

The determination of copper in brass – teacher notes

In this experiment students find out how much copper there is in brass (an alloy of copper and zinc). They dissolve the brass in nitric acid and compare the colour of the solution with that of solutions of various concentrations of copper.

The experiment has possibilities for use as an assessed practical. Two versions of the student worksheet are available – versions A and B. In version A, students are guided through the calculations at the end. This version could be used to assess skills in doing the experiment/following instructions. In version B no help is given with the calculations. This version could be used to assess skills in the treatment of results.

Students must wear appropriate eye protection.

Topic

Metals – chemical analysis

Timing

25 minutes

Equipment

Apparatus

- Eye protection
- Student worksheet
- Sheet of white paper
- Access to a balance
- Access to a fume cupboard
- Beaker, 10 cm³
- Volumetric flask, 10 cm³
- Plastic well-plate, 24 wells (eg Sigma ref: CLS3526)
- Plastic pipette (eg Aldrich ref: Z13, 503-8, fine-tip)

Chemicals

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

- Nitric acid, 5 mol dm⁻³
- Deionised water
- Copper nitrate solution, 0.50 mol dm⁻³
- Brass turnings

Observations

The brass dissolves quickly to form a blue solution. This colour is due to the copper present in the brass. (This part of the experiment must be done in a fume cupboard since nitrogen dioxide is formed.)

The intensity of the colour of this solution should lie within the range of intensities of colour of the standard solutions. Students find the nearest colour match and then calculate the copper content of the brass.

Discussion

Most brass contains about 60% copper (the remainder being zinc). Brass forms an interesting subject for a discussion on the structure of metals and alloys.

Copper metal has a face-centered cubic structure (fcc) while the structure of zinc is hexagonal. As zinc is added to copper it substitutes in the lattice to form a distorted fcc structure (zinc atoms are ca 13% larger than copper). This distorted structure is difficult to deform and accounts for the greater strength of brass compared to pure copper.

When the zinc content reaches about 36% a new body centered cubic phase appears and the strength increases markedly although the ductility is reduced. The optimum properties of strength and ductility for most uses of brass occur at about 40% zinc.

Reference

A. Street and W. Alexander, *Metals in the service of man*, 10th edn. London: Penguin, 1994.

Health, safety and technical notes

- [Read our standard health and safety guidance.](#)
- Wear eye protection throughout (splash-resistant goggles to BS EN166 3).
- Nitric acid, 5 M HNO₃ (aq) is CORROSIVE – see CLEAPSS Hazcard HC067 and CLEAPSS Recipe Book RB061. Consider wearing protective gloves.
- Copper nitrate – see CLEAPSS Hazcard HC027B and CLEAPSS Recipe Book RB031.
- Disposal: collect and retain copper/zinc solutions for appropriate disposal.