

CLAIMS

1. A method of forming mono-crystalline diamond by chemical vapour deposition, the method comprising the steps of:

- (a) providing at least one diamond seed;
- (b) exposing the seed to conditions for growing diamond by chemical vapour deposition, including supplying reaction gases that include a carbon-containing gas for growing diamond and include a nitrogen-containing gas; and
- (c) controlling the quantity of nitrogen-containing gas relative to other gases in the reaction gases such that diamond is caused to grow by step-growth without defects and graphitic inclusions.

2. A method of forming mono-crystalline diamond as in Claim 1 wherein the quantity of nitrogen-containing gas in the reaction gases is in the range of 0.0001 to 0.02 vol %.

3. A method of forming mono-crystalline diamond as Claim 1 further including diborane in the reaction gases.

4. A method of forming mono-crystalline diamond as in Claim 3 wherein the diborane is present in the range of from 0.0002 to 0.002 vol %.

5. A method of forming mono-crystalline diamond as in Claim 1 wherein the nitrogen-containing gas is selected from any one or more of the group comprising nitrogen in hydrogen, nitrogen in oxygen, nitrogen in helium, nitrogen

in nitrous oxide or nitrogen with diborane.

6. A method of forming mono-crystalline diamond as in Claim 1 wherein the chemical vapour deposition comprises maintaining the seed at a temperature in the range of 750 to 1200 °C.

7. A method of forming mono-crystalline diamond as in Claim 1 wherein the chemical vapour deposition comprises maintaining the seed at a pressure in the range of 120 to 160 mbar.

8. A method of forming mono-crystalline diamond as in Claim 1 wherein the carbon-containing gas comprises methane.

9. A method of forming mono-crystalline diamond as in Claim 1 wherein the reactions gases further comprise hydrogen.

10. A method of forming mono-crystalline diamond as in Claim 1 wherein the chemical vapour deposition occurs in the presence of microwave plasma and with hydrogen in the reactions gases.

11. A method of forming mono-crystalline diamond as in Claim 10 wherein the microwave plasma is generated by a magnetron operating at 6000 Watt and at 2.45 GHz.

12. A method of forming mono-crystalline diamond as in Claim 1 wherein the reaction gases are passed through a reaction chamber at a gas flow rate of approximately 30 l/hr.

13. A method of forming mono-crystalline diamond as

in Claim 1 wherein the seed is oriented in the (100) crystalline orientation.

14. A method of forming mono-crystalline diamond as in Claim 1 wherein the reaction gases are in the following relative quantities:

methane 20-80 sccm (standard cubic centimetres per minute),
hydrogen 300-800 sccm,
nitrogen 0.0005 - 0.2 sccm,
diborane 0.0001 - 0.01 scccm; and
oxygen 1-10 sccm.

15. A method of forming mono-crystalline diamond as in Claim 1 wherein the diamond seed is a size between 3 x 3 mm x 0.5 mm.

16. A diamond produced by the method of any one previous claim.

17. A diamond as in Claim 16 wherein the diamond is a gem quality diamond.