Creating copper

Education in Chemistry
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Technicians notes

This displacement reaction demonstration fits nicely into any introductory sequence associated with metal extraction, redox or the activity/reactivity series.

Kit

Hazcard and recipe book references are to CLEAPSS resources

- Eye protection
- Five 100 cm^3 beakers
- A balance
- Copper(II) oxide powder, 4.0 g (harmful) (*Hazcard 26*)
- Zinc powder, 1.8 g (highly flammable) (*Hazcard 107*)
- Tin lid sitting on a tripod
- Safety screens
- Bunsen burner or blowtorch
- Borosilicate test tube and holder
- Zinc oxide, a few grams (harmful)
- Hydrochloric acid, approximately 2 M, 20 cm^3 (irritant) (*Hazcard 47A, recipe sheet 43)*
- Circuit tester (power pack, bulb, crocodile clips and leads)
- Strips of copper metal
- Copper(II) sulfate solution, approximately 0.1 M (irritant) (*Hazcard 27C, recipe sheet 41)*
- Two graphite electrodes

Safety and disposal

The audience and demonstrator should wear eye protection. Safety screens should be used to protect both audience and demonstrator during the first stage. Solids can be disposed of in the bin and liquids can be washed down the sink with plenty of water

Note

Updates have been made to a number of these types of demonstrations following changes in UK explosives legislation – check with CLEAPSS to ensure your current risk assessment and quantities are up-to-date.

Preparation

Weigh out the zinc powder and copper(II) oxide into two separate beakers and then mix thoroughly by passing from one to another. Pour the mixture out into a line, approximately 5 cm long, on the tin lid.

In front of the audience

Heat one end of the mixture with a roaring Bunsen flame until it begins to glow. You may need to chase the glow down the line, as the consistency of zinc powder can vary. The reaction will burn with a bright green flame, due to the copper. As soon as the reaction subsides, invite students to notice the yellow and white powder that is present, and also the red–brown powder indicating the presence of copper. As the reaction cools, the yellow powder will turn white indicating the presence of zinc oxide. Confirm by heating a separate sample of zinc oxide in a test tube, which will turn yellow then return to white as it cools.

Once cool, the sample (now a brittle lump) can be passed around for examination. Place the lump in a beaker with the acid. The oxide layer will dissolve away along with any unreacted zinc (which may release a few bubbles of hydrogen gas) to give a colourless solution and leave the lump uniformly red–brown in colour. This will conduct electricity.

A suitable purification technique is electrolysis. Weigh the copper strip and connect it by crocodile clip to the negative terminal of the powerpack. The lump of impure copper can be connected to the positive terminal – there is little point weighing it as pieces will break off into solution. Electrolysing between 4 and 6 V in copper(II) sulfate solution for a few minutes will leave a visible deposit of copper on the copper strip – this can be patted dry and reweighed. Students may be rightly suspicious of the copper in solution, so it is worthwhile setting up an additional cell with graphite electrodes which will get visibly paler over time and indicate the consumption of the dissolved copper.