Claims

1. A coloured single crystal CVD synthetic diamond material comprising:

a plurality of layers,

wherein the plurality of layers includes at least two sets of layers which differ in terms of their defect composition and colour,

wherein defect type, defect concentration, and layer thickness for each of the at least two sets of layers is such that if the coloured single crystal CVD diamond material is fabricated into a round brilliant cut diamond comprising a table and a culet, and having a table to culet depth greater than 1 mm, the round brilliant cut diamond comprises a uniform colour as viewed by naked human eye under standard ambient viewing conditions in at least a direction through the table to the culet.

2. A coloured single crystal CVD synthetic diamond material according to claim 1, wherein the plurality of layers are parallel layers.

3. A coloured single crystal CVD synthetic diamond material according to claim 1 or 2, wherein the plurality of layers comprises at least 5, 10, 20, 30, 40 or 50 layers.

4. A coloured single crystal CVD synthetic diamond material according to any preceding claim, wherein the round brilliant cut diamond comprises a uniform colour as viewed by naked human eye under standard ambient viewing conditions in a direction from the culet to the table.

5. A coloured single crystal CVD synthetic diamond material according to any preceding claim, wherein the round brilliant cut diamond comprises a uniform colour as viewed by naked human eye under standard ambient viewing conditions from a side in a direction perpendicular to the table to culet direction.

6. A coloured single crystal CVD synthetic diamond material according to any preceding claim, wherein the round brilliant cut diamond has a size no less than 0.01 ct, 0.02 ct, 0.05 ct, 0.10 ct, 0.5 ct, 0.75 ct, 1.0 ct, 2.0 ct, or 5 ct.

7. A coloured single crystal CVD synthetic diamond material according to any preceding claim, wherein the round brilliant cut diamond has a size no more than 10 ct, 8 ct, 5 ct, 3 ct, 2 ct, or 1 ct.

8. A coloured single crystal CVD synthetic diamond material according to any preceding claim, wherein the at least two sets of layers comprise a first set of layers comprising boron dopant at a concentration sufficient to produce a blue colouration and a second set of layers comprising a lower concentration of boron dopant.

9. A coloured single crystal CVD synthetic diamond material according to claim 8, wherein the first set of layers comprises an uncompensated boron dopant concentration no less than 0.01 ppm, 0.03 ppm, 0.09 ppm, 0.15 ppm, 0.20 ppm, 0.50 ppm, 1.00 ppm, 1.50 ppm, 2.00 ppm, 3 ppm, or 4 ppm.

10. A coloured single crystal CVD synthetic diamond material according to claim 8 or 9, wherein the first set of layers comprises an uncompensated boron dopant concentration no more than 5.00 ppm, 4.00 ppm, 3.00 ppm, 2.00 ppm, 1.00 ppm, 0.50 ppm, or 0.10 ppm.

11. A coloured single crystal CVD synthetic diamond material according to any one of claims 8 to 10, wherein the first set of layers comprises single substitutional nitrogen at a concentration lower than that of the boron dopant.

12. A coloured single crystal CVD synthetic diamond material according to any one of claims 8 to 11, wherein the second set of layers comprises boron dopant at a concentration lower than that of the single substitutional nitrogen.

13. A coloured single crystal CVD synthetic diamond material according to any one of claims 8 to 12, wherein the second set of layers comprises boron dopant at a concentration no more than 1.0 ppm, 0.75 ppm 0.5 ppm, 0.25 ppm, 0.15 ppm, 0.09 ppm, 0.03 ppm, 0.01 ppm, or 0.005 ppm.

14. A coloured single crystal CVD synthetic diamond material according to any one of claims 8 to 13, wherein the second set of layers comprises single substitutional nitrogen dopant at a concentration of no more than 10 ppm, 7 ppm, 5 ppm, 3 ppm, 2.5 ppm, 2.0 ppm, 1.5 ppm, or 1 ppm.

