Claims

1. A single crystal CVD diamond material comprising:

a total nitrogen concentration of at least 3 ppm as measured by secondary ion mass spectrometry (SIMS); and

a low optical birefringence such that in a sample of the single crystal CVD diamond material having an area of at least 1.3 mm x 1.3 mm, and measured using a pixel size of area in a range 1 x 1 μm^2 to 20 x 20 μm^2, a maximum value of $\Delta n_{[average]}$ does not exceed 1.5×10^{-4}, where $\Delta n_{[average]}$ is an average value of a difference between refractive index for light polarised parallel to slow and fast axes averaged over the sample thickness.

2. A single crystal CVD diamond material according to claim 1,

wherein the single crystal CVD diamond material has a thickness of at least 0.1 mm, 0.2 mm, 0.3 mm, 0.4 mm, 0.5 mm, 0.7 mm, 1.0 mm, 1.5 mm, 2.0 mm, 2.5 mm, 3.0 mm, or 5 mm.

3. A single crystal CVD diamond material according to claim 1 or 2,

wherein the sample of single crystal CVD diamond material used to measure birefringence has a thickness in a range 0.5 mm to 1.0 mm.

4. A single crystal CVD diamond material according to any one of claims 1 to 3,

wherein the total nitrogen concentration of the single crystal CVD diamond material is at least 5 ppm, 7 ppm 10 mm, 15 ppm, 20 ppm, or 30 ppm.

5. A single crystal CVD diamond material according to any one of claims 1 to 4,

wherein the maximum value of $\Delta n_{[average]}$ does not exceed 8×10^{-5}.

6. A single crystal CVD diamond material according to any one of claims 1 to 5,

wherein the maximum value of $\Delta n_{[average]}$ does not exceed 5×10^{-5}.

7. A single crystal CVD diamond material according to any one of claims 1 to 6,

wherein the optical birefringence is measured in a direction of highest birefringence to within $\pm 10^{o}$.

8. A single crystal CVD diamond material according to any one of claims 1 to 7,

wherein the single crystal CVD diamond material has a neutral single substitutional nitrogen (N_s^0) concentration greater than 5 x 10^{17} atoms/cm^3, 8 x 10^{17} atoms/cm^3, or 1 x 10^{18} atoms/cm^3 as measured by electron paramagnetic resonance.

9. A single crystal CVD diamond material according to any one of claims 1 to 8,

wherein the single crystal CVD diamond material is coloured brown, yellow, blue, or pink.

10. A single crystal CVD diamond material according to any one of claims 1 to 9,

wherein the single crystal CVD diamond material is in the form of a cut gemstone.

11. A method of fabricating a single crystal CVD diamond material according to any preceding claim, the method comprising:

preparing a plurality of single crystal diamond substrates by mechanically processing the substrates and then etching the substrates to remove mechanical processing damage, wherein a growth surface of each substrate has a density of defects such that surface etch features related to defects formed by a revealing plasma etch is below 5 x 10^3/mm^2;

growing a first layer of single crystal CVD diamond material on the growth surface of each single crystal diamond substrate, and

growing a second layer of single crystal CVD diamond material on the first layer of single crystal CVD diamond material,

wherein the second layer of single crystal CVD diamond material is grown under higher nitrogen conditions than the first layer of single crystal CVD diamond material such that the synthesis atmosphere contains more than 5 ppm of nitrogen.

12. A method according to claim 11,

wherein the first layer of single crystal CVD diamond material is grown with a synthesis atmosphere containing less than 5 ppm, 3 ppm, 1 ppm, or 0.8 ppm of nitrogen.

13. A method according to claim 11 or 12,

wherein the second layer of single crystal CVD diamond material is grown with a synthesis atmosphere containing more than 7 ppm 10 mm, 15 ppm, 20 ppm, or 30 ppm of nitrogen.

14. A method according to any one of claims 11 to 13,

wherein the first layer is grown to a thickness of at least 5 micrometres.

15. A method according to any one of claims 11 to 14,
wherein the first layer is grown to a thickness of no more than 200 micrometres.

16. A method according to any one of claims 11 to 15,
wherein the second layer of single crystal CVD diamond material is yellow or brown.

17. A method according to any one of claims 11 to 16,
wherein the second layer of single crystal CVD diamond material is irradiated to produce a blue coloured material.

18. A method according to any one of claims 11 to 16,
wherein the second layer of single crystal CVD diamond material is irradiated and annealed to produce a pink coloured material.