Recommendations for the corrections of the depletion voltage values extracted from the C-V measurements

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1.The recommendations given below are based on the results presented in the talk at 6th ROSE Workshop 23.10 at CERN. The copy of the talk transparencies can be found in the Workshop Proceedings CERN/LEB 2000-006, pp.102-131.

The corrections describe the extrapolation of the measured value of the depletion voltage U_d to the "standard conditions" chosen at the Workshop as: 10kHz at +20°C. The formulae below are applicable to the measurements of the parallel capacitance C_p in the temperature range –24°C - +30°C.

There are several further restrictions in the applicability of the corrections that are listed below.

a) All our results were obtained with the detectors annealed to the minimum of the depletion voltage. Therefore the corrections are not necessary valid for the other annealing stages e.g. before the beneficial annealing or well into the reverse annealing.
b) The CV characteristic is supposed to be not too flat to produce reliable results. We required that the maximum C_p value in the CV plot should be at least by 15% higher than the plateau C_p value.
c) The shape of the CV characteristic near the C_p plateau in our measurements was free of "bumps", which lead to an ambiguous choice of the "kink" to be used for the U_d finding. We have no recommendations on the dealing with the "bumps".
d) The depletion voltage in our measurements was extracted from the two straight lines crossing in the log-log plot. Strictly speaking the corrections are applicable only for this method of the depletion voltage extraction. However we checked on several occasions that other representations e.g. $1/C_p$ vs $U^{1/2}$ gave compatible results within the uncertainties of the U_d value, related e.g. to a choice of the fit regions. Moreover the difference in the U_d for the different methods usually has a systematic behaviour. Therefore it is probably safe to assume that the dependence of the U_d with frequency and temperature is similar for the other methods.

2. The temperature correction formula is:

$$U_d(+20^oC)=U_d(t)*1.0526/[1+A*\exp(t/\tau)] \qquad (1)$$

where t is the temperature in °C, A=0.00936 and τ=11.58.

3. The parameterisation of the U_d dependence on the measurement AC frequency f given in the talk is:

$$U_d(f)= U_d(1kHz)[1-D*\log_{10}(f/1kHz)] \qquad (2)$$

where D=0.110+-0.009 and is independent on temperature.

Therefore the correction formula is:

$$U_d(10kHz)= U_d(f)*0.89/[1-0.11*\log_{10}(f/1kHz)]. \qquad (3)$$

4. It should be stressed that the above formulae reflect the present understanding of the matter. When more information on this subject is available the corrections will be updated correspondingly.