15. A coloured single crystal CVD synthetic diamond material according to any one of claims 8 to 14, wherein the second set of layers comprises single substitutional nitrogen dopant at a concentration of no less than 0.01 ppm, 0.05 ppm, 0.10 ppm, 0.5 ppm, or 0.8 ppm.

16. A coloured single crystal CVD synthetic diamond material according to any one of claims 8 to 15, wherein the second set of layers has a layer thickness larger than the first set of layers.

17. A coloured single crystal CVD synthetic diamond material according to any one of claims 8 to 16, wherein the first set of layers has a layer thickness no more than 0.1 mm, 0.08 mm, or 0.06 mm.

18. A coloured single crystal CVD synthetic diamond material according to any one of claims 8 to 17, wherein the first set of layers has a layer thickness no less than 0.001 mm, 0.01 mm, 0.015 mm, or 0.02 mm.

19. A coloured single crystal CVD synthetic diamond material according to any one of claims 8 to 18, wherein the second set of layers has a layer thickness no less than 0.1 mm, 0.15 mm, 0.20 mm, 0.25 mm, or 0.30 mm.

20. A coloured single crystal CVD synthetic diamond material according to any one of claims 8 to 19, wherein the second set of layers has a layer thickness no more than 0.400 mm, 0.375 mm, 0.350, 0.325 mm, 0.300 mm, 0.250 mm, 0.200 mm, or 0.175 mm.

21. A coloured single crystal CVD synthetic diamond material according to any one of claims 8 to 20, wherein a figure of merit (FM) for visibility of individual layers is no more than 0.15, 0.13, 0.11, 0.09, 0.07, or 0.05, wherein the figure of merit for visibility of individual layers is calculated as the product: FM = layer thickness (mm) for the first set of layers x layer thickness (mm) for the second set of layers x solid boron concentration (ppm) in the first set of layers x round cut brilliant depth (mm).

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

varying a dopant gas concentration in a single crystal CVD synthetic diamond growth process to form a coloured single crystal CVD synthetic diamond material comprising plurality of layers which differ in terms of their defect composition and colour,

wherein the dopant gas concentration and time period of the variation in dopant gas concentration is controlled such that if the coloured single crystal CVD diamond material is fabricated into a round brilliant cut diamond comprising a table and a culet, and having a table to culet depth greater than 1 mm, the round brilliant cut diamond comprises a uniform colour as viewed by naked human eye under standard ambient viewing conditions in at least a direction through the table to the culet.

23. A method according to claim 22, wherein the plurality of layers comprises a first set of layers comprising a first dopant and a second set of layers comprising a second dopant, and wherein at a transition point between a first layer and a second layer the second dopant is initially introduced at a higher concentration and then reduced during growth of the second layer to compensate for the first dopant which continues to be incorporated into the second layer after the transition point between the first and second layers.

24. A method according to claim 22 or 23, further comprising irradiating the coloured single crystal CVD synthetic diamond material.

25. A method according to any one of claims 22 to 24, further comprising annealing the coloured single crystal CVD synthetic diamond material.

Claims

1. A coloured single crystal CVD synthetic diamond material comprising:

a plurality of layers,

wherein the plurality of layers includes at least two sets of layers which differ in terms of their defect composition and colour,

wherein defect type, defect concentration, and layer thickness for each of the at least two sets of layers is such that if the coloured single crystal CVD diamond material is fabricated into a round brilliant cut diamond comprising a table and a culet, and having a table to culet depth greater than 1 mm, the round brilliant cut diamond comprises a uniform colour as viewed by naked human eye under standard ambient viewing conditions in at least a direction through the table to the culet.

2. A coloured single crystal CVD synthetic diamond material according to claim 1, wherein the plurality of layers comprises at least 5, 10, 20, 30, 40 or 50 layers.

3. A coloured single crystal CVD synthetic diamond material according to any preceding claim, wherein the round brilliant cut diamond comprises a uniform colour as viewed by naked human eye under standard ambient viewing conditions in a direction from the culet to the table.

4. A coloured single crystal CVD synthetic diamond material according to any preceding claim, wherein the round brilliant cut diamond comprises a uniform colour as viewed by naked human eye under standard ambient viewing conditions from a side in a direction perpendicular to the table to culet direction.

