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Measurement and Interpretation of the Polarization

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Short Communication

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ABSTRACT

Polarimetry is the measurement and interpretation of the polarization of transverse waves, most notably electromagnetic waves, such as radio or light waves. Typically polarimetry is done on electromagnetic waves that have travelled through or have been reflected, refracted or diffracted by some material in order to characterize that object.

DESCRIPTION

Plane polarized light:

According to the wave theory of light, an ordinary ray of light is considered to be vibrating in all planes of right angles to the direction of its propagation. If this ordinary ray of light is passed through a nicol prism, the emergent ray has its vibration only in one plane [1,2].

Applications

- Polarimetry of thin films and surfaces is commonly known as ellipsometry.
- Polarimetry is used in remote sensing applications, such as planetary science, astronomy, and weather radar.

- Polarimetry can also be included in computational analysis of waves. For example, radars often consider wave polarization in post-processing to improve the characterization of the targets. In this case, polarimetry can be used to estimate the fine texture of a material, help resolve the orientation of small structures in the target, and, when circularly-polarized antennas are used, resolve the number of bounces of the received signal (the chirality of circularly polarized wave's alternates with each reflection) [3].

Polarimeter

A polarimeter is the basic scientific instrument used to make these measurements, although this term is rarely used to describe a polarimetry process performed by a computer, such as is done in polarimetric synthetic aperture radar [4,5].

Measuring optical rotation

Optically active samples, such as solutions of chiral molecules, often exhibit circular birefringence. Circular birefringence causes rotation of the polarization of plane polarized light as it passes through the sample. In ordinary light, the vibrations occur in all planes perpendicular to the direction of propagation. When light passes through a Nicol prism its vibrations in all directions except the direction of axis of the prism are cut off. The light emerging from the prism is said to be plane polarized because its vibration is in one direction. If two Nicol prisms are placed with their polarization planes parallel to each other, then the light rays emerging out of the first prism will enter the second prism. As a result, no loss of light is observed. However, if the second prism is rotated by an angle of 90˚, the light emerging from the first prism is stopped by the second prism and no light emerges. The first prism is usually called the polarizer and the second prism is called the analyser.

A simple polarimeter to measure this rotation consists of a long tube with flat glass ends, into which the sample is placed. At each end of the tube is a Nicol prism or other polarizer. Light is shone through the tube, and the prism at the other end, attached to an eye-piece, is rotated to arrive at the region of complete brightness or that of half-dark, half-bright or that of complete darkness. The angle of rotation is then read from a scale. The same phenomenon is observed after an angle of 180˚.

CONCLUSION

Polarimetry can be used to measure various optical properties of a material, including linear birefringence, circular birefringence (also known as optical rotation or optical rotary dispersion), linear dichroism, circular dichroism and scattering. To measure these various properties, there have been many designs of polarimeter, some archaic and some in current use. The most sensitive are based on interferometers, while more conventional polarimeter are based on arrangements of polarizing filters, wave plates or other devices.

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