**Table 5.2** Chemical characteristics of commercial metallurgical grade silicon

| Element | O | Fe | Al | Ca | C | Mg | Ti | Mn | V | B | P |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Low (ppm) | 100 | 300 | 300 | 20 | 50 | 5 | 100 | 10 | 1 | 5 | 5 |
| High (ppm) | 5000 | 25 000 | 5000 | 2000 | 1500 | 200 | 1000 | 300 | 300 | 70 | 100 |
| Element | Cu | Cr | Ni | Zr | Mo | | | | | | |
| Low (ppm) | 5 | 5 | 10 | 5 | 1 | | | | | | |
| High (ppm) | 100 | 150 | 100 | 300 | 10 | | | | | | |

market. This is a relatively small amount compared to the multimillion metric ton markets of crude iron, steel, aluminium or ferroalloys. Industrial location to produce silicon metal has been guided by the vicinity of rich and pure quartz deposits and/or the availability of abundant electrical power. Leading producing countries are PR China, the United States, Brazil, Norway and France. In spite of some recent mergers, the industry remains fragmented. One may find three dozens of companies producing and marketing silicon metal, most of the plants having an annual output of 20 000 to 60 000 MT (see production of silicon metal later in this chapter). The chemical characteristics of commercial metallurgical grade silicon are indicated in Table 5.2.

The silicon metal market is traditionally divided into two main subgroups, that is, the aluminium and the chemical segments each consuming approximately half of the worldwide output. There are, however, some differences in the characteristics requested by each.

#### *5.2.4.1 Applications in aluminium*

In the aluminium industry, silicon is added to molten aluminium in which it is dissolved. A simple eutectic composition occurs at 12.6% silicon in aluminium. This has important consequences for industrial applications in the aluminium industry. Silicon is used in order to improve the viscosity, the fluidity of liquid aluminium and the mechanical properties of commercial alloys. The iron, calcium and phosphorus content in silicon are particularly critical for such applications.

There are two important groups of aluminium alloys in which silicon is one of the main alloying elements.

##### *5.2.4.1.1 Casting alloys*

By adding silicon to the melt, the fluidity is improved. Aluminium alloys near the eutectic composition are therefore used in thin-walled castings. Typical concentrations are 7 to 12%. If a few tenths of a percent of magnesium is added, the alloys may be age-hardened and thereby nearly double their yield strength.

To counteract the formation of large needle-shaped particles, the alloys are normally modified with sodium, strontium or phosphorus.

The alloys present good corrosion properties.