Investigating Electrochemical Cells

Background

An electrochemical cell makes use of a redox reaction and uses the chemical reaction to produce an electric current. Different chemical systems can be set up to produce different electrochemical cells and one way of comparing the cells is to measure the voltage that they generate. Once a particular cell has been set up there are various factors that can be investigated to see how they affect the voltage generated by the cell. Electrochemical cells can also be used as an analytical tool.

Practical Techniques

You need to find out how to make up accurate solutions.

Where to start

You should choose a simple metal/metal ion system and set up a simple electrochemical cell. You can find details in many textbooks. You should choose to metals that have distinctly different standard electrode potentials such as copper and silver, copper and magnesium or copper and zinc. Alternatively you could set up a concentration cell, where both half-cells are made from the same metal/metal ion.

You need to make up solutions with very accurate concentrations and your electrodes must be clean.

You can investigate the effect of changing the concentration of one of the solutions by diluting one of the solutions 1/10, 1/100/,1/1000 and 1/10000 etc successively.

You can process your results to see if there is a mathematical relationship between the cell voltage and the concentration.

Possible Investigations

- Investigate the effect of changing temperature, depth of electrodes and distance between electrodes on the cell voltage. Which conditions produce the maximum cell voltage?

- Can the relationship between cell voltage and concentration be used to determine the concentration of an unknown solution? How accurate/sensitive is this method of analysis?

- Investigate the use of electrochemical cells to determine the end point of a titration. For example silver nitrate is used as a reagent in volumetric analysis to determine the concentration of chloride ions. As the silver nitrate is added to the chloride ion solution a precipitate of silver chloride is produced and the concentration of silver ions falls. The electrode potential of the silver half-cell should change correspondingly. A rapid change in voltage should indicate the end point of the titration. A silver electrode can therefore be to determine the end point of the titration. This is often called a potentiometric titration.

Sources of Information

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Teachers' Notes

General

This investigation is based around standard experiments and details can be found in most chemistry books. At low concentrations, it is essential to work cleanly and avoid contamination.

Once a cell has been set up measurements can be made quickly.

Details of potentiometric titrations can often be found in older practical chemistry books.

Chemical Principles

Redox, Electrochemistry.

Essential Equipment

Burettes, pipettes, standard flasks, high resistance voltmeter

Essential Chemicals

Metals and metal salts

Safety

No risk assessment has been given. It is essential that students prepare a detailed risk assessment before they start. Teachers must be satisfied that this is suitable for the proposed investigation.