www.scienceinschool.org

Simple gravimetric chemical analysis – weighing molecules the microscale way

Activity 1: Calculation details

The formula of magnesium oxide can be found by determining the ratio of the number of moles of magnesium to the number of moles of oxygen in the compound.

To calculate the moles of magnesium initially present in the reaction with oxygen, the mass of magnesium used needs to be calculated. This is done by subtracting the mass of bottle tops plus nichrome wire (M1) from the mass of bottle tops plus nichrome wire plus magnesium (M2). This is commonly known as by weighing by difference.

Once the mass of magnesium is calculated, ask the students to calculate the number of moles of magnesium used in the reaction. This can be done by dividing the mass of magnesium by the gram formula mass of magnesium. The gram formula mass of magnesium is 24.5; this can be provided by the teacher, or the students can obtain this value from sources such as chemistry data booklets.

To calculate the number of moles of oxygen in magnesium oxide, the mass of oxygen needs to be calculated. This is done by subtracting the mass of magnesium plus bottle tops and nichrome wire (M2) from the mass of magnesium oxide plus bottle tops and nichrome wire (M3).

Once the mass of oxygen is calculated, calculate the number of moles of oxygen used in the reaction. This can be done by dividing the mass of oxygen by the gram formula mass of oxygen. The gram formula mass of magnesium is 16.

The formula of magnesium oxide can be determined from the molar ratio of magnesium to oxygen. This is done by dividing the number moles of magnesium by the number of moles of oxygen. This value should then be rounded to the nearest whole number.

Worked example

M1 = mass of bottle tops plus nichrome wire = 3.87 g

M2 = mass of magnesium plus nichrome wire and magnesium = 4.11 g

M3 = mass of the bottle top plus nichrome wire and magnesium oxide = 4.26 g

Mass of magnesium ribbon used (M2 − M1 = 4.11 − 3.87) = 0.24 g

Moles of magnesium = mass of Mg/gram formula mass of Mg = 0.24/24.5 = 0.0098

Mass of oxygen used = M3 − M2 = 4.26 − 4.11 = 0.15

Moles of oxygen = mass of O/gram formula mass of O = 0.15/16 = 0.0094

Ratio of magnesium to oxygen = moles Mg/moles O = 0.0098/0.0094 = 1.04

The value should be close to one, giving a molar ratio of approximately one magnesium to one oxygen, which suggests the formula of magnesium oxide is indeed MgO.