homopolymer, calcium carbonate, and a small amount of magnesium stearate, as an example of such a resin composition.

Citation List

Patent Documents

[0006]

[Patent Document 1] JP2001-071378A

[Patent Document 2] JP2003-026866A

[Patent Document 3] WO2018/092494

Summary

[0006a]

In a first aspect of the present disclosure, there is provided a resin composition, comprising

15 to 50 parts by mass of a 4-methyl-1-pentene/α-olefin copolymer (A) satisfying at least one of the following requirement (d) and requirement (e),

10 to 50 parts by mass of an inorganic filler (B), and

5 to 49 parts by mass of a thermoplastic elastomer (C),

wherein a total amount of 4-methyl-1-pentene/α-olefin copolymer (A), inorganic filler (B), and thermoplastic elastomer (C) is 100 parts by mass,

wherein the thermoplastic elastomer (C) is at least one selected from the group consisting of an olefinic

thermoplastic elastomer (C1) and a styrenic thermoplastic elastomer (C2), and

wherein the resin composition satisfies the following requirements (a) to (c):

(a) having a temperature at which a value of loss tangent tanδ as determined by dynamic viscoelasticity measurement at a frequency of 10 rad/s (1.6 Hz) in a temperature range of -40 to 150°C reaches the maximum (hereinafter also referred to as a tanδ peak temperature) being 0°C or more and 60°C or less;

(b) having a maximum value of loss tangent tanδ (hereinafter also referred to as a tanδ peak value) as determined by dynamic viscoelasticity measurement at a frequency of 10 rad/s (1.6 Hz) in a temperature range of -40 to 150°C being 0.6 or more and 5.0 or less;

(c) having a density of 1.0 g/cm^3 or more and 5.0 g/cm^3 or less;

(d) comprising 55 to 90 mol% of a constituent unit derived from 4-methyl-1-pentene and 10 to 45 mol% of a constituent unit derived from α-olefin having 2 to 4 carbon atoms, wherein a total of the constituent unit derived from 4-methyl-1-pentene and the constituent unit derived from α-olefin having 2 to 4 carbon atoms is 100 mol%; and

(e) having a melting point as measured by a differential scanning calorimeter (DSC) being 160°C or less, or having no observed melting point.

[0006b]

In another aspect of the present disclosure, there is provided a molded article comprising the resin composition as disclosed herein.

[0006c]

In yet another aspect of the present disclosure, there are provided daily necessities comprising the resin composition as disclosed herein.

[0006d]

In a further aspect of the present disclosure, there is provided a toy comprising the resin composition as disclosed herein.

[0006e]

In another aspect of the present disclosure, there is provided an earpiece component comprising the resin composition as disclosed herein.

[0006f]

In yet another aspect of the present disclosure, there is provided a sheet comprising the resin composition as disclosed herein.

Technical Problem

[0007]

Indexes used to evaluate viscoelasticity of materials such as elastomers upon being deformed include a coefficient of loss. The coefficient of loss is expressed as a ratio of a loss modulus (G") to a storage modulus (G') (G"/G') and is known as tanδ. A material with a large tanδ tends to have softer touch when being formed into molded articles.

[0008]

The resin composition of Patent Document 1 can be utilized as synthetic papers, which have excellent foldability and tearing properties. However, they exhibit no high tanδ peak values and are materials with poor flexibility.

Requirement (g)

Having a tanδ peak value of 0.6 or more and 5.0 or less, as determined by dynamic viscoelasticity measurement at a frequency of 10 rad/s (1.6 Hz) in a temperature range of -40 to 150°C.

[0043]

The requirement (d) above specifies that the 4-methyl-1-pentene/α-olefin copolymer (A) has a specific ratio of the constituent unit (i) derived from 4-methyl-1 pentene and the constituent unit (ii) derived from α-olefin having 2 to 4 carbon atoms.

[0044]

In the present specification, the constituent unit derived from α-olefin indicates a constituent unit corresponding to α-olefin, i.e., a constituent unit represented by $-CH_2-CHR-$(R is a hydrogen atom or an alkyl group). The constituent unit (i) derived from 4-methyl-1-pentene can be interpreted in the same manner, and indicates a constituent unit corresponding to 4-methyl-1-pentene (i.e., a constituent unit represented by $-CH_2-CH(-CH_2CH(CH_3)_2)-$).

[0045]

A lower limit value of the amount of constituent unit derived from 4-methyl-1-pentene in the aforementioned 4-methyl-1-pentene/α-olefin copolymer (A) is 55 mol%,

preferably 60 mol% and more preferably 68 mol%. An upper limit value of the amount of constituent unit derived from 4-methyl-1-pentene is, on the other hand, 90 mol%, preferably 86 mol%, more preferably 85 mol%, and further preferably 84 mol%.

[0046]

In the 4-methyl-1-pentene/α-olefin copolymer (A), the amount of constituent unit (i) derived from 4-methyl-1-pentene being in an amount of the lower limit value or more described above, also facilitates adjustment of a tanδ peak temperature of a resin composition within the aforementioned range, because the tanδ peak temperature measured by dynamic viscoelasticity falls in the vicinity of room temperature. The amount of constituent unit (i) derived from 4-methyl-1-pentene being within the upper limit value or less described above, on the other hand, improves relaxation at room temperature and fits as a molded article.

