Displacement reactions of metals – teacher notes

In this experiment, students observe the reactions between metals and metal salt solutions.

Topic

Metals – reactions with acids; reactivity series

Timing

20 minutes

Equipment

Apparatus

- Eye protection
- Student worksheet
- Clear plastic sheet (eg ohp sheet)
- Magnifying glass

Chemicals

Solutions should be contained in plastic pipettes. See the accompanying guidance on apparatus and techniques for microscale chemistry (https://rsc.li/3thGH74), which includes instructions for preparing solutions.

- Copper(II) sulfate, 0.2 mol dm^{-3}
- Iron(III) nitrate, 0.2 mol dm^{-3}
- Magnesium nitrate, 0.2 mol dm^{-3}
- Zinc chloride, 0.2 mol dm^{-3}
- Magnesium ribbon
- Zinc metal, small granules
- Iron filings or small nails
- Copper turnings

Observations

The zinc granules and magnesium ribbon rapidly darken in copper sulfate solution as they become covered with a layer of copper. Iron also reacts but the change is not so clear. Magnesium and zinc react with the iron(III) nitrate, the solution gradually darkens.

No reaction occurs between magnesium sulfate and any of the metals. Students should observe no change between any of the metals and a salt solution of the same metal.

Health, safety and technical notes

- Read our standard health and safety guidance (https://rsc.li/3uYuVzW).
- Wear eye protection throughout (splash-resistant goggles to BS EN166 3).
- Copper(II) sulfate solution, $CuSO_4(aq)$, 0.2 mol dm^{-3} – see CLEAPSS Hazcard HC027c and CLEAPSS Recipe Book RB031. Copper(II) sulfate solution causes eye damage and is TOXIC to aquatic life.
- Magnesium ribbon – see CLEAPSS Hazcard HC059A. Magnesium ribbon is FLAMMABLE and gives off highly flammable gases in contact with acids.
- Zinc powder, Zn(s) – see CLEAPSS Hazcard HC107. Zinc powder is FLAMMABLE and hazardous to the aquatic environment.
- The following chemicals and substances are of low hazard:
    - Zinc chloride 0.2 mol dm^{-3} – see CLEAPSS Hazcard HC108a.
    - Iron(III) nitrate, $Fe(NO_3)_3.9H_2O(aq)$, 0.2 mol dm^{-3} – see CLEAPSS Hazcard HC055C and CLEAPSS Recipe Book RB052.
    - Magnesium nitrate, $MgNO_3.6H_2O(aq)$, 0.2 mol dm^{-3} – see CLEAPSS Hazcard HC059b.
    - Iron filings or small nails – see CLEAPSS Hazcard HC055A.
    - Copper turnings – see CLEAPSS Hazcard HC026.