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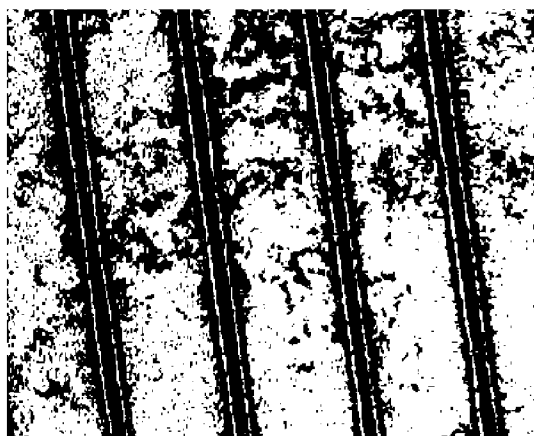
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[Continued on next page]

(54) Title: PASTE COMPOSITION FOR PRINTING



Example 1



Comparative Ex. 1

(57) Abstract: This invention provides paste composition for printing, which is particularly characterized by comprising a) 5 to 30 % by weight of an acrylate polymer resin; b) 5 to 35 % by weight of a high boiling point solvent having a boiling point of at least 200 °C; c) 5 to 35 % by weight of a low boiling point solvent having a boiling point of less than 200 °C; and d) 50 to 85 % by weight of a metal powder. The paste composition for printing in accordance with the invention is especially suitable for gravure offset printing, it can fundamentally solve re-treatment problems of materials that occur during the manufacturing of electrodes of mesh filters for shielding electromagnetic waves or electrode pattern for plasma display panels using the prior photolithography methods and at the same time, it can satisfy a variety of the properties required as a paste composition each of which is required for printing process so that appropriate offset print performance can be exerted.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Description

PASTE COMPOSITION FOR PRINTING

Technical Field

- [1] This invention relates to a paste composition for printing and more particularly, to a paste composition for printing which are especially suitable for gravure offset printing, can solve re-treatment problems of materials that occur during the manufacturing of electrodes of mesh filters for shielding electromagnetic waves or electrode pattern for plasma display panels using the prior photolithography methods and at the same time, can satisfy a variety of the properties required as a paste composition each of which is required for printing process so that appropriate offset print performance can be exerted.

Background Art

- [2] Recently, as there have been increasing demands on large size, high density, high precision, and high reliability in display devices, several pattern processing technologies are being developed and studies about numerous kinds of compositions for formation of fine electrodes suitable for such various pattern processing technologies are being actively conducted.
- [3] As plasma display panels (PDP) have quick response rate and are easy to become larger size when compared with liquid crystal panels, they are currently applied to various fields. In general, patterning methods of electrode materials using screen printing methods have been used to form electrodes on PDP. However, the prior screen printing methods requires high level of skill, pastes may run out of substrates due to their low viscosity during screen printing, and they result in decreased precision on screen so that it is difficult in the prior screen printing method to obtain large screen pattern having high precision which is required for PDP. Moreover, in the prior screen printing method, short or open on screen was likely to happen during printing.
- [4] Recently, there have been developed photolithography methods using photosensitive resin compositions to form high precision electrode circuits suitable for large area. These methods are carried out by forming uniform thick films through printing methods using photosensitive resin compositions with fine conductive powders dispersed thereon, exposing light to the thus formed thick films by using masks with desired configuration and then embodying necessary patterns by use of alkaline development solutions.
- [5] However, when patterns are formed using the photolithography methods as described above, re-treatment of materials that are removed during development process is required to save manufacturing costs and a lot of debates thereon are in progress.

- [6] To solve the aforementioned problems, studies about methods of directly forming desired patterns onto substrates as seen in gravure offset printing methods or inkjet printing methods which have been widely used in previous printing industry are now performed.

