Silicon Semiconductor

Metals have electrical conductivity. This is related to the fact that the energy band of the metal consists of continuous filled and empty states. This is related to either a half full orbital (alkali metals) or due to overlap between filled and empty orbitals (alkali earth metals). At 0 K the highest filled state is called the Fermi energy (EF). Because the energy difference between the states in the outer band is non-existent, at room temperature, electrons can easily move in the metal during application of an external field. The electrons in the outer band of a metal are said to be delocalized, i.e. they belong to the entire solid rather than being tied down to a specific atom. These delocalized electrons are responsible for the high conductivity.

The alkali metals crystallize in the body-centred cubic structure, although lithium and sodium undergo low-temperature structural phase transitions. The alkali atoms contribute one outer electron to the conduction band, with the remaining electrons tightly bound in the ion cores. The core electrons give rise to at bands that can be ignored when calculating the electronic structure and Fermi surface.

Silicon material has been widely used in semiconductor device fabrication because of its low cost and its producibility of high quality silicon dioxide needed for impurity diffusion and surface passivation processes. However, recent development of high power electronics with progressive circuit integration brings new demands for semiconductor material used and for device fabrication, as well. Most devices, which use traditional integrated circuit technology based on silicon, are not able to operate at temperatures above 250 C, especially when high operating temperatures are combined with high-power, high frequency and high radiation environments. Since silicon technology has been well established, a silicon compatible material such as silicon carbide becomes a more favorable material for such hard, demanding and challenging conditions.

Si prefer over Ge
1-silicon device can work over 150 C compared to 100 C for Ge
2-Si grows a stable oxide (silicon dioxide) which is important in the fabrication of IC as compared to Ge oxide which is not suitable for device
3- Silicon is plenty available on the surface of the earth and hence less expensive than germanium
4-The forbidden energy band of Silicon is 1.1ev which is higher than that of germanium(0.66ev) which makes silicon more stable and because of that the leakage current is reduced.
5-Ge is diffecult to doped compared with Si

In Germanium and Silicon diodes, leakage current is only of few microamperes and nanoamperes, respectively. Germanium is much more susceptible to temperature than silicon. For this reason, mostly Silicon is used in modern semiconductor devices.

Material ⇒ Property ⇓	Si	Ge	GaAs	InAs	InSb
Electron mobility	1600	3900	9200	40000	77000
Hole mobility	430	1900	400	500	850
Bandgap (eV)	1.12	0.66	1.424	0.36	0.17
Dielectric constant	11.8	16	12.4	14.8	17.7