

Description

Title of the Invention: Planar connector

Technical Field

[0001]

The present invention relates to a planar connector such as a CPU socket, having a lattice structure, within its outer frame.

Background Art

[0002]

Liquid-crystalline polymers are known, among thermoplastic resins, as materials which are excellent in dimensional accuracy, vibration-damping property and flowability and in which the generation of burrs are very little at the time of molding thereof. So far, by the utilization of the advantageous characteristics as described above, liquid crystalline polymers have been widely adopted as materials of various types of electronic components.

In particular, also with the current requirements for connectors to have increased heat-resistance (enhancement of productivity by mounting technology), densification (adoption of multi-core structure) and reduction in size, associated with ever-increasing performance of electronic devices in recent years, by the utilization of the

characteristics of the liquid crystalline polymer described above, a liquid crystalline polymer composition reinforced by glass fibers is adopted as connectors ("All survey engineering plastics '92-'93", pages 182 to 194, published in 1992, JP-A 09-204951). Planar connectors such as a CPU socket, having a lattice structure within its outer frame, tend to significantly show increased heat resistance, densification and reduction in size as described, and thus a large number of glass fiber reinforced liquid crystalline polymer compositions are adopted.

However, even a glass reinforced liquid crystalline polymer having a certain degree of good fluidity does not have performance enough to be used as a very thin-walled planar connector that has a pitch in the lattice portion of 2 mm or less and that has a width of 0.5 mm or less in the resin portion of the lattice portion for holding a terminal, which has been required in recent years. That is, in the very thin-walled planar connector described above, when the lattice portion is filled with resin, the filling pressure is increased due to the insufficient fluidity, and thus there exists a problem in which the amount of warpage deformation of the resultant planar connector is increased.

In order to solve this problem, the use of a liquid crystalline polymer composition in which the addition amount of glass fiber is reduced and which has satisfactory fluidity, but there exist a problem in which such a composition has

insufficient strength and thus is deformed by reflow soldering at the time of mounting.

As described above, the planar connector formed of a liquid crystalline polymer excellent in performance balance has not been obtained yet.

[0003]

Therefore, the present inventors proposed, in JP-A 2005-276758, a planar connector that is formed of a certain composite resin composition having a constant relationship between the weight-average length of and the blending amount of fibrous filler to be blended. According to JP-A 2005-276758 described above, it is possible to obtain a thin-walled planar connector excellent in performances such as moldability, flatness, warpage deformation or heat resistance. However, it has been found that there are cases which cannot be dealt with by JP-A 2005-276758 described above, due to factors such as changes in shape associated with an increase or the like in integration rate in recent planar connectors, especially an increase in the number of connector pins and a further decrease in the width of the lattice portion.

Hence, the present inventors have further proposed, in JP-A 2010-3661, a planar connector that is formed of a certain composite resin composition in which a plate-like filler and a fibrous filler are blended together with a certain liquid crystalline polymer.

Disclosure of the Invention

[0004]

According to JP-A 2010-3661 described above, it is possible to obtain a thin-walled planar connector excellent in performances such as moldability, flatness, warpage deformation or heat resistance, and to obtain a thin planar connector that can deal with changes in shape associated with an increase or the like in integration rate in recent planar connectors, especially an increase in the number of connector pins and a further decrease in the width of the lattice portion. However, in the technology of JP-A 2010-3661 described above, there are cases where post-molding cracks (breaks) are generated in the lattice portion, due to variations in the manufacturing of the polymer and changes in fine manufacturing conditions such as molding conditions, and it has been insufficient to receive customer satisfaction from crack resistance.

[0005]

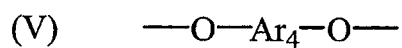
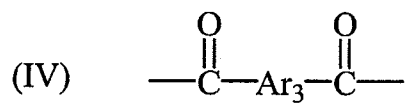
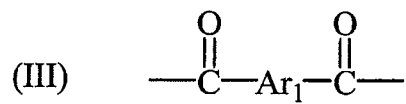
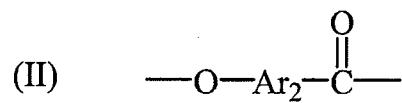
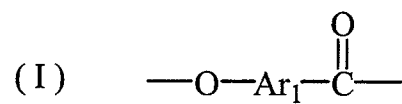
In view of the foregoing problem, the present inventors and the like have made intensive searches and studies in order to provide a planar connector formed of a liquid crystalline polymer that can stably obtain satisfactory performance in the shape of the recent planar connector and that is particularly excellent in crack resistance in which post-molding cracks are not generated in the lattice portion.

They have found that it is possible to obtain a planar connector excellent in all performances such as moldability, flatness, warpage deformation, heat resistance or crack resistance, through the use of a composite resin composition in which (B) a plate-like inorganic filler and (C) a specific fibrous filler are blended together, at a specific ratio, with (A) a wholly aromatic liquid crystalline polymer formed with a specific structure, with the result that the present invention has been completed.

