Extraction of Doping Density from C-V

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The SMART Collaboration
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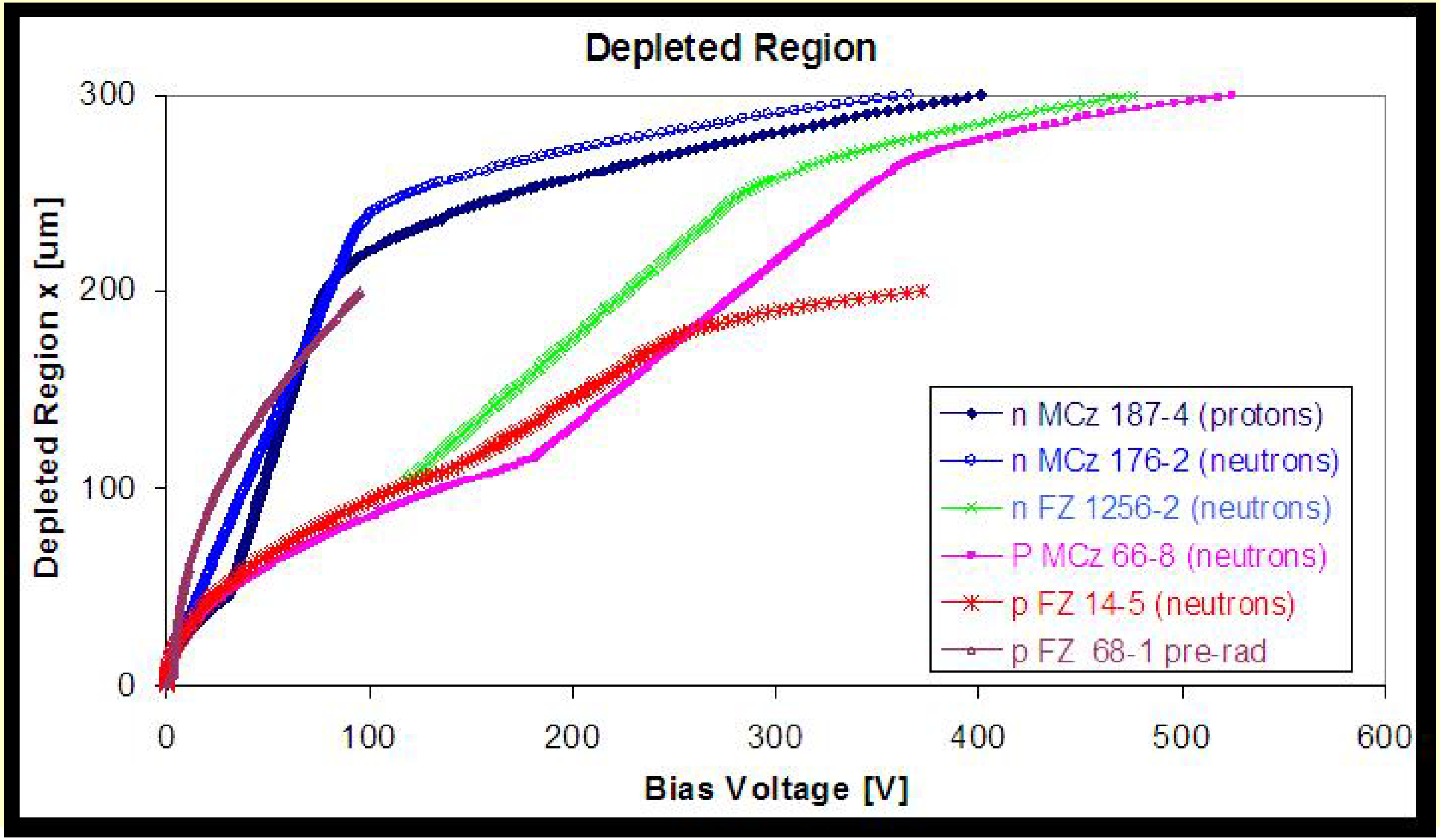
- Extraction of Neff from C-V
- Strips vs. Diodes
- Irradiated Sensors

Very Similar 1/C (V) curves

Non-uniform doping density in MCz:

