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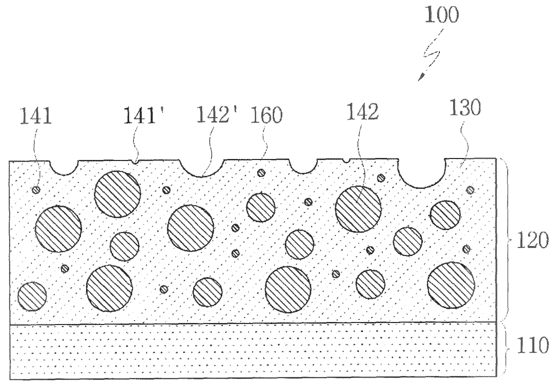
(54) POLISHING PAD AND METHOD FOR MANUFACTURING SAME

(57) Polishing pad and method of manufacturing the same, the method, whereby materials for forming a polishing layer are mixed and solidified by a chemical reaction so as to manufacture the polishing pad, the method including: grinding organic materials by using a physical method so as to form micro-organic particles; mixing the micro-organic particles formed in the operation with the materials for forming the polishing layer; mixing at least one selected from the group consisting of inert gas, a capsule type foaming agent, and a chemical foaming agent that are capable of controlling sizes of pores, with the mixture in the operation so as to form gaseous pores; performing gelling and hardening of the mixture generated in the operation so as to form a polishing layer; and processing the polishing layer so as to distribute open pores defined by opening gaseous pores on a surface of the polishing layer.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a polishing pad and a method of manufacturing the same, and more particularly, to a polishing pad including gaseous pores that allows a polishing slurry to be effectively collected and supplied and a method of manufacturing the same.

2. Description of the Related Art

[0002] A chemical mechanical planarization/polishing (CMP) process has been used for global planarization of semiconductor devices and has become important with tendencies to an increase in the diameter of a wafer, a high integration density, a micro line width, and a multilayer wiring structure.

[0003] In a CMP process, a polishing speed and the flatness of a wafer are important, and the performance of such a CMP process depends on conditions of CMP equipment and performances of a polishing slurry and a polishing pad that are consumable members. In particular, the polishing pad allows the polishing slurry supplied in a state where the polishing pad is in contact with the surface of the wafer, to be uniformly dispersed onto the wafer so that physical abrasion is provoked by abrasive particles contained in the polishing slurry and protrusions of the polishing pad.

[0004] In this case, a polishing pad's surface directly contacting the wafer needs to be saturated with the polishing slurry so that the polishing slurry flows smoothly. To this end, techniques for forming micro holes (for example, pores) in the polishing pad's surface are disclosed in U.S. Patent No. 5,578,362 and the like.

[0005] In this way, it is very important to maintain the polishing pad's surface to be saturated with the polishing slurry so as to increase the role and performance of the polishing pad in the CMP process. Thus, grooves in various shapes are formed in the polishing pad so as to form a large slurry flow, and micro holes are formed in the polishing pad's surface by opening a microporous material, as described above.

[0006] However, when pores are formed by introducing liquid microelements, there are advantages that the pores can be stably formed and a temperature of the CMP process is lowered. However, there are disadvantages that the liquid microelements are in a liquid state and thus a small amount of liquid microelements leaks during the CMP process.

[0007] Attempts for controlling many matters by introducing fine additives into a slurry due to the development of the CMP process are recently increasing. Thus, additive materials that may affect the CMP process are required not to be put into a pad. Introduction of gaseous pores has been spotlighted as a method of forming only pure pores without putting additive materials into a polyurethane matrix.

[0008] There is an advantage that a gaseous pore pad has no discharge materials that may affect the CMP process. Thus, in the gaseous pore pad, it is not easy to control gaseous pores and thus, a manufacturing process should be optimized. However, the following problems occur.

[0009] Firstly, when pores are formed by directly injecting gas into the polyurethane matrix that forms a pad or by introducing a foaming agent, it is difficult to precisely control sizes and densities of the pores. In particular, it is not easy to manufacture pores having uniform sizes of less than 50 μm compared to other methods.

[0010] Secondly, it is very difficult to change sizes of pores and densities without changing the composition of the polyurethane matrix.

[0011] Thirdly, in a pure polyurethane matrix, since abrasion is not smoothly performed when conditioning is performed using a diamond disk, a phenomenon such as pore glazing that pores may be clogged, occurs.

SUMMARY OF THE INVENTION

[0012] The present invention provides a polishing pad that may maintain an advantage of a chemical mechanical planarization/polishing (CMP) pad that introduces gaseous pores so as to form porosity and may solve or improve the above-described conventional problems and a method of manufacturing the same.

[0013] According to an aspect of the present invention, there is provided a method of manufacturing a polishing pad, whereby materials for forming a polishing layer are mixed and solidified by a chemical reaction so as to manufacture the polishing pad, the method including: (a) grinding organic materials by using a physical method so as to form micro-organic particles; (b) mixing the micro-organic particles formed in (a) with the materials for forming the polishing layer; (c) mixing at least one selected from the group consisting of inert gas, a capsule type foaming agent, and a chemical foaming agent that are capable of controlling sizes of pores, with the mixture in (b) so as to form gaseous pores; (d) performing gelling and hardening of the mixture generated in (c) so as to form a polishing layer; and (e) processing the polishing layer so as to distribute open pores defined by opening gaseous pores on a surface of the polishing layer.

[0014] According to another aspect of the present invention, there is provided a method of manufacturing a polishing pad, whereby materials for forming a polishing layer are mixed and solidified by a chemical reaction so as to manufacture the polishing pad, the method including: (a) including monomers for forming micro-organic particles in the materials for forming a polishing layer and forming and dispersing the micro-organic particles by polymerization of the monomers after stirring is performed; (b) mixing at least one selected from the group consisting of inert gas, a capsule type foaming agent, and a chemical foaming agent that are capable of controlling sizes of pores, with the mixture in (a) so as to form gaseous pores; (c) performing gelling and hardening of the mixture generated in (b) so as to form a polishing layer; and (d) processing the polishing layer so as to distribute open pores defined by opening gaseous pores on a surface of the polishing layer.

