Birefrince Characteristics of an Optical Element

R.Suganya, S. Bharanidharan, R. Sreelatha

Abstract: ***Phase difference variation in uniaxial crystal is investigated for varying thickness. Using double refraction property and optic axis method leads to the intensity measurement. The periphery example got when a unique (or focalized) shaft experiences an example of birefringent gem between two polarizers contains data which is intrinsic of the crystalline example under examination.***

Key words: Uniaxial crystal, Phase difference, Intensity and Thickness.

I. INTRODUCTION

The device that divides the unpolarized light into two components and discards one is called polarizer. A polarizer does not create transverse vibrations, but merely divides the existing vibrations into two and selects one. Symmetric crystals have the same optical properties in all directions and are optically isotropic. Other crystals are not isotropic, some have a single axis with the same properties in all directions perpendicular to this axis but different properties along these axis .Such crystals are uniaxial and the axis of symmetry is called the optic axis. These crystals will satisfy the double refraction property. calcite, Nicol, Quartz are some examples of uniaxial crystals. [1],[3],[5]

When linearly polarized light is passed through the uniaxial crystal it is split up into two rays. Ordinary ray and extra ordinary ray. These two rays travel with the same velocity of light and index of refraction along the axis. It is called optic axis. If a polarizer and analyzer are placed in crossed position no light is transmitted through the analyzer. If a piece of uniaxial crystal is inserted between the polarizer and analyzer the light from the polarizer is directed along the optic axis of the uniaxial crystal and light is transmitted by the analyzer. The vibration plane has been rotated through an angle equal to the angle through which the analyzer was turned to reextinguish the light. This property that certain substances and crystals have of rotating the plane of vibration ofpolarized light is called the optical activity.

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The light propagating through the crystal may develop a net phase difference between E-components perpendicular and parallel to the crystal optic axis, but the beam remains a singles beam of light. [25],[27],[29]

Theory

The polarizer and analyzer are placed in its maximum intensity positions.

This is achieved by fixing the polarizer at 00 and rotating the rotating the analyzer. At two points maximum intensity positions are noted.Uniaxial crystal is introduced between the polarizer and the analyzer.if it is rotated maximum intensity is obtained at two points. If these two points are joined the optic axis is obtained.Uniaxial crystal will also satisfy the double refraction property. If the transmission axis of the analyzer is placed parallel to that of the polarizer that is along x axis the intensity is Ix(α). If the transmission axis of the analyzer is placed along the z axis(i.e) perpendicular to the transmission axis of the polarizer the intensity is Iz(α). The angle between the optic axis and the transmission axis of the uniaxial crystal is varied and the corresponding intensities are noted. The components of the electric field leaving the crystal parallel and perpendicular to the optic axis are[7],[9] ,[11]

$$E_{11} = E_0 \cos(\omega t+\delta) \cos \alpha$$

$$E^{\perp} = E_0 \cos \omega t \sin \alpha$$

Where E0 is the amplitude of the incident electric field, ω its angular frequency and δ the phase difference.

If the transmission axis of the analyzer along the X axis then the intensity Ix on the analyzer is obtained by taking the time average of the square of Ex.

The Cosine of the phase difference

$$\cos \delta = \frac{(I_x)_{min} - (I_Z)_{max}}{(I_x)_{min} + (I_Z)_{max}}$$

II RESULTS & DISCUSSION

Table 1

Intensity transmittance at various angles of α

α (Degrees)	$I_x(\alpha)$ in Lux	$I_z(\alpha)$ in Lux
0	59	24
10	55	27
20	45	36
45	20	57
80	42	27
90	52	23
120	31	39
180	60	24

Table 2

Phase difference variation for different thickness

No of layers	Phase difference (rad)
1	1.99
2	3.98
3	5.97
4	7.96
5	9.95

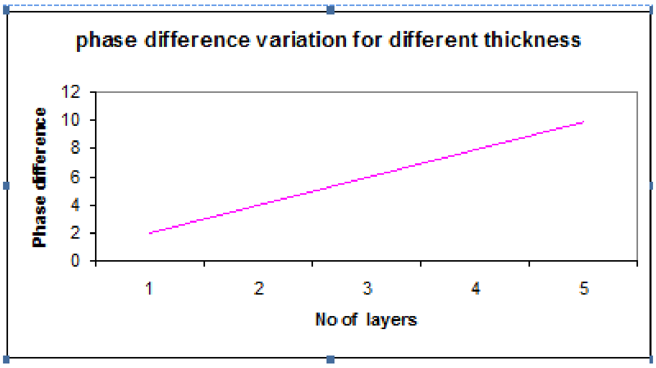

Table 1 shows that for various values of α intensity transmitted through the analyzer is not uniform, there is a random variation in the intensity. At an angle of 45 degree intensity transmitted is high. For various thicknesses the phase difference is calculated and is given in table 2. The graph is plotted for phase difference variation for different thickness, it shows a linear variation between them.

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