Assumption that 1/C(V) describes the depletion characteristics



Doping density vs. Depth

$$\frac{d^2V}{dx^2} = -\frac{\rho}{\varepsilon} = -\frac{q}{\varepsilon}N(x)$$

$$\int_0^x \frac{d^2V}{dx'^2}dx' = -[E(x) - E(0)] = -\frac{q}{\varepsilon}\int_0^x N(x')dx'$$

$$\Rightarrow E(x) = E_0 + \frac{q}{\varepsilon}\int_0^x N(x')dx'$$

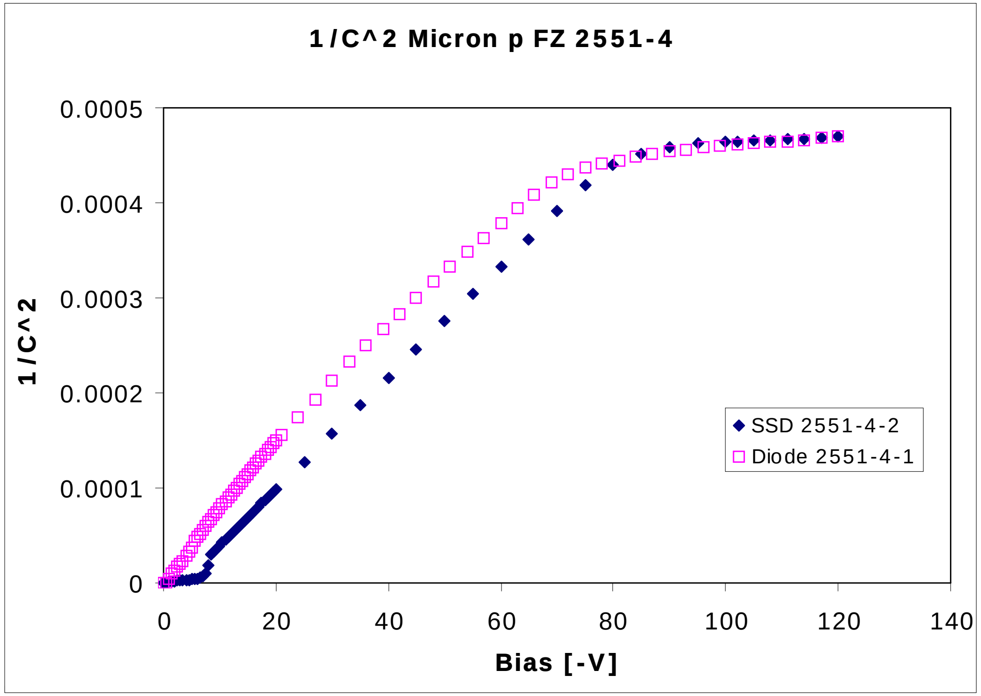
$$V(0) = V_{bias} = \int_0^d E(x,d)dx$$

Parallel plate capacitor approximation:
Divide detector in to capacitors of equal thickness t and equal capacitance Ct

$$C_t = C_o\frac{d}{t} \qquad C = \varepsilon\frac{A}{x}$$

Voltage on these capacitors depends on the doping density
As a start define regions of constant doping density.

