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**Optical functional films -- Polyethylene terephthalate (PET) --
Determination of birefringence**

光学功能薄膜 聚对苯二甲酸乙二醇酯(PET)薄膜 双折射测定方法
(English Translation)

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Foreword

This standard was drafted in accordance with GB/T 1.1-2009 given rules.

The standard reference method using redrafted ASTM D4093:1995 (Reapproved 2005) (English) "transparent or translucent plastic Birefringent material and residual strain photoelastic test methods" preparation, and ASTM D4093:1995 (Reapproved 2005) consistency Cheng Degree is not equivalent.

This standard ASTM D4093:1995 (Reapproved 2005) The main differences are as follows.

--- ASTM D4093:1995 (Reapproved 2005) in the phase delay film samples over compensation scale range only 6.1.4.3 in a simple introduction, in the optical path and then added a set value compensator, and no detailed instructions, and this standard has been described in detail;

--- ASTM D4093:1995 (Reapproved 2005) compensation method used, and used in this standard Saina Meng (Senarmont) spin Rotation analyzer method;

--- ASTM D4093:1995 (Reapproved 2005) using white light source, and this standard uses monochromatic light source;

--- ASTM D4093:1995 (Reapproved 2005) in another test portion of the inner oblique incidence birefringence involves the use of the mark Registration does not involve the in-plane birefringence;

--- ASTM D4093. in 1995 (Reapproved 2005) on residual strain of this standard does not address.

The standard proposed by China Petroleum and Chemical Industry Association.

This standard by the National Standardization Technical Committee of the optical thin film materials function (SAC/TC431) centralized.

This standard was drafted. Hefei Lucky Technology Industry Co., Ltd, China Lucky Film Group Corporation, Lucky Film Co., Ltd. of Tianjin.

Introduction

Speed of light in a vacuum is c ($3 \times 10^8 \text{m/s}$), in a transparent medium speed is v , v is always less than c , the ratio referred to them Refractive index that the refractive index $n = c/v$, isotropic material, the refractive index is a constant and the vibration direction of light propagation direction and irrelevant. Most glass and plastic materials are isotropic in the absence of stress, the refractive index is the same in all directions. When isotropic material should be subject to stress, it will have an anisotropic refractive index to have a direction, this time need to use the three principal refractive indices instead. The rate of change with the size of the strain is related to the refractive index of a transparent material if no strain occurs as n_0 , after a strain of three principal refractive index n_i suffered strain is a linear function.

$$n_i - n_0 = \sum A_{ij} S_j$$

Where $i = 1, 2, 3$ denote three directions (by Cartesian coordinates X, Y, Z represents), n_i represents a refractive index in the three directions, $j = 1, 2, 3$ and i represents the same three directions, S_j represents the strain generated in the three directions. In isotropic materials, the two constants A and B Material that is the relationship between strain and the resulting stress anisotropy occurs between.

When $i = j$, $A_{ij} = A$;

When when $i \neq j$, $A_{ij} = B$ PET film production process, after the setting by the biaxial stretching, the film plane is set to the XY plane, the film is considered in directions X and Y Stress strain occurs, there is no strain in the Z direction.

When polarized light vertical line through the transparent material, the two main strains of the material located in the S_1 and S_2 This transparent material plane, the incident light the polarization direction of S_1 and S_2 are inconsistent, this time will be split into two polarized rays respectively S_1 and S_2 strain direction vibration components, such as v_1 and v_2 denote two velocity components, compared with the refractive index $n_1 = C/v_1$, $n_2 = C/v_2$, refractive index difference between the two beams is called the Birefringent material.

$\Delta n = n_1 - n_2 = (AB) \times (S_1 - S_2) = K \times (S_1 - S_2)$ Difference in refractive index is proportional to the difference between the two principal strain, K called optical constant strain, it is a constant physical properties, reflecting the performance of the material. by the two beams of light propagation velocity in two different components is no longer synchronized, when through the thickness t of material to form the optical path difference in the two different levels S_1 and S_2 plane polarized light vibrating inside the line after the relative distance has generated through the material, known as delay (delay amount) R , R by the following formula She said.

$R = (n_1 - n_2) \times t = K \times t \times (S_1 - S_2)$ where. t represents the thickness of the material.

Since $\Delta n = n_1 - n_2 = R/t$, so the birefringence can be expressed as the thickness of the material produced by the unit phase delay.

There are two purposes birefringence measurement.

- 1) identify the main strain of the film (ie, the main stress) direction;
- 2) to determine the size of the delay amount, then obtain the magnitude of birefringence.

Using polarized light optical interference, by measuring the optical path difference compensation method.

Sena Meng Compensation Law analyzer rotation corresponds to a wavelength of 180° phase delay.

When a bunch of vertically polarized light incident on the film, will be split into the main strain S_1 and S_2 direction vibration two beams of polarized light, the two beams N_1 and n_2 the refractive index of the light and the main strain related.

$n_1 - n_0 = A S_1$ $n_2 - n_0 = B S_2$ where. n_0 is no refractive index when isotropic strain; A and B are constants associated with the material.

From the above formula can be drawn.

$n_1 - n_2 = (A - B) \times (S_1 - S_2)$ Refractive index ($n_1 - n_2$) is birefringent Δn .

Optically functional film Polyethylene terephthalate (PET) film A birefringence measuring method

1 Scope

This standard specifies the polyethylene terephthalate (PET) film birefringence measurement method using Sena Meng method should include determination of the main Change direction and the phase delay of two parts.

This standard applies to one-way or two-way stretch technology manufacturing PET film, apply a stretch plastic film manufacturing process may also be other use.

Note: This standard only relates to the film surface birefringence, the plane birefringence not considered.

2 Terms and definitions

The following terms and definitions apply to this document.

Strain

Deformation generated per unit length, it is divided into the manufacturing process

introduced by elastic strain permanent plastic strain and the presence of stress, both of which Strain will produce strain birefringence.

The optical axis azimuth optical orientation Master sample and the sample should slow axis direction TD (film manufacturing equipment transmission direction is called MD direction and the direction perpendicular to MD Called TD direction, that is, the angle between the web lateral) direction between.

Delay amount retardation Light through the spacing between the two wavefront after birefringent material, also known as the relative amount of delay.

Birefringence Anisotropic film refractive index, generally by mechanical or thermal strain generated, depending on the refractive index for the spread of the plane of polarization of the light beam orientation and Direction, usually produced by the strain, and the crystal orientation of the material during manufacture of the anisotropic material. It can also be expressed as relative unit thickness delay.

3.1 Micrometer or thickness gauge

Micrometer or thickness gauge, test accuracy of 1%.

3.2 Method Sena Meng polarimeter

Polarimeter system structure shown in Figure 1.