Claims

1. A chemical vapour deposition (CVD) method for synthesizing diamond material on a substrate in a synthesis environment, said method comprising:

providing the substrate;

providing a source gas;

dissociating the source gas; and

allowing homoepitaxial diamond synthesis on the substrate;

wherein the synthesis environment comprises nitrogen at an atomic concentration of from 0.4 ppm to 50 ppm; and

and wherein the source gas comprises:

a) an atomic fraction of hydrogen, H_f, from 0.40 to 0.75;

b) an atomic fraction of carbon, C_f, from 0.15 to 0.30;

c) an atomic fraction of oxygen, O_f, from 0.13 to 0.40;

wherein $H_f + C_f + O_f = 1$;

wherein the ratio of atomic fraction of carbon to the atomic fraction of oxygen, C_f:O_f, satisfies the ratio of $0.45:1 < C_f:O_f < 1.25:1$;

wherein the source gas comprises hydrogen atoms added as hydrogen molecules, H_2, at an atomic fraction of the total number of hydrogen, oxygen and carbon atoms present of between 0.05 and 0.40; and

wherein the atomic fractions H_f, C_f and O_f are fractions of the total number of hydrogen, oxygen and carbon atoms present in the source gas.

2. A method according to claim 2, wherein the process is carried out at a pressure greater than P_{lower} Torr, where $P_{lower} = P_{arc} - Y$ and $P_{arc} = 170(H_f + 0.25) + X$, where Y = 50 Torr and X is from 20 to -50 and P_{arc} is the pressure of the onset of unipolar arcing in the process.

3. A method according to any preceding claim, wherein the source gas is dissociated by microwaves.

4. A method according to claim 3, wherein the frequency of the microwaves is from 800 MHz to 1000 MHz.

5. A method according to any one of claims 1 to 4, wherein the substrate is maintained at a temperature of from 750°C to 1000°C.

6. Synthetic CVD diamond material comprising single substitutional nitrogen (N_s^0) at a concentration of greater than 0.5 ppm and having a total integrated absorption in the visible range from 350 nm to 750 nm such that at least 35% of the absorption is attributable to N_s^0.

7. Synthetic CVD diamond material according to claim 6, having a hue angle greater than 80° for a transmission pathlength of 1 mm.

8. Synthetic CVD diamond material according to any one of claims 6 or 7, wherein the material has a photoluminescence spectrum at 77 K using the 488 nm excitation of an argon-ion laser which shows a peak at from 543.0 to 543.2 nm, with an intensity ratio of this peak normalized to the 1st order diamond Raman (at 521.9 nm for this excitation wavelength) of greater than 0.005.

9. Synthetic CVD diamond material according to any one of claims 6 to 8, wherein the concentration of N_s^0 is greater than 2.5 ppm, as measured using the 270 nm peak using UV-visible absorption spectroscopy.

10. Synthetic CVD diamond material according to any one of claims 6 to 9, wherein the elemental concentration of individual chemical impurities other than nitrogen and hydrogen is less than 0.1 ppm.

11. Synthetic CVD diamond material according to any one of claims 6 to 10, wherein at least 50% of the volume of the synthetic CVD diamond material is formed from a single growth sector.

12. Synthetic CVD diamond material according to any one of claims 6 to 11, having the colour parameters a* between - 20 and 1; b* between 5 and 20; C* between 0 and 30 and L* between 40 and 100.

13. Synthetic CVD diamond material according to any one of claims 6 to 12, wherein the synthetic CVD diamond material is in the form of a freestanding entity having a thickness of greater than 0.2 mm.

14. Synthetic CVD diamond material according to any one of claims 6 to 12, wherein the synthetic CVD diamond material is in the form of a layer having a thickness of 0.5 mm or less.

15. Synthetic CVD diamond material according to any one of claims 6 to 13, wherein the synthetic CVD diamond material is in the form of a doublet.

16. A gemstone comprising synthetic CVD diamond material according to any one of claims 6 to 15.

17. An electronic device comprising synthetic CVD diamond material according to any one of claims 6 to 14.

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wherein $H_f + C_f + O_f = 1$;

wherein the ratio of atomic fraction of carbon to the atomic fraction of oxygen, C_f:O_f, satisfies the ratio of $0.45:1 < C_f:O_f < 1.25:1$;

wherein the source gas comprises hydrogen atoms added as hydrogen molecules, H_2, at an atomic fraction of the total number of hydrogen, oxygen and carbon atoms present of between 0.05 and 0.40; and

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3. A method according to any preceding claim, wherein the source gas is dissociated by microwaves.

4. A method according to claim 3, wherein the frequency of the microwaves is from 800 MHz to 1000 MHz.

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