
Cooling 5K/min initial
Heating 10K/min initial
Cooling 5K/min treated 4 min @80°C
Heating 10K/min treated 4 min @80°C
Cooling 5K/min treated 15 h @80°C
Heating 10K/min treated 15 h @80°C
I (A)
1/T (K-1)

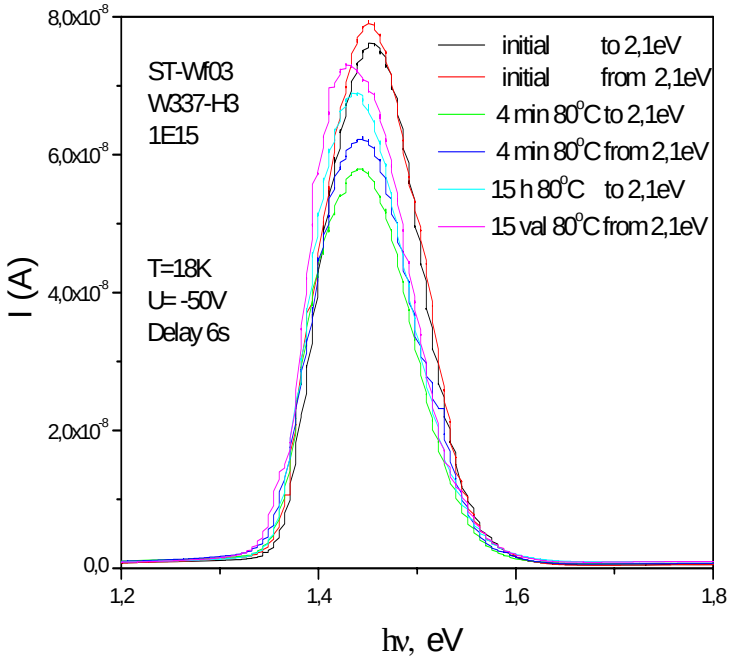

ST-W103
W837-C5
1E14
U=-50V
cooling 5K/min initial
heating 10K/min initial
cooling 5K/min after 4 min @80°C
heating 10K/min after 4 min @80°C
cooling 5K/min after 15 h @80°C
heating 10K/min after 15 h @80°C
I (A)
1/T (1/K)

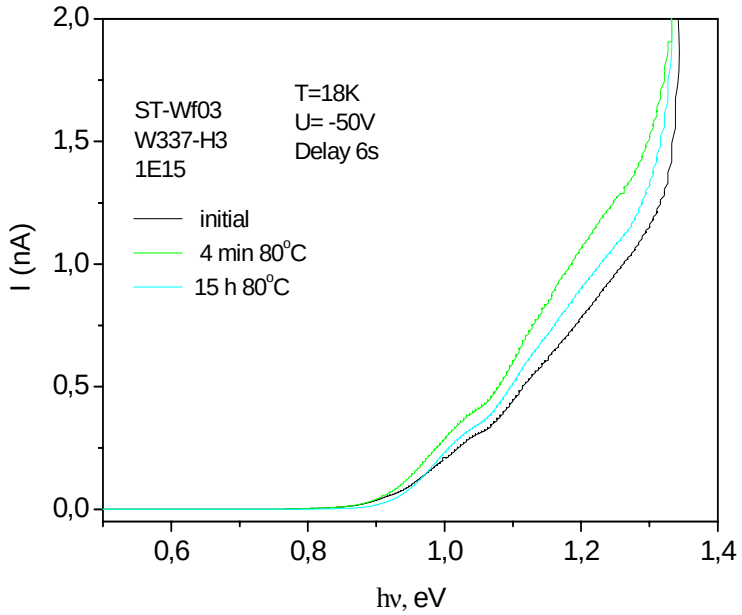
1e14 vs 1e15


ST-W103
W337-C5
1E14
T=18K
U=-50V
Delay 6s
initial to 2,1eV
initial from 2,1eV
Treated 4 min @80°C to 2,1eV
Treated 4 min @80°C from 2,1eV
Treated 15 h @80°C to 2,1eV
Treated 15 h @80°C from 2,1eV
I (A)
hν, eV
ST-W103
W337-H3
1E15
T=18K
U=-50V
Delay 6s
initial to 2,1eV
initial from 2,1eV
4 min 80°C to 2,1eV
4 min 80°C from 2,1eV
15 h 80°C to 2,1eV
15 h 80°C from 2,1eV
I (A)
hν, eV

