ROHINI
COLLEGE OF ENGINEERING AND TECHNOLOGY
Approved by AICTE and affiliated to Anna University,(An ISO Certified Institution)
Accredited by NAAC with A+ Grade

DEPARTMENT OF BIOMEDICAL ENGINEERING

III Semester

BM3301 SENSORS AND MEASUREMENTS

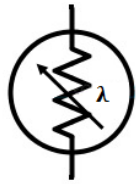
UNIT - 3

3.5 Photoconductive Cells

- The photoconductive cell is a two terminal semiconductor device whose terminal resistance will vary (linearly) with the intensity of the incident light. For obvious reasons, it is frequently called a **photoresistive** *device.*
- It changes resistance in response to a change in light intensity (the formal term is illumination)
- Also known as light dependent resistor (**LDR**).
- Photoconductive cells can be used for many of the same purposes that photovoltaic cells are used, except, of course, that they cannot act as energy sources.

Photoconductive cell construction and working:

- The photoconductive cell (PC) is a two-terminal light-sensitive semiconductor device.
- The semiconductor materials are made in the form of zig-zag strips with their ends being attached to external pins. The whole assembly is enclosed in a glass cover or protected in transparent plastic.



Photoconductive Cell Symbol

Material: Photoconductive cells are typically made using semiconductor materials. The most common material used is cadmium sulfide (CdS), although other materials such as cadmium selenide (CdSe) and lead sulfide (PbS) are also used.

Substrate: The semiconductor material is deposited or grown onto a substrate, which is usually made of ceramic or another insulating material. The substrate provides mechanical support and insulation for the photoconductive material.

Electrodes: Metal electrodes are attached to the semiconductor material to allow for electrical connections. These electrodes are usually placed at opposite ends of the photoconductive material.

Encapsulation: The entire structure is often encapsulated in a protective housing made of epoxy or another material. This encapsulation protects the photoconductive cell from environmental factors such as moisture, dust, and physical damage.

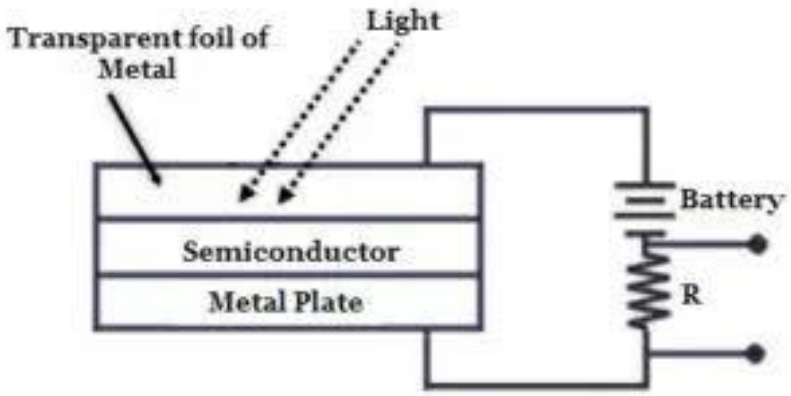


Figure.2 simple circuit for a photoconductive cell

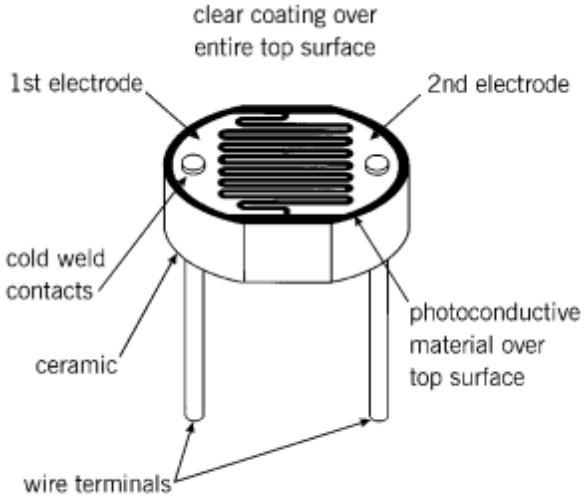


Figure 3
Typical Construction of a Plastic Coated Photocell

Working of Photoconductive cell:

1. In the absence of light, the resistance of the photoconductive cell is very high and hence the current as measured using an ammeter is also very low. This current is called dark current and the resistance corresponding to this is called ***dark resistance.***
2. This reduction in current leads to a voltage drop across the load resistor R.
3. When the photoconductive cell is exposed to external light, the resistance of the photoconductive cell decreases, resulting in a large current flow called the joint current. This is because the light energy supplied to the photoconductive cell causes its covalent bonds to be broken, resulting in the creation of electron-hole pairs.
4. Due to this increase in the number of charge carriers, the resistance of the material is proportional to the number of charge carriers.

Illumination Characteristics of Photocell (Photoconductive cell) :

Typical Characteristics of photocell is shown in figure 4

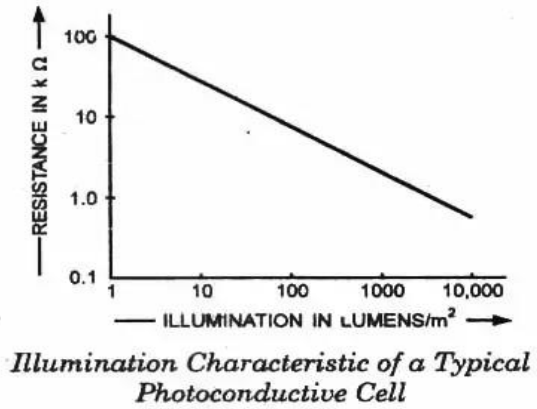


Figure 4. Typical Characteristics of Photoconductive cell

It is obvious that when the cell is not illuminated its resistance may be more than 1 00 kilo ohms. This resistance is called the dark resistance. When the cell is illuminated, the resistance may fall to a few hundred ohms. Note that the scales on the illumination characteristic are logarithmic to cover a wide range of resistance and illumination that are possible.

Advantages of Photoconductive Cell:

i. Light Sensitivity
ii. Simple Design
iii. Low cost
iv. Low power consumption
v. Fast response time

Disadvantages of Photoconductive Cell:

i. The relationship between the resistance of a photoconductive cell and incident light intensity is ***often nonlinear***.
ii. This ***temperature dependence*** can affect the accuracy of light measurements in certain applications
iii. ***Relatively Low Sensitivity***

Applications of Photoconductive Cell:

Medical Applications:

i. ***Pulse Oximetry***- Photoconductive cells can be employed in pulse oximeters to measure oxygen saturation levels in blood non-invasively.
ii. ***Photoplethysmography*** (PPG)- PPG is a technique that measures blood volume changes in tissues.
iii. ***Blood Glucose Monitoring***
iv. ***Cell and Tissue Imaging -*** Photoconductive cells can contribute to imaging systems used in biological research.
v. ***Fluorescence Spectroscopy***:
vi. ***Neuroscience Research:***
vii. ***Monitoring Light Exposure in Phototherapy***- Photoconductive cells can be employed in devices that monitor the light exposure levels during phototherapy sessions, ensuring that patients receive the appropriate amount of light for treating conditions like jaundice in newborns.

Other Applications:

i. Light Sensing and Control
ii. Photographic Exposure Control
iii. Security Systems
iv. Solar-Powered Devices
v. Optical Communication Systems
vi. Smoke Detectors
vii. Weather Stations
viii. Proximity Sensors
ix. Automotive Lighting Systems

****