1.9 REFERENCES

1. A text Book of Optics – Brijlal, S.Chand Publishing, N.Delhi
2. Optics-Satya Prakash, Pragati Prakashan, Meerut
3. Introductory University Optics, PHI Learning, New Delhi, 1998.

12.3 RETARDATION PLATES

A retardation plate, also known as plate retarders or wave plates, is an optically transparent birefringent crystal which resolves a beam of unpolarized light into two orthogonal components (ordinary light rays and extra ordinary light rays); change the relative phase difference between the components; then recombines the components into a single beam with new polarization characteristics. These plates are very useful to produce different kind of polarized light and convert one type of polarized light to other.

A retardation plate is generally a plane-parallel plate of a birefringent crystal like quartz, mica, magnesium fluoride and sapphire, with the optic axis in the plane of the surface. It is oriented so that incident polarized light may be resolved into components projected along the optic axis and perpendicular to it. These two components will experience a relative phase shift (retardation) proportional to the thickness of the plate. When the fractional part of this retardation is a nonzero value, the waveplate modifies the polarization state of incident polarized light polarizations from one state to another. A waveplate does not polarize light, but modifies the state of polarized light. Further, a relative phase shift produced by the retardation plate is subject to the availability of both components (E- rays and O- rays) of incident light which are parallel and perpendicular to its optic axis.

The amount of retardation can be expressed as birefringence times thickness. Birefringence ($\mu_o - \mu_e$) varies with temperature and wavelength. For a given temperature and wavelength, one can form the retardation plate or the wave plate for producing a wanted phase shift between the two components (ordinary light rays and extra ordinary light rays) for specific purposes. The retardation plates are mainly of two types as follows.

12.3.1 Quarter Wave Plate

A retardation plate of such a thickness that it produce a path difference of $\lambda/4$ (quarter of the wavelength of incident light) or a phase difference $\pi/2$ between the two components (ordinary light rays and extra ordinary light rays) of incident light beam passing through it, is known as quarter wave plate. Hence, for a quarter wave plate

$$\text{Path difference} = (\mu_o \sim \mu_e)\ x \text{ thickness}$$

or

$$\lambda/4 = (\mu_o \sim \mu_e)\ t\ ,$$

Where, t is the thickness of the doubly refracting crystal or birefringent crystal

$$t = \frac{\lambda}{4(\mu_o \sim \mu_e)} \qquad \text{....... (12.1)}$$

12.3.2 Half Wave Plates

If the thickness of the retardation plate is such that it produce a path difference of $\lambda/2$ (half of the wavelength of incident light) or a phase difference π between the two components (E-ray and O-ray) of incident light beam passing through it, then this retardation plate is known as half wave plate. Hence, for a half wave plate

$$\text{Path difference} = (\mu_o \sim \mu_e)\ x \text{ thickness}$$

$$\lambda/2 = (\mu_o \sim \mu_e)\ t\ ,$$

Where$t$ is the thickness of the doubly refracting crystal or birefringent crystal

$$t = \frac{\lambda}{2(\mu_o \sim \mu_e)} \qquad \text{....... (12.2)}$$

EC-46

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