[0015] According to another aspect of the present invention, there is provided a polishing pad that performs a polishing process by moving in contact with a surface of an object to be polished, the polishing pad including a polishing layer, wherein the polishing layer includes at least one of micro-organic particles formed by physically grinding organic materials and micro-organic particles formed by chemical polymerization of monomers and gaseous pores formed by at least one selected from the group consisting of inert gas, a capsule type foaming agent, and a chemical agent, and open pores that are defined by opening the gaseous pores are distributed on a surface of the polishing layer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The above and other features and advantages of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

FIG. 1 is a cross-sectional view of a polishing pad according to an embodiment of the present invention;

FIG. 2 is a schematic view of a polishing apparatus on which the polishing pad illustrated in FIG. 1 is mounted;

FIGS. 3A and 3B are views of micro-organic particles included in a polishing layer illustrated in FIG. 1;

FIGS. 4A and 4B are images obtained by comparing a surface of the polishing layer depending on whether the micro-organic particles are included in the polished layer of FIG. 1;

FIGS. 5 and 6 are flowcharts illustrating a method of manufacturing the polishing layer of the polishing pad according to embodiments of the present invention;

FIG. 7 is a graph showing surface roughness after the surface of the polishing pad of FIG. 1 is polished using a diamond disk for 10 minutes, and

FIG. 8 is an image obtained by comparing surface roughness when the micro-organic particles are introduced with surface roughness when the micro-organic particles are not introduced, after marathon polishing evaluation is performed for 5 hours so as to check abrasion performance.

DETAILED DESCRIPTION OF THE INVENTION

[0017] The present invention will now be described more fully with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown.

[0018] FIG. 1 is a cross-sectional view of a polishing pad 100 according to an embodiment of the present invention.

[0019] As illustrated in FIG. 1, the polishing pad 100 according to an embodiment of the present invention includes a support layer 110 and a polishing layer 120. The support layer 110 is used to fix the polishing pad 100 to a platen 3, as shown in FIG. 3. The support layer 110 is made of a material having stability in order to correspond to a force pressing a silicon wafer 7, i.e., an object to be polished, which is loaded at a head 5 facing the platen 3 so that the support layer 110 supports the polishing layer 120 formed on the support layer 110 with uniform elasticity with respect to the silicon wafer 7. Accordingly, the support layer 110 is made of a nonporous, solid, and uniform elastic material mainly and has lower hardness than the polishing layer 120 formed on the support layer 110.

[0020] In addition, at least a part of the support layer 110 is transparent or semitransparent so that a light beam 170 used to detect the flatness of a surface of the object to be polished can be transmitted through the support layer 110. In FIG. 3, the object to be polished is the silicon wafer 7 having a metal or insulation layer as a layer to be polished. However, various types of substrates such as a substrate, on which a thin film transistor-liquid crystal display (TFT-LCD) is to be formed, a glass substrate, a ceramic substrate, and a polymer plastic substrate may be objects to be polished. In addition, the polishing pad 100 can be manufactured without including the support layer 110.

[0021] Also, although the polishing pad 100 has a circular shape so as to be suitable for the rotation type polishing apparatus 1, as shown in FIG. 2, the polishing pad 100 can be modified in various shapes, such as a rectangular shape, a square shape, and the like, according to the shape of the polishing apparatus 1.

[0022] As shown in FIG. 2, the polishing layer 120 directly contacts the silicon wafer 7 as the object to be polished. The polishing layer 120 can be formed by mixing or chemically combining predetermined materials for forming a polishing layer.

[0023] Here, a material of a polymeric matrix 130 formed by materials for forming the polishing layer 120, i.e., materials for forming the polymeric matrix 130 may include at least one selected from the group consisting of polyurethane, polyether, polyester, polysulfone, polyacryl, polycarbonate, polyethylene, polymethylmethacrylate, polyvinylacetate, polyvinylchloride, polyethyleneimine, polyethersulfone, polyetherimide, polyketone, melamine, nylon, fluorinated hydrocarbon, or a combination thereof.

[0024] As a specific example of the polymeric matrix 130, polyurethane may be obtained from two liquid type low viscosity liquid urethane including isocyanate prepolymer and a hardener. The prepolymer that is a precursor for final polymer covers olygomer or monomer. The isocyanate prepolymer has an average 2 or more isocyanate functional groups and the content of reactive isocyanate is 4 to 16 parts by weight and may be obtained by reaction between polyol, such as polyether, polyesther, or polytetramethyleneglycol and toluene diisocyanate or methylene diphenyl diisocyanate, and the isocyanate prepolymer may react with the hardener having an isocyanate reactive group and may form polyurethane finally. Here, various polyol based on amine or polyether and polyesther, such as 4,4-methylene-bis(2-chloroaniline)(hereinafter, MOCA), may be used as the hardener. A material property of polyurethane may be adjusted by various combinations components.

[0025] In this way, the polymeric matrix 130 that constitutes the polishing layer 120 is composed of various well-known components, and a further description of well-known materials and forming materials will be omitted.

[0026] An operation of forming the polishing layer 120 may include a casting process in which polyurethane prepolymer and the hardener are mixed with each other, are injected into a mold and liquid raw materials are chemically solidified, a splitting process in which the solidified materials are cut according to a usage purpose, and a grooving process in which a slurry flow channel is formed in the cut pad. In the present invention, main features are present in types of materials to be injected in the casting process among these processes such that particular materials are included in the polishing layer 120.

[0027] In detail, micro-organic particles are included in the polishing layer 120 according to the present invention, and furthermore, pores 141 and 142 may be included in the polishing layer 120.

[0028] Here, the micro-organic particles may be particles formed of copolymer that may be made by mixing monomers used to fabricate thermoplastic resin particles, thermosetting resin particles, and polymer or particles formed of mixed materials thereof.

[0029] That is, the micro-organic particles may include at least one selected from the group consisting of polyethylene resin, polypropylene resin, polystyrene resin, polyvinylchloride resin, polyamide resin, acryl resin, polyurethane resin, polycarbonate resin, phenyol resin, amino resin, epoxy resin, urea resin, polyester resin, rubber acrylonitrile butadiene styrene copolymer (ABS), and styrene acrylonitrile copolymer (SAN).

[0030] Two methods (physical method and chemical method) may be largely used in such a way that the micro-organic particles are included in the polishing layer 120.

[0031] According to the physical method, organic materials may be ground using a mechanical method so as to form micro-organic particles and then, the micro-organic particles may be mixed with materials for forming the polishing layer 120.

[0032] According to the chemical method, monomer for forming micro-organic particles may be included in the materials for forming the polishing layer 120, and the micro-organic particles may be formed and uniformly dispersed by polymerization of corresponding monomers after a stirring process is performed.

[0033] A state in which the micro-organic particles are included in the materials for forming the polishing layer 120, is shown in FIG. 3.

[0034] FIG. 3A is a low magnification image of the micro-organic particles, and FIG. 3B is a high magnification image of the micro-organic particles.