5. A coloured single crystal CVD synthetic diamond material according to any preceding claim, wherein the round brilliant cut diamond has a size no less than 0.01 ct, 0.02 ct, 0.05 ct, 0.10 ct, 0.5 ct, 0.75 ct, 1.0 ct, 2.0 ct, or 5 ct.

6. A coloured single crystal CVD synthetic diamond material according to any preceding claim, wherein the at least two sets of layers comprise a first set of layers comprising boron dopant at a concentration sufficient to produce a blue colouration and a second set of layers comprising a lower concentration of boron dopant.

7. A coloured single crystal CVD synthetic diamond material according to claim 6, wherein the first set of layers comprises an uncompensated boron dopant concentration no less than 0.01 ppm, 0.03 ppm, 0.09 ppm, 0.15 ppm, 0.20 ppm, 0.50 ppm, 1.00 ppm, 1.50 ppm, 2.00 ppm, 3 ppm, or 4 ppm and no more than 5.00 ppm, 4.00 ppm, 3.00 ppm, 2.00 ppm, 1.00 ppm, 0.50 ppm, or 0.10 ppm.

8. A coloured single crystal CVD synthetic diamond material according to any one of claims 6 or 7, wherein the second set of layers comprises single substitutional nitrogen dopant at a concentration of no less than 0.01 ppm, 0.05 ppm, 0.10 ppm, 0.5 ppm, or 0.8 ppm and no more than 10 ppm, 7 ppm, 5 ppm, 3 ppm, 2.5 ppm, 2.0 ppm, 1.5 ppm, or 1 ppm.

9. A coloured single crystal CVD synthetic diamond material according to any one of claims 6 to 8, wherein the second set of layers has a layer thickness larger than the first set of layers.

10. A coloured single crystal CVD synthetic diamond material according to any one of claims 6 to 9, wherein the first set of layers has a layer thickness no more than 0.1 mm, 0.08 mm, or 0.06 mm and no less than 0.001 mm, 0.01 mm, 0.015 mm, or 0.02 mm.

11. A coloured single crystal CVD synthetic diamond material according to any one of claims 6 to 10, wherein the second set of layers has a layer thickness no less than 0.1 mm, 0.15 mm, 0.20 mm, 0.25 mm, or 0.30 mm and no more than 0.400 mm, 0.375 mm, 0.350, 0.325 mm, 0.300 mm, 0.250 mm, 0.200 mm, or 0.175 mm.

12. A coloured single crystal CVD synthetic diamond material according to any one of claims 6 to 11, wherein a figure of merit (FM) for visibility of individual layers is no more than 0.15, 0.13, 0.11, 0.09, 0.07, or 0.05, wherein the figure of merit for visibility of individual layers is calculated as the product: FM = layer thickness (mm) for the first set of layers x layer thickness (mm) for the second set of layers x solid boron concentration (ppm) in the first set of layers x round cut brilliant depth (mm).

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

varying a dopant gas concentration in a single crystal CVD synthetic diamond growth process to form a coloured single crystal CVD synthetic diamond material comprising plurality of layers which differ in terms of their defect composition and colour,

wherein the dopant gas concentration and time period of the variation in dopant gas concentration is controlled such that if the coloured single crystal CVD diamond material is fabricated into a round brilliant cut diamond comprising a table and a culet, and having a table to culet depth greater than 1 mm, the round brilliant cut diamond comprises a uniform colour as viewed by naked human eye under standard ambient viewing conditions in at least a direction through the table to the culet.

14. A method according to claim 13, wherein the plurality of layers comprises a first set of layers comprising a first dopant and a second set of layers comprising a second dopant, and wherein at a transition point between a first layer and a second layer the second dopant is initially introduced at a higher concentration and then reduced during growth of the second layer to compensate for the first dopant which continues to be incorporated into the second layer after the transition point between the first and second layers.

15. A method according to any one of claims 13 or 14, further comprising annealing the coloured single crystal CVD synthetic diamond material.