Properties of solar cells – the dependence on the illuminating intensity (Item No.: P1382600)

Curricular Relevance

Area of Expertise: Physics

Education Level: Age 16-19

Topic: Energy

Subtopic: Solar energy (solar heat, photovoltaics)

Experiment: Properties of solar cells – the dependence on the illuminating intensity

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Difficult	10 Minutes	20 Minutes	2 Students

Additional Requirements:

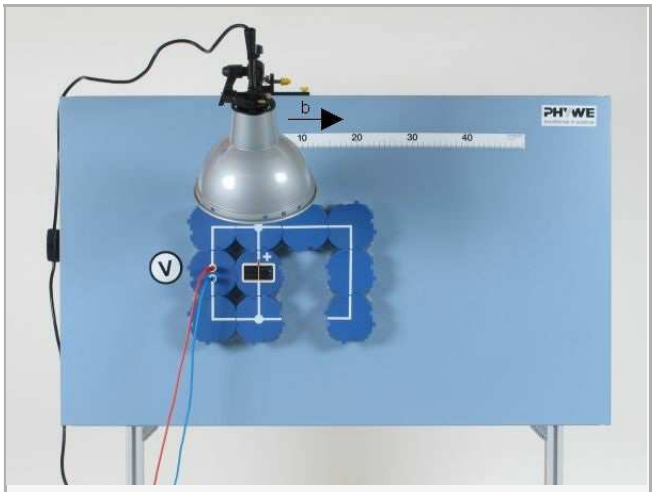
Experiment Variations:

Keywords:

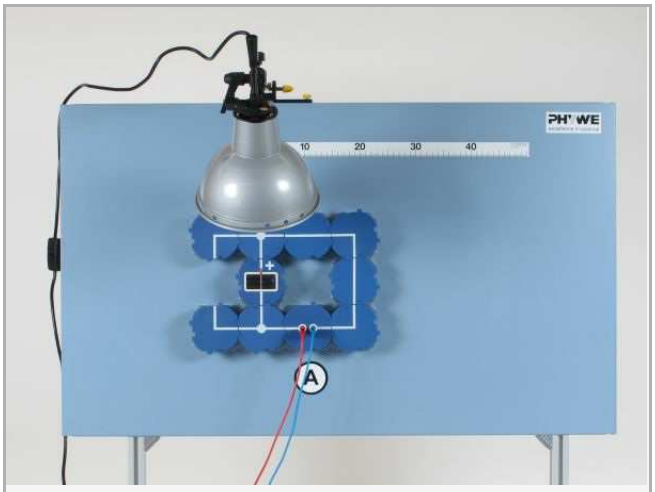
Principle and equipment

Principle

The dependence of the idle voltage generated by a solar cell and also of the short-circuit current on the illuminating intensity is to be examined.



Experimental set-up Part 1



Experimental set-up Part 2

Equipment

Position No.	Material	Order No.	Quantity
1	Multimeter ADM2, demo., analogue	13820-01	1
2	Demo Physics board with stand	02150-00	1
3	Ceramic lamp socket E27	06751-01	1
4	Solar cell (2.5x5)cm,module DB	09470-00	1
5	Clamp on holder	02164-00	1
6	Connector interrupted, module DB	09401-04	1
7	Electr.symbols f.demo-board,12pcs	02154-03	1
8	Connector, straight, module DB	09401-01	2
9	Connector, angled, module DB	09401-02	4
10	Connector, T-shaped, module DB	09401-03	2
11	Filament lamp,220V/120W,w.refl.	06759-93	1
12	Scale for demonstration board	02153-00	1
13	Bosshead, turnable	02048-04	1
14	Support rod, stainless steel, 500 mm	02032-00	1
15	Connecting cord, 32 A, 1000 mm, red	07363-01	1
16	Connecting cord, 32 A, 1000 mm, blue	07363-04	1
	Preliminary Experiment:		
	Motor, 2 V-	11031-00	1
	Disc for motor, 2 V-	11031-01	1
	Clamp on fixing magnet	021541-01	1

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Set-up and procedure

The solar cell is illluminated by a reflector lamp. The lamp is moved to the side and is realigned to face the solar cell at each position. The intensity of the illumination is thereby changed. The displacing of the lamp represents the daily movement of the sun. The idle voltage and short-circuit current are measured.

Qualitative preliminary experiment

The performance of a solar cell is dependent on the intensity of the illumination. This can be demonstrated with the help of a small motor.

