First results on the charge collection efficiency of heavily irradiated microstrip sensors fabricated on oxygenated p-type silicon.

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OUTLINE:

- Oxygen enrichment of n-type and p-type substrates
- Production and irradiation of miniature detectors
- First results of irradiated miniature detectors made on p-type oxygenated wafers

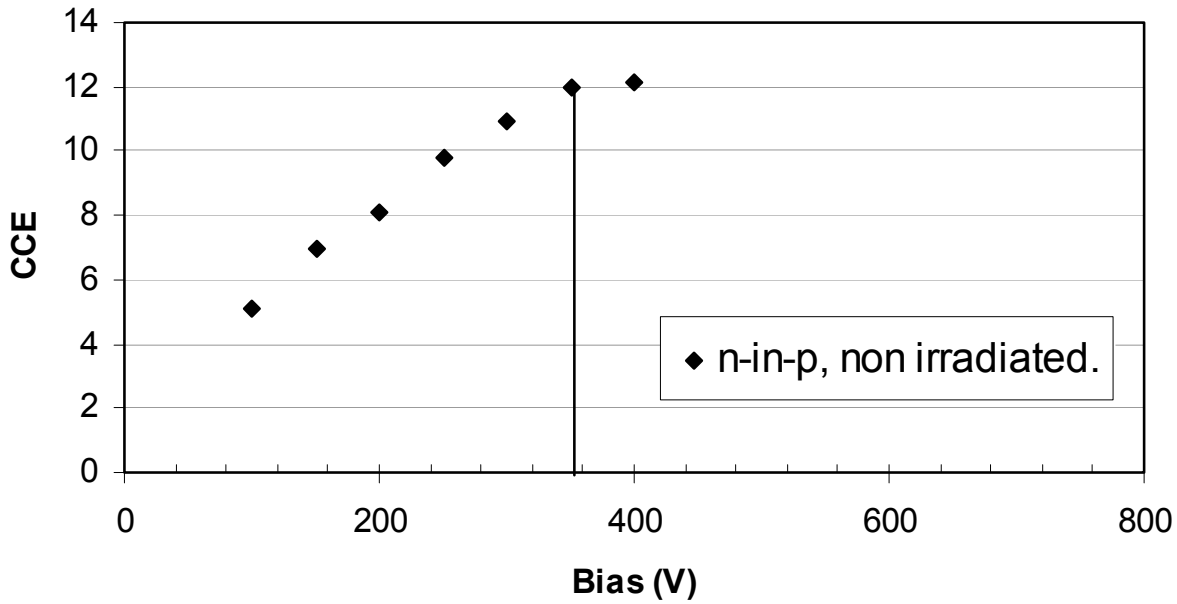
2 sets of variously flavoured detectors have been produced by CNM using a Liverpool designed mask-set. Four type of substrate were used: n-type with and without O, p-type with and without O. [O] calculated to be $\geq 10^{17}$ cm^{-3} throughout the wafer.

The 2 sets have been irradiated to 2.7 and 11.5 10^{14} p cm^{-2} in the CERN-PS, Irrad-1 facility, at room temperature and unbiased.

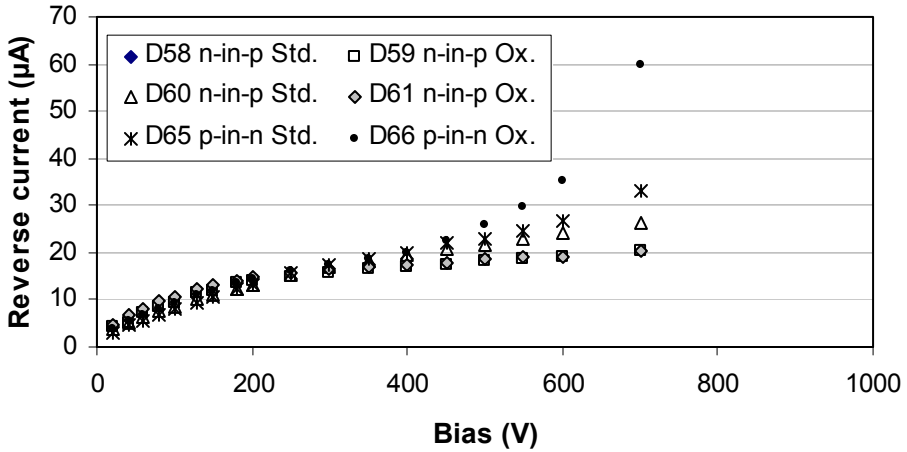
After irradiation they were kept at low temperature.

