Claims

1. A metallic substrate with a multi-layer coating, comprising in order:

i) the metallic substrate;

ii) a seed layer;

iii) a barrier layer comprising DLC deposited via a CVD method; and

iv) a functional layer comprising ta-C deposited via a PVD method; and

wherein the overall thickness of the coating is 5µm or less; wherein the substrate ~~.~~

~~2. A coated substrate according to claim 1~~ comprises multiple alternating barrier layers and functional layers; and wherein the thickness of each barrier layer is 0.5µm or less.

2~~3~~. A coated substrate according to claim 1~~2~~ comprising alternating layers of up to 10 barrier layers and up to 10 functional layers

3~~4~~. A coated substrate according to ~~any one of~~ claim~~s~~ 1 or 2~~to 3~~ which further comprises an intermediate layer between the seed layer ii) and the barrier layer iii)

4~~5~~. A coated substrate according to claim 3~~4~~ wherein the intermediate layer comprises ta-C.

5~~6~~. A coated substrate according to any of claims 1 to 4~~5~~ wherein the total thickness of all barrier layers in the substrate is up to 1.0µm.

~~7. A coated substrate according to any of claims 1 to 6 wherein the total thickness of all barrier layers in the substrate is from 0.05µm to 0.5µm.~~

6~~8~~. A coated substrate according to any of claims 1 to 5~~7~~ wherein the thickness of the functional layer is from 0.1µm to 3µm.

79. A coated substrate according to any of claims 1 to 68 wherein the thickness of the seed layer is from 0.05µm to 2µm.

810. A coated substrate according to any of claims 1 to 79 wherein the functional layer(s) is/are deposited by FCVA.

911. A coated substrate according to any of claims 1 to 810 wherein the seed layer is formed from Cr, W, Ti, NiCr, Si or mixtures thereof.

102. A coated substrate according to any of claims 1 to 911 wherein the substrate is a steel substrate.

113. A coated substrate according to claim 102 wherein the substrate comprises stainless steel, HSS, tool steel or alloy steel.

124. A coated substrate according to any of claims 1 to 911 wherein the substrate comprises Ti, an alloy of Ti, Al or an alloy of Al.

135. A coated substrate according to any of claims 1 to 124, comprising at least 2 barrier layers and at least 2 functional layers.

146. A coated substrate according to any of claims 1 to 135, comprising at least 3 barrier layers and at least 2 functional layers.

157. A coated substrate according to any of claims 1 to 146, wherein the barrier layer comprising DLC has a hydrogen content of 20% or greater.

168. A coated substrate according to any of claims 1 to 157, wherein the functional layer comprising ta-C has a hydrogen content of less than 10%.

17~~9~~. The metallic substrate with a multi-layer coating according to claim 1 ~~-~~comprising in order:

i) the metallic~~a steel~~ substrate wherein the metallic substrate is a steel substrate;

ii) the~~a~~ seed layer having a thickness from 0.05µm to 2µm;

iii) the~~a~~ barrier layer deposited by a CVD method, the barrier layer comprising DLC and having a thickness of 0.5~~3~~µm or less; and

iv) the~~a~~ functional layer comprising ta-C deposited by CVA and having a thickness of from 0.1µm to 3µm;~~.~~

wherein there are multiple alternating barrier layers (iii) and functional layers (iv).

18~~20~~. The metallic substrate with a multi-layer coating according to claim 1 comprising in order:

i) the metallic~~a steel~~ substrate wherein the metallic substrate is a steel substrate;

ii) the~~a~~ seed layer having a thickness from 0.05µm to 2µm;

iii) an intermediate layer comprising ta-C having a thickness of from 0.1µm to 1.0µm;

iv) the~~a~~ barrier layer deposited by a CVD method, the barrier layer comprising DLC and having a thickness of 0.5~~2~~µm or less; and

v) the~~a~~ functional layer comprising ta-C deposited by CVA and having a thickness of from 0.1µm to 3µm;~~.~~

wherein there are multiple alternating barrier layers (iv) and functional layers (v).

19~~21~~. A method of coating a metallic substrate, the method comprising

i) depositing onto the substrate a seed layer;

ii) depositing onto the substrate a layer of DLC having a thickness of 0.5µm or less via a CVD method; and

iii) depositing onto the substrate a layer of ta-C via a PVD method; and

iv) repeating steps ii) and iii).