

RESIN MOLDED PRODUCT WITH
IMMOBILIZED POLARIZATION ORIENTATION

The present invention relates to a resin molded product made of polyester which exhibits anisotropism in the molten state and/or a polyester containing partly in the same molecular chain a polyester which exhibits anisotropism in the molten state, said resin molded product being characterized in that it is subjected to an electric field with heating and subsequently cooled, whereby the polarization orientation is immobilized.

It is known to persons skilled in the art that when a compound having the intramolecular polarization undergoes poling with heating, or the application of a magnetic field and/or electric field with heating, the polarization is immobilized. The technique based on this knowledge is commonly used in the industry. Some ferroelectric polymeric compounds are known to be subject to the immobilization of polarization upon poling. Examples of such compounds include polyvinylidene fluoride, polytrifluoroethylene, and polyvinylidene cyanide-vinyl acetate copolymer. These ferroelectric polymers have some drawbacks. The control of orientation is not easy depending on the type of crystals, when it is necessary to bring about the polarization orientation, to immobilize the polarization in the amorphous region, or

to bring about the orientation in a specific part alone. In addition, their polarization orientation can be used only at a low temperature range, i.e., 140 to 160°C, which is limited by their heat resistance. Moreover, their response is very slow to the application of electric field to bring about polarization orientation. (E.g., about 1 hour at 100 kV/cm) To shorten the response time, it is necessary to apply a high voltage and the resin is required to have a high dielectric breakdown strength to resist such a high voltage.

In view of the above-mentioned problems, the present inventors carried out extensive studies to develop a new material capable of polarization orientation which can be used at a high temperature and can undergo the poling within a short time. In their studies, the present inventors paid their attention to the response time and polarization orientation of a low-molecular weight liquid crystal compound, and they found that there are some polymeric compounds which have the properties of liquid crystal and also the properties of polarization orientation. This finding led to the present invention.

Accordingly, the present invention provides a resin molded product made of a polyester which exhibits anisotropism in the molten state and/or a polymer containing partly in the same molecular chain a polyester which exhibits anisotropism in the molten state, said resin molded product being characterized in that it is subjected to an electric field with heating and subsequently cooled, whereby the polarization orientation is immobilized.

It is a surprise to find that contrary to expectation the resin molded product of this invention quickly responds to polarization orientation.

The polyester used in this invention is a polymer composition which exhibits optical anisotropism in the molten state and is capable of thermoplastic melt-processing. It generally falls under the category of thermotropic liquid crystal polymer.

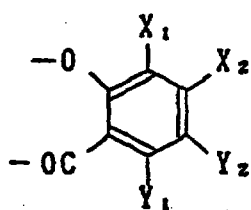
The polymer which forms the anisotropic molten phase has the properties of permitting the polymer molecular chains to assume regular parallel arrangement in the molten state. The state in which molecules are arranged in such a manner is referred to as the liquid crystal state. The polymer like this is usually produced from a monomer which has a thin, long, and flat configuration, has a high rigidity along the long axis of the molecule, and has a plurality of chain extension linkages which are coaxial or parallel with one another.

The properties of the anisotropic molten phase can be determined by an ordinary polarization test using crossed nicols. More particularly, the properties can be determined with a Leitz polarizing microscope of 40 magnifications by observing a sample placed on a Leitz hot stage in a nitrogen atmosphere. The polymer is optically anisotropic. Namely, it transmits a light when it is placed between the crossed nicols. When the sample is optically anisotropic, the polarized light can be transmitted through it even in a still state.

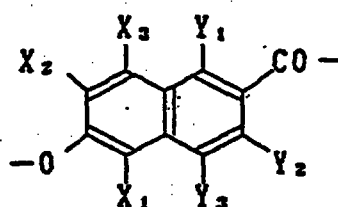
The resin molded product to this invention is characterized in that the polyester which exhibits anisotropism in the molten state is preferably one

