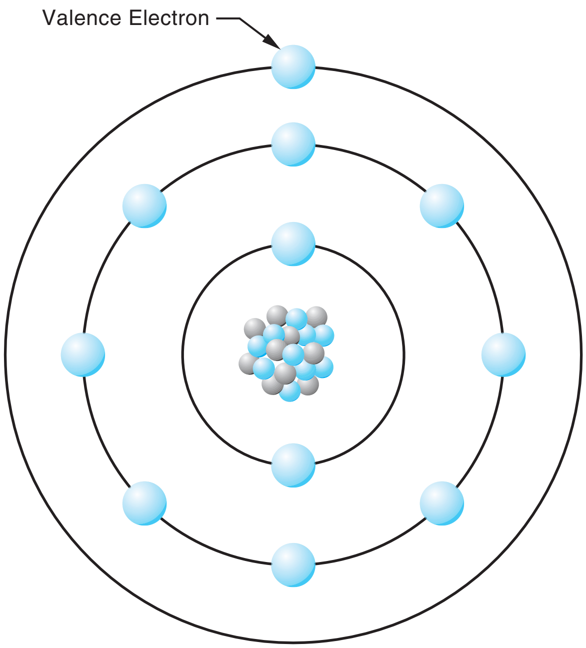

Figure 49–1
Atom of a conductor. (Source: Delmar/Cengage Learning)

most conductors are metals. The best electrical conductors are silver, copper, and aluminum. Conductors are materials that have only one or two valence electrons in their atom, Figure 49–1. An atom that has only one valence electron makes the best electrical conductor because the electron is loosely held in orbit and is easily given up for current flow.

INSULATORS

Insulators are generally made from light-weight materials that have small atoms. The atoms of an insulating material will have their outer orbits filled or almost filled with valence electrons. This means an insulator will have seven or eight valence electrons, Figure 49–2.

Because an insulator has its outer orbit filled or almost filled with valence electrons, they are tightly held in orbit and not easily given up for current flow.

SEMICONDUCTORS

Semiconductors, as the name implies, are materials that are neither good conductors nor good insulators. Semiconductors are made from materials that have four valence electrons in their outer orbit, Figure 49–3.

The most common semiconductor materials used in the electronics field are **germanium** and **silicon**. Of these two materials, silicon is used

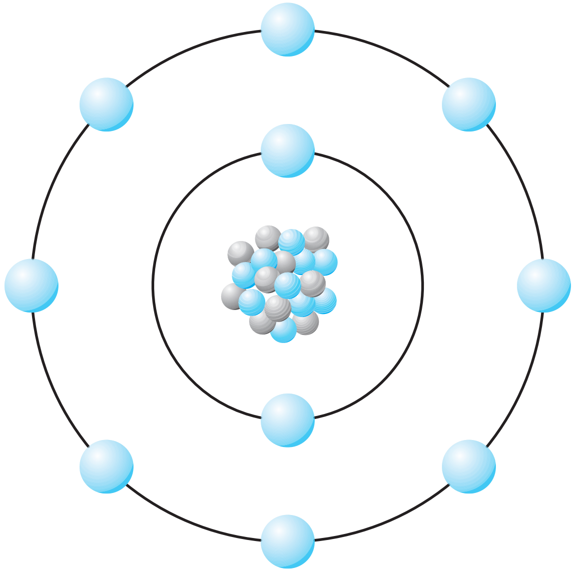

Figure 49–2
Atom of an insulator. (Source: Delmar/Cengage Learning)

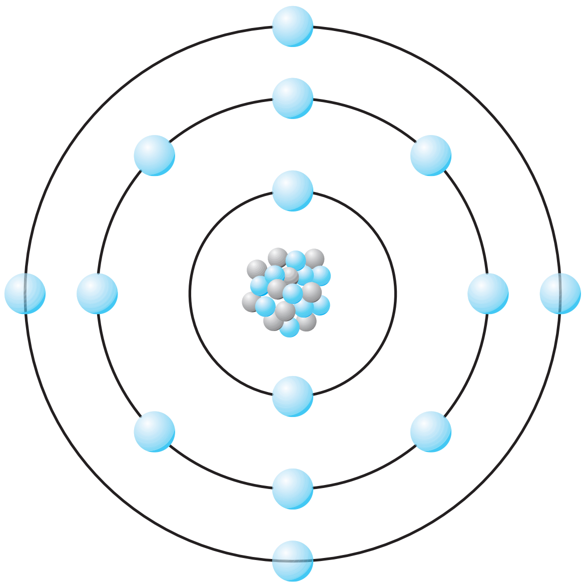

Figure 49–3
Atom of a semiconductor. (Source: Delmar/Cengage Learning)

