Polarisation

Light is a form of electro-magnetic waves that exhibit polarisation, which can oscillate in more than one orientation. Linear polarisation is represented graphically, for example, by a straight line, circular polarisation by a circle, and elliptical by an ellipse. Unpolarised light does not appear to change in its intensity as it passes through a polarising unit called an analyser. The intensity appears to remain constant and unchanging. When the intensity changes in value by rotating an analyser, then the input beam is polarised in some way. An analyser is a wave-plate of known thickness and will rotate linear polarised beams. When the input beam is polarised, then as the analyser is rotated the beam intensity will decrease to zero. Thus blocking the beam.

Birefringence is found in optically transmitting crystal, such as calcite or quartz. The affect from this activity within the crystal is to have two rays propagating through it that will 'see' different refractive indices, called the ordinary, o-, and extraordinary, e-rays. This affect is visible in many crystals and the axis along which the separation of the o- and e-rays occurs is termed the optical axis. The crystals are cut to ensure that this axis is in the direction required for the optical component that is required. The use of different materials and the arrangement of the optical axis will allow for various manipulations of the rays to be done, such as blocking the o-ray and transmitting the e-ray to produce a high extinction ratio linear polariser. The extinction ratio is the ratio of e-rays transmitted over the o-rays, thus the better this ratio, the better the beam is linearly polarised.

Polarisation is an important activity to be considered within an electro-optical system as the polarised light can be used to accurately produce left- or right-handed circular polarisation. Thus, it s possible to produce very accurate linear, elliptical, and circular polarisation that can be used to accurately separate data on a single light path.

Polarisation can be obtained by using crystals, such as calcite and quartz, in various arrangements of prisms, for example, as Glan-Taylor and Wollaston. Thin film polarisers can be made by having a thin film coated onto a substrate, such as a glass prism, or polymer film. The thin film polarisers can be tuned for the best extinction ratio at specified wavelengths as the thickness of the thin film produces a different polarisation at different wavelengths. Plates of optical glass or crystal can be used to produce polarisation by having the plates angled at a shallow angle for reflection from the surfaces that form the pile-of-plates. Wire grids held on, or in, a substrate will produce polarisation at longer wavelengths, such as far infra-red and terahertz wavebands.

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