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SPINDLE STAGE WITH EASILY CHANGED LIQUID AND IMPROVED CRYSTAL HOLDER

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ABSTRACT

A glass cell for refractive index liquids and a crystal mounting arrangement are described. These are adaptable to most spindle stages with resultant improvement in convenience and efficiency of use.

INTRODUCTION

The liquid-containing cell and crystal holding device that are components of my design of a simple single-axis crystal rotator, could be adapted to other designs [Hartshorne, 1963 a, b; Hartshorne and Stuart, 1960, 1964, R. E. Wilcox, 1959] to improve the convenience and efficiency of the apparatus.

In 1945 we made the rotation device shown in Figure 1. The design was based largely on the description of a simple rotator given by T.R.P. Gibb (1942), but modified to fit on our petrographic microscope. Standard objectives (4 mm and longer focal length), and condensers can be used with it.

THE IMMERSION CELL

One of the features that has been found particularly convenient consists of the cell that contains the refractive index liquid in which the crystal is immersed. The cell depth is about one millimeter as determined by the thickness of the slide from which the spacers were cut. The thickness of the slide used for the base of the cell was chosen to position the rotation axis at one-half the cell depth. The outside distance between the cemented spacers was made slightly less than the 22 mm width of the number 1 cover-glass used for the top of the cell in order that the cover-glass might be picked up and centered easily with the fingers. The inside distance between the spacers was made about one centimeter in order to avoid contact of the drop of immersion oil with the spacers. Figure 2A shows a large crystal in a drop of immersion oil as used in the cell. The oil drop can be near the end of the slide if necessary. The fact that the immersion liquid does not fill the cell is an important feature of this device.

The cell is prepared for use by placing a drop of immersion liquid near the center of one edge of the cover-glass which is then quickly inverted and placed on the spacers so that the hanging drop is directly over an-

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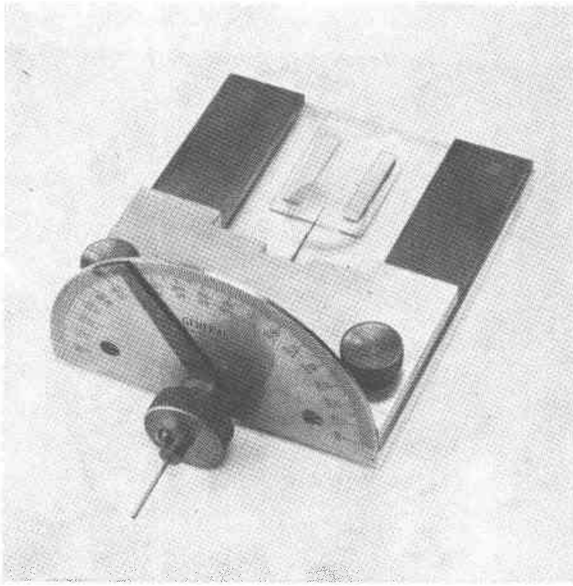

Fig. 1. Spindle stage with immersion cell and tubular crystal holder.

other drop of the oil which has been placed on the slide. These drops are promptly caused to join by means of a needle or thin glass rod touched to them in the space between slide and cover-glass. As soon as the drops are joined surface tension minimizes the tendency of the liquid to spread, and when the cell is pushed onto the previously centered crystal the drop of oil will not drift to the side of the cell but will tend to center itself around the crystal. The proper amount of oil must be found by trial for each cell but the proportion shown in Figure 2 is satisfactory. A smaller drop could be used with a smaller crystal.

The liquid in the cell can easily be changed by withdrawing the cell,

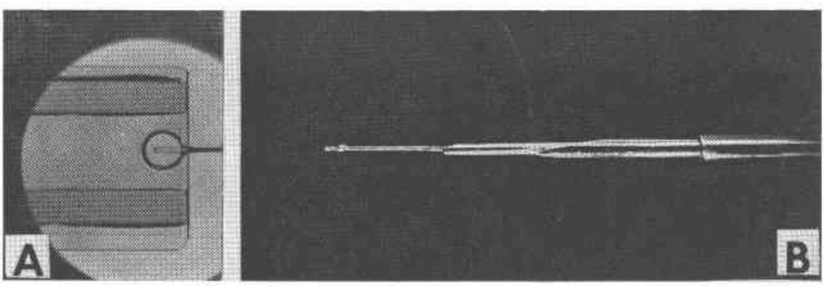

Fig. 2A. Immersion cell showing crystal in a drop of oil.
Fig. 2B. Crystal on wire fitted into telescoping hypodermic needles.

removing the cover-glass, wiping the oil off with absorbent paper, washing with solvent or detergent, then applying a drop of different immersion liquid as described above.