That is, the present invention provides a planer connector, formed of a composite resin composition containing: (A) a wholly aromatic polyester which exhibits optical anisotropy in a molten state, including, as essential constituents, the constitutional units represented by the general formulae (I), (II), (III), (IV) and (V), and which contains, relative to a total of all constitutional units, the constitutional unit (I) in an amount of 35 to 75 mol%, the constitutional unit (II) in an amount of 2 to 8 mol%, the constitutional unit (III) in an amount of 4.5 to 30.5 mol%, the constitutional unit (IV) in an amount of 2 to 8 mol%, the constitutional unit (V) in an amount of 12.5 to 32.5 mol%, and the total of constitutional units (II) and (IV) in an amount of 4 to 10 mol%; (B) a plate-like inorganic filler, and; (C) a glass fiber, where the content of (B) is 15 to 25% by weight, the content of (C) is 10 to 25% by weight, relative to the total composition, respectively, and the

total content of (B) and (C) is from 30 to 40% by weight relative to the total composition, and wherein the planar connector has a lattice structure in an outer frame and has a pitch in the lattice portion of 1.5 mm or less.

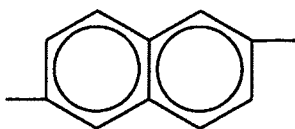
[0006]



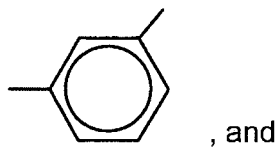
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Ar_2 is

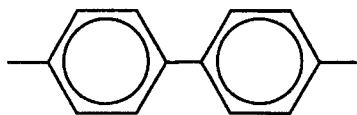


Ar_3 is



, and

Ar_4 is



[0007]

The present invention provides a planar connector being

excellent in all performances such as moldability, flatness, warpage deformation, heat resistance or crack resistance.

Brief Description of the Drawings

[0008]

[Fig. 1] Fig. 1 is a diagram showing a planar connector molded in Examples, (a) is a plan view, and (b) is a detailed diagram of an A portion where the unit of numerical values in the figure is mm.

[Fig. 2] Fig. 2 is a diagram showing a molded article used for the evaluation of crack resistance of the molded article used in Examples, (a) is a plan view, and (b) is a diagram showing its dimensions where the unit of numerical values in the figure is mm.

Detailed Description of the Invention

[0009]

Hereinafter, the present invention will be specifically explained. First, as (A) a wholly aromatic liquid crystalline polymer used in the present invention includes constitutional units (I) to (V), and in order to put the above-mentioned constitutional units (I) to (V) into practice, various compounds having ordinary ester-forming ability are used. Hereinafter, starting compounds which are required to form the wholly aromatic polyester constituting the present invention will be specifically explained in

order.

[0010]

The constitutional unit (I) is derived from 4-hydroxybenzoic acid.

[0011]

The constitutional unit (II) is derived from 6-hydroxy-2-naphthoic acid.

[0012]

The constitutional unit (III) is derived from 1,4-phenylenedicarboxylic acid.

[0013]

The constitutional unit (IV) is derived from 1,3-phenylenedicarboxylic acid.

[0014]

In addition, the constitutional unit (V) is derived from 4,4'-dihydroxybiphenyl.

[0015]

According to the present invention, it is necessary that the above-mentioned constitutional units (I) to (V) are contained, and that, relative to a total of all constitutional units, the constitutional unit (I) is within an amount of 35 to 75 mol% (preferably 40 to 65 mol%), the constitutional unit (II) is within an amount of 2 to 8 mol% (preferably 3 to 7 mol%), the constitutional unit (III) is within an amount of 4.5 to 30.5 mol% (preferably 13 to 26 mol%), the constitutional unit (IV) is within an amount of 2 to 8 mol%

(preferably 3 to 7 mol%), the constitutional unit (V) is within an amount of 12.5 to 32.5 mol% (preferably 15.5 to 29 mol%), and the total of constitutional units (II) and (IV) is within an amount of 4 to 10 mol% (preferably 5 to 10 mol%).

When the constitutional unit (I) is less than 35 mol% or more than 75 mol%, the melting point is significantly increased, and in some cases, the polymer is solidified within a reactor at the time of manufacturing, with the result that it becomes unable to manufacture a polymer having a desired molecular weight. Hence, this is not preferable.

When the constitutional unit (II) is less than 2 mol%, even in consideration of the type of filler and the blending amount of constitutional unit (II), cracks are generated in the lattice portion at the time of formation of the planar connector. Hence, this is not preferable. When the constitutional unit (II) is more than 8 mol%, the heat resistance of the polymer is reduced. Hence, this is not preferable.

When the constitutional unit (III) is less than 4.5 mol% or more than 30.5 mol%, the melting point is significantly increased, and in some cases, the polymer is solidified within the reactor at the time of manufacturing, with the result that it becomes unable to manufacture the polymer having the desired molecular weight. Hence, this is not preferable.

