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(54) Title: MULTI-LAYERED CHEMICAL-MECHANICAL PLANARIZATION PAD

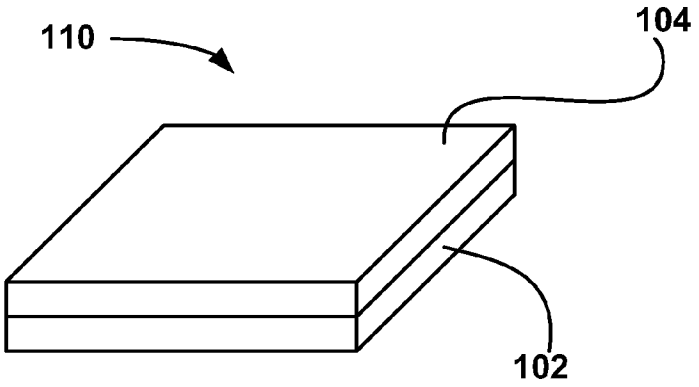

FIG. 1a

(57) Abstract: The present disclosure relates to a chemical mechanical planarization pad and a method of making and using a chemical mechanical planarization pad. The chemical mechanical planarization pad may include a first component including a water soluble composition and water insoluble composition exhibiting a solubility in water of less than that of the water soluble composition, wherein at least one of the water soluble and water insoluble compositions of the first component is formed of fibers. The chemical mechanical planarization pad may also include a second component, wherein the first component is present as a discrete phase in a continuous of the second component.

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MULTI-LAYERED CHEMICAL-MECHANICAL PLANARIZATION PAD

Cross-Reference to Related Applications

[0001] The present application claims the benefit of the filing date of U.S. Provisional Application 61/142,544, filed on January 5, 2009, the teachings of which are incorporated herein by reference.

Field

[0002] The present disclosure relates to polishing pads useful in Chemical-Mechanical Planarization (CMP) of semiconductor wafers and other surfaces such as bare substrate silicon wafers, CRT, flat panel display screens and optical glass.

Background

[0003] In semiconductor wafer polishing, the advent of very large scale integration (VLSI) and ultra large scale integration (ULSI) circuits has resulted in the packing of relatively more devices in smaller areas on a semiconductor substrate, which may necessitate greater degrees of planarity for the higher resolution lithographic processes that may be required to enable said dense packing. In addition, as copper and other relatively soft metals and/or alloys are increasingly being used as interconnects due to their relatively low resistance, the ability of the CMP pad to yield relatively high planarity of polish without significant scratching defects on the soft metal surface may become relatively critical for the production of advanced semiconductors. High planarity of polish may require a hard and rigid pad surface to reduce local compliance to the substrate surface being polish. However, a relatively hard and rigid pad surface may tend to also cause scratching defects on the same substrate surface thus reducing production yield of the substrate being polished.

Summary

[0004] An aspect of the present disclosure relates to a chemical mechanical planarization pad. The chemical mechanical planarization pad may include a first component including a water soluble composition and water insoluble composition exhibiting a solubility in water of less than that of the water soluble composition, wherein at least one of the water soluble and water insoluble compositions of the first component is formed of fibers. The chemical mechanical planarization pad may also include a second component, wherein the first component is present as a discrete phase in a continuous of the second component and the

water soluble composition may provide pores having a size in the range of 10 nanometers to 200 micrometers upon dissolution.

[0005] Another aspect of the present disclosure relates to a method of forming a chemical mechanical planarization pad, such as the above pad. The method may include forming a first component including a water soluble material and a water insoluble material, wherein at least one of the water soluble material and the water insoluble material is formed of fibers. The method may also include embedding the first component as discrete phases in a continuous phase of a second component, wherein the water soluble composition may provide pores having a size in the range of 10 nanometers to 200 micrometers upon dissolution.

[0006] A further aspect of the present disclosure relates to a method of polishing a substrate. The method may include contacting a substrate with a slurry and a chemical mechanical planarization pad, such as the above mechanical planarization pad. The chemical mechanical planarization pad may include a first component including a water soluble composition and water insoluble composition exhibiting a solubility in the slurry of less than that of the water soluble composition and at least one of the water soluble and water insoluble compositions of the first component is formed of fibers. The chemical mechanical planarization pad may also include a second component, wherein the first component is present as a discrete phase in a matrix of the second component and the water soluble composition may provide pores having a size in the range of 10 nanometers to 200 micrometers upon dissolution.

