Drift Current Lesson

Drift Current

Drift is, by definition, charged particle motion in response to an applied electric field. When an electric field is applied across a semiconductor, the carriers start moving, producing a current. The positively charged holes move with the electric field, whereas the negatively charged electrons move against the electric field. The motion of each carrier can be described as a constant drift velocity, v_d. This constant takes into consideration the collisions and setbacks each carrier has while moving from one place to another. It is considered a constant though, because the carriers will eventually go the direction they are supposed to go regardless of any setbacks, especially if you look at the direction of all the carriers, instead of each one individually.

Drift current in a semiconductor is the resultant of carrier drift. Because we are talking about a semiconductor, or specific areas in a semiconductor, we are interested in the current density. When dealing with drift current, we are interested in the current density due to drift, and drift arises in response to an electric field. Drift current also depends on the ability of the carriers to move around in the semiconductor, or the electron and hole mobility. Another parameter drift current depends on is the carrier concentration, because you have to have carriers in order for there to be current. Each one of these carriers has a charge, but in this case we will only take q as a magnitude.

Finally, we have that the current density due to drift depends on four parameters: the electric field, the electron or hole concentration, the mobility constant, and the charge. The reason we use q for both electrons and holes when it's $+q$ for holes and $-q$ for electrons, is that the electric field takes care of the sign, or direction of the current. When a negative electric field is applied, the electrons will go opposite the electric field. The electron charge is $-q$, so the resulting electron drift current will be positive. On the other hand, when the electric field is negative, the holes will go the direction of the electric field. Their charge is $+q$, so the resulting hole drift current will be negative. Vice versa when the electric field is positive.

Take a look at the demo for the electric field.

On the demo, if you click on "semiconductor" a potential will be applied, creating an electric field. You can see how the electron does not travel in a straight line, but it makes it to the other end eventually. This is an example of drift current. If you see the demo by clicking on "free space", there isn't anything for the electron to bump into in free space, so it travels in a straight line.