## CLAIMS

1. A monocrystalline diamond particle having an irregular surface, wherein the surface roughness of said particle is less than about 0.95.

2. The particle of claim 1, wherein the surface roughness of said particle is between about 0.50 and about 0.80.

3. The particle of claim 1, wherein the sphericity of said particle is less than about 0.70.

4. The particle of claim 3, wherein the sphericity of said particle is between about 0.25 to about 0.6.

5. The particle of claim 1, wherein the surface area of said particle is greater than about 20 percent higher than a conventional monocrystalline diamond particle having the same particle size distribution.

6. The particle of claim 1, where the size of the particle is between about 0.1 to about 1000 microns.

7. The particle of claim 1, wherein said particle comprises one or more spikes.

8. The particle of claim 1, wherein said particle comprises one or more pits.

9. The particle of claim 8, wherein the depth of the pits ranges in size from about 5% to about 70% of the longest length of the particle.

10. The particle of claim 9, wherein the depth of the pits ranges in size from about 40% to about 60% of the longest length of the particle.

11. The particle of claim 1, wherein said particle comprises a metallic coating.

12. The particle of claim 1, wherein in said particle ranges in size from about 0.1 micron to about 1000 microns.

13. A monocrystalline diamond particle having a sphericity of less than about 0.70.

14. The particle of claim 13, wherein the sphericity of said particle is about 0.2 to about 0.5

15. The particle of claim 13, wherein the sphericity of said particle is about 0.25 to 0.4.

16. A monocrystalline diamond particle having an irregular surface, wherein the surface roughness of said particle is less than about 0.70.

17. A monocrystalline diamond particle of claim 16, having an irregular surface, wherein the surface roughness of said particle is less than about 0.60.

18. A method for producing modified abrasive particles, comprising the steps of:

a) providing a plurality of abrasive particles;
b) providing a reactive coating on said particles,
c) heating said coated particles; and
d) recovering modified abrasive particles,

wherein said modified abrasive particles have a surface roughness that is less than about 0.95.

19. The method of claim 18, wherein said abrasive particles are diamond particles.

20. The method of claim 19, wherein said diamond particles are monocrystalline diamond particles.

21. The method of claim 18, wherein said metal coating comprises nickel.

22. The method of claim 18, wherein said heating step comprises heating said metal coated particles to a temperature of at least about 700°C.

23. The method of claim 18, wherein the percentage of metal coating to abrasive particles is about 10 wt % to about 90 wt %.

24. The method of claim 18, wherein said modified abrasive particles have an average weight loss of more than about 5% of the original weight of the particle.

25. An abrasive grain produced by the method of claim 18.

26. A tool comprising the particles of claim 18.

27. A polishing compound comprising the particles of claim 18.

28. A slurry comprising the particles of claim 18.

29 composite diamond wear coating comprising the particles of claim 18.

30. A polycrystalline diamond particle wherein the surface roughness of said particle is less than about 0.95 made by the process of claim 19.

31. A plurality of diamond particles wherein the average surface roughness of said particle is less than about 0.95.

32. The particles of claim 31, wherein the average surface roughness of said particles is between about 0.50 and about 0.80.

33. The particles of claim 31, wherein the average sphericity of said particles is less than about 0.70.

34. The particles of claim 33, wherein the average sphericity of said particles is between about 0.25 to about 0.6.

35. The particles of claim 31, wherein in said particles range in size from about microns 0.1 microns to about 1000 microns.

36. A method for lapping a material comprising the steps of:

providing a material;

providing a holder;

providing a lapping plate;

providing an abrasive slurry comprising abrasive particles wherein the average surface roughness of said particles is less than about 0.95;

affixing said material within said holder;

placing said material against said lapping plate on either one or both sides of said material;

rotating said lapping plate;

rotating said holder and said material against said lapping plate; and

applying said abrasive slurry to said lapping plate, wherein said slurry abrades said material until a desirable material thickness or surface finish is achieved.

37. A method for polishing a material comprising the steps of:

providing a material;

providing an abrasive compound or slurry on a polishing pad on a rotating tool, wherein said abrasive compound or slurry comprises abrasive particles wherein the average surface roughness of said particles is less than about 0.95;

rotating said polishing pad on said rotating tool comprising said abrasive compound or slurry;

placing said polishing pad of said rotating tool comprising said abrasive compound or slurry against said material; and

polishing said material until a desirable surface finish on said material is achieved.

38. A method for producing abrasive particles having a unique surface morphology comprising the steps of:

i. providing a plurality of abrasive particles;
ii. providing a plurality of metal particles;
iii. mixing said abrasive particles and said metal particles to form a mixture;
iv. compressing said mixture to form a compressed mixture;
v. heating said compressed mixture; and
vi. recovering modified abrasive particles.

