

Redox Reactions Including Galvanic Cells

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Experiment Overview

The experiment consists of three parts:

- ☐ Simple Redox Reactions. Spontaneous electron-transfer reactions in solution are studied and some oxidising agents, Br_2 , Cl_2 , Fe^{3+} and I_2 , are ranked in order of decreasing oxidising power.
- ☐ Measurement of Reduction Potentials of Selected Electrodes and of the Emf of an Electrochemical Cell. The cell potential, E_{cell} , for several electrochemical cells is measured using a $\text{Ag(s)} \mid \text{Ag}^+(0.0100 \text{ M})$ electrode as a reference electrode. The experimental E_{cell} values are then used to calculate reduction potentials for each of the half reactions. These reduction potentials are then used to design a galvanic cell which does not include the silver electrode. This galvanic cell is constructed, the cell voltage measured and compared to its predicted voltage.
- ☐ Use of a Silver Concentration Cell to Measure Solubility Products and Stability Constants. The silver ion concentration cell $\text{Ag(s)} \mid \text{Ag}^+(0.0100 \text{ M}) \mid \text{N} \mid \text{Ag}^+(c \text{ M}) \mid \text{Ag(s)}$ is used to determine the silver ion concentration, c , in the right hand compartment and hence the solubility products of some silver salts and the formation constants of some silver complex ions.

Aims and Objectives

The experiment aims to link theoretical knowledge of electrochemistry presented in lectures with actual physical examples. Spontaneous redox reactions are observed in test tubes and students are asked to write chemical equations to explain their observations and then draw conclusions about what has occurred at a molecular level. Galvanic cells are constructed and the theoretical knowledge of half-cells, EMF, the Nernst equation, and solubility are related with actual measurements collected in a practical situation.

Level of Experiment

First year undergraduate

Keyword Descriptions of the Experiment

Domain

general chemistry

Specific Descriptors

galvanic cell, redox, electrode potential, half-cell, solubility product, stability constant, Nernst equation

Course Context and Prerequisite Knowledge and Skills

The basic theoretical skills (activity series, redox potential tables, galvanic cells including concentration cells) are covered in lectures and in the typical general chemistry textbook used by first year students. Electrochemistry is an important interface between chemistry and everyday life and this experiment, among other things, gives students the opportunity to construct their own galvanic cell and compare the theoretical expectation of cell potential to the actual one.

The experiment also allows the student to use the Nernst equation and their experimental results to link the topics of electrochemistry with chemical equilibrium by the calculation of stability constants and formation constants.

The mathematical skills required are algebraic and should not be too difficult for most students.

Time Required to Complete

Prior to Lab: 1 h

In Laboratory: 3-4 h

After Laboratory: 1 h

Experiment History

The origin of the experiment is unknown but has been used and further developed by the staff of the Department of Chemistry at Macquarie University as a first year undergraduate experiment over many years.