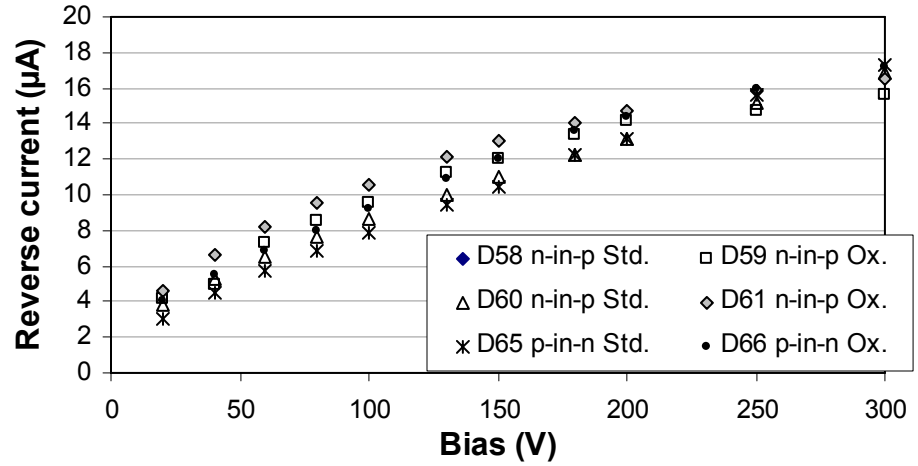
Before irradiation: n-in-p detectors

$V_{fd} \sim 350$ V

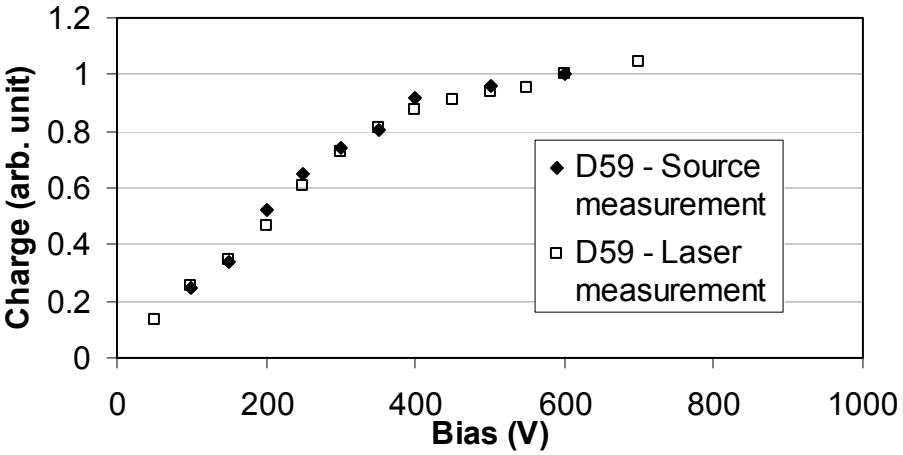


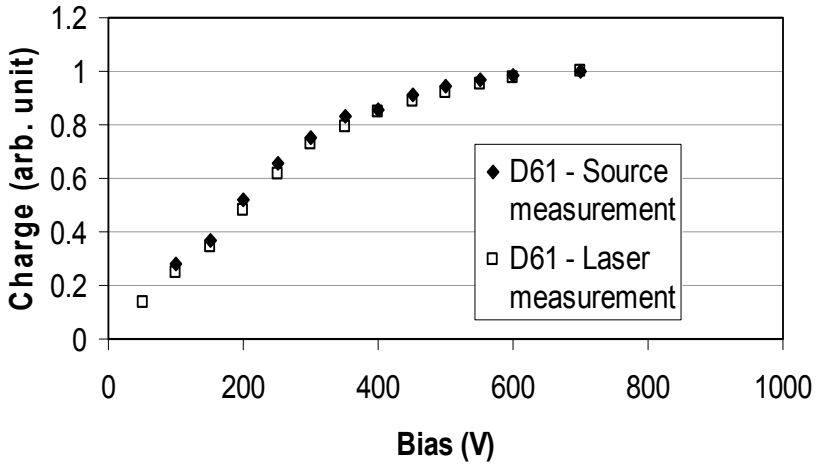
Reverse currents after 1.1 10^{15} 24 GeV/c p cm^{-2}

