Polarization by reflection

Task and equipment

Information for teachers

Additional Information

As a result of the experiment the students should realize that light reflected from plexiglass and glass is partly polarized, and that the degree of polarization depends upon the angle of incidence. They should also know that reflection from metal plates does not bring about polarization; to demonstrate this, metal plates with smooth surfaces, i.e. with good reflection properties, will be utilized.

Suggestions for Set-up and Performance

In this experiment the students are not required to carry out any measurements. It can be performed in a lab which is not completely blacked out.
It is advisable to cut out the aluminium foil and the strips of printed paper before commencing the experiment.

Remark

The vector of the electrical field strength of light polarized by reflection oscillates at right angles to the incident plane (plane defined by the incident ray and the perpendicular). Under certain circumstances it might be preferable to modify the part of the experiment with the glass plate and the printed paper as follows: place a printed sheet of paper, book, picture or suchlike underneath a glass plate. Then try to look at the object under the glass plate - first with the naked eye and then through a polarization filter - from a perspective in which you are dazzled by the reflected counterlight. This version of the experiment is more realistic and is therefore more likely to heighten awareness for the problems in the subsequent parts of the experiment. As an introduction we also recomment letting students look through a polarization filter at various objects around them which reflect daylight. They should then notice that reflected light is polarized to a greater or lesser extent, providing that it is not reflected from metal or very matt non-metal surfaces.

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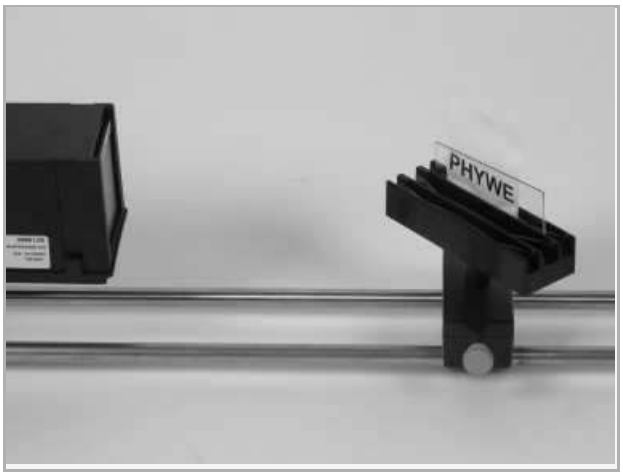
Task

Can light be polarized as a result of reflection?

Using various materials, investigate whether light which has been reflected from their surfaces is polarized and if so, whether the polarization is dependent on the angle of reflection.



Student's Sheet

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Equipment

Position No.	Material	Order No.	Quantity
1	Light box, halogen 12V/20 W	09801-00	1
2	Bottom with stem for light box	09802-10	1
3	Support base, variable	02001-00	1
4	Support rod, stainless steel, l = 600 mm, d = 10 mm	02037-00	2
5	Block, semicircular	09810-01	1
6	Slide mount for optical bench	09822-00	1
7	Mount with scale on slide mount	09823-00	1
8	Table with stem	09824-00	1
9	Plate mount f.3 objects	09830-00	1
10	Ground glass screen,50x50x2 mm	08136-01	1
11	Aperture, d 0.4mm	08206-04	1
12	Polarising filter, 50 mm x 50mm	08613-00	1
13	Diaphragm holder, attachable	11604-09	1
14	Microscopic slides, 50 pcs	64691-00	1
15	PHYWE power supply DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
Additional material			
16	Aluminium foil, approx. 50 x 50 mm		1
17	Paper, approx. 50 x 50 mm, with large print		1
18	Scissors		1

Set-up and procedure

- Set up the optic bench with the two support rods and the support base (Fig. 1 and Fig. 2).

Fig. 1

Fig. 2

- Assemble the light box according to Figures 3 and 4 and clamp it into the left part of the support base with the lens end pointing towards the optic bench (Fig. 5). Insert the ground glass screen into the well in front of the lens (Fig. 6).

Fig. 3

Fig. 4

Fig. 5

Fig. 6

- Position the table with the support into the slide mound approx. 10 cm away from the light on the optic bench (Fig. 7).

