Claims

1. A method of manufacturing synthetic CVD diamond material, the method comprising:

providing a microwave plasma reactor comprising:

a plasma chamber;

one or more substrates disposed in the plasma chamber providing a growth surface area over which the synthetic CVD diamond material is to be deposited in use;

a microwave coupling configuration for feeding microwaves from a microwave generator into the plasma chamber; and

a gas flow system for feeding process gases into the plasma chamber and removing them therefrom,

injecting process gases into the plasma chamber;

feeding microwaves from the microwave generator into the plasma chamber through the microwave coupling configuration to form a plasma above the growth surface area; and

growing synthetic CVD diamond material over the growth surface area,

wherein the process gases comprise at least one dopant in gaseous form, selected from a one or more of boron, silicon, sulphur, phosphorous, lithium and beryllium, the or each dopant present at a concentration equal to or greater than 0.01 ppm, and/or nitrogen at a concentration equal to or greater than 0.3 ppm,

wherein the gas flow system includes a gas inlet comprising one or more gas inlet nozzles disposed opposite the growth surface area and configured to inject process gases towards the growth surface area, and

wherein the process gases are injected towards the growth surface area at a total gas flow rate equal to or greater than 500 standard cm^3 per minute and/or wherein the process gases are injected into the plasma chamber through the or each gas inlet nozzle with a Reynolds number a Reynolds number in a range 1 to 100.

2. A method according to claim 1, wherein the at least one dopant is injected into the plasma chamber in a controlled manner or added to one or more source process gases prior to injection into the plasma chamber.

3. A method according to claim 1 or 2, wherein the at least one dopant comprises: one or more of boron, silicon, sulphur, phosphorous, lithium and beryllium and wherein the process gases comprise less than 0.3 ppm nitrogen; or nitrogen at a concentration of equal to or greater than 0.3 ppm and wherein the process gases comprise less than 0.01 ppm of boron, silicon, sulphur, phosphorous, lithium and beryllium.

4. A method according to any preceding claim, wherein the at least one dopant is provided in the process gases at a concentration equal to or greater than 0.05 ppm, 0.1 ppm, 0.3 ppm, 0.5 ppm, 0.7 ppm, 1 ppm, 3 ppm, 5 ppm, 10 ppm, 20 ppm, 50 ppm, 100 ppm, 200 ppm, 300 ppm, 500 ppm, 700 ppm, or 1000 ppm.

5. A method according to any preceding claim, wherein the process gases comprise a ratio of dopant concentration / carbon concentration equal to or greater than 1×10^{-6}, 10×10^{-6}, 100×10^{-6}, or 1000×10^{-6}.

6. A method according to any preceding claim, wherein the total gas flow rate fed through the gas inlet is equal to or greater than 750, 1000, 2000, 5000, 10000, 15000, 20000, 25000, 30000, 35000, or 40000 standard cm^3 per minute.

7. A method according to any preceding claim, wherein the total gas flow fed through the gas inlet is equal to or greater than 3, 10, 20, 50, 100, 200, 500, or 1000 standard cm^3 per cm^2 of the growth surface area and equal to or less than 50000, 20000, 10000, or 5000 standard cm^3 per cm^2 of the growth surface area.

8. A method according to any preceding claim, wherein the or each gas inlet nozzle has an outlet diameter in the range 0.1 mm to 5 mm, 0.2 mm to 3.0 mm, 2.0 mm to 3 mm, 0.2 mm to 2 mm, 0.25 mm to 2 mm, or 0.25 mm to 1.5 mm.

9. A method according to any preceding claim, wherein a minimum distance D_c between the gas inlet and the growth surface area is less than or equal to $6R_s$, $4R_s$, or $2R_s$, where R_s is a radius of the growth surface area.

10. A method according to any preceding claim, wherein the process gases are injected into the plasma chamber through the or each gas inlet nozzle with a Reynolds number equal to or less than 100, 80, 50, 40, or 35 and at least 1, 5, 10, 15, 20, or 25.

11. A method according to any preceding claim, wherein an operating pressure within the plasma chamber is equal to or greater than: 100, 200, 220, 240, 260, 280, 300, 320, 340, 360, 380, or 400 Torr at a microwave frequency in a range 2300 to 2600 MHz; 120, 140 160, 180, 200, 220, 240, or 260 Torr at a microwave frequency in a range 800 to 1000 MHz; or 60, 70, 80, 100, 120, 140, or 150 Torr at a microwave frequency in a range 400 to 500 MHz.

