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Depletion Voltage and short-term Annealing

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I have calculated the depletion voltage as a function of fluence for different short term annealing scenarios. The assumptions are:

the measurements take place short time after irradiation, *i.e.* after a short time compared to the short-term anneal time $\tau s(T_o)$ of the storage temperature T_o
the temperature is controlled well such that the measurement time is much smaller than the long-term anneal time $\tau l(T)$

Then for an fluence ϕ in cm^{-2}, and elapsed anneal time t_1 at temperature T_1, t_2 at temperature T_2 etc, the depletion voltage is approximately:

$$V_D\ (dt)= abs[V_o*\exp(-c*\phi)-(\phi/10^{14})*(106+300*\exp\{-\Sigma(t_i/\tau s(T_i)\})]\ [Volt]\ ,$$

with c= $1.1*10^{-13}cm^2$ and V_o the pre-rad depletion voltage.
The initial donors are removed exponentially, and acceptors are created linearly with fluence. At a fluence of about $0.5\text{-}1*10^{13}cm^2$, inversion takes place.

Table I

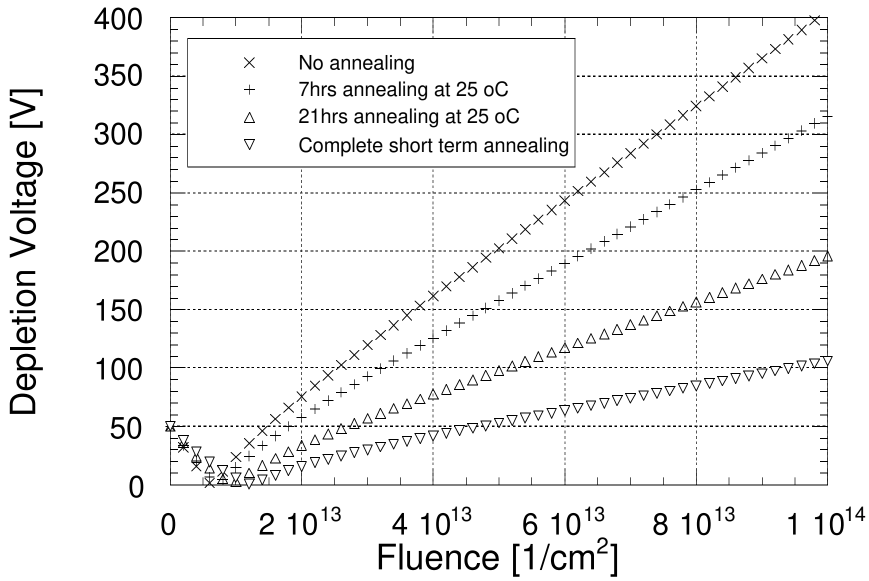
T[^{o}C]	t_s [days]	t_s [hrs]	t_l [days]
-10	403	9670	4.18e+04
-5	168	4030	1.95e+04
0	70	1680	9140
5	29.2	700	4270
10	12.2	292	1999
15	5.07	122	935
20	2.11	50.7	437
25	0.881	21.1	20
30	0.367	8.82	95.6
35	0.153	3.67	44.7
40	0.0638	1.53	20.9
50	0.0111	0.266	4.57

The figure shows the depletion voltage as a function of fluence for four cases of annealing:

No annealing -cool storage maintained
Annealing of 30% , *e.g.*by having the detectors at 25^{o}C for 7 hours
Annealing to 1/e, *e.g.* by having the detectors at 25^{o}C for 21 hours
Complete annealing, *e.g.* by having the detectors at 25^{o}C for about 50 hours

If one finds a depletion voltage of 20V, for 50V initial depletion, the fluence has to be between 0.35 and $2.2*10^{13}cm^2$.

Depletion Voltage vs Fluence for different Annealing



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