Brief Description of Drawings

[0007] The above-mentioned and other features of this disclosure, and the manner of attaining them, may become more apparent and better understood by reference to the following description of embodiments described herein taken in conjunction with the accompanying drawings, wherein:

FIG. 1a illustrates an example of a first component including a water soluble and water insoluble material arranged as layers, wherein the layers may include fabric;

FIG. 1b illustrates an example of a first component including a water soluble and a water insoluble material combined to form a fabric;

FIG. 1c illustrates an example of a first component including a water soluble material in the form of a particle dispersed in a matrix of a water insoluble material, which may include fibers;

FIG. 2 illustrates a cross-section of an example of a chemical-mechanical planarization pad;

FIG. 3 illustrates a flow diagram of an example of a method of forming a chemical mechanical planarization pad; and

FIG. 4 illustrates a flow diagram of an example of a method of using a chemical mechanical planarization pad.

Detailed Description

[0008] The present disclosure relates to a product, method of making and use of a polishing pad particularly useful for the Chemical Mechanical Planarization (CMP) of semiconductor wafer substrates where a high degree of planarity and low scratching defect may be critical. As generally illustrated in **FIG. 2** and discussed further below, the CMP pad **200** may include a first discrete phase or component **210** comprising two or more compositions each exhibiting a different water solubility, and a second continuous phase or component **220** comprising one polymeric substances or a miscible mixture of two or more polymeric substances, such that the first and second components are combined in the pad at various ratios and configurations, as disclosed herein. In addition, reference to a miscible mixture of two or more polymer components for the second component may be understood as that situation where the two polymeric substances may combine and provide a continuous phase to contain the first component as the discrete phase.

[0009] In one embodiment, the first component may include both a water soluble material and a water insoluble material, either or both of which may be in fiber form. In some embodiments, the water insoluble material may always be in fiber form. Water solubility herein may be understood as the ability of a given substance to at least partially dissolve in water. For example, the substance may have solubility in water of 30 to 100 parts per 100 parts water, including all values and increments therein, and dissolution time from 5 to over 60 seconds, including all values and increments therein. In other words, the substance may at least partially dissolve in water at room temperature or at elevated temperatures and/or upon exposure pressure or mechanical action over a period of a few seconds to 360 minutes, including all values and increments therein. Such water solubility may be achieved in a

chemical mechanical planarization process where one may use an aqueous based slurry, as described further below. The water soluble material of the first component may include one or more of the following: poly (vinyl alcohol), poly (acrylic acid), maleic acid, alginates, polysaccharides, poly cyclodextrins, as well as salts, copolymers and/or derivatives thereof. Water insoluble materials of the first component may include one or more water insoluble substance such as polyester, polyamide, polyolefin, rayon, polyimide, polyphenyl sulfide, etc., including combinations thereof. The water insoluble substance herein may therefore be understood as a substance that has a water solubility that is less than the water soluble substance noted above. For example, it may have a water solubility that is less than or equal to about 10 parts per 100 parts water.

[0010] The water soluble material of the first discrete component may have one or more of the following physical properties: density 0.3 to 1.3 gm/cc, including all values and increments therein, and Durometer hardness of 10 Shore A to over 60 Shore D, including all values and increments therein. Similarly, the water insoluble material of the first discrete component may have one or more of the following physical properties: density 0.3 to 1.3 gm/cc., including all values and increments therein, and Durometer hardness of 10 Shore A to over 80 Shore D, including all values and increments therein. As may be appreciated, in various examples, the hardness of the water insoluble material may be greater than, equal to or less than that of the soluble material.

[0011] In some examples, the first component **110**, an example of which is illustrated in **FIG. 1a**, may include a first layer **102** of water soluble nonwoven fabric stacked onto a second layer **104** of a water insoluble nonwoven fabric formed of the materials described above. In other examples, the first component **110**, illustrated in **FIG. 1b**, may specifically include a nonwoven fabric including a relatively homogenous mixture of water soluble **102** and insoluble **104** fibers formed of the materials described above. In addition, in other examples, the first component may also be a woven or knit material. In further examples, illustrated in **FIG. 1c**, the first component **110** may include water soluble particles **102**, again formed of the materials described above. The water soluble particles may be embedded in the water insoluble material **104** or otherwise combined with the water insoluble materials. Furthermore, the water soluble particles may replace all or a part of the water soluble fabric. That is, the layer **102** of water soluble material may include both water soluble fibers in combination with water soluble particles.