12. A method according to any preceding claim, wherein at least 45%, 50%, 55%, 60%, 65%, or 70% of power fed into the plasma chamber is transmitted through a base of the plasma chamber disposed opposite to the gas inlet.

13. A method according to any preceding claim, wherein a power density delivered to the growth surface area is equal to or greater than 0.05, 0.1, 0.5, 1, 1.5, 2.0, 2.5, 2.75, 3.0, 3.2, or 3.5 W/mm^2 of the growth surface area.

14. A method according to any preceding claim, wherein the gas inlet comprises an inlet nozzle array comprising a plurality of gas inlet nozzles disposed opposite the growth surface area and configured to inject process gases towards the growth surface area.

15. A method according to claim 14, wherein the gas inlet nozzle array comprises equal to or greater than 6, 7, 9, 10, 15, 20, 30, 40, 60, 90, 120, 150, 200, 300, 500, 700, 1000, 1200, 1500 gas inlet nozzles.

16. A method according to claim 14 or 15, wherein the gas inlet nozzle array comprises:

a gas inlet nozzle number density equal to or greater than 0.1 nozzles/cm^2, wherein the gas inlet nozzle number density is measured by projecting the nozzles onto a plane whose normal lies parallel to the central axis of the plasma chamber and measuring the gas inlet number density on said plane; and

a nozzle area ratio of equal to or greater than 10, wherein the nozzle area ratio is measured by projecting the nozzles onto a plane whose normal lies parallel to the central axis of the plasma chamber, measuring the total area of the gas inlet nozzle area on said plane, dividing by the total number of nozzles to give an area associated with each nozzle, and dividing the area associated with each nozzle by an actual area of each nozzle.

17. A method according to claim 16, wherein the gas inlet nozzle number density is equal to or greater than 0.2, 0.5, 1, 2, 5, or 10 nozzles/cm^2.

18. A method according to claim 16 or 17, wherein the gas inlet nozzle number density is equal to or less than 100, 50, or 10 nozzles/cm^2.

19. A method according to any one of claims 16 to 18, wherein the nozzle area ratio is equal to or greater than 30, 100, 300, 1000, or 3000.

20. A method according to any one of claims 16 to 19, wherein the nozzle area ratio is equal to or less than 100000, 30000, or 10000.

21. A method according to any one of claims 16 to 20, wherein a ratio of total nozzle area / area of the gas inlet nozzle array is equal to or less than 0.5, 0.35, 0.3, 0.2, 0.1, 0.05, 0.02, 0.01, or 0.007.

22. A method according to any one of claims 16 to 21, wherein a total area of nozzles in the gas inlet nozzle array, given in mm^2, is in a range 1 to 5000, 5 to 3000, 10 to 3000, 20 to 2750, 30 to 2750, or 50 to 2700.

23. A method according to any one of claims 16 to 22, wherein a total area of the gas inlet nozzle array over which the gas inlet nozzles are spaced, given in mm^2, is in a range 100 to 15000, 200 to 15000, 400 to 10000, 800 to 10000, or 1000 to 8000.

24. A method according to any one of claims 16 to 23, wherein the gas inlet nozzle array comprises a hexagonal close-packed array of gas inlet nozzles.

25. A method according to any one of claims 16 to 24, wherein the gas inlet nozzles are disposed in a substantially parallel or divergent orientation relative to a central axis of the plasma chamber.

26. A method according to any one of claims 16 to 25, wherein a maximum radius of the gas inlet nozzle array R_m meets the criteria: $R_m \times F_m$ is greater than or equal to R_s, where R_s is a radius of the growth surface area and Fm is equal to or greater than 0.5, 0.6, 0.7, 0.8, 0.9, or 1 and equal to or less than 1.5, 1.3, 1.2, or 1.1.

27. A method according to any preceding claim, wherein a synthetic polycrystalline CVD diamond wafer is grown, the synthetic polycrystalline CVD diamond wafer comprising the at least one dopant at a concentration which varies by no more than 50%, 40%, 30%, 20%, 10%, or 5% of a mean concentration over at least 70%, 80%, 90%, or 95% of the volume of the synthetic polycrystalline CVD diamond wafer.

28. A method according to any one of claims 1 to 26, wherein at least 10, 20, 30, 40, 50, 60, 80 or 100 synthetic single crystal CVD diamonds are grown in a single growth run, wherein the synthetic single crystal CVD diamonds having a thickness which varies by no more than 20%, 10%, 5%, 3%, 2%, or 1% of a mean thickness.

