A polish cloth including a polish layer having a polish surface configured to contact a polish object; a recess formed into the polish surface; and a coating applied at least along a bottom surface of the recess, the coating being made of a water repellent and oil repellent material.
POLISH CLOTH AND METHOD OF MANUFACTURING POLISH CLOTH

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] This application is based upon and claims the benefit of priority from Japanese Patent Application No. 2014-025523, filed on, Feb. 13, 2014 the entire contents of which are incorporated herein by reference.

FIELD

[0002] Embodiments disclosed herein generally relate to a polish cloth and a method of manufacturing the polish cloth.

BACKGROUND

[0003] Chemical mechanical polishing (CMP) is frequently used in semiconductor device manufacturing. A rotary CMP apparatus typically polishes the object such as a wafer by placing the object in contact with a polish cloth and supplying slurry onto the polish cloth while rotating the polish head and the table at the same time. The polish surface of the polish cloth is provided with multiplicity of recesses such as holes and trenches. Thus, wastes or foreign substances such as abrasive grains and chemical components of the slurry, polish dust, and polish residue accumulate in the recesses of the polish surface as increasing number of wafers are polished. Such residual waste may stick to the wafer or damage the wafer and possibly degrade the polish performance of the wafer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIG. 1 is one example of a perspective view illustrating one embodiment of a polish cloth.

[0005] FIG. 2 is one example of a partially-enlarged vertical cross-sectional view illustrating one embodiment of the polish cloth.

[0006] FIGS. 3A to 3C are examples of vertical cross-sectional views illustrating the manufacturing process flow of one embodiment of the polish cloth.

[0007] FIG. 4 is one example of a partially-enlarged vertical cross-sectional view illustrating holes, trenches, and their peripheral structures provided in one embodiment of the polish cloth.

[0008] FIG. 5 is one example of a partially-enlarged vertical cross-sectional view illustrating a foam hole formed in a polish layer provided in one embodiment of the polish cloth.

DESCRIPTION

[0009] In one embodiment, a polish cloth includes a polish layer having a polish surface configured to contact a polish object; a recess formed into the polish surface; and a coating applied at least along a bottom surface of the recess, the coating being made of a water repellent material or an oil repellent material.

Embellishments

[0010] Embellishments are described hereinafter with references to the accompanying drawings. Elements that are identical or similar across the embellishments are identified with identical or similar reference symbols and may not be re-described.

First Embodiment

[0011] A description will be given on one embodiment of a polish cloth and a method of manufacturing the polish cloth with references to the accompanying drawings. FIG. 1 illustrates one example of polish cloth 10 configured for attachment to a rotary CMP apparatus not shown. Polish cloth 10 is generally shaped like a disc and includes polish layer 11 and sub-pad layer 12. Though not described in detail, the CMP apparatus, as known in the art, is provided with components such as a rotary table, a slurry dispenser, and a dresser. The rotary table holds polish cloth 10. The slurry dispenser supplies the slurry to polish surface 13 of polish cloth 10. The dresser dresses polish surface 13 of polish cloth 10.

[0012] Polish layer 11 of polish cloth 10 comprises a foamed resin such as a foamed polyurethane. Thus, foam holes 11a are formed inside polish layer 11 as well as on the surface of polish layer 11 as shown in FIG. 5. The upper surface of polish layer 11 serves as polish surface 13. Polish surface 13 contacts the polish object, one example of which is a wafer, during the polishing process of the CMP apparatus. Multiplicity of holes 14 and trenches 15 are formed in polish surface 13. Holes 14 and trenches 15 are examples of a recess. During the polishing process of the CMP apparatus, slurry is supplied onto polish surface 13 by the slurry dispenser not shown. The slurry contains polish agents such as abrasive grains and chemical components but is mostly made of water. Sub-pad layer 12 is configured by an unwoven fabric for example and is in intimate contact with the undersurface of polish layer 11 in the opposite side of polish surface 13.

