

Theory

1.1 Charged-coupled devices (CCDs)

A charge-coupled device (CCD), is a solid state image sensor used to detect light. A CCD is an integrated circuit that is essentially an array of diodes. These diodes represent pixels and are p-doped metal-oxide semiconductor (CMOS) capacitors. The working principle of a CMOS capacitor will be explained below.

1.1.1 Semiconductor physics

A semiconductor is a type of solid state material, which is neither a conductor or an insulator. This distinction between insulators and conductors is defined from the difference in the density of states at the chemical potential at a temperature of $0K$. For metals we have a finite density of states, and otherwise it is an insulator or a semiconductor. A semiconductor is, in addition to the former, a material for which the band gap between the highest occupied states in the conduction band, and the lowest unoccupied states in the valence band, is sufficiently small to thermally excite electrons across the gap.

1.1.2 CMOS capacitors and the pn-junction

1.2 Characterization of CCDs