29. A method according to any preceding claim, wherein the atomic partial pressure of dopant within the plasma reactor is equal to or greater than: 20, 100, 200 Pa, 400 Pa, 800 Pa, 1200 Pa or 1600 Pa at a microwave frequency in a range 2300 to 2600 MHz ; 10, 50, 100, 200 Pa, 400 Pa, 600 Pa, 800 Pa, or 1000 Pa at a microwave frequency in a range 800 to 1000 MHz; 5 Pa, 25 Pa, 50 Pa, 100 Pa, 200 Pa, 300 Pa, 400 Pa, or 500 Pa at a microwave frequency in a range 400 to 500 MHz.

30. A synthetic polycrystalline CVD diamond wafer, said wafer having a longest dimension equal to or greater than 140 mm and comprising at least one dopant having a concentration which varies by no more than 50% of a mean concentration over at least 70% of the volume of the synthetic polycrystalline CVD diamond wafer.

31. A synthetic polycrystalline CVD diamond wafer according to claim 30, wherein the concentration varies by no more than 40%, 30%, 20%, 10%, or 5% over at least 70%, 80%, 90%, or 95% of the volume of the synthetic polycrystalline CVD diamond wafer.

32. A synthetic polycrystalline CVD diamond wafer according to claim 30 or 31, wherein the dopant is selected from one or more of nitrogen, boron, silicon, sulphur, phosphorous, and lithium.

33. A synthetic polycrystalline CVD diamond wafer according to any one of claims 30 to 32, wherein the synthetic polycrystalline CVD diamond wafer comprises said dopant at a concentration of at least 10^{14} cm^{-3}, 10^{15} cm^{-3}, 10^{16} cm^{-3}, 10^{17} cm^{-3}, 10^{18} cm^{-3}, 10^{19} cm^{-3}, 10^{20} cm^{-3}, 2×10^{20} cm^{-3}, 4×10^{20} cm^{-3}, 6×10^{20}, 8×10^{20} cm^{-3}, 10^{21} cm^{-3}, 2×10^{21} cm^{-3}, 4×10^{21} cm^{-3}, 6×10^{21}, 8×10^{21} cm^{-3}, or 10^{22} cm^{-3}.

34. A synthetic polycrystalline CVD diamond wafer according to any one of claims 30 to 33, wherein the synthetic polycrystalline CVD diamond wafer has a thickness of at least 0.1 mm, 0.2 mm, 0.3 mm, 0.4 mm, 0.5 mm, 0.75 mm, 1 mm, 1.25 mm, 1.5 mm, or 2 mm.

35. A synthetic polycrystalline CVD diamond wafer according to any one of claims 30 to 34, wherein the synthetic polycrystalline CVD diamond wafer has a longest dimension of at least 145 mm or 150 mm.

36. A synthetic polycrystalline CVD diamond wafer according to any one of claims 30 to 35, comprising a dopant ratio x / y equal to or greater than 2, 5, 10, 20, 50, 100, 500, or 1000, where x is said dopant and y is one or more different impurities selected from the group consisting of boron, nitrogen and silicon.

37. A synthetic polycrystalline CVD diamond wafer according to any one of claims 30 to 36, having a resistivity equal to or less than 10 Ohm-cm, 1 Ohm-cm, 10^{-1} Ohm-cm, or 10^{-2} Ohm-cm.

38. A synthetic polycrystalline CVD diamond wafer according to any one of claims 30 to 37, having a resistivity which varies by no more than ±30%, ±20%, ±10%, or ±5% of a mean resistivity for at least 70%, 80%, 90%, or 95% of at least 17 measurement points taken across at least 70% 80%, 90%, or 95% of an area the synthetic polycrystalline diamond wafer.

39. A synthetic polycrystalline CVD diamond wafer according to any one of claims 30 to 38, having a thickness variation equal to or less than 30%, 25%, 20%, 15%, 10%, 5%, or 2% of a mean thickness.

40. A layer of synthetic single crystal CVD diamond material, said layer having a thickness greater than 50 μm and comprising boron dopant having a concentration equal to or greater than 2×10^{20} cm^{-3}.

41. A layer of synthetic single crystal CVD diamond material according to claim 40, wherein the layer has a thickness of at least 0.1 mm, 0.2 mm, 0.3 mm, 0.4 mm, 0.5 mm, 0.75 mm, 1 mm, 1.25 mm, 1.5 mm, 2 mm, 2.5 mm, 3 mm, 5mm, 8mm, or 10 mm.