which contains an aromatic hydroxycarboxylic acid residue and aromatic substituted derivative residue thereof. The hydroxyl group and carboxylic acid group should preferably be substituted directly on the aromatic ring, and the hydroxyl group and carboxylic acid group may be on the same aromatic ring or different aromatic rings. In either cases, they should be in the same molecule of the aromatic cyclic compound. The aromatic hydroxycarboxylic acid resin should preferably be a compound composed of one or more kinds selected from hydroxybenzoic acid residue, hydroxynaphthoic acid residue, and their aromatic substituted derivative residue. The aromatic substituted derivative residue should have the substituent group selected from functional group which imparts the anisotropism to the intramolecular dipole moment of the hydroxycarboxylic acid compound and is at the substitution position to impart such anisotropism. In addition, the substituent group of the aromatic substituted derivative residue is one which imparts the anisotropism to the dipole moment in the direction of the line connecting the carbon atoms on the aromatic ring to which the hydroxyl group and carboxylic acid group are connected, and is at the substitution position to impart such anisotropism. Preferred examples are those represented by the following formulas (I) to (VII).

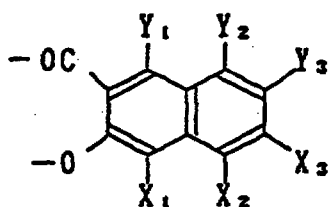




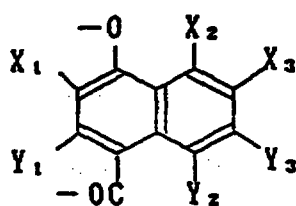
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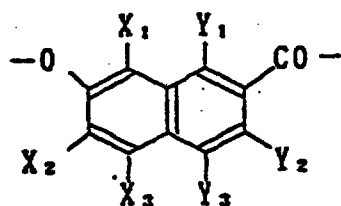
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(V)



(VI)



(VII)

(wherein the group consisting of X_1 , X_2 , and X_3 , and the group consisting of Y_1 , Y_2 , and Y_3 , are separated by a line which intersects at right

angles a line connecting the carbon atoms on the aromatic ring to which the hydroxyl group and carboxylic acid group are connected, at the center thereof; each of said groups is selected from hydrogen and substituents which differ from one another in dipole moment; and the same group does not contain substituents which differ from one another in the direction of dipole moment.

The substituent group is selected from one or more of a cyano group, nitro group, aldehyde group, carboxylic acid ester, carboxylic acid group, hydroxyl group, halogen, amino group, imino group, alkoxy group, alkyl group, phenyl group, acyl group, sulfoxy group, and sulfide group. Preferably, it is selected from hydrogen, cyano group, and nitro group, acetoxy group, chlorine, bromine, phenyl group, alkyl group, methoxy group, amino group, and alkyl-substituted amino group.

The above-mentioned polyester which exhibits anisotropism in the molten state may be a homopolymer or a block copolymer. In the latter case, the segments of the said polyester are copolymerized in the other polymer which may not be capable of polarization orientation. The other polymer is selected from one or more of an aromatic polyester, polycarbonate, polyethersulfone, polyacrylate, and polyalkylene terephthalate.

The polymer which exhibits anisotropism in the molten state may be contained in the other thermoplastic polymer. It may be dispersed in the miscible form or immiscible form. Those which are uniformly dispersible are preferable, and their examples include aromatic

polyester, polycarbonate, polyether sulfone, polyacrylate, and polyalkylene terephthalate.

The polyester which exhibits the anisotropism in the molten state may be produced by a variety of ester-forming processes.

The monomer compounds can be reacted by melt acidolysis in the absence of any heat exchange fluid. In this process, the monomers are heated to form a melt of reactants. As the reaction proceeds, the solid polymer particles begin to suspend in the melt. In the final stage of the condensation reaction, the reaction system may be evacuated to facilitate the removal of volatile by-products such as acetic acid and water.

A slurry polymerization process may also be employed in the preparation of fully aromatic polyesters suitable for use in the present invention. In this process, the solid product is obtained in the form of suspension in a heat exchange medium.

In either of said melt acidolysis and slurry polymerization processes, the organic monomeric reactants from which the fully aromatic polyesters can be derived may be employed in the reaction in a modified form obtained by esterifying the hydroxyl group of the monomer at ambient temperature (i.e., in the form of their lower acyl esters). The lower acyl groups have preferably about 2 to 4 carbon atoms. Preferably, acetate esters of the organic monomeric reactants are employed in the reaction. Also, the modified form (i.e., phenol ester) formed by esterifying the carboxylic acid group may be used for the reaction.

