Polarization of light

Light is an electromagnetic wave, i.e. it is an oscillation of the electric field intensity vector **E** and the magnetic field induction vector **B** perpendicular to it . Both of these vectors lie in a plane perpendicular to the direction of wave propagation (in the direction of the beam) and together with the vector in the direction of propagation (the so-called Poynting vector) form a right-handed system. For that reason, it is enough to consider only one of the vectors **E** and **B** , usually the intensity of the electric field **E** is chosen .

Let's imagine that we use a beam of light to guide a plane perpendicular to the direction of propagation. At each point of this plane, the vector **E** will have a different and basically completely random direction. Such radiation is called **unpolarized** . **Polarized** light differs from unpolarized light in that the **E** vectors have the same direction in the imaginary plane crossing the beam of light.

If the direction of the vector **E** is constant in a particular plane, we speak of **linear polarization** . But if the direction of the vector **E** changes over time, it will describe an ellipse. In this general case we speak of **elliptical polarization** . It is easy to see that linear polarization is a special case of elliptical polarization. Another special case of elliptical polarization is **circular polarization** , in which the vector **E** describes a circle.

Sources of polarized light

Polarized light can be obtained in the following ways:

1. **by reflection** – When light is reflected, partial polarization occurs, i.e. one direction of the **E** vectors prevails. At one particular angle (the Brewster angle), however, complete polarization can occur. The Brewster angle depends on the refractive index of the medium and therefore also depends on the wavelength.
2. **by refraction** – When light is refracted, it is partially polarized, similar to reflection. However, when light is refracted, it is always an incomplete polarization.
3. **birefringent** – Some crystals (e.g. Icelandic limestone) are anisotropic, i.e. their optical properties (refractive index) are dependent on the direction of the passing beam. When a beam of light falls on such a crystal, it is refracted into two rays (birefringence). One ray, the so-called regular ray, obeys the law of refraction, i.e. it passes as if the refractive index did not depend on the direction. The second ray, the so-called extraordinary ray, does not follow the law of refraction in its basic form, the index of refraction, which appears in the law of refraction, is not constant here, it depends on the angle at which the extraordinary ray passes through the medium. Both of these rays are linearly polarized and their vectors **E** are perpendicular to each other.
4. **polaroid** – Polaroid (polarizing filter) is a representative of the so-called absorption polarizers. The basis is parallel arranged elongated, in practice, for example, molecules of herapatite (periodide of quinine sulfate). Mechanistically, we can imagine it as a thick plank fence. If light whose vector **E** is parallel to the long axes of the molecules passes through such a medium, it partially passes through. But if light passes through, whose vector **E** is not parallel to the long axes of the molecules, such light is fully absorbed.

Measurement of optical activity

Optical activity is the ability of some substances to rotate the plane of polarized light (that is, to rotate the vector **E**). In the case of solutions, the angle by which the plane is turned also depends on the concentration of the solution.

From the point of view of principle, we can talk about two parts of the device for measuring optical activity (polarimeter):

1. **Polarizer** – A generator of polarized light that is placed in front of the cuvette with the measured solution.
2. **Analyzer** – A device that allows you to visualize the plane of polarization. In practice, we use two Polaroids, when by rotating the analyzer we find that light passes through only in some of its positions.

Links

Related articles

- Refractive index of light
- Polarimetry
- Visible light

Source

- KUBATOVA, Senta. *Biofot* [online]. [cit. 2011-01-31]. <https://uloz.to/!CM6zAi6z/biofot-doc>.