[0047]

Therefore, in the 4-methyl-1-pentene/α-olefin copolymer (A), an upper limit of the amount of constituent unit (ii) derived from an α-olefin having 2 to 4 carbon atoms is 45 mol%, preferably 40 mol% and more preferably 32 mol%.

[0048]

Hz) in a temperature range of -40 to 150°C, and it preferably has a tanδ peak value of 1.0 or more and 5.0 or less, more preferably 1.5 or more and 5.0 or less, and further preferably 2.0 or more and 4.0 or less.

[0057]

Setting the tanδ peak value within the above range renders excellent recoverability that allows a shape to gently return to its original shape in response to a tensile stress and a speed at which it is deformed.

The 4-methyl-1-pentene/α-olefin copolymer (A) preferably has an intrinsic viscosity [η] in the range of 0.1 to 5.0 dl/g, measured at 135°C in decalin. It is more preferably 0.5 to 4.0 dl/g and further preferably 1.0 to 3.5 dl/g. As will be described below, combination with hydrogen during polymerization enables control of a molecular weight, making it possible to freely obtain molecular weights in ranges from a low molecular weight to a high molecular weight and adjustment of the intrinsic viscosity [η] in the above range. Details of a measurement method of the intrinsic viscosity [η] are as will be described in the Examples below.

[0058]

The 4-methyl-1-pentene/α-olefin copolymer (A) preferably has a weight-average molecular weight (Mw) measured by gel permeation chromatography (GPC) of 1,000 to 1,000,000

in terms of polystyrenes, more preferably of 5,000 to 800,000, and further preferably of 10,000 to 500,000. Details of the measurement method are as will be described in the Examples below.

[0059]

The 4-methyl-1-pentene/α-olefin copolymer (A) preferably has a molecular weight distribution (Mw/Mn) of in the range of 1.0 to 3.5, which is a ratio of a weight-average molecular weight (Mw) to a number-average molecular weight (Mn), as measured by gel permeation chromatography (GPC). It is more preferably 1.2 to 3.0 and further preferably 1.5 to 2.8. The molecular weight distribution (Mw/Mn) being 3.5 or less lowers influences of low molecular weight and low stereoregular polymers derived from their composition distribution, and is unlikely to reduce a mechanical strength of the resulting molded article, which is preferred.

[0060]

The 4-methyl-1-pentene/α-olefin copolymer (A) has a melt mass flow rate (MFR; in accordance with ASTM D1238, temperature 230°C, load 2.16 kg) of preferably 0.1 to 100 g/10 minutes, more preferably 0.5 to 50 g/10 minutes, and further preferably within the range of 1.0 to 30 g/10 minutes.

[0061]

pentaerythritol, fatty acid esters of sorbit or sorbitan, alkyl ethers of polyhydric alcohols, and aliphatic amides of alkanolamines; and the like, and examples of anionic surfactants include alkali metal salts of higher fatty acids, sulfuric acid ester salts, sulfonate salts such as alkyl benzene sulfonates, alkyl sulfonates, and paraffin sulfonates, and phosphoric acid ester salts such as higher alcohol phosphates, and cationic surfactants include quaternary ammonium salts such as alkyl trimethyl ammonium salts. Amphoteric surfactants include amino acid-type ampholytic surfactants such as higher alkyl aminopropionates, betaine-type amphoteric surfactants such as higher alkyl dimethyl betaine and higher alkyl dihydroxyethyl betaine, and the like.

[0099]

Examples of antistatic agents include the aforementioned surfactants, fatty acid esters, and polymer-type antistatic agents. The fatty acid esters include esters of stearic acid and oleic acid, and the like, and the polymer-type antistatic agents include polyetheresteramides and the like.

[0100]

Examples of pigments include inorganic pigments (such as titanium oxide, iron oxide, chromium oxide, and cadmium sulfide) and organic pigments (azo lake-based, thioindigo-

quantified a composition of the 4-methyl-1-pentene/α-olefin copolymer (A).

[0120]

<Intrinsic viscosity>

Intrinsic viscosity is a value measured at 135°C in decalin using a Ubbelode viscometer. Approximately 20 mg of polymerized powder and pellets or a resin mass were taken and dissolved in 15 mL of decalin, and for a resulting decalin solution was measured a specific viscosity ηsp in an oil bath heated to 135°C. To this decalin solution was added 5 mL of a decalin solvent for dilution, and the specific viscosity ηsp was measured in the same manner. This dilution operation was further repeated two times, and a value of ηsp/C when a concentration (C) was extrapolated to zero, was calculated as an intrinsic viscosity [η] (see formula below).

[0121]

$$[\eta]=\lim_{C\to 0}(\eta sp/C)$$

<Weight-average molecular weight (Mw), number-average molecular weight (Mn), and molecular weight distribution (Mw/Mn value>

A molecular weight was measured by gel permeation chromatography (GPC).

[0122]