Disclosure of Invention

Technical Problem

- [7] In order to solve the problems of the prior arts described above, it is an object of the invention to provide a paste composition for printing which is especially suitable for gravure offset printing mode and can solve re-treatment problems of materials that occur in development process to save the manufacturing costs during the formation of electrode pattern for plasma display panels or mesh filters for shielding electromagnetic waves using the prior photolithography methods, and a method of forming plasma panel display electrodes or a method of preparing electrodes of mesh filters for shielding electromagnetic waves, using the above paste compositions.
- [8] Further, it is another object of the invention to provide a paste composition for printing capable of satisfying a variety of the properties required as a composition each of which is required for printing process so that appropriate offset print performance can be exerted, and a method of forming plasma panel display electrodes or a method of preparing electrodes of mesh filters for shielding electromagnetic waves, using the above paste composition.

Technical Solution

- [9] To achieve the aforementioned objects, the present invention provides a paste composition for printing comprising
- [10] a) 5 to 30 % by weight of an acrylate polymer resin;
- [11] b) 5 to 35 % by weight of a high boiling point solvent having a boiling point of at least 200 °C;
- [12] c) 5 to 35 % by weight of a low boiling point solvent having a boiling point of less than 200 °C; and
- [13] d) 50 to 85 % by weight of a metal powder.
- [14] Also, the invention provides a method of forming a plasma panel display electrode comprising forming pattern by gravure offset printing method using the above paste composition for printing.
- [15] Also, the invention provides a method of forming an electrode of mesh filter for shielding electromagnetic wave comprising forming pattern by gravure offset printing method using the above paste composition for printing.

Advantageous Effects

- [16] The paste compositions in accordance with the present invention are suitable for

gravure offset mode capable of directly forming fine pattern and have superior cost saving effects in comparison with the prior photolithography based methods and at the same time, they can satisfy a variety of the properties required as a composition each of which is required for printing process so that appropriate offset print performance can be exerted.

Brief Description of the Drawings

- [17] Fig. 1 is photographs showing minimum line widths after gravure offset printing using paste compositions for printing prepared in accordance with the examples of the invention and comparative examples.

Mode for the Invention

- [18] This invention is further described in detail.
- [19] The inventors found that so as to prepare paste compositions for gravure offset printing capable of satisfying a variety of the properties as a composition each of which is required for printing process, as a result of using acrylate polymers having appropriate molecular weight to exert proper elasticity characteristics required for the OFF mode and using suitable volatile solvents to provide advantageous calcination characteristics in SET mode, paste compositions for printing suitable for the gravure offset printing method could be prepared, and have thus completed the invention.
- [20] The paste composition for printing of the invention comprises a) 5 to 30 % by weight of an acrylate polymer resin; b) 5 to 35 % by weight of a high boiling point solvent having a boiling point of at least 200 °C; c) 5 to 35 % by weight of a low boiling point solvent having a boiling point of less than 200 °C; and d) 50 to 85 % by weight of a metal powder.
- [21] For the acrylate polymer resin of a) used in the invention, there can be used conventional acrylate polymer resins and preferably, it can be prepared by polymerizing unsaturated carbonic acid monomers, aromatic monomers and other monomers.
- [22] The unsaturated carbonic monomer functions to increase elasticity of the polymer via hydrogen bond within the polymer and in particular, there can be used acrylic acid, methacrylic acid, itaconic acid, maleic acid, fumaric acid, vinyl acrylate, an acid anhydride form thereof and so on.
- [23] Preferably, the unsaturated carbonic acid monomers are included in an amount of 20 to 50 % by weight of the total monomers used in the preparation of the acrylate polymer resin and when the content falls within the above ranges, the elasticity characteristics of the polymer, prevention of gelation during polymerization, and control of the degree of polymerization can be all satisfied.
- [24] The aromatic monomer functions to form close adhesion to substrates and stable pattern and in particular, there can be used styrene, benzylmethacrylate, benzy-

lacrylate, phenylacrylate, phenylmethacrylate, 2-nitrophenylacrylate, 4-nitrophenylacrylate, 2-nitrophenylmethacrylate, 4-nitrophenylmethacrylate, 2-nitrobenzylmethacrylate, 4-nitrobenzylmethacrylate, 2-chlorophenylacrylate, 4-chlorophenylacrylate, 2-chlorophenylmethacrylate, 4-chlorophenylmethacrylate and so on.