[0012] With respect to the first component, the water soluble material **102** may be present with the water insoluble material **104** in the range of 0.01 % to 99.99 % by weight of the combination of the water soluble and water insoluble materials, such as in the range of 0.2 % by weight to 0.8 % by weight. Thus, the water insoluble material may be present in the range of 0.01 % to 99.99 % by weight of the combination of the water soluble and water insoluble material. Furthermore, the first component may be present in the range of 0.01 % to 99.99 % by weight of the combination of the first and second components, such as in the range of 0.3 % to 0.7 % by weight.

[0013] The second component **220** serves as the continuous phase for the first component **210**, which is present as a discrete phase. As therefore illustrated in **FIG. 2**, the first component **210** may be dispersed relatively uniformly in the second component **220**. This may be understood as that situation where a relatively similar weight or volume of the first component may be present throughout the second component. In other embodiments, the first component may be distributed in the continuous phase of the second component along various gradients throughout the pad, or in a manner such that the first component is selectively provided near a given surface, such as the polishing surface, of the pad. In that regard, the second component may be considered as the continuous phase, with the first component dispersed therein.

[0014] The second component **220** may include a single polymeric substance such as polyurethane, or, as noted above, a miscible mixture of two or more polymeric substances such as polyurethane having different physical and chemical properties, which are also water insoluble. Again, miscibility may be understood as a relatively homogenous mixture, provding a continuous phase, wherein discrete phases of the polymeric substances forming the second component may be present at levels of 25% by weight or less of the second component, including all values and increments in the range of 0% to 25%, such as 0.1% to 24.9%, etc.

[0015] Accordingly, the second component may include one or more polyurethanes. Polyurethane substances suitable for forming the second component may include, but are not limited to, pre-polymers of polyurethane reacted with curatives, polyurethane resins used for injection, extrusion, blow molding or RIM operations, as well as various solvent and/or water based solutions and dispersions of polyurethane. The polishing pad matrix may also include or consist of other thermoplastic or thermoset polymers, such as polycarbonate, polysulfone, polyphenylene sulfide, epoxy, various polyesters, polyimides, polyamides, polyolefins,

polyacrylates, polymethylmethacrylates, polyvinyl chlorides, polyvinyl alcohols and/or derivatives of or copolymers of the above.

[0016] It may be appreciated that where more than one polymeric substance forming the second component is present, a first polymeric substance forming the second component may be present in the range of 1 % to 99 % by weight and the second polymeric substance may be present in the range of 99% by weight to 1% by weight. Furthermore, a third polymeric substance forming the second component may be present in the range of 1 % to 98 % by weight of the second component, including all values and increments therein. Accordingly, for example, a first polymeric substance may be present in the range of 25 % to 90 % by weight of the second component and a second polymeric substance may be present in the range of 10 % to 75 % by weight of the second component. In another example, a first polymeric substance may be present in the range of 5 to 90 % by weight of the second component, a second polymeric substance may be present in the range of 5 % to 75 % by weight of the second component and a third polymeric substance may be present in the range of 5 % to 90 % by weight of the second component.

[0017] The second component may have one or more of the following physical properties density 0.3 to 1.2 gm/cc, Durometer Hardness 30 Shore A to 90 Shore D, and compression modulus of 10 to over 500 megapascal. It may be appreciated that, in some examples, the second component may have a hardness that is greater than that of the water insoluble material of the first component. It may be appreciated that the difference in hardness may be in the range of 1 unit to 70 units of shore hardness along a given scale of hardness, including all values and increments therein, such as 1 unit of shore hardness, 10 units of shore hardness, 50 units of shore hardness, etc. Furthermore, it may be appreciated that upon transitioning of hardness scales (from A to D), the unit number itself may not be greater; however, the hardness may remain greater, e.g., a Durometer Hardness of 10 Shore D may be greater than a hardness of 30 Shore A. In other examples, the second component may have a hardness that is less than that of the water insoluble material of the first component. Again, it may be appreciated that the difference in hardness may be in the range of 1 unit to 70 units of shore hardness along a given scale of hardness, including all values and increments therein, such as 1 unit of shore hardness, 10 units of shore hardness, 50 units of shore hardness, etc. In further examples, the second component may have a hardness that is equal to that of the water insoluble material of the first component.