42. A layer of synthetic single crystal CVD diamond material according to claim 40 or 41, wherein the dopant concentration is equal to or greater than 4×10^{20} cm^{-3}, 5×10^{20} cm^{-3}, 7×10^{20} cm^{-3}, 1×10^{21} cm^{-3}, or 2×10^{21} cm^{-3}.

43. A layer of synthetic single crystal CVD diamond material according to any one of claims 40 to 42, comprising a dopant ratio x / y equal to or greater than 2, 5, 10, 20, 50, 100, 500, or 1000, where x is said dopant and y is one or more different impurities selected from the group consisting of boron, nitrogen and silicon.

44. A layer of synthetic single crystal CVD diamond material according to any one of claims 40 to 43, wherein the layer has a birefringence equal to or less than $4x10^{-4}$, $1x10^{-5}$, $5x10^{-5}$, or $1x10^{-6}$.

45. A layer of synthetic single crystal CVD diamond material according to any one of claims 40 to 44, the layer comprises a concentration of dislocation features no more than 10^5, 10^4, or 10^3 cm^{-2}.

46. A layer of synthetic single crystal CVD diamond material according to any one of claims 40 to 45, wherein the layer is orientated in a {100} crystallographic plane.

47. A layer of synthetic single crystal CVD diamond material according to any one of claims 40 to 46, wherein a concentration of said dopant varies by no more than 50%, 40%, 30%, 20%, 10%, or 5% of a mean value over at least 70%, 80%, 90%, or 95% of the layer of synthetic single crystal CVD diamond material.

48. A synthetic single crystal CVD diamond comprising a doped layer and an adjacent undoped layer, wherein an interface between the doped and undoped layer is substantially free of impurities and wherein the dopant concentration varies by at least a factor of 3 over a thickness of no more than 10 μm across the interface between the doped and undoped layers.

49. A synthetic single crystal CVD diamond according to claim 48, wherein the dopant concentration varies by at least a factor of 10, 30, 100, 300, 1000, 30000, or 100000.

50. A synthetic single crystal CVD diamond according to claim 48 or 49, wherein the thickness is no more than 3 μm, 1 μm, 0.3 μm, 0.1 μm, 0.03 μm, 0.01 μm, 0.003 μm, or 0.001 μm.

51. A synthetic single crystal CVD diamond according to any one of claims 48 to 50, wherein the interface substantially free of impurities is an interface where, in a region either side of the interface extending to 20%, 50%, or 100% of a thickness of the doped layer, an impurity concentration does not exceed 10^{14}, 3 x 10^{14}, 10^{15}, 3 x 10^{15}, 10^{16}, 3 x 10^{16}, or 10^{17}, and does not vary in concentration by more than a factor of 2, 3, 5, 10, 30, 100, 300, or 1000.

52. A synthetic polycrystalline CVD diamond wafer according to any one of claims 30 to 39 made by a method according to any one of claims 1 to 29.

53. A layer of synthetic single crystal CVD diamond material according to any one of claims 40 to 47 made by a method according to any one of claims 1 to 29.

54. A synthetic single crystal CVD diamond according to any one of claims 48 to 51 made by a method according to any one of claims 1 to 29.

Claims

1. A method of manufacturing synthetic CVD diamond material, the method comprising:

providing a microwave plasma reactor comprising:

a plasma chamber;

one or more substrates disposed in the plasma chamber providing a growth surface area over which the synthetic CVD diamond material is to be deposited in use;

a microwave coupling configuration for feeding microwaves from a microwave generator into the plasma chamber; and

a gas flow system for feeding process gases into the plasma chamber and removing them therefrom,

injecting process gases into the plasma chamber;

feeding microwaves from the microwave generator into the plasma chamber through the microwave coupling configuration to form a plasma above the growth surface area or below the growth surface area if the microwave plasma reactor is in an inverted arrangement with process gases flowing in an upwards direction; and

growing synthetic CVD diamond material over the growth surface area,

wherein the process gases comprise at least one dopant in gaseous form, selected from a one or more of boron, silicon, sulphur, phosphorous, lithium and beryllium, the or each dopant present at a concentration equal to or greater than 0.01 ppm, and/or nitrogen at a concentration equal to or greater than 0.3 ppm,

wherein the gas flow system includes a gas inlet comprising one or more gas inlet nozzles disposed opposite the growth surface area and configured to inject process gases towards the growth surface area, and

wherein the process gases are injected into the plasma chamber through the or each gas inlet nozzle with a Reynolds number in a range 1 to 100.