Fig. 7

- Place the block on the table with the rectangular surface facing the light and set at an angle of 45° to the optical axis (Fig. 8).

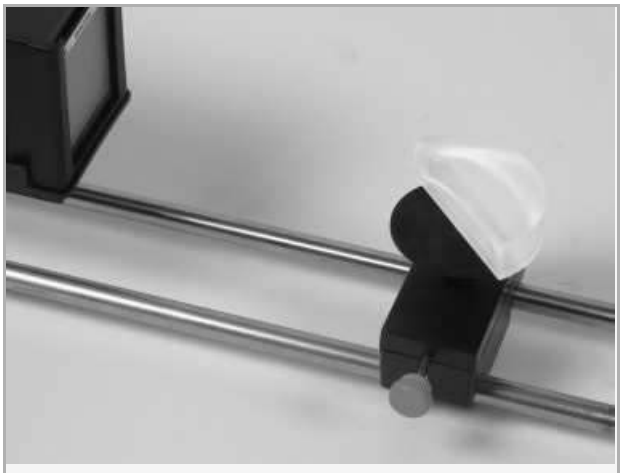

Fig. 8

- Insert the polarization filter into the diaphragm holder and attach this to the scale mount (Fig. 9).

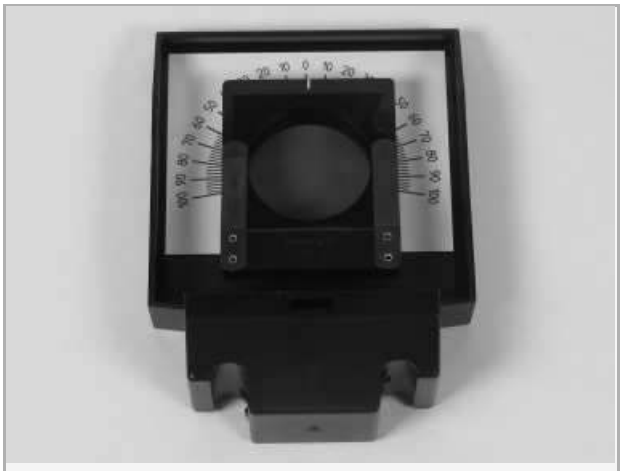

Fig. 9

- Connect the light to the power supply (12 V~) and swith on the power supply (Fig. 10); if necessary, adjust the height of the table or the light so that the rectangular surface of the block is adequately illuminated.

Fig. 10

- Look towards the light reflected from the block first with the naked eye, and then through the polarization filter which serves as an analyzer; slowly rotate the filter about its surface normal and note the observations in the report (Result – Observations 1).
- Rotate the block about its circle centre and investigate the reflected light at varying angles of incidence or reflection (which need not be measured) with the polarization filter; note your observations in the report (Result – Observations 2).
- Instead of the table with the block attache the plate holder with the glass plate (block support) to the slide mount (Fig. 11).

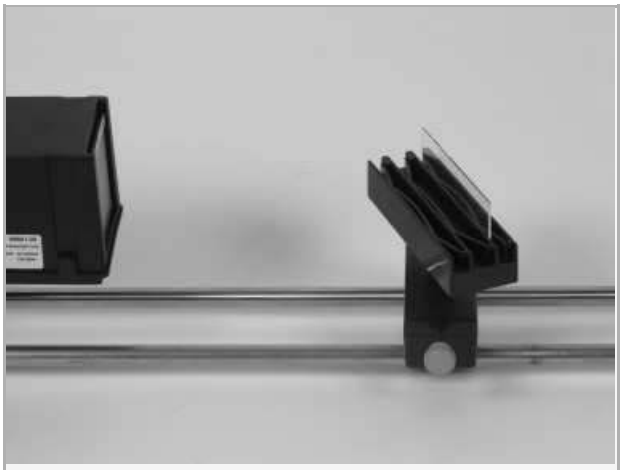

Fig. 11

- With the filter analyze the light reflected from the glass plate at varying angles of incidence and note your observations in the report (Result – Observations 3).
- Insert the paper with the large print into the plate holder behind the glass plate and direct the light onto the plate at an angle of incidence of 60° (Fig. 12); look towards the reflected light first with the naked eye, and then through the filter. Note your observations in the report (Result – Observations 4).

