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A Simple Split-Field Polarimeter

A simple split-field polarimeter can be constructed easily for a few dollars from readily available materials. The polarizer is cut from a 2-in. square sheet of polarizing material (available from several sources in pairs) as shown in Figure 1. This is easily done with a sharp hobby knife or single edge razor blade. One piece is flipped over and the cut edges are cemented together using an opaque cement like "liquid solder" or an epoxy formulation loaded with filler. The polarizer is then mounted under the lower hole of a simple frame made out of ½-in. plywood as shown in Figure 2.

A plastic full circle protractor with a second sheet of polarizing material taped over a small circular hole through its center is used as the analyzer. The upper surface of the frame is first made smooth by cementing a fairly heavy sheet of cardboard on it. The analyzer is then located on it by three map pins so that it is concentric with the upper hole in the wooden frame. Care must be taken in pushing in the pins. They must allow the protractor to be turned easily but must not allow too much play. In practice the best procedure is to use two of the pins to locate the protractor. This is done by using a slight finger pressure on the protractor's rim near the third pin toward its center.

A small mirror is mounted under the lower hole to direct light up through the optical path. Cardboard covers may be taped on over the cell compartment in case they are needed.

The sample tubes are either glass or pvc tubes of suitable diameter and length with windows epoxied on to one end. Lantern slide cover glass cut to size make good windows, and if they are big enough, the sample tubes can be stood in the cell compartment without support. The solution depth is of course determined by its volume. To obviate difficulty caused by ripples on the free surface of the solution in the sample tube, an arrangement shown in Figure 3 can be used. This set-up has a well-defined light path-length through the sample.

Although optical rotation readings can be made using a white light source, it is much better to use semi-monochromated light by using filters made out of colored cellophane in the light path. One can easily demonstrate the variation in measured optical activity with the color of light used with a set of these filters.

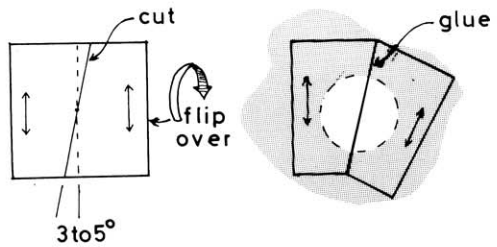

Figure 1. Cutting and mounting the polarizer. The arrows indicate the polarizer's axis.

With a good 6-in. diameter protractor, the accuracy approaches one-third degree with careful technique. A half degree accuracy is more easily attained, however.

The design of this polarimeter was worked out while the author directed the UNESCO Pilot Project for Chemistry Teaching in Asia in Bangkok, Thailand, in 1970. It was first used to teach the basic principle of the polarimeter to a group of Thai and other Asian chemistry teachers during the Thai-UNESCO Physics and Chemistry Summer Institutes held in Bangkok in April, 1970.

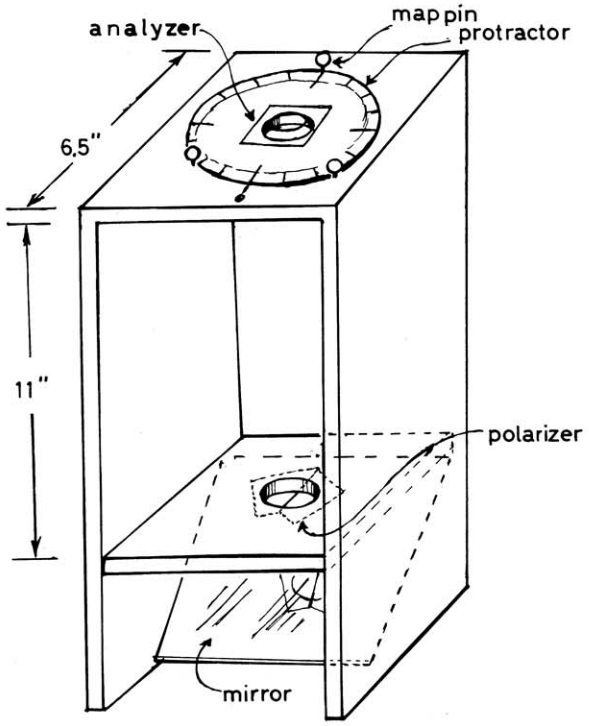

Figure 2. Plan view of the completed polarimeter.

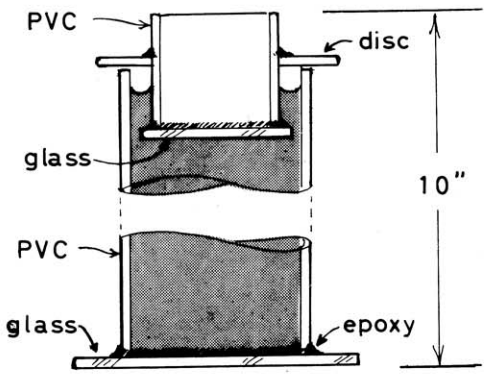

Figure 3. Construction of the sample tube.