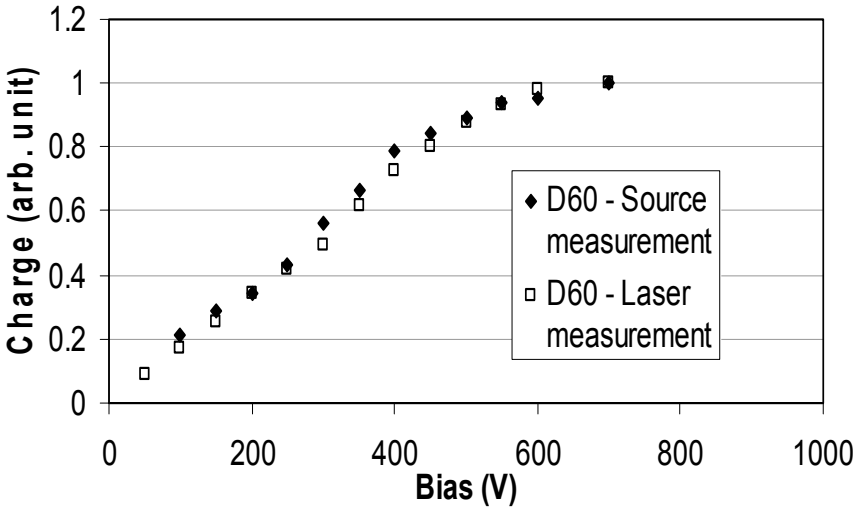


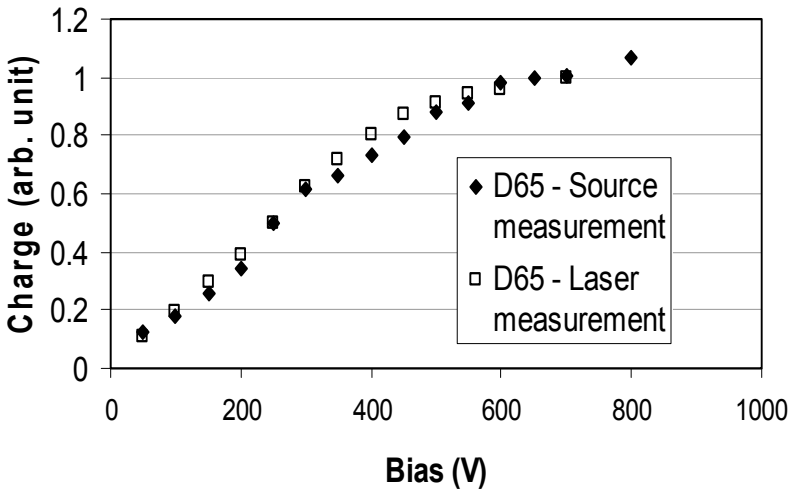


Charge collection has been measured using a 1060 nm laser and a β ^{106}Ru source. Good agreement of results.

