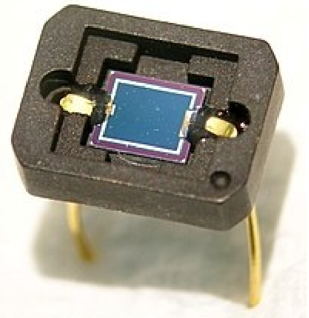
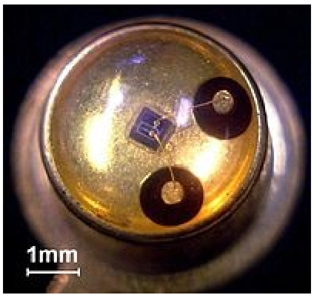
Optical radiation detectors

Radiation detectors process the incident energy emitted by the source. After the absorption of energy, the physical properties of the detector change, e.g. the release of electrons in photoelectric detectors or a temperature change in thermal detectors of optical radiation. The oldest and relatively sensitive detector of optical radiation is the human **eye**.



Photodiode



Phototransistor

Optical radiation detectors are divided into three groups according to **the principle** on which they work:

1. **Thermal detectors** use the conversion of the energy of optical radiation into thermal energy. They therefore detect an increase in the temperature of some of their parts (sensors). This change was caused by incident optical radiation. Thermal detectors tend to be non-selective (see below), but only in the optical radiation wavelength range of 0.2-50 micrometers. The most commonly used heat detectors are **thermistors**, **thermocouple** a **pyrometer**. They are most often used to detect **infrared radiation**.
2. **Photoelectric detectors** use the conversion of the energy of optical radiation into electrical energy. They are based on *photoconductivity changes, photodielectric effect (permittivity change caused by excitation of detector atoms)*, or **internal/ external photoelectric effect**. Photoelectric detectors belong to the group of selective detectors (see below). The most commonly used **photodiode**. Other photoelectric detectors are **phototransistors**, **photoresistor**, **photoelectric cell** a **photoelectric cameras**.
3. **Photochemical detectors** use photographic materials to detect radiation. The energy of optical radiation is used here to initiate a chemical reaction. A measure of absorbed energy is the density of the developed photographic image. A photographic emulsion is most often used as a photochemical detector.

We divide the detectors according to **the type of detection**:

- **direct detection** is the detection of optical radiation in which the radiation detector has the same resonant frequency as the measured optical radiation
- **indirect detection** is the exact opposite of direct detection

For all types of optical radiation detectors, we also describe their **four basic parameters**:

- **Detectability** − shows the detector's ability to detect information transmitted by radiation. It results from the threshold value of the detectable power of optical radiation.
- **Conversion efficiency** − is most often defined as the ratio between the resulting energy and the energy entering the detection process.
- **Time response** − the period of time during which the output signal of the detector changes significantly.
- **Spectral characteristic** − is the dependence of the output value of the detector on the frequency of the incident radiation. If the spectral characteristic is constant over a large range, we call the detector non-selective. In the opposite case, i.e. if it is not constant, we are talking about a selective detector.
  - **A non- selective** detector is in no way affected by **the wavelength** of the incident radiation. These are, for example, heat detectors.
  - **A selective** detectors are influenced by the wavelength of the incident radiation. These are, for example, photoelectric detectors.

All types of detectors that are used today are classified as indirect detectors (see below). If we wanted to use direct detectors, their dimensions would have to be in the range of several micrometers and the entire complex would have to have **a frequency** of 10^{15} **Hz**. This is currently not achievable with available technologies.

Human eye

The human eye is the oldest and quite sensitive detector of optical radiation. It is spectrally selective in the wavelength range of 400 to 800 nm (some authors also mention 400 to 700 nm). The human eye is most sensitive to a wavelength of 555 nm. It is able to detect the light flux as low as several tens of **photons** per second. The human eye contains two other types of optical radiation detectors, **cones** and **rods**. The sensitivity of these two detectors is not constant, as a result we can observe adaptations of the eye (automatic adaptation of the eye to the input intensity of optical radiation).

Links

Related articles

- Ionizing Radiation
- Photometry

Used literature

- NAVRÁTIL, Leoš – ROSINA, Jozef. *Medicínská biofyzika.* 5. edition. 2005. ISBN 978-80-247-1152-2.
- VRBOVÁ, Miroslava – JELÍNKOVÁ, Helena. *Úvod do laserové techniky.* 1. edition. Praha : Vydavatelství ČVUT, 1998. ISBN 80-01-01108-9.