

Figure 3.1 The basic MOS capacitor structure

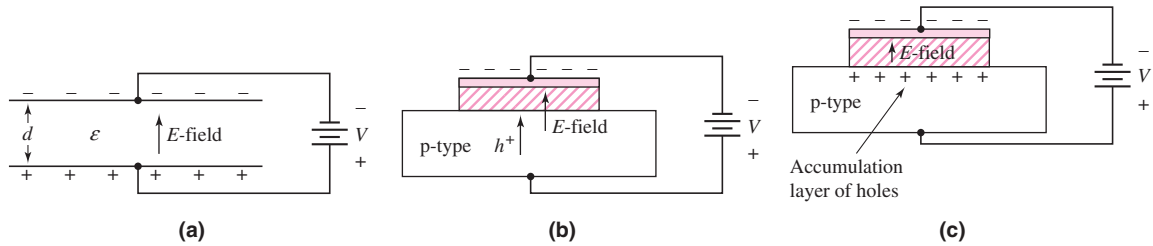


Figure 3.2 (a) A parallel-plate capacitor, showing the electric field and conductor charges, (b) a corresponding MOS capacitor with a negative gate bias, showing the electric field and charge flow, and (c) the MOS capacitor with an accumulation layer of holes

semiconductor, the holes in the p-type semiconductor will experience a force toward the oxide-semiconductor interface. The equilibrium distribution of charge in the MOS capacitor with this particular applied voltage is shown in Figure 3.2(c). An accumulation layer of positively charged holes at the oxide-semiconductor interface corresponds to the positive charge on the bottom “plate” of the MOS capacitor.

Figure 3.3(a) shows the same MOS capacitor, but with the polarity of the applied voltage reversed. A positive charge now exists on the top metal plate and the induced electric field is in the opposite direction, as shown. In this case, if the electric field penetrates the semiconductor, holes in the p-type material will experience a force away from the oxide-semiconductor interface. As the holes are pushed away from the interface, a negative space-charge region is created, because of the fixed acceptor impurity atoms. The negative charge in the induced depletion region corresponds to the negative charge on the bottom “plate” of the MOS capacitor. Figure 3.3(b) shows the equilibrium distribution of charge in the MOS capacitor with this applied voltage.

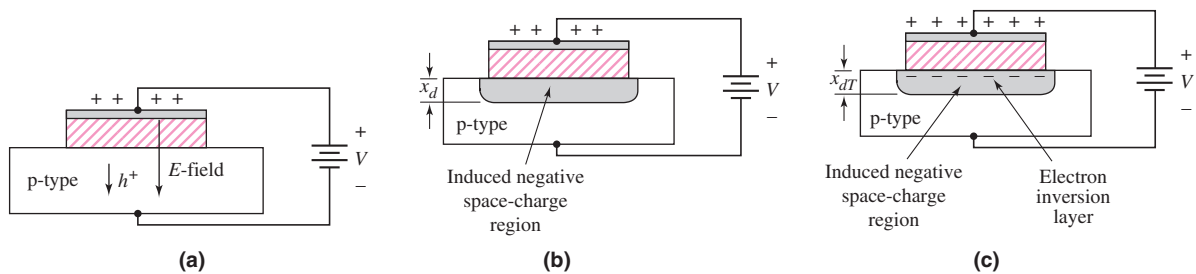


Figure 3.3 The MOS capacitor with p-type substrate: (a) effect of positive gate bias, showing the electric field and charge flow, (b) the MOS capacitor with an induced space-charge region due to a moderate positive gate bias, and (c) the MOS capacitor with an induced space-charge region and electron inversion layer due to a larger positive gate bias