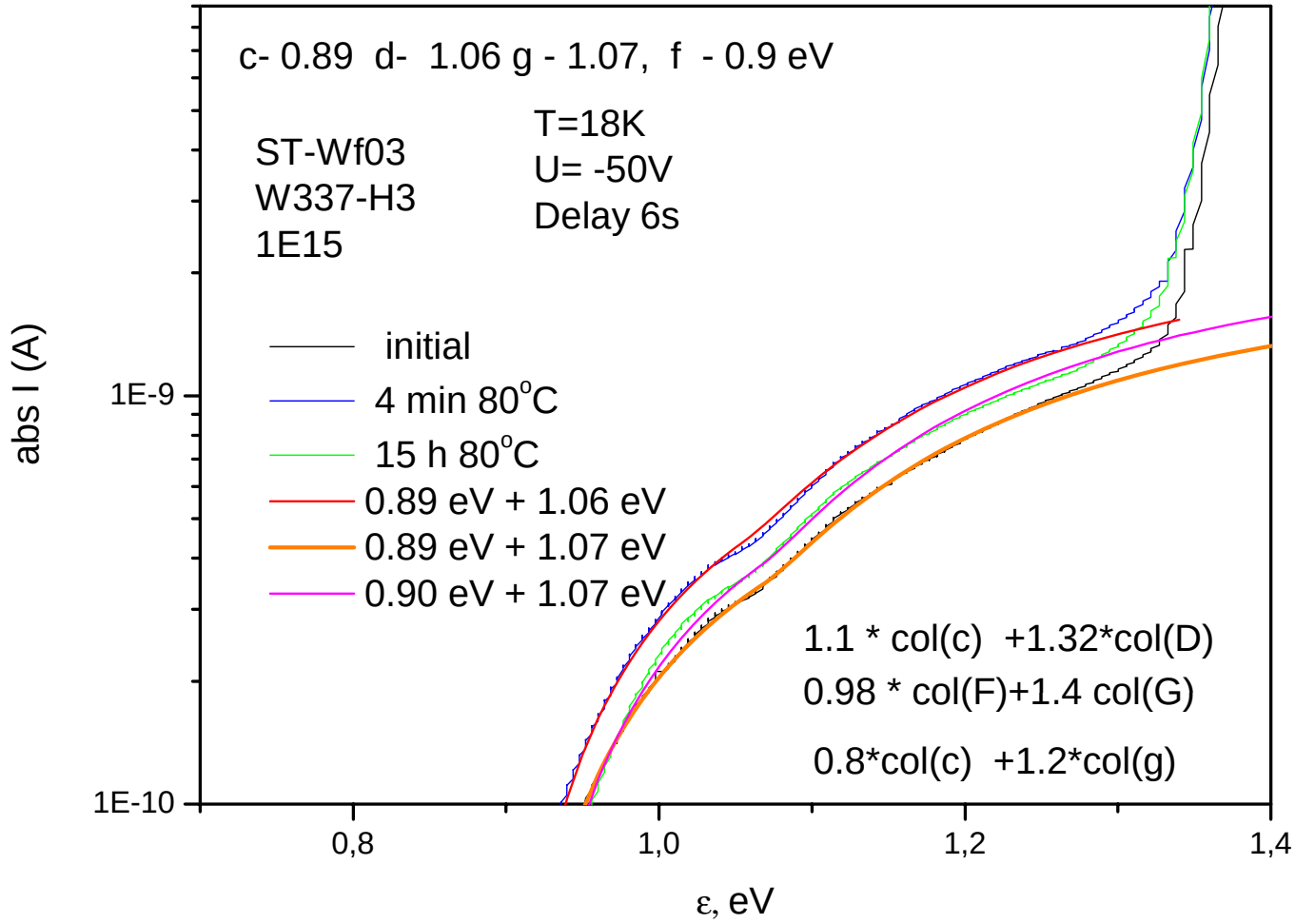
1e15


ST-Wf03
W337-H3
1E15
T=18K
U= -50V
Delay 6s
initial to 2,1eV
initial from 2,1eV
4 min 80°C to 2,1eV
4 min 80°C from 2,1eV
15 h 80°C to 2,1eV
15 h 80°C from 2,1eV
I (A)
hν, eV

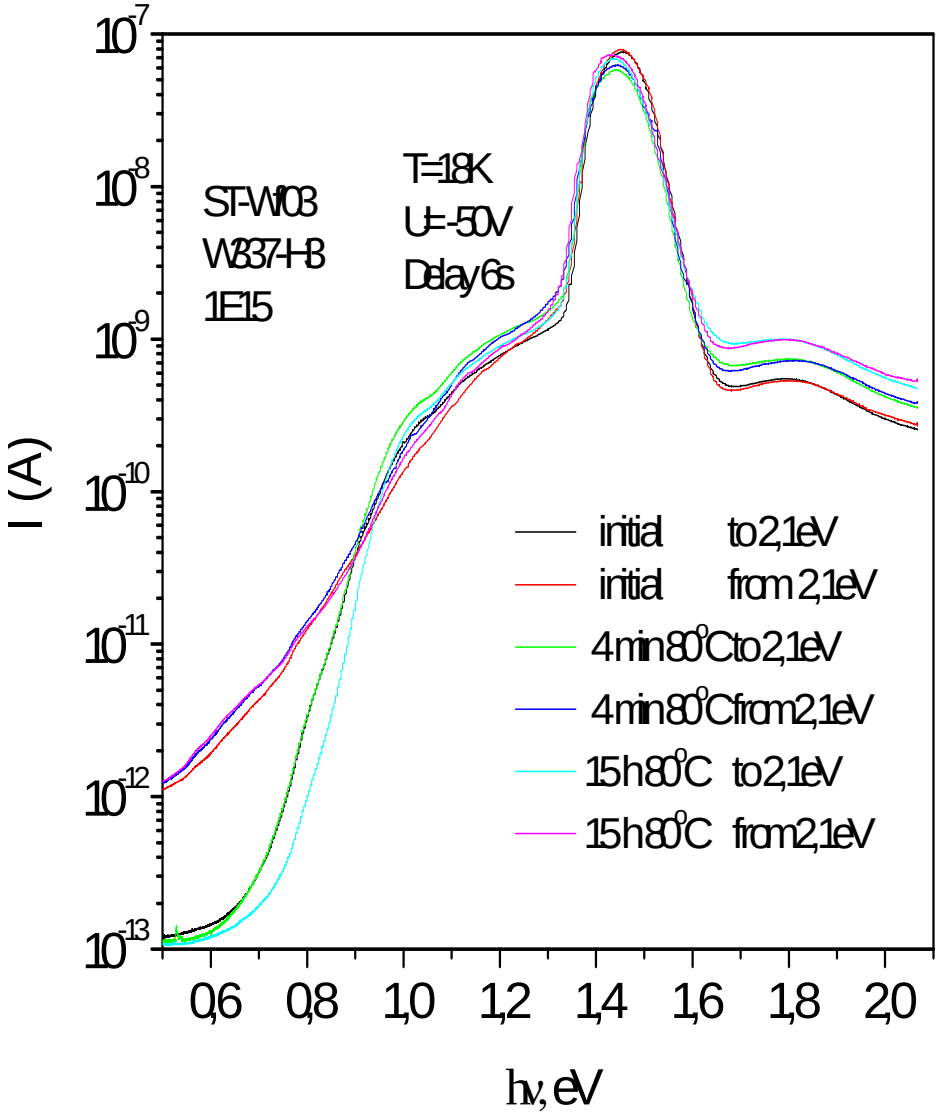

ST-Wf03
W337-H3
1E15
T=18K
U= -50V
Delay 6s
initial to 2,1eV
initial from 2,1eV
4 min 80°C to 2,1eV
4 min 80°C from 2,1eV
15 h 80°C to 2,1eV
15 val 80°C from 2,1eV
I (A)
hν, eV

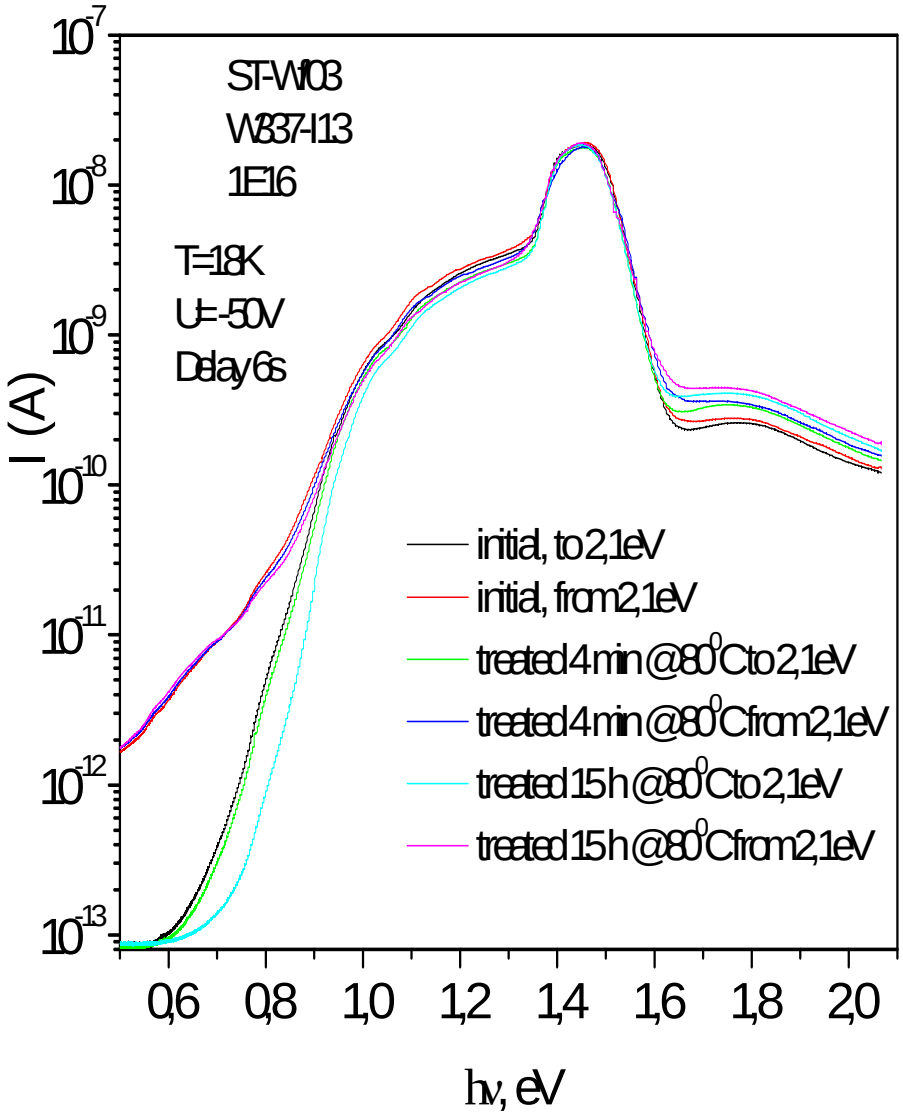

ST-Wf03
W337-H3
1E15
T=18K
U= -50V
Delay 6s
initial
4 min 80°C
15 h 80°C
I (nA)
hν, eV