[0013] As shown in FIG. 2 for example, coating C is applied along the inner surface of hole 14 or more specifically, along the bottom surface and the side surface (or both side surfaces when viewed in the cross section of FIG. 2) of hole 14. Coating C comprises a water repellent and oil repellent material. Coating C is also applied along the inner surface of trench 15 or more specifically, along the bottom surface and the side surface of trench 15. In one embodiment, the thickness of coating C ranges from tens of nanometers (nm) to several micrometers (μm). Various types of organic resins may be employed as the water repellent and oil repellent material. Among such resins, it is preferable to use a fluorine-based resin. In the description given herein, a material possessing water repellency and oil repellency is also referred to as “water repellent and oil repellent material”. Coating C comprising water repellent and oil repellent material is applied along holes 14 and trenches 15 of polish cloth 10. Thus, the contact angle of fluid within holes 14 and trenches 15 is increased. In one embodiment, the fluid is a slurry made mostly of water.

[0014] The contact angle of the slurry in holes 14 and trenches 15 is preferably increased as much as possible and is preferably at least 100 degrees or greater. In other words, coating C is preferably made of a material that increases the contact angle of the slurry in holes 14 and trenches 15. For example, coating C may be formed that provides a significantly high contact angle of 150 degrees or higher. In another example, coating C may be formed that provides an exceptionally high contact angle of 180 degrees substantially reaching the upper limit. Thus, in the present embodiment, a “high contact angle” ranges from 100 degrees to 180 degrees, in other words, equal to or greater than 100 degrees and equal to or less than 180 degrees. Further, applying coating C, comprising water repellent and oil repellent material, to holes
and trenches 15 of polish cloth 10 reduces the friction coefficient in holes 14 and trenches 15.

[0015] Further, applying coating C, comprising water repellent and oil repellent material, to trenches 15 of polish cloth 10 improves the flow of slurry in trenches 15. Trenches 15 throw off the slurry from polish cloth 10 with centrifugal force exerted by the rotation of polish cloth 10 during the polishing process.

[0016] Next, a description will be given on one example of a manufacturing process flow of polish cloth 10 with reference to FIGS. 3A to 3C. In the present embodiment, the manufacturing process includes a coating step and a dressing step.

[0017] In the coating step illustrated in FIG. 3A for example, coating C comprising water repellent and oil repellent material is formed entirely across polish surface 13 including holes 14 and trenches 15. A film of coating C may be formed by dipping the molded polish cloth 10 into a solution of the water repellent and oil repellent material. Alternatively, a film of coating C may be formed above the molded polish cloth 10 by gasifying the water repellent and oil repellent material. Examples of methods for forming a film of coating C above polish cloth 10 using gasified water repellent and oil repellent material include PVD (Physical Vapor Deposition), CVD (Chemical Vapor Deposition), or the like known in the art.

[0018] Next, in the dressing step illustrated in FIG. 3B for example, the dresser not shown is used to dress the regions of polish surface 13 covered by coating C of holes 14 and trenches 15. As a result, portions above the broken line indicated in FIG. 3B for example are removed, consequently removing coating C formed in regions of polish surface 13 exclusive of holes 14 and trenches 15. Thus, as illustrated in FIG. 3C for example, the foregoing manufacturing process flow produces polish cloth 10 in which coating C, comprising water repellent and oil repellent material, remain along the bottom surface and side surface of each hole 14 and trench 15. The regions of polish surface 13 exclusive of holes 14 and trenches 15, in other words, the regions dressed in the dressing step are referred to as uncoated regions D which are not coated with the water repellent and oil repellent material. Uncoated regions D contact the wafer during the polishing process and thus, contribute to the polishing of the wafer.

[0019] In polish cloth 10 manufactured in the above described manner, slurry does not easily remain in holes 14 because of the water repellent and oil repellent effect of coating C. In trenches 15, slurry is easily discharged from polish cloth 10 by the water repellent and oil repellent effect of coating C and further by the centrifugal force exerted by the rotation of polish cloth 10. Thus, waste does not easily remain in holes 14 and trenches 15. Further, waste remaining in holes 14 and trenches, if any, can be discharged rapidly. As a result, it is possible to prevent the growth and enlargement of waste remaining in holes 14 and trenches 15.

[0020] In the schematic example illustrated in FIG. 4, holes 14 and trenches 15 are closed by wafer W during the polishing process. As illustrated, coating C possessing water repellency and oil repellency is applied along the bottom surfaces of holes 14 and trenches 15. Thus, as indicated by arrow A for example, slurry inside holes 14 and trenches 15 is restrained from moving downward and thus is moved inward. As a result, the convective flow of slurry inside holes 14 and trenches 15 is reinforced by the flow of slurry, such as those indicated by arrows A and B, produced inside holes 14 and trenches 15. This increases the contact percentage of slurry to wafer W and consequently improves the polishing rate.

