mixture of methyl ethyl ketone and/or toluene and ethanol is filtrated using a 5-μm-aperture filter at a filtration temperature of 25°C and a filtration pressure of 10 mmHg. Patent Literature 1 also teaches that using such a polyvinyl acetal resin can improve productivity because such a resin leaves less undissolved matter when dissolved in an organic solvent and thus can shorten the filtration time.

CITATION LIST

- Patent Literature

[0005]

Patent Literature 1: JP 2005-325342 A

SUMMARY

[0005a] In one aspect, provided herein is a conductive paste for an internal electrode used for forming an internal electrode of a multilayer ceramic capacitor, the conductive paste comprising: a polyvinyl acetal resin;an organic solvent; and a conductive powder, the polyvinyl acetal resin having: a wavenumber A (cm^{-1}) of a peak within a range of 3,100 to 3,700 cm^{-1} in an IR absorption spectrum measured using an infrared spectrophotometer; and a hydroxy group content (mol%), the wavenumber A of the peak and the hydroxy group content satisfying relations of the following formulas (1) and (2): [(3,470 − A)/Hydroxy group content] ≤ 5.0 (1) (3,470 − A) ≤ 150 (2) wherein A is a wavenumber which is lower than 3,470 cm^{-1} and at which a transmittance a (%) satisfying [100 − (100 − X)/2] is exhibited, where X (%) is a minimum transmittance of the peak within the wavenumber range of 3,100 to 3,700 cm^{-1}.

- Technical problem

[0006]

Meanwhile, with the recent increase in functionality

and reduction in size of electronic devices, multilayer ceramic capacitors having smaller size and greater capacity have been demanded. To meet such a demand, finer undissolved matter must be sufficiently removed. However, even the polyvinyl acetal resin disclosed in Patent Literature 1 may leave finer undissolved matter that cannot be sufficiently removed, and may require filtration or the like to remove the undissolved matter, lowering productivity.

[0007]

The present invention aims to provide a conductive paste which leaves less fine undissolved matter when dissolved in an organic solvent and thus can be easily filtrated, which has excellent printability, and which can exhibit excellent surface smoothness after printing.

- Solution to problem

examples of the metal atom include a sodium atom, a lithium atom, and a potassium atom. Preferred among these is a sodium atom.

[0045]

The constitutional unit represented by the formula (7-1) is preferably derived from an α-dicarboxy monomer. Examples of the α-dicarboxy monomer include dicarboxylic acids having a radically polymerizable unsaturated double bond such as methylenemalonic acid, itaconic acid, 2-methyleneglutaric acid, 2-methyleneadipic acid, and 2-methylenesebacic acid, metal salts thereof, and methyl esters thereof. In particular, itaconic acid, metal salts thereof, and methyl esters thereof are preferred.

The α-dicarboxy monomer herein means a monomer having two carboxy groups on the α carbon.

[0046]

The polyvinyl acetal resin preferably contains the constitutional unit represented by the formula (7-2).

The polyvinyl acetal resin containing the constitutional unit represented by the formula (7-2) can have better solubility in a solvent.

In the formula (7-2), R^4, R^5, and R^6 each independently represents a hydrogen atom or a C1-C10 alkyl group, R^7 represents a C0-C10 alkylene group, and X^3 represents a hydrogen atom, a metal atom, or a methyl group.

[0047]

In the formula (7-2), when the alkyl groups represented by R^4, R^5, and R^6 each have a carbon number of 1 to 10, steric hindrance is less likely to occur, allowing polymerization reaction during the synthesis of raw materials to sufficiently proceed. The lower limit of the carbon number of each of the alkyl groups represented by R^4, R^5, and R^6 is preferably 1 and the upper limit thereof is 5, more preferably 3.

[0048]

R^4 and R^5 may be the same as or different from each other, but are preferably the same as each other. R^4, R^5, and R^6 are preferably hydrogen atoms.

