KEITHLEY INSTRUMENTS

Package 82 Instruction Manual Addendum

INTRODUCTION

This addendum to the Package 82 Instruction Manual is being provided in order to supply you with the latest information in the least possible time. Please incorporate this information into the manual where indicated.

Once band bending voltage is known, graphs of ψ_S vs. V_{GS}, C_Q vs. ψ_S, and C_H vs ψ_S can be generated. Examples are shown in Figures 4-17 through 4-19. Again, CV curves for the device are shown in Figure 4-11.

V_{FB} and ϕ_0 Interpolation

The program determines flatband voltage, V_{FB}, by locating the V_{GS} point where C_H approximately equals C_{FB}. V_{FB} is then interpolated from the closest V_{GS} values.

A straight line interpolation from the previous or following data points is used, and the interpolated V_{FB} and ϕ_0 points are computed.

Interface Trap Density vs. Energy from Midgap (D_{IT} vs E_T)

Interface trap density is calculated from C_{IT} as shown below (Nicollian and Brews 322).

$$C_{IT} = \left(\frac{1}{C_Q} - \frac{1}{C_{OX}}\right)^{-1} - \left(\frac{1}{C_H} - \frac{1}{C_{OX}}\right)^{-1}$$

And:

$$D_{IT} = \frac{(1 \times 10^{-12})\, C_{IT}}{Aq}$$

Where: C_{IT} = interface trap capacitance (pF)
D_{IT} = interface trap density ($cm^{-2}\ eV^{-1}$)
C_Q = quasistatic capacitance (pF)
C_H = high-frequency capacitance (pF)
C_{OX} = oxide capacitance (pF)
A = gate area (cm^2)
q = electron charge (1.60219×10^{-19}C)
1×10^{-12} = units conversion for C_{IT}

The results are stored in the D_{IT} column of the array as calculated.

Interface trap energy from midgap, E_T, is computed from ψ_S offset by bulk potential, ϕ_B as follows:

$$\psi_S - \phi_B \rightarrow E_T$$

Where: ψ_S = band bending (V)
E_T = interface trap energy from midgap (eV)

And:

$$\phi_B = \frac{kT}{q} \ln\left(\frac{N_X}{n_I}\right)$$

Where: ϕ_B = bulk potential (eV)
kT = thermal energy at room temperature (4.046×10^{-21}J)
n_I = intrinsic carrier concentration in silicon ($1.45 \times 10^{10} cm^{-3}$)
N_X = N at 90% w_{MAX}, or N_A or N_D if entered by the user

A typical example of a D_{IT} vs. E_T plot is shown in Figure 4-20.