A fit to Lucovsky model n-Si 1e15



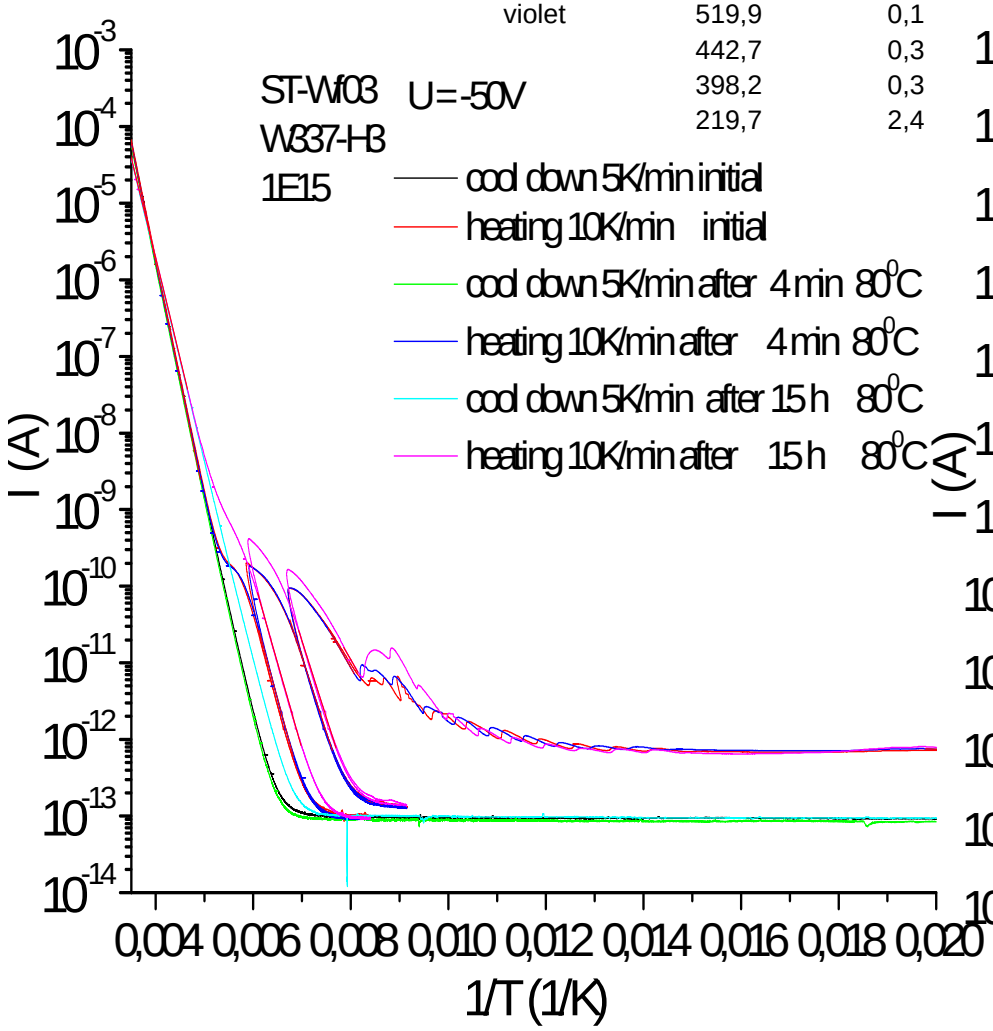
1e15 vs 1e16

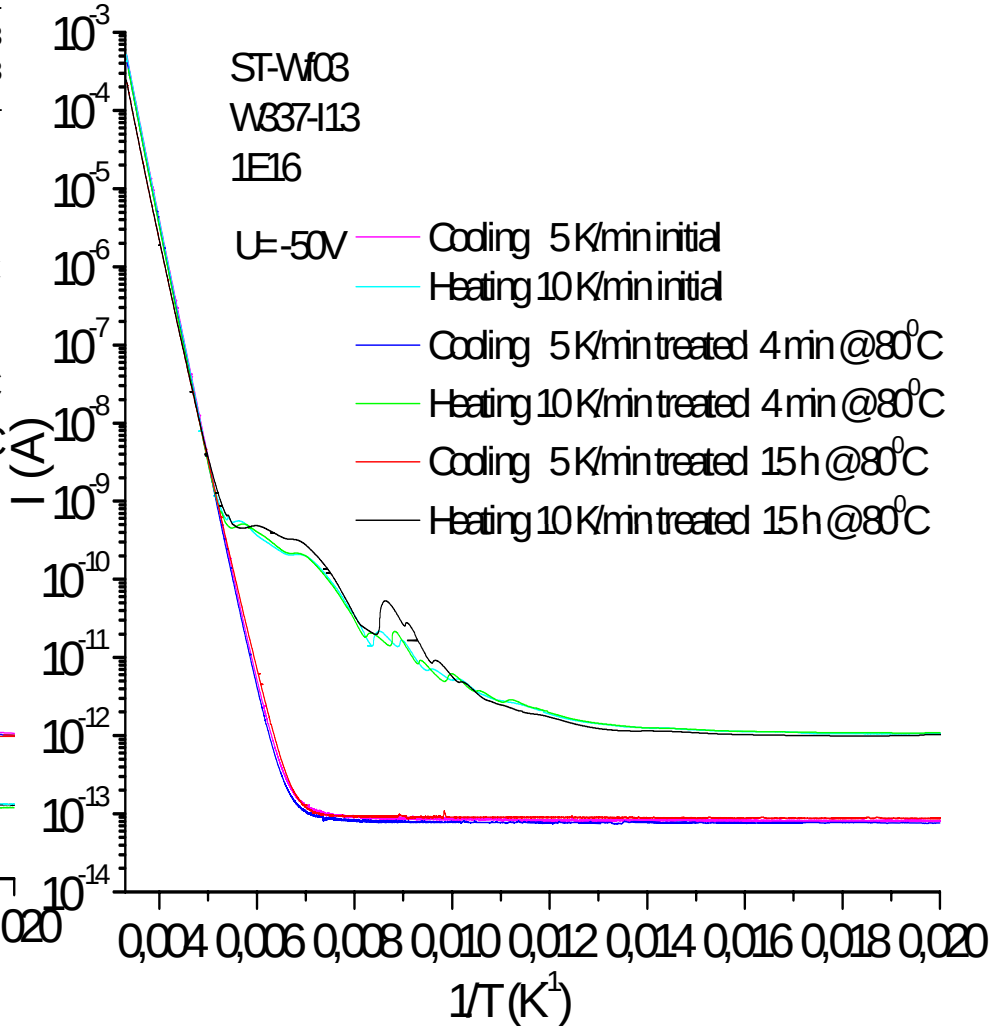

ST-Wf03
W837-H-B
1E15
T=18K
U=-50V
Delay 6s
initial to 2,1eV
initial from 2,1eV
4 min 80°C to 2,1eV
4 min 80°C from 2,1eV
15 h 80°C to 2,1eV
15 h 80°C from 2,1eV
I (A)
hν, eV