Typical examples of the catalysts that can be used in both of the melt acidolysis and slurry processes include dialkyltin oxides (such as dibutyltin oxide), diaryltin oxides, titanium dioxide, antimony trioxide, alkoxytitanium silicates, titanium alkoxides, alkali metal and alkaline earth metal salts of carboxylic acids (such as zinc acetate), Lewis acids (such as BF_3), and hydrogen halides and other gaseous acids (e.g., HCl). The catalyst is generally used in an amount of about 0.001 to 1 wt%, particularly about 0.01 to 0.2 wt%, based on the monomer.

The aromatic polymers suitable for use in the present invention are substantially insoluble in ordinary solvents and, therefore, they are unsuitable for use in a solution processing. However, these polymers can be processed easily by the ordinary melt processing. Particularly preferred aromatic polymers are soluble in pentafluorophenol to some extent.

The aromatic polyester which is preferably used in the present invention have a weight-average molecular weight of about 1,000 to 200,000, preferably about 2,000 to 50,000, particularly about 3,000 to 25,000.

The molecular weight may be determined by gel permeation chromatography or other standard methods which need no polymer solution, such as a method in which terminal groups are determined by infrared spectroscopy using a compression-molded film sample. The molecular weight may also be determined by the light-scattering method using a solution of pentafluorophenol.

The above mentioned aromatic polyester preferably has an inherent viscosity (I.V.) of at least about 0.5 dl/g, for example, about 0.5 to 10.0 dl/g as measured in a 0.1 wt% solution in pentafluorophenol at 60°C.

The polyester which exhibits anisotropism in the molten state may contain another ferroelectric substance. Such ferroelectric compound enhances the properties of the polyester used as a ferroelectric material. The ferroelectric compound may be inorganic compounds, organic compounds, or polymeric compounds.

Examples of the organic compounds include quartz, lead zirconate titanate, potassium hydrogen phosphate, barium titanate, lead titanate, lead niobate, lithium niobate, lithium tantalate, strontium barium niobate, $\text{Pb}(\text{B}_1\text{B}_2)\text{O}_3$, and $\text{PbTiO}_3\cdot\text{PbZrO}_3\cdot\text{Pb}(\text{B}_1\text{B}_2)\text{O}_3$ (where B_1 represents Mg, Co, Ni, Mn, or Zn; and B_2 represents Nb, Ta, Sb, or W).

Examples of the organic compounds include low-molecular liquid crystal compounds, Rochelle salt, and triglycin sulfate. Explanation on low-molecular liquid crystal compounds will be found in "Ekisho no Saishin Gijutsu" (Latest Technology of Liquid Crystals) by Matsumoto and Tsunoda (Kogyo Chosakai) and "Handbook of Liquid Crystals" by K.Kelker and R.Hatz (Weinheim, 1980)

Examples of the polymeric compound include polymers and copolymers of vinylidene fluoride, trifluoroethylene, vinylidene cyanide, and chloroacrylonitrile.

The polyester obtained in this invention is usually subjected to poling when it is formed into sheet or film. After poling, it may be

used in the form of powder having polarization orientation. This powder may also be dispersed into a thermosetting or thermoplastic resin.

Examples of the thermosetting resin include phenolic resin, epoxy resin, melamine resin, urea resin, unsaturated polyester resin, and alkyd resin.

Examples of the thermoplastic resin include polyethylene, polypropylene, polybutylene, polybutadiene, polyisoprene, polyvinyl acetate, polyvinyl chloride, polyvinylidene chloride, polystyrene, acrylic resin, ABS resin, AS resin, BS resin, polyurethane, silicone resin, fluoroplastic, cyan resin, polyacetal, polycarbonate, polyethylene terephthalate, polybutylene terephthalate, aromatic polyester, polyamide, polyacrylonitrile, polyvinyl alcohol, polyvinyl ether, polyetherimide, polyamideimide, polyetherimide, polyetherketone, polyethersulfone, polysulfone, polyphenylene sulfide, and polyphenylene oxide.

Preferred ones are aromatic polyester, polycarbonate, polyether sulfone, polyacrylate, polyalkylene terephthalate, and polymers and copolymers derived from vinylidene fluoride, trifluoroethylene, vinylidene cyanide, and chloroacrylonitrile.