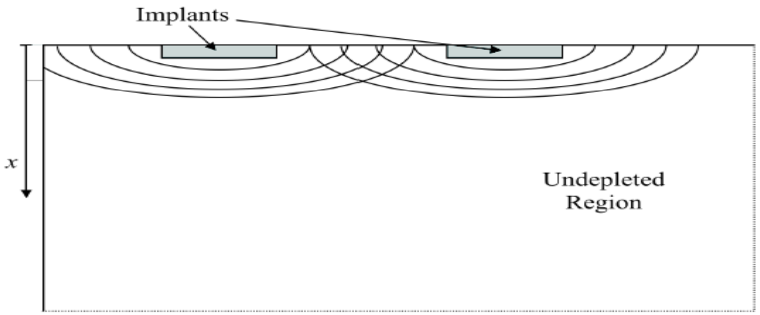
Example: Pre-rad Micron Diode and SSD



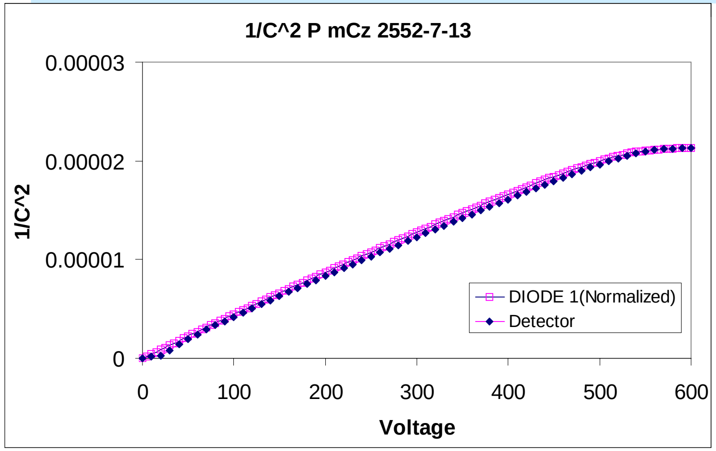
E. Barberis et al. NIM A 342 (1994) 90-95

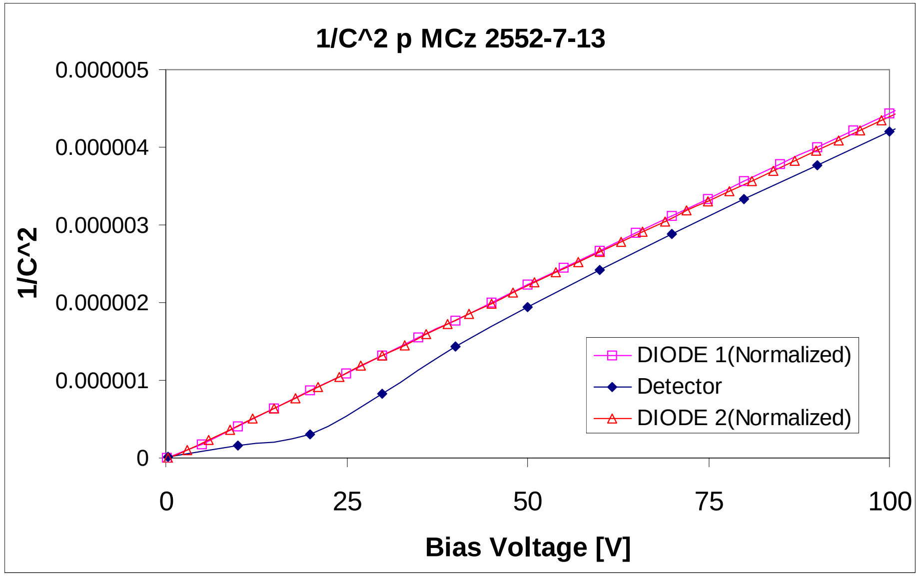
Capacitances in silicon microstrip detectors

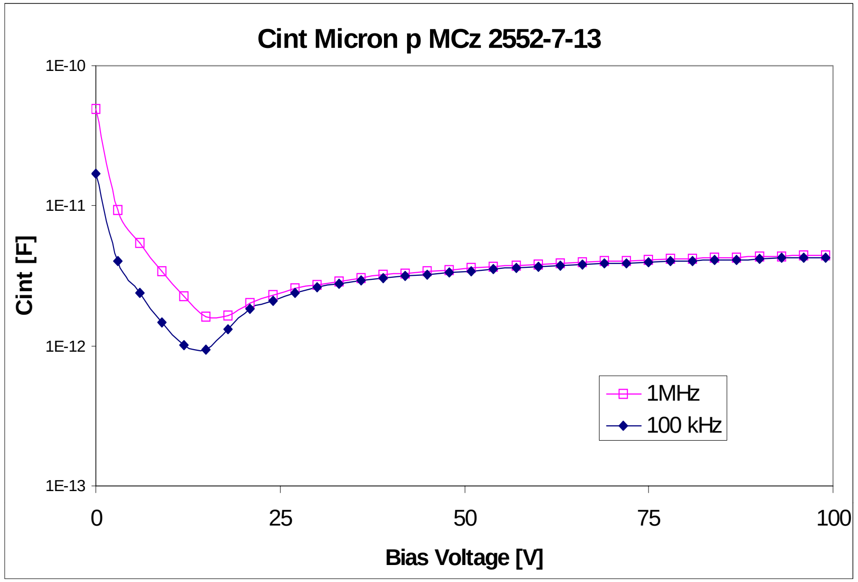
$$V_D = V_{D0}\left[1 + 2\frac{p}{d} f\left(\frac{w}{p}\right)\right],$$