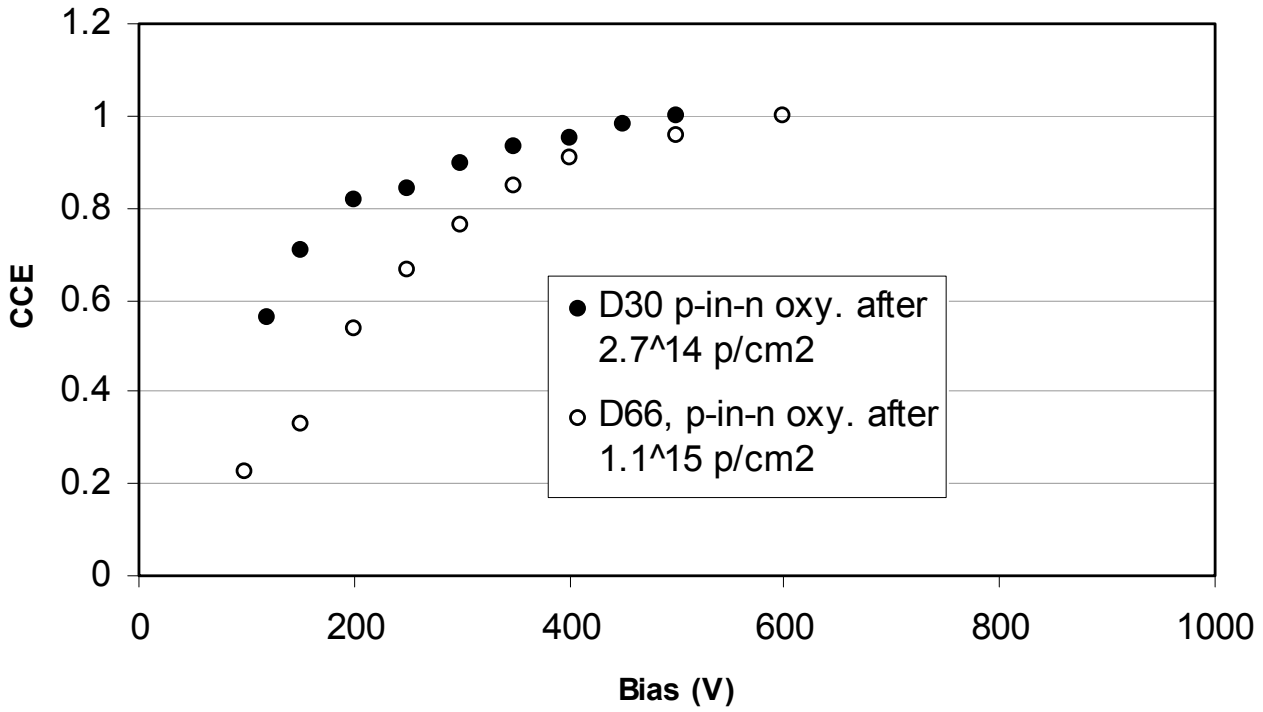




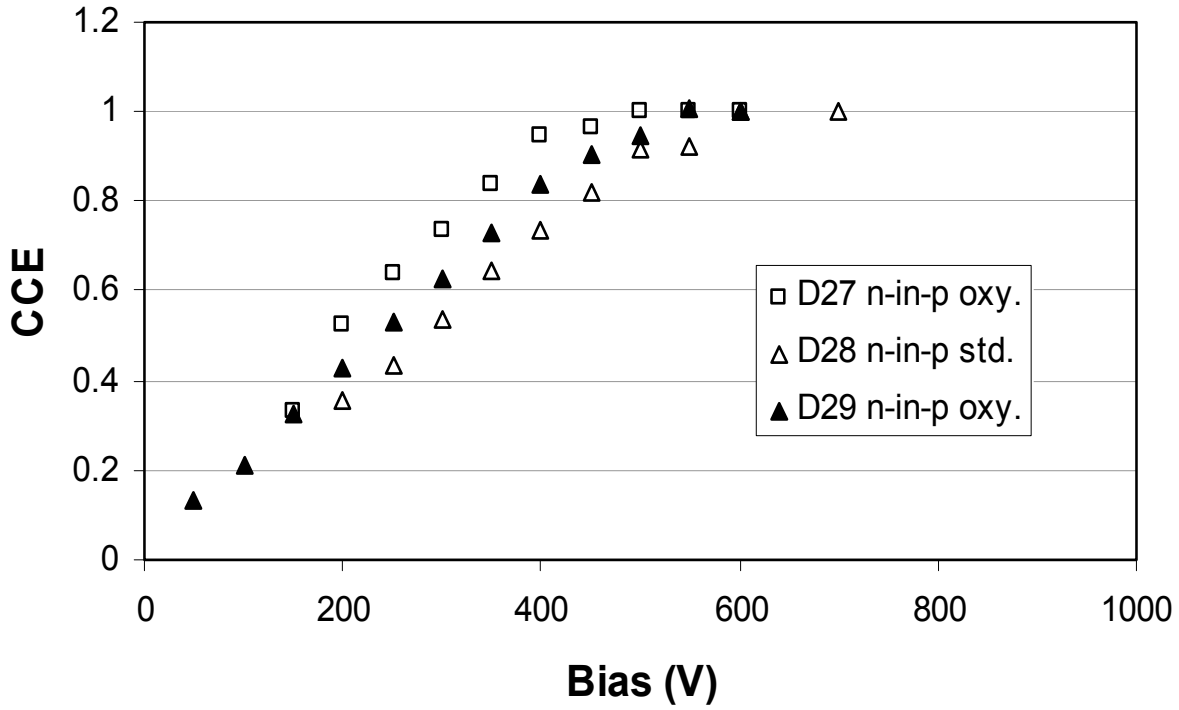