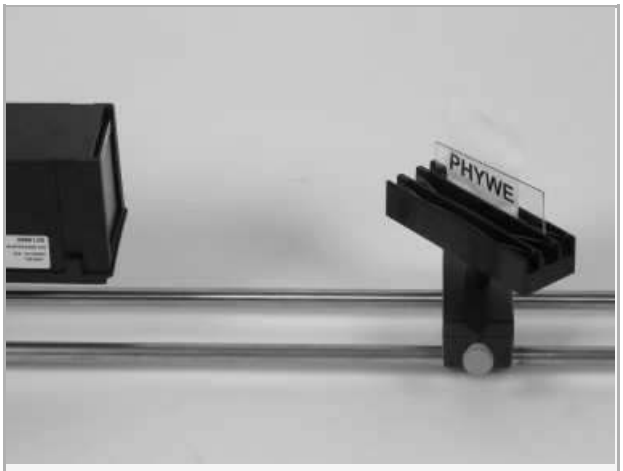

Fig. 12

- Now insert a metal plate (hole diaphragm, d = 0.4 mm) into the plate holder and use the filter to analyze the reflected light at various angles of incidence (Fig. 13). Finally, insert the shiny aluminium foil into the plate holder in front of the metal plate and analyze the light reflected from the foil (Fig. 14).

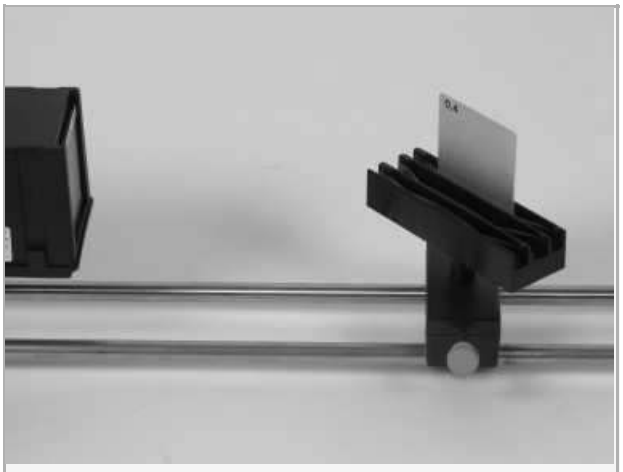

Fig. 13

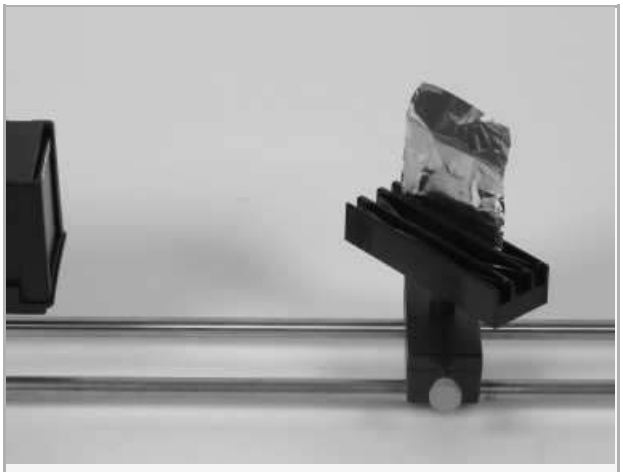

Fig. 14

- Note your observations in the report (Result – Observations 4).
- Switch off the power supply.

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Report: Polarization by reflection

Result – Observations 1

Note down your observations during the rotation of the analyzer:

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Result – Observations 2

Note your observations during the second part of the experiment:

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Result – Observations 3

Note down your observations during the experimental part with glass plate:

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Result – Observations 4

Note down your observations during the experimental part with lettered paper:

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Result – Observations 5

Note down your observations during the last experimental part with a metal plate and the aluminium foil:

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Evaluation – Question 1

Summarize the results of your observations.

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Evaluation – Question 2

The observations made under Result – Observations 4 are utilized in photography. Explain why this is so.

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