When the constitutional unit (IV) is less than 2 mol%, even in consideration of the type of filler and the blending

amount of constitutional unit (IV), cracks are generated in the lattice portion at the time of formation of the planar connector. Hence, this is not preferable. In addition, when the constitutional unit (IV) is more than 8 mol%, the heat resistance of the polymer is reduced. Hence, this is not preferable.

Furthermore, when the constitutional unit (V) is less than 12.5 mol% or more than 32.5 mol%, the melting point is significantly increased, and in some cases, the polymer is solidified within the reactor at the time of manufacturing, with the result that it becomes unable to manufacture the polymer having the desired molecular weight. Hence, this is not preferable.

Moreover, when the constitutional units (II) + (IV) are less than 4 mol%, the crystallization heat quantity of the polymer determined by differential calorimetry indicating a crystallized state of the polymer is 2.5 J/g or more, and even in consideration of the type of filler and the blending amount of constitutional units (II) + (IV), cracks are generated in the lattice portion at the time of formation of the planar connector. Hence, this is not preferable. The desired value of the crystallization heat quantity is 2.3 J/g or less, and is more preferably 2.0 J/g or more. In addition, when the constitutional units (II) + (IV) are more than 10 mol%, the heat resistance of the polymer is reduced. Hence, this is not preferable.

Meanwhile, the crystallization heat quantity refers to a heat quantity determined as follows: in differential calorimetry, after the observation of an endothermic peak temperature (T_{m1}) which is observed when the polymer is measured under a condition in which the temperature of the polymer is increased from the room temperature at 20°C/minute, the polymer is held for 2 minutes at a temperature of $T_{m1} + 40^{\circ}\text{C}$, and thereafter the heat quantity of an exothermic peak is determined from the peak of the exothermic peak temperature observed when the polymer is measured under a temperature drop condition of 20°C/minute.

[0016]

Meanwhile, as long as the object of the present invention is not disturbed, a small amount of known constitutional unit other than the constitutional units (I) to (V) described above can also be introduced into the wholly aromatic liquid crystalline polymer.

[0017]

JP-A 59-43021 and JP-A 02-16120 have proposed a liquid crystalline polymer having both heat resistance and easy processing, and JP-A 02-16120 has proposed, in Examples, a liquid crystalline polymer including the constitutional unit (I) in an amount of 64 mol%, the constitutional unit (II) in an amount of 1 mol%, the constitutional unit (III) in an amount of 15.5 mol%, the constitutional unit (IV) in an amount of 2 mol%, and the constitutional unit (V) in an

amount of 17.5 mol%. However, even if this liquid crystalline polymer has a composition with the same type of filler and the same blending amount of constitutional units as in the present invention, there exist problems in which crack are generated in the lattice portion at the time of formation of the planar connector.

[0018]

In contrast to this, in the present invention, it is possible to obtain the planar connector having good moldability and being excellent in all performances such as moldability, flatness, warpage deformation, heat resistance or crack resistance by limiting the amounts of constitutional units (I) to (V) and the amounts of constitutional units (II) + (IV), to the range described above.

[0019]

The wholly aromatic liquid crystalline polymer of the present invention is polymerized through the use of a direct polymerization method or an interesterification method, and in the polymerization, there are used a melt polymerization method, a solution polymerization method, a slurry polymerization method, a solid polymerization method and the like.

In the present invention, in the polymerization, there can be used an acylating agent to a polymerization monomer, and as an acid chloride derivative, a monomer which is activated at its end. Examples of the acylating agents

include acid anhydride such as acetic acid anhydride, and the like.

In these polymerization, various catalysts can be used, and typical examples include dialkyltin oxides, diaryltin oxides, titanium dioxide, alkoxytitanatesilicate salts, titanium alcoholates, alkali metal salts or alkali earth metal salts of carboxylic acids, Lewis acids such as BF_3 , and the like. Generally, an amount of the catalyst is preferably about 0.001 to 1 weight%, particularly about 0.003 to 0.2 weight% on the basis of the total weight of monomers.

[0020]

In addition, when carrying out the solution polymerization or slurry polymerization, there are used liquid paraffin, high heat resistive synthetic oil, inert mineral oil and the like as a solvent.

[0021]

The reaction conditions include a reaction temperature of 200 to 380°C, an ultimate pressure of 0.1 to 760 Torr (namely, 13 to 101,080 Pa). Particularly in melt reaction, a reaction temperature is 260 to 380°C, preferably 300 to 360°C, and an ultimate pressure is 1 to 100 Torr (namely, 133 to 13,300 Pa), preferably 1 to 50 Torr (namely, 133 to 6,670 Pa).

[0022]

The reaction can be initiated by charging the whole starting monomers, the acylating agent and the catalyst into

one reactor (one-stage method), or causing the resultant substance to react with the monomers (III) and (IV) (two-stage method) after acylating the hydroxyl groups of the starting monomers (I), (II) and (V) with the acylating agent.

