

Fact sheet: metallic bonding

Metallic bonding is a type of strong chemical bond that occurs in **pure metals** and **alloys**. Metals are **giant three-dimensional structures** where layers of **positive metal ions** are surrounded by a sea of **delocalised outer-shell electrons**.

Structure and properties

A large amount of energy is required to overcome metallic bonds, so metals and **alloys** have **high melting and boiling points**.

The metal ions in the three-dimensional **lattice** structure are closely packed. This means that metals have a **high density**.

Metals are good **electrical conductors** because the delocalised electrons are free to move through the structure and carry electrical **charge**.

The movement of electrons allows thermal energy to pass efficiently through metals, which means they are good **thermal conductors** too.

Did you know ...?

The melting and boiling points of metals are related to the number of outer shell electrons. The greater the **charge** of the metal ion, the greater the number of **delocalised electrons** and the stronger the bonds.

Did you know ...?

The chemical formula of a metal is just the symbol for the element as metallic lattices do not contain a fixed number of atoms, eg sodium is represented as Na.

Pure metals

Pure metals only contain one type of metal atom, so the atoms are arranged in layers which can slide over one another. This means they are **malleable** – can be hammered or pressed into shape without breaking or cracking – and **ductile**, so they can be drawn into wires.

Alloys

Alloys are mixtures of two or more elements where at least one is a metal. Metallic bonds are the **strong electrostatic attractions** between the positively charged metal ions and the delocalised electrons.

In an **alloy**, the atoms are different sizes which distorts the layered structure. This means greater force is needed to make the layers slide over one another, which makes an alloy harder and stronger than the pure metal.

Did you know ...?

Aluminium alloys are used to make aircraft, because they're **lightweight** and very **strong**. They are also **corrosion resistant** due to the ability of aluminium to form a thin protective layer of aluminium oxide.