ST-Wf03
W837-H13
1E16
T=18K
U=-50V
Delay 6s
initial, to 2,1eV
initial, from 2,1eV
treated 4 min @80°C to 2,1eV
treated 4 min @80°C from 2,1eV
treated 15 h @80°C to 2,1eV
treated 15 h @80°C from 2,1eV
I (A)
hν, eV

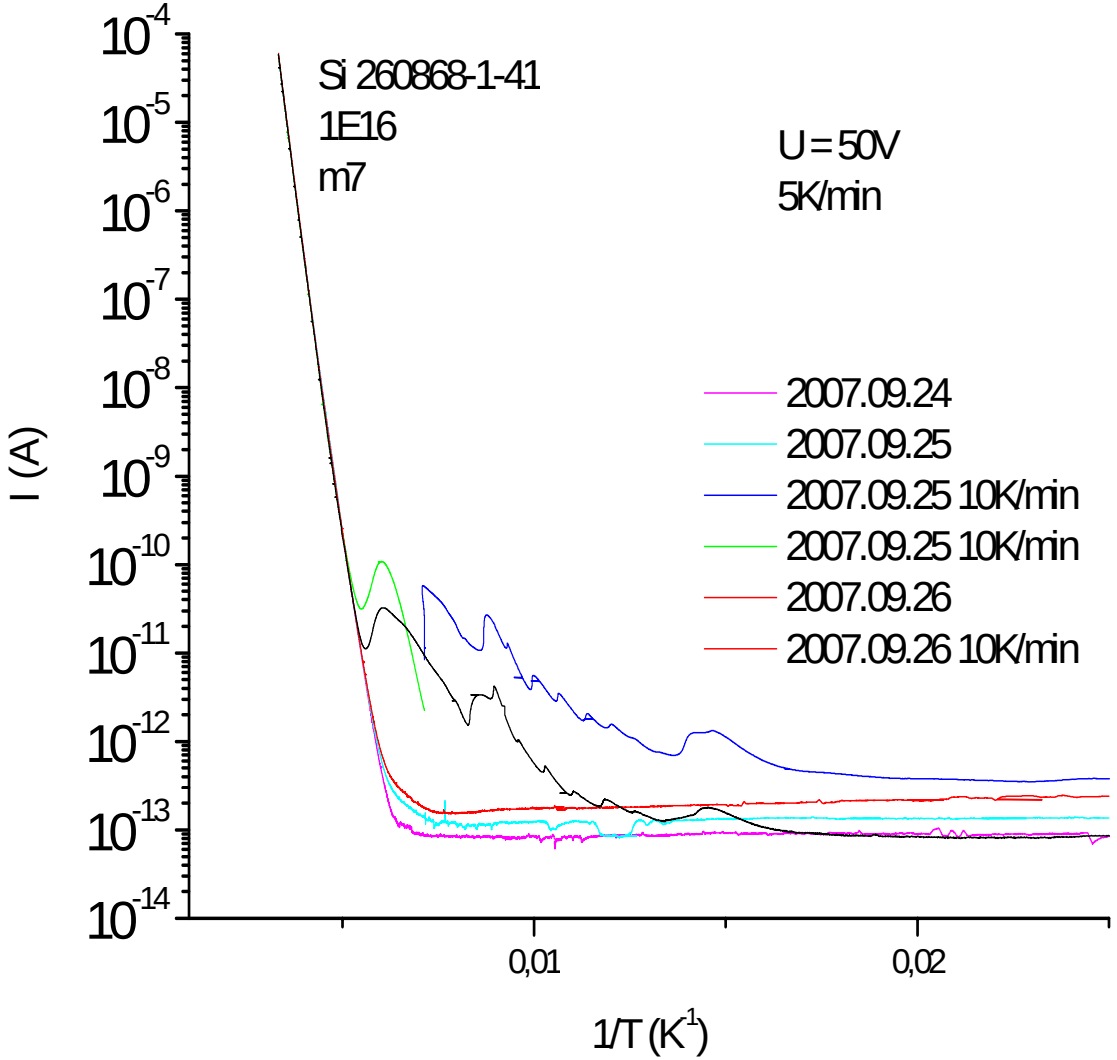
1e-15 vs 1e16

337-H3	ΔE, meV	±ΔE
blue	3,5	0,1
	218,3	0,2
	391,8	0,3
	465,3	0,6
	615,1	0,1
violet	519,9	0,1
	442,7	0,3
	398,2	0,3
	219,7	2,4