[0023]

The melt polymerization is carried out by, after the inside of a reaction system reaches a predetermined temperature, starting pressure reduction up to a predetermined degree of pressure reduction. After a torque of a stirrer reaches a predetermined value, an inert gas is introduced, and the pressure is changed from the pressure-reduced state through a normal pressure to a predetermined pressurized state, and then a polymer is discharged from the reaction system.

[0024]

The polymer manufactured by the above-mentioned polymerization method can increase its molecular weight by the solid polymerization in which heating is performed in an inert gas, under a normal pressure or a reduced pressure. Preferred solid polymerization reaction condition is a reaction temperature of 230 to 350°C, preferably 260 to 330°C, and an ultimate pressure is 10 to 760 Torr (namely, 1,330 to 101,080 Pa).

[0025]

The fact that the polymer is a liquid crystalline polymer which exhibits optical anisotropy at the time of melting is

an indispensable element for having both thermal stability and easy processability in the present invention. Among wholly aromatic polyesters including the above-mentioned constitutional units (I) to (V), although there is the wholly aromatic polyester in which an anisotropic molten phase is not formed depending on constitutional components and sequence distribution in a polymer, the polymer according to the present invention is limited to the wholly aromatic polyester which exhibits optical anisotropy at the time of melting.

[0026]

The properties of the molten anisotropy can be confirmed by a polarizing test method in common use, through the utilization of the orthogonal light polarizer. More specifically, the conformation of the molten anisotropy can be carried out by melting a sample placed on a hot stage manufactured by Linkam Co. Ltd. through the use of a polarizing microscope manufactured by Olympus Co., Ltd., and then by observing the molten sample under nitrogen atmosphere at a magnification of 150 times. The above-mentioned polymer is optically anisotropic, and when the polymer is inserted between orthogonal light polarizers, light can be transmitted. When a sample is optically anisotropic, polarized light can be transmitted even in a molten static liquid state.

[0027]

As an index of processability of the present invention, liquid crystallinity and melting point (temperature in which crystallinity is expressed) can be considered. Whether liquid crystallinity is exhibited or not is deeply related to fluidity at the time of melting, and it is essential that the polyester of the present invention exhibits liquid crystallinity at a molten state.

[0028]

Since a nematic liquid crystalline polymer causes significant viscosity reduction at its melting point or more, exhibiting liquid crystallinity at a temperature of the melting point or higher is an index of processability. The melting point is preferably high as much as possible from the viewpoint of heat resistance, but in consideration of thermal degradation at the time of melt processing of the polymer and the heating capacity or the like of a molding machine, the preferred melting point (temperature in which crystallinity is expressed) is indicated as 390°C or less. Meanwhile, more preferable is 380°C or less.

[0029]

Furthermore, in order for the fluidity of the lattice portion to be ensured, it is preferable that a melt viscosity at a temperature higher than its melting point by 10 to 40°C and at a shear rate of 1000 sec⁻¹ is 1 x 10⁵ Pa·s or less. More preferable is 5 Pa·s or more and 1 x 10² Pa·s or less. It is possible for the nematic liquid crystalline polymer

to realize these melt viscosities, by including liquid crystallinity.

[0030]

The composite resin composition used in the present invention includes (A) the wholly aromatic liquid crystalline polymer, (B) the plate-like inorganic filler and (C) the glass fiber.

Examples of (B) the plate-like fillers used in the present invention include talc, mica, glass flakes, various metal foils and the like, and the plate-like filler is preferably one type or more selected from talc and mica. In addition, the average particle size of (B) the plate-like inorganic filler is not particularly limited, and although, in consideration of the fluidity of a thin-walled portion, the average particle size is preferably low, it is necessary to maintain a given size in order to reduce warpage deformation. Specifically, the average particle size is 1 to 100 μm , and is preferably 5 to 50 μm .

[0031]

In (C) the glass fiber used in the present invention, its weight average fiber length is preferably 250 to 800 μm . When the weight-average fiber length exceeds 800 μm , the fluidity is degraded and thus the glass fiber cannot be molded or a connector excellent in flatness cannot be realized even if the glass fiber can be molded, whereas, when the weight-average fiber length is less than 250 μm , there are

unfavorable cases where crack resistance is degraded and thus cracks are generated in the lattice portion of the molded article.

In addition, the fiber diameter of (C) the glass fiber is not particularly limited, but generally, glass fibers of about 5 to 15 μm in diameter are used.

[0032]

Furthermore, in the composite resin composition used in the present invention, it is necessary that the content of (B) is 15 to 25% by weight relative to the entire composition, the content of (C) is 10 to 25% by weight relative to the entire composition, and the total content of (B) and (C) is 30 to 40% by weight (preferably, 30 to 35% by weight) relative to the entire composition.