[0035] The pores 141 and 142 included in the polishing pad 100 may be pores of which sizes are capable of being controlled by at least one selected from the group consisting of inert gas, a capsule type foaming agent, a chemical foaming agent, and liquid microelements.

[0036] Here, the liquid microelements are formed of a liquid material that is not compatible with the polymeric matrix 130 that constitutes the polishing layer 120, i.e., a material selected from the group consisting of aliphatic mineral oil, aromatic mineral oil, silicon oil which does not have a hydroxyl group at the end of molecules, soybean oil, coconut oil, palm oil, cottonseed oil, camellia oil, hardened oil, or a combination thereof.

[0037] The liquid microelements may be dispersed into the polymeric matrix 130 in a micro spherical shape. The average diameter of spheres may be between 1 to 50 μm, for example, between 10 to 40 μm. The diameter of spheres in the above range is most optimal to the collection and supply of a polishing slurry 13. However, the diameter of spheres can be changed depending on a type of the polishing slurry 13, and the size of the liquid microelements can be also changed.

[0038] Types of the pores 141 and 142 may be distinguished from each other by a method of forming the pores 141 and 142. For example, the pores 141 and 142 are formed by injecting inert gas, a capsule type foaming agent, or a chemical foaming agent.

[0039] Here, the inert gas may be gas having a valence of 0 that is chemically stable, i.e., helium (He), neon (Ne), argon (Ar), krypton (Kr), xenon (Xe), or radon (Rn). Furthermore, the inert gas may be any gas that does not react with the polymeric matrix 130, i.e., that does not participate in a urethane reaction, such as N_2, apart from 8 group elements of the periodic table.

[0040] The foaming agent that is mixed with a predetermined material and generates a large amount of bubbles by evaporation or reaction by heat, can be largely classified into a chemical foaming agent and a physical foaming agent.

[0041] In the chemical foaming agent, foaming occurs in carbon dioxide that is generated by a reaction with water by using vitality of an isocyanate group, and thus water is used for a foaming agent. In the physical foaming agent, bubbles are formed by generating reaction heat by injecting gas or using a decomposable or evaporative foaming agent, and thus, the physical foaming agent does not participate in polymerization. Types and features of these foaming agents are already well-known and thus, detailed descriptions thereof will be omitted.

[0042] The pores 141 and 142 are formed on the polishing layer 120 by mixing the inert gas or various foaming agents (capsule type foaming agent or chemical foaming agent). Different pores 141 and 142 that are controlled by a plurality of methods may be included in the polishing pad 100, and FIG. 1 is a cross-sectional view of the polishing pad 100 in which the plurality of pores 141 and 142 are included.

[0043] FIGS. 4A and 4B are images obtained by comparing a cross-section of the polishing pad 100 including the pores 141 and 142, as described above, depending on whether the micro-organic particles are included in the polished layer 120 of FIG. 1.

[0044] That is, FIG. 4A shows a pore distribution state of the surface of the polishing pad 100 when the micro-organic particles are not introduced (included) in the polishing layer 120, and FIG. 4B shows a pore distribution state of the surface of the polishing pad 100 when the micro-organic particles are introduced (included) in the polishing layer 120. In FIGS. 4A and 4B, other conditions (conditions such as temperature of forming combination materials of the polishing pad 100 and time) for forming the polishing pad 100 than the micro-organic particles are the same.

[0045] As illustrated in the comparison images of FIGS. 4 and 4B, when the polishing pad 100 is formed by including the micro-organic particles, the distribution of pores are more compact.

[0046] In the casting process, appropriate viscosity of a polyurethane undiluted solution that may collect pores on the gas and a sufficient stirring ability of a casting machine are required so that small and uniform pores can be stably formed when gas or foaming agents are injected into the polyurethane matrix. Since viscosity of most polyurethane raw solutions used in the related art is lower than a level at which the gas can be stably collected, the amount of the gas discharged in the air is larger than the amount of the gas that remains in polyurethane such that entire porosity is lowered and it is difficult to form pores having small sizes.

[0047] However, like in the current embodiment, the micro-organic particles are introduced (included) in a polyurethane prepolymer undiluted solution so that the viscosity of the undiluted solution is increased by interaction between the micro-organic particles and polyurethane and this contributes to formation of small and uniform pores together with acquisition of sufficient porosity.

[0048] Furthermore, even when the composition of the polyurethane matrix is not changed due to adjustment of the content of the micro-organic particles, the sizes of pores and porosity may be adjusted.

[0049] Hereinafter, a method of manufacturing the polishing layer 120 of the polishing pad 100 according to an embodiment of the present invention will be described with reference to FIG. 5.

[0050] First, organic materials are ground using a physical method and are formed as micro-organic particles (S100), and the micro-organic particles are mixed with materials for forming the polishing layer 120 (S110). In detail, the above-described material for forming the polymeric matrix 130 may be mixed with the ground micro-organic particles (S110).

[0051] In the mixing process, inert gas (or a predetermined foaming agent that replaces the inert gas), such as Ar, is together mixed with the material for forming the polymeric matrix 130 (S120).

[0052] Amounts of the mixed insert gas may be adjusted according to the sizes of pores to be formed depending on types.

[0053] Subsequently, gelling and hardening are performed (S130). That is, the mixture is injected into a cast having a predetermined shape and then solidified through gelling and hardening. Gelling is performed for 5 to 30 minutes at 80 to 90°C, and hardening is performed for 20 to 24 hours at 80 to 120°C. However, processing temperature and time can be variously changed to provide optimal conditions.

[0054] Last, the resultant structure of the hardening, having the predetermined shape, is processed (S140). The resultant structure is processed through taking off the cast, cutting, surface treatment, and cleaning. First, the hardened resultant structure is taken out of the cast and cut to have a predetermined thickness and shape. It is apparent that the polishing layer 120 can be formed in the shape of sheet using any method, such as casting or extrusion, known in the field of polymer sheet manufacturing in order to increase the productivity. Grooves in various shapes may be formed in a surface of the polishing layer 120 so that the polishing slurry 13 can be uniformly supplied across the working surface of the polishing layer 120.

[0055] After a cleaning process is performed, the polishing layer 120 is completed. During the cleaning process, pores 141 exposed at the surface of the polishing layer 120 flow out, and thus open pores 141' and 142' are distributed on the polishing layer surface 160.

[0056] The polishing pad 100 can be constituted only by the polishing layer 120. However, when necessary, the support layer 110 can be made using a method widely known in the field of manufacturing the polishing pad 100 and is combined with the polishing layer 120 to complete the polishing pad 100.

