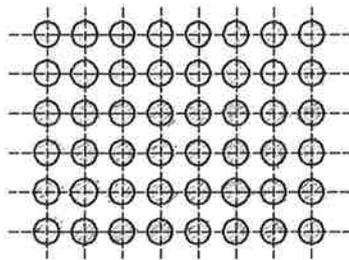


Alloying of Metals

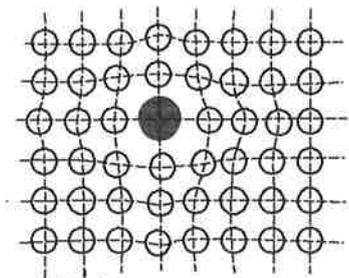
When metals are mixed to form **alloys** the properties of the resultant alloy are often very different to the properties of the metals from which the alloy is formed. If two metals are mixed together in the liquid state they will dissolve in each other in the same way as alcohol and water. They are said to be completely soluble in each other¹. The metal which is in the majority is called the *solvent* whilst the metal in the minority is called the *solute*. When the alloy solidifies some or all of the solute metal atoms may stay in solution with the solvent atoms, forming what is called a *solid solution*. This results in the alteration of the properties of the alloy compared with the component metals because of the alteration of the solute lattice.

A pure metal will have a particular lattice structure that will be regular and even as shown below.



Even lattice structure of pure metal

If a second metal atom is added to this lattice there will be a distortion of the solvent metal lattice due to the size difference between the atoms of the solute and solvent as shown below



Distorted lattice due to addition of second metal

It is this distortion of the solvent metal lattice that results in an increase in the strength of the pure

¹ There are exceptions to this where some metals do not form a solution in the liquid state. In this case they are said to be immiscible.

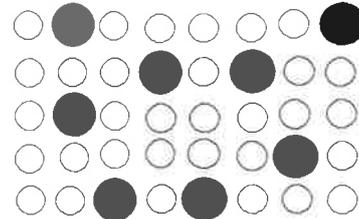
metal by a process known as **solid solution strengthening**.

The type of solid solution formed when two metals are dissolved in each other depends on the relative sizes of the atoms of the two metals.

Two different types of solid solution can form.

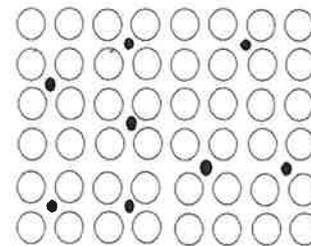
1. Substitutional Solid Solution.

Solute atoms substitute positions with the solvent atoms



2. Interstitial Solid Solution

Solute atoms fit in the spaces (*interstitial sites*) between the solvent atoms.



The amount of solute that can dissolve in the solvent depends on several factors such as the atomic size difference and crystal structures of the two metals and can vary from zero to 100%. When an unlimited amount of one metal can dissolve in another in the solid state the two metals are said to exhibit **total solid solubility**.