When the content of (B) is less than 15% by weight, it is unfavorable that the amount of warpage deformation is increased, whereas, when the content of (B) is more than 25% by weight, it is unfavorable that the crack resistance is degraded and thus cracks are generated in the lattice portion. When the content of (C) is less than 10% by weight or is more than 25% by weight, it is unfavorable that the crack resistance is degraded and thus cracks are generated in the lattice portion. In addition, when the total content of (B) and (C) is less than 30 % by weight relative to the entire composition, it is unfavorable that the heat resistance is reduced, whereas, when the total content of (B) and (C) is

more than 40 % by weight, it is unfavorable that the crack resistance is degraded and thus cracks are generated in the lattice portion.

[0033]

Molding of the composite resin composition of the present invention makes it possible to obtain various planar connectors, and is especially effective for a very thin-walled planar connector which has not been industrially provided for practical purposes so far and in which a lattice portion has a pitch of 1.5 mm or less, the width of the resin portion of the lattice portion holding a terminal is 0.5 mm or less, and the height of the entire product is 5.0 mm or less.

When such a planar connector is described in more detail, it is a connector which is molded in an Example and shown in Fig. 1, which is formed with an external frame portion whose thickness is 4.0 mm or less and a lattice portion whose thickness is 4.0 mm or less, and which has several hundred pin holes in the lattice portion of a product of about 40 mm × 40 mm × 1 mm. As shown in Fig. 1, the shape in which the lattice portion has a pitch of 1.5 mm or less, and a resin portion holding a terminal has a width of 0.5 mm or less is very difficult to be injection-molded. Meanwhile, the planar connector of the present invention also includes a planar connector in which an opening portion having appropriate size is provided in the lattice portion.

[0034]

The use of the composite resin composition of the present invention, as shown in Fig. 1, makes it possible to mold a planar connector, with satisfactory moldability, which has a very small width of the resin portion in the lattice portion and in which the lattice portion has a pitch of 1.5 mm or less (1.2 mm), the resin portion holding the terminal has a width of 0.5 mm or less (0.18 mm), and its flatness is also excellent.

When this flatness is numerically specified, the flatness before going through an IR reflow process for surface mounting at a peak temperature of 230 to 280°C is 0.05 mm or less, and a planar connector having a difference of the flatness between before and after the reflow of 0.10 mm or less can be said to have an excellent flatness for practical purposes.

[0035]

A molding method for obtaining the connector having such an excellent flatness is not particularly limited, and an economical injection molding method is preferably used. In order to obtain the connector having such an excellent flatness, it is important to use the liquid crystalline polymer composition described above, and molding conditions in which residual internal stress is not present are preferably selected. In order to decrease the filling pressure and the residual internal stress of the obtained

connector, the cylinder temperature of a molding machine is preferably equal to or more than the melting point $T^{\circ}\text{C}$ of the liquid crystalline polymer, and when the cylinder temperature is excessively high, there is generated a problem such as a leak from a cylinder nozzle caused by the decomposition or the like of the resin, and thus the cylinder temperature is $T^{\circ}\text{C}$ to $(T + 30)^{\circ}\text{C}$, and is preferably $T^{\circ}\text{C}$ to $(T + 15)^{\circ}\text{C}$. In addition, the mold temperature is preferably 70 to 100°C . When the mold temperature is low, it is unfavorable that the filling resin composition causes a flowing defect, whereas, when the mold temperature is high, it is unfavorable that a problem of generation of burring or the like is caused. With respect to the injection speed, the molding is preferably performed at a speed of 150 mm/sec or more. When the injection speed is low, there are cases where only an unfilled molded article is obtained, and even when a completely filled molded article is obtained, the filling pressure is high and the residual internal stress is high, with the result that only a connector having a poor flatness is obtained.

[0036]

Adding to the composite resin composition, an additive such as a nucleating agent, a pigment such as carbon black or a calcined pigment, an antioxidant, a stabilizer, a plasticizer, a lubricant, a release agent or a flame retardant, a composition is obtained with desired properties, also

falling within the scope of the composite resin composition according to the present invention.

Examples

[0037]

Hereinafter, the present invention will be specifically described using examples, but the present invention is not limited to these Examples. Meanwhile, the measurements of physical properties and tests in the examples were performed by the following methods.

(1) Apparent melt viscosity

CAPILOGRAPH 1B type manufactured by Toyo Seiki Seisaku-sho, Ltd. in which $L = 20$ mm and $d = 1$ mm was used, and an apparent melt viscosity was measured at a temperature 10 to 20°C higher than the melting point at a shear rate of 1000/s in conformity with ISO11443.

(2) Measurement of flatness of connector

A planar connector (having 750 pin holes) in which, as shown in Fig. 1, the overall size was 39.82 mm × 41.82 mm × 1 mm t and the pitch at the lattice portion was 1.2 mm was subjected to injection-molding by using the resin composition pellets under the following conditions.

