Centrifuge Method of Cutting Crystals

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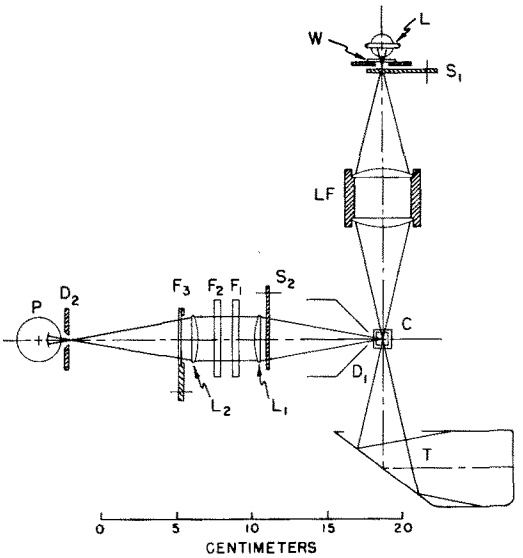

FIG. 1. Optical system.

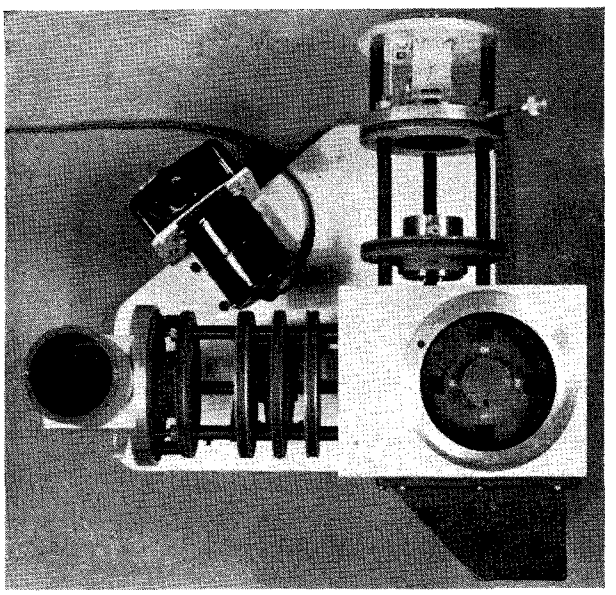

FIG. 2. Top view of the instrument with covers removed.

duction of stray light by diaphragming. L is a General Electric H4AX mercury arc lamp with its base and outer glass envelope removed. W is a fused quartz window; S_1 and S_2 are are shutters. D_1 and D_2 are diaphragms; C is a 1×1-cm fused quartz cell; T is a light trap; and P is a 931A photomultiplier. The two functions of focusing and filtration in the input beam are accomplished by the lens-filter combination LF consisting of a stainless-steel cell 30 mm long and 32 mm in diam having plano-convex lenses ($r_1=\infty$, $r_2=47.5$ mm, $d=4.5$ mm) made of Corning No. 9863 uv-transmitting glass in place of end windows and filled with a solution of 50 g of nickel sulfate ($NiSO_4 \cdot 6H_2O$) in 100 ml of water. F_1 is a filter of Corning No. 3850 glass, color specification 0–51. F_2 is an interference filter having a peak transmission at 400 mμ and a half-width of 5 mμ. L_1 and L_2 are glass lenses of 85-mm focal length and 28-mm aperture. F_3 is a removable neutral filter to aid in calibration.

The uv lamp used gave better results than any of several laboratory mercury arcs tested. The nickel sulfate has a strong absorption peak at 393 mμ. It stops any light that might otherwise scatter and pass through the interference filter. The lenses in LF are made of filter glass because ordinary fused quartz fluoresces in the 400-mμ region. The photomultiplier is supplied with 1150 V and the anode current read with a General Radio type 1230A electrometer. Figure 2 shows a top view of the instrument with all covers removed.

The sensitivity of the fluorometer is typically 0.0063 μA/rad for the salicylic acid system and 0.025 μA/rad (4×greater) for the HTA system. The dose required to double the background reading is 10 rad for salicylic acid and 1.5 rad for HTA. In comparison, the Aminco-Bowman spectrophotofluorometer gives corresponding backgrounds of 6 and 0.5 rad for the two systems, with a ratio of sensitivities of 4.4. Thus the performance of the filter fluorometer comes within a factor of two of the grating instrument for the salicylic acid system and within a factor of three for the HTA system.

We would like to thank W. A. Armstrong for help with the dosimetry and R. Wilson for his preliminary work on the filtration.

[1] W. A. Armstrong and D. W. Grant, Can. J. Chem. **38**, 845 (1960).
[2] W. A. Armstrong, R. A. Facey, D. W. Grant, and W. G. Humphreys, Can. J. Chem. **41**, 1575 (1963).