- [25] Preferably, the aromatic monomers are included in an amount of 10 to 30 % by weight of the total monomers used in the preparation of the acrylate polymer resin and more preferably, they are included in an amount of 15 to 20 % by weight. When the content falls within the above ranges, close adhesion to substrates, adhesion strength of pattern, directionality of the formed pattern, formation of stable pattern, and easy elimination during calcination process can be all satisfied.
- [26] Other monomers used in the preparation of the acrylate polymer resin, in addition to the unsaturated carbonic acid monomers and the aromatic monomers, function to control the glass transition temperature and polarity of the polymer.
- [27] For the other monomers, there can be used 2-hydroxyethyl(meth)acrylate, 2-hydroxyoctyl(meth)acrylate, methyl(meth)acrylate, ethyl(meth)acrylate, or n-butylacrylate and they are preferably included in an amount of 20 to 60 % by weight of the total monomers used in the preparation of the acrylate polymer resin, in consideration of close adhesion to substrates, heat resistance and glass transition temperature of the polymer.
- [28] The acrylate polymer resin can be prepared by polymerizing the above described monomers in the presence of a solvent so that the gelation of the unsaturated carbonic acid monomers, aromatic monomers and other monomers from can be prevented and proper volatile properties can be controlled during offset printing process.
- [29] For the solvent, propyleneglycol monomethyl ether, dipropyleneglycol monomethyl ether, propyleneglycol monomethyl ether propionate, ethyl ether propionate, terpeneol, propyleneglycol monomethyl ether acetate, dimethyl amino formaldehyde, methyl ethyl ketone, butylcarbitol, butylcarbitol acetate, gammabutyrolactone, or ethyl lactate can be used alone or in a mixture.
- [30] The acrylate polymer resin obtained by the polymerization of the above monomers in the presence of the solvent has preferably a weight average molecular weight of 10,000 to 100,000 and more preferably, 20,000 to 50,000. When the weight average molecular weight falls within the above ranges, the problem that pattern transfer from gravure grooves to blanket could be difficult during OFF mode due to the increased flow characteristics of the polymer resulting from low glass transition temperature of the polymer resin and the problem that the injection of the composition into the gravure grooves could be difficult due to the excessive elasticity characteristics of the polymer resin can be solved at the same time.

- [31] The acrylate polymer resin is preferably included in an amount of 5 to 30 % by weight of the paste composition for printing of the invention. When the content is less than 5 % by weight, a problem is likely to happen during the OFF mode due to the decreased elasticity of the composition, and when it is in excess of 30 % by weight, the electrical resistance of the formed pattern can be increased.
- [32] Also, the invention comprises b) the high boiling point solvent of which the boiling point is at least 200 °C. The high boiling point solvent is not restricted to special ones as long as its boiling point is 200 °C or higher and in particular, there can be used gammabutyrolactone, butylcarbitol acetate, carbitol, methoxy methyl ether propionate, terpineol and so on.
- [33] Preferably, the high boiling point solvent is included in an amount of 5 to 35 % by weight of the paste composition for printing of the invention. When the content is less than 5 % by weight, the flow decrease rate of the solvent becomes rapidly fast and thus pattern transfer may not be easy in the OFF mode during printing process, and when it is in excess of 35 % by weight, the directionality of pattern can be decreased because it is difficult to control the flow of the composition in the SET mode during offset printing and pattern broadening phenomena during printing can be deteriorated.
- [34] Also, the invention comprises c) the low boiling point solvent of which the boiling point is less than 200 °C.
- [35] The low boiling point solvent is not restricted to special ones as long as its boiling point is less than 200 °C and in particular, there can be used propyleneglycol monomethyl ether, dipropyleneglycol monomethyl ether, propyleneglycol monomethyl ether propionate, ethyl ether propionate, propyleneglycol monomethyl ether acetate, methyl ethyl ketone, ethyl lactate and so on.
- [36] Preferably, the low boiling point solvent is included in an amount of 5 to 35 % by weight of the paste composition for printing of the invention. When the content is less than 5 % by weight, the directionality of pattern can be decreased because it is difficult to control the flow of the composition in the SET mode during offset printing and pattern broadening phenomena during printing can be deteriorated and when it is in excess of 35 % by weight, flow decrease rate becomes rapidly fast and thus pattern transfer may not be easy in the OFF mode during printing process.
- [37] Preferably, the combined amount of the high boiling point solvent of b) and the low boiling point solvent of c) are 40 % by weight or less of the paste composition for printing of the invention. When the content is in excess of 40 % by weight, the viscosity of the paste is decreased and there is a possibility of print performance being deteriorated. Furthermore, it is preferably to control the viscosity of the final paste composition for gravure offset printing in the range of 5,000 to 20,000 cP by suitably blending the volatile solvents of the high boiling point solvent and low boiling point