As a gate, a film gate from the longest side (the side of 41.82 mm) was used, and the thickness of the gate was set at 0.3 mm.

The obtained connector was placed at rest on a horizontal

table, and the height of the connector was measured through the use of an image-measuring machine Quick Vision 404PROCNC manufactured by Mitutoyo Corporation. At this time, the position at 0.5 mm was measured, at an interval of 10 mm, from the end surface of the connector, and the difference between the maximum height and the minimum height was set to be the flatness.

Furthermore, IR reflow was performed under the following conditions, the flatness was measured by the method described above, and the difference of flatness before and after the reflow was determined.

[IR reflow conditions]

Measuring machine: a large tabletop reflow soldering device RF-300 manufactured by Japan Pulse Laboratories, Inc. (a far infrared heater was used)

Sample feed speed: 140 mm/sec

Reflow furnace transit time: 5 min

Temperature conditions: preheat zone; 150°C, reflow zone; 225°C, peak temperature; 287°C

[Molding conditions]

Molding machine: SE30DUZ manufactured by Sumitomo Heavy Industries, Ltd.

Cylinder temperature:

(Nozzle) 360°C - 365°C - 340°C - 330°C (Examples 1 to 6, Comparative example 8)

370°C - 370°C - 370°C - 380°C (Comparative

examples 1 and 2)

350°C - 350°C - 340°C - 330°C (Comparative
examples 3 to 7)

Mold temperature: 80°C

Injection speed: 300 mm/sec

Holding pressure: 50 MPa

Pressure holding time: 2 sec

Cooling time: 10 sec

Screw rotational speed: 120 rpm

Screw back pressure: 1.2 MPa

[0038]

(3) Melting point of liquid crystalline polymer

Through the use of a DSC manufactured by Perkin Elmer Inc., after the observation of an endothermic peak temperature (T_{m1}) which is observed when the polymer is measured under a temperature rise condition of 20°C/min from room temperature, the polymer is held for 2 minutes at a temperature of $(T_{m1} + 40)^{\circ}\text{C}$, and then after the polymer was once cooled to room temperature under a temperature drop condition of 20°C/min, there is measured a temperature of the endothermic peak observed when the polymer was measured again at a temperature rise condition of 20°C/min.

(4) Minimum filling pressure

The minimum injection filling pressure at which a satisfactory molded article can be obtained when the planar connector of Fig. 1 was subjected to injection-molding was

set to be the minimum filling pressure.

[0039]

(5) Deflection temperature under load

A liquid crystalline polymer compositions containing a plate-like filler and glass fiber was individually subjected to injection-molding under the following molding conditions, and the deflection temperature under load was measured in conformity with ISO075-1,2.

[Molding conditions]

Molding machine: SE100DUZ manufactured by Sumitomo Heavy Industries, Ltd.

Cylinder temperature:

(Nozzle) 360°C - 370°C - 370°C - 360°C - 340°C - 330°C

(Examples 1 to 6, Comparative example 8)

370°C - 370°C - 370°C - 370°C - 370°C - 380°C

(Comparative examples 1 and 2)

350°C - 350°C - 350°C - 350°C - 340°C - 330°C

(Comparative examples 3 to 7)

Mold temperature: 80°C

Injection speed: 2 m/min

Holding pressure: 50 MPa

Pressure holding time: 2 sec

Cooling time: 10 sec

Screw rotational speed: 120 rpm

Screw back pressure: 1.2 MPa

[0040]

(6) Crack resistance

A liquid crystalline polymer composition containing a plate-like filler and glass fiber was individually subjected to injection-molding through the use of an injection molding machine under the following molding conditions, into a molded article shown in Fig. 2. In the injection-molded article for evaluation shown in Fig. 2, the diameter of the circumference was 23.6 mm, 31 pores of ϕ 3.2 mm were formed therewithin and the minimum thickness of the pore-to-pore distance was 0.16 mm. As a gate, a three-point gate indicated by arrow part in Fig. 2 was adopted.

After the observation of the injection-molded articles, the articles that were molded at injection speeds of 50 mm/sec and 150 mm/sec and that were free from cracks were indicated by double circles, the articles that were molded at an injection speed of 150 mm/sec and that were free from cracks were indicated by circles and the articles that generated cracks in both cases were indicated by crosses.

[Molding conditions]

Molding machine: SE30DUZ manufactured by Sumitomo Heavy Industries, Ltd.

Cylinder temperature:

(Nozzle) 370°C - 375°C - 360°C - 350°C (Examples 1 to 6, Comparative example 8)

360°C - 360°C - 360°C - 370°C (Comparative examples 1 and 2)

350°C - 350°C - 340°C - 330°C (Comparative examples 3 to 7)

Mold temperature: 140°C

Injection speed: 50 mm/sec or 150 mm/sec

Holding pressure: 100 MPa

Pressure holding time: 2 sec

Cooling time: 10 sec

Screw rotational speed: 120 rpm

Screw back pressure: 1.2 MPa

[0041]

Examples 1 to 6 and Comparative Examples 1 to 8

The above-mentioned test pieces of the liquid crystalline polymer composition containing the plate-like filler and glass fiber were prepared under the following conditions and were evaluated, and then the results shown in Table 1 were obtained.