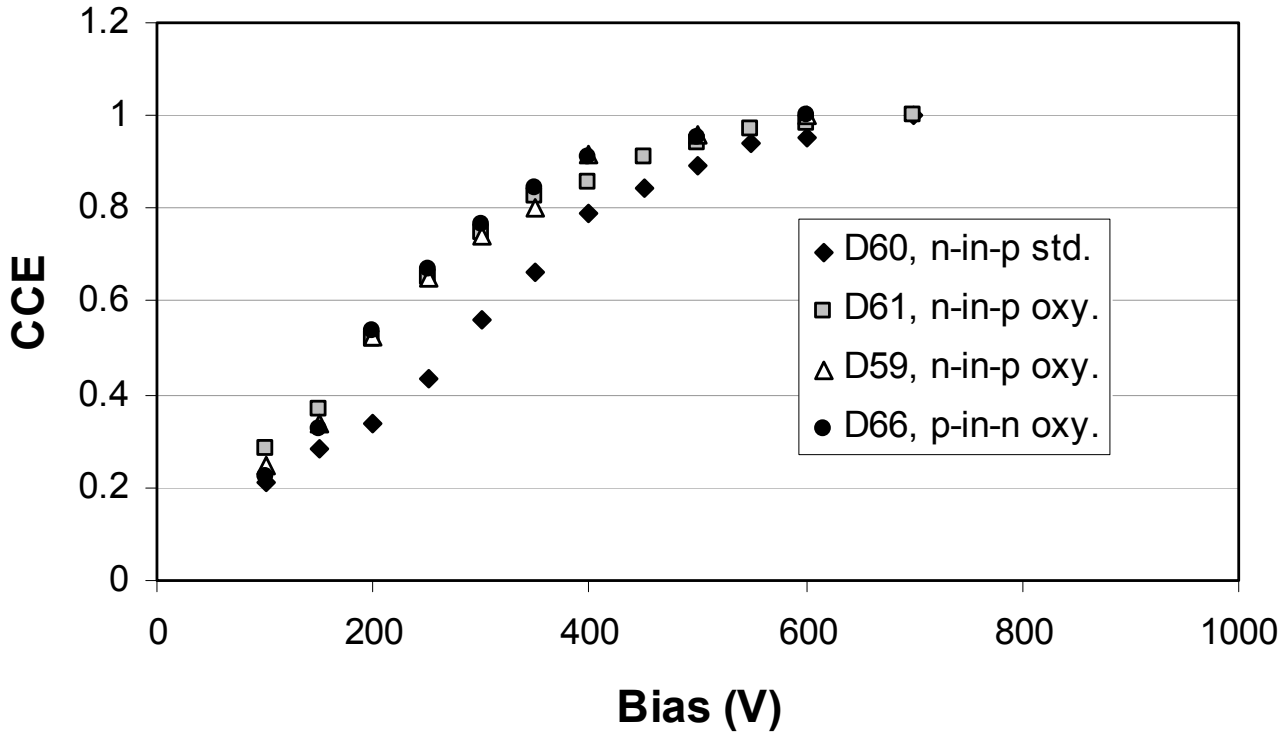
P-in-n with oxygenated substrate at the two different doses.



