EE236 LAB2 Supporting Document

WEL

January 2022

1 Zener Diode [1]

- When a heavily doped junction is reverse biased, the energy bands become crossed at relatively low voltages (i.e., the n-side conduction band appears opposite the p-side valence band) indicates, the crossing of the bands aligns the large number of empty states in the n-side conduction band opposite the many filled states of the p-side valence band.
- If the barrier separating these two bands is narrow, tunnelling of electrons can occur. Tunnelling of electrons from the p-side valence band to the n-side conduction band constitutes a reverse current from n to p; this is the **Zener effect**.

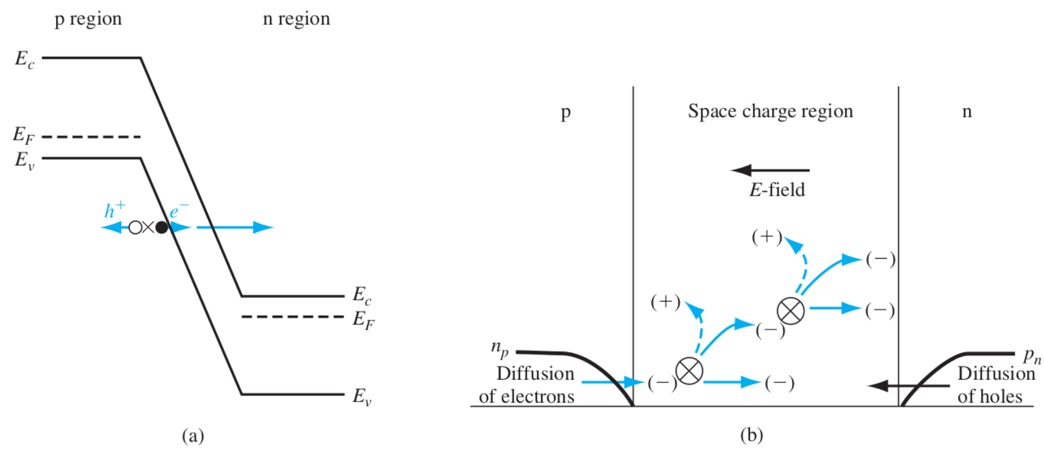

Figure 1: (a) Zener breakdown mechanism in a reverse-biased pn junction; (b) avalanche breakdown process in a reverse-biased pn junction.[2]

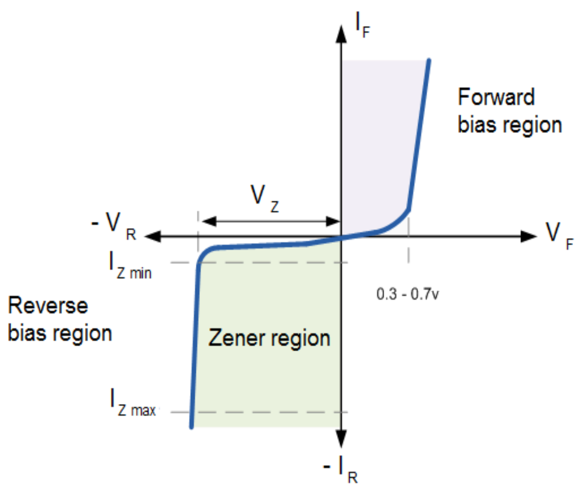

Figure 2: Zener diode IV characteristics

- The basic requirements for tunnelling current are a large number of electrons separated from a large number of empty states by a narrow barrier of finite height.
- The tunnelling probability depends upon the width of the barrier, it is important that the metallurgical junction be sharp and the doping high.
- The transition region W extends only a very short distance from each side of the junction.
- However, if Zener breakdown does not occur with reverse bias of a few volts, avalanche breakdown will become dominant.

References

[1] B. G. S. S. Banerjee, *Solid State Electronic Devices, 7th Edition.* Boston : Pearson, [2016], 2016.

[2] D. Neamen, *Semiconductor Physics And Devices.* McGraw-Hill Education, 2011.