[0057] FIG. 6 illustrates a method of manufacturing the polishing layer 120 of the polishing pad 100 according to another embodiment of the present invention.

[0058] The method of FIG. 6 is different from the method of FIG. 5 in that micro-organic particles are included in the polishing pad 100 by using a chemical method.

[0059] That is, monomers for forming the micro-organic particles are included in materials for forming the polishing layer 120, and the micro-organic particles are formed and dispersed into a corresponding mixture solution by polymerization of corresponding monomers after a stirring process is performed (S200).

[0060] Subsequently, at least one selected from the group consisting of inert gas, a capsule type foaming agent, and a chemical foaming agent that are capable of controlling sizes of pores, is mixed in the mixture solution so as to form gaseous pores (S210).

[0061] Subsequent processes, i.e., processes of gelling and hardening the mixture so as to form the polishing layer 120 (S220) and processing (S230) are the same as the above descriptions and thus, redundant descriptions thereof will be omitted.

[0062] More details of the present invention will be described by explaining specific experimental examples. Details not described below are omitted because they can be technically inferred by those skilled in the art. It will be apparent that the scope of the present invention is not limited to the following experimental examples.

<Experimental Example 1>

[0063] 1600 g of polytetramethylene glycol (having a molecular weight of 1000) was put into 5 l of a flask, and 400 g of styrene monomer and a very small amount of an initiator AIBN were slowly put at 100 to 130°C so that a chemical reaction (polymerization) was induced and uniform microparticles could be generated and dispersed into polytetramethylene glycol. The viscosity of polytetramethylene glycol in which the uniform micro-organic particles were dispersed, was 1,700 cPs(25°C).

<Experimental Example 2>

[0064] 120 g of the polytetramethylene glycol in which the uniform micro-organic particles were dispersed, manufactured in Experimental Example 1, and 52 g of toluene diisocyanate were put, were reacted at the temperature of 70 to 80°C for 4 to 5 hours so that the content of NCO of a final product was 9.0%.

[0065] The viscosity of the manufactured isocynate prepolymer was 10,900 cPs(25°C).

<Experimental Example 3>

[0066] A reaction between the isocynate prepolymer manufactured in Experimental Example 2 and MOCA (a kind of a urethane hardener)(a mixture ratio of 10:3) was induced using a casting machine, and simultaneously, injection of gas was performed in the mixture. The mixture in which the gas was injected, was put into a rectangular cast of 80°C. Then, gelling was performed for about 30 minutes, and thereafter, hardening was performed in an oven for 20 hours at 100°Cs. The hardened mixture was taken out of the cast, and the surface of the hardened mixture was cut to form the polishing layer 120 of the polishing pad 100.

[0067] An image of pores formed on a surface of the polishing layer 120 according to this result is shown in FIG. 4B, and an average pore diameter was 32 μm.

[0068] After the manufactured pad was polished using a diamond disk for 10 minutes, surface roughness of the pad was Ra 5.82, Rp 15.05, and Rv 24.07, as shown in FIG. 7.

[0069] In FIG. 7, the horizontal axis represents to a distance from a central axis of the polishing layer 120, and the vertical axis represents a height of the polishing layer surface 160.

[0070] Marathon polishing evaluation was performed for 5 hours so as to check abrasion performance of the manufactured pad, and a result thereof is shown in FIG. 8.

[0071] As shown in FIG. 8, surface roughness was improved when the micro-organic particles are introduced, compared to a case where the micro-organic particles are not introduced.

[0072] That is, the micro-organic particles are dispersed between polyurethane matrices and thus constitute interfaces that contact between the particles and the polyurethane matrix. This means that polyurethane is configured to have a weak adhesion force at the interfaces compared to a case where polyurethane is in a pure state, so that, when conditioning is performed using a diamond disk during a CMP process, characteristics in which the polishing pad is better abraded, are shown.

[0073] In this way, the micro-organic particles constribute to improvements in abrasion performance, and positive effects are shown in improvements in a phenomenon of pore glazing.

[0074] While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims.

Claims

1. A method of manufacturing a polishing pad, whereby materials for forming a polishing layer are mixed and solidified by a chemical reaction so as to manufacture the polishing pad, the method comprising:

    (a) grinding organic materials by using a physical method so as to form micro-organic particles;
    (b) mixing the micro-organic particles formed in (a) with the materials for forming the polishing layer;
    (c) mixing at least one selected from the group consisting of inert gas, a capsule type foaming agent, and a chemical foaming agent that are capable of controlling sizes of pores, with the mixture in (b) so as to form gaseous pores;
    (d) performing gelling and hardening of the mixture generated in (c) so as to form a polishing layer; and
    (e) processing the polishing layer so as to distribute open pores defined by opening gaseous pores on a surface of the polishing layer.

2. A method of manufacturing a polishing pad, whereby materials for forming a polishing layer are mixed and solidified by a chemical reaction so as to manufacture the polishing pad, the method comprising:

(a) including monomers for forming micro-organic particles in the materials for forming a polishing layer and forming and dispersing the micro-organic particles by polymerization of the monomers after stirring is performed;
(b) mixing at least one selected from the group consisting of inert gas, a capsule type foaming agent, and a chemical foaming agent that are capable of controlling sizes of pores, with the mixture in (a) so as to form gaseous pores;
(c) performing gelling and hardening of the mixture generated in (b) so as to form a polishing layer; and
(d) processing the polishing layer so as to distribute open pores defined by opening gaseous pores on a surface of the polishing layer.

3. The method of claim 1 or 2, wherein the micro-organic particles comprise at least one selected from the group consisting of polyethylene resin, polypropylene resin, polystyrene resin, polyvinylchloride resin, polyamide resin, acryl resin, polyurethane resin, polycarbonate resin, phenyol resin, amino resin, epoxy resin, urea resin, polyester resin, rubber acrylonitrile butadiene styrene copolymer (ABS), and styrene acrylonitrile copolymer (SAN).

4. The method of claim 1 or 2, wherein the inert gas is selected from the group consisting of 8 group elements of a periodic table and gas that does not react with the materials for forming the polishing layer.

5. The method of claim 1 or 2, further comprising including liquid materials that constitute liquid microelements in the polishing layer in the materials for forming the polishing layer.

6. A polishing pad that performs a polishing process by moving in contact with a surface of an object to be polished, the polishing pad comprising a polishing layer,
wherein the polishing layer comprises at least one of micro-organic particles formed by physically grinding organic materials and micro-organic particles formed by chemical polymerization of monomers and gaseous pores formed by at least one selected from the group consisting of inert gas, a capsule type foaming agent, and a chemical agent, and
open pores that are defined by opening the gaseous pores are distributed on a surface of the polishing layer.

