Claims

1. A single crystal CVD diamond material comprising:

three orthogonal dimensions of at least 2 mm;

one or more regions of low optical birefringence, indicative of low strain, such that in a sample of the single crystal CVD diamond material having a thickness in a range 0.5 mm to 1.0 mm and an area of greater than 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} for the one or more regions of low optical birefringence, 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;

one or more regions of high optical birefringence, indicative of high strain, such that in said sample of the single crystal CVD diamond material and measured using said pixel size, $\Delta n_{[average]}$ is greater than 1.5×10^{-4} and less than 3×10^{-3}; and

wherein every 1.3 mm x 1.3 mm area of the sample of the single crystal CVD diamond material comprises at least one of said regions of high optical birefringence.

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

wherein the one or more regions of high optical birefringence each comprise a plurality of dislocations extending laterally in a line across the single crystal CVD diamond material.

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

wherein the one or more regions of high optical birefringence each comprise a bundle of dislocations at a point localized in lateral dimensions of the single crystal CVD diamond material.

4. A single crystal CVD diamond material according to any preceding claim,

wherein the one or more regions of high optical birefringence each have a width in a range 5 to 500 µm.

5. A single crystal CVD diamond material according to any preceding claim,

wherein the regions of high optical birefringence have a spacing in a range 50 µm to 1.3 mm.

6. A single crystal CVD diamond material according to any preceding claim,

wherein the regions of high optical birefringence are configured in a regular pattern.

7. A single crystal CVD diamond material according to any preceding claim, wherein the regions of high optical birefringence are equally spaced.

8. A single crystal CVD diamond material according to any preceding claim, wherein $\Delta n_{[average]}$ of the one or more regions of low optical birefringence does not exceed 8×10^{-5}.

9. A single crystal CVD diamond material according to any preceding claim, wherein the single crystal CVD diamond material has a neutral single substitutional nitrogen (N_s^0) concentration in a range 3×10^{15} atoms/cm^3 to 5×10^{17} atoms/cm^3 as measured by electron paramagnetic resonance.

10. A single crystal CVD diamond material according to any preceding claim, wherein the single crystal CVD diamond material has a low optical absorption such that said sample of the single crystal CVD diamond material has an optical absorption coefficient at a wavelength of 1.06 µm of less than 0.09 cm^{-1}.

11. A single crystal CVD diamond material according to any preceding claim, wherein the single crystal CVD diamond material is colourless or near colourless with a colour grade in a range D to J.

12. A single crystal CVD diamond material according to any preceding claim, wherein the single crystal CVD diamond material is in the form of a cut gemstone.

13. A single crystal CVD diamond material according to any preceding claim, wherein the optical birefringence in the regions of low and high optical birefringence is measured in a direction of highest birefringence to within ±10°.

14. A single crystal CVD diamond material according to any preceding claim, wherein the one or more regions of high optical birefringence each have an area of at least 100 µm x 100 µm.

15. A single crystal CVD diamond material according to any preceding claim, wherein at least 2% of a total number of pixels in every 1.3 mm x 1.3 mm area of a sample of the single crystal CVD diamond material form the one or more regions of high optical birefringence.

16. A method of manufacturing the single crystal CVD diamond material according to any preceding claim, the method comprising:

preparing a plurality of single crystal diamond substrates, each substrate having a growth surface comprising:

one or more regions for nucleating dislocations to form said one or more regions of high optical birefringence in the single crystal CVD diamond material grown thereon; and

one or more low defect regions to form said one or more regions of low optical birefringence in the single crystal CVD diamond material grown thereon, wherein the one or more low defect regions have a density of defects such that surface etch features related to defects formed by a revealing plasma etch is below $5 \times 10^3/mm^2$; and

growing at least 2 mm x 2 mm x 2 mm of the single crystal CVD diamond material on the growth surface of each of the single crystal diamond substrates while controlling CVD diamond growth conditions in order to fabricate the single crystal CVD diamond material of any preceding claim.

17. A method according to claim 16,

wherein the single crystal diamond substrates are prepared by ablating the growth surface of each of the single crystal diamond substrates with ablated regions forming the one or more regions for nucleating dislocations.

18. A method according to claim 16,

wherein the single crystal diamond substrates are prepared by implanting the growth surface of each of the single crystal diamond substrates with implanted regions forming the one or more regions for nucleating dislocations.

19. A method according to any one of claims 16 to 18,

wherein the single crystal diamond substrates are prepared by etching the growth surface after forming the one or more regions for nucleating dislocations, the etching being controlled to remove processing damage from the one or more low defect regions but not to fully remove the one or more regions for nucleating dislocations such that said regions for nucleating dislocations are in a form capable of generating sufficient dislocations in the single crystal CVD diamond material grown thereon that $\Delta n_{[average]}$ is greater than 1.5×10^{-4} and less than 3×10^{-3} thus forming the regions of high optical birefringence.