

Metallic bonding in copper: Johnstone's triangle

Learning objectives

- 1 Describe a metal and its uses based on observations.
- 2 Use symbolic models to represent metallic bonding.
- 3 Explain how the type of bonding in a metallic compound relates to the properties you can observe.

Introduction

Copper is a metal with many uses in electrical appliances, plumbing, building and for its aesthetic qualities.

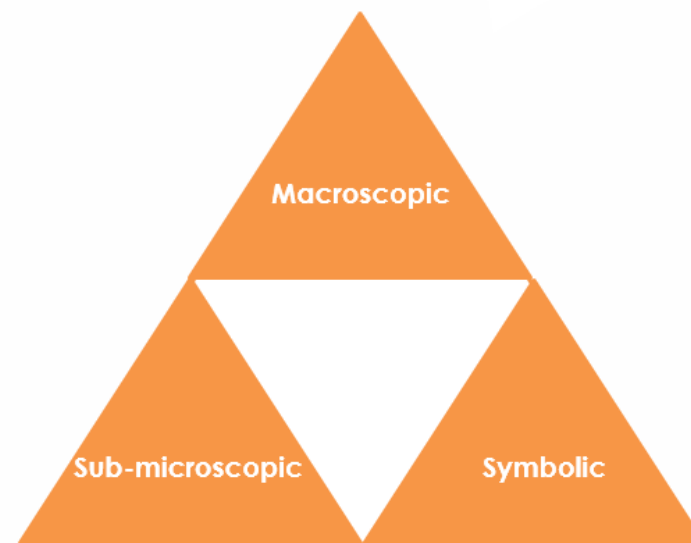
Johnstone's triangle

In chemistry we make sense of the things that we can see by representing what we can't see using formulas, equations, diagrams and models.

Johnstone's triangle is a way of thinking about these different concepts as different corners of a triangle:

- Macroscopic – what we can see
- Symbolic – what we use to represent what we've seen
- Sub-microscopic – smaller than we can see

Being able to connect and move between these three different levels is important for scientific understanding.



Macroscopic - What do we observe?

Match the common uses of copper below with the properties that make it suitable.

Electrical wires

Saucepan

Water pipes

Jewellery

Ductile

Malleable

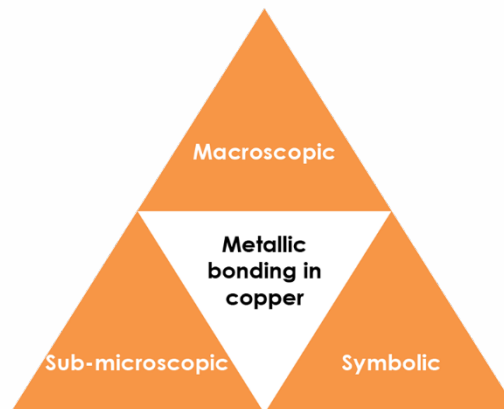
Lustrous (shiny)

Good conductor of heat and electricity

**Sub-microscopic****What is happening that we can't see?**

With reference to the structure and bonding in metals explain why:

- Copper is malleable
- Copper is a good conductor of heat and electricity

**Symbolic****How do we represent it?**

Complete a metallic bonding diagram for copper by adding electrons to this diagram.