7. The polishing pad of claim 6, wherein the micro-organic particles comprise at least one selected from the group consisting of polyethylene resin, polypropylene resin, polystyrene resin, polyvinylchloride resin, polyamide resin, acryl resin, polyurethane resin, polycarbonate resin, phenyol resin, amino resin, epoxy resin, urea resin, polyester resin, rubber acrylonitrile butadiene styrene copolymer (ABS), and styrene acrylonitrile copolymer (SAN).

8. The polishing pad of claim 6 or 7, wherein the inert gas is selected from the group consisting of 8 group elements of a periodic table and gas that does not react with the materials for forming the polishing layer.

9. The polishing pad of claim 6 or 7, wherein the polishing layer comprises liquid microelements that are formed in a predetermined region of the polishing layer.

FIG. 1

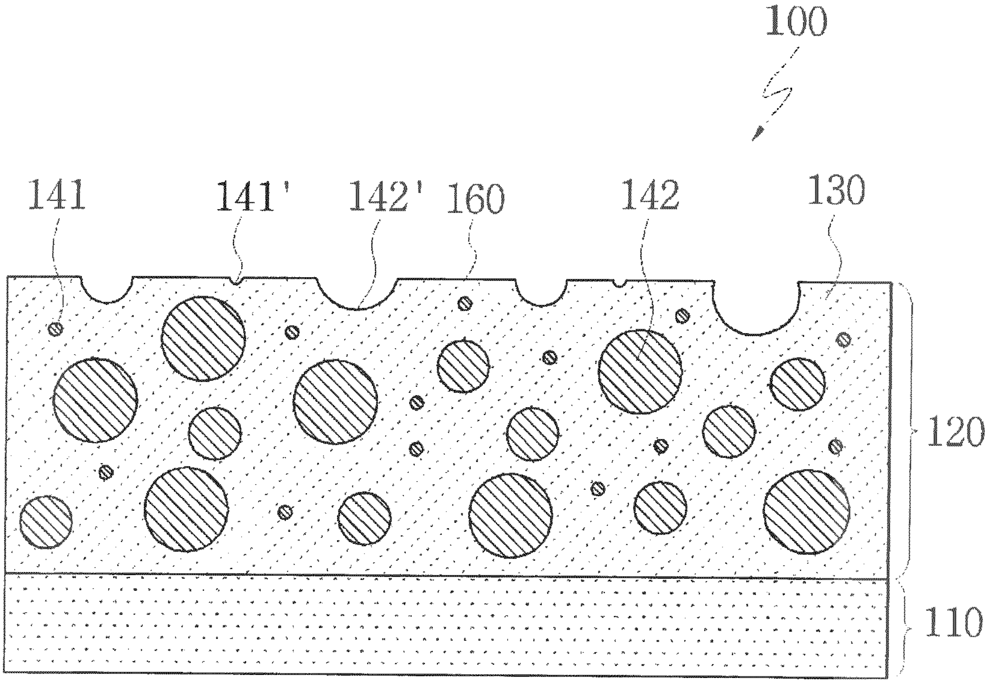


FIG. 2

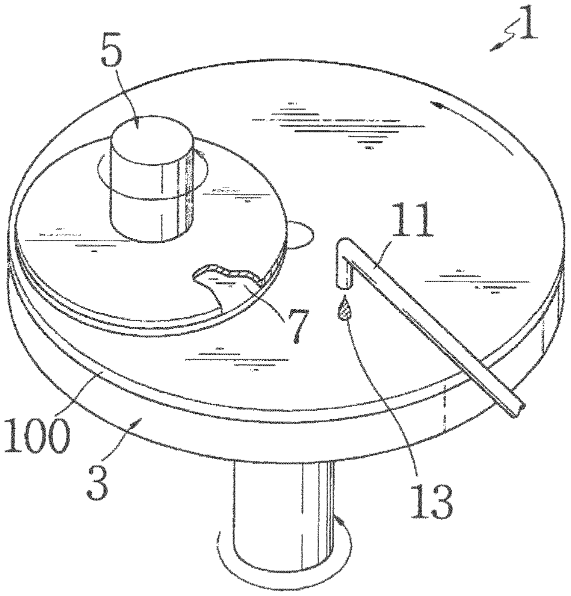


FIG. 3A

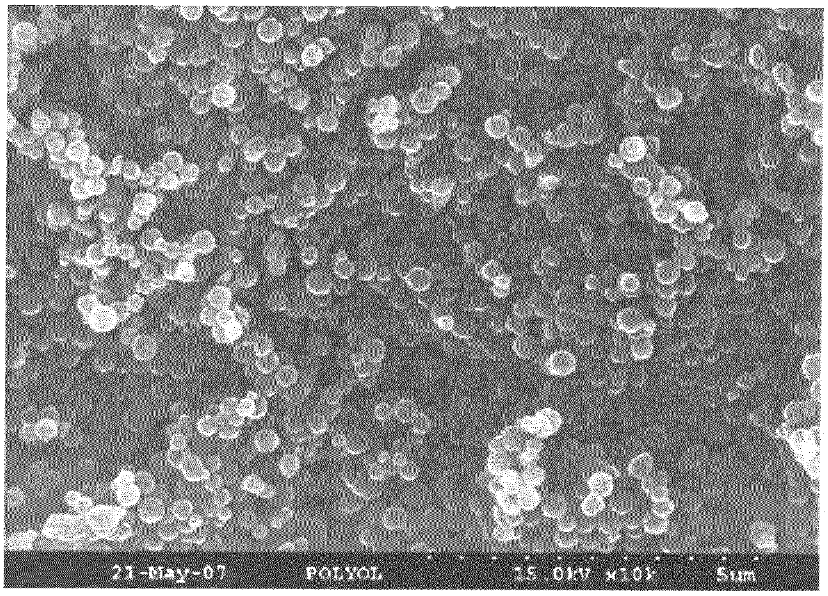

21-May-07
POLYOL
15.0kV x10k
5um

FIG. 3B

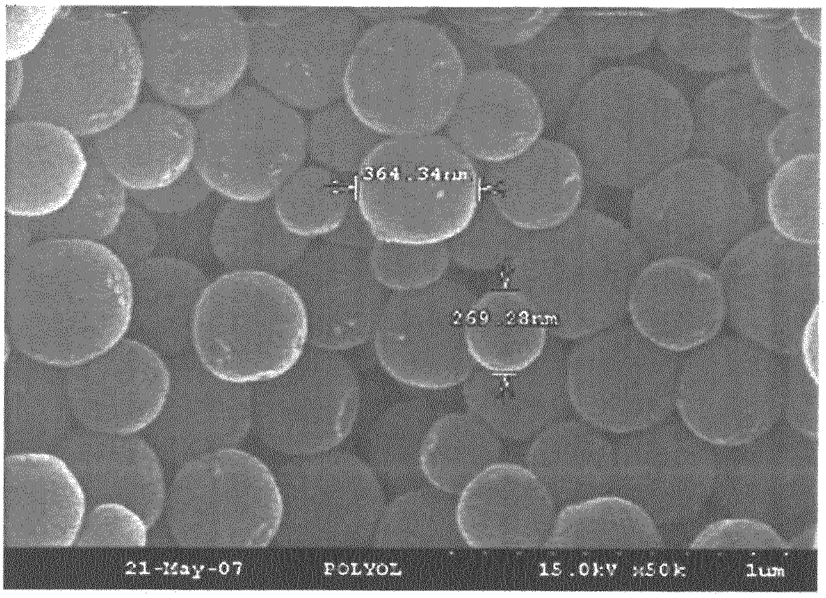

364.34nm
269.28nm
21-May-07
POLYOL
15.0kV x50k
1um

FIG. 4A

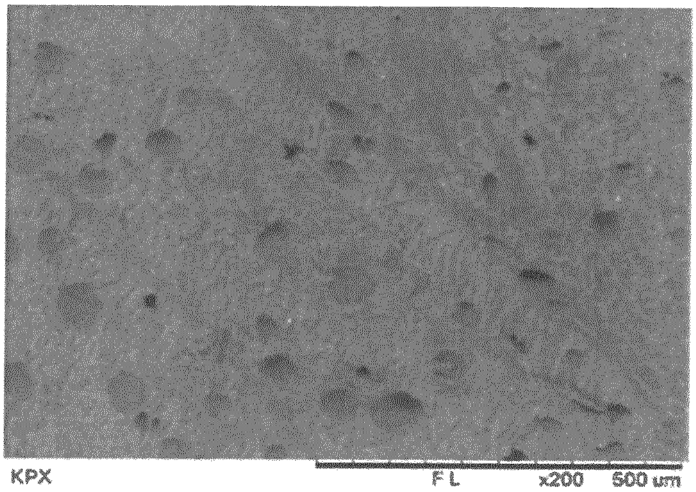


FIG. 4B

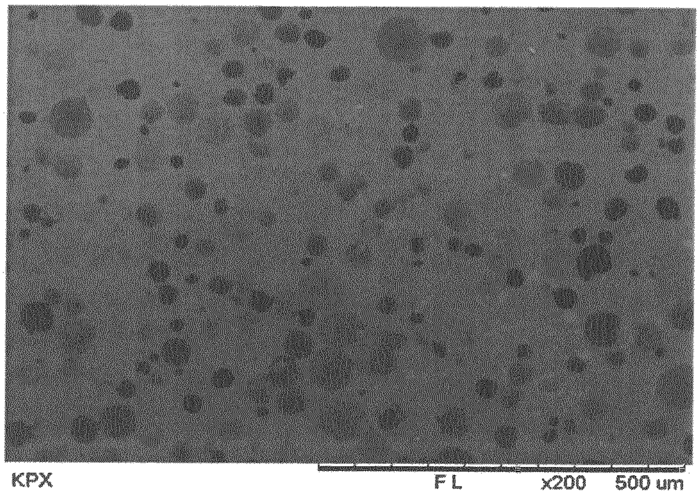


FIG. 5

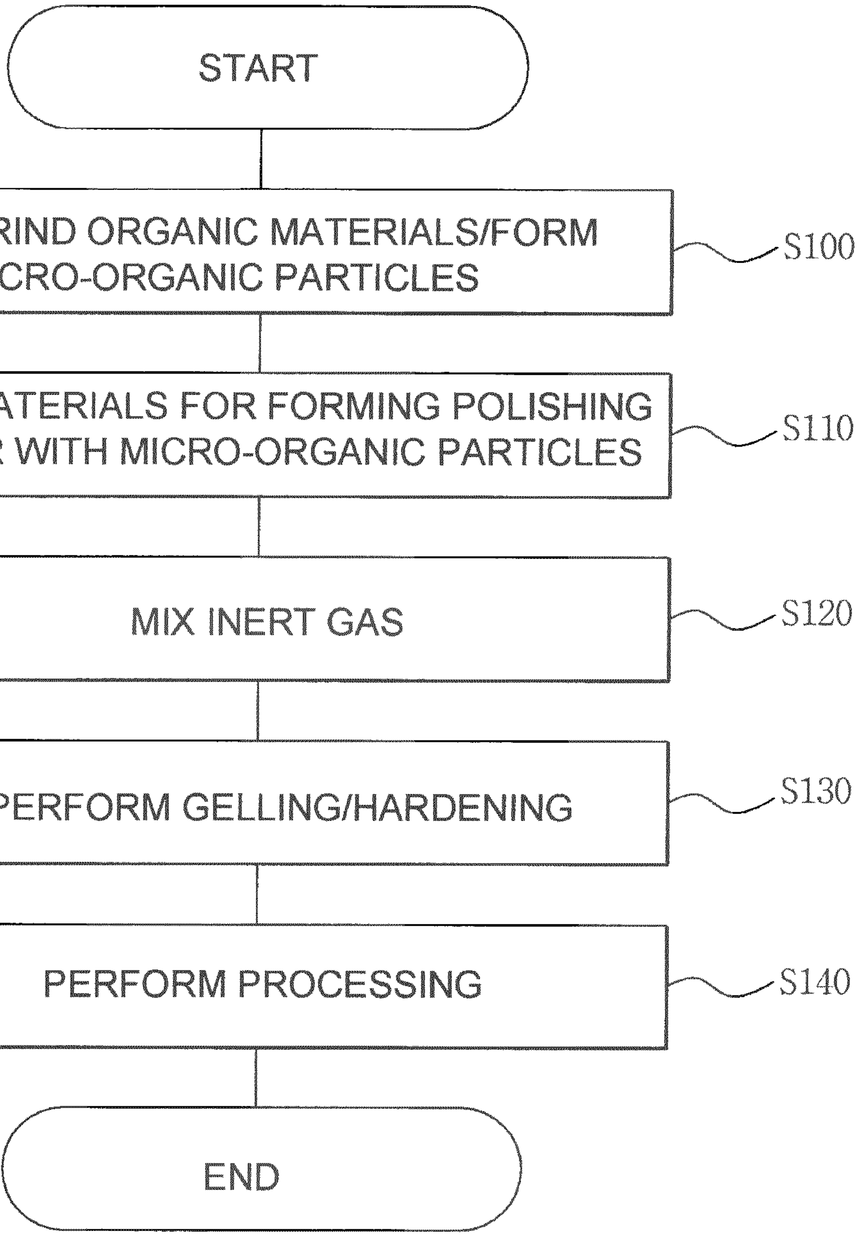

START
GRIND ORGANIC MATERIALS/FORM MICRO-ORGANIC PARTICLES
S100
MIX MATERIALS FOR FORMING POLISHING LAYER WITH MICRO-ORGANIC PARTICLES
S110
MIX INERT GAS
S120
PERFORM GELLING/HARDENING
S130
PERFORM PROCESSING
S140
END

