Relation between gate voltage and surface potential

Consider an ideal MOS capacitor on a p-Si substrate. Write down an expression for the surface potential Ψ_s in terms of the applied gate voltage V_G in depletion.

$$V_G = \Psi_s + V_{ox} = \Psi_s - \frac{Q_d}{C_{ox}}$$

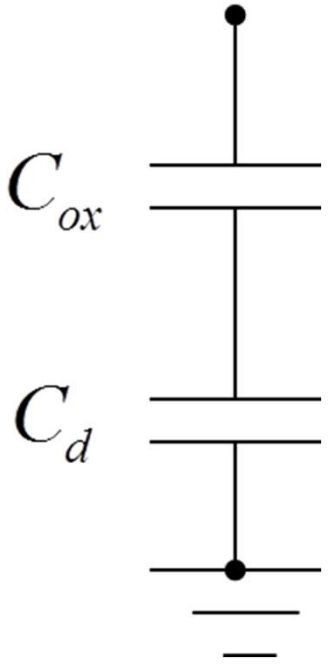
$$\Rightarrow V_G = \Psi_s + \frac{qN_aW}{C_{ox}}$$

$$\Rightarrow V_G = \Psi_s + \frac{\sqrt{2\varepsilon_s qN_a\Psi_s}}{C_{ox}}$$

Relation between gate voltage and surface potential

For the MOSCAP in the previous question, the ratio of an applied small-signal gate voltage v_g to the corresponding surface potential is:

$$\left(1+\frac{\sqrt{\varepsilon_s q N_a / 2\Psi_s}}{C_{ox}}\right)$$



$$v_g = \left(1+\frac{C_d}{C_{ox}}\right)\psi_s$$

Body coefficient m

$$m = 1+\frac{C_d}{C_{ox}} = 1+\frac{\varepsilon_s t_{ox}}{\varepsilon_{ox} W}$$

$$W = \sqrt{\frac{2\varepsilon_s \Psi_s}{qN_a}}$$