The above procedure has been found to produce a good quality optical surface on silicon.

INSTRUMENTATION

A schematic view of the experimental apparatus used to determine the values of the piezobirefringence constants of silicon is given in Fig. 1. The light source consists of a General Electric 6 volt, 54 watt vertical tungsten ribbon lamp. A wide aperture lens system was used to collimate the light into a parallel beam and direct it through a nicol prism polarizer. The vibration direction of the polarizer is oriented 45° from vertical, the latter being the direction of stress application to the crystal. A mask, provided with an aperture proper to the crystal dimensions, is placed between the polarizer and crystal specimen in order to eliminate all light except that passing through the specimen.

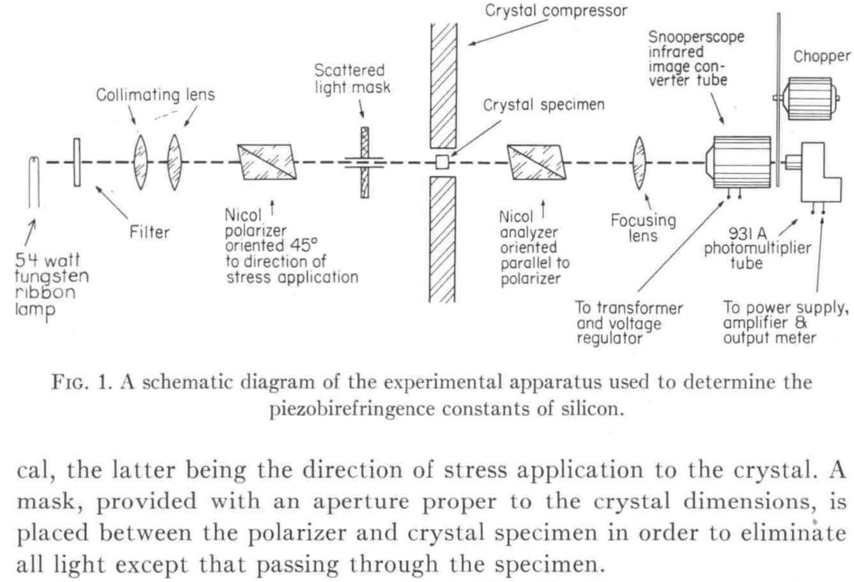

FIG. 1. A schematic diagram of the experimental apparatus used to determine the piezobirefringence constants of silicon.

The apparatus used to apply stress to the silicon is a second class lever type of crystal compressor. The unit is similar to one previously described (2); however, the following modifications have been made: *a*) The pressure ram of the earlier model has been replaced by opposed vertical sections of $\frac{3}{4}$ inch diameter steel drill rod machined square at the ends and equipped with flat and parallel hardened steel tips. *b*) The cold-rolled steel plates formerly used as pressure ram guides have been replaced by a $1\frac{3}{8}$ inch thick normalized cast-iron block provided with a vertical guide hole for the drill rod plungers and an intersecting horizontal aperture for light transmission through the crystal. The pressure ram guide block is mounted vertically on a similar $1\frac{3}{8}$ inch thick cast iron base block. These improvements have been found to provide more easily reproducible conditions of stress distribution on crystal surfaces.

A nicol prism analyzer, oriented parallel to the polarizer, is placed on the opposite side of the crystal from the polarizer. A lens is used to focus the image of the crystal upon the cathode surface of a World War II war surplus British "snooperscope" infrared image converter tube, model CV-147. The brightness of the converted infrared image was measured by a 931A photomultiplier tube. The output signal from the photomultiplier tube was fed to a four-stage all-triode audio frequency amplifier tuned to 750 cps. The light chopper was placed between the infrared image converter and photomultiplier tubes in order to eliminate the effect of any image persistence by the active material of the converter tube. Changes in stress-induced retardation by the crystal specimen as a function of applied stress were read visually on a Triplett model 420-PL D.C. milliammeter. All electrical power used was drawn through a Sola CVH constant voltage transformer.

An infrared image converter tube was used in preference to a lead sulfide detector in order to permit visual inspection of the crystal specimen for optical defects and homogeneity of stress distribution. For some applications, however, the lead sulfide detector is a more advantageous instrument. The need for a phototube is then eliminated, the signal to noise ratio is better and power requirements are very simple.

Calibration of the "snooperscope" tube with respect to conversion range and band pass was carried out with a Leiss double prism-single pass spectrometer with a motor driven wavelength selector.* A zirconium point source lamp was used as a light source. The spectrometer itself was calibrated by means of a mercury vapor lamp spectrum. In order to establish the effective absorption cutoff of silicon and establish the conversion range of the image converter tube (operated at approximately 3000 volts A.C.), light from the spectrometer was transmitted through a 0.15 cm. thick polished silicon window. The converted light was observed with a 1P28 photomultiplier tube and recorded on a synchronized chart recorder.

In order to restrict the band pass, a 0.409 cm. thick Corning No. 5850 filter was inserted into the "snooperscope"-silicon system. Later, the No. 5850 filter was replaced by a distilled water filter (water thickness = 2.70 cm.). The observed transmission curves for (A) the Leiss spectrometer with the zirconium point light source, (B and C) the "snooperscope" image converter tube with a 0.15 cm. thick polished silicon window, (D) the distilled water filter, (E) the image converter tube with silicon window and water filter, (F) the Corning No. 5850 filter, and (G) the image converter tube with the silicon window and the Corning No. 5850 filter, are given for the wavelength region of 0.7–1.4 microns in Fig. 2.

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