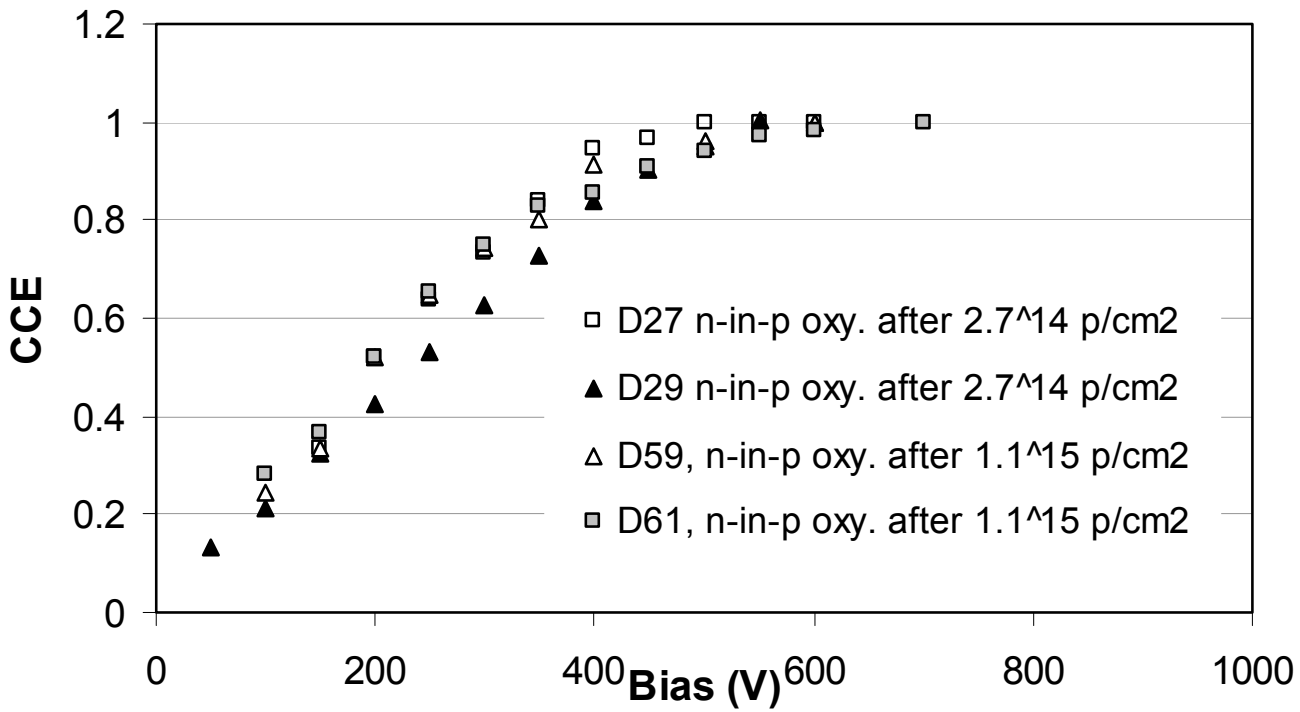
Charge collection with n-in-p detectors after 2.7 10^{14} p cm^{-2}. The presence of oxygen has small influence on the full depletion voltage.



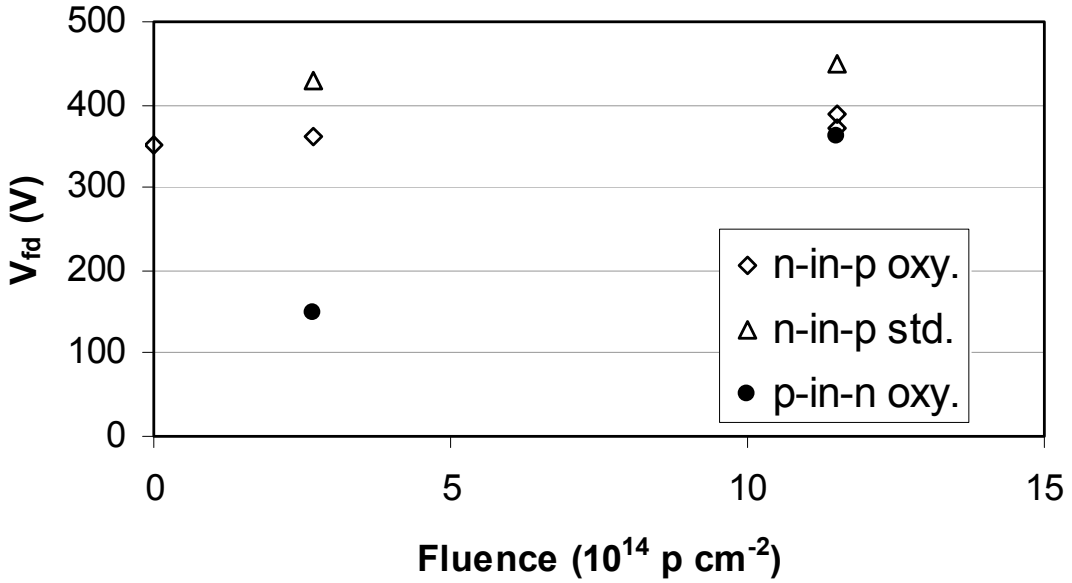
Charge collection with n-in-p detectors after 1.1 10^{15} p cm^{-2}. Again, the presence of oxygen has small influence on the full depletion voltage.