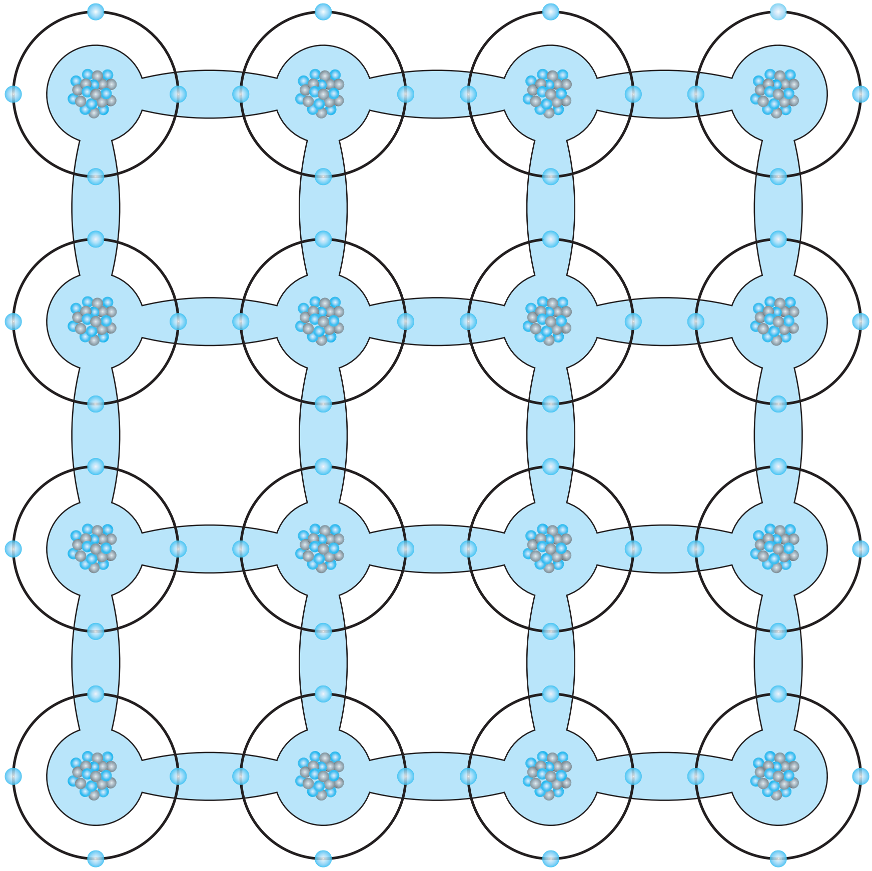

Figure 49–4
Lattice structure of a pure semiconductor material.
(Source: Delmar/Cengage Learning)

more often because of its ability to withstand heat. When semiconductor materials are refined into a pure form, the molecules arrange themselves into a crystal structure that has a definite pattern, Figure 49–4. A pattern such as this is known as a **lattice structure**.

A pure semiconductor material such as silicon has no special properties and will do little more than make a poor conductive material. If a semiconductor material is to become useful for the production of solid-state components, it must be mixed with an impurity. When the semiconductor material is mixed with an impurity that has only 3 valence electrons, such as idium or gallium, the lattice structure also becomes different, Figure 49–5. When a material that has only 3 valence electrons is mixed with a pure semiconductor, a hole is left in the material when the lattice structure is formed. This hole is caused by the lack of an electron where one should be. Because the material now has a lack of electrons, it is no longer electrically neutral. Electrons are negative particles. Because a hole is in a place where an electron should be, the hole has a positive charge. This semiconductor material now has a net positive charge, and is therefore known as a **P-type material**.