39. The method of claim 38, wherein said compressing step comprises forming said mixture into a pellet.

40. The method of claim 38, further comprising the step of adding a binder.

41. The method of claim 38, wherein said abrasive particles are monocrystalline diamond particles.

42. The method of claim 38, wherein said metal particles are iron particles.

43. The method of claim 38, wherein said heating step comprises heating said particles and said metal particles to a temperature of at least about 700°C.

44. The method of claim 38, wherein the percentage of abrasive particles to metal particles is about 20 wt% to about 80 wt %.

45. The method of claim 38, wherein said modified abrasive particles have an average weight loss of more than about 20% of the weight loss compared to conventional abrasive particles not subjected to said method.

46. Diamond particles made by the method of claim 38.

47. The method of claim 1, wherein in said particles range in size from about 0.1 micron to about 1000 microns.

48. The particle of claim 38, wherein the surface roughness of said particle is between about 0.50 and about 0.80.

49. The particle of claim 38, wherein the sphericity of said particle is between about 0.25 to about 0.6.

50. The particle of claim 38, wherein the surface area of said particle is greater than about 20 percent higher than a conventional monocrystalline diamond particle having the same particle size distribution.

51. The particle of claim 38, wherein said particle comprises one or more pits.

52. The particle of claim 51, wherein the depth of the pits ranges in size from about 5% to about 70% of the longest length of the particle.

53. The particle of claim 38, wherein said particle comprises a metallic coating.

54. A monocrystalline diamond particle having a sphericity of less than about 0.70.

55. The particle of claim 54, wherein the sphericity of said particle is about 0.2 to about 0.5

56. A monocrystalline diamond particle having an irregular surface, wherein the surface roughness of said particle is less than about 0.70.

57. A slurry comprising:

a. a plurality of monocrystalline diamond particles,
wherein the average surface roughness of said particles is less than about 0.95;

b. a major vehicle selected from the group of water-based vehicles, glycol-based vehicles, oil-based vehicles or hydrocarbon-based vehicles and combinations thereof; and

c. one or more optional additives.

58. The method of claim 57, wherein the average sphericity of said particles is between about 0.25 to about 0.6.

59. The slurry of claim 57, wherein said diamond particles are in a concentration of about 0.01 to about 60 percent by weight.

60. The slurry of claim 57, wherein said additive is selected from the group of dispersing agents, pH modifiers, surfactants, defoamers, wetting agents, viscosity modifiers, secondary abrasives and color modifiers.

61. The slurry of claim 57, wherein the total material removal of a workpiece is increased by at least about 50% as compared to a slurry containing the same amount of conventional monocrystalline diamond particles of the same size.

62. The slurry of claim 57, wherein the average wafer roughness is reduced by at least about 20% as compared to a slurry containing the same amount of conventional monocrystalline diamond particles of the same size.

63. The slurry of claim 57, wherein the total material removal of a workpiece is increased by at least about 20% as compared to a slurry containing the same amount of conventional monocrystalline diamond particles of the same size and the average wafer roughness is reduced by at least about 20% as compared to a slurry containing the same amount of conventional monocrystalline diamond particles of the same size.

64. The slurry of claim 57, wherein the workpiece is selected from the group of silicon, sapphire, silicon carbide, glass, quartz, gallium nitride, compound semiconductors, metals, ceramics, carbides, cermets, polymers, superabrasive composites, sintered polycrystalline composites, stone and gem stones.

## CLAIMS

1. A surface modified monocrystalline diamond particle having an irregular surface, wherein surface roughness is larger than zero and less than approximately 0.95.

2. The particle according to claim 1, wherein the surface roughness of the particle is between approximately 0.50 and approximately 0.80.

3. The particle according to claim 1, wherein the particle has sphericity of less than approximately 0.70.

4. The particle according to claim 3, wherein the sphericity of the particle is between approximately 0.25 and approximately 0.6.

5. The particle according to claim 1, wherein the particle has a surface area that is approximately 20% larger than a monocrystalline diamond particle having the same particle size distribution and is not surface modified.

6. The particle according to claim 1, wherein the particle size is in the range of between approximately 0.1 to approximately 1000 micrometers.

7. The particle according to claim 1, wherein the particle has one or more spikes.

8. The particle according to claim 1, wherein the particle has one or more pits.

9. The particle according to claim 8, wherein the one or more pits have depths that are in the range of approximately 5% to approximately 70% of the maximum length of the particle.

10. The particle according to claim 8, wherein the one or more pits have depths that are in the range of approximately 40% to approximately 60% of the maximum length of the particle.

