Claims

1. A method of depositing a coating on a substrate, the method comprising:

(a) depositing a first layer of ta-C on thea substrate via a CVA process, said first layer having a first hardness and a thickness of 100nm or greater;

(b) depositing a second layer of ta-C on thea substrate via a CVA process, said second layer having a second hardness and a thickness of 10nm or less, and

(c) repeating steps (a) and (b) at least once,

wherein the hardnesses of the first layers are greater than the hardnesses of the second layers.

2. A method according claim 1, comprising continuously depositing the coating on the substrate and repeating the steps to provide a coating comprising at least 5 such first layers and at least 4 such second layers.

3. A method according to claim 1 or claim 2, comprising carrying out the deposition using a substantially continuous CVA process for the first and second layers using the same CVA source, preferably a FCVA source.

4. A method according to any previous claim, comprising

(a) depositing the first layer using a CVA process at a first bias voltage;

(b) depositing the second layer using a CVA process at a second bias voltage more negative than the first.

5. A method according to any previous claim, wherein the hardnesses of the first layers are greater than 1500HV.

6. A method according to any previous claim, wherein the hardnesses of the second layers are 1500HV or less.

7. A method according to any previous claim, wherein the hardnesses of the first layers are less than 7000HV.

8. A method according to any previous claim, wherein the thickness of the second layers is 5nm or less.

9. A method according to any previous claim, wherein the thickness of the first layers is 200nm or greater.

10. A method according to any previous claim, wherein the ratio of the thicknesses of the first to second layers is from 1000:1 – 50:1.

11. A method according to any previous claim, wherein the substrate is a stainless steel substrate.

12. A method according to any previous claim, which further comprises the step of depositing a seed layer onto the substrate prior to depositing the first layer in step a).

13. A method according to claim 11 wherein the seed layer is formed from Ti, Cr, Ni, W, Si or combinations, alloys, carbides or nitrides thereof.

14. A method according to claim 13 wherein the seed layer is chromium or titanium.

15. A method according to any one of claims 12 to 14 where in the seed layer has a thickness of 0.05µm to 0.5µm.

16. A method according to any previous claim, wherein the total thickness of the coating is from 1 - 100 microns.

17. A method according to any previous claim, wherein the total thickness of the coating is 5 microns or greater.

18. A substrate comprising a coating deposited according to the method of any of claims 1 to 17, wherein the hardness of the coating is 2800HV or greater.

~~19. A substrate according to claim 18, wherein the hardness of the coating is 2000 HV or greater.~~

1920. A substrate according to ~~either~~ claim 18 ~~or 19~~, wherein the substrate is an engine component, e.g. a piston ring, a piston pin, a cam shaft, a lift valve or an injection nozzle.

20. A substrate according to claim 18 or claim 19, wherein the thickness of the second layers is 2nm or less.

21. A substrate according to any one of claims 18 to 20, wherein the ratio of the thicknesses of the first to second layers is from 500:1 to 150:1.