FIG. 6

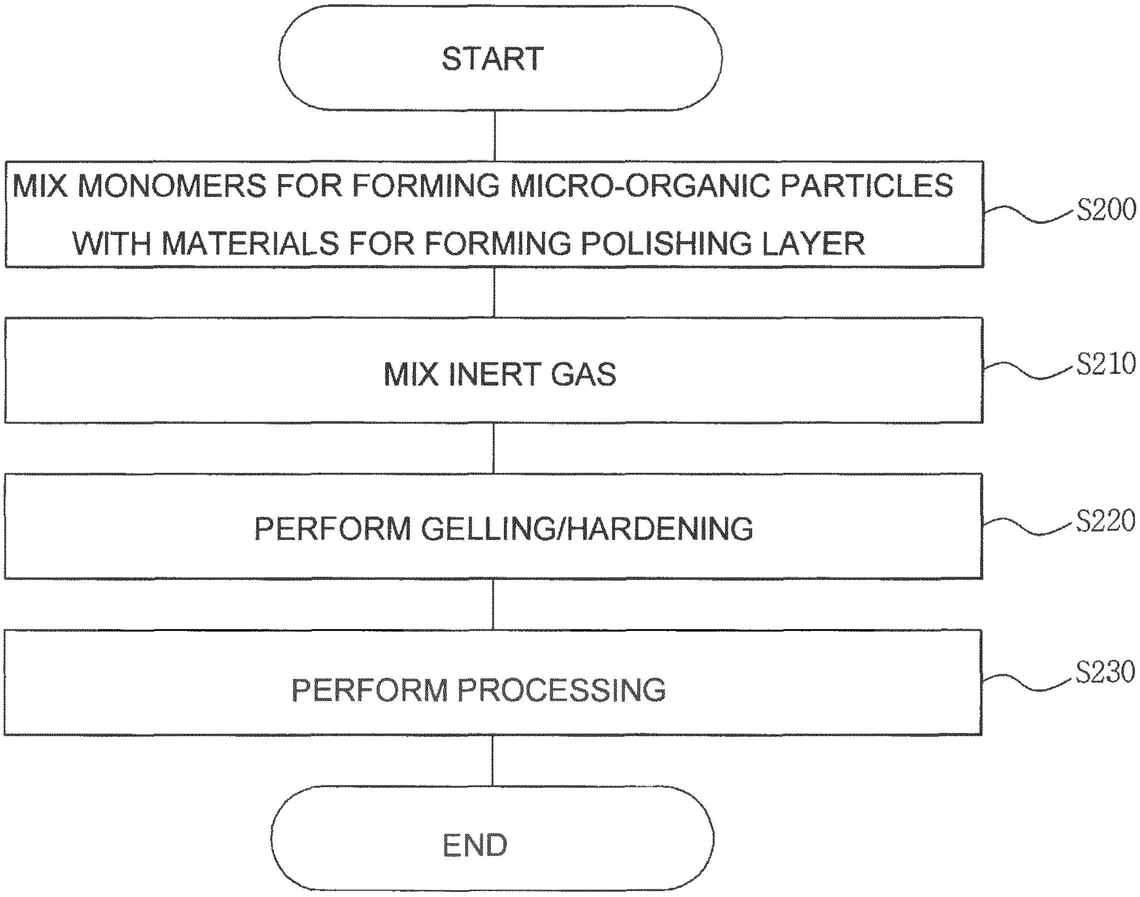

START
MIX MONOMERS FOR FORMING MICRO-ORGANIC PARTICLES WITH MATERIALS FOR FORMING POLISHING LAYER
S200
MIX INERT GAS
S210
PERFORM GELLING/HARDENING
S220
PERFORM PROCESSING
S230
END