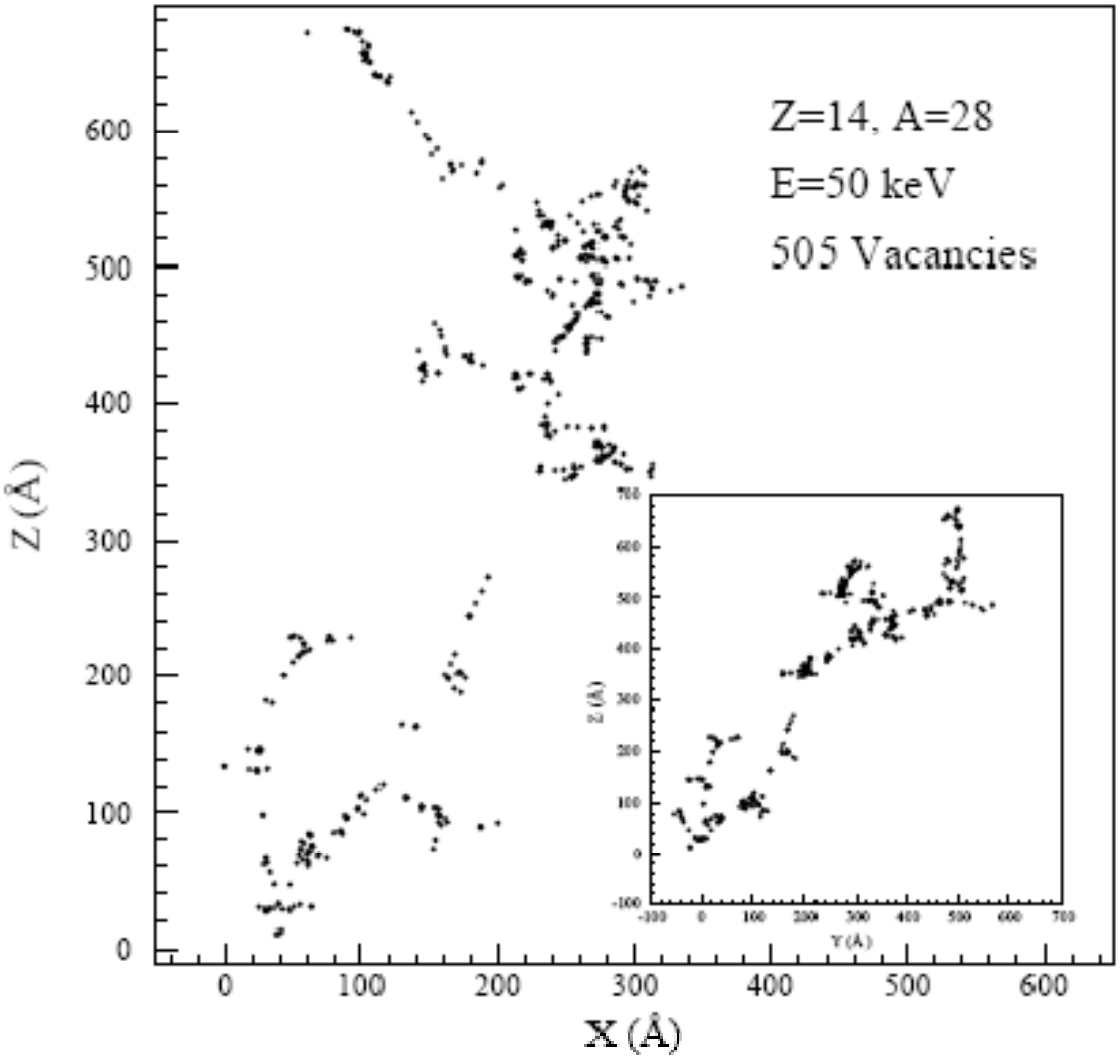




Epi-n-Si 1e-16


Si 260868-1-41
1E16
m7
U = 50V
5K/min
2007.09.24
2007.09.25
2007.09.25 10K/min
2007.09.25 10K/min
2007.09.26
2007.09.26 10K/min
I (A)
10-4
10-5
10-6
10-7
10-8
10-9
10-10
10-11
10-12
10-13
10-14
0,01
0,02
1/T (K-1)

M. Huhtinen / Nuclear Instruments and Methods in Physics Research A 491 (2002) 194–215



The spatial distribution of vacancies varies significantly from one event to the other.

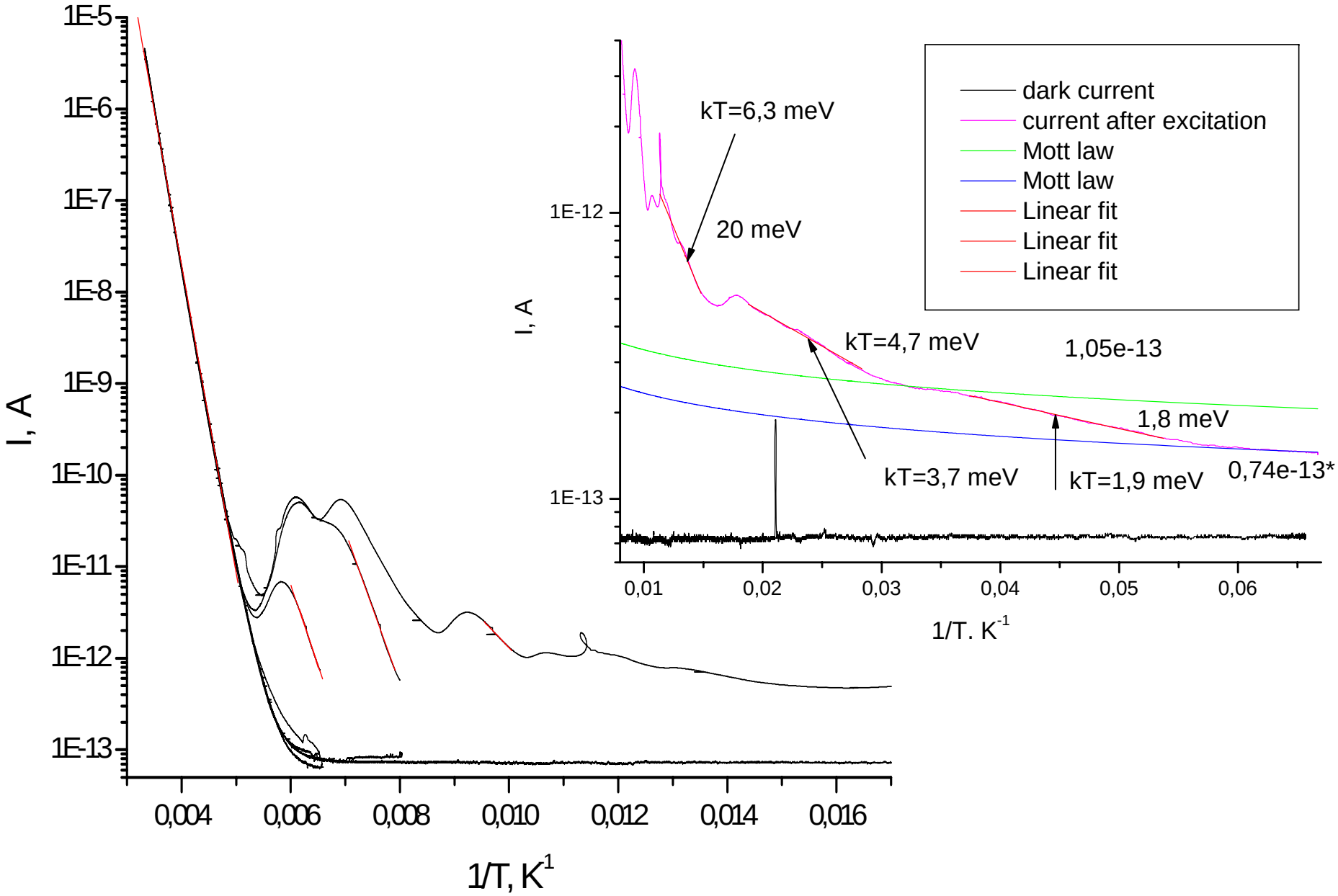
A single silicon Primary Knock-on Atom (PKA) with an energy typical of1 MeV neutron scattering has been simulated.

A characteristic tree-like structure with several sub-clusters can be observed.

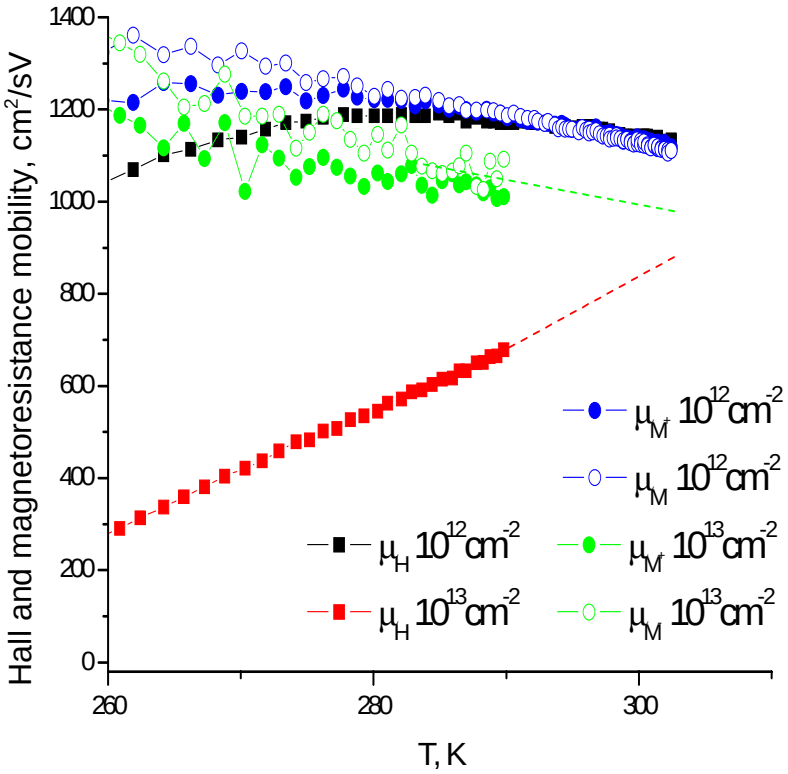
These sub-clusters correspond to lower energy ions knocked-off from their lattice sites.