solvent.

- [38] The metal powder of d) used in the invention is not restricted to special ones as long as it can be used for the formation of PDP electrodes or electrodes of mesh filters for shielding electromagnetic waves and in particular, there can be used silver, copper, nickel or alloys containing them and so on.
- [39] Preferably, the metal powder is included in an amount of 50 to 85 % by weight of the paste composition for printing. When the content is less than 50 % by weight, required performance as an electrode and electromagnetic shield performance can be deteriorated due to the increased electrical resistance of the formed pattern, and when it is in excess of 85 % by weight, the viscosity of the composition increases and it becomes difficult to disperse, and thus print performance can be deteriorated.
- [40] In addition, the paste composition for printing of the invention may further comprise a dispersion agent for the dispersion of metal powder for electrodes, a black pigment for the control of contrast, and a glass powder to increase adhesion strength to glass during calcination, if necessary, and the content is preferably 0.01 to 10 % by weight of the paste composition for printing of the invention and more preferably 0.1 to 3 % by weight.
- [41] Also, the invention provides a method of forming a plasma panel display electrode comprising forming pattern by gravure offset printing method using the above paste composition for printing, which is characterized by using the paste composition for offset printing of the invention instead of the conventional paste compositions which have been used to form electrodes of plasma display panel and adopting the gravure offset printing method, and any other known methods can be applied to form plasma display electrodes.
- [42] Also, the invention provides a method of forming an electrode of mesh filter for shielding electromagnetic wave comprising forming pattern by gravure offset printing method using the above paste composition for printing, which is characterized by using the paste composition for offset printing of the invention instead of the conventional paste compositions which have been used to form electrodes of mesh filter for shielding electromagnetic waves and adopting the gravure offset printing method, and any other known methods can be applied to form mesh filter electrodes for shielding electromagnetic waves.
- [43] The electrode formation method of plasma display panel and the preparation method of mesh filter for shielding electromagnetic waves using the paste composition for printing of the invention provide excellent print performance, the formed patterns are excellent in directionality and stability and particularly, as they take direct print mode, they have remarkably improved cost-saving effects when compared with the photolithography based methods.

[44] For better understanding of the present invention, preferred embodiments follow. The following examples are intended to merely illustrate the invention without limiting the scope of the invention.

[45]

[46] **EXAMPLES**

[47] **EXAMPLE 1**

[48] 15 % by weight of polymer resin (weight average molecular weight 25,000) where methacrylic acid (MA) : benzylacrylate (BA) : 2-hydroxyethyl(meth)acrylate (2-HEMA) : methyl(meth)acrylate (MMA) were polymerized in a ratio of 30:20:10:40 by weight, as an acrylate polymer resin, 15 % by weight of terpeneol (mixture of α -, β -, γ -terpineols) as a high boiling point solvent, 10 % by weight of propylene glycol monomethyl ether propionate (PGMEP) as a low boiling point solvent, 63 % by weight of silver as a metal powder for electrode, and 2 % by weight of an organic dispersion agent containing an amine group as a dispersion agent were mixed at a room temperature and stirred and finally, a 3-roll mill was employed to prepare a desired paste composition for printing.

