

Semiconductor Technology from A to Z

Fundamentals

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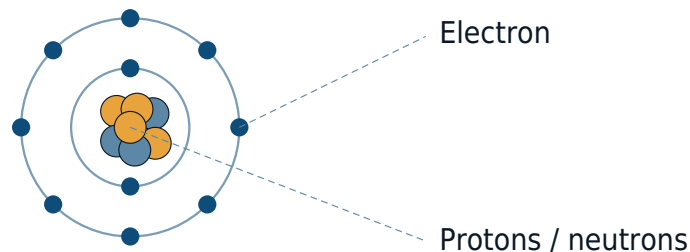
The atomic structure

The Atomic Model

An atom [Gr. átomos: indivisible] is the smallest building block of matter that cannot be further divided by chemical means. There are various types of atoms, each composed of a specific number of electrons, protons, and neutrons. Positively charged protons and uncharged neutrons form the atomic nucleus, which is orbited by negatively charged electrons at certain distances. An atom occurring in nature is electrically neutral, meaning it contains exactly as many protons as electrons. The number of neutrons, however, can vary.

According to the Bohr atomic model, the electrons are located on so-called shells, which represent different energy levels and are arranged concentrically around the atomic nucleus. There are a maximum of seven shells, which can hold varying numbers of electrons; the electrons in the outermost shell are also referred to as valence electrons.

Highly simplified representation of a neon atom



By exchanging electrons with other atoms, atoms can achieve a more stable state, which is why different types of **bonds** form between atoms.

Orders of Magnitude

Mass

The mass of an atom is determined mainly by the atomic nucleus, since the mass of protons and neutrons, at $1.67 \cdot 10^{-27}$ kg, is roughly 1800 times greater than that of the electrons in the electron shell ($9.11 \cdot 10^{-31}$ kg).

Building blocks of the atom

			
Particle	Proton	Neutron	Electron
Charge	+1	0	-1
Mass	$1.672 \cdot 10^{-27}$ kg	$1.675 \cdot 10^{-27}$ kg	$0.0009 \cdot 10^{-27}$ kg

Dimensions

The diameter of the electron shell is 0.1–0.5 nm (0.0000000001 m, or 1 ångström); the diameter of the atomic nucleus is smaller by a further factor of 100,000. To illustrate this, imagine a pinhead at the center of a football field representing the atomic nucleus. The distance to the corner flags would then correspond to the distance at which the electrons orbit the nucleus.

Density

Within the nucleus of an atom, protons and neutrons are packed extremely tightly. If Earth were compressed to the same density, its radius would shrink from its original 6,700,000 m to just 100 m.

Atoms of major importance in the semiconductor industry

