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GENERAL SILICON INFORMATION

Silicon is one of the most common elements on the surface of the earth. It is found in all parts of the world in the form of compounds with oxygen and with aluminum. A particularly common source of silicon is ordinary sand, which is nearly pure silicon dioxide. Silicon in this form is completely unsuitable for semiconductor work.

Basic manufacturers of silicon process silicon tetrachloride through a series of distillations which are used to purify it. This means that silicon tetrachloride is heated at such a temperature as to make it boil and to leave behind impurities of a higher boiling point. The tetrachloride is then liquified in a condensor at a temperature low enough to liquify it so as to pass through more volatile materials. This process is repeated until sufficient purification has been achieved.

Silicon tetrachloride is then passed a high temperature through quartz (WHICH IS SILICON DIOXIDE) tubes, causing it to decompose into pure silicon.

Despite the fact that silicon is plentiful, the expense of this extremely elaborate purification operation makes the cost of pure silicon around $50 per pound.

GENERAL SILICON CRYSTAL INFORMATION - cont'd.

To grow a crystal of silicon requires melting very pure material, which is usually done in a container of high purity quartz. The silicon is heated to its melting temperature of approximately 1440° centigrade. A small seed crystal is introduced into the molten silicon. Since heat will flow up the crystal by conduction, and be radiated from the surface, the temperature of the growing crystal will be lower than the molten silicon. When the temperature of the molten silicon is maintained near its freezing temperature, it will "grow" onto the seed crystal. Seed crystals are pulled up with a smooth, carefully controlled motor driven at a slow rate while the temperature of the melt is closely programmed in order to control the diameter of the newly solidified crystal. Since the material is growing under conditions where there are no stress energies present, the natural result is for the newly grown material to have the same crystal structure and orientation as the seed crystal. The final size of the ingot is determined by temperature control, pull rate, and crucible shaft rotation.

There are a number of difficulties in the process of crystal growing to which close attention must be paid. In the preparation of the pure silicon for melting, utmost care must be taken or contamination will result. For example, a single speck of dust can contain enough impurities to completely alter the electrical properties of the semiconductor crystal and this will change the resistivity. (Twin)

SILICON MATERIAL FABRICATION INFORMATION

Following the crystal growing operation, the material must be fabricated mechanically. This requirement involves slicing the crystal into thin slices with a diamond cutting wheel.

Many customers also request lapped wafers; this operation normally removes about 0.0015" off each side of the slice. Sometimes an even smoother finish than that obtained by the lapping operation is required and mechanical or chemical polishing is necessary. This process produces a surface so smooth that the material will act effectively as a fine mirror. Another requirement of the mechanical preparation is that the two surfaces be flat and exactly parallel to each other.

SILICON SINGLE CRYSTALS AND SLICE MEASUREMENTS

Many parameters are used to measure silicon crystals and wafers, these are: dislocation density, resistivity, diameter, and the general appearance of the crystal or slices. The most commonly used measurement to determine if the material is useable is the resistivity range; however, all the parameters are important and must be checked.