When is a light emitting diode a receiver?

Physics > Modern Physics > Solid state physics

Difficulty level	Group size	Preparation time	Execution time
easy	1	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/615d94d9b107c10003773aa8

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Teacher information

Application

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Test setup

Semiconductors offer a good opportunity to get a first insight into the physics of solids away from metals.

This experiment also provides a first insight into the basic principle of semiconductors. Thus, the principle of the band gap is examined and thus a first difference to classical conductors is presented.

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Other teacher information (1/2)

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Previous

The energy of light depends on its wavelength, or frequency. It is determined with the help of the Planck quantum of action to E=h - · f.

Principle

In order to overcome the valence band gap of the semiconductor and thus initiate a conduction process, the electrons in the conduction band must be supplied with energy.

If the semiconductor is irradiated with light, the incident light releases energy to the electrons and excites them to jump into the valence band. If the energy of the incident light is not sufficient to excite the electrons and the valence band, no current flow takes place; if electrons are suitably excited, a current flow takes place and a voltage can be formed, which can be measured in this experiment.

Other teacher information (2/2)

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Learning

The students should get first insights into the principle of the semiconductor and understand the principle of the band gap.

Tasks

- Determination of the band gap of the LEDs relative to each other.

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Student Information

Motivation

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Modern cameras use semiconductor sensors to take their photos.

In this experiment, the functioning of such a sensor is investigated and it is determined what has to be taken into account when using such a sensor.

Modern camera with semiconductor sensor

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Equipment

Position	Material	Item No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l = 600 mm, d = 10 mm	02037-00	2
3	Slide mount without angle scale	09851-02	2
4	Diaphragm holder, attachable	11604-09	2
5	LED - IR, with series resistor and 4 mm plugs	09852-10	1
6	LED - red, with series resistor and 4 mm plugs	09852-20	1
7	LED - green, with series resistor and 4 mm plugs	09852-30	1
8	LED - blue, with series resistor and 4 mm plugs	09852-40	1
9	LED - UV, with series resistor and 4 mm plugs	09852-50	1
10	Stray light tube for LED, Di = 8 mm, l = 40 mm	09852-01	1
11	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
12	Digital multimeter, 600V AC/DC, 10A AC/DC, 20 MΩ, 200 µF, 20 kHz, −20°C… 760°C	07122-00	1
13	Connecting cord, 32 A, 750 mm, red	07362-01	2
14	Connecting cord, 32 A, 750 mm, blue	07362-04	2

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Structure (1/2)

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- Set up the experiment according to steps 1 to 7.

Step 1

Step 2

Step 3

Structure (2/2)

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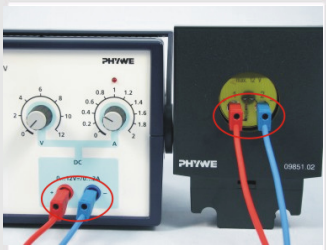
- Connect the respective LED that is to serve as a sensor to the multimeter (measuring range: 2V).

Step 4

Step 5

- Connect the LED that is to serve as the light source to the DC voltage source. Pay attention to the correct polarity!



Step 6

Step 7

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Procedure

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- LEDs with the colors red, green, blue, IR and UV are required. The wavelengths of maximum intensity (λmax) belonging to the respective LEDs are listed in the table below.
- The voltage is slowly increased until the LED "light source" starts to glow. (Since the IR LED is not visible to the eye when it lights up, the voltage is regulated here to about 2.5 V).
- Then the two LEDs are connected light-tight via the tube.
- The photo voltage generated in the LED "Sensor" is read on the multimeter.
- If a significant photovoltage occurs, document this in the corresponding cell of Table 1 in the protocol. Only enter whether a photovoltage is to be measured or not (yes/no)).

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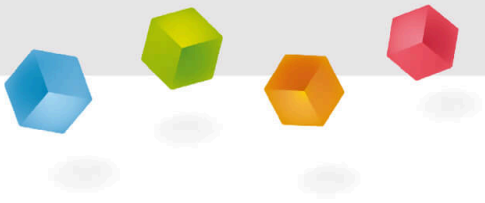

Report

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Task 1

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LED colour	Wavelength in nm	Tension?
UV	399	
blue	463	
green	514	
red	632	
IR	921	

Task 2

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Drag the words into the correct gaps.

Table 1 shows: If the _____ of the _____ is below the wavelength of the _____, a _____ has to be measured at the sensor-LED.

sensor-LED
transmitter-LED
wavelength
voltage

Check

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Slide	Score / Total
Slide 13: Wavelength range	0/4

Total score 0 / 4

Show solutions | Repeat | Export text

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