The application of electric field can be carried out by the method known to persons skilled in the art. Both sides of the sheet or film of the polyester of this invention are treated for electric conduction, and a voltage is applied to the sheet or film with heating. The voltage application may be performed continuously or intermittently (in pulse). The intermittent application in pulse is preferred for the ease of

polarization orientation. The object is achieved with minimum heating sufficient to impart kinetic energy that causes the polarization inversion. For complete polarization inversion, the heating temperature should be higher than the melting point of the polyester. At such a temperature the polarization orientation takes place very quickly because of the properties of liquid crystal the polyester originally possesses. Where the polarized anisotropic strain is required, heating below the melting point is preferred. After the treatment for polarization orientation, the molded product is cooled rapidly so that the orientation is immobilized.

The polyester and composite product thereof obtained in this invention may be incorporated with a variety of additives by the method known to persons skilled in the art. The additives include plasticizer, antioxidant, UV light absorber, antistatic agent, flame retardant, dye and pigment, surface treatment therefor, and reinforcing fiber and inorganic filler.

The polyester and compound product thereof obtained in this invention may be formed into film, sheet, fiber, and powder for a variety of applications.

As mentioned above, the present invention provides a resin molded product made of a polyester which exhibits the anisotropism in the molten state and/or a polyester containing partly in the same molecular chain a polyester which exhibits the anisotropism in the molten state, said resin molded product being characterized in that it is subjected to

an electric field with heating and subsequently cooled, whereby the polarization orientation is immobilized. The resin molded product of this invention has several features. It has extremely high heat resistance. The molecules are extremely mobile in the molten state because the molecular chain is rigid and has the property of liquid crystal. It is quickly responsive to the application of electric field. Therefore, the resin molded product of this invention finds a large variety of application. It can be used in a hot environment above 150°C in which the ordinary ferroelectric polymeric material cannot be used. It can be used as a display material or shutter element which requires heat resistance. It can also be used as a memory material and selective functional membrane if the part for the application of electric field or the part for heating (by, for example, laser irradiation) are properly selected.

The above-mentioned method is also effective in eliminating the disadvantage inherent in the resin which exhibits the anisotropism in the molten state. For example, it physically controls the properties of excessive orientation, improves the strength of weld, and prevents the fibrillation which occurs in the case of excessive orientation.

Brief Description of the Drawings:

Fig. 1 is a chart showing the relation between the wave number and the absorbance which was obtained by measuring FTIR of the film used in this invention.

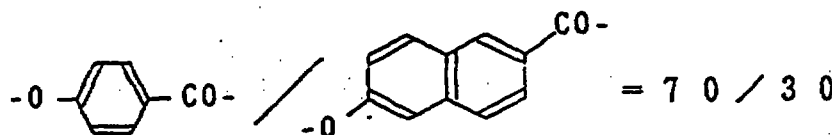
Fig. 2 is a microphotograph of the resin molded product of this invention observed under a polarization microscope.

Example 1

1261 parts by weight of 4-acetoxybenzoic acid and 691 parts by weight of 6-acetoxy-2-naphthoic acid were placed in a reactor provided with a stirrer, a nitrogen inlet tube, and a distillation tube. The mixture was heated to 250°C under a nitrogen stream and stirred vigorously at that temperature for 3 h and then at 280°C for 2 h while acetic acid was distilled off from the reactor. The temperature was elevated to 320°C and the feeding of nitrogen was stopped. The pressure in the reactor was reduced gradually to 0.1 mmHg after 20 min. The mixture was stirred at that temperature under that pressure for 1 h.

The resulting polymer had an intrinsic viscosity of 5.4 as determined in pentafluorophenol at a concentration of 0.1 wt% at 60°C.

The resulting polymer has the following constitutional units.



The resulting polymer was made into a 20-μm thick film by using a T-die extruder. The extruder and T-die were set at 300°C and 290°C, respectively. The film was uniaxially stretched at a draw ratio of 1/10. This film was examined with polarized light in the directions parallel to and perpendicular to the orientation axis by using an FTIR made by Nippon Bunko Co., Ltd. The charts obtained in the examination are shown in Figs. 1(a) and 1(b). The chart obtained without using a polarizing plate is shown in Fig. 1(c). These charts show that the film in this example is highly oriented in the axial direction.