[0018] Given the above, it may be appreciated that upon dissolution of the water soluble material, pores will then be formed within the continuous phase of the pad. Such pores may have a size of 10 nanometers to over 100 micrometers, including all values and increments in the range of 10 nanometers to 200 micrometers, 10 nanometers to 100 nanometers, 1 micrometer to 100 micrometers, etc. This porosity is now selectively formed at a location where there is also a selected presence of a water insoluble material. That being the case, the polishing pad of the present disclosure allows for the formation of pores through the dissolution of the water soluble material. The pores are then proximate to a selected water insoluble material within the pad that may provide regions of selected physical properties immediately adjacent the pore and/or defining at least a portion of the pore surface. This may then provide for improved pore stability in an ensuing polishing operation. For example, the polishing slurry may enter the pore and be retained by the water insoluble material. In addition, where particles may be present in the slurry, the particles may migrate into and be captured by the selected water insoluble material, forming a portion of the boundary of the pore. Furthermore, where particles are discharged from the substrate being polished, the particles may also be entrapped and retained by the water insoluble material within the pores. Finally, upon exposure, the water insoluble material may, in some embodiments, provide different physical properties from those present in the second component, i.e., the continuous phase, of the polishing pad.

[0019] In manufacturing a CMP pad of this embodiment, to form the first component, a water soluble material may be placed next to, intermingled with, dispersed within or otherwise combined with the insoluble material. In some examples, the water soluble material may constitute the outer layer or surface of the pad, which may be in contact with the substrate during polishing. Both soluble and insoluble materials of the first component may optionally be conditioned under controlled temperature and humidity. For example, the soluble and insoluble materials of the first component may be dried, removing residual surface moisture. Drying may occur at temperatures in the range of, for example, 37 °C to 150 °C, including all values and increments therein. Furthermore, drying may occur over a few minutes to over 60 hours, including all values and increments therein. The second component may then be introduced to the first component in a manner as to partially or completely fill or embed the first component.

[0020] In some embodiments, at least a portion of the water soluble material may be subsequently removed by exposing the CMP pad to water or an aqueous solution with or

without chemical, thermal, and/or mechanical means such as ultrasonics, accelerating removal of the water soluble component. Alternately, the water soluble material may be removed progressively during CMP as the pad is exposed to the water based abrasive slurry. Again, it may be appreciated that dissolution of the water soluble material may lead to exposure of water insoluble material present in the discrete phases of the first component.

[0021] Generally of a method of making a polishing pad for Chemical Mechanical Planarization (CMP) of microelectronic devices and semiconductor wafers may therefore be contemplated herein as illustrated in **FIG. 3**. The method may include or consist of providing at **302** a first component that includes at least two layers or two materials, one of which contains at least one water soluble material and at least one of which includes a fiber. The method may also include or consist of providing at **304** a second component comprising a homogeneous mixture of substance(s), such as a mixture of polyurethanes, and combining the first and second components in various ratios and configurations **306**, wherein the first component forms discrete phases in the continuous second component. A CMP pad may then be formed where the first component may, in some embodiments, be dispersed relatively uniformly in the second component.

[0022] In one example of forming the polishing pad, the first component, containing at least two materials, one of which is water soluble, may be placed into a mold and the second component may be poured as a polymer precursor into the mold. Pressure and/or heat may then be applied to the mold to facilitate the curing (e.g. polymerization and/or crosslinking) of the polymer precursor. In another example, the first component may be combined with the second component, wherein the second component may be in a melt state and injected or otherwise transferred into a mold. A melt state may be understood as a state where the viscosity may be sufficiently low enough to allow flow of the second component upon the application of pressure. The second component may be allowed to solidify, wherein the viscosity may be sufficiently high enough to form a relatively solidified and/or self supporting part.

[0023] Also contemplated herein is an example of a method of using a polishing pad for Chemical Mechanical Planarization (CMP) of a substrate surface, as illustrated in **FIG. 4**. The substrate may include microelectronic devices and semiconductor wafers, including relatively soft materials, such as metals, metal alloys, ceramics or glass. In particular, the materials to be polished may exhibit a Rockwell (Rc) B hardness of less than 100, including all values and increments in the range of 0 to 100 Rc B as measured by ASTM E18-07.