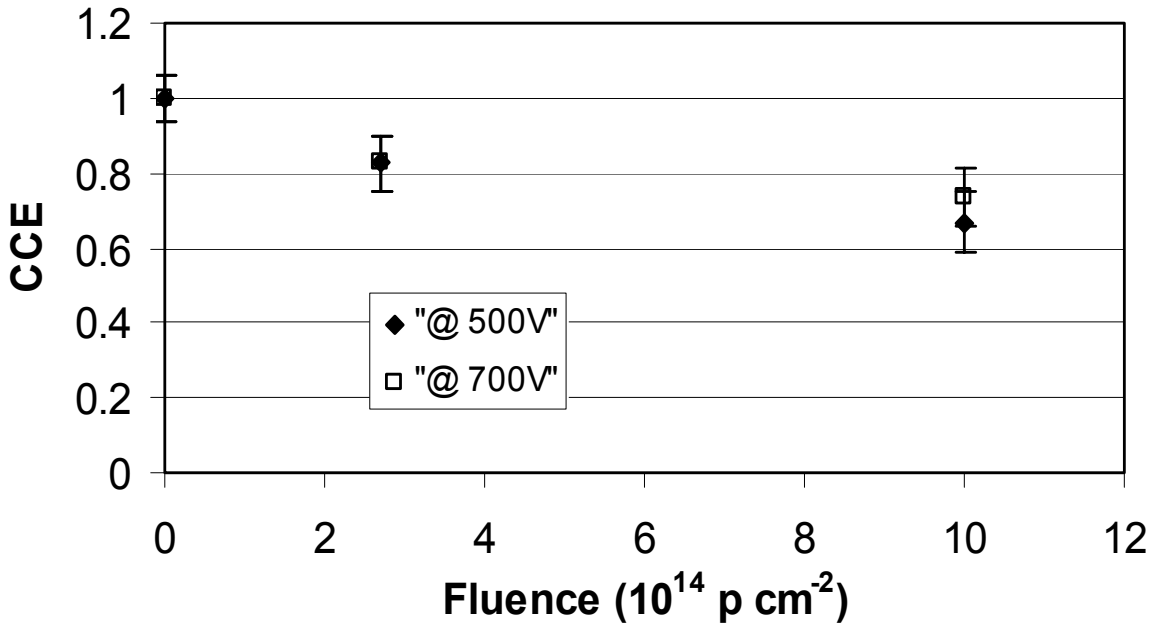
N-in-p with oxygenated substrate at the two different doses. The full depletion voltage does not vary much.



V_{fd} vs proton fluence



Charge deficit vs proton fluence



CONCLUSIONS

- Oxygenated p-type substrate has been successfully used to produce miniature micro-strip detectors
- The p-type substrates show CCE properties at least as good as n-type substrates

  $\Rightarrow$ since n-in-n micro-strip detectors show significantly lower voltages required for a given CCE, n-in-p should offer the same advantage but without the need for double-sided processing
- The oxygenated p-type detectors show less dependence of the full depletion voltage on dose.

  $\Rightarrow$ this may be due to the lower resistivity starting material and/or due to the non-inversion of the substrate
- Further studies with initial higher resistivity of the p-type substrate are needed to qualify this substrate as a detector material.