Example 6.1 Calculate the flatband voltage of a silicon nMOS capacitor with a substrate doping $N_a = 10^{17}$ cm^{-3} and an aluminum gate (Φ_M = 4.1 V). Assume there is no fixed charge in the oxide or at the oxide-silicon interface.

Solution The flatband voltage equals the work function difference since there is no charge in the oxide or at the oxide-semiconductor interface.

$$V_{FB} = \Phi_{MS} = \Phi_M - c - \frac{E_g}{2q} - V_t \ln \frac{N_a}{n_i}$$

$$= 4.1 - 4.05 - 0.56 - 0.026 \times \ln \frac{10^{17}}{10^{10}} = -0.93 \text{ V}$$

The flatband voltages for nMOS and pMOS capacitors with an aluminum or a poly-silicon gate are listed in the table below.

	Aluminum	p^+ poly	n^+ poly
nMOS	-0.93 V	0.14 V	-0.98 V
pMOS	-0.09 V	0.98 V	-0.14 V