[0042]

(Components used)

Liquid crystalline polymer 1

[Manufacturing conditions]

A polymerization vessel provided with a stirrer, a reflux column, a monomer inlet, a nitrogen inlet, a pressure reduction/outflow line was charged with the following starting monomers, a metal catalyst, an acylating agent, and then nitrogen substitution was started.

(I) 2-hydroxy-6-naphthoic acid: 166 g (48 mol%) (NHA)

(II) 1,4-phenylenedicarboxylic acid: 76 g (25 mol%) (TA)

(III) 4,4'-dihydroxybiphenyl: 86 g (25 mol%) (BP)

(IV) 4-hydroxybenzoic acid: 5 g (2 mol%) (HBA)

Potassium acetate catalyst: 22.5 mg

Acetic anhydride: 191 g

After charging of the raw materials, a temperature of the reaction system was raised to 140°C, and the reaction was carried out at 140°C for one hour. After that, the temperature was raised to 360°C over 5.5 hours, and a pressure was reduced to 5 Torr (namely 667 Pa) over 30 minutes, and then the melt polymerization was carried out while acetic acid, excessive acetic anhydride and other component having a low boiling point were being distilled. After the stirring torque reached a predetermined value, the pressure was changed from a reduced-pressure state to a pressurized state via a normal pressure by introducing nitrogen, and a polymer was discharged from the lower part of the polymerization vessel, and strands thereof were pelletized into pellets.

The obtained pellet was subjected to thermal processing under a stream of nitrogen at 300°C for 8 hours.

The pellet had a melting point of 349°C, a crystallization heat quantity of 5.6 J/g, and a melt viscosity of 23 Pa·s.

[0043]

Liquid crystalline polymer 2

[Manufacturing conditions]

A polymerization vessel provided with a stirrer, a

reflux column, a monomer inlet, a nitrogen inlet, a pressure reduction/outflow line was charged with the following starting monomers, a metal catalyst, an acylating agent, and then nitrogen substitution was started.

(I) 4-hydroxybenzoic acid: 188.4 g (60 mol%) (HBA)

(II) 6-hydroxy-2-naphthoic acid: 21.4 g (5 mol%) (HNA)

(III) 1,4-phenylenedicarboxylic acid: 66.8 g (17.7 mol%) (TA)

(IV) 4,4'-dihydroxybiphenyl: 52.2 g (12.3 mol%) (BP)

(V) 4-acetoxy aminophenol: 17.2 g (5 mol%) (APAP)

Potassium acetate catalyst: 15 mg

Acetic anhydride: 226.2 g

After charging of the raw materials, a temperature of the reaction system was raised to 140°C, and the reaction was carried out at 140°C for one hour. After that, the temperature was raised to 340°C over 4.5 hours, and a pressure was reduced to 10 Torr (namely 667 Pa) over 15 minutes, and then the melt polymerization was carried out while acetic acid, excessive acetic anhydride and other component having a low boiling point were being distilled. After the stirring torque reached a predetermined value, the pressure was changed from a reduced-pressure state to a pressurized state via a normal pressure by introducing nitrogen, and a polymer was discharged from the lower part of the polymerization vessel, and strands thereof were pelletized into pellets.

The liquid crystalline polymer 2 had a melting point of

334°C, a crystallization heat quantity of 2.7 J/g, and a melt viscosity of 18 Pa·s.

[0044]

Liquid crystalline polymer 3

[Manufacturing conditions]

A polymerization vessel provided with a stirrer, a reflux column, a monomer inlet, a nitrogen inlet, a pressure reduction/outflow line was charged with the following starting monomers, a metal catalyst, an acylating agent, and then nitrogen substitution was started.

(I) 4-hydroxybenzoic acid: 1041 g (48 mol%) (HBA)

(II) 6-hydroxy-2-naphthoic acid: 89 g (3 mol%) (NHA)

(III) 1,4-phenylenedicarboxylic acid: 565 g (21.7 mol%)

(TA)

(IV) 1,3-phenylenedicarboxylic acid: 78 g (3 mol%) (IA)

(V) 4,4'-dihydroxybiphenyl: 711 g (24.3 mol%) (BP)

Potassium acetate catalyst: 110 mg

Acetic anhydride: 1645 g

After charging of the raw materials, a temperature of the reaction system was raised to 140°C, and the reaction was carried out at 140°C for one hour. After that, the temperature was raised to 360°C over 5.5 hours, and a pressure was reduced to 10 Torr (namely 1330 Pa) over 20 minutes, and then the melt polymerization was carried out while acetic acid, excessive acetic anhydride and other component having a low boiling point were being distilled. After the stirring

torque reached a predetermined value, the pressure was changed from a reduced-pressure state to a pressurized state via a normal pressure by introducing nitrogen, and a polymer was discharged from the lower part of the polymerization vessel, and strands thereof were pelletized into pellets.