[49]

[50] **Examples 2~3 and Comparative Examples 1~2**

[51] With the exception that the compositions as shown in Table 1 below were used in Example 1, the same procedures as in Example 1 were carried out to prepare paste compositions for printing.

[52] The units used in Table 1 are % by weight.

[53] Table 1

[Table 1]

[Table]

	Example 2	Example 3	Com. Ex. 1	Com. Ex. 2
Acrylate Polymer Resin	10	10	15	15
Terpineol	10	8	17	3
PGMEP	8	10	3	17
Silver	70	70	63	63
Dispersion Agent	2	2	2	2

[54]

[55] Gravure offset printing evaluations about print performance, minimum line width, and pattern directionality were performed using the paste compositions for printing prepared in Examples 1 to 3 and Comparative Example 1 or 2 and the results are shown in Fig. 1 and Table 2 below.

[56] The print performance was evaluated by observing the level of composition remaining in blankets that was not transferred to substrates during the SET mode by an optical microscope, wherein O indicates the case where no printing composition remains in the blankets and X indicates the case where the printing composition remains in the blankets in an excess amount during the SET mode and pattern transfer to the substrates is impossible. For the evaluation of minimum line width, the minimum sizes of pattern formable by gravure offset printing were determined, and smaller size is better. For the pattern directionality, the degree of directionality in the pattern formed on the substrates after printing was observed using an optical microscope, wherein excellent case in pattern directionality was indicated as O, normal case as Δ and inferior case as X.

[57]

[58] Table 2

[Table 2]

[Table]

	Example 1	Example 2	Example 3	Com. Ex. 1	Com. Ex. 2
Print Performance	O	O	O	O	X
Minimum line widths	15 μ	20 μ	20 μ	50 μ	-
Pattern Directionality	O	O	O	X	-

[59]

[60] As seen in Table 2 above and Fig. 1, Examples 1 to 3 where pattern was formed by gravure offset printing method using the paste compositions for printing according to the present invention showed excellent print performance, narrow minimum line widths of 20 μ and less and excellent pattern directionality, when compared with Comparative Example 1 or 2. Moreover, Comparative Example 2 failed to print, resulting in no pattern.

Industrial Applicability

[61] The paste compositions in accordance with the present invention are suitable for gravure offset mode capable of directly forming fine pattern and have superior cost saving effects in comparison with the prior photolithography based methods and at the same time, they can satisfy a variety of the properties required as a composition each of which is required for printing process so that appropriate offset print performance can be exerted.

[62] Although the invention is described in detail by preferred embodiments, it is obvious to those skilled in the pertinent art that various changes and modifications can be made within the range of the spirit and scope of the invention and there is no doubt that such changes and modifications fall within the scope of the appended claims.