Other substrates to which the polishing pad may be appleid may include, for example, optical glass, cathode ray tubes, flat panel display screens, etc., in which, scratching or abrasion of the surface may be desirably avoided. A pad may be provided including, for example, (1) a first component comprising two or more layers, at least one of said layers is water soluble, and (2) a second component comprising a homogeneous mixture of substances, such that the first and second components are combined in said pad in various ratios and configurations **402**. The pad may then be utilized in combination with liquid media, such as an aqueous media, with or without abrasive particles. For example, the liquid media may be applied to a surface of the pad and/or the substrate to be polished **404**. The pad may then be brought into close proximity of the substrate and then applied to the substrate during polishing **406**. It may be appreciated that the pad may be attached to equipment used for Chemical Mechanical Planarization for polishing.

[0024] The foregoing description of several methods and embodiments has been presented for purposes of illustration. It is not intended to be exhaustive or to limit the claims to the precise steps and/or forms disclosed, and obviously many modifications and variations are possible in light of the above teaching. It is intended that the scope of the invention be defined by the claims appended hereto.

CLAIMS

What is claimed is:

1. A chemical mechanical planarization pad, comprising:

a first component including a water soluble composition and water insoluble composition exhibiting a solubility in water of less than that of said water soluble composition and at least one of said water soluble and water insoluble compositions of said first component is formed of fibers; and

a second component, wherein said first component is present as a discrete phase in a continuous of said second component and said water soluble composition provides pore having a size of 10 nanometers to 200 micrometers upon dissolution.

2. The pad of claim 1, wherein said water soluble composition comprises a first fiber and said water insoluble composition comprises a second fiber and said first and second fibers form a fabric.

3. The pad of claim 2, wherein said fabric is a nonwoven fabric.

4. The pad of claim 1, wherein said water soluble composition comprises a first fiber forming a first fabric and said water insoluble composition comprises a second fiber forming a second fabric and said first and second fabrics are layered.

5. The pad of claim 1, wherein said water soluble composition comprises water soluble particles and said water insoluble composition comprises a matrix in which said water soluble particles are embedded.

6. The pad according to any one of claims 1 through 5, wherein said water soluble material comprises one or materials selected from the group consisting of poly (vinyl alcohol), poly (acrylic acid), maleic acid, alginates, polysaccharides, poly cyclodextrins, as well as salts, copolymers and/or derivatives thereof.

7. The pad according to any one ofclaims 1 through 6, wherein said water insoluble material comprises one or more materials selected from the group consisting of polyester, polyamide, polyolefin, rayon, polyimide, polyphenyl sulfide and combinations thereof.

8. The pad according to any one of claims 1 through 7, wherein said second component includes one or more materials selected from the group consisting of polycarbonate, polysulfone, polyphenylene sulfide, epoxy, various polyesters, polyimides, polyamides, polyolefins, polyacrylates, polymethylmethacrylates, polyvinyl chlorides, polyvinyl alcohols, derivatives thereof and copolymers thereof.

9. The pad according to any one of claims 1 through 8, wherein said second component includes at least two miscible water insoluble materials.

10. The pad according to any one of claims 1 through 9, wherein said water insoluble material exhibits a Durometer hardness of 10 Shore A to over 80 Shore D and said second component exhibits a Durometer hardness of 30 Shore A to over 80 Shore D.

11. A method of forming a chemical mechanical planarization pad of any one of claims 1 through 10 comprising:

forming said first component including said water soluble material and said water insoluble material; and

embedding said first component as discrete phases in a continuous phase of said second component, wherein said water soluble material provides pores having a size in the range of 10 nanometers to 200 micrometers upon dissolution.

12. The method of claim 11, further comprising:

removing at least a portion of said water soluble material embedded in said second component.

13. The method of any one of claims 11 through 12, wherein said water soluble composition comprises a first fiber and said water insoluble composition comprises a second fiber and said first and second fibers are formed into a fabric.

14. The method of claim 13, wherein said fabric is a nonwoven fabric.

15. The method of any one of claims 11 through 12, wherein said water soluble composition comprises a first fiber forming a first fabric and said water insoluble composition comprises a second fiber forming a second fabric and said first and second fabrics are layered.

16. The method of any one of claims 11 through 12, wherein said water soluble composition comprises water soluble particles and said water insoluble composition comprises a matrix in which said water soluble particles are embedded.

17. The method of any one of claims 11 through 16, further comprising placing said first component into a mold and pouring a precursor of said second component into said mold and reacting said precursor to embed said first component in said second component.

18. The method of any one of claims 11 through 17, further comprising placing said first component into a mold; melting said second component; and disposing said second component in said mold to embed said first component in said second component.