[0049]

Examples of the C1–C10 alkyl group include linear alkyl groups such as methyl, ethyl, propyl, n-butyl, n-pentyl, n-heptyl, n-octyl, n-nonyl, and n-decyl groups, branched alkyl groups such as isopropyl, isobutyl, sec-butyl, tert-butyl, isopentyl, 2,2-dimethylpropyl, 1,1,3,3-tetramethylbutyl, and 2-ethylhexyl groups, and cycloalkyl groups such as cyclopropyl, cyclopropylmethyl, cyclobutyl, cyclopentyl, and cyclohexyl groups. Preferred among these are linear alkyl groups such as methyl, ethyl, propyl, n-butyl groups. More preferred among these are methyl and ethyl groups.

[0050]

In the formula (7-2), when the alkylene group represented by R^7 has a carbon number of 0 to 10, carboxy groups are less likely to coagulate, so that the resulting resin can have sufficient solubility in a low polarity solvent. The lower limit of the carbon number of the alkylene group represented by R^7 is preferably 0 and the upper limit thereof is preferably 5. The lower limit is more preferably 1 and the upper limit is more preferably 3.

[0051]

In the formula (7-2), examples of R^7 include the same groups as those listed for R^2 and R^3 in the formula (7-1). Preferred among these are a single bond, linear alkylene groups such as methylene, ethylene, trimethylene, and tetramethylene groups. More preferred are a single bond, a methylene group, and an ethylene group. Still more preferred is a single bond.

[0052]

When X^3 is a metal atom, examples of the metal atom include a sodium atom, a lithium atom, and a potassium atom.

CLAIMS

Claim 1. A conductive paste for an internal electrode used for forming an internal electrode of a multilayer ceramic capacitor, the conductive paste comprising:

a polyvinyl acetal resin;

an organic solvent; and

a conductive powder,

the polyvinyl acetal resin having:

a wavenumber A (cm^{-1}) of a peak within a range of 3,100 to 3,700 cm^{-1} in an IR absorption spectrum measured using an infrared spectrophotometer; and

a hydroxy group content (mol%),

the wavenumber A of the peak and the hydroxy group content satisfying relations of the following formulas (1) and (2):

$$[(3{,}470 - A)/\text{Hydroxy group content}] \leq 5.0 \quad (1)$$

$$(3{,}470 - A) \leq 150 \quad (2)$$

wherein A is a wavenumber which is lower than 3,470 cm^{-1} and at which a transmittance a (%) satisfying [100 − (100 − X)/2] is exhibited, where X (%) is a minimum transmittance of the peak within the wavenumber range of 3,100 to 3,700 cm^{-1}.

Claim 2. The conductive paste for an internal electrode according to claim 1,

wherein the polyvinyl acetal resin has a wavenumber B (cm^{-1}) of the peak within the wavenumber of 3,100 to 3,700 cm^{-1} in the IR absorption spectrum measured using the infrared spectrophotometer; and

the wavenumber A of the peak and the wavenumber B of the peak satisfy a relation of the following formula (3):

$$(3{,}470 - A)/(B - 3{,}470) \leq 1.4 \quad (3)$$

wherein B is a wavenumber which is higher than 3,470 cm^{-1}

and at which the transmittance a (%) satisfying [100 – (100 – X)/2] is exhibited, where X (%) is the minimum transmittance of the peak within the wavenumber range of 3,100 to 3,700 cm^{-1}.

Claim 3. The conductive paste for an internal electrode according claim 1 or 2,

wherein the polyvinyl acetal resin has a hydroxy group content of 16 to 25 mol%, an acetyl group content of 0.1 to 12 mol%, and an acetoacetal group content of 27 mol% or less.

Claim 4. The conductive paste for an internal electrode according to any one of claims 1 to 3,

wherein the polyvinyl acetal resin contains a carboxy group-containing constitutional unit in an amount of 0.01 to 1.0 mol%.