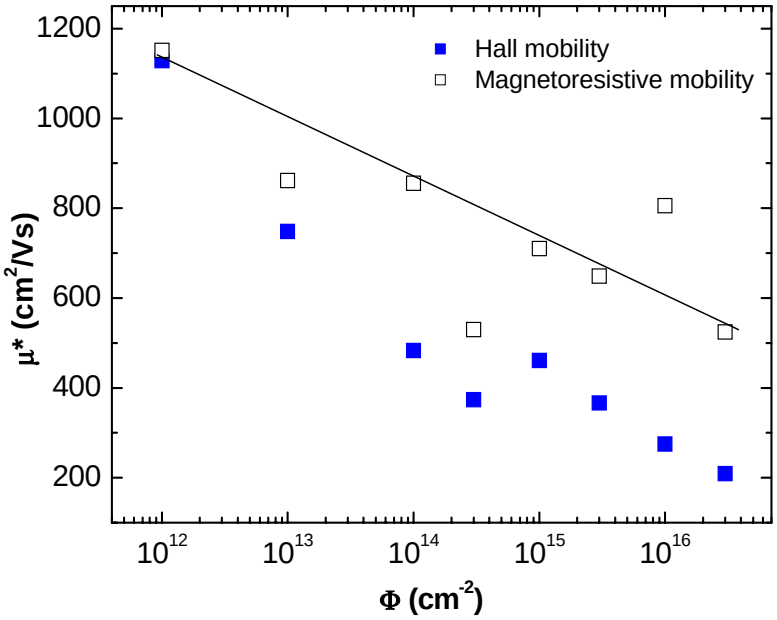
If
the PKA energy is increased above 50 keV a larger tree with several branches—each resembling that of Fig—will be observed.

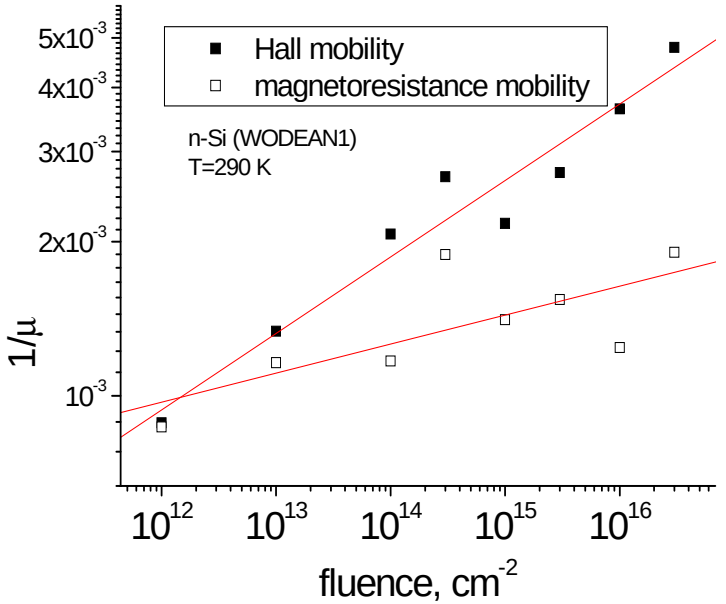
Epi-n-Si, 1e14


1E-5
1E-6
1E-7
1E-8
1E-9
1E-10
1E-11
1E-12
1E-13
I, A
0,004
0,006
0,008
0,010
0,012
0,014
0,016
1/T, K1
dark current
current after excitation
Mott law
Mott law
Linear fit
Linear fit
Linear fit
kT=6,3 meV
20 meV
kT=4,7 meV
1,05e-13
1,8 meV
kT=3,7 meV
kT=1,9 meV
0,74e-13*
1E-12
1E-13
I, A
0,01
0,02
0,03
0,04
0,05
0,06
1/T. K-1

Hall and magnetoresistance mobility dependence *vs* irradiation doze (RD50-10)



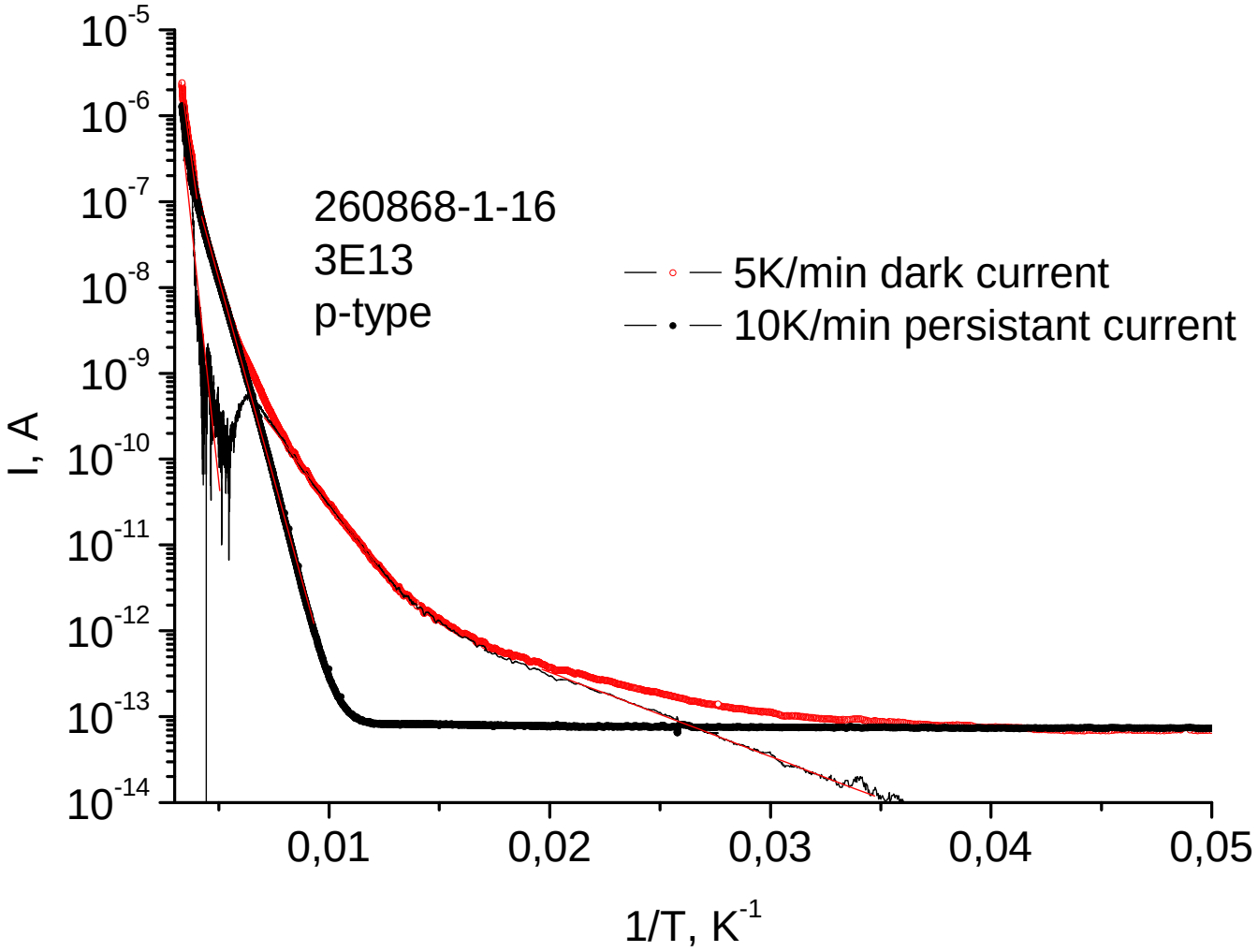




It does not give the real mobilities, but shows an existence of spatial ingomogeneities and can be proposed that the existing clusters create valleys that become more narrow at higher at higher fluences.

