

(3)

$$\textcircled{1} \quad \phi_b = \frac{kT}{q} \log_e \frac{N_A}{n_i} = \frac{1.38 \times 10^{-23} \times 300}{1.602 \times 10^{-19}} \times \log_e \frac{2.0 \times 10^{16} [\text{cm}^{-3}]}{1.5 \times 10^{10} [\text{cm}^{-3}]}$$

$$= \cancel{0.34655} (\text{eV}) \quad 0.3645 (\text{V})$$

$$2\phi_b = 0.6931 (\text{eV}) \quad 0.7290$$

空乏層厚さ

$$W_m = \sqrt{\frac{2\epsilon_0 \epsilon_{si}}{q N_A} (2\phi_b)} = \sqrt{\frac{2 \times 8.854 \times 10^{-12} \times 11.9 \times 0.6931}{1.602 \times 10^{-19} \times 2 \times 10^{16} \times 10^6}}$$

$$= \cancel{3.019} \times 10^{-7} [\text{m}] \quad 2.190$$

$$\textcircled{2} \quad C_{ox} = \frac{\epsilon_0 \epsilon_{SiO_2}}{t_{ox}} = \frac{8.854 \times 10^{-12} \times 3.9}{60 \times 10^{-9} (\text{m})} = \cancel{3.453} \times 10^{-4} (\frac{\text{F}}{\text{m}^2}) \quad 5.755$$

$$V_{th}^0 = 2\phi_b + \frac{q N_A \cdot W_m}{C_{ox}}$$

$$= \cancel{0.6931} + \frac{1.602 \times 10^{-19} \times (\cancel{10^{16}} \times 10^6) \times (\cancel{3.019} \times 10^{-7})}{\cancel{3.453} \times 10^{-4}} \quad 2 \times 10^{16} \quad 2.190$$

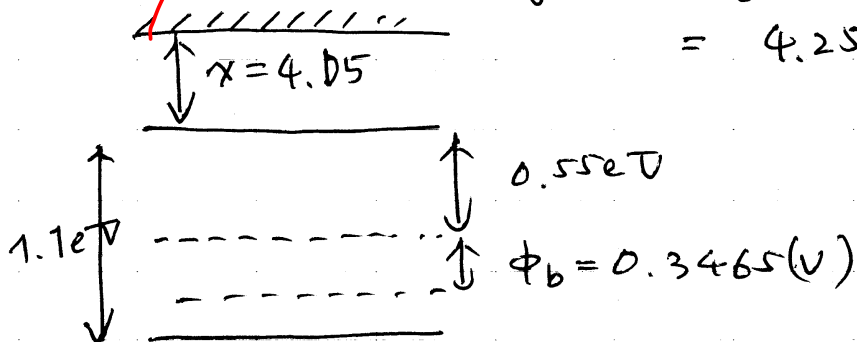
$$= \cancel{0.6931} + 1.4018 \quad 0.7290$$

$$= \cancel{2.0939} [\text{eV}] \quad 1.9479 (\text{V})$$

仕事関数差

$$\phi_{ms} = \phi_m - \phi_{si}$$

$$= 4.25 - 4.947 = -0.697 (\text{eV})$$



$$\phi_s = 4.9 + 0.55 + 0.3465$$

$$= 4.94655 (\text{eV})$$

$$V_{th}^{AR} = V_{th}^0 + \phi_{ms} = \cancel{2.0939} - 0.697 = \cancel{1.40} (\text{eV})$$

$$1.9479 \quad 1.2334$$

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$$\textcircled{3} V_{th}^{QSS} = V_{th}^{AQ} - \frac{q N_{ss}}{C_{ox}}$$

$$= \left\{ \begin{array}{l} \frac{1.40 - \frac{1.602 \times 10^{-19} \times (5 \times 10^{10} \times 10^4 \text{ (m}^2\text{)})}{3.45 \times 10^{-4} \text{ (m)}}}{1.2334} = \frac{1.40 - 0.232}{1.2334} = 1.0943 \end{array} \right.$$

$$= \left\{ \begin{array}{l} \frac{1.40 - \frac{1.602 \times 10^{-19} \times (5 \times 10^{11} \times 10^4 \text{ (m}^2\text{)})}{3.45 \times 10^{-4} \text{ (m)}}}{1.2334} = \frac{1.40 - 2.322}{1.2334} = -0.92 \text{ (V)} \end{array} \right.$$

$$= -0.1584$$

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