The obtained polymer had a melting point of 358°C, a crystallization heat quantity of 1.6 J/g, and a melt viscosity of 9 Pa·s.

[0045]

(B) Plate-like filler

· Mica: AB-25S manufactured by Yamaguchi Mica Co., Ltd., average particle diameter 25 μm

· Talc: Crown talc PP manufactured by Matsumura Sangyo Co., Ltd, average particle diameter 10 μm

(C) Glass fiber

· Glass fiber: ECS03T-786H manufactured by Nippon Electric Glass Co., Ltd., chopped strand milled fiber with a fiber diameter of 10 μm and a length of 3 mm; PF70E001 manufactured by Nitto Boseki Co., Ltd. (fiber diameter 10 μm , fiber length 70 μm)

[0046]

[Table 1]

		Examples						Comparative examples							
		1	2	3	4	5	6	1	2	3	4	5	6	7	8
Liquid crystalline polyester 1	wt%							55	68						
Liquid crystalline polyester 2	wt%									60	55	65	70	60	
Liquid crystalline polyester 3	wt%	65	65	60	60	60	70								55
Mica	wt%								22						
Talc	wt%	25	15	20	25	15	15	30			30	25		40	25
Glass fiber	wt%	10	20	20	15	25	15	15		40	15	10	30		20
Milled fiber	wt%								10						
Melt viscosity	Pa · s	17	15	21	20	25	15	39	35	45	46	40	42	39	26
Connector flatness	mm	0.039	0.040	0.030	0.030	0.045	0.045	0.053	0.048	0.055	0.040	0.053	0.062	0.035	0.035
Connector deformation amount	mm	0.076	0.057	0.065	0.062	0.057	0.060	0.043	0.055	0.127	0.052	0.083	0.130	0.055	0.055
Connector minimum filling pressure	Mpa	58	71	75	67	85	66	113	75	130	145	130	130	110	80
Deflection temperature under load	°C	273	282	277	279	283	277	315	305	270	260	270	280	245	277
Crack resistance		◎	◎	○	○	◎	◎	x	x	◎	x	x	x	○	x

Claims

[Claim 1] A planer connector, formed of a composite resin composition comprising:

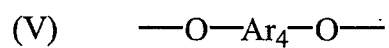
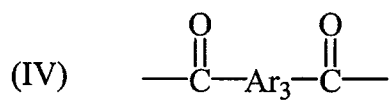
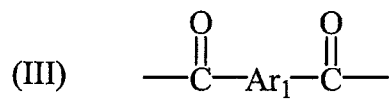
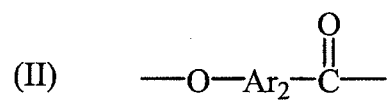
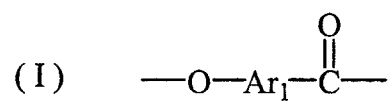
(A) a wholly aromatic polyester which exhibits optical anisotropy in a molten state, including, as essential constituents, the constitutional units represented by the formulae (I), (II), (III), (IV) and (V), and which contains, relative to a total of all constitutional units, the constitutional unit (I) in an amount of 35 to 75 mol%, the constitutional unit (II) in an amount of 2 to 8 mol%, the constitutional unit (III) in an amount of 4.5 to 30.5 mol%, the constitutional unit (IV) in an amount of 2 to 8 mol%, the constitutional unit (V) in an amount of 12.5 to 32.5 mol%, and the total of constitutional units (II) and (IV) in an amount of 4 to 10 mol%;

(B) a plate-like inorganic filler, and;

(C) a glass fiber,

wherein the content of (B) is 15 to 25% by weight relative to the total composition, the content of (C) is 10 to 25% by weight relative to the total composition, and the total content of (B) and (C) is from 30 to 40% by weight relative to the total composition, and

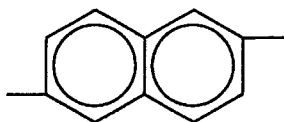
wherein the planar connector has a lattice structure in an outer frame and has a pitch in the lattice portion of 1.5 mm or less:



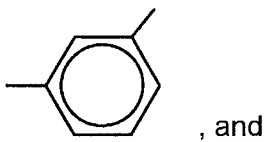
wherein Ar_1 is



Ar_2 is

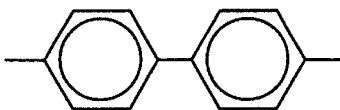


Ar_3 is



, and

Ar_4 is



[Claim 2] The planar connector according to claim 1, wherein the plate-like inorganic filler (B) is one or more selected from talc and mica.