The uniaxially oriented film was held between two Nesa glass plates provided with lead wires. The assembly was inserted into a hot stage, and the film was observed under a polarization microscope provided with crossed nicols. A fibrous pattern characteristic of nematic liquid crystal was observed when the temperature reached 80°C. Fig. 2(a) shows the pattern observed through the crossed nicols at 310°C. When an AC voltage (100 V, 60 Hz) was applied to the Nesa glass plate through the lead wires while the film was heated at 300°C, the visual field became dark within 12 seconds and the fibrous pattern of Fig. 2(a) disappeared. Fig. 2(b) shows a pattern observed 20 seconds after the application of AC voltage (100 V). With the voltage applied, the temperature was lowered to 200°C. At 200°C, the application of voltage was suspended. The film was allowed to cool to room temperature. After 1 week, the film was examined in the same manner as mentioned above. The visual field remained dark. This indicates that the polarization orientation took place in the direction in which the voltage was applied and the orientation was immobilized in the polymer.

The film sample was heated again to 300°C and the Nesa glass plates were slid in the opposite direction so that shear is exerted to the film sample. The film sample was observed under a polarization microscope in the same manner as mentioned above. The same fibrous pattern as that observed before the voltage application was observed.

Table 1 shows the results obtained under different conditions.

Table 1

Voltage (V) of electric field	Type of electric field	Time for dark change (sec)	Optical density $\log I_0/I$
40	60 Hz, AC	870	1.7
60	60 Hz, AC	240	2.2
80	60 Hz, AC	100	2.3
100	60 Hz, AC	12	2.4
100	DC	10	2.4

Comparative Example 1

The same film sample as obtained in Example 1 was heated to 400°C without applying the voltage and observed under a polarization microscope. The visual field did not become dark. Then, the temperature of the film sample was lowered to 200°C; but the fibrous pattern did not disappear.

Comparative Example 2

166 parts by weight of terephthalic acid, 166 parts by weight of isophthalic acid, and 250 parts by weight of diacetoxymethylhydroquinone were placed in a reactor provided with a stirrer, a nitrogen inlet tube, and a distillation tube. The mixture was heated to 260°C under a nitrogen stream and stirred vigorously at that temperature for 2.5 h and then at 280°C for 3 h while acetic acid was distilled off from the reactor. The temperature was elevated to 320°C and the feeding of nitrogen was stopped. The pressure in the reactor was reduced gradually

to 0.1 mmHg after 15 min. The mixture was stirred at that temperature under that pressure for 1 h.

The resulting polymer had an intrinsic viscosity of 0.87 as determined in a 1:1 mixed solvent of tetrachloroethane and phenol at a concentration of 0.5 wt%.

The resulting polymer was made into a film sample in the same manner as in Example 1 (extruder at 270°C and T-die at 260°C). The film sample was observed under a polarization microscope as in Example 1. The film sample exhibited a fibrous pattern at 250°C. A DC voltage (100 V and pulse) was applied for 30 minutes at 300°C. The visual field did not become dark, and the fibrous pattern did not disappear. The same was true of the film sample after cooling.

Example 2

138.2 parts by weight of polyethylene terephthalate (having an intrinsic viscosity of 0.36) was added to 162 parts by weight of polyester (having an intrinsic viscosity of 0.77) preliminarily polymerized at 260°C for 3 hours in the same manner as in Example 1. The reaction was continued in the same reactor at 280°C for 4 hours with vigorous agitation. The reaction temperature was raised to 320°C and the feeding of nitrogen was stopped. The reactor was evacuated to 0.1 mmHg after 15 minutes. Stirring was continued for 1 hour at this temperature and pressure.

The resulting polymer had an intrinsic viscosity of 2.9 as determined in pentafluorophenol at a concentration of 0.1 wt% at 60°C.

The resulting polymer was found to be composed of 40 mol% of polyethylene terephthalate and 60 mol% of hydroxybenzoic acid and hydroxynaphthoic acid.

The polymer was made into a film in the same manner as in Example 1, and the film was observed on the hot stage. The fibrous pattern appeared at 230°C, and the visual field became dark when an AC voltage (100 V) was applied for 20 seconds at 280°C. The dark visual field remained after the film was allowed to cool at room temperature. The fibrous pattern was restored when the film was subjected to shear with heating. The results are shown in Table 2.