[0021] In the present embodiment, coating C comprising water repellent and oil repellent material is applied along the bottom surfaces and side surfaces of holes 14 and trenches 15 formed in polish surface 13 of polish cloth 10 contacting the wafer. Polish cloth 10 configured in the above described manner does not allow waste to easily remain in holes 14 and trenches 15 formed in polish surface 13.

[0022] Further in the present embodiment, the regions of polish surface 13 of polish cloth 10 exclusive of holes 14 and trenches 15 are referred to as uncoated regions D which are not coated with the water repellent and oil repellent material. In other words, coating C is not applied to the regions of polish cloth 10 that contact the wafer during the polishing process and that contribute to wafer polishing. As a result, the polish performance is not reduced by coating C.

[0023] Still further in the present embodiment, multiplicity of foam holes 11α are formed in polish layer 11 of polish cloth 10. Thus, multiplicity of foam holes 11α also exist in the bottom surfaces and side surfaces of holes 14 and trenches 15 formed in polish layer 11. However coating C is applied along the bottom surfaces and side surfaces of holes 14 and trenches 15 of polish cloth 10, meaning that foam holes 11α existing in the surfaces of holes 14 and trenches 15 are covered by coating C. Thus, it is possible to inhibit accumulation of waste in foam holes 11α existing in the surfaces of holes 14 and trenches 15.

[0024] As described above, the present embodiment provides a polish cloth in which waste does not easily remain in the recesses formed into the polish surface. The present embodiment further provides an optimal manufacturing process flow for manufacturing of the polish cloth.

[0025] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

[0026] For example, the polish cloth may be configured so that the coating, possessing water repellent and oil repellent material, is applied at least along the bottom surface of each recess formed into the polish surface.

What is claimed is:
1. A polish cloth comprising:
a. a polish layer having a polish surface configured to contact a polish object;
    a recess formed into the polish surface; and
    a coating applied at least along a bottom surface of the recess, the coating being made of a water repellent and oil repellent material.
2. The polish cloth according to claim 1, wherein the coating is further applied along a side surface of the recess.
3. The polish cloth according to claim 1, wherein the polish surface further includes an uncoated region, the uncoated region occupying a region exclusive of the recess.

4. The polish cloth according to claim 1, wherein a fluid contact angle in the recess ranges from 100 to 180 degrees.

5. The polish cloth according to claim 2, wherein a fluid contact angle in the recess ranges from 100 to 180 degrees.

6. The polish cloth according to claim 3, wherein a fluid contact angle in the recess ranges from 100 to 180 degrees.

7. The polish cloth according to claim 1, wherein the polish layer further includes a foam hole.

8. The polish cloth according to claim 2, wherein the polish layer further includes a foam hole.

9. The polish cloth according to claim 3, wherein the polish layer further includes a foam hole.

10. The polish cloth according to claim 4, wherein the polish layer further includes a foam hole.

11. A method of manufacturing a polish cloth, the method comprising:
    forming a polish layer having a polish surface configured to contact a polish object;
    forming a recess into the polish surface;
    applying a coating entirely above the polish surface including the recess, the coating being formed of a water repellent and oil repellent material; and
    removing the coating located in regions of the polish surface exclusive of the recess so that the coating remains at least along a bottom surface of the recess.

12. The method according to claim 11, wherein the removing leaves the coating along a side surface of the recess.

13. The method according to claim 11, wherein the removing forms an uncoated region in the polish surface, the uncoated region occupying a region exclusive of the recess.

14. The method according to claim 11, wherein the applying increases a fluid contact angle in the recess so as to range from 100 degrees to 180 degrees.

15. The method according to claim 12, wherein the removing increases a fluid contact angle in the recess so as to range from 100 degrees to 180 degrees.

16. The method according to claim 13, wherein the removing increases a fluid contact angle in the recess so as to range from 100 degrees to 180 degrees.

17. The method according to claim 11, wherein forming the polish layer forms a foam hole in the polish layer.

18. The method according to claim 12, wherein forming the polish layer forms a foam hole in the polish layer.

19. The method according to claim 13, wherein forming the polish layer forms a foam hole in the polish layer.

20. The method according to claim 14, wherein forming the polish layer forms a foam hole in the polish layer.

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