

Investigation of Rotation of Plane Polarised Light using a Home Made Polarimeter

by Michael G. Crisp

Experiment Overview

Students construct a simple polarimeter and use it to investigate the optical activity of common sugar (sucrose). Sucrose is an optically active molecule and therefore rotates the plane of polarisation of plane polarised light. Students have an opportunity to create a series of sugar solutions of known concentrations using an analytical balance and volumetric flasks.

Learning Experience

This experiment is an effective learning tool as it incorporates not only the theory and practice of polarimetry, making solutions of known concentration, error analysis, scientific graphing, but also students are able to construct their own polarimeter which helps to demystify scientific equipment. Often instrument are perceived by students simply as “beige boxes” which magically give you a number or a graph. This experiment aims to show the student that with relatively simple equipment you can still investigate chemical phenomena.

Aims and Objectives

The aim of this experiment is to introduce students to polarimetry and the idea that some molecules can rotate the plane of polarisation of plane polarised light. The experiment directly relates to the lecture material and helps reinforce the theory by allowing students to see first hand the effect that a chiral compound has on plane polarised light.

Level of Experiment

First year undergraduate chemistry

Keyword Descriptions of the Experiment

Domain

general chemistry

Specific Descriptors

polarimetry, optical activity, chirality

Course Context

To put the experiment into course context the following is an excerpt from the Flinders University Syllabus for Chemistry 1:

Chirality and Optical Isomerism

This lecture series will focus on an introduction to molecular chirality (or handedness). This important phenomenon is associated not only with the molecules of nature but also with those we encounter commonly in the laboratory. At the completion of this section of lectures you should be able to:

☐ *Define isomerism*

- *structural isomerism*
- *geometric isomerism*
- *optical isomerism*

☐ *Define the following terms: chiral, achiral, asymmetric carbon, enantiomers, racemate (racemic mixture), optical isomerism, dextrorotatory, and laevorotatory.*

☐ *Describe the components and function of a polarimeter.*

☐ *Recognize the structural feature responsible for optical isomerism in medium-sized molecules.*

☐ *Give examples of the significance of chirality in the biological world.*

Prerequisite Knowledge and Skills

The practical, or laboratory skills, required by the students for this experiment include:

- Making solutions of known concentration
- Using an electronic balance
- Using volumetric flasks
- Scientific graphing and data analysis
- Construction of a simple polarimeter

Time Required to Complete

Prior to Lab: 30 min

In Laboratory: 2-3 h

After Laboratory: N/A

Experiment History

This experiment was adapted from Stary and Woldow (2001), and was introduced into the second semester of first year undergraduate chemistry at Flinders University in 2005 as part of the redevelopment of the first year undergraduate chemistry practicals. It is supposed to be a short and fun experiment that allows students to make solutions of known concentrations, use a common consumer chemical (sucrose) and to realise that instruments can be quite simple (“home-made” polarimeter) and not at all mysterious in their operation.

Comments

Anyone interesting in discussing the manufacture / purchase of these polarimeters should contact Michael Crisp, the author of the educational analysis (who also developed the experiment); Michael's contact details are available at the bottom of the Educational Analysis page.

References

Stary, F. E. & Woldow, N. (2001). Build a simple polarimeter. *Journal of Chemical Education*, **78**, 644.