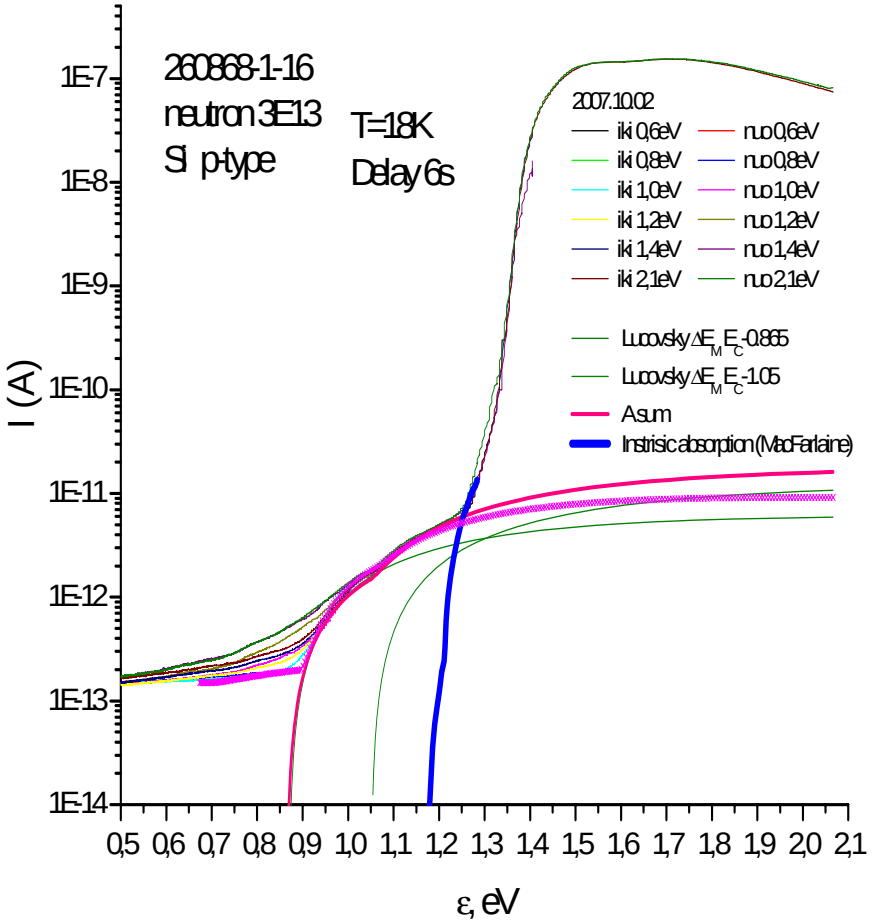
At high field (full depletion), the influence of these inhomogeneities decreases, but **this field is related to the barrier between the inhomogeneities** (A.Rose, RCA)