FIG. 7

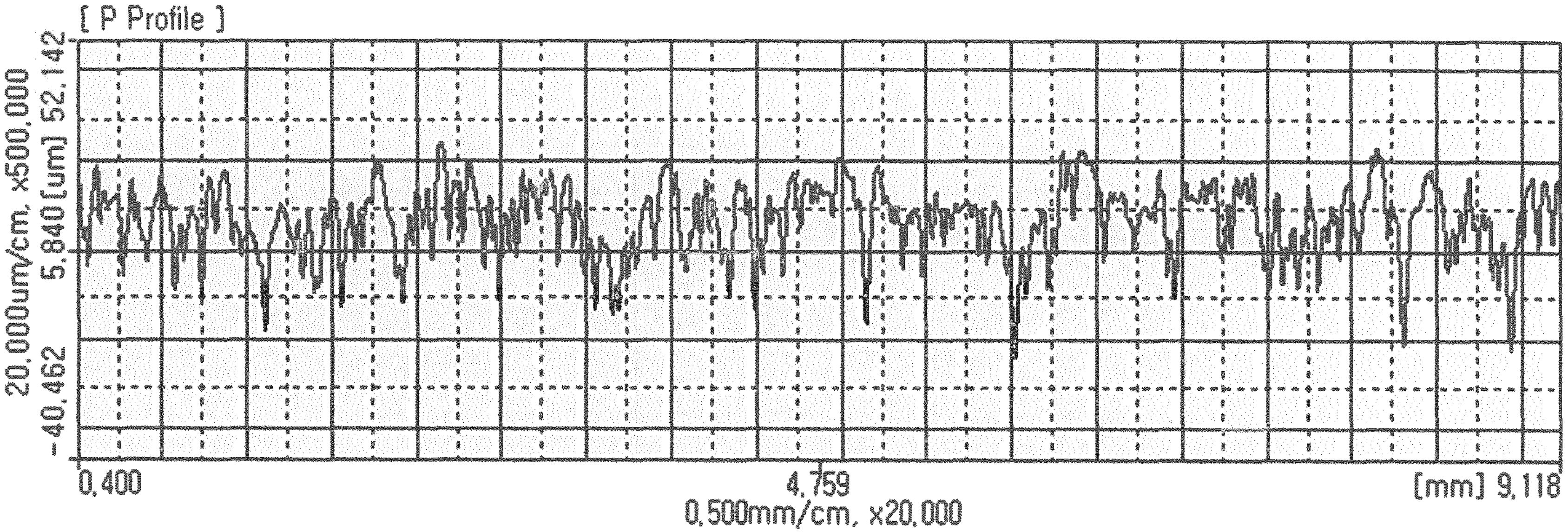
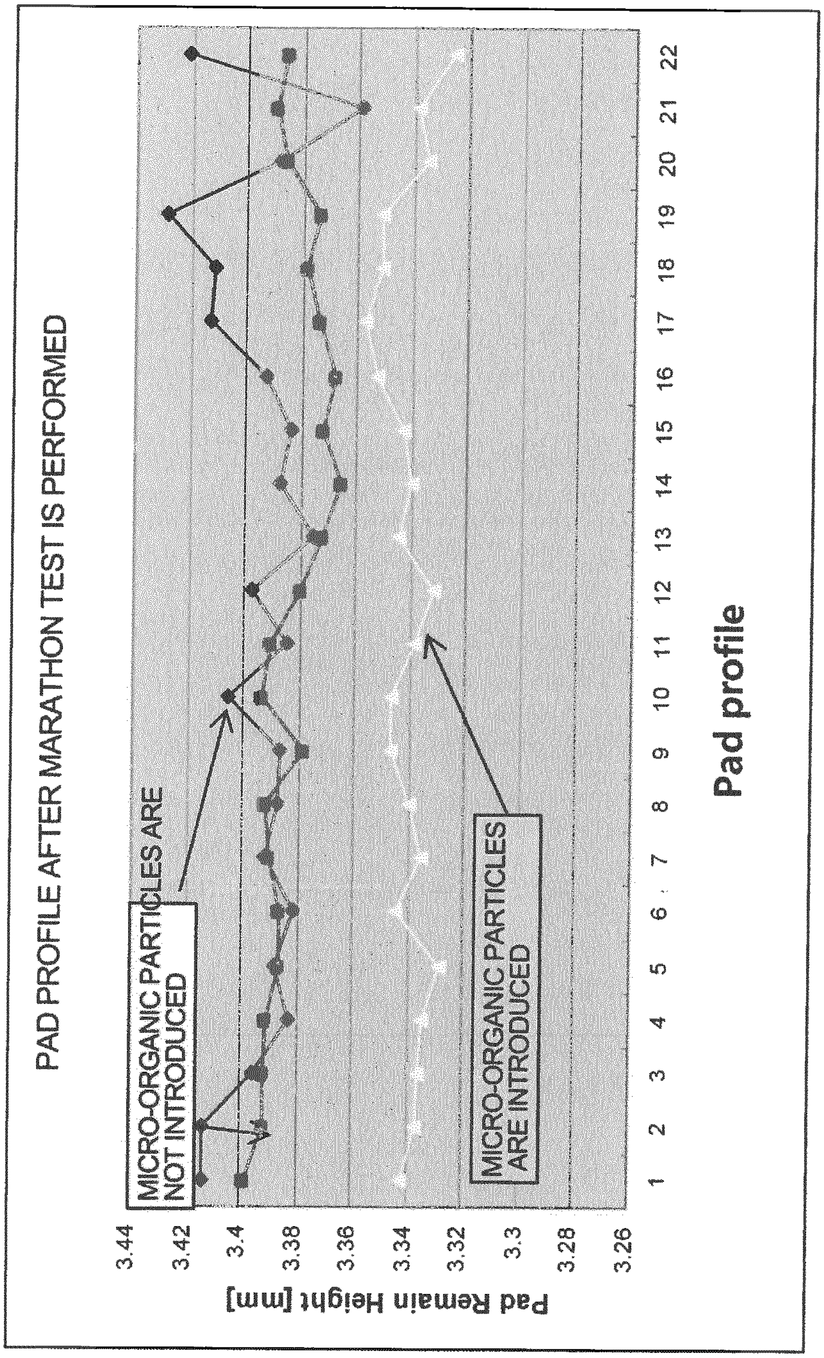

[P Profile]
20,000um/cm, x500,000
52,142
5,840 [um]
-40,462
0,400
4,759
[mm] 9,118
0,500mm/cm, x20,000

FIG. 8


PAD PROFILE AFTER MARATHON TEST IS PERFORMED
MICRO-ORGANIC PARTICLES ARE NOT INTRODUCED
MICRO-ORGANIC PARTICLES ARE INTRODUCED
Pad Remain Height [mm]
3.44
3.42
3.4
3.38
3.36
3.34
3.32
3.3
3.28
3.26
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
Pad profile

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2013/001085

A. CLASSIFICATION OF SUBJECT MATTER

B24D 11/00(2006.01)i, B24D 3/16(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B24D 11/00; B24D 5/00; B24B 27/06; B24D 18/00; B24D 3/34; B24D 3/32

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: IPC as above
Japanese Utility models and applications for Utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS (KIPO internal) & Keywords: grinding, micro organic, foaming agent, pore, organic particle

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-2005-0106026 A (DOW GLOBAL TECHNOLOGIES LLC) 08 November 2005 See abstract, pages 6, 10-15, claims 1-6 and figures 3, 6.	1-9
A	US 2006-0035573 A1 (PRESTON, Spencer et al.) 16 February 2006 See abstract, paragraphs [0053]-[0081] and figures 3, 7.	1-9
A	KR 10-2007-0046748 A (KURE GRINDING WHEEL CO., LTD.) 03 May 2007 See abstract, pages 5-8, 19 and claims 1-4, 7 and 8.	1-9
A	KR 10-0986969 B1 (CHA, Yun-Jong et al.) 11 October 2010 See abstract, paragraphs [0019]-[0036] and claims 1-3.	1-9
A	KR 10-2001-0055971 A (DONG SUNG A & T. CO.,LTD.) 04 July 2001 See abstract and claims 18-22.	1-9

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"&" document member of the same patent family

Date of the actual completion of the international search 02 MAY 2013 (02.05.2013)	Date of mailing of the international search report **03 MAY 2013 (03.05.2013)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex-Daejeon, 189 Seonsa-ro, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2013/001085

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KR 10-0986969 B1	11.10.2010	NONE	
KR 10-2001-0055971 A	04.07.2001	NONE	

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