

An Introduction to Optics for Chemists

Author: Hugh Cartwright

Practical:

Abstract

Optical methods and spectroscopy are used in every branch of chemistry from the most biological to the most physical. Wave properties, which light exemplifies, also underlie the modern ideas of atomic structure and chemical bonding. The purpose of this experiment is both to give a grounding in the principles of optics as used in chemistry and introduce the use of lasers.

Intended academic level

1st year University

Duration

Varies with prior experience of students, but typically around 10 hours for a pair of students. The experiment cannot be completed by inexperienced students in a single session, but because it is broken into a number of short tasks it can readily be completed over several shorter sessions.

Outcomes

An appreciation of a number of important factors relating to spectroscopy and the use of lasers. Practical experience in such tasks as aligning and levelling laser beams.

Materials

Drilled and threaded 2-d optical bench for placing moveable optical components. (A linear optical rail is not suitable for some of the experiments and a 2-d bench makes positioning of the components straightforward). HeNe laser. Various further components are required, depending upon the tasks to be completed by students. These components include mountings for optical components, adjustable mirrors, irises, lenses, a white light source, prisms, hemispherical lenses, Polaroid sheets, 35 mm slides of repeating patterns, and a microscope. Although not all components are required to complete parts of the experiment, the greater the selection of components, the greater the range of tasks that can be completed.

Costs

Costs depend upon the range of equipment purchased and its quality. A complete set of equipment can be purchased for around £2,500, but this figure may be reduced or exceeded by a substantial margin by changing the quality purchased. Running costs are essentially zero.

Further comments

Experience suggests that occasional interaction with knowledgeable demonstrators is essential if students are to benefit fully from the experiment. Some students have had little prior contact with optical components and need help in aligning and using them. Even students with A-level physics find some of the experiments take them into quite new territory. Photographs of the suggested arrangement of optical components on the optical bench are very helpful.

Reading

Experiment script, available from the URL given above

Contact details

Dr Hugh Cartwright

Physical & Theoretical Chemistry Laboratory

Oxford University

South Parks Road

Oxford OX1 3QZ