XXV INTERNATIONAL PHYSICS OLYMPIAD

BEIJING, PEOPLE'S REPUBLIC OF CHINA

PRACTICAL COMPETITION

July 15, 1994

Time available: 2.5 hours

READ THIS FIRST!

INSTRUCTIONS:

1. Use only the ball pen provided.
2. Your graphs should be drawn on the answer sheets attached to the problem.
3. Write your solution on the marked side of the paper only.
4. The draft papers are provided for doing numerical calculations and draft drawings.
5. Write at the top of every page:
   - The number of the problem
   - The number of the page of your report in each problem
   - The total number of pages in your report to the problem
   - Your name and code number

EXPERIMENTAL PROBLEM 1

Determination of light reflectivity of a transparent dielectric surface.

Experimental Apparatus

1. He-Ne Laser(～1.5mW).The light from this laser is not linearly polarized.

2. Two polarizers ($\mathbf{P}_1$, $\mathbf{P}_2$) with degree scale disk (Fig. 1), one ($\mathbf{P}_1$) has been mounted in front of the laser output window as a polarizer, and another one can be fixed in a proper place of the drawing board by push-pins when it is necessary.

3. Two light intensity detectors (D_1, D_2) which consisted of a photocell and a microammeter (Fig. 2).

4. Glass beam splitter(B).

5. Transparent dielectric plate, whose reflectivity and refractive index are to be determined.

6. Sample table mounted on a semicircular degree scale plate with a coaxial swivel arm(Fig. 3).

7. Several push-.pins for fixing the sample table on the drawing board and as its rotation axis.

8. Slit aperture and viewing screen for adjusting the laser beam in the horizontal direction and for alignment of optical elements.

9. Lute for adhere of optical elements in a fixed place.

10. Wooden drawing board.

11. Plotting papers

Experiment Requirement

1. Determine the reflectivity of the p-component as a function of the incident angle (the electric field component, parallel to the plane of incidence is called the *p*-component).
   (a) Specify the transmission axis of the polarizer (A) by the position of the marked line on the degree scale disk in the *p*-componet measurement(the transmission axis is the direction of vibration of the electric field vector of the transmitted light).
   (b) Choose any one of the light intensity detector and set its micro-ammeter at the range of "×5". Verify the linear relation ship between the light intensity and the micro-ammeter reading. Draw the optical schematic diagram. Show your measured data and calculated results(including the calculation formula)in the farm of a table. Plot the linear relationship curve.

(c) Determine the reflectivity of the *p*-component as a function of the incident angle. Draw the optical schematic diagram. Show your measured data and calculated reflectivity(including the calculation formula)in the form of a table. Plot the reflectivity as a function of the incident angle.

2. Determine the refractive index of the sample as accurate as possible.

Explanation and Suggestion

1. Laser radiation avoid direct eye exposure.

2. Since the output power of the laser beam may fluctuate from time to time, the fluctuation of light output has to be monitored during the performance of the experiment and a correction of the experimental results has to be made.

3. The laser should be lighting all the time, even when you finish your experiment and leave the examination hall, the laser should be keeping in work.

4. The reflected light is totally plane polarized at an incident angle θ_B while $\mathrm{tg}\,\theta_B = n$ (refractive index).

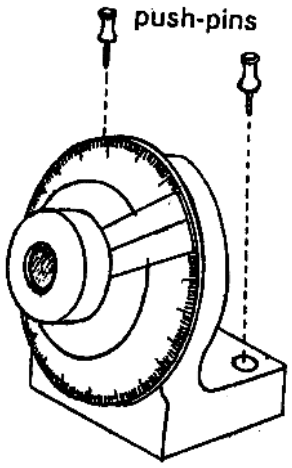


Fig. 1 polarizers with degree scale disk

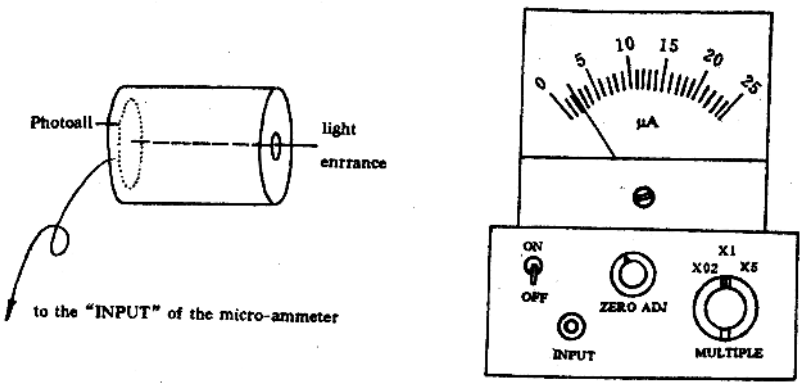


Fig. 2 Light intensity detector

(1) Insert the plug of photocell into the “INPUT” socket of microammeter

(2) Switching on the microammeter.

(3) Blocd off the light entrance hole in front of the photocell and adjust the scale reading of micro ammeter to “0”.

(4) Set the “Multiple” knob to a proper range.

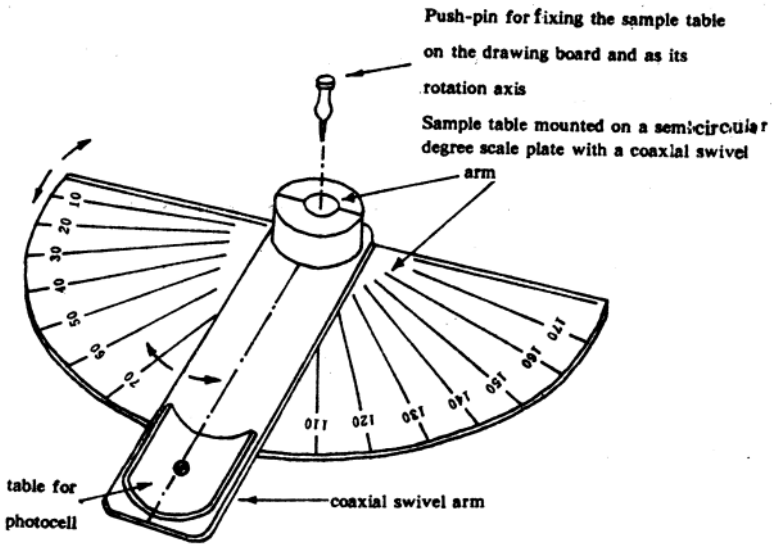


Fig.3 Sample table mounted on a semicircular degree scale plate