19. The method of any one of claims 11 through 18, wherein said second component includes at least two miscible water insoluble materials.

20. A method of polishing a substrate comprising:

contacting a substrate with a slurry and the chemical mechanical planarization pad according to any one of claims 1 through 10.

21. The pad of claim 1, wherein said water soluble material comprises one or materials selected from the group consisting of poly (vinyl alcohol), poly (acrylic acid), maleic acid, alginates, polysaccharides, poly cyclodextrins, as well as salts, copolymers and/or derivatives thereof.

22. The pad of claim 1, wherein said water insoluble material comprises one or more materials selected from the group consisting of polyester, polyamide, polyolefin, rayon, polyimide, polyphenyl sulfide and combinations thereof.

23. The pad of claim 1, wherein said second component includes one or more materials selected from the group consisting of polycarbonate, polysulfone, polyphenylene sulfide, epoxy, various polyesters, polyimides, polyamides, polyolefins, polyacrylates, polymethylmethacrylates, polyvinyl chlorides, polyvinyl alcohols, derivatives thereof and copolymers thereof.

24. The pad of claim 1, wherein said second component includes at least two miscible water insoluble materials.

25. The pad of claim 1, wherein said water insoluble material exhibits a Durometer hardness of 10 Shore A to over 80 Shore D and said second component exhibits a Durometer hardness of 30 Shore A to over 80 Shore D.

26. A method of forming a chemical mechanical planarization pad comprising:

forming a first component including a water soluble material and a water insoluble material, wherein at least one of said water soluble material and said water insoluble material is formed of fibers; and

embedding said first component as discrete phases in a continuous phase of a second component, wherein said water soluble material provides pores having a size in the range of 10 nanometers to 200 micrometers upon dissolution.

27. The method of claim 26, further comprising:

removing at least a portion of said water soluble material embedded in said second component.

28. The method of claim 26, wherein said water soluble composition comprises a first fiber and said water insoluble composition comprises a second fiber and said first and second fibers are formed into a fabric.

29. The method of claim 28, wherein said fabric is a nonwoven fabric.

30. The method of claim 26, wherein said water soluble composition comprises a first fiber forming a first fabric and said water insoluble composition comprises a second fiber forming a second fabric and said first and second fabrics are layered.

31. The method of claim 26, wherein said water soluble composition comprises water soluble particles and said water insoluble composition comprises a matrix in which said water soluble particles are embedded.

32. The method of claim 26, further comprising placing said first component into a mold and pouring a precursor of said second component into said mold and reacting said precursor to embed said first component in said second component.

33. The method of claim 26, further comprising placing said first component into a mold; melting said second component; and disposing said second component in said mold to embed said first component in said second component.

34. The method of claim 26, wherein said second component includes at least two miscible water insoluble materials.

35. A method of polishing a substrate comprising:

contacting a substrate with a slurry and a chemical mechanical planarization pad, wherein the chemical mechanical planarization pad comprises a first component including a water soluble composition and water insoluble composition exhibiting a solubility in said slurry of less than that of said water soluble composition and at least one of said water soluble and water insoluble compositions of said first component is formed of fibers, and a second component, wherein said first component is present as a discrete phase in a matrix of said second component and said water soluble composition of said first component provides pores having a size in the range of 10 nanometers to 200 micrometers upon dissolution.