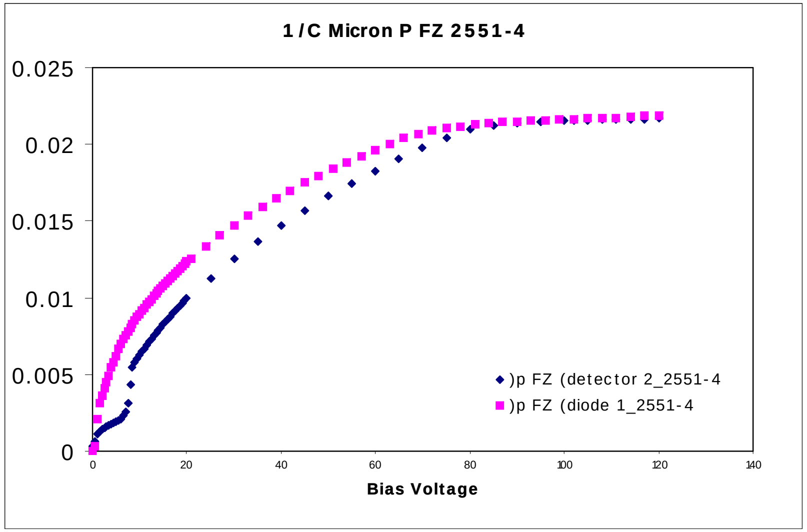
Example: Pre-rad Micron Diode and SSD

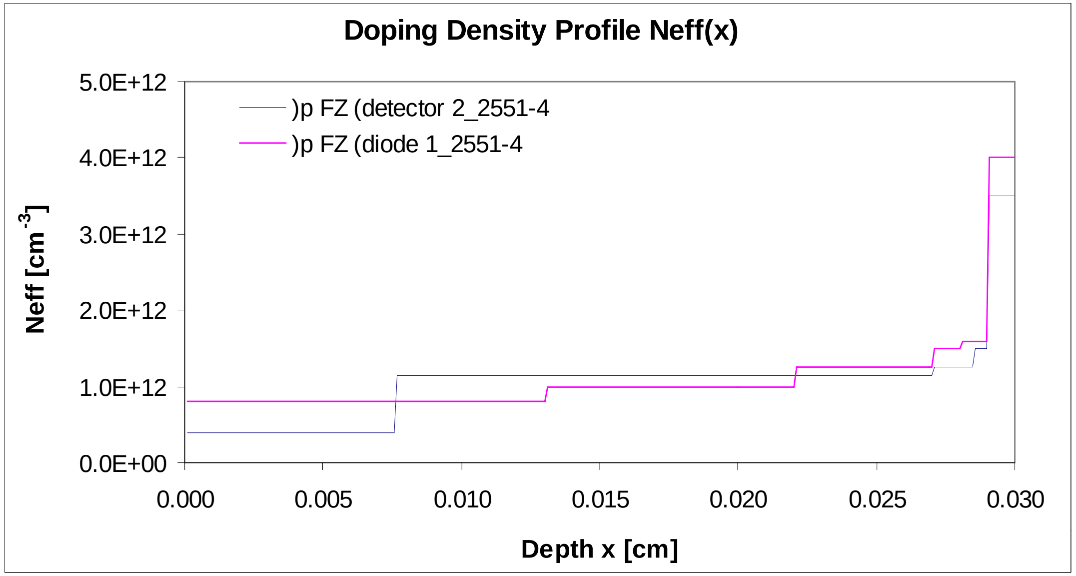




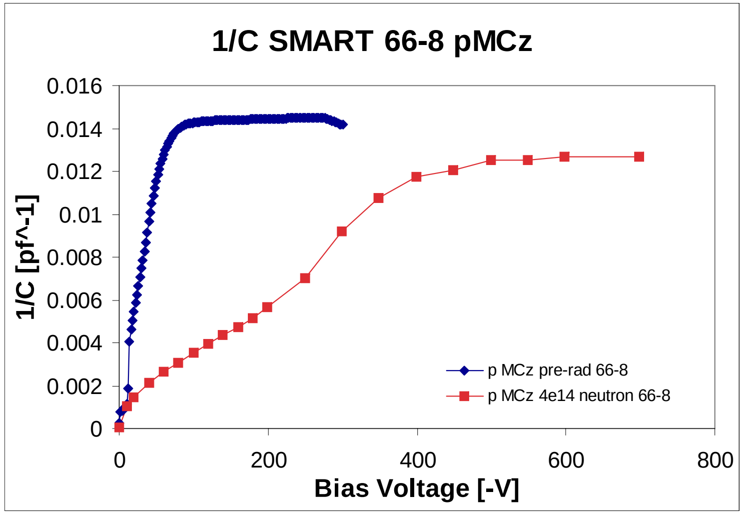


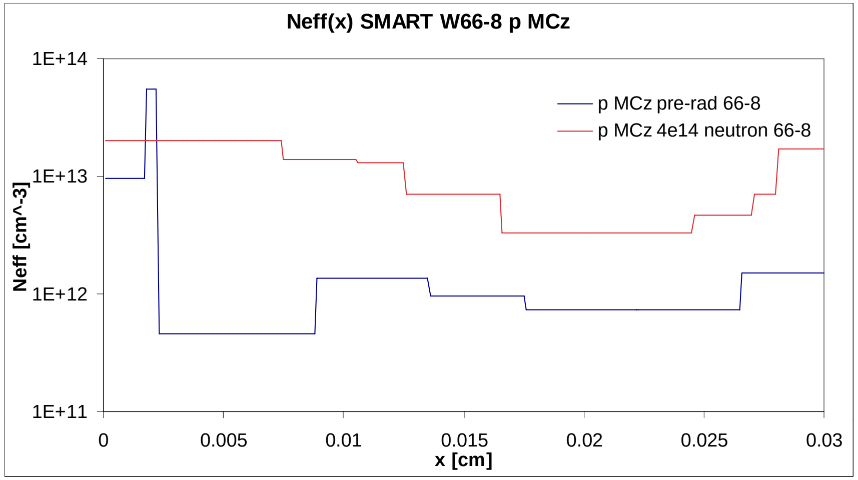
Example: Pre-rad Micron SSD

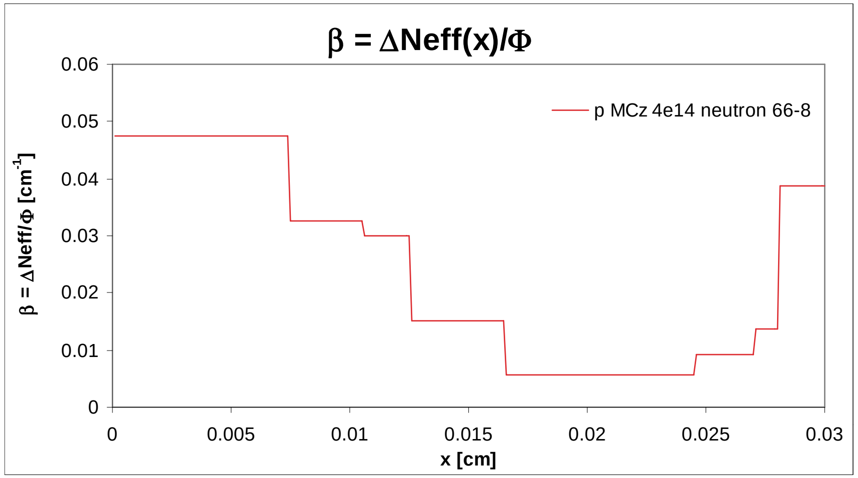




Example: Post-rad SMART p-type SSD







Conclusions

C-V yields information of Neff(x) profile.

Very similar 1/C (V) curves for different wafer material

Difference Diode – SSD due to depletion around the strips

Damage factor β seems to be depth dependence

Thanks to RD50 collaborators in Ljubljana and Louvain
for efficient and (for us easy) irradiation