Table 2

Voltage (V) of electric field	Type of electric field	Time for dark change (sec)	Optical density $\log I_0/I$
60	60 Hz, AC	1100	2.1
80	60 Hz, AC	215	2.2
100	60 Hz, AC	20	2.3
100	DC	18	2.3

Example 3

900 parts by weight of 4-acetoxybenzoic acid, 431 parts by weight of 4-acetoxy-3-chlorobenzoic acid, and 690 parts by weight of 6-acetoxy-2-naphthoic acid were placed in a reactor provided with a stirrer, a nitrogen inlet tube, and a distillation tube. The mixture was heated to 250°C under a nitrogen stream and stirred vigorously at that temperature

for 3 h and then at 280°C for 2 h while acetic acid was distilled off from the reactor. The temperature was elevated to 320°C and the feeding of nitrogen was stopped. The pressure in the reactor was reduced gradually to 0.1 mmHg after 20 min. The mixture was stirred at that temperature under that pressure for 1 h.

The resulting polymer had an intrinsic viscosity of 5.0 as determined in pentafluorophenol at a concentration of 0.1 wt% at 60°C.

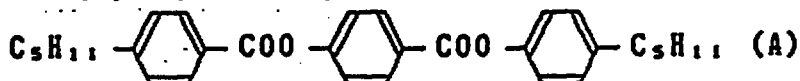
The polymer was made into a film in the same manner as in Example 1, and the film was observed on the hot stage. The fibrous pattern appeared at 250°C, and the visual field became dark when a DC voltage (100 V, pulse) was applied for 19 seconds at 280°C. The dark visual field remained after the film was allowed to cool at room temperature. The fibrous pattern was restored when the film was subjected to shear with heating. The results are shown in Table 3.

Table 3

Voltage (V) of electric field	Type of electric field	Time for dark change (sec)	Optical density $\log I_0/I$
60	60 Hz, AC	210	2.2
80	60 Hz, AC	95	2.3
100	60 Hz, AC	11	2.4
100	DC	9	2.4

Example 4

38.4 parts by weight of p-amybenzoic acid and 36.0 parts by weight of acetoxybenzoic acid were reacted under reflux in 200 ml of toluene. Then, 41.2 parts by weight of p-amyphenol was added, and the reaction was continued under reflux. Thus there was obtained amyphenolbenzoate ester (amyphenyl carboxylate).



This low-molecular compound had a T_m of 78°C . It exhibited the Schlieren pattern or the properties of nematic liquid crystal under a polarization microscope. Twenty parts by weight of the low-molecular compound (A) was added to 100 parts by weight of the polymer obtained in Example 1, and the resulting composition was formed into a film in the same manner as in Example 1. The film was optically observed. The fibrous pattern was observed at 250°C , and the visual field became dark when a DC voltage (100 V, pulse) was applied for 7 seconds at 280°C . The dark visual field remained after the film was allowed to cool at room temperature. The fibrous pattern was restored when the film was subjected to shear with heating.

Example 5

60 parts of the polymer obtained in Example 2 (which exhibits the anisotropism in the molten state) was mixed with 40 parts by weight of polyethylene terephthalate. The mixture was made into a film and the film was observed in the same same manner as in Example 1. The visual field became dark when a DC voltage (100 V, pulse) was applied for 20 seconds at 280°C . The $\log I_0/I$ was 1.8.



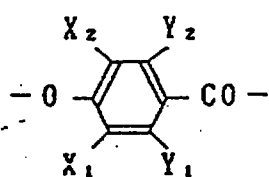
CLAIMS

1. A resin molded product made of a polyester which exhibits anisotropism in the molten state and/or a polymer containing partly in the same molecular chain a polyester which exhibits anisotropism in the molten state, said resin molded product being characterized in that it is subjected to an electric field with heating and subsequently cooled, whereby the polarization orientation is immobilized.
2. A resin molded product as set forth in Claim 1, wherein the polyester which exhibits anisotropism in the molten state is one which is composed mainly of an aromatic hydroxycarboxylic acid residue and one or more aromatic substituted derivative residues thereof.
3. A resin molded product as set forth in Claim 2, wherein the aromatic hydroxycarboxylic acid residue is a hydroxybenzoic acid residue or hydroxynapthoic acid residue.
4. A resin molded product as set forth in Claim 1, wherein the ^{polymer}~~polyester~~ containing partly in the same molecular chain a polyester which exhibits anisotropism in the molten state is a copolymer composed of a polyester which exhibits anisotropism in the molten state and one or more polymers selected from other aromatic polyesters, polycarbonate, polyether sulfone, polyacrylate, and polyalkylene terephthalate.