- Fix the motor to the magnetic board with the clamp, attach the disc.
- Connect the motor to the solar cell.
- Change the illuminating intensity, starting with the greatest distance away of the lamp, i.e. with the smallest illuminating intensity.
- Observe the motor
  The motor only runs slowly under weak illumination. The stronger the illumination, the quicker it runs. This is particularly true for small illuminating intensities, so that these should be used to start with. A further point to consider is that the motor keeps running for some time, even when the lamp has already been switched off, for example.

Measurement of the idle voltage

- Connect up the circuit as in Fig. 1; place the modules at the left edge of the board and fix the lamp at the top edge of the board, vertically above the solar cell, using the support material and the clamp; bring the zero mark on the scale to the position of the lamp.
- Select the 1 V- measurement range, measure the idle voltage U_0, enter the value in Table 1.
- Move the lamp to the side in steps of 10 cm and at each distance b realign the lamp to face the solar cell; note the idle voltage for each position.

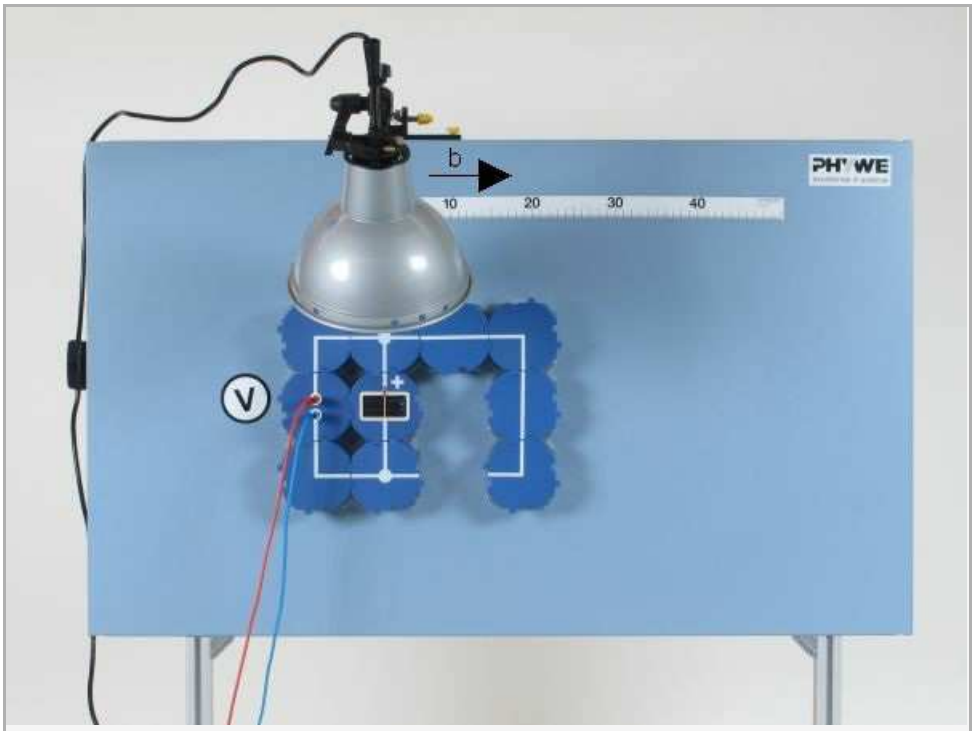

Fig. 1

Measurement of the short-circuit current

- Change the circuit to that shown in Fig. 2; select the 300 mA- measurement range, measure the short-circuit current I_{SC}, and note the measured value.
- Reduce the distance b of the lamp from the solar cell in steps of 10 cm; realign the lamp at each distance, measure and note the short-circuit current.