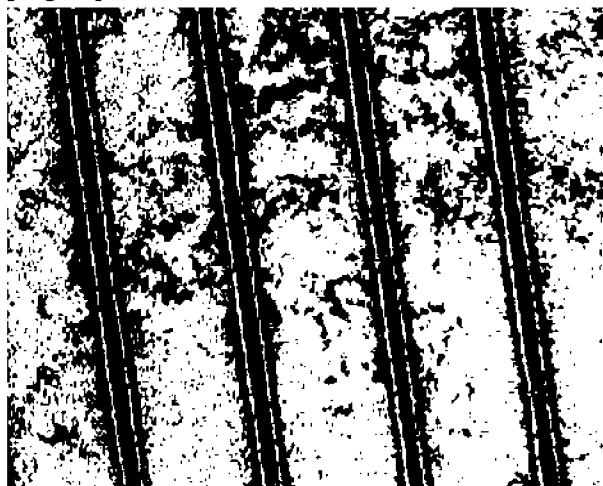
Claims

- [1] A paste composition for printing comprising:
- a) 5 to 30 % by weight of an acrylate polymer resin;
 - b) 5 to 35 % by weight of a high boiling point solvent having a boiling point of at least 200 °C;
 - c) 5 to 35 % by weight of a low boiling point solvent having a boiling point of less than 200 °C; and
 - d) 50 to 85 % by weight of a metal powder.
- [2] The paste composition for printing according to claim 1 wherein the acrylate polymer resin of a) is prepared by polymerizing i) 20 to 50 % by weight of an unsaturated carbonic acid monomer, ii) 10 to 30 % by weight of an aromatic monomer, and iii) 20 to 60 % by weight of a monomer selected from the group consisting of 2-hydroxyethyl(meth)acrylate, 2-hydroxyoctyl(meth)acrylate, methyl(meth)acrylate, ethyl(meth)acrylate, n-butylacrylate and a mixture thereof, in the presence of a solvent.
- [3] The paste composition for printing according to claim 2 wherein the unsaturated carbonic acid is selected from the group consisting of acrylic acid, methacrylic acid, itaconic acid, maleic acid, fumaric acid, vinyl acetate, an acid anhydride form thereof and a mixture thereof.
- [4] The paste composition for printing according to claim 2 wherein the aromatic monomer is selected from the group consisting of styrene, benzylmethacrylate, benzylacrylate, phenylacrylate, phenylmethacrylate, 2-nitrophenylacrylate, 4-nitrophenylacrylate, 2- nitrophenylmethacrylate, 4-nitrophenylmethacrylate, 2-nitrobenzylmethacrylate, 4-nitrobenzylmethacrylate, 2-chlorophenylacrylate, 4-chlorophenylacrylate, 2-chlorophenylmethacrylate, 4-chlorophenylmethacrylate, a mixture thereof.
- [5] The paste composition for printing according to claim 1 wherein the acrylate polymer resin has a weight average molecular weight of 10,000 to 100,000.
- [6] The paste composition for printing according to claim 1 wherein the high boiling point solvent of b) is selected from the group consisting of gammabutyrolactone, butylcarbitol acetate, carbitol, methoxy methyl ether propionate, terpeneol, and a mixture thereof.
- [7] The paste composition for printing according to claim 1 wherein the low boiling point solvent of c) is selected from the group consisting of propyleneglycol monomethyl ether, dipropyleneglycol monomethyl ether, propyleneglycol monomethyl ether propionate, ethyl ether propionate, propyleneglycol monomethyl ether acetate, methyl ethyl ketone, ethyl lactate, and a mixture

thereof.

- [8] The paste composition for printing according to claim 1 wherein the silver powder of d) is selected from the group consisting of silver, copper, nickel, an alloy containing them, a mixture thereof.
- [9] The paste composition for printing according to claim 1 further comprising at least one additive selected from the group consisting of a dispersion agent, black pigment, and glass powder.
- [10] A method of forming plasma panel display electrode comprising forming pattern by gravure offset printing method using the paste composition for printing as described in any one of claims 1 to 9.
- [11] A method of forming electrode of mesh filter for shielding electromagnetic wave comprising forming pattern by gravure offset printing method using the paste composition for printing as described in any one of claims 1 to 9.

[Fig. 1]



Example 1



Comparative Ex. 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2007/001722**A. CLASSIFICATION OF SUBJECT MATTER***C09D 133/08(2006.01)i, C09D 133/06(2006.01)i, C08L 33/08(2006.01)i, C08L 33/06(2006.01)i, C09D 7/12(2006.01)i, B41M 5/00(2006.01)i, H01B 1/20(2006.01)i, H01B 1/22(2006.01)i, H01J 9/02(2006.01)i, H01J 17/49(2006.01)i*

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility models and applications for Utility models since 1975
Japanese Utility models and applications for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS(KIPO Internal), CA(STN), esp@cenet, ScienceDirect

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y A	US 6214527 B1(KOSAKA et al.) 10 April 2001 (10-04-2001) See abstract; column 2, line 15-column 6, line 48; Claims 1-2	1, 5-11 2-4
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06 AUGUST 2007 (06.08.2007)

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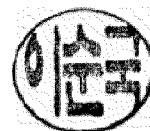
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