2. A method according to claim 1, wherein the process gases are injected towards the growth surface area at a total gas flow rate equal to or greater than 500 standard cm^3 per minute.

3. A method according to claim 1 or 2, wherein the at least one dopant is added to one or more source process gases prior to injection into the plasma chamber.

4. A method according to any preceding claim, wherein the at least one dopant comprises: one or more of boron, silicon, sulphur, phosphorous, lithium and beryllium and wherein the process gases comprise less than 0.3 ppm nitrogen; or nitrogen at a concentration of equal to or greater than 0.3 ppm and wherein the process gases comprise less than 0.01 ppm of the or each of boron, silicon, sulphur, phosphorous, lithium and beryllium.

5. A method according to any preceding claim, wherein the at least one dopant is provided in the process gases at a concentration equal to or greater than 0.05 ppm, 0.1 ppm, 0.3 ppm, 0.5 ppm, 0.7 ppm, 1 ppm, 3 ppm, 5 ppm, 10 ppm, 20 ppm, 50 ppm, 100 ppm, 200 ppm, 300 ppm, 500 ppm, 700 ppm, or 1000 ppm.

6. A method according to any preceding claim, wherein the process gases comprise a ratio of dopant concentration / carbon concentration equal to or greater than 1×10^{-6}, 10×10^{-6}, 100×10^{-6}, or 1000×10^{-6}.

7. A method according to any preceding claim, wherein the total gas flow rate fed through the gas inlet is equal to or greater than 750, 1000, 2000, 5000, 10000, 15000, 20000, 25000, 30000, 35000, or 40000 standard cm^3 per minute.

8. A method according to any preceding claim, wherein the total gas flow fed through the gas inlet is equal to or greater than 3, 10, 20, 50, 100, 200, 500, or 1000 standard cm^3 per cm^2 of the growth surface area and equal to or less than 50000, 20000, 10000, or 5000 standard cm^3 per cm^2 of the growth surface area.

9. A method according to any preceding claim, wherein the or each gas inlet nozzle has an outlet diameter in the range 0.1 mm to 5 mm, 0.2 mm to 3.0 mm, 2.0 mm to 3 mm, 0.2 mm to 2 mm, 0.25 mm to 2 mm, or 0.25 mm to 1.5 mm.

10. A method according to any preceding claim, wherein a minimum distance D_e between the gas inlet and the growth surface area is less than or equal to $6R_s$, $4R_s$, or $2R_s$, where R_s is a radius of the growth surface area.

11. A method according to any preceding claim, wherein the process gases are injected into the plasma chamber through the or each gas inlet nozzle with a Reynolds number equal to or less than 100, 80, 50, 40, or 35 and at least 1, 5, 10, 15, 20, or 25.

12. A method according to any preceding claim, wherein an operating pressure within the plasma chamber is equal to or greater than: 100, 200, 220, 240, 260, 280, 300, 320, 340, 360, 380, or 400 Torr (i.e. 13.3, 26.7, 29.3, 32.0, 34.7, 37.3, 40.0, 42.7, 45.3, 48.0, 50.7, 53.3 kPa) at a microwave frequency in a range 2300 to 2600 MHz; 120, 140 160, 180, 200, 220, 240, or 260 Torr (i.e. 16.0, 18.7, 21.3, 24.0, 26.7, 29.3, 32.0, 34.7 kPa) at a microwave frequency in a range 800 to 1000 MHz; or 60, 70, 80, 100, 120, 140, or 150 Torr (i.e. 8.0, 9.3, 10.7, 13.3, 16.0, 18.7, 20.0 kPa) at a microwave frequency in a range 400 to 500 MHz.

13. A method according to any preceding claim, wherein at least 45%, 50%, 55%, 60%, 65%, or 70% of power fed into the plasma chamber is transmitted through a base of the plasma chamber disposed opposite to the gas inlet.

14. A method according to any preceding claim, wherein a power density delivered to the growth surface area is equal to or greater than 0.05, 0.1, 0.5, 1, 1.5, 2.0, 2.5, 2.75, 3.0, 3.2, or 3.5 W/mm^2 of the growth surface area.

15. A method according to any preceding claim, wherein the gas inlet comprises an inlet nozzle array comprising a plurality of gas inlet nozzles disposed opposite the growth surface area and configured to inject process gases towards the growth surface area.