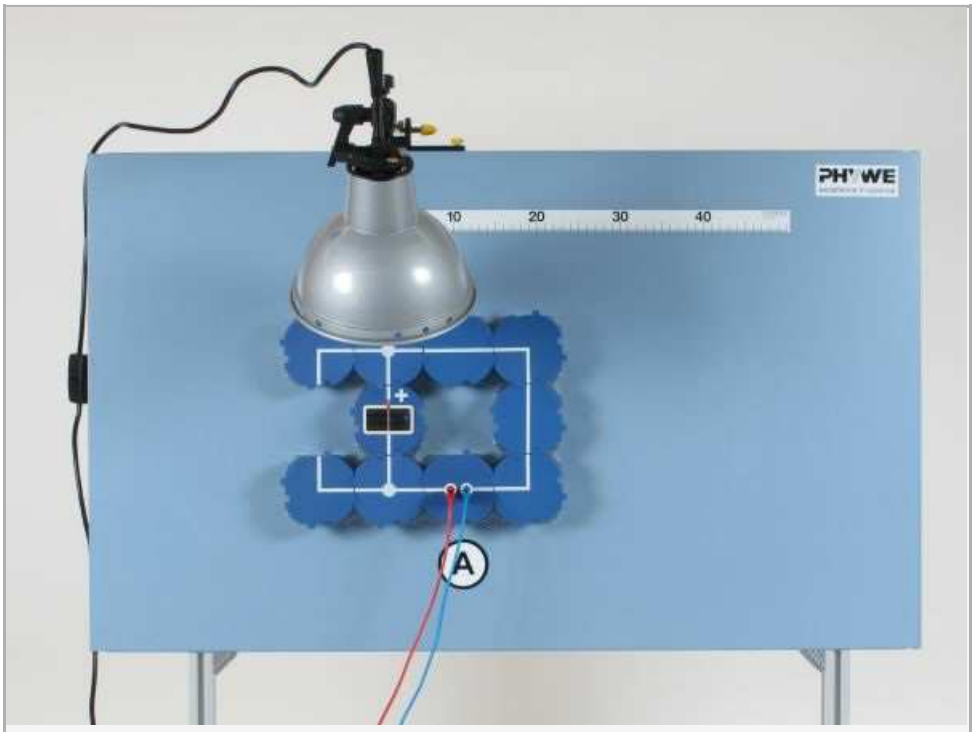

Fig. 2

Observation and evaluation

Observation

Table 1

$\frac{b}{cm}$	$\frac{U_0}{cm}$	$\frac{I_K}{mA}$
0	0.56	270
10	0.54	250
20	0.54	200
30	0.52	170
40	0.51	115
50	0.50	92
60	0.49	70
70	0.48	48
77	0.48	36

Evaluation

The graphs shown in Fig. 3 and Fig. 4 are given on plotting the measured values. The following can be derived from them:

The idle voltage of a solar cell only decreases slightly with a decrease in the illuminating intensity. In contrast to this, a decrease in the illuminating intensity has a considerable effect on the short-circuit current of a solar cell. The idle voltage U_0 is the maximum voltage generated by a current source when it is under no load; the short-circuit current is the maximum value of the current of a current source.

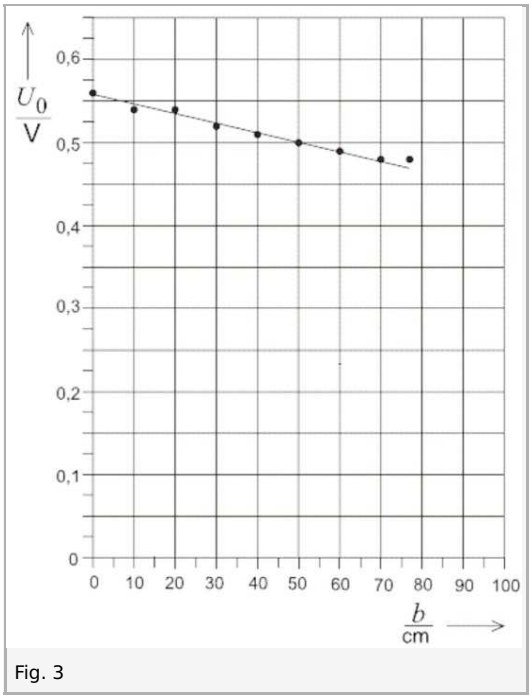

Fig. 3

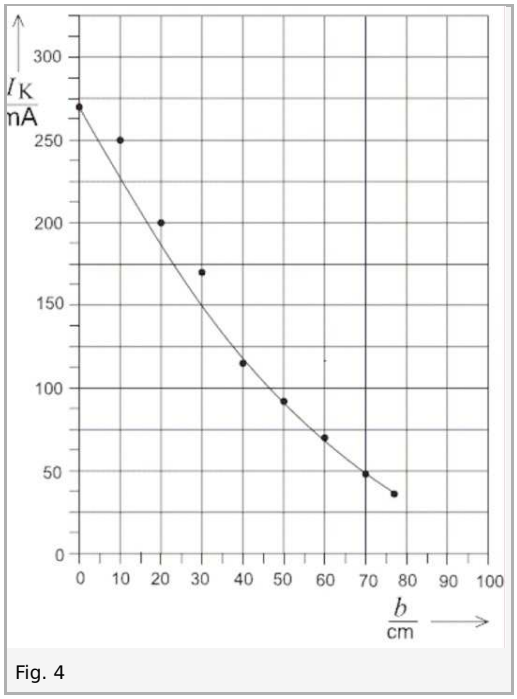

Fig. 4