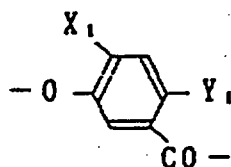


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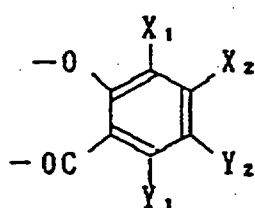
5. A resin molded product as set forth in Claim 1, wherein the polyester which exhibits anisotropism in the molten state and/or the ^{polymer}~~polyester~~ containing partly in the same molecular chain a polyester which exhibits anisotropism in the molten state is contained in another thermoplastic polymer.
6. A resin molded product as set forth in Claim 2, wherein the substituent group of the aromatic substituted derivative residue is one which imparts anisotropism to the intramolecular dipole moment of the hydroxycarboxylic acid compound and is at the substitution position to impart such anisotropism.
7. A resin molded product as set forth in Claim 2, wherein the substituent group of the aromatic substituted derivative residue is one which imparts anisotropism to the dipole moment in the direction of the line connecting the carbon atoms on the aromatic ring to which the hydroxyl group and carboxylic acid group are connected, and is at the substitution position to impart such anisotropism.
8. A resin molded product as set forth in claim 2, wherein the aromatic hydroxycarboxylic acid residue is composed of one or more kinds selected from the following formulas (I) to (VII).



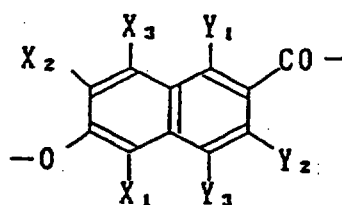
(I)



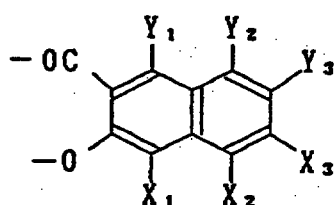
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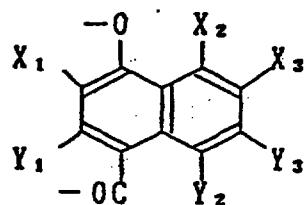
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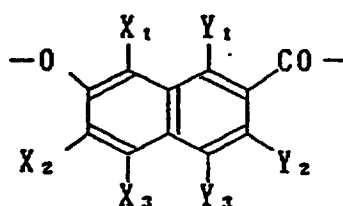
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(VI)



(VII)



(wherein the group consisting of X_1 , X_2 , and X_3 and the group consisting of Y_1 , Y_2 and Y_3 are separated by a line which intersects at right angles a line connecting the carbon atoms on the aromatic ring to which the hydroxyl group and carboxylic acid group are connected, at the center thereof; each of said groups is selected from hydrogen and substituents which differ from one another in dipole moment; and the same group does not contain substituents which differ from one another in the direction of dipole moment.

9. A resin molded product as set forth in any of Claims 6 to 8, wherein the substituent group is selected from one or more of a cyano group, nitro group, aldehyde group, carboxylic acid ester, carboxylic acid group, hydroxyl group, halogen, amino group, imino group, alkoxy group, alkyl group, phenyl group, acyl group, sulfoxy group, and sulfide group.

10. A resin molded product as set forth in any of Claims 6 to 8, wherein the substituent group is one or more kinds selected from cyano group, nitro group, acetoxy group, chlorine, bromine, phenyl group, alkyl group methoxy group, amino group, and alkyl-substituted amino group.

11. A resin molded product as set forth in Claim 1, wherein the polyester which exhibits anisotropism in the molten state is one which has a molecular weight of 2,000 to 50,000.



12. A resin molded product as set forth in Claim 1, wherein the polyester which is subjected to an electric field is one which contains a ferroelectric compound.