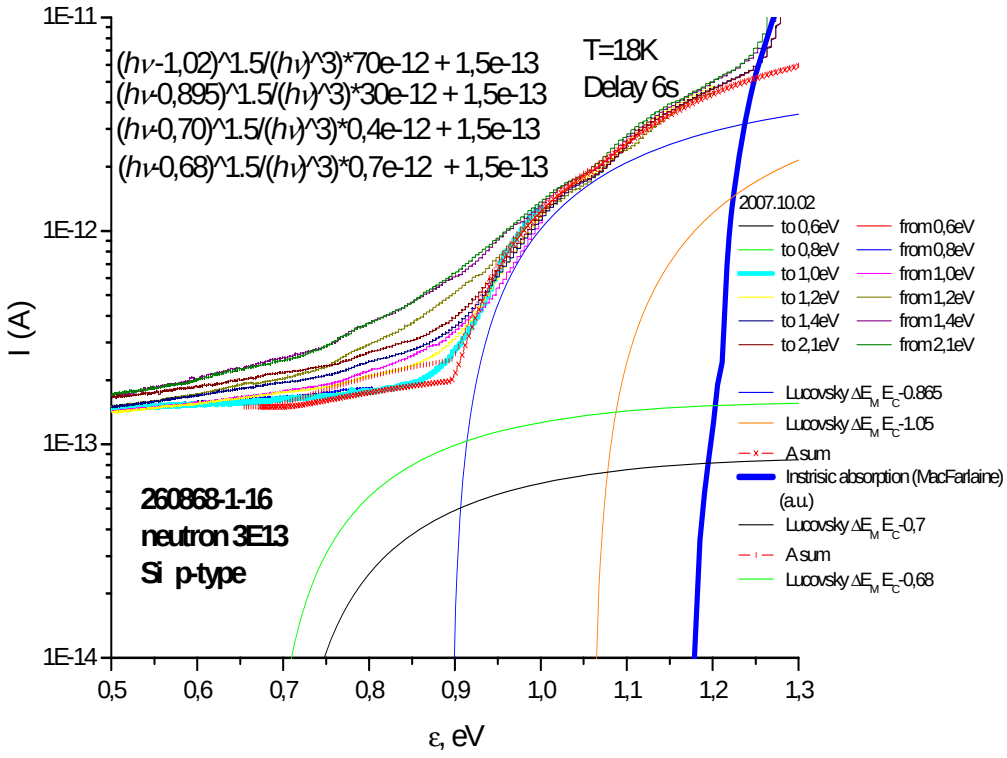
Epi-p-Si -3e13



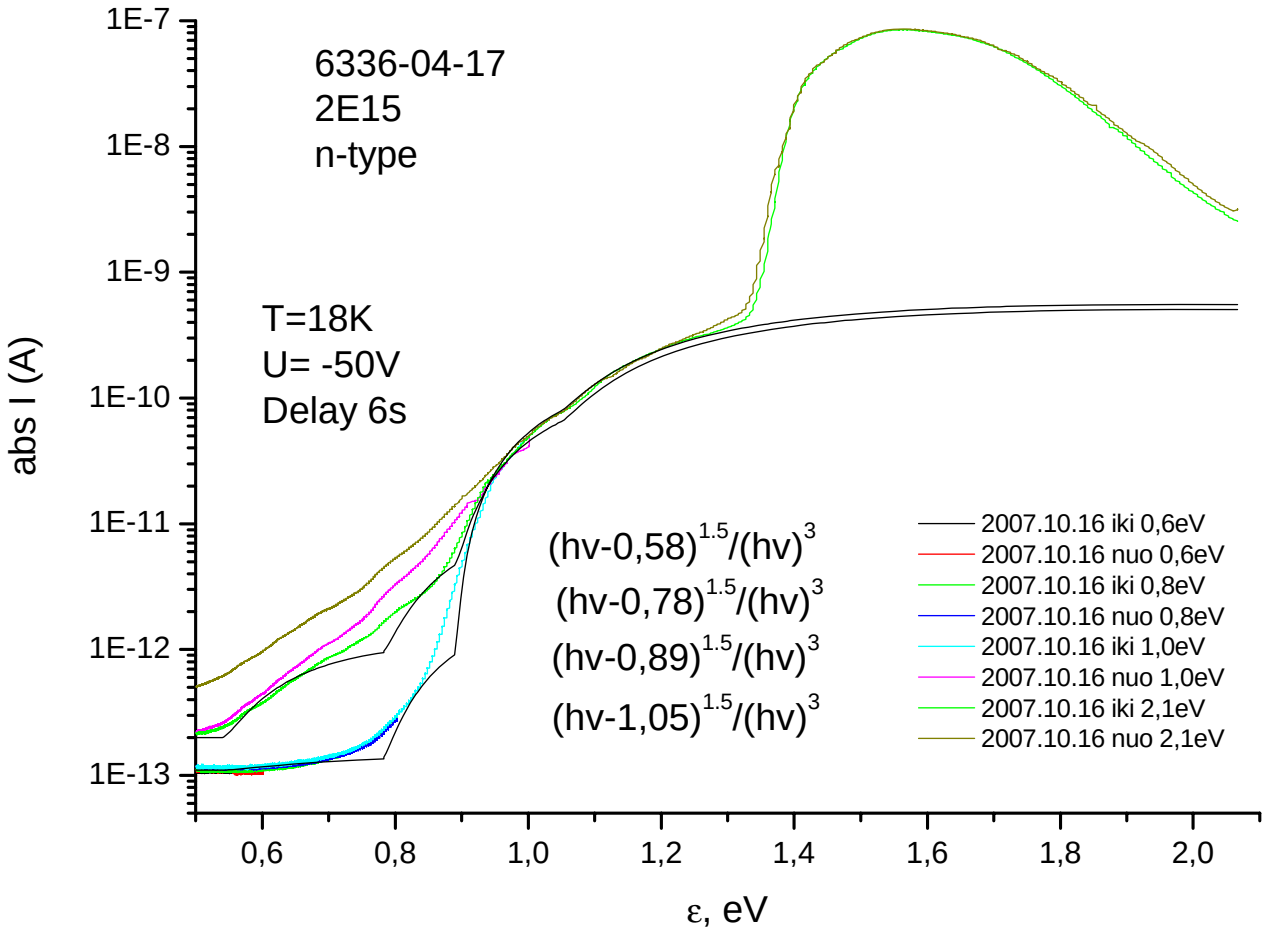
ΔE, meV	±ΔE
190,1	0,1
395,4	0,5
68,1	0,7
19,4	0,1

Epi-p-Si 3e13


260868-1-16
neutron 3E13
Si p-type
T=18K
Delay 6s
2007.10.02
iki 0,6eV
iki 0,8eV
iki 1,0eV
iki 1,2eV
iki 1,4eV
iki 2,1eV
nuo 0,6eV
nuo 0,8eV
nuo 1,0eV
nuo 1,2eV
nuo 1,4eV
nuo 2,1eV
Lucovsky ΔE_M E_C-0.865
Lucovsky ΔE_M E_C-1.05
A sum
Instrisic absorption (MacFarlaine)
I (A)
ε, eV

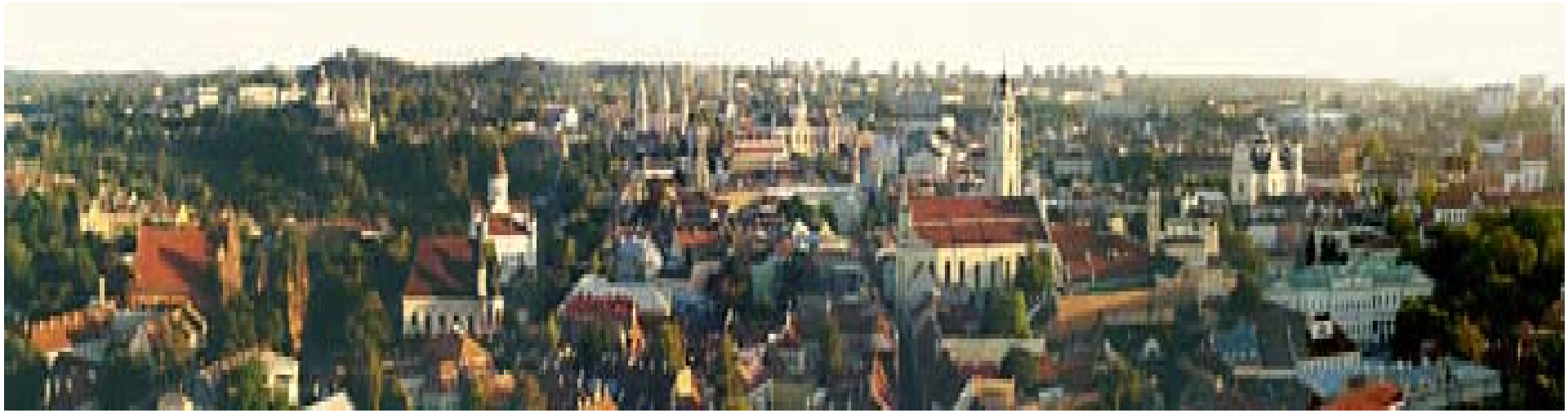

(hν-1,02)^1.5/(hν)^3)*70e-12 + 1,5e-13
(hν-0,895)^1.5/(hν)^3)*30e-12 + 1,5e-13
(hν-0,70)^1.5/(hν)^3)*0,4e-12 + 1,5e-13
(hν-0,68)^1.5/(hν)^3)*0,7e-12 + 1,5e-13
T=18K
Delay 6s
2007.10.02
to 0,6eV
to 0,8eV
to 1,0eV
to 1,2eV
to 1,4eV
to 2,1eV
from 0,6eV
from 0,8eV
from 1,0eV
from 1,2eV
from 1,4eV
from 2,1eV
Lucovsky ΔE_M E_C-0.865
Lucovsky ΔE_M E_C-1.05
A sum
Instrisic absorption (MacFarlaine) (a.u.)
Lucovsky ΔE_M E_C-0,7
A sum
Lucovsky ΔE_M E_C-0,68
260868-1-16
neutron 3E13
Si p-type
I (A)
ε, eV

Epi-n-Si 2e15


6336-04-17
2E15
n-type
T=18K
U= -50V
Delay 6s
abs I (A)
1E-7
1E-8
1E-9
1E-10
1E-11
1E-12
1E-13
0,6
0,8
1,0
1,2
1,4
1,6
1,8
2,0
ε, eV
(hv-0,58)^1.5/(hv)^3
(hv-0,78)^1.5/(hv)^3
(hv-0,89)^1.5/(hv)^3
(hv-1,05)^1.5/(hv)^3
2007.10.16 iki 0,6eV
2007.10.16 nuo 0,6eV
2007.10.16 iki 0,8eV
2007.10.16 nuo 0,8eV
2007.10.16 iki 1,0eV
2007.10.16 nuo 1,0eV
2007.10.16 iki 2,1eV
2007.10.16 nuo 2,1eV

Conclusions:

- Midgap centres in n-Si and p-Si can be reveled
- Thermal treatment changes mostly shallow levels region
- Thermally stimulated persistent conductivity demonstrate the percolation at low temperature and activation current properties at higher temperature.
- Thermal treatment changes mostly percolation current region.



Thank You for Your attention !