16. A method according to claim 14, wherein the gas inlet nozzle array comprises equal to or greater than 6, 7, 9, 10, 15, 20, 30, 40, 60, 90, 120, 150, 200, 300, 500, 700, 1000, 1200, 1500 gas inlet nozzles.

17. A method according to claim 15 or 16, wherein the gas inlet nozzle array comprises:

a gas inlet nozzle number density equal to or greater than 0.1 nozzles/cm^2, wherein the gas inlet nozzle number density is measured by projecting the nozzles onto a plane whose normal lies parallel to the central axis of the plasma chamber and measuring the gas inlet number density on said plane; and

a nozzle area ratio of equal to or greater than 10, wherein the nozzle area ratio is measured by projecting the nozzles onto a plane whose normal lies parallel to the central axis of the plasma chamber, measuring the total area of the gas inlet nozzle area on said plane, dividing by the total number of nozzles to give an area associated with each nozzle, and dividing the area associated with each nozzle by an actual area of each nozzle.

18. A method according to claim 17, wherein the gas inlet nozzle number density is equal to or greater than 0.2, 0.5, 1, 2, 5, or 10 nozzles/cm^2.

19. A method according to claim 17 or 18, wherein the gas inlet nozzle number density is equal to or less than 100, 50, or 10 nozzles/cm^2.

20. A method according to any one of claims 17 to 19, wherein the nozzle area ratio is equal to or greater than 30, 100, 300, 1000, or 3000.

21. A method according to any one of claims 17 to 20, wherein the nozzle area ratio is equal to or less than 100000, 30000, or 10000.

22. A method according to any one of claims 17 to 21, wherein a ratio of total nozzle area / area of the gas inlet nozzle array is equal to or less than 0.5, 0.35, 0.3, 0.2, 0.1, 0.05, 0.02, 0.01, or 0.007.

23. A method according to any one of claims 17 to 22, wherein a total area of nozzles in the gas inlet nozzle array, given in mm^2, is in a range 1 to 5000, 5 to 3000, 10 to 3000, 20 to 2750, 30 to 2750, or 50 to 2700.

24. A method according to any one of claims 17 to 23, wherein a total area of the gas inlet nozzle array over which the gas inlet nozzles are spaced, given in mm^2, is in a range 100 to 15000, 200 to 15000, 400 to 10000, 800 to 10000, or 1000 to 8000.

25. A method according to any one of claims 17 to 24, wherein the gas inlet nozzle array comprises a hexagonal close-packed array of gas inlet nozzles.

26. A method according to any one of claims 17 to 25, wherein the gas inlet nozzles are disposed in a substantially parallel or divergent orientation relative to a central axis of the plasma chamber.

27. A method according to any one of claims 17 to 26, wherein a maximum radius of the gas inlet nozzle array R_m meets the criteria: $R_m \times F_m$ is greater than or equal to R_s, where R_s is a radius of the growth surface area and Fm is equal to or greater than 0.5, 0.6, 0.7, 0.8, 0.9, or 1 and equal to or less than 1.5, 1.3, 1.2, or 1.1.

28. A method according to any preceding claim, wherein a synthetic polycrystalline CVD diamond wafer is grown, the synthetic polycrystalline CVD diamond wafer comprising the at least one dopant at a concentration which varies by no more than 50%, 40%, 30%, 20%, 10%, or 5% of a mean concentration over at least 70%, 80%, 90%, or 95% of the volume of the synthetic polycrystalline CVD diamond wafer.

29. A method according to any on of claims 1 to 27, wherein at least 10, 20, 30, 40, 50, 60, 80 or 100 synthetic single crystal CVD diamonds are grown in a single growth run, wherein the synthetic single crystal CVD diamonds having a thickness which varies by no more than 20%, 10%, 5%, 3%, 2%, or 1% of a mean thickness.

30. A method according to any preceding claim, wherein the atomic partial pressure of dopant within the plasma reactor is equal to or greater than: 20, 100, 200 Pa, 400 Pa, 800 Pa, 1200 Pa or 1600 Pa at a microwave frequency in a range 2300 to 2600 MHz ; 10, 50, 100, 200 Pa, 400 Pa, 600 Pa, 800 Pa, or 1000 Pa at a microwave frequency in a range 800 to 1000 MHz; 5 Pa, 25 Pa, 50 Pa, 100 Pa, 200 Pa, 300 Pa, 400 Pa, or 500 Pa at a microwave frequency in a range 400 to 500 MHz.