The crystal can be cleaned of oil by dropping a suitable solvent, such as iso-octane, over it from a pipette, or, preferably, by removing the entire stage assembly and dipping the crystal (held with the axis of rotation vertical) into a small beaker of solvent.

A spindle stage whose design does not provide space for an immersion cell of the kind described above can be cut out to make such a space for a similar cell of suitable dimensions.

The Crystal Holder

Another feature that has been found convenient is the improved crystal holding spindle. The solid wire originally used has been replaced by a metal tube of about the same diameter into which two other tubes have been telescoped. A piece of copper wire (30 gauge or smaller) about an inch long is slipped into the central hole, and the crystal is cemented onto the end of the wire. Figure 2B shows the arrangement made from hypodermic needle tubing chosen to be snug fitting. Grease or wax can be applied if the tubes and wire are too loose but friction is usually sufficient to prevent rotational or longitudinal slipping after positioning adjustments have been made.

The tubes shown are of hypodermic needle guages: 18, 21, and 26. If still smaller bores are desired, 32 guage will fit into 26 guage, etc. (Such tubing is available from Hamilton Co., Whittier, California 90608.[1])

Copper wire, 30 gauge B&S., 0.255 mm diameter is generally used after stretching it to reduce its diameter enough to permit inserting it into the 26 gauge, 0.25 mm inside diameter, tube. Stretching the wire straightens and hardens it, but, if necessary, it can be straightened by rolling between two pieces of glass. While working on the stage of a stereoscopic microscope the end of the wire can be cut off square (or some other angle) with a razor blade before cementing the crystal onto it. In cases where the wire is too large for the crystal a short terminal segment can be flattened by pressing it against the glass stage of the microscope with a small screwdriver blade, then cutting off the sides of the flattened portion with a razor blade to leave a slim point. The flattened end can be split or notched to fit the shape of the crystal if doing so will help achieve a desired orientation.

If possible the crystal to be mounted should have its optic normal

[1] Reference to a company/or product named by the Department is only for purposes of information and does not imply approval or recommendation of the product to the exclusion of others which may also be suitable.

direction determined by a preliminary study in order that it may be cemented on to the wire with the axis of rotation and optic normal coincident. The orientation should be adjusted by nudging the crystal carefully with a needle while the cement ("Weldwood" furniture cement is good), is still soft, but, if necessary, small adjustments can be made by judiciously bending the copper wire.

The crystal on its wire may be kept for future reference by withdrawing it from the hypodermic needle and sticking it into a hole in a cork stopper which is then pushed into a suitable vial appropriately labeled.

Discussion

Mounting crystals on small diameter copper wire has been satisfactory, but, although they cannot easily be shaped or bent, there may be some advantage in special cases in the use of small diameter hypodermic tubing, sewing needles with the eye cut off, or fine glass tubes or threads substituted for the copper wire. Tubing has the advantage that the cement tends to go into the hole, thus avoiding any appreciable bead of cement around the crystal. If X-ray data are to be sought a short piece of glass fiber might be waxed onto the copper wire, the crystal being cemented onto the glass with an amorphous cement. A goniometric mount has been described by the author (Jones 1960) for samples intended for X-ray study.

In order to achieve rotation about the optic normal it is sometimes necessary to bend the mounting wire so that it "precesses" around the rotation axis. The crystal can be kept in the drop of immersion liquid at the end of the cell, Figure 2A, even in such a case provided the off-axis angle is not greater than about 30°. The opening in the microscope stage is usually large enough so that the bent wire does not touch anything, and the cap lens of the condenser would be off. It is not necessary to use objectives of short focal length when measuring the optic axial angle of a crystal rotated on its optic normal.

Straightforward determination of principal refractive indices and optic axial angles are possible if the crystal can be rotated on its optic normal but even with a random orientation the properties may be determined by somewhat laborious procedures described in the references given below.

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