Centrifuge Method of Cutting Crystals*

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IN some experiments in which the strengths of small iron crystals (whiskers) were being determined by the high speed rotor technique, it became necessary to cut the whiskers accurately to predetermined sizes. Mechanical cutting methods were ruled out because of the damage done to the crystal. Electropolishing, acid cutting, and the acid saw methods gave surfaces which were too rough and edges which were slightly rounded. The problem was solved by carrying out the simple acid cutting process in a centrifugal field. Apparently the centrifugal field sweeps the gas bubbles from the surface as well as producing a more uniform acid concentration over the surface. As a result,

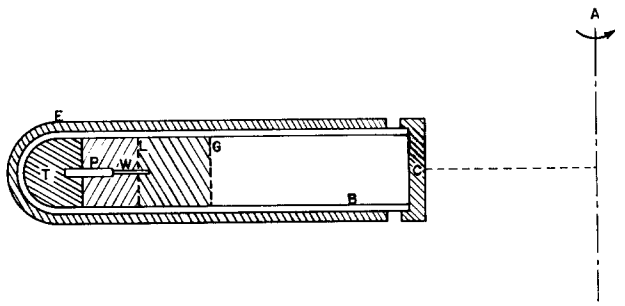

FIG. 1. Schematic diagram of crystal cutter.

the surface of the cut is smooth and its edges are sharp. The iron whiskers used were grown by the hydrogen reduction of ferrous chloride.[1,2] They were square in cross section and several centimeters long. The sides of the square varied from about 10 to 1000 μ for different crystals. Approximately cube shaped well-balanced rotors were cut from these whiskers.

A comparatively low speed standard International Clinical centrifuge is used to spin the arrangement shown in Fig. 1. E is the regular metal centrifuge test-tube-shaped holder for the glass test tube B. These spin about the axis A as shown. T is a Teflon plug in which is mounted a small diameter short stainless steel pin P. The iron whisker W is cemented to the flat end of this pin in the position shown in Fig. 1. Almost any type of cement that will not harm the whisker is satisfactory. With the centrifuge stationary, the axis of the tube E is vertical with W pointing up. In this position B is filled with a heavy inert liquid such as 3M FC-43 fluorochemical to the level indicated by the dashed line L. A nitric acid water solution is next carefully layered on top of the heavier FC-43 up to the second dashed line G. The Teflon cap C is then put in place and the centrifuge started. As the centrifuge starts spinning the axis of E moves to the horizontal position shown in Fig. 1 so smoothly that no mixing occurs. When the whisker is dissolved down to the line L the centrifuge is stopped and the acid is removed with a hypodermic needle syringe. If the process is carried out with care the cut along L is very smooth and is an approximately cylindrical surface with a radius or curvature equal to its distance from the axis A ($\sim$12 cm). Also its edges are sharp. The FC-43 fluorochemical in time will dissolve minute quantities of nitric acid which in turn will slightly etch the other crystal faces. However by working with almost 40% nitric acid the cutting process usually takes place in about 10 min and no etching by dissolved acid is observable. The above method clearly can be used for cutting almost any type or size of crystal which is soluble.

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[1] S. S. Brenner, Acta Met. 4, 62 (1956).
[2] R. V. Coleman, J. Appl. Phys. 29, 1487 (1958).

Streak Camera Technique for Simultaneous Measurement of Shock and Free-Surface Velocities*

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A USEFUL modification of the knife-edge optical technique[1,2] has been developed which enables an accurate simultaneous determination of both shock and free-surface velocity. Two (or more) wires are located so that one wire monitors the time and structure of the shock disturbance entering the sample and the other monitors the time and structure of the shock leaving the sample, as well as the free-surface motion of the sample.

The experimental set-up is given schematically in Fig. 1. The reflective driver plate and sample, wires, and objective lens are positioned on a wooden optical bench in the laboratory. At the firing site, this assembly, Fresnel lens, field lens, and relay lenses are aligned optically using a point light source projected through the camera. The folding mirrors are then inserted into the system and adjusted. The Fresnel lens is located so that the light during the experiment completely fills the objective lens.

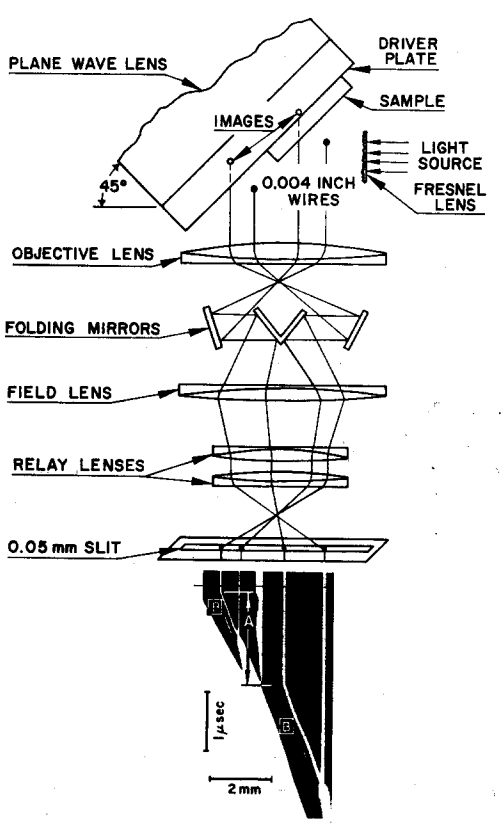

FIG. 1. Schematic drawing of experimental technique. A represents the shock transit time through the sample. B illustrates the slopes that are related to free-surface velocity.