

Investigating Electrolysis Reactions

Background

When an electric current is passed through a liquid (solution or melt), chemical reactions take place at the two electrodes. At the positive electrode, the anode, oxidation takes place and at the negative cathode reduction occurs. The products formed at each electrode depend on the ions present in the liquid and the relative ease with which they are oxidised or reduced.

In this experiment you will electrolyse various aqueous solutions and identify the products formed at the electrodes.

Equipment required

U-tube

Power supply (0-12 V)

Pair of carbon electrodes (at least 4 cm long) Pair of copper electrodes (at least 4 cm long)

Pair of electrical leads with alligator clips on the ends Stand and clamp

Dropper

Copper (II) sulfate solution [CuSO_4] 0.5 mol L⁻¹ (30 mL) Potassium iodide solution [KI] 0.5 mol L⁻¹ (15 mL) Universal indicator (1 mL)

Procedure

A Electrolysis of Potassium Iodide Solution

- #1 Secure a U-tube with a retort stand and clamp. Fill the U-tube with 0.5 mol L⁻¹ KI solution to within 2 cm of the overflow outlets.
- #2 Connect two carbon electrodes to the 12 V D.C. power supply using electrical leads with alligator clips as shown in Figure 42.1. Place about 1.5 cm of the electrodes into the solution.
- #3 Electrolyse the solution for about 2 minutes. Note any reaction such as gas evolution, deposition of solid or colour change which takes place at the electrodes. Record your observations.
- #4 Carefully remove the negative electrode from the solution and add 3 or 4 drops of universal indicator solution to that side of the U-tube.
Record the colour and pH of the solution

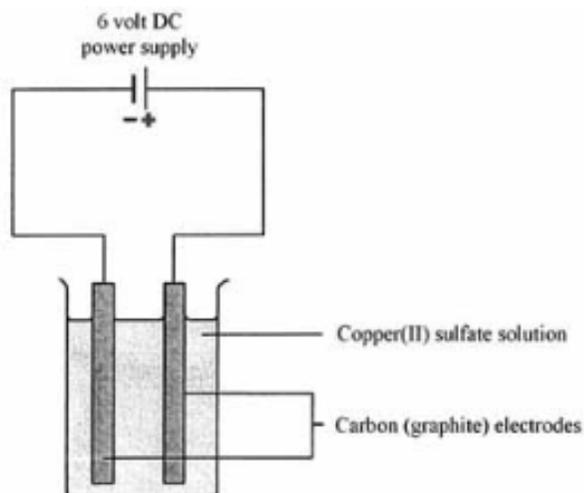
B Electrolysis of Copper(II) Sulphate Solution with Carbon Electrodes

#1 Using the same procedure as in part A electrolyse a 0.5 mol L⁻¹ CuSO₄ solution for 5 minutes. Again note any reactions taking place at the electrodes.

C Electrolysis of Copper(II) Sulfate Solution with Copper Electrodes

Electrolyse for 5 minutes in the same way a fresh sample of 0.5 mol L⁻¹ CuSO₄ solution, except in this case use copper electrodes. Again note any reactions taking place at the electrodes. #2

#2 After the electrolysis remove the electrodes and note the appearance of the cathode



copper sulphate crystals

Processing of results, and questions

1 For each of the electrolysis reactions

a state the products formed at the anode (+ve) and cathode (-ve),

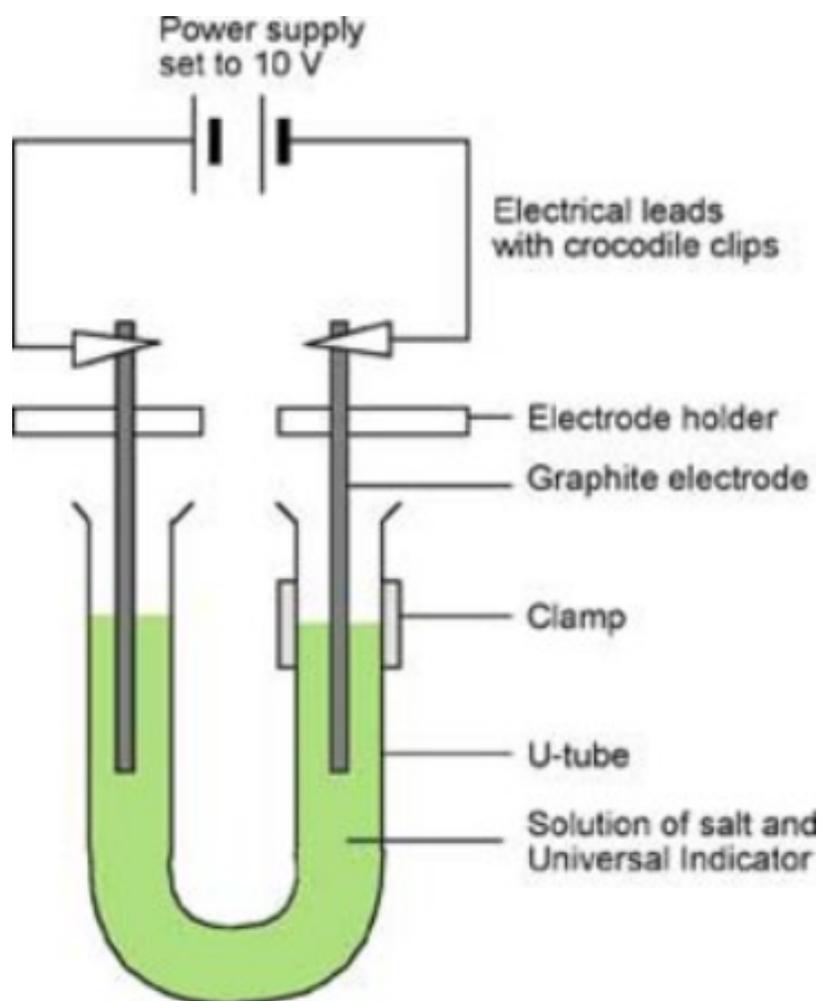
b write equations for the separate electrode reactions and an equation to represent the total reaction,

c list possible reactions at each electrode and the reaction predicted from a table of standard reduction potentials. Do the observed reactions agree with these predictions?

2 In electrolytic cells such as these, what conducts the current through the solution? Illustrate your answer with reference to the electrolysis of the KI solution.

3 Suggest a way that you could determine if the equation you have written for the anode reaction in part C is correct.

4 Suggest possible applications for the process illustrated in part C.



Suggested
Further Activity