11. The particle according to claim 1, wherein the particle has a metal coating on the surface thereof.

12. The monocrystalline diamond particle according to claim 1, wherein the surface roughness is less than approximately 0.70.

13. The monocrystalline diamond particle according to claim 12, wherein the surface roughness of the particle is less than approximately 0.60.

14. A method for manufacturing the monocrystalline diamond particle according to claim 1, comprising:
a) providing a plurality of abrasive particles;
b) providing a reactive coating on the particles;

c) heating the coated particles; and
d) recovering a modified abrasive particle,
wherein the modified abrasive particles have a surface roughness of approximately less than 0.95.

15. The method according to claim 14, wherein the metal coating contains nickel.

16. The method according to claim 14, wherein the heating step includes heating the metal coated particle to a temperature of at least approximately 700°C.

17. The method according to claim 14, wherein the percentage of the metal coating in relation to the particle is approximately 10 wt% to approximately 90 wt%.

18. The method according to claim 14, wherein the modified abrasive particle has an average mass loss of approximately 5% or more of the mass of the original particle.

19. A polishing grain containing the monocrystalline diamond particle manufactured using the method according to claim 14.

20. A tool containing the monocrystalline diamond particle manufactured using the method according to claim 14.

21. A polishing material containing the monocrystalline diamond particle manufactured using the method according to claim 14.

22. A slurry containing the monocrystalline diamond particle manufactured using the method according to claim 14.

23. A composite diamond wear resistant coating containing the monocrystalline diamond particle manufactured using the method according to claim 14.

24. A monocrystalline diamond particle produced using the manufacturing method according to claim 14, wherein the surface roughness is less than approximately 0.95.

25. A method for lapping a material using the monocrystalline diamond particle according to claim 1, comprising:
providing the material;
providing a holder;
providing a lapping plate;
providing a polishing slurry containing an abrasive particle;
attaching the material inside the holder;
facing the material to the lapping plate and arranging using either or both sides of the material;
rotating the lapping plate;

facing the holder and the material to the lapping plate, and rotating; and
applying the polishing slurry to the wrapping plate,
wherein the average surface roughness of the abrasive particle is less than approximately 0.95, and the slurry polishes the material until a desired material thickness or surface finish is achieved.

26. A method for polishing the material using the monocrystalline diamond particle according to claim 1, comprising:
providing the material;
providing a polishing compound or slurry on a polishing pad that is on a rotating tool;
rotating the polishing pad that is on the rotating tool and contains the polishing compound or slurry;
placing the polishing pad that is on the rotating tool and contains the polishing compound or slurry facing the material; and
polishing the material until a desired finish is achieved on the material,
wherein the polishing compound or slurry contain abrasive particles with average surface roughness of less than approximately 0.95.

27. A method for manufacturing the monocrystalline diamond particle according to claim 1 having unique surface morphology, comprising:
I providing a plurality of abrasive particles;
II providing a plurality of metal particles;
III forming a mixture containing the abrasive particles and the metal particles;
IV forming a compressed mixture by compressing the mixture;
V heating the compressed mixture; and
VI recovering a modified abrasive particle.

28. The method according to claim 27, wherein the compressing step forms the mixture into a pellet.

29. The method according to claim 27, further comprising:
a step that adds a binder.

30. The method according to claim 27, wherein the abrasive particle is a monocrystalline diamond particle.

31. The method according to claim 27, wherein the metal particle is an iron particle.

32. The method according to claim 27, wherein the heating step includes heating the abrasive particles and the metal particles to a temperature of at least approximately 700°C.

33. The method according to claim 27, wherein the percentage of the abrasive particles in relation to the metal particles is approximately 20 wt% to approximately 80 wt%.

34. The method according to claim 27, wherein the modified abrasive particles have an average mass loss of approximately 20% or more when compared to abrasive particles to which the method has not been applied.

35. A diamond particle produced using the method according to claim 27.

36. The method according to claim 27, wherein the size of the monocrystalline diamond particle is in the range of approximately 0.1 micrometers to approximately 1000 micrometers.

37. The method according to claim 27, wherein the surface roughness of the monocrystalline diamond particle is
between approximately 0.50 and approximately 0.80.

38. The method according to claim 27, wherein the sphericity of the monocrystalline diamond particle is between approximately 0.25 and approximately 0.6.

39. The method according to claim 27, wherein the monocrystalline diamond particle has a surface area that is approximately 20% larger than a monocrystalline diamond particle having the same particle size distribution to which the method has not been applied.

40. The method according to claim 27, wherein the monocrystalline diamond particle has one or more pits.

41. The method according to claim 40, wherein the depths of the pits are in the range of approximately 5% to approximately 70% of the maximum length of the particle.

42. The method according to claim 27, wherein the monocrystalline diamond particle has a metal coating.