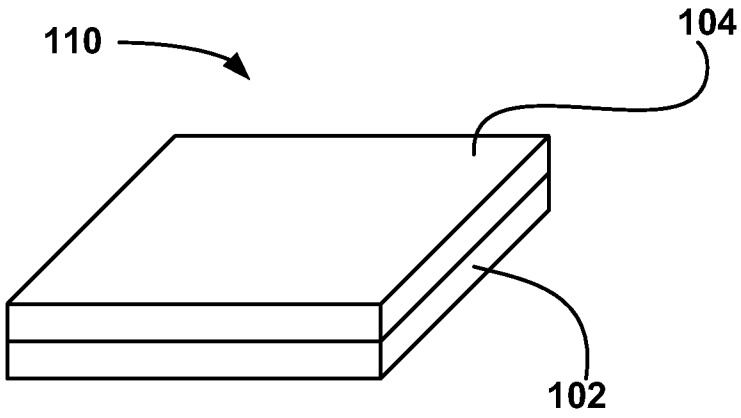

FIG. 1a

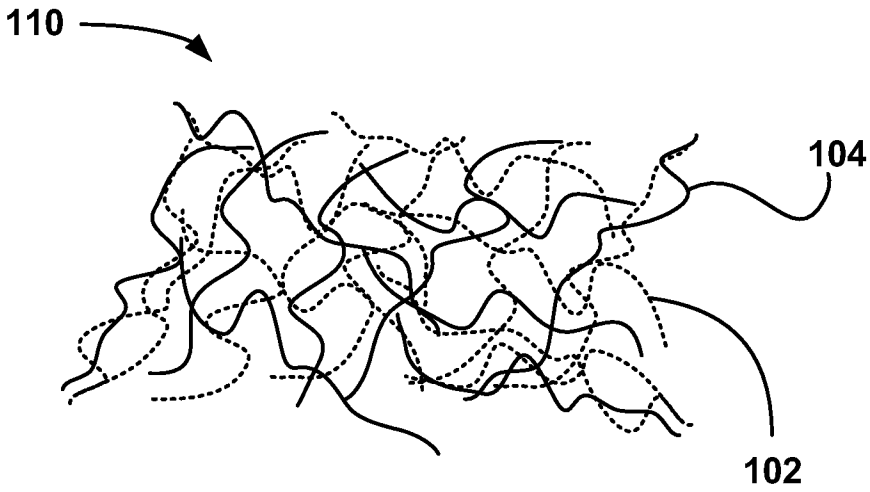

FIG. 1b

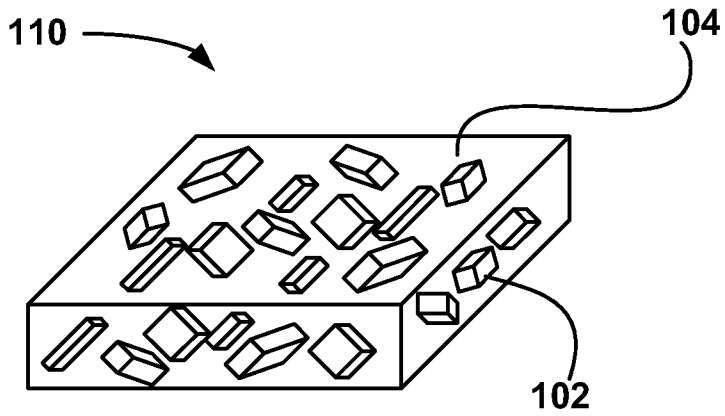

FIG. 1c

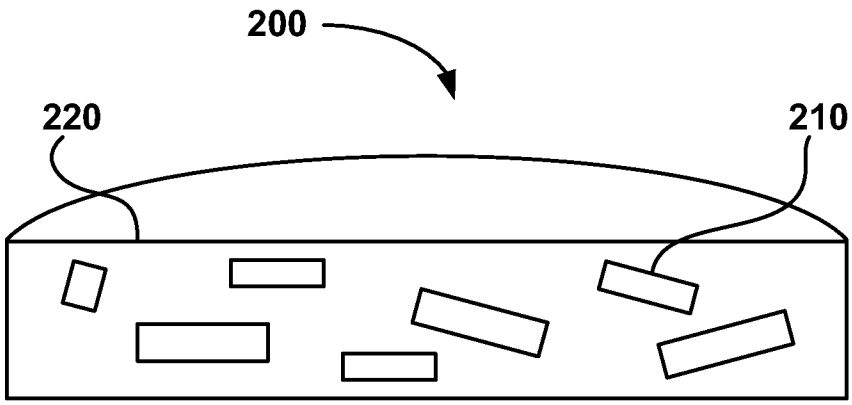

FIG. 2

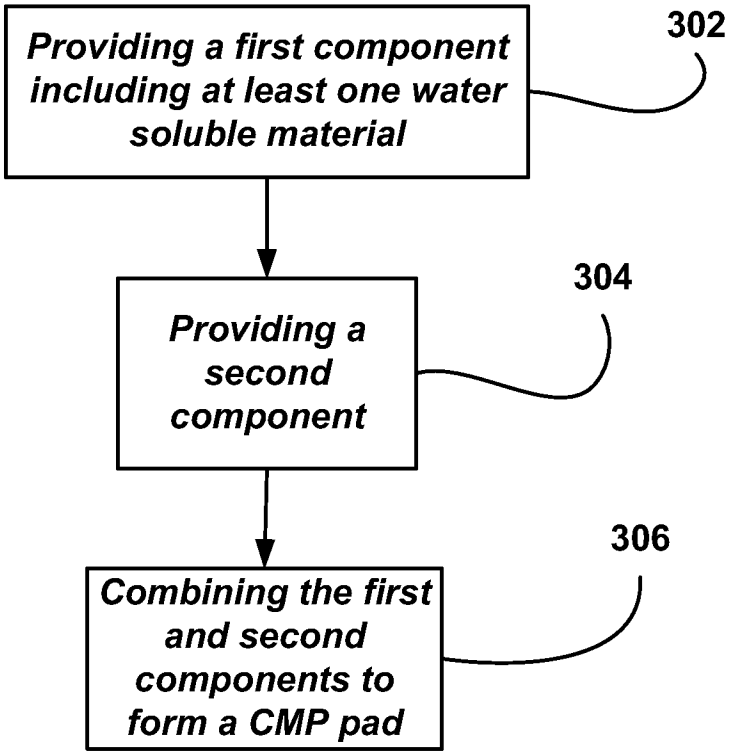
Providing a first component including at least one water soluble material
302
Providing a second component
304
Combining the first and second components to form a CMP pad
306

FIG. 3

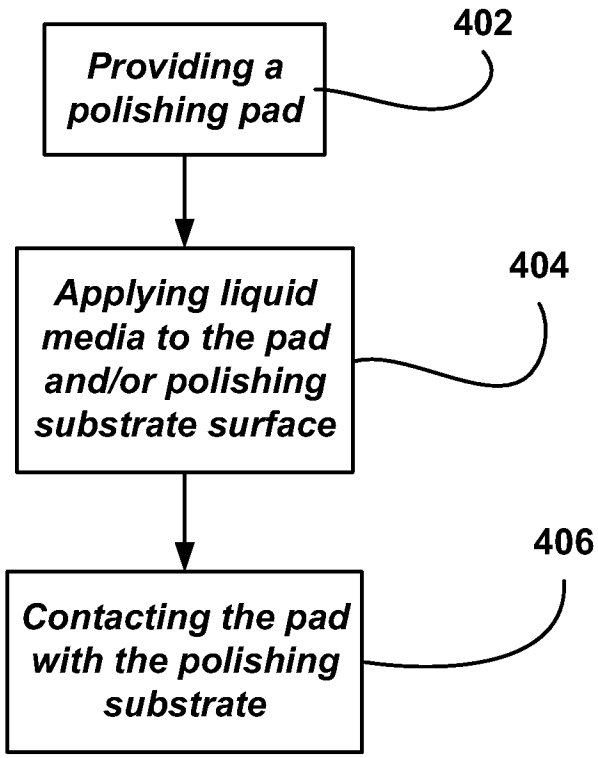
Providing a polishing pad
402
Applying liquid media to the pad and/or polishing substrate surface
404
Contacting the pad with the polishing substrate
406

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 10/20081

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - B24D 3/20; B24D 3/34; B24D 7/04 (2010.01)
USPC - 451/534; 451/526; 451/532; 522/90
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)
IPC(8) - B24D 3/20; B24D 3/34; B24D 7/04 (2010.01)
USPC - 451/534; 451/526; 451/532; 522/90

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
IPC(8) - B24D 3/20; B24D 3/34; B24D 7/04 (2010.01) (text search)
USPC - 451/534; 451/526; 451/532; 522/90 (text search)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST (USPT, PGPB, EPAB, JPAB); Google. Search terms: chemical mechanical planarization pad hardness Durometer fiber matrix non-woven mold, molding disssolution precursor polyvinyl alcohol polyacrylic acrylic vinyl maleic acid alginate polysaccharide polycyclodextrin cyclodextrin polyester polyamide polyolefin rayon polyimide polyphenyl sulfide

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/0146131 A1 (Vangsness et al.) 19 June 2008 (19.06.2008), Abstract, para [0002], [0017], [0018], [0022], [0023], [0036], [0037], [0038], [0040], [0042], [0044]	1-6, 20-31, 33-35
Y		32
Y	US 2006/0116059 A1 (Chen et al.) 01 June 2006 (01.06.2006), abstract, para [0016], [0017], [0039], [0035]	32

☐ Further documents are listed in the continuation of Box C. ☐

* 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
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"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
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 February 2010 (11.02.2010)	09 MAR 2010

Name and mailing address of the ISA/US	Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 10/20081

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 7-19
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.