CELLA FOTOVOLTAICA: giunzione P-N

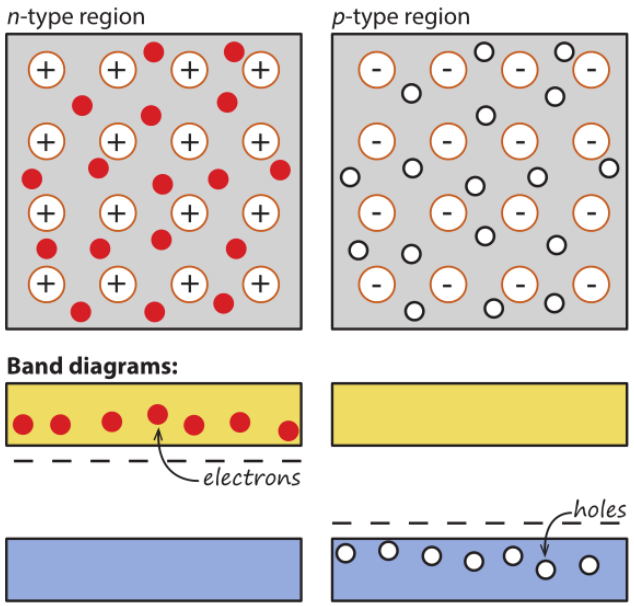

Figure 8.1: Schematic representation of an isolated *n*-type and *p*-type semiconductor and corresponding band diagrams.

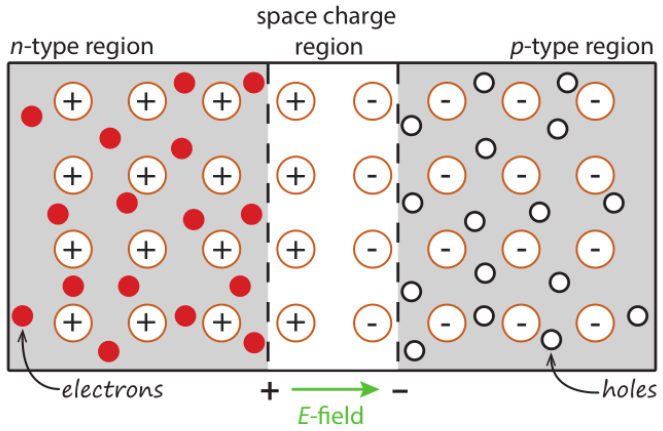

Figure 8.2: Formation of a space-charge region, when *n*-type and *p*-type semiconductors are brought together to form a junction. The coloured part represents the space-charge region.

When a *p*-type and an *n*-type semiconductor are brought together, a very large difference in electron concentration between *n*- and *p*-type regions causes a diffusion current of electrons from the *n*-type material across the *metallurgical junction* into the *p*-type material. The term "metallurgical junction" denotes the interface between the *n*- and *p*-type regions. Similarly, the difference in hole concentration causes a diffusion current of holes from the *p*- to the *n*-type material. Due to this diffusion process the region close to the metallurgical junction becomes almost completely depleted of mobile charge carriers. The gradual depletion of the charge carriers gives rise to a space charge created by the charge of the ionised donor and acceptor atoms that is not compensated by the mobile charges any more. This region of the space charge is called the *space-charge* region or *depleted region* and is schematically illustrated in Fig. 8.2. Regions outside the depletion region, in which the charge neutrality is conserved, are denoted as the quasi-neutral regions.

The space charge around the metallurgical junction results in the formation of an internal electric field which forces the charge carriers to move in the opposite direction than the concentration gradient. The diffusion currents continue to flow until the forces acting on the charge carriers, namely the concentration gradient and the internal electrical field, compensate each other. The driving force for the charge transport does not exist any more and no net current flows through the *p*-*n* junction.

When a *p*-*n* junction is illuminated the additional electron-hole pairs are generated in the semiconductor The concentration of minority carriers (electrons in the *p*-type region and holes in the *n*-type region) strongly increases. This increase in the concentration of minority carriers leads to the flow of the minority carriers across the depletion region into the quasi-neutral regions. Electrons flow from the *p*-type into the *n*-type region and holes from the *n*-type into the *p*-type region. The flow of the photo-generated carriers causes the so-called *photo-generation current*, J_{ph}, which adds to the thermal-generation current, J_{gen}.